Surgery
PATIENT SAFETY, OT ZONE AND SURGICAL POSITIONS

WHO Surgical safety checklist

- Has 3 components:
  - Sign in: Ward → OT complex
    i) Confirm identity
    ii) Written consent
    iii) Site marking → Preferably by surgeon
    iv) Allergies
    v) Prophylactic antibiotics
    vi) Serology

- Time out: Before surgery: Reconfirm identituy
  - Surgeon:
    i) Name of surgery proposed
    ii) Duration of surgery
    iii) Anticipated blood loss

  - Anesthetist:
    i) Any specific concerns
    ii) Prophylactic antibiotics

- Sign out: Skin closure
  - Nurse:
    i) Count the equipments
    ii) Count gauze pieces

  - Surgeon:
    i) Name of actual surgery performed
    ii) Critical steps
    iii) Equipment malfunction

  - Anesthetist:
    i) Actual blood loss
    ii) Concerns, if any

- MC cause of wrong site surgery → Communication errors
- Lined gauze pieces [with radio opaque line] I used to locate if gauze piece left inside body → using C-arm or X-ray.

Consent

- Consent must include:
  i) Identity of patient
  ii) Name of surgery
  iii) Details of surgery
iv) Potential complications: Those with incidence rate of > 1%
v) Alternate procedures
vi) Name of surgeon
vii) Consent signed by:
   - Patient
   - Witness
   - Surgeon

**OT zoning**

- Protective zone - Change rooms
  - Transfer bay
  - Pre and post-op rooms
  - ICU / PACU
- Clean zone (connects protective zone to aseptic zone)
  - Equipment store room
  - Maintenance workshop
- Aseptic zone - OT
- Disposal zone - where all waste is disposed

**Common surgical positions**

- Supine:
  - Mc position used for surgeries (abdominal, breast surgery etc.)
- Lithotomy:
  - For obstetric, gynaecological, urological procedures
  - Hemorrhoid and fissure surgeries
  - TURP, TURBT
  - Disadvantage: If lithotomy prolonged; legs not supported properly → improper padding or over abduction → injury to common peroneal nerve
- **Lateral / Kidney position:**
  - For thoracotomy, pyelolithotomy, nephrectomy
  - Disadvantage: Over abduction of arm → Brachial plexus injury

- **Jack-Knife position:**
  - Hemorrhoid and fissure surgeries
  - Not used now due to risk of positional asphyxia

- **Prone position:**
  - For spinal surgeries

- **Sitting / Fowler’s position:**
  - For cranial surgeries → posterior fossa procedures
  - Advantage: Better exposure
    - Provides relatively blood less field to operate
  - Disadvantages: ↑ Risk of air embolism → Prevented by tying / ligating the vein before cutting it

- **Rose / Barking dog position:**
  - For thyroidectomy
  - Patient is supine
  - Towel roll placed below shoulder blades → Causes neck extension
  - Head supported using head ring
  - 30° head end elevation → relatively blood less field
  - ↑ risk of air embolism → Ligate veins before cutting to prevent it

- **Air embolism:**
  - Manifests as sudden drop in saturation. At least 10 cc of air can give rise to air embolism
  - When suspected, patient put into Durant’s / recovery position;
    - Foot end up - head end low and right side up → makes sure air doesn’t enter pulmonary circulation
    - Aspirating blood out of central line might suck out air emboli
- Neutral position: Head end and foot end at same level

- Trendelenburg position: Raised foot end, used in pelvic surgeries and varicose vein surgeries

- Reverse Trendelenburg position: Head end raised

[Reverse Trendelenburg + right side up position] → used for "Laparoscopic cholecystectomy"

- Advantage: Bowel moves down and left, opens up gall bladder fossa for easier dissection
- Disadvantage: CO₂ accumulates beneath right diaphragmatic causing right shoulder tip pain [MC complication laparoscopic cholecystectomy]
Surgical blades

- No. 11: Stab blade
- No. 12: Suture removal
- Blades with belly are used to make incisions
- No. 15: To make precise incisions
- No. 22: Incisions for thoracotomy, laparotomy

*Belly* of the blade is the sharpest portion of a blade.

- Passing sharp objects in OT
  - Ideal: kidney tray with pointed end towards you, i.e., surgeon
  - Far to near
    - Blade perpendicular to skin
    - Oblique technique will cause undermining of edges
Energy sources

- Energy sources → Leading cause of fire in OT.

**Energy Sources**

- Cautery:

<table>
<thead>
<tr>
<th>Bipolar cauter y</th>
<th>monopolar / unipolar cauter y</th>
</tr>
</thead>
</table>
| Circuit:—
  - Completed locally between 2 prongs.
  - Current does not flow through body. | Circuit:—
  - Machine  
  - Current ➔ Bowie tip
  - Current ➔ Cautery
  - Cautery ➔ Cut/coagulate pad  
  - [Current through body] |
| Only coagulation can be done | Blue button:—
  - Coagulate ➔ High-voltage alternating current
  - Yellow button:—
  - Cut ➔ Low-voltage continuous current |

- Cautery pad:—
  - Not attached ➔ No circuit, no current.
  - Must be properly placed covering adequate surface area.
    (Wide contact area.), in a well vascularized area with less hair ➔ If placed improperly; burns at cautery pad site.

- Monopolar:—
  - Current passes through body ➔ Avoided in patient with cardiac pacemaker [Bipolar used]
  - Thermal damage to nearby vital nerves ➔ Avoided in Parotid, thyroid, penile surgeries [Bipolar used]

- Ligasure:— It is an energy source
  - Uses heat + pressure ➔ coagulation
  - Can coagulate vessels up to 7 mm in diameter.
  - 1st generation Ligasure ➔ only coagulation
  - 2nd generation Ligasure ➔ coagulation followed by cutting.
Harmonic scalpel

- Oscillatory blade at 20000 - 50000 Hz oscillation causes protein denaturation, coagulation without heat production.
- Can be used close to vital structures
- Precise cut
- Can coagulate vessels up to 7 mm in diameter
- Can cut through scar tissue.

- Thunderbeat S:
  - Has features of both ligasure and harmonic scalpel.
SUTURES AND KNOTS

Types of knots

- **Square / Reef knot**: Secure knot.
  
  ![Square Knot Diagram]
  
- **Granny's / Slip knot**: No crossing; insecure knot.
- **Surgeon's knot**: Secure knot.
  
  ![Surgeons Knot Diagram]

Skin suturing

- **Skin**: Everted edges
- **Bowel**: Inverted edges
- **3 instruments**: Needle holder; toothed forceps; straight scissors
- **Simple suture**: Aim: Everted edges
- **If everted edges not possible**: mattress sutures:
  - Horizontal: Eversion and homeostasis; Least cut-through rate
  - Vertical: Eversion

- If 'x' is depth of wound, then, distance between wound edge and knot on each side must be 'x'.
- Distance between a sutures must be '3x.'
Suturing techniques

- Sub-cuticular sutures:
  - Continuous bite from inside
  - No mark on skin
  - Cosmetically better
  - 3-0 monacryl [Cutting / reverse cutting needle]
- Aberdeen’s / Cobbler’s knot:
  - Correct way for continuous suture
- Running locked sutures:
  - Even distribution of tension
- Far – near – near – far suture: For obliterating large cavities

Bowel anastomoses

- Inverted edges required; Strongest layer: Submucosa

Bowel anastomosis

- Single layer
  - 1st layer: Albert layer
  - Vicryl used, continuous
  - 2nd layer: Lemert layer
  - Interrupted silk used
  - Helps in edge inversion
- Two layer
  - Linear cutter:
    - Sleeve gastrectomy
    - Side to side bowel anastomosis
    - Circular stapler:
      - Stapled hemorrhoidopexy
      - LAR
      - Esopha.gojejunoanastomosis
- Stapled

Bowel Staplers

- Leading cause of leak → ↑ tension
- Disparity in luminal sizes → Cheatle’s split → Longitudinal split,
  anti - mesenteric border, in narrow lumen
- Connell loop := Edge of anastomosis; Ensures inversion of mucosa.
Needles and types

- Round body:
  - O cross-section
  - Atraumatic
  - Used for bowel, bladder, ureter, CBD

- Cutting
  - \( \Delta \) cross-section
  - Traumatic
- Reverse cutting:
  - \( \nabla \) cross-section
  - Used for skin, fascia

- Half circle \( \rightarrow \) GIT
- 'J' shaped \( \rightarrow \) Vagina
- Compound circle \( \rightarrow \) Oral cavity
- Quarter circle \( \rightarrow \) eye

Sutures

- Smaller number \( \rightarrow \) Thicker ; easier to handle thread
- Larger number \( \rightarrow \) Finer ; more likely to break

\[ \text{monofilament} \rightarrow \text{Single filament} \]
- Disadvantage: Has 'stronger memory'
  - Tendency to resist knot formation \( \rightarrow \) opens up as a result
  - Eg: Polydioxanone (PDS); monocryl; nylon (Ethilon); Catgut

\[ \text{braided} \rightarrow \text{Multiple intertwined filaments} \]
- Easier to handle / knot
- Disadvantage: Higher wound infection rate
  - Eg: Silk; Vicryl

\[ \text{Nature} \rightarrow \text{more tissue reaction} \]
\[ \text{Synthetic} \rightarrow \text{more inert} \]
- Most inert \( \rightarrow \) Synthetic non-absorbable

Absorbable sutures:

- Natural:
  - Catgut [From sub mucosa of sheep gut]:
    - Absorption time (by enzymatic degradation): 10-30 days
    - Tensile strength: 3-5 days
  - Chronic catgut:
    - Catgut coated with chromic salts
    - Absorption time: 30-60 days
    - Tensile strength: 7-9 days
  - Uses: Suture sub-cutaneous tissue. Now replaced by Vicryl.
→ Synthetic:
  - Monocryl: Best for subcuticular
    - Monofilament: 3-0
  - Vicryl: Braided polyglactin; Dissolves completely (Proteolysis) in 60-90 days
  - Uses: Bowel anastomoses 3-0
    - CBD 5-0
    - Ureter 5-0
    - Subcutaneous tissue 3-0
→ Special types of Vicryl:
  - Vicryl rapide (Polyglactin 910): Rapidly dissolving Vicryl
  - Vicryl plus (Triclosan): Antibiotic coated; ↓ wound infections
  - Barbed Vicryl:
    - Face lift surgery
    - Disadvantage: Painful

→ PDS (Polydioxanone): Monofilament
  - 180 days
  - Uses: Same as Vicryl
  - Tracheo-bronchial repairs

Non-absorbable sutures

→ Natural: Silk: Braided
  - Skin, 2nd layer of bowel anastomoses
→ Cotton: Not used much

→ Synthetic:
  → Prolene (Polypropylene):
    - Uses: Used as mesh material, in hernia repair
    - Rectus sheath closure (No. 1)
    - Vascular repair: Non elastic; no inflammation
      - Aorta: 2-0 prolene
  → Nylon: Monofilament; Ethilon
    - Uses: Skin; Fix drains; Nerve repair; Tendon repair;
      - Cataract (10-0)
Polyester: Ethibond
  - Uses: Tendon repair; Rectus sheath
Surgical steel: Skin staplers; Sternotomy incisions

Suture removal timing

- Scalp: 5 days
- Face: 3-5 days
- Neck: 5-7 days
- Thorax: 10-12 days
- Abdomen: 12-14 days
- Joint: Minimum 14 days
CAUSES OF POST-OP FEVER

Post-op day - 1

- MCC of fever on POD 1: Atelectasis
  Prevention: Chest physiotherapy - Incentive spirometry

- POD: Post-op day

Post-op day - 2 - 3

- MCC of hospital acquired infection overall: UTI
- Atelectasis causes pneumonia on 3rd day if not treated
- Superficial thrombophlebitis [MCC: IV cannula]

Post-op day - 4 - 5

- MCC of hospital acquired infection in surgical patients:
  Surgical site infection
  Wound infection occurring within 30 days of surgery or within 1 year in case of implant
- Deep vein thrombosis prevention
  Pharmacological [LMWH] ➔ Mechanical
  ➔ Early ambulation ➔ Pneumatic anti-DVT stockings

Post-op day - 6

- Burst Abdomen / Abdominal wound dehiscence:
  Closed rectus sheath opens ➔ serous discharge ➔ Salmon fluid sign

- Management:
  Emergency: Urobag/ Bogota bag, laparostomy ➔ Nylon/Prolene
  Cutting/ Reverse cutting needle used
  Definitive: resuture rectus sheath ➔ No. 1 Prolene used
  [Length of prolene used = 4 times wound length ➔ Jenkins theory of mass closure]
Predisposing factors for burst abdomen:
- Patient related factors:
  - Malnutrition
  - Chronic cough
  - Constipation
  - Immunocompromised
  - Obesity
- Surgery/surgeon related factors:
  - Emergency surgery > elective
  - Midline incision > transverse
  - Absorbable suture material > non-absorbable

Post-op day - 7 and beyond

- Intra-abdominal collections or abscesses:
  - MC site:
    - Supine patient ➔ Morison’s / Hepatorenal pouch
    - Ambulatory patient ➔ Pouch of Douglas / pelvis
    - Overall ➔ Pouch of Douglas / pelvis
- Features:
  - Fever with chills and rigors
- IOC:
  - CECT abdomen
- Management:
  - CT/USG-guided pigtail catheter drainage
  - Also used to drain liver abscesses
WOUNDS

Wound scoring systems

ASEPSIS wound score: -
- A → Additional treatment
- S → Serous discharge
- E → Erythema
- P → Purulent exudate
- S → Separation of deep tissues
- I → Isolation of bacteria
- S → Stay in hospital

Southampton’s wound score: -
- 0 → Normal healing
- 1 → Mild bruising / erythema
- 2 → Erythema + other signs of inflammation
- 3 → Clear or serosanguinous discharge
- 4 → Pus discharge
- 5 → Separation of tissue / wound breakdown

Types of wounds

1 → Clean wound [Surgical Site Infection rate (SSI) : < 2%] -
- Clean incised wounds
- Eg: - Thyroid surgery
  - Breast surgery
  - Uncomplicated hernia surgery
  - Coronary artery bypass graft
  - Knee replacement

II → Clean contaminated wound [2 - 10%] - GI/GU system -
- when no inflammation
  Eg: - Elective / interval cholecystectomy
  - Elective appendicectomy
  - Bowel surgery in prepared bowel
  - Removal of urinary stone when no UTI
  - Early phase of duodenal perforation [Chemical peritonitis stage]
III → Contaminated wound [10% - 20%] → EMU/EMU system entry when non-purulent inflammation +
  Eg.: - Emergency cholecystectomy
  - Emergency appendectomy
  - Bowel surgery in unprepared bowel
  - Removal of urinary stone in UTI

IV → Dirty wound [> 20%] → pus present
  Eg.: - All abscesses
  - Fecal contamination
  - Bacterial peritonitis
  - Neglected traumatic wound > 48hrs

  → Golden period for traumatic wound = 6 hrs
  → Decisive period = 4 hrs
  → Golden period for trauma = 1 hrs

* Clean case is the 1st case posted on an elective OT list.*

**Warning:** Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

**Prevention of wound infection**

1) Hand washing → Simplest and most effective way to prevent wound infection
  - Alcohol hand rub vs soap and water → Equivalent if hands not visibly soiled
  - Surgeon → Hands washed with hands up, elbows down
    - Duration → 1st hand wash → 3 - 5 min; Subsequent surgeries → 2 min each
    - Frequently missed parts in hand wash →
      - Thumb
      - Tip of fingers
      - Interdigital clefts

2) Patient should bathe with antiseptic solution, a night before surgery

3) Use of prophylactic antibiotics →
   - Best time: 1 hr before surgery
   - Prolonged surgery: Repeat dose after 4 hrs
- Clean and contaminated wound → Single dose is enough
  [ Exception: Implant usage ]

4) Hair removal := Best method and time → On table clipping of hair

5) Cleaning of part := Alcohol based solution / Betadine solution used.
   - Abdominal surgeries → Males – Nipples → Mid-thigh area
     Females := Inframammary fold → Mid-thigh area
   - While cleaning abdomen := Swab moved medial to lateral
   - While cleaning thigh := Swab moved lateral to medial
   - Sebaceous cyst of forearm := Clean incision site and go circumferentially outwards

- Limb surgery := Clean till one joint up
  - Allow cleaning liquid to dry before commencing surgery.

6) Adequate hemostasis and proper dissection

7) Drapes := Cloth v/s plastics (both offer same protection)

8) Avoid hypothermia and hyperglycemia.

9) Ideal OT parameters := Temperature : 18 – 22 °C
   - Relative humidity: 50 – 60%
   - Minimum 15 air exchanges / hr [At least 4 fresh air changes]
   - Air inside OT should flow from sterile to less sterile area.
   - Ultra – clean laminar air flow system inside OT

10) Washing cavity with antiseptic solution → not useful; saline is enough

11) O₂ inhalation immediate post – op → Reduces wound infection rate
Types of wound healing

- **Healing by Primary intention:**
  - Wound sutured
  - Faster healing, cosmetically better scar

- **Secondary intention:**
  - Wound left open → heals by contracture
  - More granulation tissue; Bad scar
  - More wound contracture → Keloid / Hypertrophic scar formation

- **Tertiary intention:** Delayed primary closure
  - Infected wound → Initially left open → Healthy granulation tissue appears in few days
  - Sutured later (Good scar)

Dressing techniques and materials

- **VAC dressing / Negative pressure dressing:**
  - 135 mm Hg
  - Occlusive dressing connected to VAC unit
  - Sucks out exudate and brings in more cell which hasten wound healing.

- **Uses:** Chronic non-healing wounds like:
  - Venous ulcers
  - Arterial ulcers / Neuropathic ulcers
  - Bed sores
  - Burns wound without eschar
  - Diabetic ulcer without osteomyelitis
• Alginate and foam dressing: Absorbs exudate
  - High drainage wounds like abscess cavities.

• Hydrocolloid and hydrogel dressings: Occlusive, waterproof
  - Drawback: Causes maceration of skin edge.
    - Does not absorb exudate.

• Transparent film dressings:
  - Opsite
  - Tegaderm
    - Occlusive, waterproof
    - Advantage: Transparent
      - Bathing possible
    - Drawback: Maceration of skin edge
      - Does not absorb exudate

Dressing Materials

Dressing Materials

VAC DRESSING - VAC PRESSURE DRESSING.
Surgical Nutrition

- Surgical nutrition
  - Enteral
  - Parenteral
- Advantage of enteral over parenteral:
  - Physiological, cheap
  - Entero-hepatic circulation
  - Intestinal microvilli patent
  - Prevents translocation of gut bacteria.

Enteral Nutrition

- Best route:
  - Oral
- If oral not possible:
  - Nutritional requirement
  - < 3 weeks
  - > 3 weeks
- < 3 weeks:
  - Good gastric emptying:
    - "Ryle's tube / Nasogastric tube"
    - Length: From earlobe to tip of nose to xiphisternum
    - Best position: Sitting with neck flexed
- > 3 weeks:
  - Poor gastric emptying:
    - "Nasojejunal tube / Freka's tube"
  - Good gastric emptying:
    - "Feeding gastrostomy"
    - Done at body of stomach, along greater curvature.
  - Peristalsis
  - Stamm gastrostomy: Stab incision made; more peri-drain leakage.
  - Witzel method: Tunnel created for tube placement before piercing stomach wall; less peri-drain leakage
  - PEG [Percutaneous Endoscopic Gastrostomy]: Tube placed taking endoscopic light as reference. Usually clubbed with tracheostomy. Types of methods: push, pull and introducer
  - Advantage: more physiological than jejunostomy.
  - Disadvantage: aspiration risk.
• Poor gastric emptying: Feeding jejunostomy
  - Along anti-mesenteric border
    - Stamm
    - Witze1

• Complications of enteral nutrition:
  - Tube related (MC): Block or migration of tube
    - Tube may get pulled out
  - Feeding regime related (MC): Osmotic diarrhoea

Parenteral nutrition

• Indications:
  - Short bowel syndrome.
  - Prolonged paralytic ileus (> 72 hours).
  - Acute IBD episodes.
  - Initial phase of acute severe pancreatitis.

• Modes of TPN:
  1) Central line: Best
     - For nutrition, most preferred ➔ Subclavian
     - Subclavian ➔ ↑ Pneumothorax risk
     - Tunneled: Least infection risk.
     - JV ➔ Easier to insert

  2) PICC line: Peripherally inserted central catheter

  3) Peripheral IV line: Least preferred
     - Wide bore - Short length cannula used

TPN - Total Parenteral Nutrition

• 1 - 1.5 L / 24 hrs
• Contains:
  - 40 - 50% carbohydrates
  - 30 - 40% fats
  - 10 - 20% proteins
  - Trace elements
  - Vitamins
• Based on carbohydrate content:
  - High osmolar TPN ➔ ↑ Carbohydrate ➔ ↑ CO₂, RQ > 1
  - Low osmolar TPN ➔ ↓ Carbohydrate ➔ ↓ CO₂, RQ < 1
    - Preferred in patients with pulmonary failure.
• Complications of TPN:
  • Central line related:
    - Pneumothorax
    - Air embolism
    - Blockade
    - Migration
    - MC:
      CIS / CRS [Catheter induced sepsis → same organism in catheter tip and blood / Catheter related sepsis → different organisms]

• Feeding regime related:
  - MC "overall": Hyperglycemia
  - Cholestasis: Common reason to stop TPN → predisposes patient to acalculous cholecystitis.
  - Refeeding syndrome:

    Chronically malnourished patient [catabolic state] → large quantities of TPN → Refeeding syndrome [anabolic state]

• Causes:
  - Hypomagnesemia
  - Hypophosphatemia
  - Hypokalemia

  → Arrhythmias and CHF

• Prevention:
  - Gradual ↑ in volume of TPN infusion.
  - Thiamine supplementation
  - Strict electrolyte monitoring after TPN has been started.

Short bowel syndrom: 00:32:32

• No meaningful absorption
• <500 cm of small bowel
• Causes: MC: Vascular causes → Superior mesenteric artery embolism
  - Crohn's disease
  - Post trauma
• Features: malabsorption features
  - Bacterial overgrowth
- Treatment:
  - Long-term TPN
  - Small intestinal transplant
  - Surgeries:
    - Bianchi procedure: longitudinal splitting of bowel \& end to end anastomosis \( \rightarrow \) absorption
    - Disadvantage: Narrow lumen, compromised vascularity.
    - STEP [Serial Transverse Enteroplasty]: Linear cutter fired alternatively on bowel. Bowel assumes a zig-zag shape with \( \uparrow \) surface area \( \rightarrow \) \( \uparrow \) food absorption.
### SHOCK

#### Hypovolemic shock

<table>
<thead>
<tr>
<th>Class</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Blood volume lost</td>
<td>0 - 15%</td>
<td>15% - 30%</td>
<td>30% - 40%</td>
<td>&gt; 40%</td>
</tr>
<tr>
<td>Blood loss amount</td>
<td>400 - 500 cc</td>
<td>1 L</td>
<td>1.5 L</td>
<td>&gt; 2 L</td>
</tr>
<tr>
<td>Pulse rate</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td>Not recordable</td>
</tr>
<tr>
<td>SBP</td>
<td>Normal</td>
<td>↓</td>
<td>↓</td>
<td>N/R</td>
</tr>
<tr>
<td>DBP</td>
<td>Normal</td>
<td>Narrow</td>
<td>Narrow</td>
<td>N/R</td>
</tr>
<tr>
<td>RR</td>
<td>↑</td>
<td>↓</td>
<td>↓</td>
<td>↑ ↑ ↑</td>
</tr>
<tr>
<td>Urinary output (UO)</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>Anuria</td>
</tr>
<tr>
<td>Mental status</td>
<td>Anxious, Thirsty</td>
<td>Confused</td>
<td>Comatose</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>Oral liquids</td>
<td>IV crystalloids</td>
<td>IV crystalloids + colloids</td>
<td>Transfusion</td>
</tr>
<tr>
<td>Base deficit</td>
<td>0 to -2</td>
<td>-2 to -6</td>
<td>-6 to -10</td>
<td>-10 or less</td>
</tr>
</tbody>
</table>

- Hypovolemic shock: most type of shock
- Pathophysiology of shock:
  - Class I shock:
    - Effects similar to blood transfusion.
    - All parameters are in normal range.
  - Class II shock: Compensated hypovolemic shock
    - Blood loss → Sympathetic system stimulated → Adrenaline, Noradrenaline release → ↑ pulse rate
    - Cardiac output N → ↑ venous return ↔ Peripheral vasoconstriction
    - ↑ PVR (↓ cold extremities)
    - ↑ DBP

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Pulse rate is earliest manifestation of hypovolemic shock.

- **Class III shock**: Decompensated hypovolemic shock. SBP first starts to reduce here.

  \[ \text{↑ blood loss} \rightarrow \text{↓ SBP, ↓ CO} \]

- **Best clinical indicator of fluid resuscitation**: Urinary output
  
  \[ \text{Adults} \rightarrow > 0.5 \text{ ml/kg/hr} \]
  
  \[ \text{Children} \rightarrow > 1 \text{ ml/kg/hr} \]

- **Best indicator to determine amount of fluid required in a patient with shock**: PCWP [Pulmonary capillary wedge pressure] > CVP [Central venous pressure]

### Massive blood transfusion

- Replacing entire circulating volume in 24 hrs [OR]
  
  Transfusing > 10 units /24 hrs.

- **Complications**:
  
  - Hypothermia, Hypocalcemia, Hypokalemia, Hyperkalemia
  
  - TRALI [Transfusion Related Acute Lung Injury]
  
  - Infection
  
  - MCC of death: → Coagulopathy → Hypothermia, Dilution of clotting factors in stored blood; ↓ platelets may be caused →
    
    \[ \text{PRBC : FFP : Platelets = 1 : 1 : 1} \rightarrow \text{↓ coagulopathy risk} \]

### Indices to monitor shock

- Shock index: \( \frac{HR}{\text{SBP}} \rightarrow > 0.9 \) suggests decompensated shock/highest mortality rate.

- Modified shock index: \( \frac{HR}{\text{MAP}} \) → most sensitive index

- **ROPE [Pulse rate over pressure evaluation]**:
  
  \[ \frac{PR}{\text{PP}} \rightarrow > 3 \rightarrow \text{decompensated shock} \]

### End points of resuscitation

- Systemic circulation: MVOS [Mixed venous oxygen saturation]

- Muscle perfusion: NIRS [Near infra-red spectroscopy]

- Brain perfusion: NIRS
- Gut perfusion: Gut mucosal pH
  - Sub-lingual capnometry
  - Laser doppler flowmetry
  - Gut tonometry

- Triggers for peri-operative RBC transfusion:
  - Hb [g/dl]: < 6 → Benefit
  - 6 - 8 → Only give if ongoing bleeding present
  - > 8 → No benefit

### Blood substitutes

- 1st generation: Perfluorocarbon
- 2nd generation: Stroma free Hb
- Next generation:
  - Polyethylene glycol hemoglobin (PEG)
  - Hemospan 1/k/a MP40X
  - Pyridoxylated hemoglobin polyoxyethylene conjugate (PHP)

### Hypovolemic shock v/s other types of shock

<table>
<thead>
<tr>
<th>Hypovolemic Shock</th>
<th>Cardiogenic</th>
<th>Neurogenic</th>
<th>Anaphylactic</th>
<th>Septic - Warm</th>
<th>Septic - Cold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse rate</td>
<td>↑↑</td>
<td>↑/↓</td>
<td>↑</td>
<td>↑</td>
<td>↑/↓</td>
</tr>
<tr>
<td>SBP</td>
<td>↓↓</td>
<td>↓↓</td>
<td>↓↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Cardiac output</td>
<td>↓↓</td>
<td>↓↓</td>
<td>↑</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Peripheral vascular</td>
<td>↑↑</td>
<td>↑</td>
<td>↓↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>resistance</td>
<td>↓↓</td>
<td>↓↓</td>
<td>↓↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>JVP</td>
<td>↓↓</td>
<td>↑</td>
<td>↓↓</td>
<td>↓</td>
<td>Normal</td>
</tr>
</tbody>
</table>
SIRS and sepsis

- **Systemic inflammatory response syndrome**: Body's response to inflammation.
  - IL-1, IL-6, TNFα
  - Temperature <36°C or >38°C
  - WBC < 4000 or > 12,000 (CR) > 10% bands forms peripheral smear
  - RR > 20 / min or PCO₂ < 3.3 mm Hg
  - PR > 90 / min without influence of inotropes
  - Any 2 parameters → SIRS

- **Sepsis**: SIRS + known foci of infection

- **Septic shock**: Sepsis causing hypotension
  - But it does NOT respond to fluids

- **MODS**: Multiple organ dysfunction syndrome.
  - Failure of 2 or more organ systems.

**Sepsis 3.0 guidelines**

1. SIRS is out, qSOFAR / SOFA are in;
   - qSOFAR: quick Sequential [Sepsis-related] Organ Failure Assessment score.
     - SBP < 100 mm Hg [Hypotension]
     - Altered mental status
     - RR > 22 / min [Tachypnea]
     - Any 2 present → Poor outcome
### SOFA score:

<table>
<thead>
<tr>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Respiratory System</td>
<td></td>
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<tr>
<td>$\frac{P_aO_2}{FiO_2}$ (mmHg)</td>
<td>2400</td>
<td>&lt;400</td>
<td>&lt;300</td>
<td>&lt;200 with Respiratory Support</td>
<td>&lt;100 with Respiratory Support</td>
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<tr>
<td>Hepatic system Bilirubin (mg/dl)</td>
<td>1.2</td>
<td>1.2-1.9</td>
<td>2.0-5.9</td>
<td>6.0-11.9</td>
<td>&gt;12.0</td>
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<tr>
<td>Cardiovascular System</td>
<td>MAP</td>
<td>MAP</td>
<td>Dopamine</td>
<td>Dopamine</td>
<td>Dopamine</td>
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<td></td>
<td>70</td>
<td>&lt;70</td>
<td>5J-15 or epinephrine</td>
<td>&gt;15 or epinephrine</td>
<td>&gt;70J or Norepinephrine &gt;0.1</td>
</tr>
<tr>
<td></td>
<td>mmHg</td>
<td>mmHg</td>
<td>&lt;5 or Dobutamine (Any dose)</td>
<td>0.1</td>
<td></td>
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<tr>
<td>Coagulation Platelets $\times 10^3$/$\mu$L</td>
<td>2150</td>
<td>&lt;150</td>
<td>&lt;100</td>
<td>&lt;50</td>
<td>&lt;30</td>
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<tr>
<td>Central nervous System Glasgow coma scale</td>
<td>15</td>
<td>13-14</td>
<td>10-12</td>
<td>6-9</td>
<td>4</td>
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<tr>
<td>Renal System Creatinine (mg/dl) urine output (ml/d)</td>
<td>&lt;1.2</td>
<td>1.2-1.9</td>
<td>2.0-3.4</td>
<td>3.5-4.9</td>
<td>&gt;5.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;500</td>
<td>&lt;400</td>
</tr>
</tbody>
</table>

a) Severe sepsis is out

b) Sepsis: Life threatening organ dysfunction caused by dysregulated host response to infection.

c) Septic shock: Need for vasopressors and SLactate >2 mmol/l
### Surviving sepsis guidelines

- Parameters to be met in first 6hrs of resuscitation.
  i) CVP 8-12 mm Hg
  ii) MAP ≥ 65 mm Hg
  iii) Urinary output ≥ 0.5 ml/kg/hr
  iv) MVOS 65%

  Superior venacava $O_2$ saturation $[ScvO_2]$ 70%

### Ebb and flow

<table>
<thead>
<tr>
<th>Phase</th>
<th>Duration</th>
<th>Role</th>
<th>Physiological</th>
<th>Hormones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebb</td>
<td>&lt;24 hrs</td>
<td>Maintenance of blood volume</td>
<td>$\downarrow$ EMR, $\downarrow$ temp, $\downarrow$ O2</td>
<td>Catechol, Cortisol, aldosterone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>catecholamines</td>
<td>Consumption, vasoconstriction, $\uparrow$ CO, $\uparrow$ heart rate, acute phase proteins</td>
<td></td>
</tr>
<tr>
<td>Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catabolic</td>
<td>3 - 10 days</td>
<td>Maintenance of Energy</td>
<td>$\uparrow$ EMR, $\uparrow$ Temp, $\uparrow$ O2 Consumption, -ve Na Balance</td>
<td>$\uparrow$ Insulin, Glucagon, Cortisol, Catechol but insulin resistance</td>
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<tr>
<td>Anabolic</td>
<td>10 - 60 days</td>
<td>Replacement of lost tissue</td>
<td>+ve Nitrogen balance</td>
<td>Growth hormone, IGF</td>
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<tr>
<td>(moore)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COMMON SURGICAL SWELLINGS

Lipoma

- Benign fat collection, usually encapsulated.
- Long standing, slow growing, usually painless.
- O/E: Soft; Pseudofluctuation
  - Slip sign
- Diagnosis: FNAC
- Management: Excision: Cosmetic
  - Pain
  - Rapid ↑ in size
  - Suspected sarcomatous change → more risk in retroperitoneum, thigh.

- Dercum’s disease:
  - Multiple lipomatosis; Treatment: same as lipoma.
  - D/D: Neurofibromatosis → FNAC to differentiate

Sebaceous cyst

- Is a result of blocked hair follicle which transforms to a cyst
- O/E: Punctum (characteristic)
- H/O whitish, thready discharge from swelling
- Management: Excision
- Complications:
  - Infection → Antibiotics
  - Pus (drainage and cyst excision)
  - Sebaceous horn → secretions exit and solidify to form a horn-like structure

Dermoid cyst

- Epithelial elements entrapped along lines of embryonic closure.
- Epithelial lining
- Tuft of hair over the cyst
- O/E: Fluctuant swelling
- Common sites:
  - Outer canthus of eye
  - Post auricular dermoid
• D/D: Implantation dermoid → Happens due to trauma; at site of trauma.
  Eg: Post-ear piercing

• Diagnosis: FNAC
  If cyst attached to periosteum → Bone erosion
  → Imaging to rule out bone erosion and intra-cranial extension to be done.

• Management: Excision
• Complications: Infection, rupture, rarely malignant change.

Cystic hygroma

• A/H/A: Lymphangioma.
• Sequestered lymphatic tissue.
• MC location: Posterior triangle of neck
  Other locations: Axilla, inguinal region

• Presentation:
  → In utero
  → Large → Obstructed labour
  → Rupture → Respiratory distress
  → Infection

• O/E: Cystic; Fluctuation
  → Contains clear fluid → “Brilliantly transilluminant”.

• Management:
  → Aspiration followed by sclerotherapy
  → Best → Excision:
  → Nerve likely to get injured → Spinal accessory nerve.

Thyroglossal cyst

• Remnant of thyroglossal tract.
• MC location: Midline of neck, subhyoid.
• Features: Fluctuant; moves with deglutition and with protrusion of tongue.

• Diagnosis: FNAC
  To rule out if it is the only functioning thyroid tissue.

• Management:
  → Sistrunk procedure: [Removal of cyst + tract till base of tongue + part of hyoid]
  → I and D → Contraindicated → Causes thyroglossal fistula.
• Thyroglossal fistula: Never congenital, always acquired.
  - Treatment: Sistrunk procedure.

Branchial cyst

• Persisting cervical sinus → Branchial cyst
• Lined by epithelium with fluid inside
• Features: Swelling in neck
• O/E:
  → Related to sternocleidomastoid muscle
    [Along anterior border, upper 1/3rd of sternocleidomastoid]
  → Fluctuant
• Diagnosis: FNAC
• Management: Excision and exploration of entire tract

• Branchial fistula:
  - Failure of fusion of a² arch with a⁵th arch,
  - [Along anterior border, lower 1/3rd of sternocleidomastoid]
  - Management: Excision

Submandibular swelling

• Location: Submandibular triangle of neck
• D/D: Submandibular lymph node.
  ↓
  "Bimanual palpation" to differentiate from submandibular gland swelling.
  ↓
  Gland is palpable; Lymph node is not.

Ranula

• Mucous extravasation cyst from sublingual salivary gland
• Features:
  - Cystic swelling in the floor of mouth
  - Fluctuant
  - "Brilliantly translucent"
• Management: Marsupialization or Excision of cyst + sublingual gland
• MC structure injured during ranula surgery: Sub-lingual gland duct
• MC nerve injured: Lingual nerve
- Plunging ranula:
  - Mucous retention cyst involving sublingual and submandibular salivary glands.
  - Presents as swelling in oral cavity and neck.
  - Management: Excision of oral swelling + sublingual gland + aspiration of submandibular swelling.
- Parotid swelling: On side of swelling, ear lobe is lifted up.

**Tubercular cervical lymphadenopathy**

- MC group involved: Level 2 lymph node (LN).
- Pathology:
  - Caseous necrosis → Periadenitis
    - [LN wall inflamed]
  - Matting [LN stuck to each other]
  - LN mass filled with pus, adherent to deep fascia
  - Abscess cavities → below and above fascia; i.e., COLD abscess in neck → "Collar stud abscess".
- Diagnosis: Anti gravity aspiration → ZN staining.
- Management: ATT.

**Carbuncle**

- Multiple follicular inflammatory lesion coalesce to form an abscess.
- Location: Nape of neck.
- Diabetic / immunocompromised patient.
- Management: Antibiotics and drainage [Cruciate incision used].
ULCERS

Ulcer - breach in continuity of epithelium or mucous membrane

Types of ulcer

- Punched out edge: Arterial ulcer
  - Neuropathic/Trophic ulcer

- Sloping edge: Healing ulcer
  - Venous ulcer

- Undermined edge: Tuberculosis

- Rolled-out, pearly white edge: Basal cell carcinoma [Rodent ulcer]

- Raised, everted cauliflower like edge: Squamous cell carcinoma

Varicose ulcer

- MC site: Gater area [close to medial malleolus]
- Theory: Ambulatory venous hypertension theory
- Precursor lesion: Lipodermatosclerosis
- Chronic venous insufficiency → Fat obliterates and skin becomes shiny.
- "Inverted champagne bottle" appearance
- IOC: Duplex scan
CEAP classification

- Telangiectasia: vessel diameter = < 1 mm
- Reticular veins: < 3 mm
- Varicose veins: > 3 mm

<table>
<thead>
<tr>
<th>Clinical Classification (C)</th>
<th>Etiologic Classification (E)</th>
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<tbody>
<tr>
<td>C₀</td>
<td>No visible/palpable signs of venous disease</td>
</tr>
<tr>
<td>C₁</td>
<td>Telangiectasias or reticular veins</td>
</tr>
<tr>
<td>C₂</td>
<td>Varicose veins</td>
</tr>
<tr>
<td>C₃</td>
<td>Edema</td>
</tr>
<tr>
<td>C₄</td>
<td>Pigmentation and/or eczema</td>
</tr>
<tr>
<td>C₅</td>
<td>Lipodermatosclerosis and/or atrophy</td>
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<tr>
<td>C₆</td>
<td>Healed venous ulcer</td>
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<tr>
<td>C₇</td>
<td>Open venous ulcer</td>
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<td></td>
<td>Subscript</td>
</tr>
<tr>
<td></td>
<td>Asymptomatic</td>
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<tr>
<td></td>
<td>Symptomatic</td>
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</table>

- Features of varicose ulcer: Shallow ulcer, sloping edges
  - Pale granulation tissue
  - Pigmented margins

- Management: Bisgaard's regimen → Education
  → Elevation of limb
  → Elastic compression stockings
  → Dressings
  → Surgery for varicose veins

- Long standing ulcer: Marjolin's ulcer ← malignant change
  Usually SCC

Arterial ulcer

- Due to arterial insufficiency.
- Features: Punched out edges; non-healing
  - Floor: slough
  - Absent pulsations
- Diagnosis: Duplex scan
- Management: Treat underlying cause
Trophic / Neuropathic ulcer

- Features:
  - Painless
  - Punched out edges
  - Pale granulation; non-healing
  - Chronic → margins become fibrotic

- Causes:
  - Leprosy; Diabetes; Neurological disorders

- Common in weight bearing areas; e.g., sole

- Management:
  - Treat underlying cause
    - Debride ulcer → Flap to cover ulcer

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with marrow edition 4 videos.

Diabetic ulcers

- Combination of:
  - Microangiopathy
  - Accelerated atherosclerosis
  - Neuropathy
  - ↑ Sugar concentration in tissue
    → Infection

- In weight bearing areas:
  - Ball of 1st toe
  - Heel

- Non-healing, painless ulcer
- Bone → Can cause osteomyelitis

- Stages:
  1) → Inflammation but no breach of skin
  2) → Breach, but superficial
  3) → Deep ulceration
  4) → Bone involved

- Management:
  - Control of diabetes
    - Local debridement
    - Antibiotics
    - Dressings
    - Vacuum assisted closure (VAC) dressing
      - If osteomyelitis + with non-healing diabetic ulcer → Amputation
Bedsores

- > 30 mm Hg constantly, for prolonged period of time
- Mc site: Ischium > Greater trochanter
- Features: punched out, erode till bone, non-healing ulcer tendency
- Staging:
  1. Non-blanchable erythema without breach
  2. Partial thickness \( \rightarrow \) Epidermis and dermis involved
  3. Dermis/ sub-cutaneous tissue
  4. Muscle/Bone

- Management:
  - Remove pressure
  - Debridement
  - dressings
  - VAC dressing

- Flap: TFL (Tensor Fascia Lata) flap \( \rightarrow \) MC flap for bedsores \( \rightarrow \)
  Based on 'lateral circumflex femoral vessels'

- Prevention:
  - Patient turned at least for 10 min every 2 hours
  - Air/Water mattresses used
INSTRUMENTS

Linear stapler / linear cutter:
- Uses:
  - Bowel anastomosis
  - Sleeve gastrectomy
- If bleeding occurs along staple line: oversew with suture
- If stapler cartridge doesn’t fire:
  the part gets cut & not stapled

Circular stapler:
- Uses:
  - Stapled haemorrhoidopexy
  - Low anterior resection
  - Oesophago - Jejunostomy

Needle holder:
- Criss - Cross serrations with a groove
  So that needle is stable while taking a bite.

Needle

Swaged end

Correct place to hold the needle: 1/3rd from swaged & 2/3rd from pointed end.

Forceps:
- Plain / Non tooth:
  Uses: Places where trauma is to be avoided
  - Bowel
  - CBD
  - Ureter
Toothed:
Uses: To grip a tough structure
- Skin
- Fascia
- Sheath

3 instruments for skin suturing: Needle holder, Tooth forceps, straight scissors.

Russian forceps:
Used for: Neck dissection
Axillary clearance
Advantage: Strong grip over tissue serration on the handle part
for better finger grip.

Bard parker handle:
Used to mount the blades

Blades:
- Blades 10, 15, 20, 21, 22, 23
  all have a belly:
  ↓
  used for making incisions
- Blade 11 - Pointed
- Stab blade - used for 1 & D
- Blade 12 - Curved front
  → suture removal

- In OT, always pass blades in a kidney tray → prevent injury to surgical staff.
  On passing the blade back to the nurse →
  pointed end of the blade is facing the surgeon.
whenever incision is made, blade should be perpendicular to skin edge
( slanting blade = beveled edge )
"incision is always made from far to near "

Artery Forceps:
- Types:
  - Straight
  - Curved
- Transverse serrations present
- Uses: - to stop the blader
  Smallest artery forceps K/a.
  mosquito artery forceps

Babcock tissue forceps:
- 2 cups with gaps
- Uses: - Holding tubular structures
  (appendix, fallopian tube )
  Prevent crushing.

Kochers tissue forceps:
- One side - 2 teeth, other side 1 tooth
- Uses: To hold tough structure.
  - Sheath
  - Fascia.
  - Cervix in hysterectomy

Allis forceps:
- multiple teeth on both
  sides which interlock with
  each other.
Uses: - Holding tough structures
  Skin edges - mastectomy,
  Thyroidectomy
Ramples sponge holder:
- used for holding gauze / sponge for painting the surgical area.

Cleaning: Clean the incision site & go circumferentially outward.

Refractors:
- Non self-retaining retractor
  - Langenback’s retractor
    - solid 90° angle at one end
    - used for retraction superficial tissue
  - Zerry/Army navy retractor:
    - One side - solid handle ➔ for superficial tissue
    - Other side - a hooks with gap ➔ for superficial tissue but can suture between them.

- Cat’s Paw retractor: used for superficial tissue.
- Deaver retractor: used to retract deeper structure

Instruments in laparoscopic surgery:
To create pneumoperitoneum:
- Open method / Hasson method
- Veress needle: - Spring loaded instrument with beveled edge.
- Stop valve: Helps to regulate the flow of CO₂.

To know if needle is in peritoneal cavity:
Drop Test: Drop of saline at the opening of needle, if drop gets sucked in → needle in peritoneal cavity
Saline method: Inject 10 cc saline → freely go through & cannot aspirate the saline back.

- Laparoscopic trocar:
  used to insert laparoscopic instruments into cavity

- SILS Port (Single incision laparoscopic surgery port)
  - single port has 3 channel
  - multiple instruments can be inserted.
  - Cosmetically superior
- Incision - 15mm infraumbilical incision
- Disadvantage / complication - High chance of umbilical hernia.

LAPAROSCOPIC INSTRUMENTS
- needle nose (big bird) grasper
- tissue dissector
- scissors

- Big bird grasper
- Maryland's tissue dissector
- Scissors

\{ only tip of instrument exposed, rest of the parts are black \\
\downarrow insulation \\
\downarrow to prevent glare in body cavity

Capacitance - electric leak due to break of insulation
Burn undesired structure.

Bowel clamp - Non traumatic:
- No teeth
- Used at the bowel ends during anastomosis.

Periosteal elevator:
- Mainly used in orthopedic procedures
Jollis thyroid retractor:
- A retractor used for surgery.

Humbys Knife

Electric dermatome

- Used for - split thickness skin graft
- Thickness - 0.005 - 0.012 inches
- Punctate hemorrhage + ➔ graft is of right thickness
- Meshing / scoring of the graft:
  - ↑ surface area of graft
  - Prevent seroma.
BASICS OF TRAUMA MANAGEMENT

Trimodal distribution

Cause of death:
- Immediately after trauma:
  1. Severe head injury (most cause)
  2. Transection of great vessels
- Death within 1 hour of injury:
  1. Airway obstruction
  2. Tracheobronchial injury
  3. Open pneumothorax
  4. Tension pneumothorax
  5. Acute circulatory arrest
  6. Haemothorax
  7. Cardiac tamponade
- Death after days/weeks:
  1. Delayed head injury
  2. Sepsis
     - 'golden hour'
     1st hour after trauma
     Proper intervention can prevent trauma
     - 'platinum minutes'
     1st 10 minutes after trauma

Surgery • v2.0 • Marrow 4.0 • 2020
Scanned with CamScanner
Triage

- **Multiple casualty event**
  - Multiple people injured
  - Number does not overwhelm medical facilities available

- **Mass casualty event**
  - Multiple people injured
  - Number overwhelms medical facilities available
  - Example: earthquake, floods, bomb blast

**Principle of triage:**
- "Save as many in as little time as possible."

**Colour coding in triage:**
- **Red** → Urgent intervention → (1) Airway obstruction:
  - (a) Tracheobronchial injury
  - (b) Open pneumothorax
  - (c) Tension pneumothorax
  - (d) Acute circulatory arrest
  - (e) Haemothorax
  - (f) Cardiac tamponade
- **Yellow** → Admitted, stabilised → (1) Fractures
  - Intervention can wait
  - (a) Moderate head injury
- **Green** → "Walking wounded" → (1) Minor bruises
  - Require:
    - (a) Laceration
- **Black** → Dead bodies / Moribund patients
  - Segregated

**Advanced trauma life support (ATLS)**

- Based on principle: ABCD
  - **A** → Airway management
  - **B** → Breathing management
  - **C** → Circulation
  - **D** → Disability management
Exception: c ABCD

Done in "field settings." E.g.: war field
C -> control of exsanguinating hemorrhage.
In BLS (advanced cardiac life support) -> CAB principle followed

Pre-hospital management:
On transporting patient, information collected from:

Ambulance driver  

> m -> mechanism of injury
> I -> Injuries
> S -> signs and symptoms
> T -> Treatment given

Patient

> A -> Allergies
> m -> medical condition
> P -> Past history
> L -> Last meal
> E -> Events leading to trauma.

ATLS

Primary survey  

ABCD + life threatening injuries

Airway
- Airway obstruction
- Tracheobronchial tree injury

Breathing
- Tension pneumothorax
- Open pneumothorax

Circulation
- Massive hemothorax
- Cardiac tamponade
- Traumatic circulatory arrest

Secondary survey

detailed survey

Search for all other injuries

Log roll

Minimum: 4 people required
In limb fracture: 5 people required
Airway: Cervical spine injury

- Cervical spine stabilised 1st before managing airway.
  - to avoid cervical injury during intubation.
  - a person procedure.

- Precautions taken during transfer of cervical spine patient.
  1. done on hard board
  2. supine position
     - strap → head, thorax & pelvis.
  3. Prone position → unconscious patients
     - Prevents aspiration
     - Lateral position → not done.

Nexus Criteria

- Assessment of cervical injury.
- 1. Nexus - National Emergency X-ray Utilization Study
   - Nexus - mnemonic.
     - N - Neuro deficit
     - E - EtOH (alcohol)/intoxication
     - X - Extreme distraction injuries
     - U - Unable to provide history
       - altered level of consciousness
     - S - Spinal tenderness (midline)

National Emergency X-Ray Utilization Study (NEXUS) Criteria:

- Yes: No Radiography
- No: Radiography

NEXUS Mnemonic
- N - Neuro deficit
- E - EtOH (alcohol)/intoxication
- X - Extreme distracting injuries
- U - Unable to provide history
- S - Spinal tenderness (midline)
→ If any features present
   ↓
   Indicates cervical injury
   ↓
- Stabilize cervical spine → Hard Philadelphia collar.
- Imaging of cervical spine.
  (Minimal - x-ray)

→ If factors are absent
   ↓
   - Imaging of cervical spine not required
   Canadian C spine rule.
   - For assessment of cervical injury.

**Canadian C Spine Rule**

ASIA (American Spinal Injury Association) Impairment scale.
For assessment of spinal cord injury.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Complete</td>
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<tr>
<td>B</td>
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</tr>
<tr>
<td>C</td>
<td>Incomplete</td>
</tr>
<tr>
<td>D</td>
<td>Incomplete</td>
</tr>
<tr>
<td>E</td>
<td>Normal</td>
</tr>
</tbody>
</table>
Airway Assessment

- If patient can speak
  - Airway intact (simplest method)
  - Danger signs:
    1. Unable to speak
    2. Comatose patient
    3. Patient with GCS ≤ 8
    4. Non-purposeful movement
  - Danger signs present → Definitive airway to be achieved.

- Intubation
  - Orotracheal intubation (MC)
  - Nasotracheal intubation
    - Contraindicated in anterior skull base fracture
  - Videolaryngoscope
    - Used during intubation for better visualization.

- If orotracheal intubation fails due to
  1. Severe maxillofacial injury
  2. Difficult airway management

- Emergency management
  - Needle cricothyroidotomy
    - High flow oxygen given
      - Quick procedure
      - Y connector used

- Definitive management
  - Tracheostomy
High flow oxygen of 15 lts / minute
- ‘Y’ connector kept → 1 second on and 4 second off.
→ After 15 - 30 mins
  ↓
  Co₂ retention
  Surgical cricothyroidotomy
  ↓
  avoided in patients < 12 years
  ↓
  causes: subglottic stenosis.

Breathing and circulation

Breathing.
(1) chest examination rule out (1) Open / tension pneumothorax (2) Cardiac tamponade
  ↓
  - Inspection
  - Palpation
  - Percussion
  - Auscultation.
(2) pulse oximetry (adjunct)

Circulation:
  ↓
  Insertion of a large bore IV lines
  
  Minimum 18 G needle.
→ Patient dehydrated → 16 G / 14 G needle used.
→ IV line insertion not possible (shock)

Emergency management
  ↓
  venous cut down
  ↓
  Great saphenous vein
  ↓
  needle insertion below tibial tuberosity
  ↓
  IV fluids / blood
  ↓
  done in any age group

Definitive management
  ↓
  Central line insertion
  ↓
  mc vein
  ↓
  Internal jugular vein
  ↓
  done in any age group

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Updates in ATLS:

- Judicious fluid therapy.
  
  - 1 Lt of fluid instead of 2 Lts

- Damage control resuscitation:
  1. Anticipate and treat traumatic coagulopathy.
  2. Control permissive hypotension.
  3. Limit crystalloid infusion
  4. Prevent: Dilution coagulopathy.

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Crash - 2 Trial 00:35:54

- Role of Tranexamic acid.
  
  "significantly reduce mortality in adult trauma patients"
  Dose: 1 g over first 10 minutes.
  Followed by
  1 g over 8 hrs

- Indications:
  1. Significant hemorrhage
  2. SAP (systolic blood pressure) < 90 mmHg
  3. Heart rate > 110 beats / min

- In a trauma patient

Rapid fluid infusion is not a substitute for controlling bleeding.
Disability management

Glasgow coma score.

- Includes mainly 3 responses:
  1. Eye opening.
  2. Verbal response.

- Minimum score: 3; maximum score: 15

- \( V_3 \rightarrow \) verbal response in head injury patients (MC)

  - Inappropriate words:
  - Mumbling sounds (E.g: aa, maa)

  - Incomprehensible sound

  - \( V_1 \rightarrow \) If patient is intubated \( \rightarrow \) score 1 added.

  - Abnormal flexion to painful stimuli

  - Decorticate rigidity

  - Abnormal extension to painful stimuli

  - Decerebrate rigidity

  - Highest motor response - to be recorded.

GCS - P score and GCS - PA score

- GCS - P score.

  - Pupillary response score not added to GCS score.

- Pupillary response / reactivity score.

  1. \( O \rightarrow \) If both pupils are reacting

  2. \( I \rightarrow \) Any one pupil reacting.

  3. \( A \rightarrow \) Both pupils not reacting.

- \( \rightarrow \) GCS - PA score

  - Age of patient assessed.

    - Younger age \( \rightarrow \) better prognosis.

- \( \rightarrow \) NT - Non testables

  - In intubated patients verbal response cannot be assessed.

    - Written as VNT in GCS score.
# Ebb and Flow

<table>
<thead>
<tr>
<th>Phase</th>
<th>Duration</th>
<th>Role</th>
<th>Physiological</th>
<th>Hormones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebb</td>
<td>&lt;24 hrs</td>
<td>Maintenance of blood volume, catecholamines</td>
<td>Dec BMR, Dec temp, Dec O2 consump, vasoconst, Inc CO, Inc heart rate, acute phase proteins</td>
<td>Catechol, Cortisol, aldosterone</td>
</tr>
<tr>
<td>Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catabolic</td>
<td>3 – 10 days</td>
<td>Maintenance of energy</td>
<td>Inc BMR, Inc Temp, Inc O2 consump, -ve N2 balance</td>
<td>Inc. Insulin, Glucagon, Cortisol, Catechol but insulin resistance</td>
</tr>
<tr>
<td>Anabolic</td>
<td>10 – 60 days</td>
<td>Replacement of lost tissue</td>
<td>+ve Nitrogen balance</td>
<td>Growth hormone, IGF</td>
</tr>
<tr>
<td>(MOORE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Phases:**

1. **Ebb phase.**
   - Occurs < 24 hrs of injury.
   - For maintenance of blood volume and energy conservation.
   - (1) ↓ Basal metabolic rate.
   - (a) ↓ Thyroid hormones.
   - (b) ↓ Oxygen consumption.
   - (c) ↓ Body temperature.
   - Hormones required:
     - (1) Catecholamines
     - (2) Cortisol
     - (3) ↓ Insulin.

**Proper resuscitation**

- Reduced duration of ebb phase.
- (a) **Flow phase**

**Catabolic phase**

- 3 – 10 days after trauma
- → → Basal metabolic rate
- → Temperature increases
- → Negative nitrogen balance
  - Hormones.
  - (1) ↑ Thyroid hormone

**Anabolic phase**

- 10 – 60 days after trauma
- → Positive nitrogen balance
- → Hormones
  - (1) ↑ Insulin
  - (2) ↑ Growth hormones.
(a) ↑ Insulin
   (Insulin resistance in organs)

**Updates**

1. **RTS** - Revised trauma score
   - Includes:
     - Gas score
     - Systolic blood pressure
     - Respiratory rate.

2. **TRISS** - Trauma and injury severity score
   - Includes:
     - Revised trauma score
     - Mechanism of injury
     - Age
     - **ISS** - Injury Severity Score

   Assessment of injury in various organs.

3. **MESS**
   - Severity score
   - Includes:
     - Type of injury
     - Shock
     - Ischemia
     - Age group
   - **IF** mess score:
     - ≤ 6 Salvageable limb.
     - ≥ 7 Amputation.

---

**Mangled Extremity Severity Score (MESS)**

<table>
<thead>
<tr>
<th>Types Characteristics</th>
<th>Injury</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low energy</td>
<td>stab wound, simple closed fx, small-caliber GSW</td>
<td>1</td>
</tr>
<tr>
<td>2. Medium energy</td>
<td>open/multi-level fx, dislocation, moderate crush</td>
<td>2</td>
</tr>
<tr>
<td>3. High energy</td>
<td>shotgun, high-velocity GSW</td>
<td>3</td>
</tr>
<tr>
<td>4. Massive crush</td>
<td>logging, trainee, oiling accidnets</td>
<td>4</td>
</tr>
</tbody>
</table>

**Shock Group**

- Normotensive
- Transiently
- Hypotensive

**Ischemia Group**

- 1. None
- 2. Mild
- 3. Moderate
- 4. Advanced

**Age Group**

- 1. < 30 yo
- 2. > 30 < 50

---

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ABDOMINAL TRAUMA

MC organ injured:
1. Overall
2. Blunt trauma
3. Penetrating trauma
4. Gunshot wound (GSw)
5. Seat belt syndrome
6. Deceleration injury
7. Children

: Spleen
: Spleen > Liver > Small intestine
- Liver > Small intestine > Diaphragm
- Small intestine > Colon > Liver
- Mesentery
- DJ Flexure
- Spleen > Kidney

Blunt trauma to abdomen

<table>
<thead>
<tr>
<th>Blunt trauma</th>
<th>Hemodynamically stable</th>
<th>Unstable</th>
</tr>
</thead>
<tbody>
<tr>
<td>First investigation</td>
<td>Fast</td>
<td></td>
</tr>
<tr>
<td>IOC</td>
<td>CECT</td>
<td></td>
</tr>
</tbody>
</table>

If positive:

FAST (Focused Assessment with Sonogram in Trauma)

Advantage:
- Fast (done in 2-5 mins)

Quadrants assessed:
1. Epigastrium (look for: cardiac tamponade)
2. (R) hypochondrium (liver injury)
3. (L) hypochondrium (spleen injury)
4. Pelvis
Minimum fluid detected \(\rightarrow\) 100 cc.
\(\text{eFAST (extended FAST)}\)

\[\downarrow\]

- FAST + thoracic cavity assessment

\[\downarrow\]

4 quadrants + left \& right thoracic cavity = 6 quadrants
- a.k.a. BOAST (Bedside Organ Assessment with Sonography after Trauma)

\[\rightarrow\] FAST + ve.

if \& Hyperchoic area.

---

**Penetrating abdominal trauma**

Penetrating woula

- Superficial to peritoneum
- Peritoneal breach (+)

\[\downarrow\]

Local exploration

? suturing

\[\downarrow\]

Peritonitis

Omentum hanging out of the wound, bile staining of dressing, patient is unstable

\[\downarrow\]

CECT

\[\downarrow\]

Laparotomy

**DPL - Diagnostic Peritoneal Lavage**

- **Indication:**
  - Hemodynamically unstable patient \(\rightarrow\) when FAST not available

- **Procedure:**
  - Empty bladder (Foley's) \& stomach (Ryle's tube)
  - Introduce catheter below umbilicus
  - First aspirate \(\rightarrow\) 10 cc of frank blood

\[\downarrow\]

if no blood aspirated \(\rightarrow\) Laparotomy

\[\downarrow\]

Instill 1L of RL

\[\downarrow\]

Aspirate

\[\downarrow\]

+ ve DPL if:
a) > 1 Lakh RBC /mm³
b) > 500 WBC /mm³
c) > 175 IU / L [S. Amylase]
d) Faecal matter, food particles, bile

Drawbacks of DPL:
cannot assess: Retroperitoneal trauma and renal injury

**Splenic injury**

Suspect splenic injury if

Fracture of 9-11th ribs on left side.

Kehr sign

On lifting left lower limb referred to pain to (l.) shoulder tip

Blood below left hemidiaphragm causes irritation to diaphragm

**Grades of splenic trauma.**

---

**Table 1. Simplified Version of the Splenic Injury Scale of the American Association for the Surgery of Trauma**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Injury Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Laceration &lt;1 cm parenchymal depth or subcapsular hematoma &lt;10% of surface</td>
</tr>
<tr>
<td>II</td>
<td>Laceration 1 to 3 cm or subcapsular hematoma 10% to 50%</td>
</tr>
<tr>
<td>III</td>
<td>Laceration &gt;3 cm or subcapsular hematoma &gt;50%</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration to segmental or hilar vessels with significant devascularization (&gt;25% of spleen)</td>
</tr>
<tr>
<td>V</td>
<td>Completely shattered spleen or hilar injury with complete devascularization</td>
</tr>
</tbody>
</table>
Trauma Management:

Grade I/II → Usually stable → CECT → Conservative Management

- IOCT
  - Monitor vitals
  - ARD 24 hr CECT
  - Hematocrit

If grade of injury ↑

- Angioembolisation
  - Fails
  - a) Unstable
  - b) Contrast blush (+)

Surgery (Splenectomy/Splenorrhaphy)

Grade IV/V → Unstable → IOCT [CT] → Surgery

Note:
- Children with splenic trauma → Preserve spleen

Liver Injury

- Suspect injury if:
  - Bruising or fracture of 9-11th ribs on right side
  - Penetrating injury below nipple on right side

Grades of injury:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description of Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma: subcapsular, &lt;10% surface area. Laceration: capsular tear, &lt;1 cm depth</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma: subcapsular, 10-50% surface area; intraparenchymal &lt;10 cm diameter. Laceration: capsular tear, 1-3 cm depth, &lt;10 cm length</td>
</tr>
<tr>
<td>III</td>
<td>Hematoma: subcapsular, &gt;50% surface area of ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma &gt;10 cm or expanding. Laceration: &gt;3 cm parenchymal depth</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration: parenchymal disruption involving 25-75% hepatic lobe or 1-2 Couinaud segments</td>
</tr>
<tr>
<td>V</td>
<td>Laceration: parenchymal disruption &gt;75% hepatic lobe or ≥ 3 Couinaud segments</td>
</tr>
<tr>
<td>VI</td>
<td>Vascular: intrahepatic venous injuries (Retrohepatic vena cava / Central major hepatic veins)</td>
</tr>
<tr>
<td></td>
<td>Vascular: hepatic avulsion</td>
</tr>
</tbody>
</table>

Management:

Grade I, II, III → Conservative.

Grade IV, V, VI → Unstable

Exploration
4 P's in liver trauma management
- Push: Bimanual compression/pressure
- Pringles
- Plug: Sengstaken-Blakemore tube insertion
- Pack: place packs/mops for 24-48 hours
  ↓
  Re-explore
  Pringle manoeuvre: 15-30 mins in one sitting.
  Compress hepatic pedicle at foramen of Winslow.

↓
↓
↓
↓
if bleeding
Source: Portal vein tributaries or Hepatic artery branches
if bleeding continues
Source: Hepatic veins

- If hepatic artery bleed not controlled ⇒ Ligate
  but Portal vein injury ⇒ Repair
- CBD injury ⇒ Repair and insert T-tube
  Note: Do not fill liver defects with omentum.

Complications of liver injury:
1. Hemorrhage
2. Bile leak
3. Abscess

Mesenteric injury

Types
↓
↓
↓
↓
Longitudinal injury
No loss of bowel vascularity
Repair the tear

Transverse injury
Bowel vascularity lost
Resection and anastomosis

Duodenal injury
1. Duodenal hematoma
   - Bowel rest
- Ryle's tube → NPO
  2. Perforation (Duodenal)
     → Omental (Graham) Patch Repair

Pancreatic injury
secondary to blunt Trauma.
most important prognostic factor → disruption of main pancreatic duct (mPD)

Parenchymal injury
  → mPD disrupted

but duct (N)
distal pancreas
  → Conservative management
  → involves head and neck
  → Distal pancreatectomy
  → Beger procedure (Duodenum preserving pancreatic head resection)

Colonic and rectal injury

Perforation
  → Laparotomy
  → Emergency management
  → Hartman procedure
  → Resect perforated segment
  → Proximal end → colostomy
  → Distal end → buried in peritoneum

Damage control surgery (DCS)

A/V/A abbreviated laparotomy
indication: Lethal triad of trauma.

Coagulopathy

Hypothermia

Acidosis
Phases of DCS:

Phase I  
Temporary closure  
Emergency laparotomy  
Aim:
- To control bleeding
- Prevent contamination

Temporary closure:
- Urobag/Bogota bag laparostomy
- Opsite

Identification of patient in ER in OT

Phase II  
In ICU

Phase III  
24-48hrs

Stages of DCS:
1. Patient selection
2. Control of hemorrhage and contamination
3. ICU Care
4. Definitive surgery
5. Abdominal closure

Abdominal compartment syndrome

Causes:
1. Severe burns → Gut distension
   a. Bowel obstruction
   3. Massive ascites
   4. Abdominal trauma

Clinical features:
Pressure on IVC
- Venous return
- Cardiac output
- Heart rate

Diaphragm pushed up
- Thoracic volume
- Hypoxia
- Intrathoracic pressure

Renal artery compressed
- RR
- GFR
- Urine output

Bladder pressure:
Marker of intra-abdominal pressure.
To measure intra-abdominal pressure:
Insert Foley’s to drain bladder.
Push 50 cc normal saline

Connect to pressure apparatus

<table>
<thead>
<tr>
<th>Grades</th>
<th>Description</th>
<th>IAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>IAP 12-15 mm Hg</td>
<td></td>
</tr>
<tr>
<td>Grade II</td>
<td>IAP 16-20 mm Hg</td>
<td></td>
</tr>
<tr>
<td>Grade III</td>
<td>IAP 21-25 mm Hg</td>
<td></td>
</tr>
<tr>
<td>Grade IV</td>
<td>IAP &gt;25 mm Hg</td>
<td></td>
</tr>
</tbody>
</table>

**IAH MN**  Sustained or repeated pathologic elevation of **IAP ≥ 12 mm Hg**

**ACS**  Sustained elevation of IAP of > 20 mm Hg with new organ dysfunction

Management:
1. Correct acidosis
2. IV fluids
3. Decompressive laparotomy
Thoracic Trauma

- Thoracic trauma cause → > 50% trauma deaths
- In 80% thoracic injuries
  ↓
  management: Conservative (Chest tube)
- Causes Hypoxia (Serious consequence of thoracic trauma)
- MC cause of mortality
  ↓
  Blunt thoracic injury
  ↓
  Tracheobronchial injury
  ↓
  Hemothorax
  ↓
  Secondary to pulmonary laceration

Investigation:
- First: X-ray chest - AP view
- Emergency: eFAST

Thoracic Injuries

- Immediately life threatening
  ↓
  1. Airway obstruction
  2. Tension / open pneumothorax
  3. Pericardial tamponade
  4. Massive haemothorax
  5. Tracheobronchial injuries

- Potentially life threatening
  ↓
  1. Aortic injuries
  2. Flail chest
  3. Myocardial contusion
  4. Rupture of diaphragm
  5. Oesophageal injuries
  6. Pulmonary contusion.

Rib Fractures and Flail Chest

Rib Fractures:
- MC thoracic trauma.
- MC in adults
- In children → Ribs are more pliable
  ↓
  - Internal damage occurs
  - Fractures are uncommon.
Management:
- Analgesics.
- No strapping.
- High velocity impact causes:
  - 1st rib fractured
  - 10 - 13th rib fracture
    \[ \text{Uncommon} \]
- If 1st fractured, suspect injury to:
  1. Subclavian vessels
  2. Brachial plexus
  3. Apex of lungs
- In 10 - 13th rib fracture → Floating ribs.
  - Injury to:
    1. Left spleen
    2. Right liver.
  - MC ribs Fractured during CPR → 4th - 5th ribs.

Flail chest.

**Definition**

- **ATLS**
  - Fracture of 2 or more consecutive ribs at 2 or more places
- **Bailey's**
  - Fracture at 3 or more consecutive ribs at 3 or more places.

Flail chest:

- Paradoxical chest wall movement
  - Rare
- Pulmonary contusion
  - MC cause of death

Management:

1st Line: Adequate analgesics (thoracic epidural) and oxygenation

If \( P_O_2 < 60 \text{ mmHg}, \) respiratory \( \geq 20/\text{min.} \)

IPPV - Intermittent positive pressure ventilation
  - Fails
  - Surgical Correction of flail chest.
Tension pneumothorax

Definition: pneumothorax with rapid hemodynamic compromise

Conditions:
1. Pulmonary laceration / injury (me)
   ↓
   IPPV given without a chest tube insertion

Indications of chest tube (before IPPV)
- Suspected lung injury
- Subcutaneous emphysema

2. Tracheo - Bronchial injury
3. Open pneumothorax → Sucking wound in chest wall
   ↓
   > 1/3rd circumference of trachea
   - In penetrating chest wall injury
     ↓
     One way valve formed
     ↓
     Air accumulation causes
     Same side: Lung collapse
     Opposite side: Hyperinflation of lungs
     ↓
     Mediastinal shift
     ↓
     Compression over heart
     ↓
     Hemodynamic changes

Clinical Features:
1. ↑ Respiratory rate.
2. ↓ CO = ↑ Heart rate x ↓ SV
   \{ Cardiac tamponade. \}
3. ↑ Jugular venous pressure
4. On percussion → Hyper resonant.
5. Absent breath sounds
   - These changes rapidly develop in minutes
   - Both tension pneumothorax and cardiac tamponade are clinical diagnosis
methods to Differentiate

- Tension pneumothorax
  1. Percussion: Hyper resonant note
  2. Auscultation: ↓ Breath sounds

- cardiac tamponade
  - muffling heart sound

eFAST signs of tension pneumothorax:
1. Stratosphere sign.
2. Bar code sign.
3. Sea shore sign.

Management of pneumothorax

- Emergency
  “Needle thoracocentesis”
  - Adults
    - wide bore IV needle used
    - 5th inter costal Space in mid Clavicular line
  - children
    - wide bore IV needle used
    - 4th inter costal Space in mid Clavicular line

- Definitive
  - Tube thoracocentesis
    - Insertion of inter costal tube in triangle of safety and cover sucking wound with gauze and tape on 3 sides

![FIGURE 6.4: Dressing for Treatment of Open Pneumothorax](image)
Promptly close the defect with a sterile occlusive dressing that is large enough to overlay the wound’s edges. Tape it securely to three sides to provide a flutter valve effect.

Tension pneumothorax

Simple pneumothorax
- No hemodynamic compromise.
- Management:
  - Needle insertion not required.
  - Direct ICT insertion if indicated.
Hemothorax

→ Accumulation of blood in pleural space
→ Source: Intercostal vessels
→ Clinical features:
  ↓ Cardiac output
  ↓ Systolic blood pressure.
  ↑ Heart rate.
→ On examination:
  • Absent breath sounds on side
  • Percussion: dull note

Investigation:
  X-ray: Air fluid level seen

Management:
  ICT insertion in triangle of safety.

→ Indications of emergency thoracotomy:
  1. Output > 1.5lt's Blood at time of ICT insertion
  2. > 200 cc/hr for 3 consecutive hours
  3. Cardiac tamponade
  4. Thoracic aortic injury
  5. Tracheo bronchial injury
  6. Esophageal rupture

→ Indications of emergency room thoracotomy:
  1. Open cardiac massage
  2. Massive air leak
  3. Massive bleeding

Chest tubes

→ Inserted in triangle of safety

Boundaries:
1. Anteriorly: Anterior axillary fold
2. Posteriorly: Posterior axillary fold
3. Apex: Axilla
4. Base: 5th intercostal space.
Always inserted at upper border of lower rib
Other end of chest tube connected to under water seal
( Submerged under water)
  ↓
Air comes out as bubbles
Air does not move back to lungs.
If column of water moves up and down with each breath in under water seal.
  ↓
it confirms right/ correct positioning of chest tube

**Positioning of chest tube on x-ray**

- Correct position is when all holes of chest tube are inside thoracic cavity

- Stopped column movement: blocked / displaced tube (clot)
- Excessive bubbling in water column
  ↓
  Bronchopleural fistula.

- ICT removed when:
  1. Lung expands → Breath sound present
  2. Output < 100 cc / 24 hrs
  3. In chest x-ray - Lung has expanded
  4. At peak of inspiration, when patient holds breath

---

**Traumatic Aortic injury**

Site:
1. Distal to ligamentum arteriosum (MC)
   a. Left subclavian

Clinical Features:
1. Difference in blood pressure
  ↓
  Between both limbs
2. Absent pulsations in unilateral limb
Investigation:
- Chest x-ray
  1. Wide mediastinum.
  2. Depressed left main bronchus
- eFAST
  Collection in thoracic cavity

Management:
1. Permissive hypotension
   - Rupture of aorta ➔ Systolic blood pressure
     BP should be maintained at lower limit of normal

2. Esmolol (β Blocker)
   To maintain
   1. Heart rate < 80 bpm
   2. Mean arterial pressure 60–70 mmHg

3. Surgery ➔ Graft repair
   - Endoscopic repair ➔ Open repair
     IOC
     Stable patient ➔ Unstable
     CT angiography ➔ Transesophageal echo (TEE)

Cardiac tamponade

- Rapid accumulation of blood in pericardial space.
- Cause: penetrating trauma
  - with 60–75 cc of blood
- Clinical features:
  - Cardiac output = Heart rate x ↓↓ SV
  - JVP
  - Kussmaul sign present
  - Muffled heart sounds
- Beck's triad
  1. Muffled heart sounds
  2. ↑ JVP
  3. Hypotension.

Investigation:
  FAST or eFAST
  Placed on epigasistrum → Look for cardiac tamponade

- Blood in pericardial space (Hyper echoic)
  ↓ Positive FAST

Management

Emergency
  ↓ Needle pericardiocentesis
  → Needle inserted in sub-xiphoid area, at 45° perpendicular to skin
  → Towards left shoulder tip, under echo guidance
  Complications: Arrhythmias (HC)

Definitive
  ↓ Emergency Thoracotomy (anterolateral
  Thoracotomy)
  ↓ Repair tear and insertion of pericardial drain

Even if 10cc blood aspirated → There is dramatic improvement in hemodynamic profile

Sternal Fractures

- Uncommon
- High velocity impact required
- Suspect: myocardial contusion

Management:
  Monitor: 1. Cardiac enzymes
  2. Serial 12 lead ECG's
Traumatic diaphragmatic injury

→ Causes:
  1. Blunt abdominal trauma
  2. Penetrating thoracic injury
→ Left side more common
  Left side > right side
→ Clinical features:
  1. Delayed / Silent presentation
  2. Breathlessness

→ On examination:
  • ↓ breath sounds
  • Bowel sounds present in thoracic cavity

Investigation:
  On x-ray:
  Ryles tube / orogastric tube
  ↓
  Coils up in thoracic cavity

Management:

Open surgery
  ↓
Via abdominal / Thoracic approach
  ↓
  VATS video assisted thoracoscopic surgery
  ↓
→ Repair diaphragm using prolene sutures and chest tube insertion.

Junctional zone:
→ Area between nipple and till rib cage end
→ Injuries can cause both thoracic and abdominal complications

Neck trauma

Trauma neck zone
Zone 1: Thoracic inlet to upper border of cricoid cartilage.
  ⇒ Vital structures present.
  ⇒ Associated with maximum mortality

Zone 2: Cricoid to angle of mandible
  ⇒ Most exposed area.
  ⇒ Prone for injury (md)
  ⇒ Most surgically accessible zone

Zone 3: Angle of mandible to base of skull
  ⇒ Major vessels present

Management:
  ⇒ Management of zone 2 patients

  Stable (majority)
  ↓
  Conservative management

  Unstable
  ↓
  Neck exploration

  In zone 1 and zone 3
  Angiography, angio embolization
  ↓ if fails
  Neck exploration

  Hard signs of neck trauma.
  1. Air bubbling from a penetrating injury.
  2. Neurological deficit
  3. Expanding haematoma.
  4. Absent pulsations
  5. Severe haemorrhagic shock
  ↓
  Resistant to fluid therapy
HEAD TRAUMA

• Head trauma is the leading cause of death in patients with trauma.

Surgical anatomy of scalp

Skin
Connective tissue
Aponeurosis
Loose areolar tissue
Periosteum

• Connective tissue layer
  - fibrous tissue septa
  - wall of blood vessel

Blood vessel wall is adherent to fibrous septae
  - Laceration
  - vessel cannot undergo vasoconstriction
  - profuse bleeding

Emergency management
  - apply pressure

Definitive management
  - Suturing
    • Silk / nylon
    • No. 1 / 0
    • cutting needle
    • removed: 5 - 7 days

• Aponeurotic layer
  - Subaponeurotic bleeding: black eye / raccoon eyes
- Loose areolar tissue
  - emissary veins: can carry retrograde infection and cause cavernous sinus thrombosis

- Periosteal layer
  - skull fractures

**Skull fractures**

```
Skull Fractures

Depressed #  |  Non-depressed skull #
---         |  ---
• Treated as compound #  |  • Conservative management
• Antibiotics
• Indications for surgery
  - Focal neurological signs
  - depressed more than thickness of adjacent skull.

Skull Base Fractures

Anterior skull base #  |  middle cranial fossa #  |  Posterior cranial fossa #
---              |  ---              |  ---

• Anterior cranial fossa #
  - Cribiform plate #
  - Clinically, epistaxis

CSF Rhinorrhea
  to differentiate

Clinical
  Halo/Target sign

Biochemical
  β2 transferrin in CSF

Blood

CSF

- Other clinical features:
  - Black eyes / Raccoon eyes
  - Frontal lobe contusions
  - Anosmia.
• middle cranial fossa. #
  - # of petrous part of temporal bone
  - Clinically, CSF otorrhea
    - Haemotympanum
    - Battle sign
      - discoloration over
        mastoid seen 24 - 48h
  - Facial nerve injury
  - Temporal lobe contusion
  - Paradoxical rhinorrhea
    - collection in middle ear tube nose

• Posterior cranial fossa. #
  - # of occipital bone
    - clinically,
      - visual disturbances
      - 6th cranial nerve injury
      - Occipital contusion
      - Basilar artery injury
      - Vernet syndrome: Jugular foramen syndrome
        9 - 11th cranial nerve injury
  - Management of cranial fossa fractures
    1. 3rd generation cephalosporin
    2. NCCT

NICE guidelines for head injury

1. Cervical spine injury should be suspected in all patients with head injury

2. GCS monitoring
   - first 2 hours → every 1/2 hour
   - next 4 hours → every hour
   - after 6 hours → every 2 hours

3. Indications to involve a neurosurgeon
   1. GCS ≤ 8
   2. Unexplained confusion > 4 hours
   3. GCS falls after admission
4. Loss of consciousness
5. ENT bleed
6. > 2 episodes of vomiting
7. Seizures
8. Focal neurological signs
9. Cranial fossa #
10. Penetrating CNS injury

(4) Indications for NCCT head
1. GCS < 13 at any point
2. GCS < 15 after 24 hours of admission
3. Age > 65y
4. Coagulopathies
5. Dangerous mechanism of injury
6. Retrograde amnesia > 30 minutes

**Warning:** Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with marrow edition 4 videos.

**Brain injury**

- Can be compounded by hypoxia / hypotension
- Isolated head injury will not cause hypotension till terminal stages.
- If a patient with trauma has a head injury + hypotension

- Concomitant spinal injury
- Bleeding elsewhere
  - Floor
  - Neck
  - Thorax
  - Abdomen
  - Pelvis

- Grading of Brain injuries - GCS
  - Minor → 15 / 15 without loss of consciousness
  - Mild → 14 - 15 with loss of consciousness
  - Moderate → 9 - 13
  - Severe → ≤ 8
Primary brain injury

1. Concussion
   - mildest
   - Colorado classification
     1 → confusion
     2 → amnesia
     3 → loss of consciousness
   - NCCT - normal
   - Post concussion syndrome (Chronic traumatic encephalopathy)

2. DAI: Diffuse Axonal Injury
   - most severe
   - shearing force between grey and white matter
   - Clinically, coma.
   - NCCT - normal
   - Investigation of choice - MRI: punctate hemorrhages at grey
     and white matter junction
     corpus callosum
   - HPE, clubbed axons
   - retraction balls.
   - worst prognosis.

3. Intracranial hemorrhages
   - Contusion / Intraparenchymal
   - SAH
   - EDH
   - SDH

**Contusion / Intraparenchymal hemorrhage**

- most common traumatic brain hemorrhage
- site: temporal region - more common
  frontal region.
Contusions

- Hematoma
  - Coalesce and ↑ in size
  - Resolve
  - Surgical intervention

- Investigation: serial CTs
  - SAH - subarachnoid hemorrhage
    - Trauma is the most common cause of SAH
    - Majority of traumatic SAH → conservatively

Extradural hemorrhage

- Mostly arterial: middle meningeal artery
- Young patients
- High velocity impact
- Clinically presents with lucid interval. It is not pathognomonic of EDH. Seen in other brain injuries as well
- Investigation of choice NCCT
  - Biconvex lens shaped bleed
  - Bleeding is between skull and dura
- Management:
  - Indications
    - > 30 cc clot size
    - > 5 mm midline shift
    - > 1.5 cm thickness
  - Craniotomy (flap of bone)
- Burr hole (drill-hole)

Surgery

At site of bleed
Done on same side

If unable to localize side
(eg: no CT available)

Surgery done on the side of pupillary dilatation

- False localizing sign: Kernohan notch phenomena
  example: Left sided EDH → Temporal (uncal) herniation
  → Left pupil dilated
  → Sometimes it can press on corticospinal tract of the opposite side (Right side)
  → Left sided hemiparesis

Subdural hematoma

- Chronic subdural hematoma
  - elderly
  - venous
  - Cortical bridging veins
  - Clinical features
    - Trivial trauma
      - days / weeks
      - Gradually developed altered sensorium
- Investigation of choice NCCT
  - Concave-convex (crescentic) bleed
  - Bleeding is between dura and arachnoid.
- Management - surgery
  - Indications, > 1 cm thickness
    > 5 mm midline shift
  - Other indications for surgery are:
    1. Fall in GCS > 2 points
    2. Fixed/dilated pupil
    3. ICP > 20 mm Hg

  - Surgery
    - Craniotomy
    - Burr-hole
  - Extent of brain damage, SDH > EDH

Secondary brain injury

- Occurs due to ↑ ICT (intracranial tension)
- ↑ ICT is due to edema.
- Compounded by hypoxia, hypercapnea, hypotension.
- Monro Kellie doctrine

- States that brain has tremendous capacity to compensate
  (for an increasing mass or bleed), but once the point of
  decompensation is met, there can be sudden decompression
  and herniation of brain

- Cerebral perfusion pressure (CPP)
  \[ CPP = MAP - ICP \]
  \[ CPP \geq 60 \text{ mm Hg} \]
- Cushing reflex → Bradycardia
  Hypertension
  Altered respiration
  
  \[ \uparrow \text{ICP} \rightarrow \uparrow \text{MAP (mean arterial pressure)} \]
  \[ \downarrow \]
  \[ \uparrow \text{Systolic BP} \]
  \[ \downarrow \]
  \[ \uparrow \text{Cardiac output} = HR \times \text{Stroke Volume (SV)} \]
  \[ \uparrow \text{SV} \]
  \[ \downarrow \]
  \[ \uparrow \text{Diastolic filling} \]
  \[ \downarrow \]
  \[ \uparrow \text{Diastolic interval} \]
  \[ \downarrow \]
  \[ \downarrow \text{HR} \]

- Variant of Cushing reflex = Hypotension instead of hypertension
- Cushing ulcer → stress ulcer in acid producing area of stomach

### Management

00:56:01

- Management of raised ICT in head injury
  1. Adequate \( \text{O}_2 \)
  2. Adequate perfusion by maintaining \( \text{SBP} \geq 100 \text{ mmHg} \)
  3. Avoid hyperglycemia: Avoid dextrose containing solution
  4. IV mannitol
  5. Hyperventilation: only moderate amounts,
     if severe / sustained → not recommended

- Barbiturate coma → not recommended
- Hypothermia

- Steroids → no role in management of \( \uparrow \text{ICT} \) due to trauma.

- Prophylactic antiepileptics → doesn't reduce incidence of late post traumatic seizures (3-5%)

- Goals of Treatment in Head Injury
  - \( \text{ICP} : 20 - 25 \text{ mmHg} \)
  - \( \text{CPP} : \geq 60 \text{ mmHg} \)
- \( \text{PaO}_2 \geq 100 \text{ mmHg} \)
- \( \text{Pa}_2\text{O}_3 \geq 15 \text{ mmHg (Brain tissue O}_3\text{ tension)} \)
- Serum Na\(^+\) : 135 - 145
- Glucose : 80 - 160 mg / dL

- **Management of mild head injury**
  - Evaluate
  - Do CT if indicated
  - Criteria to discharge
    - GCS 15 / 15
    - Normal CT
    - Not under influence of drugs / alcohol
    - Accompanied by responsible adult

- **Management of moderate head injury**
  - Admit
  - CT
  - Monitor and do serial CECT

- **Management of severe head injury \( \leq 8 \)**
  - Intubation \( \oplus \)
  - NCCT

**Glasgow Outcome Score**

1. Death
2. Persistent vegetative state
3. Severe disability
4. Moderate disability
5. Good recovery

**Brain death**

- **Criteria for brain death**
  - GCS = 3
  - Non reactive pupils
  - Absent brainstem reflex
  - No spontaneous ventilatory effort
THERMAL INJURIES

Burns

- Indications to transfer patients to a burns unit
  - >10% partial thickness burns
  - 3rd/4th degree burns in any age group
  - Inhalational injuries
  - Burns patients requiring IV fluids
  - Chemical/electric burns
  - Burns involving sensitive areas, palms, soles, face, genitalia
  - Burns + Trauma

- ABCDE
  - Exposure
    - Extent
    - Cause

- Airway:
  - if inhalational burns are present or not
  - Danger signs
    - burnt / singed nasal hair
    - hoarseness of voice
    - carbonaceous deposits in sputum
    - burns in a closed room
    - burns involving head, face and neck
    - altered mental sensorium
  - Danger signs → Prophylactic intubation

- Breathing
  - Can suffer due to
    - hypoxia
    - co poisoning
    - eschar around chest

- Circulation
  - extent of burns damage is proportional to inflammatory mediators released.
Burns → Tissue → Cytokines → Vasodilatation → Evaporation → Leaky vessels → Extra vascular space → Albumin → H₂O → Albumin → H₂O → 3rd space loss → Hypovolemic shock

- > 15% total body surface area burns in adults
- > 10% total body surface area burns in children
- Leaky vessels persist till 12 hours after minor burns
  - Colloids like albumin are avoided for resuscitation

Burns: Fluid resuscitation

- Minor amount of burns → oral liquids (containing salt)
- Parkland's formula for IV fluids
  - Ringer lactate (crystalloid)

\[ 4 \times \text{Body weight} \times \text{TBSA burnt} = \text{Fluid requirement for first 24 hours} \]

\[ \frac{1}{2} \text{given in first 8 hours} \]
\[ \frac{1}{2} \text{given in the next 16 hours} \]

TBSA - Total body surface area
- First degree burns are not included. It is calculated from the time of injury (burn).

- Children: Dextrose containing maintenance fluids given

  - 100 ml/kg in 24h for 10 kgs
  - 50 ml/kg in 24h for next 10 kgs
  - 20 ml/kg in 24h for every kg after 20 kgs.

  **Example:** 22 kg child:

  \[
  \begin{align*}
  10 \times 100 & \rightarrow 1000 \\
  10 \times 50 & \rightarrow 500 \\
  2 \times 20 & \rightarrow 40 \\
  \text{Total dextrose} & = 1540 \text{ ml in 24 hrs}
  \end{align*}
  \]

  - Muir & Barclay formula (colloids)

    \[
    0.5 \times \text{body weight(kgs)} \times \text{TBSA} = \text{one portion}
    \]

    6 portions over 36 hours

**ATLS Formulae (for RL)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Age</th>
<th>Fluid rate</th>
<th>Target urine output</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd/3rd degree</td>
<td>Adult</td>
<td>(2 \times BW \times \text{TBSA})</td>
<td>(0.5 \text{ml} / \text{kg} / \text{hr})</td>
</tr>
<tr>
<td></td>
<td>Child &lt;14y</td>
<td>(3 \times BW \times \text{TBSA})</td>
<td>1 \text{ ml} / \text{kg} / \text{hr}.</td>
</tr>
<tr>
<td></td>
<td>Infant</td>
<td>(3 \times BW \times \text{TBSA} + ) maintenance fluids</td>
<td>1 \text{ ml} / \text{kg} / \text{hr}.</td>
</tr>
<tr>
<td>4th degree/electrical</td>
<td>All ages</td>
<td>(4 \times BW \times \text{TBSA})</td>
<td>(1 - 1.5 \text{ ml} / \text{kg} / \text{hr}) (till urine clears)</td>
</tr>
</tbody>
</table>

**How To Calculate TBSA Burn**

1. Palm → 1%

2. Wallace rule of 9
   - Adults:
3. Lund and Browder charts: Best method.

Degrees Of burns

1 degree burns
- Involves epidermis
- Red
- Tender
blanching on pressure
- Heal spontaneously without scarring 3 - 5 days
- Example: Sunburn

<table>
<thead>
<tr>
<th>1st degree superficial</th>
<th>2nd degree deep burns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involves epidermis + papillary Dermis</td>
<td>Involves epidermis + dermis</td>
</tr>
<tr>
<td>Red, tender, blanching</td>
<td>Red, less tender, some areas won't blanch</td>
</tr>
<tr>
<td>Blister formation</td>
<td>Hypertrophic scars and Keloids</td>
</tr>
<tr>
<td>Heal without scarring 10 - 14 days</td>
<td></td>
</tr>
</tbody>
</table>

- 2nd degree burns → proper dressing → to avoid infection

III and IV degree burns
- III → Subcutaneous tissue
- IV → muscle layers
- Black, charred
- Painless
- Fixed capillary staining

- management: Early excision followed by split thickness skin grafting

zones of burns

1. Zone of coagulation
   - most injured
   - Irreversible damage
3. Zone of stasis
   - Injured but salvageable
   - Can progress to either coagulation or hyperemia.

3. Zone of hyperemia.
   - Vasodilatation
   - Resolves

Burns: management

- Burns → Washed with water (15°C) → at least 10 mins.
- Don't burst blisters
- Patients with > 15 - 20% TBSA burns
  → Gastric distention & paralytic ileus → Nasogastric tube

- Nutrition in burns
  - Basal energy expenditure (BEE):
    - Normal → 1.0 [20 kcal/kg/day]
    - Sepsis → 1.4
    - Severe sepsis → 1.8
    - Severe burns → 2
  - Early initiation of enteric nutrition
  - Maximum Na loss → day 5 - 10
    → At least 20% calories should come from proteins
  - Davies formula to calculate protein requirement:
    - Children: 3g/kg + 1 x TBSA burnt
    - Adults: 1g/kg + 3 x TBSA burnt

- Eschar - thickened fibrotic tissue
  - Circumferential → Compartment syndrome (> 30mmHg)
    - Pain on passive extension
    - Pain not relieved with analgesics

- Management - Escharotomy (or fasciotomy)
  - Up till deep fascia is incised

- Dressing materials:
  - 1st degree: expose the wound
- 2nd degree:
  - Superficial burns —— Vaseline / Paraffin gauze
    Collagen dressing (if non-infected)
  - Deep burns
    Collagen dressing
    Hydrocolloid dressing (Duoderm)

- Other materials/creams used:
  1. Silver sulphadiazine (1%)
     - Most common
     - Good action against pseudomonas, gram-ve bacteria.
     - Doesn’t penetrate eschar.
  2. Silver nitrate
     - Good action against pseudomonas, little action against gram-ve bacteria.
     - Problems: frequent applications, black staining
  3. Mafenide acetate 5%
     - Can penetrate eschar.
     - Problems: painful application induce metabolic acidosis
  4. Cerium nitrate (best agent)
     - Can penetrate eschar and is immunomodulatory

- Management of contractures
  - Z-plasty
  - V-Y plasty

- Most common cause of death in burns
  - Immediate —— Asphyxia > Neurogenic shock
  - Early (1-3 days) —— Hypovolemic shock
  - Late (>3 days) —— Septic shock
  - Overall —— Septic shock

- Most common organism —— Pseudomonas

Burns: special situations

1. Circumferential burns: escharotomy
a. Acid / Alkali burns:
- Alkali is more severe than acid burns
- Never try neutralization
- Wash thoroughly with water.
- Hydrofluoric acid burns
  - Hyperkalemia
  - Hypocalcemia
  - Metabolic acidosis
  - Management: Calcium gluconate (route of drug based on area of burns)

  If involving large areas
  \[ \text{Arrhythmias} \]

  \[ \text{Small} \]
  * Topical

  \[ \text{medium} \]
  * i/v

  \[ \text{very severe / large} \]
  * Intra-arterial

3. Electrical burns
- A/C burns
  - Cause
  \[ \text{tetany} \rightarrow \text{myoglobinuria} \rightarrow \text{ATN (Acute Tubular necrosis)} \]

  \[ \text{Arrhythmias} \]
  \[ \text{(leading cause of death)} \]

  - Usually high grade (3rd/4th degree)
  - Entry and exit burns

4. Lightning injury:

Lightning injury

\[ \text{Indirect injury} \]

- Lighting strikes an object
- Sparks

\[ \text{Superficial burns on exposed areas} \]

\[ \text{Ful partial burns} \]

\[ \text{Direct injury} \]

- High grade electrical injury

- Tetany

- Arrhythmias

Hypothermia

- Core temperature: Rectal temperature

- Staging management
<table>
<thead>
<tr>
<th>Stage</th>
<th>Clinical symptoms</th>
<th>Core temp</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conscious shivering</td>
<td>32 - 35°C</td>
<td>Passive warming</td>
</tr>
<tr>
<td>2</td>
<td>Impaired conscious not shivering</td>
<td>38 - 32°C</td>
<td>ECG: J (Osborne) waves passive and active rewarming</td>
</tr>
<tr>
<td>3</td>
<td>Unconscious, not shivering, vital signs present</td>
<td>24 - 26°C</td>
<td>Stage 2 + ECMO extra corporeal membrane oxygenation</td>
</tr>
<tr>
<td>4</td>
<td>No vital signs</td>
<td>&lt;24°C</td>
<td>Stage 2 + 3 + CPR upto 3 doses of epinephrine</td>
</tr>
</tbody>
</table>

- Passive rewarming
  - dry the patient
  - warm clothes
  - cover up

- Active rewarming
  - External: heating pad
  - warm bottles
  - Internal: hot IV fluids
  - gastric lavage with hot fluid
  - ECMO

**Frostbite and trenchfoot**

Frostbite:

- ICE crystals formed in tissue: membrane injury
  - microvascular damage
  - tissue anoxia

- Rewarming may lead to reperfusion injury

- Stages:
  1. hyperaemia and no tissue necrosis
  2. large vesicles
     - painful
     - skin loss
III: hemorrhagic vesicles
- full thickness skin loss

IV: muscle/bone involved

Trench foot:
- Prolonged exposure to cold and tissue is wet
  - microvascular damage
    - Stasis and occlusion

  - Leg → pale → Numb → Pain / paresthesias
    - vasodilation

- Secondary infection: Cellulitis
  - gangrene

Management
- Gradual rewarming
- Leg dipped in water at 40 ºC
- Don't rub the tissue
- Pain → analgesics
- Be aware of reperfusion injury: hyperkalemia
  - Acidosis
- If gangrene → wait for demarcation → Amputation
  - line to appear
Surgical anatomy of the breast

- Modified sweat gland
- Extent
  - Bulk: 2nd - 6th ribs
  - Sternum, till anterior axillary fold
  - Also extends:
    - Superior → clavicle
    - Inferior → 8th rib
    - Lateral → Latissimus Dorsi
- Axillary tail of spence

- Retraction
- Slit → Duct Ectasia.
- Circumferential
- Malignancy

- 15 - 20 Lactiferous ducts
- Ligaments of Cooper → dimpling / puckering
- Fascia

- Dimpling and retraction are not signs of skin involvement in breast cancer
* Peau d'orange
  → orange peel appearance
  → Occurs due to blockade of subdermal lymphatics
  → If Θ in cancer: sign of skin involvement
  → most conspicuous sign

Lymphatic draining of breast and TDLU

- Anterior  → Based on Pectoralis minor muscle
- Central
- Apical
- Lateral
- Posterior groups

TDLU
→ Terminal Duct Lobular Unit
→ Functional unit
→ majority of cancers arise from this unit.
Triple assessment of breast lump

- History and physical examination
  - Radiological
    - HPE
      - FNAC Fine needle aspiration cytology
    - Techniques followed in physical examination
      - USG Breast
      - Mammography
      - 23 - 30G needle
        - young patients
          - dense breast tissue
            - hard to differentiate between a lump and fibrous tissue in mammography
            - Drawback:
              1. Cannot differentiate between invasive and in situ
              2. ER, PR, HER2 status cannot be determined
              3. High false negative rate
          - IOC: Tru-cut biopsy
          - GOLD: Excisional standard biopsy

Tru-cut biopsy:
- 14G core needle biopsy
- 8-10G needle
- Best for Breast Biopsy: 14G needle
- Incisional biopsy technique

Radiological tests for breast- mammography

- mammography
- Contact radiography
- Radiation exposure: 0.1 - 0.2 cGy
- 2 views:
  - CC (Craniocaudal)
  - MLO (Medio Lateral Oblique)
→ Latest technique: 3D Full Field Digital mammogram (Tomosynthesis)
  • Advantage: useful in Dense breasts

![mammogram image]

→ MLO:
  • Maximum Breast tissue is seen
  • Axilla is visualised

→ Screening
  → mammograms are best screening modality for Breast cancer
  → Starts: 40 years (annual)

→ Diagnostic
  → starts at 40 years

- mammography
  - USG
  - MRI

→ BIRADS score (Breast Imaging reporting and Data System)

<table>
<thead>
<tr>
<th>Category</th>
<th>Management</th>
<th>Likelihood of cancer</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Recall for additional imaging and/or await for examinations</td>
<td>n/a</td>
<td>Get alternative imaging test</td>
</tr>
<tr>
<td>1</td>
<td>Negative</td>
<td>Essentially 0%</td>
<td>Routine screening after 1 year</td>
</tr>
<tr>
<td>2</td>
<td>Benign</td>
<td>Essentially 0%</td>
<td>Routine screening after 1 year</td>
</tr>
<tr>
<td>3</td>
<td>Probably Benign</td>
<td>&gt; 0% but ≤ 2%</td>
<td>Short term 6 months</td>
</tr>
<tr>
<td>4 → Suspicious</td>
<td>Tissue Diagnosis</td>
<td>Biopsy</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>4a. Low suspicion of malignancy (≥3% to ≤10%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4b. Moderate suspicion for malignancy (≥10% to ≤50%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4c. High suspicion for malignancy (≥50% to ≤95%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 → Highly suggestive of malignancy</td>
<td>Tissue Diagnosis</td>
<td>≥ 95%</td>
<td></td>
</tr>
<tr>
<td>6 → Known biopsy proven</td>
<td>Surgical excision when clinical appropriate</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

**Typically Benign**

- **Lead pipe classification** → Fat Necrosis
- **Broken Needle** → Duct Ectasia
- **Tea cup** → Fibrocystic Disease
USG and MRI

USG
- Advantages:
  1. Best investigation to differentiate between solid vs cystic lumps
  2. Best radiological test for a pregnant lady with breast lump
  3. < 40 years
- it is operator dependant.

MRI
1. IOC: to detect multifocal and multicentric breast cancers

2. IOC: in ladies with Breast implant

- Linguiini Sign
  - intra capsular rupture of implant on USG → step ladder sign
  - Extra capsular rupture on USG → Snow storm appearance
  - Best imaging test to identify local recurrence after surgery (scar)
Risk factors of Breast cancer

- Breast cancer - Hormone driven cancer
- Risk factors:
  1. ↑ age
  2. Early menarche
  3. Late menopause
  4. Nulliparity
  5. Obesity
  6. Alcohol
  7. Family History (maternal and paternal are equally important)
  8. Hormone Replacement Therapy (HRT)
     - Estrogen + Progesterone: ↑↑ risk
     - Low dose OCPs: Doesn’t increase risk for breast cancer
  9. Radiation Exposure
  10. Maternal Age at first live birth

   \[
   \begin{align*}
   \text{<30 years} & \quad \text{(protective)} \\
   \text{>30 years} & \quad \text{(↑↑)}
   \end{align*}
   \]
   - Breast feeding → At least 1 year is protective

- Risk
  - No increased risk
- Conditions:
  - Adenosis, sclerosing or florid
  - Apocrine metaplasia
  - Cysts, macro and/or micro
  - Duct Ectasia
  - Fibroadenoma
  - Fibrosis
  - Hyperplasia
  - Mastitis (inflammation)
  - Periductal mastitis
  - Squamous metaplasia
→ Slightly increased risk (1.5 - 2 times)
→ Hyperplasia, moderate florid solid or papillary.
→ Papilloma with a fibrovascular core

→ Moderately increased risk (5 times)
→ Atypical Hyperplasia (ductal or lobular)
→ Solitary papilloma of lactiferous sinus
→ Radial scar lesion

**Pathology of breast cancer**

Breast cancer

- Sporadic (90%)
- Familial (10%)

- MC gene mutated in breast cancers → p53
- MC gene mutated in familial breast cancers → BRCA 1

**BRCA gene**

- BRCA 1
  - mQ
  - ↑↑
  - ↑
  - ↑
  - ↑
- BRCA 2
  - 13Q
  - ↑
  - ↑
  - ↑
  - ↑

Risk for:
- Breast cancer
- Ovarian cancer
- Pancreatic cancer
- Male breast cancer
- Prostate

- Cancers seen in both:
  - Primary peritoneal cancer
  - Colorectal cancer
    - More aggressive
  - (Basal subtype)
  - MC histology
    - Medullary
    - Usually luminal
• BRCA mutations
don predispose patients to Hereditary
Breast and Ovarian Cancer syndrome.
(HBOC syndrome)
• 1st degree relatives are screened
• BRCA mutation
• Lifestyle changes:
  • weight reduction
  • Regular exercise
  • Stop smoking / alcohol
  • MRI screening: 25 years

• Risk Reduction

Risk Reduction Techniques

- Bilateral Prophylactic mastectomy
- Bilateral Salpingo-Oophorectomy (BSO)
- Tamoxifen (SERM)

→ ↓ Breast: ↓↓ 95%
cancer
→ ↓ Ovarian: ↓ 0%
cancer
→ ovarian: 90%
cancer
(10% Risk of fallopian stump cancer)
→ ↓ Breast: 50%
cancer
• After completion of family but before 40 years.

-upper Outer Quadrant → most affected quadrant of breast cancer
-Lower Inner Quadrant → least affected Quadrant of breast cancer
Infiltrating ductal carcinoma (IDC)
- Malignant Histological type: Infiltrating Ductal Carcinoma NOS
  NOS → Not otherwise Specified.
- Histological IDC:
  → Tubular
  → Mucinous
  → Medullary
  (decreasing order of prognosis)

Invasive lobular cancer (ILC)
- Single file pattern
- Mutation in E-cadherin.

Receptors

Breast Cancer

ER, PR

HER-2-neu Receptor

0
1+ → Negative
2+ → Equivocal
3+ → Positive

Non amplified

amplified

Trastuzumab/Herceptin

→ 0-8
→ Aired score

ER, PR

HER-2

brown nucleus

membrane stained brown, empty nucleus
Molecular classification of breast cancer

- Based on gene expression profiling

<table>
<thead>
<tr>
<th>ER</th>
<th>PR</th>
<th>HER 2/new</th>
<th>Ki 67</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(proliferation index marker)</td>
<td></td>
</tr>
</tbody>
</table>

Luminal A: +    +    -    Low (<14%)
- m. c
- Best prognosis

Luminal B:
- majority: +    +    +    low/ high
- minority: +    +    -    High

Basal type: -    -    -    High
(Triple negative)
- Most aggressive type
- Breast cancer: worst prognosis
- Cytokeratin 5/6 Θ
- Initially good response to Anthracycline chemotherapy
- But they tend to relapse within 1½ - 2 years
- Young

Her 2/new: -    -    +    Low/ High
- Enriched

Claudin low: -    -    -    high
- But cytokeratin 5/6 Θ

Diagnosis and management of breast cancer

- IOC for diagnosis: Tru-cut Biopsy
- IOC for staging: PET-CT
  or
  CECT thorax/Abdomen
  + Bone scan

- TNM staging
  T → Tumor
  T₀ → No Tumor
  T₆ → In situ cancer

DCIS
Ductal
Paget's Disease

Surgery v2.0 Marrow 4.0 2020
→ LCIS (Lobular) is no longer considered in situ
→ Benign Disease

→ ≤ 3 cm
  \( T_1 \text{ mic} \rightarrow < 0.1 \text{ cm} \)
  \( T_1a \rightarrow 0.1 - 0.5 \text{ cm} \)
  \( T_1b \rightarrow >0.5 - 1 \text{ cm} \)
  \( T_1c \rightarrow 1 - 2 \text{ cm} \)
  \( T_2 \rightarrow >2 \text{ cm but } < 5 \text{ cm} \)
  \( T_3 \rightarrow >5 \text{ cm} \)

\[ T_4 \]

- Involvement of chest wall
- Involvement of skin
- Inflammation of breast cancer
  \[ \text{worst prognosis} \]
  \[ \rightarrow > 1/3^{rd} \text{ of breast} \]
  \[ \text{show peau d'orange} \]

→ Pectoralis major, \( \rightarrow \) dimpling,
  minor are \( \rightarrow \) retraction
  not \( \rightarrow \) adherent to
  not considered \( \rightarrow \) skin are not
  as involvement \( \rightarrow \) considered
  of chest wall \( \rightarrow \) as involvement
  of skin .

\( N \)

\( N_0 \rightarrow \text{No Lymph Node} \)

\( N_1 \rightarrow \text{Mobile Axillary lymph node} \)

\( N_2 \rightarrow \)
  \[ A : \text{Fixed / matted} \]
  \[ B : \text{Internal mammary lymph node} \]
  \[ \text{Axillary} \]

\( N_3 \rightarrow \)
  \[ A : \text{Infracavicular lymph node} \]
  \[ B : \text{Internal mammary and axillary} \]
  \[ C : \text{Supracavicular lymph node} \]

Ipsilateral Lymph Node :
\[ \rightarrow \text{If contralateral lymph nodes } \rightarrow \text{metastatic disease} \]
\( m_0 \rightarrow \) No distant metastasis
\( m_1 \rightarrow \) Distant metastasis
  - M. e Site: Bones (vertebral column)
  - Due to Batson Plexus
  - Lumbar vertebrae (MC)
  - Type: osteolytic > osteoblastic

Prefixes used in TNM staging:
- cTNM → clinical
- pTNM → pathological
- rTNM → recurrent
- mTNM → multiple
- yTNM → After neoadjuvant
- aTNM → Autopsy

- Isolated Tumor cells
  → cluster ≤ 0.2 mm and ≤ 200 cells.
- micrometastasis
  → deposit > 0.2 mm and ≤ 2.0 mm
  or
  ≤ 0.2 mm and > 200 cells
- macrometastasis
  → deposit > 2.0 mm

- Sentinel Lymph Node biopsy in Breast cancer:
  → If sentinel lymph node shows: Isolated Tumor cells or micrometastasis
  ↓
  Its not considered positive
Management of breast cancer: Surgery

- **Surgery**
  - **Breast**
  - **Mastectomy**
    - **Conservation surgery (BCS)**

- **Overall Survival**: Same
- **Loco regional recurrence (LRR)**: 4-5% to <1%
  - **Radiotherapy is mandatory**

**Breast conservation surgery (BCS)**
- **Lumpectomy**
- **Earlier margin**: 1 CM margin
  - **Now**: 1 MM margin

- **Contraindications of BCS**
  - Technical
    - 1. Multicentric (absolute)
    - 2. Multifocal (relative)
    - 3. Lobular cancer (tends to be multicentric)
    - 4. Locally advanced breast cancer
    - 5. Large tumor/breast ratio
  - Relative
    - 1. Pregnancy (absolute)
    - 2. Collagen vascular disease (SLE/RA)
    - 3. Prior radiotherapy to chest wall

**Mastectomy**
- **Radical mastectomy**
- **Modified**
- **Simple**
  - → by Halsted
  - Structures removed:
    - Breast
    - NAC (Nipple-areola complex)
  - Radical mastectomy (MRm)
  - Incision: Elliptical Stewart
  - Structures removed:
    - Breast + NAC
    - Pectoralis Fascia
- Pectoralis major
- Pectoralis minor
- Level 1, 2, 3 axillary lymph nodes

- Lymph nodes are not removed

- Breast + NAC
- Pectoralis fascia
- Level 1, 2, 3 axillary lymph node
- Pectoralis minor

- Done in:
  - Ductal carcinoma in situ (DCIS)
  - Fungating lesion (Toilet mastectomy)
  - Phyllodes tumor

**Auchincloss**

**Scanlon**

**Patey**

- Pectoralis minor is retracted

- Cut pectoralis minor

**Boundaries of Axillary dissection**

- Thoraco dorsal pedicle supplies latissimus dorsi - lateral
- Axillary vein - superior
- Angular vein - inferior
- Halsted ligament - medial
- Long thoracic nerve is not a boundary.

- Structures saved in MRM:
  - Boundaries of axillary dissection
  - Pectoralis major
  - Lateral and medial pectoral nerve preserved.

**Complications following MRM**

1. Hemorrhage
2. Injury to nerves
   - M. C. injured nerve: inter costo brachial nerve (ICBN)
   - Sensory nerve to axilla.
   - Long thoracic nerve → winging of scapula
     (Nerve of Bell)
   - Thoracodorsal nerve → latissimus dorsi
   - Lateral and medial → Pectoralis major and minor
   - Pectoral nerve
3. Flap necrosis
4. M.C. complication: Seroma formation
   - Accumulation of fluid beneath the flap
   - Drains are removed when output <40 cc/day for 2 consecutive days
   - Seroma
   - Aspiration under aseptic conditions and do pressure dressing
5. Lymphedema.
   → Post mastectomy lymphedema. → m. C. cause of upper limb lymphedema.
   → 2-10%
   → Factors ↑ risk:
     • Lymph node removal
     • Radiation to axilla
     • Infections in upper limb
   → Long standing lymphedema. → Angiosarcoma/ Lymphangiosarcoma
    ↓
     Stewart Treves syndrome
     → lag of 10-12 years
     → Bluish/ reddish nodules
     → Management: Forequarter amputation
     → Poor prognosis
     → Chemotherapy

6. Local recurrence / scar recurrence
   → MRI is IOC.
   → But false positive within 6 months of Radiotherapy

7. Phantom breast syndrome
   • m. C. cause: Inter costa- brachial nerve neuralgia; (IC&N)

Sentinel lymph node biopsy (SLNB)

- 1st draining lymph node from cancer
- 1st cancer for which SLNB performed: Penile
- Surgeon: Cabana
- Other cancers
  → Breast
  → Malignant melanoma
  → Vulval
  → Head and neck
In breast cancer:
- Indication: no clinical lymph node enlargement in axilla.
- Identification:
  1. Blue dye: methylene blue
     - Patent blue
     - I-15 cc of dye is injected in periareolar region (subcutaneous plane)
   - Lymph nodes which are blue in colour ⇒ Sentinel lymph nodes
     ↓ sent for
     Frozen section

Θ For Tumor
Θ For Tumor

Axillary lymph node clearance
(Minimum 10 lymph nodes are to be removed)

⇒ No axillary clearance
    ↓
    Risk of lymphedema.

⇒ Complications of blue dye technique
  1. M.C.: skin tattooing
  2. Necrosis
  3. Anaphylaxis
  4. Bluish urine

2. Radi nucleotide method
   ⇒ Tc\(^{99}\) tagged sulphur colloid
   ⇒ Using gamma camera, the hot or most radioactive lymph node is found.

3. Combined method.
   ⇒ Best technique
   ⇒ Hot and blue lymph node

4. Sentimag technique
   ⇒ Ferric oxide compound is injected
   ⇒ Magnetic scanner is used to detect sentinel lymph node.
   ⇒ No radiation exposure
- M.C. nerve injured: ICBN (Intercostal brachial nerve)
- Majority of sentinel lymph nodes: Level I of axilla.
- Majority of patients: usually more than 1 sentinel lymph node.
Breast reconstruction: Flaps

- M. C. used flap: TRAM (Transverse rectus abdominis myocutaneous) flap
- Best flap: DIEP (Deep inferior epigastric artery perforator)

Chemotherapy

- Indications:
  1. Positive lymph node
  2. Triple negative breast cancer (TNBC)
  3. HER 2 negative tumor
     (Chemotherapy + Herceptin (Trastuzumab) → 1 year
  4. > 1 cm in size
  5. Locally advanced breast cancer.

- Traditional chemotherapy: CAF
  CMF

  → C
  Cyclophosphamide
  Adria mycin
  5-Fluorouracil

  → C
  Cyclophosphamide
  Methotrexate
  5-Fluorouracil

- Side effects: Hemorrhagic cystitis
  Metabolite causing haemorrhagic cystitis:
  Acrolein
  Preventive agent used: mesna

- Latest chemotherapy:
  4 AC/EC followed by 4 T
- 4 cycles of:
  - Adriamycin + Cyclophosphamide
  - Epirubicin + Cyclophosphamide
  - Taxanes
    - (Paclitaxel / Docetaxel)
    - Can cause neuropathy

Chemopert: A device placed below collar bone
- Helps to give chemotherapy and to draw blood.

- Situations where chemotherapy is avoided in breast cancer:
  1. Poor performance status:
     - Scores to assess performance status:
       - Karnofsky score
       - Eastern cooperative oncology score
  2. >70 years of age
  3. \( T_1 \) No, Mo and ER, PR + but HER2 neu -

- Candidates for molecular tests
  - Oncotype DX
  - MammaPrint
  - Endopredict
  - PAM 50
  - \( \rightarrow \) 21 gene
  - \( \rightarrow \) 70 gene
  - \( \rightarrow \) 12 gene
  - \( \rightarrow \) 50 gene
  - ER, PR +
  - ER, PR -

- Based on these tests: Recurrence Score
  - Low: Avoid chemotherapy
  - High: Chemotherapy should be given

eternalsoul_494@yahoo.com
Radiotherapy

- Indications:
  1. Post breast conservation surgery
  2. Positive lymph node
  3. Locally advanced breast cancer
  4. > 5 cm

Types:

Conventional
- WBI
  (whole breast irradiation)
  → 25 days
  → Single sitting/day
  → 50 - 54 Gy
  → Given to:
  - Chest wall
  - Supravacular and infraclavicular fossa
  - Internal mammary lymph nodes

APBI
- (Accelerated partial breast radiation)
  → 5 days
  → 2 sittings/day
  → 30 - 35 Gy
  → Given to:
  - Tumor cavity
  - Adjacent tissue

• Indications for APBI:
  1. Patient 50 years or more
  2. Negative margins
  3. ER, PR
  4. T, tumor
  5. No lymphovascular invasion (LVI)
  6. Unifocal tumor

Hormonal therapy

- Only in ER, PR

  Pre-menopausal
  Post-menopausal
- SERM
  (Tamoxifen)
- Aromatase inhibitors
  (Letrozole, Anastrozole, Exemestane)

Earlier: 5 years
5 years

Atlas trial: 10 years
10 years

- Side effects of Tamoxifen:
  1. m. c.: Hot flashes
  2. Endometrial hyperplasia
  3. DVT

Side effect

(1) m. c.: Osteoporosis

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

**Early breast cancer**

\[ T_1 / N_0 \]
\[ T_2 / N_1 \]
\[ N_2 \]

\[ T_3, N_0 \rightarrow \text{Large operable Breast cancer} \]

\[ T_1 / N_0 \]
\[ T_2 / N_1 \]
\[ N_2 \]

Surgery:
1. Breast conservation surgery (BCS)
2. If clinically \( N_0 \) Axilla
   - SLNB
3. If BCS is contraindicated;
   - Mastectomy

Chemotherapy:
1. \( T_1 / N_0 \) \( m_o \) \( \rightarrow \) ER, PR, T
2. Molecular Tests

- Radiotherapy if @ lymph nodes
- After BCS

Surgery • v2.0 • Marrow 4.0 • 2020
2. If TNBC
   - If HER & NEU △
   - If Lymph node △
     → Chemotherapy + Herceptin

Hormonal therapy:
- ER, PR △

T, No mo (Large operable breast cancer)
→ Neoadjuvant chemotherapy
   → Shrink tumor
   → Surgery

Locally advanced and metastatic breast cancer

Locally advanced Breast cancer
→ T₂₅, N₁, M₀
→ Any T, m₀
→ Any N, m₀
→ Any N, m₀

Neoadjuvant chemotherapy → mRM → Radiotherapy
→ If Her & NEU △ : Herceptin
→ If ER, PR △ : Hormonal therapy

- Most important prognostic factor for breast cancer: Axillary lymph node status
- Most important prognostic factor for metastatic breast cancer:
  - ER, PR Status

Metastatic breast cancer
- Palliative
  - ER, PR △
    - No visceral crisis
      → Hormonal therapy
  - ER, PR △
    → Her & NEU △
      → Visceral crisis
      → Chemotherapy

Surgery • v2.0 • Marrow 4.0 • 2020
Till tumor responds, continue hormonal therapy

Hormone Resistant

Chemotherapy

→ Trastuzumab
  → pertuzumab
  → HER 2 NEU
  → metastatic cancer

→ Palbociclib
  → CDK 4/6 inhibitor
  → ER, PR, HER 2 NEU
  → metastatic cancer

→ Atezolizumab
  → metastatic TNBC
  → PD-L1 inhibitor

→ Alpelisib
  → PI 3 K inhibitor
  → ER, PR
  → metastatic cancer

→ Olaparib
  → PARP inhibitor
  → BRCA Positive

→ Fulvestrant
  → Selective estrogen down regulator

Breast cancer: Special Situations

01:14:56

1. Male Breast Cancer
   • 0.5 - 1%
   • Risk Factors:
     → BRCA 2 > 1 mutation
     → Wntenifer syndrome
     → Cirrhosis
   • Diagnosis, management and prognosis: Same as female cancer

2. Bilateral breast cancer
   • BRCA positive patients
   • Both tumors are staged separately
   • Higher stage tumor governs treatment.
3. Pregnancy associated breast cancer
   - Breast cancer during pregnancy or within one year of delivery
   - Presents with lump
   - Imaging: USG
   - Diagnosis: Tru-cut biopsy
   - Usually ER, PR 
   - Aggressive tumors
   - Management: Surgery

   Surgery
   ├── BCS is contraindicated because radiotherapy cannot be given
   │    └── mastectomy
   └── If patient comes in 2nd/3rd trimester
       ├── BCS can be done and radiotherapy is given after delivery
       └── Chemotherapy
           ├── Contraindicated in 1st trimester
           └── Radiotherapy and hormone therapy
               └── Contraindicated in all trimesters

Ductal carcinoma in situ (DCIS)

Types
   ─── Papillary
   │     m. C
   │     ├── microcalcifications
   │     │     └── Lumps
   │     ├── ER, PR 
   │     └── diagnosis: Stereotactic tru-cut biopsy
   ├── Cribiform
   │    └── with necrosis
   │         └── most aggressive
   │             └── usually presents as a lump
   │                 └── ER, PR 
   └── Solid
       └── Comedo
**Management:**

- Surgery
  - BCS
  - Simple mastectomy
- Chemotherapy: No role
- Radiotherapy: If BCS
- Hormone therapy: If ER, PR
- Least loco regional recurrence rate

**Van Nuys Scoring System (For DCIS):**

- Age
- Size of DCIS
- Type of DCIS
- Margin status

-> ER, PR is not included

**Extensive Intraductal Component (EIC):**

- Invasive Tumor
  - In situ Component (>25% of Invasive Tumor)

**Lobular Carcinoma in situ:**

- Benign condition with risk of cancer (1% per year)
- Tends to be bilateral and multicentric
- ER, PR
- Pleomorphic LCIS
  - ER, PR
  - Behaves like high grade DCIS
- Clinical Features:
  - Incidental diagnosis
  - Lump
  - Microlcalsifications
LCIS

- If positive in a margin: Risk of cancer conversion
- No active management
- No surgical management
- But if pleomorphic LCIS:
  - Manage like DCIS

Preventive steps:
- Prophylactic bilateral mastectomy
- Chemotherapy: Tamoxifen
- Observation
Breast Abscess

Lactational breast abscess
1. Most common organism - Staphylococcus aureus
2. Source of infection - oropharynx of the child
3. Clinical Features
   - Pain
   - Fever
   - Swelling
   - Fluctuation (late sign)

Breast abscess associated with duct ectasia
1. Occurs in peri-menopausal women
2. Cause - aerobic + anaerobic microbes
3. Diagnosis - USG
4. Management
   (i) Antibiotics
   (ii) Surgery - Hadfield’s Procedure

Late sign seen in → i) Breast
   (ii) Parotid
   (iii) Palmar
   (iv) Plantar
   (v) Ischiorectal abscess

4. Diagnosis
   Ultrasound (USG)

5. Management
   (i) Antibiotics - Amoxicillin + Clavulanic Acid
      (or)
      Cloxacillin
   (ii) Analgesics
   (iii) Incase of Pus
      USG guided aspiration [atleast - 2 attempts ]
      Failure
      1% D [ Incision & Drainage ] with Blade number - 11
After 19D

Supress lactation [Cabergoline]

Prevents Fistula formation

v) Incase of Non-healing abscess suspect

Tuberculosis (or) Inflammatory breast cancer

Confirmatory diagnosis - Biopsy from the wall of the lesion

Aberrations of normal development & involution [ANDI]

ANDI covers all benign breast conditions

Age related conditions:

15 - 25 years - Fibroadenoma (most common)
Fibrocystic disease
Cyst in breast

25 - 40 years - Fibrocystic disease (most common)
Fibroadenoma
Cysts
Phyllodes tumor

> 40 years - Fibrocystic disease (most common)
Duct ectasia

Fibroadenoma

Mammogram - Popcorn Calcification

- most common cause of breast lump
• Age group - 15 - 25 yrs

Clinical features
- Firm, mobile lump
- Painless
- 10% cases multiple fibroadenoma

Diagnosis →
- USG
- Mammogram “Pop corn” calcification

Types →
Based on histopathological examination (HPE)
 Fibroadenoma

  ↓

  Pericanalicular  Intracanalicular

  ↓

  Hard type

management

(i) Indications for surgery
- Cosmetic
- Painful
- Rapid ↑ in size
- Family history of breast cancer
- Giant fibroadenoma (> 5cm)

(ii) Type of incision
a. Periareolar incision
  ↓
  Closure of incision - Subcuticular sutures
b. Gillard Thomas incision
  ↓
  Infra mammary incision
(iii) Scarless fibroadenoma surgery

- RFA
- Mammatome

[Radio frequency ablation] [Vacuum assisted biopsy system]

Mammatome → 8G needle

Limitations
a. Fibroadenoma > 2cm size
b. Fibroadenoma away from midline

Phyllodes tumor

- Also known as cystosarcoma phylloides
- Occurs in 3rd/4th decade of life
- Benign or malignant
  - Number of mitotic figure on a biopsy (Trucut/Excisional biopsy)
    ↓
    Differentiate Benign / malignant
  - FNAC has no role

1. Clinical features
   - Rapidly enlarging breast lump
   - Dilated veins
2. Diagnosis
   - Biopsy
     - Malignant Phyllodes
       - Hematogenous spread
       - Most common site: lungs
       - <10% spread to lymph nodes (LN)
3. Management of Phyllodes tumor

surgery

Lumpectomy  simple mastectomy

[ wide Local excision ]

Indications for simple mastectomy

- Recurrence
  [ Phyllodes - Recurrence is very common ]
- very large tumor
- malignant

Mastalgia

mastalgia

Cyclical  Non-Cyclical

1. Seen in Fibroadenosis /
   Fibrocystic disease
2. occurs in 25-40 yrs
3. clinical features
   • Pain [ Beginning of cycle ]
4. on examination
   • Lumpy Breast
5. Diagnosis
   usg
6. Management
   • Life style changes
   • weight reduction
   • ↓ tea/ coffee

1. Causes - Tietze syndrome
   (costochondritis)

Treatment - Intraläsional triamcinolone
a. monder's disease
   • Superficial thrombophlebitis of
     chest veins
   • Cord-like structure
   • Presentation - Pain
   • most Common Vein Involved
     ↓
     Lateral Thoracic vein
   • Treatment - Analgesics

Mondor's Cord
- Vitamin E & Primrose oil Capsules
  x 2 months
  Pain persists
- Low dose Tamoxifen (preferred)
- Danazol

Breast cysts

1. Diagnosis
   - USG
2. Aspiration - indications
   - Symptomatic individuals
   - Large cyst
   - Complex cyst (solid features+)
   - Aspirate
   - Non Bloody
   - Cyst resolves completely
     → bloody
     → Residual cyst
     → management - Excision of cyst
     - Fluid cytology not required
     - Fluid cytology [To rule out cancer]

Nipple discharge

<table>
<thead>
<tr>
<th>Single duct</th>
<th>Multiple duct</th>
<th>Surface of nipple</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serous</td>
<td></td>
<td>Paget's Eczema</td>
</tr>
<tr>
<td></td>
<td>- Pregnancy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Puberty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Cancer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Duct ectasia</td>
<td></td>
</tr>
<tr>
<td>Greenish / Bluish</td>
<td>multiple duct ectasia</td>
<td>[most common cause of pathological nipple discharge]</td>
</tr>
<tr>
<td>Milkish</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Lactation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ Prolactin</td>
<td></td>
</tr>
<tr>
<td>Bloody</td>
<td>Single Duct</td>
<td>Multiple Duct</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>• Duct papilloma</td>
<td>• Cancer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Duct ectasia</td>
</tr>
</tbody>
</table>

1. Duct Papilloma.
   - Most common cause of bloody nipple discharge
   - 10% cases → multiple
   - 10% cases → associated with DCIS (Ductal carcinoma in situ)
   
   **Clinical Features**
   - Bloody nipple discharge from a single duct

   **Diagnosis**
   i) USG → Ectatic duct  [mass inside a dilated duct]
   ii) Cytology of nipple discharge → low sensitivity
   iii) Ductoscopy

   **Management**
   - Microdochectomy
     - Tennis racquet incision
     - Single duct & lump → excised

2. Duct Ectasia.
   - Age → >40yrs (perimenopausal women)
   
   **Clinical Presentation**
   - Dilated ducts
   - Stasis of secretion
   - Periductal mastitis [Zuska's disease]
   - Periareolar abscess/
     - Bluish / Greenish
   - Sinus formation
   - Discharge [multiple ducts]

   **Diagnosis**
   - USG → multiple dilated ducts
   - Rule out cancer
Management
- Antibiotics
- If the condition persists ⇒ Hadfield procedure [cone excision of multiple ducts]

Paget's disease & Eczema

**Paget's** → Superficial manifestation of an underlying malignant condition

<table>
<thead>
<tr>
<th>Paget's disease</th>
<th>Eczema</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unilateral</td>
<td>• Bilateral</td>
</tr>
<tr>
<td>• Eczema-like condition</td>
<td>• NAC - not destroyed</td>
</tr>
<tr>
<td>• Nipple areolar complex (NAC) - destroyed</td>
<td></td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Management</td>
</tr>
<tr>
<td>• Punch biopsy ⇒ Paget cells in epidermis</td>
<td>• Topical steroids</td>
</tr>
<tr>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>ER &amp; PR+, HER2, Neu+, CEA+</td>
<td></td>
</tr>
<tr>
<td>• 70% cases have an underlying lump</td>
<td></td>
</tr>
<tr>
<td>Lump</td>
<td></td>
</tr>
<tr>
<td>usually DCIS, IDC (invasive ductal carcinoma)</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>management of the underlying lump</td>
<td></td>
</tr>
</tbody>
</table>
### Abnormalities of breast tissue & nipple

<table>
<thead>
<tr>
<th>Abnormalities of breast tissue</th>
<th>Abnormalities of nipple</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Polymastia</td>
<td>1. Polythelia</td>
</tr>
<tr>
<td>• Accessory breast tissue</td>
<td>• Accessory nipples</td>
</tr>
<tr>
<td>• Most common site – Axilla</td>
<td>• Athelia</td>
</tr>
<tr>
<td>Clinical features</td>
<td>• Absence of nipples</td>
</tr>
<tr>
<td>• Cosmetic blemish</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>• Excision</td>
<td></td>
</tr>
<tr>
<td>Indications for excision</td>
<td></td>
</tr>
<tr>
<td>• Cosmesis</td>
<td></td>
</tr>
<tr>
<td>• Pain</td>
<td></td>
</tr>
<tr>
<td>• Lump</td>
<td></td>
</tr>
<tr>
<td>2. Amastia</td>
<td></td>
</tr>
<tr>
<td>• Absence of breast tissue</td>
<td></td>
</tr>
<tr>
<td>• Known as Poland syndrome</td>
<td></td>
</tr>
<tr>
<td>• Absence of unilateral pectoralis major &amp; breast tissue</td>
<td></td>
</tr>
</tbody>
</table>

#### Breast reduction surgery

- Breast hypertrophy
  - Patient presents with large breast
  - Neck pain, backache, fungal infections
- Inverted “T” pattern of breast reduction
- Distance between 2 nipples in breast reduction = 19-31 cms.
Gynecomastia

Enlargement of male breast tissue

Causes of gynecomastia

- Physiological
  - i) Puberty
  - ii) Newborn
  - iii) Senile

- Pathological
  - i) Idiopathic
  - ii) Drug Induced
    - D - Digoxin
    - I - INH (isoniazid)
    - S - Spironolactone, Steroids
    - C - Cirmetidine, K - Ketoconazole
    - O - Oestrogen
  - iii) Lepromatous / mumps orchitis
  - iv) Cirrhosis
  - v) Klinefelter syndrome
  - vi) Tumors - Renal cell cancer
    - Hepatocellular cancer
    - Testicular cancer associated with para-neoplastic syndrome

Diagnosis

USG → Atleast 3cm diameter disc of breast tissue

Management

- Traditional → Present
  - ↓
  - Sub-cutaneous
  - Mastectomy
  - Liposuction
  - Gland excision
THYROID - 1

Thyroid - surgical anatomy

- Thyroid - butterfly shaped gland
- Has 2 lobes which is connected by isthmus

![Diagram of thyroid anatomy]

- Blood supply - Thyroid
  i) Arterial supply
    a. Superior Thyroid Artery [STA]
      - Branch of external carotid artery
    b. Inferior Thyroid Artery [ITA]
      - Branch of Thyrocervical trunk (which is a branch of subclavian)
      - Supplies parathyroid gland
    c. Thyroid ima. artery
      - Direct branch from arch of aorta
  ii) Venous drainage
    a. Superior Thyroid Vein [STV]
      - Drains into Internal Jugular Vein [IJV]
    b. Middle Thyroid vein [MTV]
      - Drains directly into IJV
      - Seen in 30% cases
      - Surgical importance
      - First vessel to be ligated during thyroidectomy
    c. Inferior Thyroid vein [ITV]
      - Drains into brachiocephalic vein
• Nerve Supply - Thyroid
  a. External laryngeal nerve [ ELN ]
     - Supplies only to Cricothyroid [ tensor of vocal cords ]
     - Cricothyroid : used to speak at high pitch.
     - Associated with superior pole.
     - Nerve : is away from artery(close to the gland)
               is close to the artery(away from the gland)
  b. Recurrent Laryngeal Nerve [ RLN ]
     - associated with inferior pole
     - Böhr’s Triangle
       • Common carotid artery
       • ITA
       • RLN
       Helps to identify RLN during surgery
     - Right RLN - 25% cases have non-recurrent laryngeal nerve
     - Course of RLN
       i) Left RLN : Longer course
       : Winds around arch of aorta.
       ii) Right RLN : Comparatively short course
       : Winds around subclavian artery
     - Sensory supply below the cords
     - Supplies all muscles, except - Cricothyroid
     - Common site of injury : Berry’s ligament
       ↓
       [ condensation of pretracheal fascia ]
       : organ of zuckerkandl
       ↓
       [ Posterior lateral aspect of the gland ]

• Ligation of arteries
  i) STA - ligated close to the gland
     - Importance : To prevent injury to ELN
  ii) ITA - ligation of capsular branches close to the gland
     - Importance : To prevent devascularization of
                   Parathyroid gland (hypoparathyroidism)

Note :
  • Bipolar cautery is preferred [ prevent thermal damage to
    nerves ]
Thyroid gland - clinical examination

i) Inspection of thyroid gland
   a. Normal thyroid gland - not visible
   b. Instruct the patient to swallow and check for
      i) Gland mobility
      ii) Lower limit of the swelling
         - If mobility - absent (on inspection)
         ↓
         Palpation of Thyroid gland
         ↓
         Lower limit - not felt ⇒ Retrosternal goitre

ii) Palpation of thyroid gland
   a. Examiner stands behind the patient
      - Examination of nodularity & lower limit
   b. Pizzillo's method
      - Patient's hands behind the head, and is asked to push
        against clasped hands on the occiput
      - Enlargement of gland
        • Uniform enlargement - physiological goitre
        - Colloid goitre
        - Hashimoto's disease
      - Nodularity of the gland
        • Isolated nodules of different size
        ↓
        Nodular goitre
      - Swelling lateral to thyroid
        ↓
        Aberrant gland / lymph node from cancer
   c. Lahey's method
      - Examiner stands in front of the patient
      ↓
      Pushes the gland to one side
      ↓
      Palpates margins / lateral borders [Best method]
      - Examination of one side at a time
        [Pressure on both sides at a time ⇒ syncopal attack]
   d. Cribbs' method
      - Examiner stands in front of the patient
      - Patient instructed to swallow while examining
      - Thumb of the examiner is used
      ↓
      To check for nodularity
iii) Eye signs:
The patient & examiner should be at same eye level

- von Grawe’s sign
  Examiner supports the patient’s head
  ↓
  Patient is instructed to follow the moving object
  ↓
  Failure of the upper eye lid to follow a downward movement of
  the eyeball

- Stellwag’s sign
  Infrequent blinking

- Joffroy’s sign
  - Lack of wrinkling of the forehead when the patient looks up
    with the head kept straight
  - Bulged eyeballs

- Möbius sign
  Patient is instructed to focus on a distant object
  ↓
  Examiner - introduce an object suddenly in the line of sight
  ↓
  Patient is now instructed to shift his focus on the object in
  examiner’s hand.
  ↓
  Examine for convergence
  - Inference: Inability to maintain convergence

Investigation in thyroid disorders

1. Investigation - Thyroid Function Test (TFT)
   - T<sub>3</sub>, T<sub>4</sub>, TSH (Thyroid Stimulating Hormone)
   - Free T<sub>3</sub> / T<sub>4</sub>
   - Anti-thyroid antibody
   Inference: ↑↑ TSH → Hypothyroidism
   ↓↓ TSH → Hyperthyroidism

2. Ultrasound (USG) neck
   - Check for:
     - Gland enlargement
     - Nodularity
     - Vascularity
     - Lymph nodes
   - Exception: Hyperthyroidism features + low TSH
     ↓
     Thyroid scan
3. FNAC
- Fine needle aspiration cytology
- IOC (Investigation of choice) for thyroid disorders.
- USG-guided FNAC → ↑ yield of FNAC

Note:
Cannot differentiate between follicular adenoma vs Carcinoma, Bethesda classification of FNAC [Not a true Bethesda classification]

<table>
<thead>
<tr>
<th>Thy1</th>
<th>Thy1c</th>
<th>Repeat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non diagnostic</td>
<td>Non-diagnostic cystic</td>
<td>USG-guided FNAC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thy2</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-neoplastic (Benign)</td>
<td>[if no indicator for resection present]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thy3</th>
<th>Thy5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follicular</td>
<td>Suspicious of malignancy</td>
</tr>
<tr>
<td></td>
<td>malignant</td>
</tr>
<tr>
<td></td>
<td>Surgery</td>
</tr>
</tbody>
</table>

4. Thyroid scan

- Technetium - 99 scan
- Conveys only about uptake of the gland
- Indications
  - Low TSH + Hyperthyroidism
  - Ectopic / Aberrant thyroid tissue

- Iodine 133 scan
- Conveys: uptake + organification of the gland

**Normal Thyroid Scan**
i) Cold nodule
   - Nonfunctioning nodule
   - 20% chance of malignancy

ii) Hot nodule
    - Hyperfunctioning nodule
    - 4% chance of malignancy
    - Solitary toxic nodule

iii) Grave's disease
    - Diffuse, ↑ in uptake

iv) Toxic nodular goitre
    - Also known as Plummer's disease

v) Thyroiditis
   - Diffuse ↓↓ uptake

5. Whole body iodine scan
   - To check for residual / metastasis / recurrence
   - Postsurgery in DTC (Differential thyroid cancer)

6. CECT - Thorax & Neck
   - Contrast Enhanced CT [CE - CT]

Indications
- Retrosternal goitre
- Large malignant goitre

Embryology of thyroid gland & associated conditions
• Remnant of thyroid tract
  1. Development of thyroid gland
     • Thyroid gland develops from thyroglossal tract
     • Thyroglossal tract - arises from foramen caecum
       [Tongue - Junction of anterior 2/3rd & posterior 1/3rd]
       ↓
       Tract descends into the neck
       ↓
       At tracheal cartilage - Tract splits into 2
       ↓
       Tract - obliterates ?
       Thyroid gland is left behind

2. Thyroglossal cyst
   • If the Thyroglossal tract persists
       ↓
       Thyroglossal cyst
       • Hyoid Bone - Forms around the tract
       • Most common site for thyroglossal cyst → Subhyoid
         Clinical features of thyroglossal cyst
         i) Mid line neck swelling
         ii) Swelling moves with - deglution & protrusion of tongue
       Diagnosis of thyroglossal cyst
         i) FNAC
         ii) USG neck - To identify the presence of normal thyroid gland

management of thyroglossal cyst
   ii) Sistrunk surgery
      Removal of cyst + Tract ( till base of tongue ) + a part of hyoid bone

Note
Long standing case of thyroglossal cyst
   ↓
   PTC [ Papillary thyroid cancer ]

3. Thyroglossal fistula
   • Always an acquired condition
   • Either due to i) D of thyroglossal cyst
     ( or )
     due to rupture of thyroglossal cyst
   • Management : Sistrunk surgery

4. Lingual thyroid
   • Thyroid gland below the tongue
   • USG Neck - To identify the presence of normal thyroid gland
Goitre

Diffuse goitre vs. multinodular goitre

i) Diffuse goitre [physiological goitre]
   - Cause: iodine deficiency
   - Occurs in pregnancy / puberty [↑ demand]
   - Variable stimulation of gland by TSH

   Thyroid gland

   Hyper-functioning / Non-functioning / Normal

ii) Multinodular goitre
   - Cause: Variable stimulation of thyroid gland by TSH

   Multiple nodules
   - Diffuse goitre → multinodular goitre
   - Active area: internodular area

Note:
(i) Multinodular goitre - multiple nodules
(ii) Isolated nodule
   - Single nodule - Palpable
   - Rest of the gland - Not palpable

(iii) Dominant thyroid nodule
   - Single (dominant) nodule - Palpable
   - Rest of the gland - Palpable
• Risk of cancer in thyroid swelling

Isolated nodule

<table>
<thead>
<tr>
<th>Solid</th>
<th>Cystic</th>
</tr>
</thead>
<tbody>
<tr>
<td>84%</td>
<td>16%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>48%</td>
<td>12%</td>
<td>24%</td>
<td>6%</td>
</tr>
</tbody>
</table>

(ii) Dominant Nodule

<table>
<thead>
<tr>
<th>Solid</th>
<th>Cystic</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>24%</td>
<td>6%</td>
<td>12%</td>
<td>3%</td>
</tr>
</tbody>
</table>

(iii) Retrosternal goitre

- types

Cause - Ectopic thyroid tissue in mediastinum
Prevalence - 10%
Blood supply - mediastinal vessels
Clinical features:
  - Dyspnoea
  - Stridor
  - Swelling

on Examination:
  - Lower limit of the swelling - not palpable
  - Pemberton's sign - bilateral arm elevation

Facial congestion
  - In case of dark skin individuals
    - Check for conjunctival congestion

Starts in the neck, but plunges into mediastinum
Prevalence - 90%
Blood supply - Thyroid vessels
Investigations:
  IOC - CECT neck & thorax

Treatment:
  i) Surgery
     - most common surgical approach - Neck incision
       (Cervical incision)
  ii) Indications for sternotomy
       a). Malignant retrosternal goitre
       b). Mediastinal goitre
       c). Very large retrosternal goitre
       d). Recurrence in mediastinum

Thyroid surgery

i) Indications for thyroid surgery
   a). Neoplasia
      - FNAC positive Thy 3 - 5
      - Clinical Suspicion: Old age
        - Male sex
        - Hard texture
        - Fixity
        - Recurrent laryngeal nerve palsy
        - Lymphadenopathy
        - Recurrent cyst
   b). Toxic adenoma
   c). Pressure symptoms
   d). cosmetics
   (i) Position for thyroid surgery
      • Rose position
        - Supine
        - Towel roll below shoulder blades
        - Neck extension
        - 30° head up
          i) ↓ venous congestion
          ↓
          Blood less field
          ii) But, ↑ risk of air embolism
   (ii) Incision for thyroid surgery
      • Collar incision
        - a fingers breath above suprasternal notch
        - Extending from one sternocleidomastoid to another sternocleidomastoid
(w) Types of thyroid surgeries

a. Hemithyroidectomy
   - Lobectomy + Isthmusectomy

b. Subtotal thyroidectomy
   - 2x subtotal lobectomy
   + Isthmusectomy
   - 8gm of tissue is left behind

c. Total thyroidectomy
   - 2x Lobectomy + Isthmusectomy

d. Near total thyroidectomy
   - also known as Hartley Dunhill procedure
   - Lobectomy + Subtotal lobectomy + Isthmusectomy
   - A part of tissue is left behind in one lobe

(w) Injury Rate
- Injury rate of • RLN injury
  • Hypothyroidism
  • Hypoparathyroidism
  \[\text{Equivalent for Total, subtotal } \cap \text{near total thyroidectomy}\]
- But, in case of recurrence in previously dissected (Near \& Sub total thyroidectomy)
  \[\downarrow\]
  Dissection of neck - difficult
Thyroid surgery - complications

1) Most common - Hemorrhage
2) Injury to nerve

- ELN (Upper pole)
- RLN (Lower pole)

In case of thyroid surgery: ELN > RLN injury

1) ELN injury
   - Unilateral
   - Bilateral injury
     - Patient presents with hoarseness
     - RLN injury
     - Unilateral
     - Bilateral injury
       - Presentation - Hoarseness
       - Presentation - Life threatening
         - Aspiration
         - Aphonia

3) Post-operative respiratory distress
   - Laryngeal edema (most common)
   - Bilateral (6-L) RLN injury
   - Laryngomalacia
   - Tension hematoma
     - Management - removal of sutures and evacuation of hematoma
     - Hypoparathyroidism (Late \( \rightarrow \) 48 - 72 hrs)
     - Hypothyroidism

Hypoparathyroidism

1. Cause - vascular insult to the parathyroid glands
2. Symptoms
   - manifests after 48 to 72 hours
• Perioral numbness / Tingling (earliest symptom)
  ↓
  Paraesthesia
  ↓
  Tetany
  ↓
  Respiratory distress [cause of death]

3. Signs

Trousseau sign
[Carpopedal spasm]

i) Trousseau’s sign
  • Carpopedal spasm caused by inflating the blood pressure cuff above Systolic BP.
  • Also known as obstetrician’s hand deformity

ii) Chvostek’s sign
  • Twitching of facial muscles in response to tapping over the area of facial nerve.

The above signs are seen due to neuromuscular hyperexcitability.

4. Management

> monitor – symptoms ↓ Serum Ca²⁺

Severe symptoms ↓ serum Ca²⁺ < 8mg/dl

Minor symptoms ↓ Serum Ca²⁺ > 8mg/dl

• Ca²⁺ gluconate (iv)
• Oral Ca²⁺
• Oral vitamin D3
• Oral calcium
• Oral vitamin D3

5. Permanent Hyperparathyroidism
- Seen in 1 – 2% cases
- Hyperparathyroidism persisting for > 1yr following thyroid surgery
Joli’s thyroid retractor

**MIVAT**

- Minimally Invasive Video Assisted Thyroid surgery

**Approach:**
- Most common approach → Transaxillary
- Via Nipples
- Retroauricular approach
- Transoral approach

**Indications**
- Thyroid swelling < 3cm in size
- T1 Papillary thyroid cancer
- Parathyroid adenoma

**Contraindications**
- Thyroiditis
- Large nodules
Hyperthyroidism

Clinical features:
- Thin
- Irritable
- Weight loss
- Diarrhoea
- Tremors
- Tachycardia
- Heat intolerance
- Oligomenorrhea

Causes:
1. Graves disease (mc) [↑ uptake on thyroid scan ]
2. Solitary toxic nodule / adenoma, associated with TSH↓
- Coupled shock protein
3. Plummer's disease (Toxic nodular goitre)
4. TSH secreting pituitary adenoma - TSH ↑↑
5. Jod-Basedow phenomenon: Iodine induced hyperthyroidism
6. Factitious hyperthyroidism (exogenous in take of thyroxine)
7. Struma ovarii
   - Ectopic thyroid tissue in ovary
8. Apathetic hyperthyroidism in elderly patients
   - Overt clinical signs and symptoms

Note:
- Factitious hyperthyroidism & struma ovarii
  - No increase in uptake during thyroid scan
- Feature of hyperthyroidism + Low TSH

  Thyroid scan
Management of hyperthyroidism

- Drugs alone
  - Carbimazole
    - Inhibits thyroid peroxidase (TPO)
    - Avoided in 1st trimester
  - Propylthiouracil
    - Inhibit peripheral T4 to T3 conversion
    - Inhibit TPO

S/E: Agranulocytosis.

- Drugs administered before surgery
  - Euthyroid state
    - Thyroid storm can be avoided

Before any intervention:
- 4 - 8 weeks prior to intervention
  - Antithyroid drugs
  - Nonselective B blockers
    - Propranolol
    - Nadolol (OD dose)
  - Last dose of anti-thyroid drugs: Evening before surgery
  - B blockers: Continued 7-10 days after surgery

7 - 10 days before intervention:
  - Lugol's iodine given → ↓ vascularity of gland

Thyroid storm

- Uncontrolled thyrotoxicosis
  - Before surgery
  - During surgery (Rough handling of gland)
  - After surgery
• MC cause (overall)
  → Inadequate preparation
• Stress
• Upper respiratory tract infections (viral)

Clinical features:
• Tachycardia → Arrhythmias (Leading cause of death)
• Dehydration
• Confusion
• Hyperthermia

Management:
1. Aggressive IV fluid therapy
2. Cool the patient
3. IV steroids
4. Large doses of carbimazole

Grave's disease

• Autoimmune, Female > male
• Autoantibodies [stimulating] against thyroid receptor
  Earlier known as→LAST (Long acting thyroid stimulating antibodies)
  Now → TSH receptor antibodies

Associated conditions:
- Addison's disease
- Myasthenia gravis
- Pernicious anaemia
- HLA-DR3 / DR8

HPE: Tall columnar cells
  Scalloping of colloid

Clinical features:
- Feature of hyperthyroidism
- Pretibial myxedema
- Thyroid Acropathy → Subperiosteal bone formation
- Eye signs:
  1. Exophthalmos
  2. Stellwag’s sign - Infrequent blinking
  3. Dakiympie’s sign - lid retraction
  4. Von Graefe’s sign - lid lag
  5. Joffroy’s sign - absence of forehead wrinkling
  6. Moebius sign - loss of accommodation reflex
Thyroid scan: Diffuse ↑ in uptake
Diagnosis: clinical features and antibody levels

**Management of Grave’s disease**

1. In a child → Drugs only
2. Pregnant woman → propylthiouracil (PTU)
3. Adult without goitre → > 45 year: Drugs followed by radioiodine ablation (RIA)
4. Adult with goitre → Drugs followed by surgery
5. Elderly patients with co-morbid conditions
   → Drugs followed by radioiodine ablation
6. Eye sign → Drugs followed by surgery
   "RIA can worsen eye signs"

**Surgical option for Grave’s disease**

<table>
<thead>
<tr>
<th></th>
<th><strong>Total</strong></th>
<th><strong>Subtotal</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thyroidectomy</td>
<td>thyroidectomy</td>
</tr>
<tr>
<td>1. Control of toxicity</td>
<td>Immediate</td>
<td>Immediate</td>
</tr>
<tr>
<td>2. Return to euthyroid state</td>
<td>Immediate</td>
<td>Variable - upto 12 months</td>
</tr>
<tr>
<td>3. Recurrence risk</td>
<td>None</td>
<td>Lifelong - upto 5%</td>
</tr>
<tr>
<td>4. Risk of thyroid failure</td>
<td>100%</td>
<td>Lifelong - upto 30%</td>
</tr>
<tr>
<td>5. Risk of permanent hypoparathyroidism</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>6. Need for follow-up</td>
<td>minimal</td>
<td>Lifelong</td>
</tr>
</tbody>
</table>

- Preferred modality → Total thyroidectomy

- Toxic nodular goitre (Plummer disease)
  Management: Drugs followed by total thyroidectomy

- Solitary toxic nodule
  > 45 years → drugs followed by RIA
Hypothyroidism

- Clinical features: Dull, lethargic patient
  - Alopecia
  - Bradycardia
  - Constipation
  - Weight gain
  - Cold intolerance
  - Menorrhagia
  - T3 ↓, T4 ↓, TSH ↑

Causes:
1. Iodine deficiency (most overall)
   - In Western countries: Hashimoto's thyroiditis
2. Wolff-Chaikoff syndrome
   - Iodine induced hypothyroidism
3. Non-functioning pituitary adenoma
4. Sheehan's syndrome - postpartum pituitary hemorrhage
5. Dysmorphogenesis - defect in thyroxine oxidase enzyme
6. Euthyroid sick syndrome
   - Non-thyroidal disorders causing ↓ T3 & T4 but TSH → normal
7. Refetoff syndrome
   - End organ resistance to T4
   - TSH normal

Hashimoto's thyroiditis

- Autoimmune, females > males
- Associated with: HLA-DR3 / DR8
  - Down's syndrome
  - Turner's syndrome

Auto antibodies
- Blocking antibodies against Thyroid receptor
  - TPO enzyme
  - Thyroglobulin

Clinical features:
- Auto antibodies
  - Stimulate lymphocytes
  - Infiltrate gland

Surgery • v2.0 • Marrow 4.0 • 2020
Destroy follicles

Stored hormone released into circulation
(Transient hyperthyroidism)

Phase of Hashitoxicosis

Repeated attacks and destruction of follicles

No regeneration

Prolonged hypothyroidism

Features:
- Diffuse enlargement of gland
- Long standing Hashimoto's → Lymphoma

On HPE:
- Lymphocytic infiltration
- Hurthle cells → also seen in: thyroid lymphoma
  - Hurthle cell cancer
  - Follicular thyroid cancer

Diagnosis:
Autoantibody levels

Management:
Thyroxine replacement
if diffuse goitre + → surgery

De Quervain / viral / granulomatous thyroiditis

- Type of subacute thyroiditis
- HLA-B 35 association
6 weeks
sentinel event [viral - URTI] → Lymphocytes infiltrate gland
↓
Destroy follicles
↓
stored hormone is released (initial hyperthyroidism)
↓
Single attack ← Hypothyroidism
↓
Follicles regenerate gradually
↓
euthyroid status

• Self limiting
• ↑ ESR
Note: ↑ ESR & HLA-B 35 → help differentiate De Quervain &
postpartum thyroiditis
• Painful neck enlargement
management
  - Steroids
  - symptomatic management

Riedel’s thyroiditis

• A/K/A Fibrosing thyroiditis
• Associated with IgG 4

Fibrosis
↓
within the gland
woody hard thyroid
[ D/D → Anaplastic carcinoma of thyroid ]
in vicinity :
RLN involvement → Hoarseness
Tracheal involvement → Stridor
Diagnosis:
- IOC - Tru-Cut biopsy

Features:
- Diffuse enlargement of gland
- Painless neck enlargement

Management:
- Steroids
- Tamoxifen
- Thyroxine replacement if required

Associated with:
- Peyronie's disease
- Dupuytren's contracture
Thyroid cancers

Syndromes causing thyroid cancers
1. Familial adenomatous polyposis → Papillary thyroid cancer (PTC) due to APC gene mutation
2. Gardner’s syndrome → Follicular thyroid cancer (FTC)
3. Werner Syndrome,
   wrn1 gene
   Progeroid syndrome
   PTC / FTC / Hurthle cell cancer
4. MEN 2a syndrome.
   medullary thyroid cancer (MTC) due to RET gene mutation.
5. Cowden syndrome → PTEN mutation
   GI polyps
   Breast cancer
   Thyroid cancer - FTC / PTC.
   Fibrous dysplasia
7. Carney complex
   γ PPAR gene mutation
Batman syndrome:
   Breast
   Adrenal
   Thyroid
   MA - Atrial myxomas
   Naevus.

Staging of thyroid cancers

<table>
<thead>
<tr>
<th>TNM definitions (AJCC 8e)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TX</td>
<td>Primary tumor cannot be assessed</td>
</tr>
<tr>
<td>T0</td>
<td>No evidence of primary tumor</td>
</tr>
<tr>
<td>T1</td>
<td>Tumor ≤ 2 cm in greatest dimension limited to the thyroid</td>
</tr>
<tr>
<td>T1a</td>
<td>Tumor ≤ 1 cm in greatest dimension limited to the thyroid</td>
</tr>
<tr>
<td>T1b</td>
<td>Tumor &gt; 1 cm but ≤ 2 cm in greatest dimension limited to the thyroid</td>
</tr>
<tr>
<td>T2</td>
<td>Tumor &gt; 2 cm but ≤ 4 cm in greatest dimension limited to the thyroid</td>
</tr>
<tr>
<td>T3</td>
<td>Tumor &gt; 4 cm limited to the thyroid or gross extrathyroidal extension invading only strap muscles</td>
</tr>
<tr>
<td>T3a</td>
<td>Tumor &gt; 4 cm limited to the thyroid</td>
</tr>
<tr>
<td>T3b*</td>
<td>Gross extrathyroidal extension invading only strap muscles (sternothyroid) from a tumor of any size</td>
</tr>
<tr>
<td>T4</td>
<td>Gross extrathyroidal extension into major neck structures</td>
</tr>
<tr>
<td>T4a</td>
<td>Gross extrathyroidal extension invading subcutaneous soft tissues, larynx, trachea, esophagus, or recurrent laryngeal nerve from a tumor of any size</td>
</tr>
<tr>
<td>T4b</td>
<td>Gross extrathyroidal extension invading prevertebral fascia or encasing carotid artery or mediastinal vessels from a tumor of any size</td>
</tr>
</tbody>
</table>
Nodal involvement:

\[ N_0 \rightarrow \text{no nodes} \]

\[ N_1 \rightarrow \text{Level 6 lymph nodes / Delphian nodes} \]

- **NX**: Regional lymph nodes cannot be assessed
- **N0**: No evidence of regional lymph nodes metastasis
- **N0a**: One or more cytologic or histologically confirmed benign lymph node
- **N0b**: No radiologic or clinical evidence of locoregional lymph node metastasis
- **N1**: Metastases to regional nodes
  - **N1a**: Metastases to level VI or VII (pretracheal, paratracheal, or pre/parathyroid/Delphian, or upper mediastinal) lymph nodes, this can be unilateral or bilateral disease
  - **N1b**: Metastases to unilateral, bilateral, or contralateral lateral neck lymph nodes (levels I, II, III, IV, or V) or retropharyngeal lymph nodes
- **M0**: No distant metastasis
- **M1**: Distant metastasis

*All categories may be subdivided as solitary tumor (s) and multifocal tumor (m) – the largest tumor determines the classification*

---

**Differentiated Thyroid Cancer (DTC) – PTC, FTC, Hurthle cell cancer**

8th American Joint Committee on Cancer changes

<table>
<thead>
<tr>
<th>DTC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The age cutoff used for staging was increased from 45 to 55 years of age at diagnosis</td>
</tr>
<tr>
<td>2.</td>
<td>Minor extrathyroidal extension detected only on histological examination was removed from the definition of T3 disease and therefore has no impact on either T category or overall stage</td>
</tr>
<tr>
<td>3.</td>
<td>N1 disease no longer upstages a patient to stage III. If &lt; 55 years of age at diagnosis, N1 disease is stage I. If ≥ 55 years of age, N1 disease is stage II</td>
</tr>
<tr>
<td>4.</td>
<td>T3a is a new category for tumors &gt; 4 cm confined to the thyroid gland</td>
</tr>
<tr>
<td>5.</td>
<td>T3b is a new category for tumors of any size demonstrating gross extrathyroidal extension into strap muscles (sternothyroid, sternothyroid, thyrohyoid, or omohyoid muscles)</td>
</tr>
<tr>
<td>6.</td>
<td>Level VII lymph nodes, previously classified as lateral neck lymph nodes (N1b) were re-classified as central neck lymph nodes (N1a) to be more anatomically consistent and because level VII presented significant coding difficulties for tumor registrars, clinicians, and researchers</td>
</tr>
</tbody>
</table>

Minor extrathyroidal extension to strap muscles \(\rightarrow T3b\)

**Anaplastic cancer**

Staged same way as DTC

<table>
<thead>
<tr>
<th>Anaplastic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Unlike previous editions where all anaplastic thyroid cancers were classified as T4 disease, anaplastic cancers will now use the same T definitions as differentiated thyroid cancer</td>
</tr>
<tr>
<td>2.</td>
<td>Intrathyroidal disease is stage IVA, gross extrathyroidal extension or cervical lymph node metastases is stage IVB, and distant metastases are stage IVC</td>
</tr>
</tbody>
</table>
Papillary thyroid cancer (PTC)

Differentiated Thyroid Cancer (DTC)

\[
\begin{align*}
\text{Papillary thyroid cancer (PTC)} & \quad \text{Follicular thyroid cancer (FTC)} \quad \text{Hürthle cell cancer}
\end{align*}
\]

- MC in iodine sufficient areas overall.
- Females > males
- 3rd - 4th decade of life

Risk factors:
1. Radiation exposure
   - PTC associated with radiation exposure are more aggressive.
   a. Long standing thyroglossal cyst

Genetics:
- MC gene - BRAF
- Glial derived neurotrophic factor (GDNF)
- RET / PTC mutations
  - RET / PTC 3 → Aggressive
  - Short latency
  - RET / PTC 1 → less aggressive

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Features:
- Swelling (MC)
  - Microcarcinoma / occult carcinomas: < 1cm in size.
  - Cyst
  - Multifocal in origin
  - Lymphatic spread more common.
  - Level 6 / Delphian lymph nodes

Lateral aberrant thyroid:
- Lymph node metastasis from an occult PTC.
- LN palpable
- Hematogenous spread: MC → Lungs
Diagnosis of PTC

Confirmed by FNAC.
HPE:
1. Psammoma bodies → Foci of dystrophic calcification.
2. Orphan Annie-eye nuclei
3. Nuclear grooving.

Management:

- Surgery

- If: patient < 40-45 years < 2 cm size tumor unifocal
  No lymphovascular invasion
  No distant metastasis
  All criteria
  Hemithyroidectomy

- Otherwise

  - Tumor in thyroid
    - Total thyroidectomy (TT)
      - If level 6 lymph node
        - Total thyroidectomy + central neck dissection (CND)
          - If level 6 + other node enlarged
            - TT + CND + modified radical neck dissection (MRND)
              (w/L or b/L)

T3, T4 tumor: Prophylactic level 6 clearance

- After surgery
  - Identify if residual disease
    - or metastasis
      - Whole body iodine scan
        - Pre requisites: TSH > 20 mU/L

Preparation for iodine scan:
- Conventional: Thyroxine not given for 4-6 weeks after surgery.
- New method: Recombinant TSH injection.
whole body iodine scan

If residual disease or metastasis

Radioiodine ablation (I<sup>131</sup>)
- t/2a: 7-8 days
- β rays
- 50 - 100 mCi

No residual disease or metastasis

TSH suppression → Thyroxin is given
TSH level brought to lower limit of normal.

In patients with lymph node and extracapsular spread

Follow-up:
- 6 monthly
- USG neck
- Serum thyroglobin (Tg)

Single dose of Radioiodine ablation

• Also given in: Persistently high thyroglobulin after treatment

serum thyroglobin (tumour marker of DTC)

if serum Thyroglobulin > 2 ng/ml

Suspect recurrence

whole body iodine scan

Note:

• If patient has anti-thyroglobulin antibodies
  → Thyroglobulin not a reliable marker

• If tumor resistant to Radioiodine ablation → EBRT (External beam radiotherapy)
• PTC → best prognosis

Lindsay tumor:

Follicular variant of papillary cancer

Follicular Thyroid Cancer (FTC)
Genetics:
- Upregulation of miRNA \( \rightarrow 197, 346 \)
- PTEN gene
- BAX gene

Spread:
- Hematogenous \( \rightarrow \) Lymphatic
- Bones (m.e.) \( \downarrow \) to level 6 lymph nodes
- Pulsatile bony metastasis

Presentation:
- Swelling

Diagnosis:
- FNAC \( \rightarrow \) cannot differentiate between follicular adenoma & carcinoma.
- Follicular neoplasm
- Hemithyroidectomy
- Frozen section

Follicular carcinoma
- Surgical principles similar to PTC

Adenoma
- No further surgery

Post-op period & Follow-up \( \rightarrow \) same as PTC

Prognosis:
- Bad compared to PTC

Hurthle cell carcinoma:
- Earlier considered as variant of FTC
- More aggressive than classical FTC
- Higher bony metastasis rate
Prognosis of thyroid cancer

Prognostic factors:

- MACIS → Post-Operative score.
- Young patient: Good prognosis
  > 50 yrs: Bad prognosis
- Capsular invasion or size > 4cm → Bad prognosis

Most important prognostic factor: Age.

Anaplastic thyroid carcinoma

- Worst prognosis
- Least common type
- 5-7th decade
- p53 mutation.
- miRNA – 17 – 92 upregulation
- β-catenin mutation.

Clinical features:
- Rapidly progressive thyroid swelling
- Local invasion.
- Distant metastasis

1. RLN involved → Hoarseness
2. Trachea → Stridor
3. Very hard swellings

MC → Lungs
Diagnosis: FNAC
  if FNAC inconclusive → Tru-Cut biopsy

Management
  Staging same as DTC.
  1. If tumor restricted to thyroid.
     ↓
     Aggressive surgery (TT + CND + MRND)

  a. If tumor is beyond thyroid: Palliative management.
     - Chemotherapy
     - Dabrafenib
       (Tyrosine kinase inhibitor used in metastatic & anaplastic carcinoma)

  If pressure over trachea. → Isthmusectomy.

Thyroid lymphoma

- 5-7th decade
- Non-Hodgkin B-cell lymphoma.

Clinical features:
  - Thyroid swelling.
  - 'B' symptoms - Fever
    Night sweats
    Weight loss

FNAC cannot characterize lymphoma.
∴ Tru-Cut biopsy done

Management:

Chemotherapy
  R - Rituximab [CD 20 inhibitor]
  C - Cyclophosphamide
  H - Hydroxydaunorubicin
  O - Oncovin
  P - Prednisolone

Followed by Radiotherapy.

- If residual / recurrent disease. → Surgery.
Medullary thyroid cancer (MTC)

- Parafollicular ('C') cells
  ↓
  Secrete calcitonin

- Arise from ultimobranchial bodies from neural crest

Types:
  Sporadic > Familial
    • MEN 2A syndrome
    • Most aggressive MTC.
      ↓
      MEN 2B Syndrome.
      • Younger age.
      • Multicentric.
      • Pentagastrin stimulation
        ↓
        ↑ calcitonin.
        ↓
        MTC.

Features:
- Thyroid swelling
- Diarrhoea (due to serotonin)
- Flushing (histamine)
- Cushing disease (ACTH)
- Multifocal
- Lymphatic & hematogenous spread.
  ↓
  Level 6 nodes Liver (mc)

- Aggressive tumors.
- CEA can be raised.

Diagnosis: FNAC → Amyloid rich stroma.
management:
Surgery

1. If restricted to thyroid: TT + CND.

1. If thyroid + level 6 nodes: TT + CND + MRND
   or
   thyroid + level 6 nodes + other nodes

Note:
No role of iodine scan & radioiodine ablation (RIA) in MTC

Metastatic MTC:
- Vandetanib
- Cabozantinib

Tyrosine Kinase inhibitors

Note:
Always rule out pheochromocytoma in patients with MTC

MEN Syndrome

- Multiple Endocrine Neoplasia Syndrome
- MEN I / Wermer syndrome:
  - Menin gene mutation - Chromosome 11
  - Pituitary adenoma - mC → Prolactinoma
  - Parathyroid adenoma - mC clinical association (95%)
  - Pancreatic endocrine tumours
    (mC pancreatic endocrine neoplasm)

    in MEN I
    - Gastrinoma

    overall
    - Insulinoma

- Adrenocortical tumors
- Thymic tumors
- Collagenoma
MEN 2 syndrome - RET proto-oncogene mutation (chromosome 10)

- MTC only
  - Exon 618 mutation
    - MTC (m. c.)
    - Parathyroid adenoma.
    - Pheochromocytoma.
    - Megacolon (SA > AB)
      - Exon 634 mutation

- MEN 2A
  - A/K/A sipple syndrome
    - MTC (m. c.)
    - Parathyroid adenoma.
    - Pheochromocytoma.
    - Megacolon (SA > AB)

- MEN 2B
  - A/K/A MEN 3 / Gorlin syndrome
    - MTC
    - Medulloblastoma
    - Mucosal neuromas
    - Marfanoid features
    - Megacolon
      - Exon 918 mutation
      - Most aggressive

Any patient with MEN 2 syndrome

1st degree relatives screened for RET mutation.

- Low risk
  - Exon 768, 790
- Medium risk
  - Exon 618, 634
- High risk
  - Exon 918

Prophylactic thyroidectomy
- at 20 years
- 5-10 yrs
- 1 year of life.

MEN 4 syndrome:
- CMM1B gene mutation - chromosome 12
  - Pituitary adenomas
  - Parathyroid adenomas
  - Renal tumours
  - Adrenal tumours
  - Reproductive organ tumors
PARATHYROID

Anatomy of parathyroid glands, hypoparathyroidism & hyperparathyroidism

Anatomy
- 4 parathyroid glands
- Supplied by: inferior thyroid artery
- Development of parathyroids:
  → superior parathyroids → 4th Arch
  → inferior parathyroids and thymus → 3rd Arch
  variable location

5% → 5 parathyroid glands

Hypoparathyroidism
- m. c. → iatrogenic
- Di George syndrome (A/V/A catch - a.a.)
  → Deletion of 22q 11
  → Features:
    mnemonic → CATCH
    C → Cardiac defects
    A → Atypical facies
    T → Thymic hypoplasia
    C → Cleft lip and palate
    H → Hypocalcemia

Hyperparathyroidism
- Clinical features:
  mnemonic: Bones, Stones, abdominal groans, psychiatric overtones
  Pathological fracture
  Bones → Subperiosteal bone resorption (radial aspect)
    → Salt and pepper skull
    → Brown Tumors (osteitis fibrosa cystica) → von Recklinghausen disease
    proximal myopathy
  stones → multiple and recurrent renal stones (m. c. symptomatic manifestation)
  Abdominal groans → colicky
  → Pancreatitis
  → Peptic ulcers
Psychiatric overtones
- Pathognomic feature: Band Keratopathy
  ↓
  Corneal deposition (CaPO₄ crystals)

Primary hyperparathyroidism

- Risk: Radiation exposure to neck
- Associated with: MEN I and IIa syndrome
  → Multiglandular disease (5%)  
- Biochemical tests:
  - Serum Ca²⁺ ↑
  - Serum PTH ↑
  - Serum PO₄ ↓
  - Urinary Ca²⁺ and PO₄ ↑

- Cause:
  - Adenoma  >  Hyperplasia
    → Single gland enlarged  → All glands involved

  → Most sensitive test to localise parathyroid tissue
    ↓
    Tc⁹⁹ Sestamibi scan
    → Localises to mitochondria
    (False → Hurthle cell tumor)

  → SPECT (single photon emission CT)

- Management: Adenoma
  → Surgery:
    Removal of adenomatous gland

  Intra-operative PTH Assay
  ↓ PTH 1/2 Life: 5-7 minutes
  Pre-operative PTH measured → Remove gland  → Intra-operative PTH within 10 minutes of removal
  If ≥ 50% drop in PTH, adenomatous gland removed (Miami Protocol)
Minimally invasive surgery
- can be done but contraindicated in
  - multigland disease
  - Familial syndromes
  - Lithium induced

Thyromectomy (cervical)
- done in 1° hyperparathyroidism if involves lower parathyroids
- in 1° hyperparathyroidism with familial syndromes
- in 2° hyperparathyroidism

• After parathyroid surgery
  ➔ hungry bone syndrome
  ➔ bones actively take up Ca^{++}
  ➔ Hypocalcemia

Management of 1° hyperparathyroidism in hyperplasia

• management: Hyperplasia
  ➔ surgery:
    ➔ 3 1/2 glands removed and autotransplantation of tissue:
    ➔ 1/2 gland is left at normal place.
    ➔ Brachioradialis
    ➔ Sternoideida-
    ➔ of non-dominant hand

Hyperparathyroidism type

Residual hyperparathyroidism
  ➔ Raised PTH within 6 weeks after surgery

Recurrent hyperparathyroidism
  ➔ Raised PTH after 6 months (But normal PTH for those 6 months)
  ➔ Casanova test
    ➔ To identify recurrence due to autotransplanted tissue
Measure PTH selectively from:
- Neck vein
- Brachial vessels

- Test: 20 times higher value in Brachial vessel

Indications for surgery in asymptomatic hyperparathyroidism:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Indication for Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&lt; 50 years</td>
</tr>
<tr>
<td>Serum calcium</td>
<td>&gt; 1 mg/dL (≥ 0.25 mmol/L) above upper limit of normal</td>
</tr>
<tr>
<td>Bone mineral density</td>
<td>(a) t-score ≤ 2.5 (osteoporosis)</td>
</tr>
<tr>
<td></td>
<td>(b) Vertebral fracture on imaging study</td>
</tr>
<tr>
<td>Creatinine clearance</td>
<td>(a) Reduced to &lt; 60 mL/min</td>
</tr>
<tr>
<td></td>
<td>(b) 24-hour urine for calcium &gt; 400 mg/day and increased stone risk by biochemical stone risk analysis</td>
</tr>
<tr>
<td></td>
<td>(c) Nephrolithiasis or nephrocalcinosis</td>
</tr>
</tbody>
</table>

Secondary hyperparathyroidism & calciphylaxis

2° Hyperparathyroidism
- Causes:
  1. Long standing (Chronic renal failure)
  2. Intestinal malabsorption
  3. Lithium intake
  4. Vit D deficiency
- Associated with Fibroblast growth factor 23
- Management:
  - Correction of CRF
    - Vit D3
    - Oral Ca2+
  - Calcimimetic drugs
    → Cinacalcet
    → ↑ sensitivity of Ca2+ receptors
  - Surgery
  - Renal transplant

Calciphylaxis
- Hypercalcemic uremic arteriopathy
- Deposition of Ca2+ in blood vessels, subcutaneous tissue
- Painful pruritic nodules in skin
Tertiary hyperparathyroidism & pseudohyperparathyroidism

3° Hyperparathyroidism
• seen in:
  1. Chronic renal failure
  2. Post renal transplant

  One of the glands can undergo adenomatous change

• Management: Surgery

Pseudohyperparathyroidism
• A/V/A Hypercalcemia of malignancy
• M.C paraneoplastic syndrome
• M.C seen in squamous cell carcinoma of lungs
• Medical emergency
• Clinical Features:
  - Confusion
  - Dehydration
  - Vomiting
  - ECG changes
    → ↑ PR interval
    → shortened QT interval

• Management:
  1. Aggressive LV fluid therapy
  2. Once hydration is adequate → Furosemide
  3. Bisphosphonates
    → Zoledronic acid

Parathyroid cancer

• 1%
• Risk factors:
  1. Radiation exposure
  2. Hyperparathyroidism
    Jaw tumor syndrome (ossifying jaw tumor)
    → due to HRPT2 gene (parafibromin) inactivation
• M = F
• M.C cause of death: Symptomatic hypercalcemia
• HPE: = Fibrous bands
- vascular invasion
- ↑ mitotic figures
- Immuno histo chemistry: - Inactivation of parafibromin
  - PGP 9.5

- Management: - RO resection
  - Chemotherapy has no benefit
  - Drugs: Cinaclacet
    - Azidothymidine
    - Octreotide
    - Parathyroid immuno therapy
ADRENAL GLAND AND NET

Adrenal gland - incidentaloma

Adrenal incidentaloma:

Cause: Non-functioning adenoma (75%)
- Cushing syndrome (13%)
- Adrenal metastasis (2%)
  - Breast (ma)
  - Lung
  - Renal
- Carcinoma (2%)

- Rule out functional tumours, pheochromocytoma.

Workup:
- Dexamethasone suppression test
- Plasma fractionated metanephrines
- Serum electrolytes
- Serum DHEA
- Serum metanephrines
- Urinary cortisol

Imaging: MRI > CECT
- FNAC → only indicated if suspicion of metastasis
  - Rule out pheochromocytoma before FNAC

Management:
- Functional tumor / pheochromocytoma → manage accordingly

Incidentaloma:

> 4 cm
- Surgery (Laparoscopic adrenalectomy)

< 4 cm
- Monitored by 3-6 monthly MRI

Indications for surgery:
1. > 25% ↑ in tumor size between 2 imaging tests.
2. Suspicion of malignancy
**Pheochromocytoma**

Catecholamine producing tumors

- Adrenal
  - Pheochromocytoma
    - Site: medulla

- Extra-adrenal
  - Paraganglioma
    1. MC site: organ of Zuckerkandl (sympathetic chain)
    2. Parasympathetic chain
    - MC site: carotid body

**Rule of 10%**
- 10% B/L
- 10% Extra-adrenal
- 10% Familial
- 10% Children

**Types**

- Sporadic
  - M = F
  - 4th / 5th decade

- Familial
  - M = F
  - Occur earlier
  - B/L
  - 1. MC → Neurofibromatosis-1 (NF-1)
  2. MEN 2 syndrome (Benign)
  3. Sturge Weber syndrome
  4. VHL syndrome
  5. Familial paraganglioma
  - Syndrome (mutation of Succinyl dehydrogenase (SDH) B and C)

**Note:**
- If metastasis → malignant pheochromocytoma

**Diagnosis of pheochromocytoma**

PASS score (Pheochromocytoma in Adrenal gland Scale Score)
- Ki 67
- Vascular invasion
- Capsular invasion

*Surgery* • v2.0 • Marrow 4.0 • 2020
HPE: Zellballen pattern / salt & pepper nuclei
Immunohistochemistry (IHC): synaptophysin
chromogranin

Gross section: greyish pink tumour with areas of
haemorrhage & necrosis

Catecholamines released:
- Adrenal pheochromocytoma: Noradrenaline (NA) > Adrenaline
- Paraganglioma: Noradrenaline
  [Deficient in phenyl etranolamine N-methyl trasferase alpha blocker]
- Malignant pheochromocytoma: dopamine, homovanillic acid
- MEN syndrome: Adrenaline > Noradrenaline

Clinical features:
Classical triad: Tachycardia
Sweating
Headache (MC presenting symptom)

MC feature: Hypertension

Majority
Episodic HTN

Small proportion
Continuous HTN

Investigations:
- Screening test: 24 hr urinary VMA / metanephrines.
  [VMA → vanillylmandelic acid]
- Plasma fractionated metanephrines (most sensitive test)

- Imaging IOC: MRI > CECT
  T2W MRI: light bulb sign

- Extra-adrenal pheochromocytoma/malignant pheochromocytoma
  with metastasis

  IOC: 68 DOTR-TATE scan

  If patient diagnosed at young age → Germline mutation tests done

Management of pheochromocytoma

- α-blocker → Phenoxybenzamine (10 mg OD)
- β-blocker added → if tachycardia 🙊
Surgery:
- Laparoscopic adrenalectomy (open procedure → only for very large tumors)
- Adrenal vein ligation → sudden ↓ in BP

Metastasis:
- To bones, lungs & liver
- Drugs: mitotane
  - Chemotherapy: dacarbazine, vincristine

Pheochromocytoma during pregnancy:
  1st & 2nd trimester → α-blocker
  Followed by surgery
  3rd trimester → Elective LSCS after α-blockade.
  Followed by adrenalectomy after few weeks

Adrenocortical carcinoma

- Bimodal distribution → children (1st spike)
  4th decade (2nd spike)
- Female > Male (1.5:1)
- Non functional → Functional
  - More aggressive
  - Poorer prognosis
  - Hormonal assay can be used to monitor

Clinical features:
- Pain, lump
- If functional → cushing syndrome (MC)

Malignant potential:
- Size
- Necrosis
- Capsular / vascular invasion
  - IOC: MRI > CECT
  - Rule out functional tumours

Macfarlane staging:
  - Stage I: < 5 cm
  - II: > 5 cm
  - III: locally invasive.
  - IV: distant metastasis
Management:
- Surgery → open adrenalectomy
  → R0 resection
- Metastatic disease:
  - Chemotherapy → etoposide
  → cisplatin
  - Mitotane
  - Ketoconazole

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Neuroblastoma:

- Malignant tumour → arise from sympathetic nervous system
- MC site: Adrenal medulla > paravertebral sympathetic chain
- MC abdominal malignancy in children
- <5 years of age.

Types:
1. Sporadic
2. Familial → ALK mutation.

HPE:
- Intratumoral calcifications
- Homer-Wright rosettes
- Small round blue cell tumor

IHC:
- Positive for: Synaptophysin
  → Chromogranin

Clinical feature:
- Abdominal lump → cross the midline
- Metastasis (70%)

a) Blueberry muffin lesions.
b) Racoon eyes.

c) Dancing eyes (Opsoclonus-myoclonus)

d) Metastasis to liver, lungs

1OC : MRI > CT

IF METS → mIBG (metaiodobenzylguanidine) Scan.

Rule out Functional disease:
- Serum cortisol
- Homovanillic acid
- Metanephrine.

Staging → Bone marrow aspirate

Management
- Surgery
- Chemotherapy → Etoposide
  Cisplatin

low risk patients
   ↓
  surgery
  (consider chemotherapy)

medium risk patient
   ↓
  surgery

high risk patient
   ↓
  Neoadjuvant chemotherapy
   ↓
  surgical removal

Neuroendocrine tumors (NET)
Distribution of neuroendocrine tumours:

<table>
<thead>
<tr>
<th>Site</th>
<th>Distribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>10</td>
</tr>
<tr>
<td>Stomach</td>
<td>5</td>
</tr>
<tr>
<td>Duodenum</td>
<td>2</td>
</tr>
<tr>
<td>Small bowel (ileal)</td>
<td>25</td>
</tr>
<tr>
<td>Appendix (MC)</td>
<td>40</td>
</tr>
<tr>
<td>Colon</td>
<td>6</td>
</tr>
<tr>
<td>Rectum</td>
<td>15</td>
</tr>
</tbody>
</table>

Foregut carcinoids
- Drain into systemic veins
  - Majority $\rightarrow$ Argentaffin
  - Serotonin not produced
- Chromogranin A secreted into blood
  - Metastasis $\rightarrow$ MC : Bones

Midgut carcinoids:
- MC $\rightarrow$ Appendicular carcinoids
- Serotonin secretion $\rightarrow$
  - Portal vein
  - Liver
  - Metabolized
  - No carcinoid syndrome.
- If liver metastasis $\rightarrow$ Cause carcinoid syndrome
- MC site of metastasis in midgut $\rightarrow$ Liver

Clinical features:
- MC (overall): Flushing
- MC symptom of abdominal carcinoids $\rightarrow$ pain

Carcinoid syndrome

Patient presents with:
- Bronchospasm
- Diarrhea
- Flushing (MC)

- Cardiac lesion $\rightarrow$
  - Tricuspid regurgitation $>$ Pulmonary regurgitation $>$ Pulmonary stenosis
Diagnosis of NETs
Clinical features and investigations

1. Urinary 5 HIAA (Hydroxyindoleacetic acid)

2. Blood: Chromogranin A can be measured

Imaging:

**Serotonin receptor scintigraphy (SRS)**
A/H/A octreotide scan

Management

↓

Surgery

If malignant / metastasis
- Chemotherapy
  - Cisplatin
  - 5 FU
  - Octreotide

↓

Appendicular carcinoids:

Tumor < 2 cm size
or ≥2cm away from base

↓

simple appendicectomy

Tumor > 2cm size
or < 2cm from base

↓

Right hemicolectomy

Gastric carcinoids / NET

| Classification: |
|-----------------|-----------------|-----------------|
| Type            | Histological pattern | size and location | causative factor and prognosis |
| 1. Benign, non-function, well-differentiated | Gastric corpus; < 1 cm mucosa / submucosa | ECLomas in chronic atrophic gastritis, hypergastrinaemia |
| 2. Benign or low-grade malignant, differentiated | 1-2cm, angioinvasion mucosa / submucosa | ECLomas with hypergastrinaemia, results of gastrinoma in MEN I |
| 3. Low-grade malignant, differentiated | 2cm, invasion beyond submucosa | Sporadic ECLomas not related to hypergastrinaemia, causative factor unknown, poor prognosis |
| 4. Intermediate or small cell type, high-grade | different size | | |
Type I:
- mc
- Elderly females
  - Gastric due to - Gastric atrophy
    - Pernicious anemia.
- Endoscopic resection.

Indications for antrectomy:
- > 1 cm size & infiltration of wall
- Recurrent
- > 6 in number

Type II:
  - Gastrin due to MEN I syndrome.
    Management same as type I.

Type III:
  - Sporadic, solitary
  - Gastrin - normal
  - Upper GI haemorrhage
  - > 2 cm in size
  - Liver metastasis common

Management:
  - Gastrectomy
  - Liver lesion → chemoembolization.

Type IV:
- Large ulcerated lesion.
- Similar to adenocarcinoma.
- Bad prognosis
Surgical anatomy of oesophagus

- Oesophagus is a muscular tube - starts at the level of $C_6$.
  
  $u$ - upper incisor

![Diagram showing anatomical locations](image)

- Three constrictions in oesophagus:
  - at Pharyngooesophageal junction
  - at Arch of aorta / left main stem bronchus
  - at Diaphragm

  at the level of $C_6$
  at the level of $T_5$
  at the level of $T_6$

- The diaphragmal openings:
  - at the level of $T_6$
    - Inferior vena cava
    - Phrenic nerve
  - at the level of $T_5$
    - Oesophagus
    - Vagus nerve
    - Left gastric artery
  - at the level of $T_6$
    - Aorta
    - Thoracic duct

- At the level of $C_6$ - Narrowest portion of GIT
  - if a foreign body gets impacted
    - Endoscopic removal
  - MVC site for iatrogenic perforations
Oesophagus - blood supply, lymphatics

- It has segmental blood supply

<table>
<thead>
<tr>
<th>Upper 1/3rd (cervical)</th>
<th>Arteries</th>
<th>Veins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Inferior thyroid artery</td>
<td>• Inferior thyroid vein</td>
</tr>
<tr>
<td></td>
<td>• Descending thoracic aorta</td>
<td>• Azygous vein</td>
</tr>
<tr>
<td></td>
<td>• Bronchial artery</td>
<td></td>
</tr>
<tr>
<td>Middle (Thoracic)</td>
<td>• Left gastric artery&lt;sup&gt;↓&lt;/sup&gt; In maller vein tear&lt;sup&gt;↓&lt;/sup&gt; Left gastric artery bleeds</td>
<td>• Left gastric vein or coronary vein&lt;sup&gt;↓&lt;/sup&gt; Drains into portal vein&lt;sup&gt;↓&lt;/sup&gt; Liver&lt;sup&gt;↓&lt;/sup&gt; Metastasis from oesophageal cancer can enter liver through coronary vein</td>
</tr>
<tr>
<td>Lower 1/3rd</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Lymphatic drainage - lymphatics travel longitudinally<sup>↓</sup> Skip metastasis / lesions in Ca. oesophagus

Upper and lower oesophageal sphincter

- Upper oesophageal sphincter
  - Both anatomical and physiological entity (area of high pressure and narrowing)
  - Muscles - Thyropharyngeus cricopharyngeus
    - Oblique fibres
    - Horizontal fibres

- Lower oesophageal sphincter
  - Only physiological entity (area of high pressure only)
  - 8 - 25 mm Hg
  - The lower oesophageal sphincter (L.E.S) is tonic (contracted), it relaxes when food bolus reaches oesophagus and contracts again.
Oesophagus - peristalsis

- The oesophagus lacks Serosa.
- The strongest layer of oesophagus - Submucosa.

Peristalsis

- Primary (1°) Peristalsis
  - Food enters oesophagus
  - A propulsive wave occurs
  - this pushes food down

- Secondary (2°) Peristalsis
  - If 1° peristalsis is unable to push food down
  - a° peristaltic wave is generated
  - Propulsive in nature

- Tertiary (3°) Peristalsis
  - Non propulsive
  - generated in between meals
  - ↑ frequency of 3° peristalsis - seen in elderly patients
  - called as presby oesophagus

Congenital tracheo - esophageal fistula

- Classification of tracheo - esophageal fistula (TEF)

  Type - A
  → Atresia

  Type - B
  → m.C

  Type - C
  → least common

  Type - D
  → ‘H’- type
Clinical Features
- It can be associated with N-myc mutation
- Respiratory distress
- If oesophagus is not patent - excessive dribbling of saliva.
- At birth - on suctioning the oral cavity
  ↓
  if increased secretions present
  ↓
  An orogastric tube is inserted → in TEF there is coiling of the tube.

Tracheo-oesophageal fistula - diagnosis 00:27:32

Diagnosis
- Confirmatory diagnosis - contrast study (iohexol > Dinosil)
- If oesophagus is patent or distal end is communicating with trachea
  - the Air goes into stomach
  ↓
  This appears as fundal gas bubble

- IOC for H-type - combined tracheo-oesophagoscopy
- Once diagnosis is confirmed
  ↓
  Rule out other congenital anomalies
  ↓
  V - vertebral defects
  A - Anorectal malformations
  C - Cardiac defects - M/C
  T
  E - Tracheoesophageal Fistulas
  R - Renal agenesis
  L - Limb defects

Tracheo-oesophageal fistula - management 00:31:31

- Management - based on Waterson's criteria.

\[
\text{Birth weight} \quad \text{presence or absence of pneumonia} \\
\text{\( > 2.5 \text{ kg} \)} \quad \text{(-)} \rightarrow \text{definitive surgery}
\]
2) 1.5 - 2.5 kg  
   -/+  
   - Antibiotics  
   - Build up nutrition for few days  
   \[\rightarrow\]  
   Surgery  
3) < 1.5 kg  
   -/+  
   - Antibiotics / Gastrostomy  

- Surgery - Thoracotomy (posterolateral)  
- For TEF type B, C, D, E - Cameron Haight surgery  

\[\text{e.g. - Procedure - in Type - C}\]

\[\begin{align*}
\text{Step 1} & \rightarrow \text{cut the fistula.} \\
\text{Step 2} & \rightarrow \text{Repair trachea (Polydioxanone sutures)} \\
\text{Step 3} & \rightarrow \text{Anastomose oesophagus.}
\end{align*}\]

\text{mC early complication of this surgery - Leak}  
\text{mC late complication of this surgery - Stricture at the anastomotic site}  

\underline{Management of type - A tracheo esophageal fistula}

- Type A - Atresia  
  \[\text{Two ends are close to each other} \rightarrow \text{Anastomosis}\]  
  \[\text{Two ends are far apart} \rightarrow \text{Gastrostomy - for nutrition} \rightarrow \text{As the child grows and the two ends come close} \rightarrow \text{Anastomosis}\]  

\text{Flourish device - Approved by US FDA}  
\[\downarrow\]  
\[\text{magnets inserted in both ends} \downarrow \text{They attract both ends} \uparrow \text{growth}\]
Gastro Esophageal Reflux Disease (GERD)

- Length of the intrabdominal oesophagus - 3-5 cm
  most important factor which helps in maintaining LES tone / in preventing reflux

- Other factors which maintain patency of LES
  - Angle of His (Gastroesophageal angle)
  - Pinching effect right crura of diaphragm
  - Arrangement of gastric folds (Least contribution)

- GERD develops - if length of intrabdominal oesophagus < 2 cm
  if pressure < 6 mm Hg

- Earliest pathophysiological indicator of reflux
  ↑ TLOSR (Transient LES relaxation)

Gastro esophageal reflux disease - clinical features, diagnosis

- Clinical features - Retrosternal burning sensation (Heart burn)
  - Bad taste in oral cavity
  - Pharyngitis / laryngitis
  - Dental caries

- Investigations - done if not responding to medications.
  - IOC
  - Gold standard
    - Endoscopy
    - 24 hour pH monitoring
      - done in patients, if endoscopy is inconclusive or if patient is being planned for surgery.
    - The pH probe is placed 5 cm proximal to Gastroesophageal junction
      - if pH < 4 for > 4% time in a 24 hr period
        - DeMeester score > 14.7
          - Indicates - GERD (Wireless method - Bravo 24)
Gastro-esophageal reflux disease - management

- Lifestyle changes – Avoid food particles which relax LES
  - chocolates
  - fried / fatty food
  - spicy food
  - citrus fruits
  - tea / coffee

- Small frequent meals
- Meals at least 2 hours before going to bed.
- Medications – Prokinetic agents / PPI (proton pump inhibitors)

Indication for surgery
  1) If patient fails to respond to medical therapy
  2) If complications present – Barrett’s oesophagus
     - Cancer
     - Stricture
  3) If it is associated with hiatus hernia

Gastro-esophageal reflux disease - surgery - fundoplication

Principles of fundoplication
  1) Restore adequate intra-abdominal length – Minimum 3 cm
  2) Tighten diaphragmatic crura around oesophagus
  3) Wrap fundus around oesophagus – Shoe sign maneuver

- Partial wrap
- Complete wrap

- Dor – 180° anterior
- Toupet – 180° – 270° posterior
- Belsey mark – 270° (Anterior)

Nissen’s fundoplication

Laparoscopic fundoplication

- 4 to 5 ports – used for fundoplication
- 360° wrap

Complications of fundoplication
- m.C intraoperative complication – Pneumothorax (while creating pneumoperitoneum)
  - Early complication
- m.C overall complication – Gas bloat syndrome

Scanned with CamScanner
(the stomach is tight around oesophagus - patient cannot relieve gas from stomach)

- Therefore, Partial wrap or a Floppy Niessens is preferred.

Newer modalities - for management of GERD
- Inject polymers - endoscopically around LES
  
  Tighten sphincter
  
  ↑ recurrent rate - not preferred
- Good long term results - with Endoscopic RFA (RadioFrequency ablation)
- Linx device - magnetic beads around LES
- Collis Gastroplasty - To achieve adequate length of oesophagus
  
  linear stapler is placed

Gastroesophageal reflux disease - complications

Barret's oesophagus
  
  - Specialised intestinal metaplasia.
  
  Squamous epithelium of oesophagus
  
  replaced by columnar epithelium

- ↑ risk of adenocarcinoma oesophagus
- It develops in long standing GERD

Surgery • v2.0 • Marrow 4.0 • 2020
• Pathognomic feature - Goblet cells
• C/F - patients can be symptomatic or long term GERD
• Diagnosis - Endoscopic biopsy
  
  check for Goblet cells
  
  Biopsy is taken from Red velvety mucosa.

• The barrett’s can be
  
  Long segment
  > 3cm
  
  The abnormal mucosa is visible
  
  Biopsy is easily done

  short segment
  < 3cm
  
  The abnormal mucosa is visible
  
  Biopsy is easily done

  cardia, metaplasia/ microscopc’s barrett’s
  
  The abnormal mucosa is not visible
  
  The mucosa is highlighted with chromoendoscopy

Barrett’s esophagus

Chromoendoscopy and barrett’s oesophagus management 01:12:25

Chromoendoscopy
• Highlight abnormal mucosa.

• Lugol’s iodine
  
  used for
  
  Squamous epithelium

• Methylene blue
  
  used for barrett’s and adenocarcinoma.
Barrett's oesophagus - management
- Seattle protocol - a yearly surveillance & biopsy

Barrett's only
- Low grade dysplasia
  - Ablate abnormal mucosa
- High grade dysplasia
  - Ablate mucosa
  - Surgery (esophagectomy)

Metaplasia
- Ablate abnormal mucosa

Continue 2 yearly protocol
- APC
- RFA
- 3 monthly protocol
- Argon Photocoagulation
- 6 monthly endoscopic protocol
### Oesophageal Cancer

<table>
<thead>
<tr>
<th>Squamous cell carcinoma (SCC)</th>
<th>Adenocarcinoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>- m.c - overall</td>
<td>- m.c - in western world</td>
</tr>
<tr>
<td>- m.c - in India</td>
<td>- m.c site - lower 1/3 rd</td>
</tr>
<tr>
<td>- m.c site - middle 1/3 rd</td>
<td>- Risk Factors</td>
</tr>
<tr>
<td>- Risk Factors</td>
<td>- Obesity</td>
</tr>
<tr>
<td>Smoking, Alcohol</td>
<td>- GERD</td>
</tr>
<tr>
<td>Preservatives rich food</td>
<td>- Smoking, Alcohol</td>
</tr>
<tr>
<td>Smoked Food</td>
<td>- CREST syndrome</td>
</tr>
<tr>
<td>Tylosis - Autoimmune</td>
<td>- (Scleroderma)</td>
</tr>
<tr>
<td></td>
<td>- (Adenocarcinoma &gt; SCC)</td>
</tr>
<tr>
<td>↑ Sec</td>
<td></td>
</tr>
<tr>
<td>Palmoplantar Keratoderma</td>
<td></td>
</tr>
<tr>
<td>Zenker's diverticulum</td>
<td></td>
</tr>
<tr>
<td>Achalasia Cardia</td>
<td></td>
</tr>
<tr>
<td>Vitamin E &amp; Selenium deficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Esophageal Cancer - clinical feature, diagnosis

- Earliest feature - Dysphagia.
  - Progressive dysphagia
  - Difficulty to swallow solids > liquids
- Weight loss
- Advanced signs - Involvement of Lt. Recurrent laryngeal nerve:
  - Hoarseness of voice
  - Malignant tracheoesophageal fistula - Chronic cough

**Diagnosis:**
- IOC - Endoscopic biopsy
- Staging -
  - Overall staging
    - PET-CT (Positron emission tomography)
    - Isotope used - 18 FDG
  - IOC for T, N staging
    - EUS (endoscopic ultrasound)
Endoscopic ultrasound

- Mucosa - white (hypoechogenic)
- Muscularis mucosa - Black
- Submucosa - white
- Muscularis propria - Black
- Serosa - white.

Advanced esophageal cancer with lymphnode involvement

Esophageal Cancer - Other investigations, TNM - Staging

Barium studies
- Barium swallow shows
  - Rat tail appearance (or)
  - Apple core appearance (also seen in colon cancer on barium enema)

Shouldering effect

Achalasia cardia

Carcinoma esophagus
**T, N, M Staging**

<table>
<thead>
<tr>
<th>T status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;0&lt;/sub&gt;</td>
<td>High-grade dysplasia</td>
</tr>
<tr>
<td>T1</td>
<td>Invasion into the lamina propria, muscularis mucosae, or submucosa</td>
</tr>
<tr>
<td>T2</td>
<td>Invasion into muscularis propria</td>
</tr>
<tr>
<td>T3</td>
<td>Invasion into adventitia</td>
</tr>
<tr>
<td>T4a</td>
<td>Invades resectable adjacent structures (pleura, pericardium, diaphragm)</td>
</tr>
<tr>
<td>T4b</td>
<td>Invades unresectable adjacent structures (spina, vertebral body, trachea)</td>
</tr>
</tbody>
</table>

**N status**

<table>
<thead>
<tr>
<th>N status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N&lt;sub&gt;0&lt;/sub&gt;</td>
<td>No regional lymph node metastases</td>
</tr>
<tr>
<td>N1</td>
<td>1 to 3 positive regional lymph nodes</td>
</tr>
<tr>
<td>N2</td>
<td>4 to 6 positive regional lymph nodes</td>
</tr>
<tr>
<td>N3</td>
<td>7 or more positive regional lymph nodes</td>
</tr>
</tbody>
</table>

**M status**

<table>
<thead>
<tr>
<th>M status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M&lt;sub&gt;0&lt;/sub&gt;</td>
<td>No distant metastases</td>
</tr>
<tr>
<td>M1</td>
<td>Distant metastases</td>
</tr>
</tbody>
</table>

**Histologic grade**

- G1: Well differentiated
- G2: Moderately differentiated
- G3: Poorly differentiated
- G4: Undifferentiated

- **MC site of distant metastasis** - liver

---

**Siewert classification of gastro esophageal junction tumors**

- **Siewert classification**

  - **Type I**
    - Semi proximal to 1 cm proximal to the gastroesophageal junction (GEJ)
  - **Type II**
    - 1 cm proximal to acm distal to the GEJ
  - **Type III**
    - 2 cm distal to 5 cm distal to the GEJ

  - The 8<sup>th</sup> AJCC (American Joint Committee on Cancer) update is -
    - Type I & Type II: Treated as esophageal Cancer
    - Type III: Treated as gastric cancer

---

**Esophageal Cancer - 8<sup>th</sup> AJCC update**

- **T<sub>1</sub> subcategorized as**
  - **T<sub>1a</sub>** - Tumor invades the lamina propria or muscularis mucosae
    - Tumors are above submucosa
    - So, amenable to endoscopic resection
  - **T<sub>1b</sub>** - Tumor invades submucosa

- **T<sub>4a</sub>** - Includes direct invasion of peritoneum
- **G<sub>4</sub>** was eliminated
- Cancers of oesophagogastric junction that have their epicentres within proximal 2 cm of the gastric cardia are staged as esophageal cancer.

- Those with epicentres >2 cm distal to esophago-gastric junction, even if the esophagus is involved are staged as stomach cancers.

**Oesophageal cancer - Management**

- Surgery
  - Oesophagectomy
    - Margin status
      - Proximally - 10 cm margin
      - Distal - 5 cm margin

- Chemotherapy
- Radiotherapy

**Oesophageal cancer - Management - Types and complications of oesophagectomy**

<table>
<thead>
<tr>
<th>Transhiatal (orringer)</th>
<th>Ivor Lewis</th>
<th>McKayown (3 field esophagectomy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site of tumor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Lower 1/3 rd tumor</td>
<td>• Mid 1/3 rd tumors below aortic arch</td>
<td>upper 1/3rd and mid 1/3rd tumor (Above aortic arch)</td>
</tr>
<tr>
<td>• Mainly</td>
<td>• Sometimes - Lower 1/3rd tumors</td>
<td></td>
</tr>
<tr>
<td>• Sometimes mid 1/3 rd</td>
<td>• 2 incisions Abdominal</td>
<td>3 incisions Abdominal</td>
</tr>
<tr>
<td></td>
<td>Right thorax</td>
<td>Thoracic</td>
</tr>
<tr>
<td>No. 9 site of incisions</td>
<td>Site of anastomosis - Neck</td>
<td>Left Neck</td>
</tr>
<tr>
<td>• 2 incisions one at midline abdominal, other at left neck</td>
<td>Thorax</td>
<td>Neck</td>
</tr>
</tbody>
</table>

Complications of Ivor lewis
- mC complication - Atelectasis
- MC cause of mortality - Anastomotic leak leads to mediastinitis

- MC long term complication - Stricture at anastomotic site

Complications of esophagectomy
- Neck anastomosis leaks more commonly
  - but majority are managed conservatively

- Chyle leak- injury to thoracic duct

Esophageal replacement
- MC used - Gastric tube
  - Based on Right gastroepiploic (main) vessels
  - Right gastric vessel
- If stomach is affected with acid or alkali injury
  - Colon (Preferred) or jejunum is used.

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Esophageal Cancer- Chemotherapy, Radiotherapy

- 5 Fluorouracil or cisplatin based
  - Given in-lymph node positive advanced cancers
  - Trials have shown - Chemotherapy + Radiotherapy is better than Chemo or radiotherapy alone
  - In advanced cancers (T3/T4) - Neoadjuvant chemotherapy
  - Most important Prognostic factor - "T" stage / depth of invasion
Malignant tracheo-esophageal fistula, leiomyoma

- C/F - Chronic cough
- Seen in middle 1/3rd tumors of esophagus
- Management of choice - SEMS (self-expanding metallic stent)
- m.C complication - migration of stent
- If stent is blocked - Lasers can be used to relieve the blockade. Leiomysoma.
- m.C benign tumor of esophagus
- On barium swallow - Punched out / Semilunar defect
- Management - Enucleation

Esophageal diverticulae

- Upper esophageal
  - Zerker’s diverticulum
    - False diverticulum
    - Located in upper 1/3rd
    - Pulsion diverticulum
      - Due to ↑ pressure
- Mid esophageal
  - Parabronchial diverticulum
    - Only true diverticulum of esophagus (involves all the layers)
    - An e.g. of traction diverticulum
      - Seen in Tuberculosis / Histoplasmosis
        - A mediastinal node with TB attached to esophagus
- Lower esophageal
  - Epiphrenic diverticulum
  - False diverticulum
  - Pulsion diverticulum
    - Due to ↑ pressure
As the node heals with fibrosis, pulls the esophagus along with it

- Diagnosis - Barium swallow
- Management - if symptomatic or a large diverticulum

Diverticulectomy

Zenker's diverticulum

- Out pouches through Kilian's dehiscence - space between thyropharyngeus and cricopharyngeus muscle.
- Pulsion diverticulum - due to ↑ pressure
- Only mucosa is involved - false
- Starts in midline posteriorly but ends on left of midline.
- C/F - Seen in 416th decade
  - Regurgitation of food - earliest symptom
  - Halitosis - Foul odour
  - Aspiration pneumonitis - in later stages - Dysphagia

Intermittent dysphagia
Complication
- Aspiration pneumonia

can lead to lung abscess

Diagnosis
- Barium swallow

Zenker's diverticulum - Management

- Zenker diverticulum
  - Very small: Zenker < 2 cm
  - Large: Zenker > 2-4 cm

Diverticulotomy + cricopharyngeal myotomy

Endoscopic diverticulopexy (Dohlman procedure)

-> Endoscopically the mouth of diverticulum is opened

- Botulinum toxin

Classically opened using stapler

Now lasers are used

Hiatal Hernia

- Hernia through the hiatus (opening in diaphragm) - GEJ lies intrabdominally
- MC diaphragmatic hernia overall - sliding hiatal hernia
- MC congenital diaphragmatic - Bochdalek / left posterolateral
sliding hernia.
- The GE junction lies in the thoracic cavity
- C/A - usually asymptomatic GERD

- IOC - Traditionally - Barium meal
  - CT with oral contrast (preferred)

- management - only Symptomatic patients
  - require surgery
  - fundoplication
    - (restores adequate length of intra-abdominal length, hernia, GERD)

Rolling or Paraesophageal Hernia or Type - II

- A portion of stomach migrates through hiatal opening into thoracic cavity, but GEJ is normal.
- The herniated stomach can undergo - volvulus and necrosis
  - hence, life threatening condition

- There can be longitudinal ulcers - just below the herniated stomach
  - known as cameron ulcers

- management - All patients require surgery
  - Through abdominal route
  - reduce hernia & tighten diaphragmatic crura.
  - to ↓ recurrence
Type III hiatal hernia
- Mixed - sliding + rolling
- Management - depends on rolling component

Types IV hiatal hernia
- Paraesophageal hernia - but content other than stomach herniates through.
OESOPHAGUS 3

Schatzki ring

- Benign Condition.
- Involves:
  - mucosal ring (MC)
  - Sub mucosal ring

Clinical Features:
Intermittent dysphagia
Diagnosis: Barium swallow

'a' ring appearance.

Rings:
A ring → Proximal limit of vestibule.
B ring → Schatzki's ring
→ at squamo columnar junction.
C ring → Distal limit of hiatal hernia.

management

Asymptomatic
observation

Symptomatic
Balloon dilatation

Foreign body ingestion

Impacted at C6
or Pharyngo esophageal
junction.

Impacted distal to C6
or pharyngo esophageal
junction

endoscopic removal

Observation

serial 24hrs x-rays taken
check location of foreign body

- Asymptomatic
- Distally progressive foreign body
  ↓
  observation

Symptomatic
  ↓
  Endoscopic removal

Button batteries

→ Can corrode and cause perforation.
→ Endoscopic removal should be done even if
  1. Asymptomatic patient.
  2. Present distal to C6

Corrosive injury to oesophagus

<table>
<thead>
<tr>
<th>due to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid</td>
</tr>
</tbody>
</table>
| Cause:
  1. Coagulation and fibrosis remains superficial |
  2. Severe pylorospasm (gastric injury) |
| Alkali (Odour less) |
  Ingested in larger quantity
  Causes:
  1. more esophageal damage
  2. deeper penetration due to Saponification

→ Corrosive injury - Increases risk for Oesophageal carcinoma.

Management:

1. Stabilization - IV fluids.
   → Prophylactic antibiotics → no use
2. Early skilled endoscopy
   ↓
   - Check extent of damage
   - Plan further management.

→ Corrosive injury causes: strictures

Dilatation
  ↓
  Bougie / balloon dilatation.

Severe cases
  ↓
  Esophagectomy
Oesophagus replaced by Colon/Jejunum
Because stomach can be involved.

Esophageal perforation

Iatrogenic esophageal perforation:
- At upper 1/3rd of esophagus.
- Post endoscopy.
- Increased risk in:
  1. Therapeutic endoscopy
  2. Endoscopy in malignant patient.
  3. Rigid endoscopy.

Clinical feature:
- Chest pain or abdominal pain
- Post endoscopy.
- IOC: CECT management
  - Small perforation
  - Cervical oesophagus
  - No/minimal sepsis
  - Stable patient
  - Conservative management
    1. NPO (nil per oral)
    2. IV fluids
    3. IV antibiotics
    4. Analgesic.
  - Large perforation
  - Late presentation
  - Thoracic oesophagus
  - Sepsis
  - Thoracotomy and perforation repair.
Spontaneous esophageal perforation

- a/v/a. Boerhaave syndrome
- occurs due to
  - forceful vomiting against closed glottis.
  - mc site - left posterolateral wall of lower 1/3rd of oesophagus
  - Common in alcoholics

  Clinical features:
  1. "Mackler triad"
    - Retching
    - Chest pain
    - Subcutaneous emphysema.
  2. Pneumomediastinum.
    - air from oesophagus enters mediastinum.
    - on auscultation: 'Hamman Crunch'
      - 'Crunching Sound'

  IOC:
  - Stable patient → CECT
  - Unstable patient → Contrast study
    - Iohexol medium > Dinosil medium

  Chest x-ray findings:
  - Pneumomediastinum
    1. Continuous diaphragm sign
    2. Spinnaker Sign
    3. Ginkgo leaf Sign

Management:
- Early presentation (within 12 hrs)
  - minimal sepsis
  - Stable patient
  - Late presentation
  - unstable patient
  - ↑ Sepsis.
Thoracotomy and cervical oesophagostomy repair with chest tube with gastrostomy.

**Steps:**

- Removal of perforated area.
- Cervical oesophagostomy
- Proximal end of oesophagus in neck
- Cervical oesophagostomy
- Distal end of oesophagus closed
- Gastrostomy done (for nutrition)
- If patient survives:
  - Anastomosis done after 10 - 12 weeks.
- MC cause of mortality (40-50%) in Boerhaave syndrome is mediastinitis

**Motility disorders**

- Achalasia cardia.
  - Occurs due to:
    1. Failure of relaxation of lower oesophageal sphincter.
    2. Loss of ganglion cells (derived from neural crest)
    - In myenteric / Auerbach plexus. (lower half)
    - Loss of ganglion cells → Lower esophageal sphincter does not relax.

**Clinical features:**

1. Regurgitation (earliest)
2. Dysphagia.
   - Initially: more to liquids > solids.
   - Later: Solids = Liquids
3. Halitosis.
4. Aspiration pneumonitis. (MC complication)
5. Lung abscess.
Types of achalasia

- Primary Achalasia
  - Loss of ganglion cells
  - Chaga's disease
  - Trypanosoma cruzi

- Secondary Achalasia
  - Rapidly progressive
  - Malignancy

- Vigorous Achalasia
  - Alacrimia, achalasia
  - ACTH resistant adrenal insufficiency

- Pseudo Achalasia

- Tripple 'R' syndrome

Diagnosis:
- Barium Swallow
- Bird's beak appearance
- Gold standard: manometry

Findings: Chicago classification
1. Failure of Lower esophageal sphincter to relax
2. Ineffective contraction in body of Oesophagus
3. Lower esophageal sphincter pressure ≥ 26 mm Hg

Latest Chicago classification
- Based on
- High resolution manometry

Integrated relaxation pressure (IRP)
Definition: mean of 4 Sec of maximal swallow induced lower esophageal sphincter relaxation

Classification

<table>
<thead>
<tr>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
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<tbody>
<tr>
<td>Classic achalasia</td>
<td>Paraesophageal Compression</td>
<td>Spastic achalasia</td>
</tr>
<tr>
<td>➔ Elevated IRP</td>
<td>➔ IRP</td>
<td>➔ IRP</td>
</tr>
<tr>
<td>Lack of lower esophageal sphincter relaxation</td>
<td>➔ Failed peristalsis</td>
<td>➔ No normal peristalsis</td>
</tr>
<tr>
<td>➔ Failed peristalsis 100%</td>
<td>➔ Pan oesophageal pressurisation ≥ 20% of swallows</td>
<td>➔ Spastic contraction</td>
</tr>
<tr>
<td>➔ Distal contractile index (DCI)</td>
<td>➔ DCI cannot be measured</td>
<td>DCI &gt; 450 mm Hg /s/cm with ≥ 20% of swallows</td>
</tr>
</tbody>
</table>
Management of achalasia

- Medical management
  - Nitrates
- Endoscopic management
  - Calcium channel blocker
  - Balloon dilatation
- Surgical management
  - Heller's myotomy

NOTES - Natural Orifice Transluminal Endoscopic Surgery
- POEM - Per Oral Endoscopic Myotomy

POEM - Per oral endoscopic myotomy.

Procedure:
- Endoscope inserted in the inner layer of Oesophagus.
  - Tunnel passed at esophagogastric junction.
  - Remove circular muscle
  - Lower esophageal sphincter relaxed
  - Mucosa - sutured

Done for: type I classical achalasia.
Laparoscopic Heller's myotomy:
- Muscle incised at 5 cm proximal and 2 cm distal to GE junction.
  ↓
Lower esophageal sphincter relaxation.
  ↓
 mc Complication: GERD
  ↓
Heller's surgery + Floppy Nissen fundoplication.
  →
Achalasia causes ↑ risk of Squamous cell carcinoma of oesophagus.

Diffuse oesophageal spasm

→ New terminology: Distal esophageal spasm.
→ Clinical features:
  1. Chest pain similar to angina.
     ↓
    Normal ECG.
  2. Dysphagia.

Investigations:
  1. Barium swallow.
     ↓
    Spasm of circular muscle
     ↓
    Cork screw or Rosary bead appearance of Oesophagus.

  2. Manometry.
    → ↑ duration >2.5 sec Contraction.
    → ↑ amplitude >130mm Hg

  3. In high resolution manometry
     ↓
    • DCI >450 mm Hg/sq cm. (↑ contraction)
    • Integrated relaxation pressure - Normal
     ↓
    Lower esophageal sphincter is relaxed

Management
↓
Medical management
Nitrates, calcium channel Blockers

If patient does not respond
↓
myotomy
Nutcracker oesophagus

- Mc motility disorders.
- Clinical features:
  1. Dysphagia (mc)
  2. Chest pain

Investigation:
- Classical manometry:
  - > 180 mm Hg pressure.
  - Normal peristalsis
  - Duration of contraction > 7 sec.

Jack Hammer Oesophagus.
- Variant of nutcracker Oesophagus.
- New name: Hyper contractile Oesophagus.
- On high resolution manometry
  - Distal Contractile Integral (DCI) > 8000 mm Hg /s/cm
- On classical manometry
  - Pressure > 300 mm Hg

Feline oesophagus

- Oesophageal mucosa appears
  - Stacked up
- Seen in
  1. GERD (mc)
  2. Eosinophilic esophagitis
- Lower 1/3rd of Oesophagus
  - Idiopathic
  - Seen in children
  - Proximal 1/3rd of Oesophagus affected
- In eosinophilic esophagitis
  - Deep ulcers → strictures

Investigation:
- Endoscopy: Stacked up mucosa

Management:
  1. Immunotherapy against IL-5
  2. Steroids.
Oesophageal infections

1. Esophageal candidiasis
   → Associated with oral thrush in immunocompromised patients.
   → Investigation:
     1. Endoscopy:
        Shaggy depositions on Oesophagus
     2. Barium swallow:
        Mucosal deposits
        ↓
        Shaggy appearance
        Worm like ulcers
        (Similar to varices)

2. Cytomegalovirus infection
   → post transplant
   → in graft versus host disease.
   → Appearance: Serpiginous or geographical ulcers.

3. Herpes infection.
   → Associated with Herpes labialis.
   → Small ulcers, raised margins.

Dysphagia cusoria

→ Due to aberrant right subclavian vein.
UPPER GI HEMORRHAGE

- Hemorrhage above the ligament of trietz

Non-Variceal bleeds (70%-80%)
Variceal bleeds (30%)

Non variceal hemorrhage

1) Most common cause: peptic ulcers
duodenal > gastric
vessel involved gastroduodenal artery

2) 2nd most common cause: gastritis

Type A (Autimmune)
- Autoantibodies against parietal cells.
- Hypochlorhydria.
- Pernicious anemia.
- Spares antrum
- ↑ risk of cancer

Type B (Bacterial)
- H. pylori
- Antrum affected commonly
- Variant: pan gastritis
- ↑ risk of cancer

- Stress gastritis: Stomach or gastric mucosa is the most sensitive mucosa to hypovolemic insult
- Most common site of ischaemia in GIT is splenic flexure

Cushing
(head injury)

Curling
(burns)

Most common: Acid producing area of stomach
Most common: D1 duodenum

- NSAID induced gastritis
- Gastritis in AIDS → Cryptosporidiosis
3) Mallory-Weiss tear

- Longitudinal tear in mucosa (most common) and/or submucosa.
- Starts at gastroesophageal junction and proceeds to involve cardia.
- Vessel implicated: Left gastric artery.
- Clinically seen in alcoholics, after forceful vomiting.
- Investigation of choice: Endoscopy.
- Usually self-limiting.
- Management: Conservative.
  If persistent bleed, angioembolization or cautery of bleed is done.

4) GAVE (Gastric Antral Vascular Ectasia)

- Portal gastropathy.
- Females > Males.
- Associated with autoimmune disorders, collagen vascular disorders, SLE or rheumatoid arthritis.
- Dilated submucosal venules in antrum.
- On endoscopy: Watermelon stomach, fundus is spared.
- Management:
  - APC: Argon Photocoagulation.
  - If recurrent/severe: Antrectomy.

5) Menetrier’s disease
- Hypertrophy of gastric mucosal folds
  - mediated by TGF-α
- Earliest clinical feature, protein losing enteropathy
  - Other features are upper GI bleed
  - ↑ risk of cancer
- Investigation - endoscopy
- Management : Cetuximab
  - if severe then total gastrectomy

6) Dieulafoy lesions
- Dilated submucosal arterioles
- Males > Females
- Similar to angiodyplasias in colon
- Mostly seen in elderly
- Clinically presents with upper GI bleed
- Management : Coagulate the vessel

7) Tumors

Variceal hemorrhage: portal hypertension

- Hepatic venous Pressure Gradient (HVPG)
  \[ \text{HVPG} = \frac{\text{Wedge Hepatic venous Pressure}}{\text{Free hepatic venous Pressure}} \]
  \[ = \text{(inflated balloon)} \quad \text{and} \quad \text{(deflated balloon)} \]
  \[ \geq 10 \text{ mm Hg} \rightarrow \text{Portal HTN} \]
  \[ \geq 12 \text{ mm Hg} \rightarrow \text{Varices start to bleed} \]

- Causes of portal hypertension

- Extra hepatic
  - 1. Portal vein thrombosis - pre-Sinusoidal
    - Sarcoïdosis
    - Crow’s disease
  - 2. Splenic vein thrombosis - pre-Sinusoidal
    - Schistosomiasis
    - Alcoholism
  - 3. Tumors - portal fibrosis - pre-Sinusoidal
    - Cryptogenic cirrhosis
  - 4. Trauma - hemorrhage - pre-Sinusoidal
    - Wilson's disease

- Intra hepatic
  - 1. Sinusoidal
    - Cirrhosis - severe tricuspid
    - Alcoholism - regurgitation
  - 2. Post Sinusoidal
    - Non-Cirrhotic - Viral
    - Constrictive pericarditis
    - Antitrypsin deficiency - IVC obstruction
    - Budd-Chiari syndrome
- Portal vein thrombosis (extra-hepatic portal venous obstruction)
  - commonly seen in 1st - 3rd decade
  - Cavernous change is seen in portal vein / web
    - course
      - Fulminant → liver failure
      - Gradual → Portal HTN and splenomegaly

- Splenic vein thrombosis
  - Left sided portal hypertension
  - Usually secondary to Acute pancreatitis
  - Management: Splenectomy

- Non-cirrhotic portal fibrosis (NCPF)
  - 3rd - 4th decade
  - No cirrhosis → no bridging fibrosis
  - Diagnosis of exclusion
  - Splenomegaly
  - Management: Transplant

- Budd-Chiari Syndrome
  - It is hepatic venous outflow occlusion
  - Causes of occlusion
    - Prothrombotic state → web in outflow vessels
      - Pregnancy
      - Protein C, S deficiency
        - Typically seen in young females.
          - Clinically
            - Gradual course: Abdominal pain
            - Fulminant course: fulminant liver failure
    - Imaging: CECT
    - Management
      - Liver failure → Transplant
      - Identify and treat the cause
      - Lifelong anticoagulation

- Clinical features of portal hypertension
  - Splenomegaly
  - Ascites
  - Liver failure
  - Porto systemic shunts
    - lower part of oesophageal bare area of liver:
      - umbilicus → Caput medusae
      - retroperitoneum
      - rectum
Caput medusae

- Investigation of Choice: Doppler
  Diagnosis is made by: HVPG

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Management of variceal hemorrhage

- Baveno classification
  - Small: Minimally elevated varices above the esophageal mucosal surface
  - Medium: Tortuous varices occupying less than 1/3rd of the esophageal surface
  - Large: Varices that occupy more than 1/3rd of the esophageal surface

management:
- Manage Airway
  - Breathing
  - Circulation
- Insert a large bore IV lines and give IV fluids
- Give IV agents (Best): IV terlipressin
  - more commonly used: IV Octreotide
  - not used: IV Propranolol
- IV PPI (Proton pump inhibitors) have no role in controlling hemorrhage before endoscopy
- Early endoscopy

Band ligation  $\Rightarrow$  Sclerotherapy

most common sclerosing agent in sodium tetradecyl sulphate
Others:
- Sodium morrhuate
- Polidocanal
- Ethanolamine oleate
Complications:
- Increased risk of perforation
- Chest pain

Outcomes:

Bleeding Stops
- Monitor for 24h
- If no re-bleed
  - Discharge
  - Oral Propranolol
    (Prophylaxis to reduce incidences of bleeding)

Rebleeds
- And trial of endoscopic management
  - Fails
    - Prepare for TIPSS
      1. Correct coagulation profile
      2. Tube is used to temporarily to control bleeding

Sengstaken Blakemore tube

It has 3 channels
- Esophageal balloon channel
- Gastric balloon channel
- Gastric aspiration channel

- First gastric balloon is inflated (300ml air)
  - If bleeding does not stop then inflate oesophageal balloon (40 mmHg)
- Oesophageal balloon is deflated every 12 hours to prevent necrosis.
  - Minnesota tube: modification of above tube with 1 extra channel - oesophageal aspiration
TIPSS and shunt surgeries

**TIPSS**
- Transjugular intrahepatic portosystemic shunt
- Stent is placed between a hepatic vein branch and a portal vein branch
  - Decompression of portal system
  - Reduce portal pressure and control bleeding

- **Used:**
  - Variceal hemorrhage
  - Intractable ascites

- **Contraindications:**
  - Portal vein Thrombosis

- It is a non-selective shunt
  - Most common early complication - hepatic encephalopathy/confusion.
  - Most common long term complication - blockade of stent
  - Re-bleed

**Shunt**

- **Shunts**
  - Selective
    - Only splenic blood is shunted
  - Non-Selective
    - Splenic + gut blood is shunted
    - Hepatic encephalopathy
      - (toxins in gut blood precipitate in the brain)

- **Shunt surgeries**
  - Indications: Child-Pugh category ‘A’ where recurrent bleeding
  - Warren Shunt: Distal splenorenal shunt (selective shunt)
  - Linton shunt: Proximal splenorenal shunt (Non-selective shunt)
- End to side portocaval shunt: Eck Fistula (Non-selective shunt)
- Side to side splenorenal shunt: Milr's shunt (Non-selective shunt)

- Left gastric venocaval shunt: Inokuchi shunt (Selective shunt)

- If bleeding is still not controlled, esophageal devascularization → Sugiura procedure
  devascularize lower 6 cm of oesophagus

Prognosis of upper GI haemorrhage

Prognostic scores
1. BLEED criteria.
   - Ongoing Bleeding
   - Low systolic BP
   - Elevated prothrombin time
   - Erratic mental status
   - Comorbid Disease requiring ICU admission
2. Forrest Classification
- Endoscopic classification which tells risk of re-bleeding

<table>
<thead>
<tr>
<th>Risk</th>
<th>Class</th>
<th>Description</th>
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<tbody>
<tr>
<td>High</td>
<td>Acute hemorrhage Class I&lt;sub&gt;a&lt;/sub&gt;</td>
<td>Spurtin hemorrhage Oozing hemorrhage</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Signs of recent hemorrhage Class II&lt;sub&gt;a&lt;/sub&gt;</td>
<td>Non-bleeding visible vessel adherent clot</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Class II&lt;sub&gt;b&lt;/sub&gt;</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Class II&lt;sub&gt;c&lt;/sub&gt; Lesions without active bleed Class III</td>
<td>Flat pigmented spot Clean ulcer base</td>
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3. Rockall Score

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<thead>
<tr>
<th>Variable</th>
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<td><strong>Clinical Parameters</strong></td>
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<td>Age</td>
<td>&lt; 60</td>
<td>60 - 79</td>
<td>&gt; 80</td>
<td>Renal</td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
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<td>Failure, meta-</td>
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<td></td>
<td></td>
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<td>static</td>
</tr>
<tr>
<td>Shock</td>
<td>No Shock</td>
<td>Pulse &gt; 100/m</td>
<td></td>
<td>disease</td>
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<tr>
<td><strong>Endoscopic Parameters</strong></td>
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<tr>
<td>Source of bleeding</td>
<td>Mallory</td>
<td>All other causes</td>
<td>Malignancy</td>
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<tr>
<td></td>
<td>- Weiss tear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stigmata of recent bleed</td>
<td>Adherent clot or vessel</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Glasgow – Blatchford scoring system
   - pre - endoscopic assessment

5. ALMS 65 score
STOMACH - 1

Surgical Anatomy:

Blood supply of the stomach:

- Celiac trunk → Lt. gastric artery
- Common Hepatic → Rt. gastric artery
- Short gastric A.
- Splenic artery
- Lt. gastroepiploic artery
- Gastroduodenal artery
- Rt. gastroepiploic artery

- Short gastric artery lies in the Gastroplenic ligament.
- Left gastric artery is the dominant artery of the stomach.
- Artery that bleeds in the Mallory Weiss tear
- Artery that bleeds in Type 4 Gastric ulcer
- Stomach doesn't undergo necrosis even after ligating a vessel because of extensive submucosal anastomosis between the vessels.

Idiopathic hypertrophic pyloric stenosis

- Also known as Congenital hypertrophic pyloric stenosis. (CHPS)
- m > F (4:1)
- First born male child of the family - more common.
- Associated with maternal erythromycin intake during pregnancy.

Pathogenesis:
- Hypertrophic pyloric muscle
- Functional gastric outlet obstruction.

Clinical features:
- Pt. is normal at birth (in duodenal atresia: bilious vomiting since birth)
- Symptoms start after 2 - 3 weeks.

- Symptoms: Projectile vomiting
Non Bilious Vomiting

- No Protein energy malnutrition.
- Diagnosis: USG Abdomen

  - Hypertrophied pylorus
  - Thickness: > 4 mm
  - Length of the pyloric channel: > 16 mm

- On x-ray abdomen:
  - Single bubble sign

- On contrast study:
  - String sign
  - Double track sign
  - Mushroom sign

- On USG: Target sign, Antral Nipple sign.

  Because of gastric outlet obstruction, typical metabolic abnormalities are seen.

Hypochloremic hypokalemic metabolic alkalosis
paradoxical aciduria due to gastric outlet obstruction

\[ \text{HCl} \text{ vomited out} \]
\[ \text{H}^+ \rightarrow \text{metabolic alkalosis} \rightarrow \text{Renal compensation} \]
\[ \downarrow \text{Cl}^- \]
\[ \downarrow \text{Na}^+ \]
\[ \text{HCO}_3^- \text{ lost in urine} \]
\[ \text{Hyponatremia.} \]
\[ \text{RAAS} \rightarrow \text{Aldosterone actively reabsorbs Na}^+ \text{ in the collecting duct} \]
Actively reabsorbs Na⁺

K⁺ or H⁺ in urine.

- First K⁺ excreted in urine → Hypokalemia.
- Later it starts excreting H⁺ ions in the urine leading to Paradoxical Aciduria. Its paradoxical, because body is already deficient in H⁺ ions; still eliminates H⁺ ions.

Examination:
- Best time to examine: when the child is feeding
- visible peristalsis from Lt to Rt.
- Palpable olive shaped swelling in epigastrum
- Projectile vomiting

Management:
- Correct dehydration and metabolic abnormality first.
- Best fluid -
  0.45 NS + Dextrose ± KCl: if not → RL

- KCl is only added when renal function recovers and urine output is adequate.

Surgery: Ramstedt pyloromyotomy - Mucosa is intact in this surgery

Situations

uneventful
(mucosa - not injured)

Eventful
mucosa injured and Repaired

Start feeding in 4-6 hours wait for 24-48 hours

Peptic Ulcers

Duodenal ulcers (MC)  ➤ Gastric ulcers

- MC site of peptic ulcer: D₁ (first part of duodenum)
- >90% associated with H. Pylori.
- Associated with acid hypersecretion. Therefore Duodenal ulcers respond to acid reducing surgery or vagotomy or PPI

Clinical features of duodenal ulcers:
- Epigastric Pain
- Silent Presentation or
- Presents with complications

Complications of duodenal ulcers:
- MC complication: Bleeding
- Peptic ulcers are the most common cause of upper GI Hemorrhage.
- Posterior ulcers - Bleed - Vessel implicated: Gastroduodenal artery (GDA) [MC vessel in bleeding peptic ulcer]
- MC vessel implicated in bleeding peptic ulcer: GDA.
- Diagnosis: Endoscopy

Management:
- At least 2 attempts of endoscopic mx
  Needs to be tried
  - Fails
  - Surgery (duodenotomy and under running of the vessel)
- Anterior ulcers - Perforate → intra peritoneally : peritonitis
  - Abdominal pain
  - Guarding
  - Board like rigidity
  - Rebound tenderness

- Diagnosis - x-ray chest (erect x-ray preferred)
  Gas under the diaphragm
  (Sign of hollow viscus perforation)
  - If pt. is too sick and can't stand up
  - Lateral Decubitus position
  - Best inv. To detect free air: CECT (done only in stable pt.)

Management: Laparotomy
- Graham's patch repair
  (Omental patch repair)
- Rarely posterior ulcers perforate into Retroperitoneum

Valentino Syndrome
- Collection in Rt. retroperitoneum
- Mimics Acute appendicitis

Gas around Rt. Kidney
- Renal Veil Sign

Gastric Ulcers

- 60–70% are associated with H. pylori.
- All gastric ulcers should be biopsied to rule out cancer.
- Diagnosis: Upper GI Endoscopy.
  - "U" maneuver should be done to see fundal gastric ulcer.
- Classification of Gastric ulcers: Johnson’s classification.
  - Type I: Ulcer along the lesser curvature close to the incisura angularis (type of gastric ulcer (not peptic ulcer))
  - Type II: Ulcer in the prepyloric region + ulcer in the Duodenum
  - Type III: Only prepyloric ulcer.
  - Type IV: High up in the body along the lesser curvature.
  - Type V: Diffuse ulcers due to NSAIDs.

II & III: Due to Acid hypersecretion - Responds to Vagotomy / PPI’s.
- MC Gastric ulcer to bleed: Type IV.

Clinical features:
- Pain
- Silent presentation
- Dyspepsia
- Complications: Perforation >> Bleeding
  - Peritonitis
  - Endoscopic Management
    - Fails twice
  - Laparotomy
  - Surgery

Definitive Surgery for Gastric Ulcers:
- Type I: Distal Gastrectomy
- II, III: Distal Gastrectomy + Vagotomy / PPI
- IV: Pouchet, Csendes procedures
H. Pylori

- CagA, Vac A: Genes encode for toxin.
- Urease enzyme: Survive in the acidic environment.
- H. pylori can cause: Peptic ulcers
  - Type B gastritis
  - Gastric cancer
  - MALTomas
- H. Pylori is slightly protective against adenocarcinoma of esophagus.

Gastric reconstruction surgeries

1. Billroth I:
   - Distal gastrectomy + End to End Gastroduodenal anastomosis.
   - If tension present → Leak can occur.

2. Billroth II Reconstruction:
   - Polyga reconstruction: Similar to Billroth II

End to side gastrojejunal anastomosis
Roux en Y gastrojejunostomy

- Limb carry bile (biliopancreatic limb)
- Limb continuous with bowel (Roux limb)

End to side jejunojejunostomy anastomosis

- Gastrojejunostomy can either be
  - Ante colic
  - Jejunum is brought of infront of
    - Colon
  - Hernia, behind Roux limb K/a
    - Peterson’s hernia

- Retrocolic
  - Behind the colon
  - Hernia, in the transverse
    - Mesocolon window K/a
    - Stemmer’s hernia

Vagotony

- Acid reducing surgery done in duodenal ulcers, type 3 and 4 gastric ulcers.

Ant. Trunk of vagus
  - Motor branch to GB
    - (GB contraction)
  - Crus of Ant. nerve of latarjet
    - [Responsible for acid secretion]
  - Motor branch to Pylorus
  - If this is cut, to Stasis
    - r/o gall stone formation
    - Carry out drainage procedure
    - ulcer recurrence post vagotomy
  - Post trunk of vagus
    - Post N of latarjet
    - Criminal N of GRASSI
    - left behind during vagotomy

01:07:42
Carry out drainage procedure
- Heinke mickulicz pyloroplasty
- Gastrojejunostomy

Types of Vagotomy:

- Vagotomy
  - HSV
    - Highly selective vagotomy
    - Cut the crow’s foot branches but stop 7 cm from pylorus
  - Truncal Vagotomy
    - Maximum acid reduction
    - Ulcer recurrence rate: < 1%
    - Vagotony complications: Maximum
      - HSV done in chronic ulcers
      - Since the development of PPI's, vagotomies are not being done

Complications following Gastric reconstruction and vagotomy:
- Hemorrhage during surgery
- Anastomotic leak
- Duodenal stump blow out — On day 4
  - Abdominal pain + Peritonitis
- Internal Hernias — Steimel’s and Peterson’s
- Ulcers at the anastomotic site or just distal to it
- Bilious vomiting
- Afferent loop Syndrome — Stasis in Biliopancreatic limb
- Post vagotomy diarrhea — Osmotic diarrhea
  - Octreotide is not useful
- Nutritional complications — IDA — Iron Deficiency Anemia
  - MC complication overall
    - Vit B12
    - Ca²⁺
- Dumping syndrome:
  - Early dumping
    - Occurs due to rapid influx of fluid due to Hyperosmolar
  - Late dumping
    - Occurs due to rebound Hypoglycemia seen due to
Contents in the bowel:
- Starts within 10 mins of consumption of meals.
- C/F: Epigastric fullness
  - Bloating
  - Nausea & Vomiting
- Worsens with consumption of more food
- Duration of attack for both: 30-40 mins

Excessive insulin release:
- Starts after 45 mins to 1 hour
- C/F: of Hypoglycemia:
  - Headache, Sweating, tachycardia, dizziness.
- Worsens with exercise.

Dietary changes in Dumping Syndrome:
- Small frequent meals
- Avoid sugar rich meals
- Avoid liquids with meals
- Avoid sugar rich liquids
- Avoid simple sugars
- High Protein diet
- If symptoms still persist → OCTREOTIDE is helpful.
  ↓
  Symptoms persist even after octreotide
  ↓
  Convert to Roux-en-Y Gastrojejunostomy.
STOMACH -2

GASTRIC CANCER
Risk factors:
- Smoking
- Alcohol Consumption
- Consumption of smoked food or fish
- Preservative rich food
- H. pylori
- Gastric resections and reconstructions
- Menétriers disease
- Polyps: Adenomatous polyps / True adenomas
  - Associated with Familial Adenomatous Polyposis syndrome
  - MC polyps: Metaplastic polyps associated with H. Pylori
  - These metaplastic polyps DO NOT increase the risk
- Gastritis - Type A and B
- Type A Blood group
- Since the advent of refrigeration, incidence of gastric cancer has gone down.
  Site for gastric cancer:
- MC site in Western world: Proximal stomach
- MC site in Asia and over all: Antrum

LAUREN'S CLASSIFICATION OF GASTRIC CANCER:

Intestinal
- Due to Environmental factors
- Men > women
- Increasing incidence with age
- Microsatellite instability

Diffuse
- Due to familial factors
- Women > men
- Younger age group
- Poorly differentiated signet ring cells
- Decreased E-cadherin

- Early gastric cancer: Japanese classification - Above the muscle layer
- Advanced gastric cancer: Borrmann classification - Invades the muscle layer
- Type I: Polypoidal type of early gastric cancer - Best prognosis
- Type IV: Diffusely infiltrative type of advanced gastric cancer - Worst prognosis (Linitis Plastica)
molecular classification of Gastric cancer:
- EBV related: PD-L1/a overexpression; immunotherapy is useful
- microsatellite instability: Hypermutation
  MLH-1 silencing
- Chromosomal instability: TP53 mutation, RAS activation
- Genetically stable type: Diffuse histology → worst prognosis. CDH-1 mutation

Clinical features of Gastric cancers:
- L - Lump
- O - Gastric outlet obstruction (GOO)
- D - Dyspepsia, (New onset)
- S - silent presentation.
- GOO now - a-days: Gastric cancers.
- Weight loss is a major symptom in Gastric cancers

Atypical presentations of gastric cancers

1. Sister mary joseph's nodule:
   - Periumbilical metastasis which is seen in Gastric (GC) and ovarian cancers.
2. Krukenberg tumor
   - B/L ovarian metastasis
   - MC cancer which gives rise to Krukenberg's tumor: Gastric cancer
     Breast, colorectal cancers.

Old theory: Transcoelomic spread / drop mets.
Latest: Retrograde lymphatic spread.
3. Irish nodule: Left axillary lymphadenopathy
   - Sign of advanced disease in any GI / GU Malignancy.
5. Blumer's Shelf nodules:
   - Pelvic metastasis into pouch of Douglas / Retrovesical pouch in males
   - Sign of advanced disease in any GI cancer.
   - Felt on Digital Rectal Examination.
6. Migratory thrombophlebitis: Trousseau syndrome
   - MC seen in pancreatic cancer.
   - Typical of Glucagonoma.
7. Leser Trelat sign

- Multiple seborrheic keratosis in internal cancers.
- Resolves after gastrectomy.

Tripe palms

- Hyperkeratotic palms
- Sign of internal malignancy

**Warning:** Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with marrow Edition 4 videos.

**Diagnosis of Gastric Cancers:**

- Endoscopic biopsy
- Over all staging: PET-CT (18 FODG: ± 1/2 - 110 mins)
- TNM staging: EUS

---

| Primary tumour (T) | T3 | Tumour penetrates the subserosal connective tissue without invasion of the visceral peritoneum or adjacent structures
| TX | Primary tumour cannot be assessed |
| T0 | No evidence of primary tumour |
| T1a | Carcinoma in situ, intraepithelial tumour without invasion of the lamina propria |
| T1b | Tumour invades the lamina propria or the muscularis mucosae |
| T2 | Tumour invades the submucosa |
| T3 | Tumour invades the muscularis propria |
| T4a | Tumour invades the serosa (visceral peritoneum) |
| T4b | Tumour invades adjacent structures |

| N1 | Metastasis in 1–2 regional lymph nodes |
| N2 | Metastasis in 3–6 regional lymph nodes |
| N3 | Metastasis in 7 or more regional lymph nodes |
| N3a | Metastasis in 7–15 regional lymph nodes |
| N3b | Metastasis in 16 or more regional lymph nodes |
site of Distant metastasis of Gastric cancer: LIVER.
management:

- Surgery
  - Surgery for tumor
  - Prox. margin: 5cm
  - Distal margin: pylorus

- Chemotherapy
  - L. nodes if bulky - Neoadjuvant Chemotherapy
  - S-Fu, cisplatin

- Radiotherapy
  - Given to gastric bed to prevent local recurrence
  - Mc site of recurrence

- For a prepyloric tumor: Distal gastrectomy - (30%) of stomach is removed.
- Tumor in body of stomach: subtotal / partial gastrectomy - 60-70% stomach is removed.
- Tumor in the fundus: Total gastrectomy with esophagojejunal anastomosis

Surgery for the Lymphnodes:
- Japanese divided LN's into various stations
  1: Rt. para. cardiac
  2: Lt. para. cardiac
  3: Lesser curvature
  4: Greater curvature
  5: Supra. pyloric
  6: Infra. pyloric
- If we remove 1-6 stations: D, gastrectomy / LN clearance
- 1-6: Around the stomach
7: Lt. Gastric vessels
8: common Hepatic vessels.
9: celiac axis
10: Hilum of spleen
11: splenic Artery.
• if we remove 1 - 11 stations: D2 Gastrectomy/clearance
  ↓
  Optimal LN clearance
Minimum no.of LN Removed: 15

One-liners for gastric cancer

• most important prognostic factor:
  over all T-stage / Depth
• most important prognostic factor in operable cancer: LN status
• mc site of distant mets: Liver
• if there is PD/L gene mutation: Pembrolizumab
  - approved for metastatic /recurrent gastric cancers.
• HER - 2 Neu mutation: Trastuzumab/Herceptin
• Oral fluoropyrimidine derivative: Tegafur; it is combined with
  enzyme inhibitors K/a Oteracil and Gimeracil; if these three
  drugs are combined it is known as S1 chemotherapy - its an ORAL
  Chemotherapy for advanced Gastro cancer.

Gastro intestinal stromal tumors (GIST)

• Arise from the intestinal pacemaker cells of Kajal.
• mc site for GIST: stomach.
  Sporadic >> Familial
• Carney’s triad
• Gastric GIST
• Paraganglionomas
• Pulmonary chondromas
• Gastric GIST in Carney’s triad
  are usually SDH gene mutated.
  ↓
  Resistant to imatinib
• Gastric GIST are multifocal and
  Aggressive.
• GIST behave like sarcomas. They don’t metastasize to LN’s
• Lynch node clearance is not required.
• Hematogenous spread is common. MC site distant to metastasize: Liver.

Clinical features:
• MC: Upper GI Hemorrhage.
• Mass
• Pain
• Perforation
• GIST is a Radiological Diagnosis. Biopsy is NOT mandatory.
• IOC: CECT
• Monitoring therapy in metastatic GIST: PET-CT is used.

Management:
Mainstay: surgery - Resect the tumor in 2 cm margin.
• If present in stomach - wedge resection with 2 cm margin.
• LN clearance - NOT Required.
• If tumor is adherent to another structure → Resect the other structure too.
• If malignant/metastatic GIST → Imatinib
• If Imatinib Resistant → Sunitinib or Sorafenib

Pathology of GIST:
• On HPE: Epithelial or spindle type.

\[
\begin{align*}
\text{Benign} & \quad \text{GIST} & \quad \text{malignant} \\
\downarrow & \quad \text{Fletcher's Classification} & \quad \text{Size of the tumor} \quad \text{No. of mitotic figures} \quad \text{Single most important prognostic factor.}
\end{align*}
\]

<table>
<thead>
<tr>
<th>Malignancy Risk</th>
<th>Size (cm)</th>
<th>Mitotic (50 hpf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>&lt; 2</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Low</td>
<td>2-5</td>
<td>5-10</td>
</tr>
<tr>
<td>Intermediate</td>
<td>5-10</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>High</td>
<td>&gt; 10</td>
<td>&gt; 10</td>
</tr>
</tbody>
</table>

Note: 50 hpf = 50 high magnification fields (400x)
Source: Fletcher et al., 2012.

Immunohistochemistry:
• CD 117 / c-KIT - MC IHC marker in > 90% GIST
• CD 34 - present in 65-70% of GIST.
• DOG-1 - most specific marker for GIST.
• wild type of GIST - c-KIT -ve
• PDGFR α - ve
Gastric lymphoma

\[ \text{\textit{\textbf{Gastric lymphoma}}} \]

1° Gastric lymphoma << stomach can be involved as a secondary site as a part of diffuse lymphomatous process.

1° Gastric lymphoma:
- it is NHL - B - cell lymphoma.
- it is a Diffuse large B-cell lymphoma (DLBCL)
- Stomach is the most extranodal site in GIT to be involved with lymphomas.

Clinical features:
- Lump
- upper G.I. Hemorrhage
- B symptoms of lymphoma.

Diagnosis: Endoscopic Biopsy

Management: 1st line: chemotherapy \[ \rightarrow \] surgery

\( R - \text{Rituximab (CD20)} \)
\( C - \text{cyclophosphamide} \)
\( H - \text{Hydroxydaunorubicin} \)
\( o - \text{Oncovin / vincristine} \)
\( p - \text{prednisolone} \)

MALToma

- mucosal associated Lymphoid Tissue tumor.
- most often seen in stomach, associated with H. pylori

\[ \text{\textit{\textbf{MALToma}}} \]

High grade \[ \downarrow \] manage as lymphomas

Low grade \[ \downarrow \] H. pylori eradication therapy.
Gastric volvulus

- MC type overall
- Associated with Diaphragmatic defects
- Rolling / paraesophageal hiatal hernias
- Acute presentation
- Complete vascular compromise

Clinical features:
- Borchardt's triad: upper abdominal pain.
  - Retching
  - Inability to insert Ryles tube

IOC: CECT

- In contrast study: cascade sign.

Management: surgery

If stomach necrosed
  - Resect
  - Also correct Diaphragmatic defects if present.

If not necrosed
  - Derotate
  - Gastropexy

Trichobezoar

- Hair ball inside the stomach.
- Associated with psychiatric disorders.
- MC in females > males.
Clinical features:
- Present with Gastric outlet obstruction
- IOC: CECT
- Mx: surgical Removal
- If duodenal extension is present, it's known as Rapunzel syndrome.

- Gastric ulcers can give rise to two deformities

  - Hourglass deformity
  - Kissing ulcers
INTESTINAL OBSTRUCTION - 1

Intestinal obstruction - type, clinical features, investigation

1. Type of intestinal obstruction
   - Dynamic
     - Proximal
     - (P) D (Distal)
   - Adynamic
     -

   - Physical obstruction (feces) of bowel wall
   - Contraction of bowel -normal
   - Dynamic obstruction
     - Proximal bowel contracts -vigorously
       - (↑ ↑ bowel sounds)
     - Silent abdomen
       - Silent abdomen is a normal clinical sign
       - [Ominous sign of perforation / strangulation]

   - No physical obstruction of the bowel wall
   - No contraction / peristalsis
   - Adynamic obstruction

2. Clinical features
   a. History of
      - Colicky abdominal pain
      - Abdominal distension
      - Vomiting
      - Obstipation [non passage of feces / flatus]

   b. Order of appearance of symptoms may vary according to the site of obstruction
      - Eg - incase of duodenal obstruction
        - Vomiting → early feature
        - Obstipation → late feature
      - Eg - incase of large bowel obstruction
        - Vomiting → late feature
        - Obstipation → early feature
3. Investigations
   A. Initial Investigation → X-ray abdomen

   Erect  supine

   - Air fluid level > 3 ⇒ obstruction
   - To identify site of intestinal obstruction
   1. Jejunum
      - Step-ladder / concertina effect
      - Feathery appearance
      - Complete volvulus
   2. Ileum
      - Featureless loops of wangensteen
   3. Large bowel

   - Appears in the periphery
   - Incomplete haustrations
     [Not extending from one wall to the other]

b. Investigation of choice (IOC)
   - Children → USG (ultrasound)
   - Adults → CE-CT (contrast enhanced computed tomography)

C. Finding of intestinal ischaemia on CT
   - Reduced bowel wall enhancement
Intestinal obstruction - management

Initial management
- Nil per oral (NPO)
- i.v (intravenous) fluids
- Nasogastric (NG) tube / Ryle's tube
- Bowel decompression

Surgical management
- 1st structure to be visualised
  - Caecum

  - Distended
    - Large bowel obstruction
  - Collapsed
    - Small bowel obstruction

  - Patients not responding to initial management
    - Surgery

  - Note: identification of viable / non-viable bowel surgery

  - Viable
    - Pink / red
    - Mesenteric pulsations
    - Bowel stimulation → peristalsis
  - Non-viable
    - Dusky / black
    - No pulsations
    - Bowel stimulation → peristalsis

Duodenal atresia

- Most common cause of bowel obstruction in neonates
- Commonly associated with Down's syndrome
- Clinical features
  - Mother - polyhydramnios
  - Child - Bilious projectile vomiting since birth
  (Differentiate from congenital hypertrophic pyloric stenosis)

Surgery • v2.0 • Marrow 4.0 • 2020
• Investigations
  1) Initial investigation
     • X-ray → Double bubble sign
       (also seen in annular pancreas)
  2) CT
     • Definite diagnosis

• Types of duodenal atresia
  Type I → 1) most common type
     mucosal web
     wind sock deformity

  Type II → 1) short fibrous band
     2) muscle layer - intact

  Type III → 1) complete obstruction
     2) No continuation

• Management of duodenal atresia.
  Surgery
  → Duodenoduodenostomy ▶ Duodenojejunostomy

Intussusception

Definition
Telescoping of bowel into the other
Proximal bowel telescopes into distal bowel

Parts
• Intussusceptum → bowel that telescopes inside
• Intussusceptum → bowel that receives the other
• Narrowest part → neck of intussusception
• Apex of intussusception → ist part to undergo ischaemia

Types of intussusception

Primary ➤ Secondary

• Occurs in children
• 5-10 month
  (till 2 years)
• Preceded by URTI
  (upper respiratory tract infection)
• Occurs a° to pathological lead point
• Most common lead - point overall ➤ polyp
• Other lead points
  - meckel's diverticulum

Surgery • v2.0 • Marrow 4.0 • 2020
- Cause → hypertrophy of peyer's patches
  - cancer
  - carcinoid
- Nature of intussusception
  ↓
  ileocolic (most common)
- Nature of intussusception
  ↓
  colo-colic
- Primary is more common than secondary
  ⊴: ileocolic is more common than colo-colic

History
- child experiences spells when he/she cries & raises the leg
- Red current jelly stools (blood mixed with mucus)

On Examination
  - Empty right iliac fossa (RIF)
  - Sausage shaped lump in right lumbar region
    ↓ sign of dance
  - Intussusception → sometimes felt on digital rectal examination
    [Rectal prolapse → no gap between rectal wall and prolapse
    intussusception → gap between rectal wall & intussusception

Investigations of intussusception
- initial investigation → x-ray - erect, spine (same for all intestinal
  obstruction)
- IOC → children - USG, Adults - CECT

USG -

Target / Dough nut / pseudo - kidney sign
- presence of mesentric vessels within the bowel lumen

- contrast enema
  - Only with gastrografin
  - claw / pincer sign
management of intussusception

1. Contrast enema
   - Both diagnostic & therapeutic
   - Children: 60-70% reductions can be achieved

2. Surgery
   Indications for surgery / contraindication for contrast
   (i) Recurrent intussusception
   (ii) To tackle pathological lead point
   (iii) Perforation of bowel
   (iv) Strangulation of bowel

   During surgery - Bowel management
   
   Viable
   ↓
   - Squeeze from most distal part
   - Most difficult part to reduce → last part

   Non-viable bowel (perforation)
   ↓

   Resection & Anastomosis

   Squeeze from most distal part

   Squeeze the intussusception

Retrograde intussusception:
   - Distal bowel telescopes into proximal bowel
   - Rare
   - Seen in patients with Roux-en-Y gastrojejunostomy

   [(Distal) jejunum goes into biliary limb (proximal)]

Volvulus - Sigmoid volvulus

1. Sigmoid volvulus
   - Most common volvulus in GIT
   - Usually rotates anti-clockwise

   Predisposing factors for sigmoid volvulus
   - Long & narrow mesentery
   - Redundant sigmoid
- Loaded (constipated) sigmoid

Common in patients with
- Antipsychotic medications
- Hypothyroid patients
- Institutionalized patients

Clinical features of sigmoid volvulus
- Vomiting (late sign)
- Obstruction
- Marked distension

Investigation in sigmoid volvulus
- Initial investigations → x-ray abdomen (erect & supine)
  ↓
  Coffee bean sign / bent inner tube sign
  Sigmoid volvulus → Apex of the volvulus in right upper quadrant
  Cecal volvulus → Apex of the volvulus in left upper quadrant
- IOC → CECT
- Contrast enema → Bird’s beak / ace of spade appearance
  ↓
  (Also seen in Achalasia cardia)

Management of sigmoid volvulus

Stable
- No features of peritonitis
- No sepsis
  ↓
a. Temporary measure
  - Sigmoidoscopic decompression
b. Definitive measure
  - Sigmoidectomy
  - Sigmoidopexy (High recurrence rate)

Unstable
- Peritonitis (+)
- Sepsis (+)
  ↓
  Hartmann’s procedure
  - Resection of perforated area
  ↓
  Closure of peritoneal cavity
  i) Anastomosis of proximal & distal end
  End → After 2-3 months
Volvulus - caecal volvulus & compound volvulus

Caecal volvulus
- Females > males
- Age: 4<sup>th</sup>-5<sup>th</sup> decade
- Mobile caecum
- Rotates clockwise

Clinical features
(similar to bowel obstruction) - Vomiting
- Obstipation

Investigation:
- Initial investigation → x-ray abdomen (erect & supine)
- IOC → CECT

Management

No peritonitis ↓
- Colonoscopy has no role
- Surgery

perforation/strangulation ↓
- Right Hemicolectomy

caecopexy

Right hemicolecetomy

3. Compound volvulus
- Also known as ilio-sigmoid knotting
- Cause - long pelvic mesocolon
  ileum rotates around sigmoid

Other causes of dynamic bowel obstruction

a. Strictures
  Can be seen in - Tuberculosis
  - Crohn's disease
management:

patient - A (TB)

1 $\frac{3}{4}$ ft

3 strictures within $\frac{3}{4}$ ft of ileum

patient - B (Crohn's)

4 ft

3 strictures within 4 ft evenly distributed

management:

Resection & anastomosis

Heineke-Mikulicz stricturoplasty

management:

stricturoplasty

b. meconium ileus

Soap bubble appearance

Neuhauser sign

- seen more commonly in cystic fibrosis
- thick secretion ⇒ bowel obstruction
- In-utero aseptic peritonitis

Clinical Features

- Non passage of meconium
- Distended bowel loop

Investigation:

1. Initial investigation

x-ray abdomen ⇒ soap bubble appearance [Neuhauser sign]

- microcolon
a. sweat chloride test

management:
* Initial management → Gastrograftin enema.
  ↓ Fails
  Bishop Koop surgery → Ileostomy
  +
  End-to-side ileostomy

Bishop Koop surgery
INTESTINAL OBSTRUCTION - 2

- MC cause of bowel obstruction: Adhesions
- Most adhesions are post surgical.

Non surgical causes of bowel adhesions:
- TB
- Crohn's
- Endometriosis
- PID
- Post radiotherapy

Clinical features: Same as cardinal features of bowel obstruction
On Examination:
  - Scar over the abdomen
Initial investigation: X-ray abdomen erect and supine
Loc: CECT

Management:
- Dynamic bowel obstruction - conservative management can be tried for 48 - 72 hours.
- Majority patients have spontaneous resolution of the condition
- Gastrografin helps in resolution of adhesive intestinal obstruction.
- Last resort: Surgery - Adhesiolysis.
- If recurrent adhesive obstruction present - Noble plication
  - Charles Philippe procedure

Meckel's diverticulum

- Remnant of vitellointestinal duct.
- Situated in the antimesenteric border
- Independent blood supply.
- True diverticulum - it has all the layer of bowel.
- Rule of 2: 2% population 2 inches long
- Situated 2 feet proximal to iliocecal junction
- 20% patients - ectopic mucosa in the Meckel's
- MC ectopic mucosa: gastric mucosa > pancreatic mucosa.
Presentations of Meckel's:

1. Incidentally detected Meckel's:
   - Incidental Meckel's
     - Wide mouth
     - Broad base
     - Narrow mouth
     - Narrow base
     - No intervention required
     - Diverticulectomy.

2. Meckel's diverticulitis:
   - Inflamed Meckel's diverticulum.
   - Mimic acute appendicitis.
   Management: Diverticulectomy
   IOC: CECT.

3. Perforated Meckel's:
   - Patient presents with peritonitis
   Management: Resection and anastomosis of bowel.

4. Meckel's in hernial sac:
   - Littre's hernia.

5. Bleeding Meckel's:
   - MC presentation in children
   - Bleed is because of Ectopic gastric mucosa.
   - C/F: Lower gastrointestinal hemorrhage
   IOC: Tc 99m pertechnate Scan - most sensitive investigation
   - Can detect bleeding of 0.1 ml/sec
   Management: Self-limiting.
   - If persistent bleed => Embolisation.
   Definitive management: Diverticulectomy.

6. Bowel Obstruction:
   - MC presentation in adults.
   Obstruction of bowel by Meckel's
   - Can act as a pathological lead point for intussusception - MC method
   - A band from Meckel's to umbilicus
   - Bowel can undergo volvulus around it
Superior mesenteric artery syndrome

- Wilkie's / Cast Syndrome
- Compression of 3rd part of duodenum in between SMA and aorta.
  (SMA - Superior mesenteric artery)
- It is due to loss of angle between aorta & SMA due to loss of fat that maintains the angle.
- @ Angle : 25 - 45°.

Predisposing Factors:
- Rapid weight loss
- Spinal cast
- Anorexia nervosa.
- If the angle is < 20 - 22° D3 gets compressed

Clinical features:
- Bilious vomiting
- H/O weight loss.

IOC: CT - angiography

Management:
- Ask them to gain weight - Nutrition support.
- Strong's procedure: Duodenal derotation procedure

  Cut the ligament of trietz

- Procedure of choice: Duodenojejunostomy.

Ladd's Band

- MC intestinal malrotation abnormality.
Ladd's band runs from right Hypochondrium to caecum

Duodenum gets compressed by this band.

Duodenal obstruction
Management: Excision of Ladd's band.

Adynamic causes of bowel obstruction

1. Hirschsprung disease:
   - RV/RV congenital megacolon.
   - Absence of ganglion cells in both Meissner's and Auerbach's plexus

   Functional intestinal obstruction.
   - Gliol Cell Derived Neurotrophic Factor (GDNF) is implicated.
   - Common in: Down's Syndrome
     - Men an > ab

Clinical features:
- MC Presentation: Non-passage of meconium
- Abdominal distension.

On Examination:
- On Digital rectal examination: Child passes meconium
- Diagnosis: Rectal biopsy - Full thickness
  - Absence of ganglion cells
  - Hypertrophic nerve trunks
  - Immunohistochemistry: Acetylcholine esterase.
  - Manometry can support diagnosis.

- Adults with Hirschsprung → Chronic constipation.
- Extent of the disease → Contrast enema.

Dilated bowel → Normal Transitional Zone
Constricted bowel
Management:

- Surgery
  - Single stage
  - a stage procedure
    - Done if there is massive distension of colon.
      - 1st stage: colostomy
        - Few weeks
      - 2nd stage: definitive surgery

Principles of definitive surgery:
1. Bypass the abnormal segment (or)
2. Resect the abnormal segment.

Procedures:

- Hirschprung
  - Pull through procedures
    - Duhamel
    - Swenson
    - Soave
  - Laparoscopic procedures
    - Minimally invasive georgeson’s procedure.

Best method to find out normal bowel: Intra-operative frozen section from edge

- Look for ganglion cells

Mesenteric ischemia

- Mesenteric ischemia
  - Arterial
    - Non-occlusive mesenteric
      - CHF patients
        - m*: correct CHF
          - papaverine
      - Occlusive mesenteric ischemia
          - AMIE
          - Acute mesenteric artery embolism
          - AMAT
          - Acute mesenteric artery thrombosis
  - Venous
AMAE:
- MC type of mesenteric bowel ischemia
  - Source of emboli: Heart
  - Common in patient with atrial fibrillation
    - MC vessel affected: Superior mesenteric artery
    - Middle colic artery
  - Clinical features: Bowel attack
  - Sudden abdominal pain
  - Ends with peritonitis
  - IOC: CT Angiography

Management of AMAE:

Early (within 4-8 hours)
- Bowel is viable
  - Embolectomy (Fogarty's balloons)

Late with gangrene
- Patient lands up in short bowel syndrome
- Superior mesenteric artery embolism is the MC cause of Short Bowel Syndrome - Overall.

Acute mesenteric artery thrombosis
- Secondary to atherosclerosis of superior mesenteric artery

Clinical features:
- Bowel angina
- Postprandial abdominal pain - starts 10-20 minutes after meals, persist till 1-2 hrs.
- Weight loss
  - IOC: CT Angiography
  - Management: Bypass grafting

Venous: mesenteric venous thrombosis
- Secondary to Virchow's triad
  - IOC: CT Angiography

Management: Anticoagulation
  - Papaverine
  - On imaging: Thumbprint sign
Paralytic Ileus

- Depends on extent of surgery, bowel handing
  - Sepsis
  - Metabolic factors - Uraemia
    - Hypokalemia - MC cause
  - Hypothermia
- MC Segment affected - Ileum.
- Pacemaker of bowel situated at fundus of stomach.
- Last to recover - colon

Management:
- IV fluids
  - Nil per oral
  - Ryle's tube
  - Correct metabolic abnormality
  - CECT - to rule out other causes of obstruction.

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Colonic pseudo-obstruction

- A/K/A Ogilvie's Syndrome.

Causes:
- Patients with neurological conditions - parkinson's disease, Alzhiemers
- Antipsychotic medications
- Retropertoneal hematoma
- Spinal injury

On Examination:
- Features of large bowel obstruction.
- Caecum - Distended or perforated.
  - > 9cm Caecum - Dangerous sign.
- Small bowel - normal with bowel sounds.
- IOC : CECT - done to rule out bowel obstruction.

Management:
- Catchpole regimen - Single shot of IV Neostigmine.
- Colonoscopic decompression.
SMALL AND LARGE BOWEL - BENIGN CONDITIONS

Ileostomy and colostomy

<table>
<thead>
<tr>
<th>Ileostomy</th>
<th>Colostomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any portion can be chosen (entire ileum is mobile)</td>
<td>Transverse colostomy only</td>
</tr>
<tr>
<td>Higher output (ileostomy flux)</td>
<td>Sigmoid colostomy mobile parts of colon</td>
</tr>
<tr>
<td>More fluid and electrolyte imbalance</td>
<td>Semi-solidsolid output</td>
</tr>
<tr>
<td>Output - Liquid in nature higher chances of skin excoriation (liquid irritates skin)</td>
<td>Easier to handle</td>
</tr>
<tr>
<td>Gross appearance - Pouts above the surface of skin (prevents liquid from contacting the skin)</td>
<td>Gross appearance - at the same level as that of skin</td>
</tr>
</tbody>
</table>
Types of stoma

- End stoma
  - One end is taken out
  - After abdominal perineal resection
  - After Hartmann procedure
- Loop stoma
  - Entire loop taken out
- Double barrel stoma
  - Two ends taken out side by side
  - Placement of stoma: Along outer border of rectus abdominis
  - Away from bony landmarks usually along the spinoumbilical line (Line joining the anterior superior iliac spine and umbilicus)

Complication of stoma

1) Earliest complication - Necrosis of stoma.
   a) Fluid and electrolyte imbalance
2) Skin excoriation - mc complication of ileostomy - overall mc early complication for colostomy
3) Stoma obstruction
4) Prolapse
5) Retraction
6) Para. - Stomal herniation - Another loop of bowel herniates from the side
   - mc long term complication
   - Loop colostomy > End colostomy
   - Management - simple suture repair
     - 100% recurrence
     - Mesh repair - preferred
Fecal fistula

High output (> 500cc / 24 hrs )  Low output (< 200cc / 24 hrs )

management:
S - Skin excoriation, sepsis control
N - Nutritional management (TPN)
A - Anatomical delineation (imaging)
P - Planned surgery

<table>
<thead>
<tr>
<th>Favourable Factors: (Fistula undergoes closure)</th>
<th>Unfavourable Factors: (Fistula cannot undergo spontaneous closure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site - • Esophageal, Duodenal stump</td>
<td>• Gastric, lateral duodenal</td>
</tr>
<tr>
<td>• Ileal, pancreatic fistula</td>
<td>• Jejunal fistula.</td>
</tr>
<tr>
<td>Output - Low (&lt; 200cc / 24 hrs)</td>
<td>High (&gt; 500 cc / 24 hrs )</td>
</tr>
<tr>
<td>Sepsis - absent</td>
<td>Present</td>
</tr>
<tr>
<td>Distal obstruction - absent</td>
<td>Present</td>
</tr>
<tr>
<td>Nutrition - Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Defect - &lt; 1cm</td>
<td>&gt; 1cm</td>
</tr>
<tr>
<td>Length of tract - &gt; 1 cm</td>
<td>• Malignancy</td>
</tr>
<tr>
<td></td>
<td>Radiotherapy</td>
</tr>
<tr>
<td></td>
<td>Foreign body</td>
</tr>
</tbody>
</table>
Short bowel syndrome

- < 200 cm of small intestine (SI) - Short bowel syndrome causes
  1) MC - Superior mesenteric artery embolism
  2) Crohn's
  3) Trauma

- C/F - Malabsorption
  - Diarrhea
  - Weight loss
  - Bacterial overgrowth
  - If ileum is not present - ↓ Vitamin B12
  - ↓ Bile salt absorption → diarrhea.

- If large bowel + ileocecal junction is present
  ↓ Absorption to some extent (+)

- If jejunum is removed - Ileum can adapt.

Short bowel syndrome - management

- Total parenteral nutrition
  ↓ Long term

- Small intestine transplant
  ↓ Evolving method

- Drugs
  ↓ Teduglutide
  (GLP - 2 analogue)
  • Cholestyramine
  • Loperamide

  ▼ Bianchi procedure
  ▼ Disadvantage
  • ↓ Lumen
  • Bowel vascularity suffers

  ▼ STEP
  ▼ Serial transverse enteroplasty
Bianchi surgery - procedure

- Open the bowel
- Split the bowel longitudinally into two
- Roll each portion in the form of bowel and end to end anastomosis

Step procedure

- A linear stapler is fired along the mesenteric and anti-mesenteric borders alternatively

  ↓

  Creates zig-zag piece of bowel

  ↓

  ↑ transit time - ↑ absorption

Inflammatory Bowel disease

<table>
<thead>
<tr>
<th>Crohn's disease</th>
<th>Ulcerative colitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Incidence ↑</td>
<td>• 25 - 40 yrs</td>
</tr>
<tr>
<td>• Peak - 20 - 40 yrs</td>
<td>• males &gt; Females</td>
</tr>
<tr>
<td>• 2nd peak - 70 yrs</td>
<td>• Smoking is protective</td>
</tr>
<tr>
<td>• Females &gt; males</td>
<td>• Involves colon - Rectum - Mc.</td>
</tr>
<tr>
<td>• Smoking ↑↑ risk</td>
<td>i) Proctitis</td>
</tr>
<tr>
<td>• Refined diet ↑ risk</td>
<td>pancolitis</td>
</tr>
<tr>
<td>• NOD2 / card is gene</td>
<td>Backwash ileitis</td>
</tr>
<tr>
<td>• It can involve any portion of the GII from oral cavity</td>
<td>• Anal involvement is uncommon</td>
</tr>
<tr>
<td>• Mc. - terminal ileum</td>
<td></td>
</tr>
<tr>
<td>• Relative rectal sparing</td>
<td></td>
</tr>
<tr>
<td>• Anal involvement is common</td>
<td></td>
</tr>
<tr>
<td>(Fissures / fistulae)</td>
<td></td>
</tr>
</tbody>
</table>

Inflammatory bowel disease - Gross differences
<table>
<thead>
<tr>
<th>Crohn's disease</th>
<th>Ulcerative colitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Creeping fat sign</td>
<td>• Only mucosa &amp; submucosa is involved</td>
</tr>
<tr>
<td>• Transmural inflammation (All the layers of bowel are involved)</td>
<td>causes pseudopolyps</td>
</tr>
<tr>
<td>when it heals with fibrosis</td>
<td>• Continuous spread</td>
</tr>
<tr>
<td>Strictures</td>
<td>• crypt abscess</td>
</tr>
<tr>
<td>colovesical / Colovaginal Fistula</td>
<td>• DAIM (Dysplasia associated mucosal lesions) - ↑ risk of cancer</td>
</tr>
<tr>
<td>• Skip lesions present</td>
<td>• Cancer risk - after 8-10 yrs (ulcerative colitis &gt; crohn's)</td>
</tr>
<tr>
<td>• Non-caseating granulomas differential diagnosis</td>
<td>• ↓ Goblet cells</td>
</tr>
<tr>
<td>- Tuberculosis</td>
<td></td>
</tr>
</tbody>
</table>

![Image of Pseudo polyps]
### Inflammatory Bowel disease - Clinical features, diagnosis, management

<table>
<thead>
<tr>
<th>Crohn’s disease</th>
<th>Ulcerative colitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C / F -</strong> mimic acute appendicitis</td>
<td></td>
</tr>
<tr>
<td>Abdominal pain diarrhoea</td>
<td></td>
</tr>
<tr>
<td><strong>Diagnosis -</strong> Biopsy</td>
<td></td>
</tr>
<tr>
<td><strong>Radiological signs -</strong> on barium meal follow through</td>
<td></td>
</tr>
<tr>
<td>↓ <strong>Stricture -</strong> string sign of Kantor (due to stricture in terminal ileum)</td>
<td></td>
</tr>
<tr>
<td>↓ <strong>Aphthous ulcers -</strong> target sign</td>
<td></td>
</tr>
<tr>
<td><strong>Modified montreal classification -</strong> to assess the severity</td>
<td></td>
</tr>
<tr>
<td><strong>Stool calprotectin -</strong> marker of Crohn’s</td>
<td></td>
</tr>
<tr>
<td><strong>Management -</strong> medical</td>
<td></td>
</tr>
<tr>
<td>Steroids - enema, oral, intravenous (rapid remission/control)</td>
<td></td>
</tr>
<tr>
<td><strong>S-ASA derivatives</strong></td>
<td></td>
</tr>
<tr>
<td>Azathioprine - steroid sparing effect</td>
<td></td>
</tr>
<tr>
<td>Infliximab - for perianal disease in Crohn’s</td>
<td></td>
</tr>
<tr>
<td>Vedolizumab - integrin</td>
<td></td>
</tr>
<tr>
<td><strong>Surgical management -</strong> conservative resection</td>
<td></td>
</tr>
<tr>
<td><strong>Indications -</strong> complications like strictures, perforation, fistulae</td>
<td></td>
</tr>
<tr>
<td>1. <strong>Toxic megacolon</strong></td>
<td></td>
</tr>
<tr>
<td>2. <strong>Cancer</strong> (radical resection)</td>
<td></td>
</tr>
<tr>
<td><strong>C / F -</strong> bloody diarrhoea</td>
<td></td>
</tr>
<tr>
<td><strong>Diagnosis -</strong> Biopsy</td>
<td></td>
</tr>
<tr>
<td><strong>Risk of toxic megacolon is higher</strong></td>
<td></td>
</tr>
<tr>
<td>↓ if diameter is &gt; 6 cm in large bowel</td>
<td></td>
</tr>
<tr>
<td>↑ <strong>Chances of rupture</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Severity of disease</strong></td>
<td></td>
</tr>
<tr>
<td>1. Mild – &lt; 4 stools per day, no systemic signs</td>
<td></td>
</tr>
<tr>
<td>2. Moderate – &gt; 4 stools/day, no systemic signs</td>
<td></td>
</tr>
<tr>
<td>3. Severe – &gt; 6 bloody stools/day with systemic signs</td>
<td></td>
</tr>
<tr>
<td>4. Fulminant – &gt; 10 stools with toxic megacolon</td>
<td></td>
</tr>
<tr>
<td><strong>Indications for surgery</strong></td>
<td></td>
</tr>
<tr>
<td>1. Steroid side effects +</td>
<td></td>
</tr>
<tr>
<td>2. Not responding to medical management</td>
<td></td>
</tr>
<tr>
<td>3. Complications + surgery - Total proctocolectomy followed by IPAA (ileo-anal pouch anastomosis) J-shaped ileal pouch is anastomosed with anal canal</td>
<td></td>
</tr>
<tr>
<td><strong>Complications of surgery</strong></td>
<td></td>
</tr>
<tr>
<td>1. Pouchitis (MC) - managed conservatively</td>
<td></td>
</tr>
<tr>
<td>2. Small bowel obstruction (MC) complication associated with mortality</td>
<td></td>
</tr>
</tbody>
</table>
| All extraintestinal manifestations resolve after surgery except primary sclerosing cholangitis, ankylosing spondylitis
Diverticular disease of colon

- MC Site: Sigmoid colon
- False diverticula
- Only mucosa forms the diverticula
- Comes out through mesenteric border

Diverticulosis:
- 4th or 5th decade of life
- Associated with constipation
- Clinical features: Constipation, Abdominal pain
- Complications
- IOC: Barium enema (saw tooth appearance)
- Management: Laxatives, manage complications, increase risk of cancer.

Complication of diverticular diseases

1. Bleeding:
- MCC of massive lower GI haemorrhage
- Right side diverticula bleeds more commonly
- Management: Angioembolization or resection
a. Diverticulitis:
Hinchey Classification:
I - Pericolic abscess
II - Pelvic abscess
III - Purulent peritonitis
IV - Fecal peritonitis
- Clinical features: Abdominal pain, fever, diarrhoea ↑, TLC
- IOC: CECT
- management:
  - Pericolic abscess
    <5cm
    Antibiotics
    >5cm
    Pigtail drainage
- Purulent & faecal peritonitis - Hartmann procedure
- Diverticulitis can also give rise to Colovesical/Colovaginal fistula.

Angiodyplasia:
- Dilated submucosal veins.
- And most cause of massive lower GI haemorrhage
- Seen in elderly
- Right colon > left colon
- MC in Caecum
- Diagnosis: Colonoscopy/capsule endoscopy.

Lower gastrointestinal hemorrhage

- management - IV Fluids
  ↓
  stabilise
  ↓
  Colonoscopy
  ↓
  Before colonoscopy - rule out Local causes
  ↓
  if colonoscopy negative
  Suspect - if upper GI hemorrhage
    leading to Lower GI hemorrhage
    ↓
    Done - using NG Tube, Upper GI endoscopy
    if positive
    ↓
    if negative
  if colonoscopy positive
  cauterize the vessel
Bowel tuberculosis (TB)

<table>
<thead>
<tr>
<th>Ulcerative TB</th>
<th>Hyperplastic TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>• due to weak immune response</td>
<td></td>
</tr>
<tr>
<td>• Mc site – terminal ileum</td>
<td></td>
</tr>
<tr>
<td>• Ulcers in Typhoid horizontal causes strictures lead to Bowel obstruction</td>
<td></td>
</tr>
<tr>
<td>in Typhoid longitudinal causes perforation</td>
<td></td>
</tr>
<tr>
<td>If there is strong immune response</td>
<td></td>
</tr>
<tr>
<td>C/F -</td>
<td></td>
</tr>
<tr>
<td>• Mass in right iliac fossa</td>
<td></td>
</tr>
<tr>
<td>• Weight loss</td>
<td></td>
</tr>
<tr>
<td>• Obstruction Differential diagnosis – cecal cancer</td>
<td></td>
</tr>
</tbody>
</table>

Radiological signs:

Capsule Endoscopy

- Normal angle in ileocecal junction – Acute
- In ileocecal junction TB – the cecum is pulled up – Causes obtuse angle
- Goose neck deformity - pulled up cecum + stricture at terminal ileum because of stricture - Proximal ileum - dilated
- Sterlein sign - Narrowing of terminal ileum
- Fleischner sign / inverted umbrella sign - Thickening of ileum
- Diagnosis - Colonoscopic biopsy - to rule out cancer
- Management - Anti tuberculoid therapy
  - if Lump persists / obstruction - Right hemicolectomy

Tuberculosis in abdomen

- mesenteric lymph node enlargement
- Ascites
- pyoperitoneum
**RECTUM AND ANAL CANAL**

**Digital Rectal Examination (DRE)**

- **most common position**: Left Lateral / Sims' position
  - In adults → right index finger
  - In children → little finger

- **External inspection**:
  - External hemorrhoids
  - Fistula openings
  - Skin tags
  - Acute anal fissure: contraindication for DRE

![Diagram of rectum and anal canal]

- 1st finger along posterior wall → Sacral hollow and 1st finger along Anticlockwise → lateral wall at 3′O clock position → anterior wall → prostate (males), cervix and pouch of Douglas (POD)
- 3rd finger in Clockwise → to check the lateral wall at 9′O clock position

- check for blood staining after DRE
- Anoscope and proctoscope

---

Surgery • v2.0 • Marrow 4.0 • 2020

Scanned with CamScanner
- sigmoidoscope: 60 cm

**Sigmoidoscope**

- colonoscope: 110 - 140 cm
  up to caecum can be examined

**Anatomy of rectum and anal canal**

- Rectum: 12-14 cm
- Mucosal folds: Houston's valve
- Upper and lower part of rectum: convex towards right
- Middle part: convex towards left
- Lower rectum is not covered with peritoneum.
- Below dentate line: pain can be felt
- External > internal sphincter maintains continence
Rectal prolapse

- Partial thickness prolapse
  - Mucosal prolapse
  - Common in children
  - Due to an underdeveloped sacral curve
  - Seen after bouts of diarrhoea
  - Management
    - 1st episode: digital reposition
    - Recurrent: Sclerotherapy, Thiersch wiring

- Full thickness prolapse
  - All layers involved
  - Starts as a rectal intussusception
  - Involves anterior wall
  - If > 5 cm in length, fold of peritoneum can be felt anteriorly by DRE
  - Commonly, females > males
  - Elderly
  - Management:

  Surgery

  - Perineal approach
    - Easier to perform
    - Less operative complication
    - High recurrence rate
    - Frail, elderly patients
    - Eg: Thiersch wiring
    - Delorme repair
    - Altemier repair
    - (Perineal rectosigmoidectomy)

  - Abdominal approach
    - Technically demanding
    - More operative complications
    - Least recurrence rate
    - Young, fit patients
    - In young males, mobilization of rectum from sacrum causes injury to sacral nerves
    - Impotence
    - Eg: Well's and Ripstein rectopexy
    - Frykman-Goldberg - Resection rectopexy
• Complications of abdominal approaches:
  - most common: constipation
  - impotence
  - mesh can erode into rectum
  - recurrence

• RED: Rectal evacuation disorder
  - starting point of rectal prolapse
  - starts as intussusception
  - evaluated by defecography

• SRUS: solitary rectal ulcer syndrome
  - ulcer in anterior wall
  - around 8 cm from anal verge
  - biopsy to rule out cancer.
  - management: STARR procedure
    stapled Transanal rectal resection of
    intussusception

Anorectal malformations

• If anorectal malformations are present, look for

  vertebral defects
  Anal atresia
  Cardiac defects
  Tracheo-
  Esophageal abnormalities
  Renal anomalies
  Limb abnormalities

• Investigation: Invertogram
  - Done around 24 hours
  - child is inverted
  - metallic marker is placed at
    anal opening
  - distance between tip of gas
    and metallic marker

  < 2cm  > 2cm
  Low anorectal malformation  High anorectal malformation.

• Investigation of choice in anorectal malformation: MRI
- Most common abnormality:
  in males → Rectobulbar fistula
    if fistula with bladder neck, then outcome is poor.
  in females → Rectovestibular fistula
- Other examples:

<table>
<thead>
<tr>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perineal fistula</td>
<td>Perineal fistula</td>
</tr>
<tr>
<td>Rectourethral fistula</td>
<td>vestibular fistula - MC</td>
</tr>
<tr>
<td>Rectobulbar - MC</td>
<td>Persistent cloaca</td>
</tr>
<tr>
<td>Prostatic fistula</td>
<td></td>
</tr>
<tr>
<td>Rectovesical fistula</td>
<td>Imperforate anus</td>
</tr>
<tr>
<td>Imperforate anus</td>
<td>Rectal atresia</td>
</tr>
<tr>
<td>Rectal atresia</td>
<td></td>
</tr>
</tbody>
</table>

- Based on level of anomaly:
  High → Fistulae
  Intermediate → Anal atresia
  Low → Anal atresia
- Management of anorectal malformations:

  Low anomalies → High anomalies →
  Colostomy →
  Definitive surgery →
  PSARP: posterior sagittal Anorectoplasty (Pena)
Pilonidal sinus

- Also called as Jeep driver's disease / bottom.
- Seen in hairy men
- Most common site: natal cleft
- Clinical feature: sinuses in midline natal cleft
  - pus
  - abscess
- Management: Antibiotics
  - If pus → drain abscess
  - To reduce recurrence: Trim hair definitive surgery
- Definitive surgery
  - Rhomboid / Limberg flap
- Kardyakis surgery
Hemorrhoids

- Also known as piles
- Most common cause for bleeding per rectum
- Due to bleeding from dilated vascular channels
- Pathology - Loss of elasticity of anal cushions
  (Failure to retract)
- Sites of primary hemorrhoids

11 '0' clock

3 '0' clock

7 '0' clock

- Secondary hemorrhoids - occurs in between the sites of 11'

- Clinical features:
  - Constipation
  - Painless bleeding P/R --> painful in

  External hemorrhoids --> Thrombosed piles

- Thrombosed pile
- Also called as Melgey 5 day self healing lesion
- Painful
- Reddish/Bluish nodule
- Only hemorrhoids to be felt on DRE.
- Management

Acute setting
Incision and evacuate clot

Conservative
- Antibiotics
- Pain control

Later, definitive surgery

- Investigation of choice: proctoscopy
- Grades of hemorrhoids
  1. only bleed; don't prolapse
  2. prolapse but spontaneously reduce
  3. prolapse but have to be pushed inside
  4. Remain prolapsed

Management of hemorrhoids

- Management depends on grade of hemorrhoids
  1: Lifestyle changes - Avoid Fried / Fatty food
     High fibre diet
     Liquid intake
  
  Laxative
  Sitz Bath
  
  2: Lifestyle changes + Banding > sclerotherapy
     - Sclerotherapy: most common agent: sodium tetradecyl SO4
      Injected in the submucosal plane at the apex above dentate line - causes fibrosis - hemorrhoids pulled up
     - Banding: Rubber bands around pile in 7 - 10 days, mass sloughs out

  III: II + surgery
  IV: surgery

- Indication for surgery
  1. III, IV haemorrhoids
  2. Grade II which does not respond to banding / sclerotherapy
  3. Thrombosed pile

- Surgeries:
  1. Open hemorrhoidectomy / Milligan Morgan hemorrhoidectomy
3. Procedure of choice: stapled haemorrhoidopexy
   - Hemorrhoids are pulled up using a circular stapler
   - Purse string suture applied above the dentate line
   - Circular stapler applied above it
   - Stapler cuts a portion of mucosa, and it hitches up the hemorrhoids

4. OSHL / HALO: Haemorrhoidal artery ligation operation

- Complications of surgery
  - Most common - urinary retention
  - Reactonary hemorrhage
  - Pain
  - Incontinence
  - Stenosis
  - Recurrence
- Complications of haemorrhoids
  - Thrombosis
  - Fibrosis
  - Ulceration
  - Gangrene
  - Portal pyemia
Anal fissures

- Breach in continuity of anal epithelium
- Most common: 1. posterior midline - 6 o'clock (ischemia)
  a. anterior midline - 12 o'clock (following vaginal delivery)

- Clinical features:
  - Painless bleeding P/R
  - Constipation
  - Hard stools

- Chronic anal fissures are associated with a skin tag / sentinel pile

- Investigation of choice: External inspection

- Management:
  - Lifestyle changes
  - Laxative
  - Sitz bath
  - Local application of 2% xylocaine jelly

- Nitrate gel
  - Relaxes the sphincter
  - Common side effect: headache

- Inj Botox

- Surgery
  1. Lateral anal sphincterotomy
     - Internal sphincter: pearly white circumferential fibres
     - Complications: Incontinence
  2. Anal advancement flap
     - Usually done in females with low anal tone and anterior fissures
Perianal fistulae

- Occurs secondary to anal sepsis
  At level of dentate line
  Anal glands get infected
  perianal abscess: Incision and drainage (cruciate incision)

  Abscess not drained properly, spontaneous rupture

  Perianal Fistula

- Clinical features
  - pus discharge P/R, staining of undergarment
  - pain
  - multiple perianal fistulae: watercan perineum

- Conditions causing watercan perineum
  1. Crohn's disease (Krohn's)
  2. Trauma (Krush)
  3. TB (Hoch's)
  4. Cancer (Kancer)
  5. Immunocompromised

- on examination,
  - external inspection → see external opening
  - CRE → feel the tract and internal opening

- Good's rule

  External opening II

  10 clock Anterior

  8 o clock

  6

  4 o clock

  Posterior

- Exception: Not applicable if external opening > 3cm from anal verge

Surgery • v2.0 • Marrow 4.0 • 2020
- Investigation of choice: MR Fistulogram.
- Park's classification for perianal fistula.

1. Intersphincteric (most common)
2. Transsphincteric
3. Suprasphincteric / supralevator
4. Extrasphincteric (due to trauma)

Management of perianal fistulae

- Based on level of opening
  - High Fistula
    - above anorectal ring
    - Seton treatment
  - Low Fistula
    - below anorectal ring
    - Fistulotomy,
      - Fistulectomy,
      - LIFT,
      - VAFT.

- Fistulotomy - track is laid open
- Fistulectomy - entire tract is removed

- Fistulotomy / Fistulectomy is not done for anteriorly placed fistulae. They are done for intersphincteric and transsphincteric fistulae.
- LIFT: Ligation of fistulous tract
  - sphincter sparing procedure for transsphincteric fistulae
  - incontinence does not develop
- VAFT: video assisted fistula therapy
  - plug / glue (cyanoacrylate) are used to fill the fistulous tract
management of high perianal fistulae:
- seton treatment

- a thread (seton) passed through fistulous tract
- it is then tightened in serial intervals
- seton gradually cuts the tract

- seton types
  - draining seton
  - crohn's disease
  - multiple fistulae
  - cutting seton

- strawberry lesion of rectosigmoid
  - infection by spirochaeta or b. fusiformis
  - bloody diarrhoea
  - sigmoidoscopy: multiple areas of oozing
  (resembles over - ripe strawberry)
COLORECTAL POLYPS AND CANCER

Surgical anatomy of large bowel

Superior mesenteric artery
Splenic flexure: Griffith point
(Watershed junction)
Most common site for ischemic colitis
Marginal artery of Drummond
Arc of Riolan
Left artery
Sigmoid artery
Superior rectal artery
Sudek point: Rectosigmoid
(Watershed area)

Polyps: Hamartomatous polyps

- Polyps:

Inflammatory
Pseudopolyps
(Ulcerative colitis)

Hyperplastic
Polyps

Adenomatous
Polyps
- Tubular
- Tubulo-villous
- Villous

Hamartomatous
Polyps
- Single juvenile polyp
- No risk of cancer.
- Juvenile polyposis
Syndrome, SMAD 4 gene
- ↑ risk of cancer.
- Peutz Jegher syndrome
- Multiple hamartomatous
- Polyps in arborizing pattern
- Periportal melanosis +
- Most common presentation-obstruction
Increased risk of
cancers: Pancreatic cancer (100% risk),
perianpillary cancer,
colorectal cancer, thyroid cancer, duodenal
adenocarcinoma.

Surgery • v2.0 • Marrow 4.0 • 2020
- STK-11 / LKB-1 gene
  on chr : 19
- site : jejunum
  - Cowden syndrome
    AD (autosomal dominant)
    PTEN gene mutation on chromosome 10
  - GI polyps are not premalignant
    associated with skin lesions increased risk of breast, thyroid and uterine cancer
  - Myhre Smith syndrome
  - Cronkhite-Canada Syndrome
  
  - Cronkhite-Canada Syndrome
    - Multiple GI polyps
    - Polyps are not premalignant
    - Ectodermal dysplasia
      - Alopecia
      - Koliornychia
    - Bloody diarrhoea, anaemia.

**Warning:** Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

**Polyps : adenomatous polyps**

- Tubular polyps
- Villous polyps
- Tubulovillous polyps

- Premalignant: ↑ risk of colorectal cancer.
  - Larger the size
  - More the number
  - Sessile > pedunculated
  - Villous > tubular

- Villous polyps in rectum leads to hyponatremia, acidosis, hypalbuminemia.
- Haggitt classification

Apex (0) non invasive
Head (1) invading the muscularis mucosa.
Neck (2)
Stalk (3)
Base (4) invading submucosa.

Till level 2 → Endoscopic resection of polyp Transanal polypectomy
In case of pedunculate polyp- Snare polypectomy
Sessile polyp - Infiltrate saline below polyp
Adenoma, carcinoma, sequence (classical pathway)
By-vogelstein
- Normal epithelium
  - First /initial hit in APC gene on chromosome 5
    - Early adenoma.
  - KRAS gene
    - Intermediate adenoma
  - Late adenoma
    - Final/late hit in P53 gene
    - Carcinoma
Alternate pathway- mismatch repair gene (MSH 9/MLH gene are implicated)

Familial adenomatous polyposis coli syndrome

Autosomal dominant
Chromosome 5- APC gene
>100 adenomatous polyps in colon (Attenuated FAP<100 polyps)

Mutation present
Screening-benefit modality
When polyps develop- perform IPAA
• On endoscopy,

• 100% risk of colorectal cancer
• Diagnosis : Colonoscopy
• Management : Total proctocolectomy followed by IPAA (ileo - anal pouch anastomosis.)

  → Gardner syndrome : features of FAP
  variants
  sebaceous Cysts osteomas
  (mandible) desmoid tumors
  (soft tissue Sarcoma over
  anterior abdominal
  wall)

  → Turcot syndrome : features of FAP
  CNS tumors : glioblastoma
  multiforme (adults)
  medulloblastoma (children)

• Associated with : CHRPE - Congenital hypertrophy of retinal pigment
  epithelium.
  Hepatoblastoma.

• Genetic counselling - 1st degree relatives

  ↓
  APC gene testing

  ↓
  mutation Θ
  screening : from 10y
  best modality : Colonoscopy / sigmoidoscopy
  same risk as general
  population

  ↓
  mutation Θ
  same risk as general
  population

- If no polyps by 30 years - risk of FAP reduces
HNPCC (Hereditary non polyposis colonic cancer) - mutation of mismatch repair gene (MSH2/MLH1) mc
- These genes show micro satellite instability (MSI)

Detected by Bethesda classification
- A/K/A Lynch surgery

Lynch I Lynch II

Increased risk of colorectal
Extra colonic cancer
uterine cancer- MC
Pancreatic cancer ovarian
cancer gastric carcinoma.

Diagnosis
modified Amsterdam Criteria

1. Rule-out FAP
2. Atleast 3 family members should be affected.
3. Atleast 2 successive generations should be affected.
4. Atleast 1 should be first degree relative.
5. Atleast 1 should be diagnosed before 50 years.

<table>
<thead>
<tr>
<th></th>
<th>FAP</th>
<th>HNPCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor initiation by APC gene</td>
<td>Accelerated</td>
<td>Normal</td>
</tr>
<tr>
<td>Tumor progression by p53 gene</td>
<td>Normal</td>
<td>Accelerated</td>
</tr>
</tbody>
</table>

Colorectal Cancers

- Risk factors
  - Alcohol
  - High fat diet
  - Red meat
  - IBD (UC > crohn's)
  - diverticular disease
  - Post cholecystectomy
  - Ureterosigmoid anastomosis (100% risk)
  - Adenomatous polyps
  - Syndromes
  - Selenium deficiency

- Protective factors
  - NSAIDS
  - Selenium supplementation
  - High fibre diet
Gastrointestinal System

- Screening
  1) Best modality: Colonoscopy (100-140cm), every 10 years
  2) Sigmoidoscopy: 60cm, every 5 years
  3) FOBT (Fecal occult blood testing), every year.
  4) To be started in normal population: 50 years
     High-risk: 10y before diagnosis of youngest relative

4) Virtual colonoscopy: CECT followed by 3D reconstruction.

- Very sensitive in detecting lesions > 6mm in size

<table>
<thead>
<tr>
<th></th>
<th>Conventional colonoscopy</th>
<th>Virtual colonoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Faster</td>
<td>-</td>
</tr>
<tr>
<td>Muscle details</td>
<td>Better</td>
<td>-</td>
</tr>
<tr>
<td>Extramucosal details</td>
<td>-</td>
<td>Better</td>
</tr>
</tbody>
</table>

Clinical Features

<table>
<thead>
<tr>
<th>Right sided colorectal cancer</th>
<th>Left sided colorectal cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulcerative lesion-bleed-iron deficiency anemia</td>
<td>mc site- Rectum&gt; rectosigmoid</td>
</tr>
<tr>
<td>Alteration of bowel habits-Late onset.</td>
<td>Alteration of bowel habits-Early onset- Increased frequency Tenesmus</td>
</tr>
<tr>
<td>Obstruction- late feature.</td>
<td>Obstruction- early feature</td>
</tr>
<tr>
<td></td>
<td>Apple core deformity present</td>
</tr>
</tbody>
</table>

- IOC for diagnosis: Colonoscopic biopsy.
- 4-5% colorectal cancer - Synchronous cancer/ Field cancerisation.
- IOC for staging: PET CT.
- IOC for TNM stage of rectal cancer- MRI with Endorectal coil.

Colorectal cancers: staging

- TNM staging: 8th AJCC classification

Tis: Carcinoma in situ
T1: invades submucosa (above muscle layer)
T2: invades muscle layer
T3: invades through muscle layer to connective tissue
T4a: invades through peritoneum
T4b: invades any other structure
N1: 1-3 nodes
N2: 4 or more nodes
M1a: 1 organ or site without peritoneal mets / non - regional lymph nodes
M1b: 2 or more organs or sites without peritoneal mets
M1c: multiple organs / peritoneal metastasis
- Minimum lymph nodes required for TNM staging = 12 nodes

- Dukes staging / modified Astler coiler classification
  A  B  C  D  → distant metastasis
  B1  B2  C1  C2

  mucosa
  submucosa
  muscle layer
  serosa

  LN+  LN+

5 year survival rate:
A: 90%  B: 60-70%  C: 30%  D: <30%

Rectal Cancers: Management

- Principles:
  1. Proximal margin → 5 cm
  2. Distal margin → 2 cm
  3. Radial margin → 5 cm

Rectum
- Anal canal
  >5-5.5 cm
  within 5 cm
  Anorectal ring
  a-2.5
  Dentate line
  a-2.5
  Anal verge
LAR
if >5-5.5cm above the anal verge resection of rectum below peritoneal reflection (lower 1/3rd of rectum)
Low Anterior resection
- Removal part of Sigmoid colon & rectum
Colo-anal anastomosis (Circular stapler)

Total mesorectal excision (TME) by Heald
- because LN@ in mesorectum

APR
- Abdomino- perineal resection
- Removal of rectum and anal canal
- Permanent end colostomy

• Ta TME - Trans anal TME
  - Example of NOTES: natural orifice transluminal endoscopic surgery
  - In T1 and some T2 tumors

Surgery:
1. Tumour in caecum-Right hemicolectomy
   (13-15 cm of terminal ileum + caecum + ascending colon + hepatic flexure + go beyond right branch of middle colic arteries)
2. Tumor in ascending colon/hepatic flexure/transverse colon
   Extended Right hemicolectomy (resection beyond splenic flexure)
   Followed by ilio-colic anastomosis.
3. Tumor in splenic flexure/descending colon
   Left Hemicolectomy
   (From beyond right branch of middle colic arteries to sigmoid with high ligation of inferior mesenteric artery)
4. Tumor in Sigmoid colon
   Low anterior resection
   - Laparoscopic surgery has faster recovery and less pain compared to Open surgery.
   - No difference in oncological outcome.
   ERAS - Enhanced Recovery After Surgery Protocol
   - Presurgical carbohydrate loading
- Adequate hydration and pain control
- Avoid NG tube / Drain
- Early mobilisation
- Early initiation of feeding

Chemotherapy:
- Included in LN + disease.
- T3/T4 lesion.
- FOLFOX = 5FU, Oxiplatin, Folinic Acid.
- FOLFIRI = 5FU, Folinic acid, Irinotecan
- CAPEOX = Capecitabine, Oxiplatin
- Radiotherapy: only for Rectal cancer
- Chemotherapy can be given
  - In neoadjuvant setting - * short course for 5-6 days followed by surgery.
  - * Long course down staging for weeks; wait for 6 weeks before surgery.
- Intracavity radiotherapy / Papillon technique / Contact Radiotherapy

PS: Signet ring cell in Rectal Ca. biopsy - Poor outcome
- Immunotherapy: used for metastatic colorectal cancer.
  - Bevacizumab - monoclonal Ab agonist VEGF
  - Cetuximab - monoclonal Ab agonist EGFR
  - Panitumumab - monoclonal Ab agonist EGFR
  - Pembrolizumab, Nivolumab - PD1 inhibitor (used in patients with high MSI)

- mCC of death in colorectal cancer - liver mets
- Most common site for distant metastasis → Liver
  - Metastatectomy improves survival.
    Irrespective of number of mets if FLR (Functional Liver Reserve) > 25%

- Most important prognostic factor: Lymph node status > stage
Anal Carcinoma

- Anal SCC
  - Risk Factors: HPV

- Anal Adenocarcinoma
  - Majority managed like rectal Ca

- Anal SCC
  - Risk Factors: HPV
  - Diagnosis: biopsy
  - Management: Nigro regimen for 1 month
    - Combined chemoradiation
      - 5FU + Mitomycin C / Cisplatin
      - If tumor completely resolves: monitor
        - Recurrence (20-30%)
      - Residual tumors: Surgery APR

Inguinal LN gets enlarged in anal cancer

Note:
1. Colorectal cancer patient can come to emergency with obstruction:
   - Hartmann procedure, Paul Mikulicz operation (proximal colostomy + take out distal mucus fistula)
   - Resection and anastomosis
   - Stents
2. CEA - Tumor markers for colorectal cancer
APPENDIX

Surgical anatomy of appendix

- **most common** - Retrocecal
  and most common - Pelvic
  Least common / most difficult to diagnose - post-ileal

- **Appendicular artery** - Branch of lower division of ileocolic artery
  - End artery
  - Lies in the mesoappendix except at apex
    Terminal part prone to thrombosis
    Perforation is most common at apex

- **Accessory appendicular artery** - Artery of Seshachalam
  - Branch of posterior caecal artery

- **Appendix** → Base has a constant location
  At the junction of 3 taenia coli

### Acute appendicitis: Etiology

- **Acute appendicitis**
  - **Obstructive**
  - Catarrhal (Non-obstructive)
    Common in children
- Obstructive appendicitis
  - Lumen gets obstructed
    \[ \uparrow \text{Pressure in lumen} \]
    \[ \downarrow \text{lymphatic blockade} \rightarrow \text{venous blockade} \]
    \[ \downarrow \text{Arterial compromise} \]
    \[ \downarrow \text{Perforation} \]

- Most common cause of obstruction: 
  *Calcium* (CaPO₄)

Others courses:
- Ascariasis
- Foreign body
- Carcinoid tumor

**Acute appendicitis: clinical features**

- Rare in infants
  - Common in children (male = female)
  - Max incidence: Teenage (male > female)
  - Can be seen in adults also

- **MANTRELS scoring system / modified Alvarado score**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration of pain</td>
<td>1</td>
</tr>
<tr>
<td>Anorexia</td>
<td>1</td>
</tr>
<tr>
<td>Nausea and vomiting</td>
<td>1</td>
</tr>
<tr>
<td>Tenderness</td>
<td>a</td>
</tr>
<tr>
<td>Rebound pain</td>
<td>1</td>
</tr>
<tr>
<td>Elevated temperature</td>
<td>a</td>
</tr>
<tr>
<td>Leukocytosis</td>
<td>1</td>
</tr>
<tr>
<td>Shift of white blood cell count to the left</td>
<td>1</td>
</tr>
</tbody>
</table>

Total: 10

- If score < 5 \[\rightarrow\] unlikely
- 5 or 6 \[\rightarrow\] possible
- 7 or 8 \[\rightarrow\] likely
- 9 or 10 \[\rightarrow\] highly likely
- Other scoring systems: Tzanakis score
  Ripasa score

- Symptoms: anorexia.
  fever (late / uncommon)

- Signs
  - Tenderness at McBurney's point
  - Rovsing sign: Pressure on left iliac fossa → pain in right iliac fossa
  - Psoas sign / Cope psoas test - Hyperextension of right hip
    or
    - Flexion of right hip against resistance
      ↓ Pain
  - Obturator sign - Flexion and internal rotation of right hip
    ↓ pain

- Non specific signs:
  - Dunphy sign - pain on coughing
  - Ten horn sign - pain on pulling right testis
  - Aaron sign - Form pressure in right iliac fossa → pain in epigastrium

- Signs of appendicitis based on location
  - Retrocecal appendicitis
    - Psoas sign
    - Patient can keep his right leg in flexion.

  - Pelvic appendicitis
    - Irritate rectum: pelvic diarrhoea
      tenesmus
    - Irritate bladder: ↑ frequency of micturition
    - Pain on digital rectal examination

  - Post-ileal appendicitis
    - Hardly any signs elicited
    - Slight pain on deep pressure
Differential diagnosis of acute appendicitis

- Infants and children
  - *Yersinia* : mesenteric adenitis
    - fever is common
  - Intussusception
  - Bowel obstruction
  - Ureteric colic
  - Meckel's diverticulitis

- Adult
  - Ureteric colic
  - Gastroenteritis
  - Bowel obstruction
  - Torsion

- Adult females
  - Mittelschmerz : mid-cycle ovulatory pain
  - Endometriosis
  - Pelvic inflammatory disease
  - Ectopic pregnancy

- Elderly
  - Diverticulitis
  - Ureteric colic
  - Obstruction

- Investigation of choice
  - in adults : CECT
  - In children : USG → elongated tubular structure
    - non compressible
    - blind ending
    - probe tenderness
    - free fluid
    - Diameter > 6 mm

![USG: Appendicitis](image)
Management of acute appendicitis

- **management** - Appendicectomy
  - Open
  - Laparoscopic

- **incision in open appendicectomy**
  - McBurney incision
    - Grid iron incision (muscle splitting)
    - (Emergency appendicectomy)
  - Lanz inclusion / skin crease / bikini incision
    - (Interval appendicectomy)
  - Rocky-Davis incision
  - Lower midline incision - appendicular perforation

- **steps**
  - Identify base of appendix - junction of 3 taenia coli
  - If appendix not inflamed, search last 2 feet of ileum
    - For inflamed Meckel's diverticulum
  - If appendix is inflamed:
    - Stump of appendix < 4-5 mm
    - If long stump - stump appendicitis
  - If base is inflamed
    - Bury the stump
    - (Do not crush the base)
    - Purse string suture
    - Z-stitch
  - If base is gangrenous and cecal wall is gangrenous - **Right hemicolectomy**

- **Appendicitis in Crohn's disease**
  - If Crohn's disease is controlled: Appendicectomy
  - If active Crohn's disease: conservative management

- **in laparoscopic appendicectomy**
  - 3 trocars: infraumbilical
    - Hypogastric
    - Left iliac fossa

**Complications of appendicectomy**

1. Hemorrhage
2. Injury to iliohypogastric nerve: increased - incidence of right inguinal hernias.
3. Wound infection (most common)
4. Fecal Fistula
5. Portal pyaemia
6. Stump appendicitis
7. Adhesive intestinal obstruction (most common long term complication)
Appendicular perforation

Conditions where perforation can occur:-
1) Infants, children: omentum not fully developed
2) Elderly: vessels of omentum atherosclerosed
3) Pregnancy
4) Adhesions
5) Immunocompromised

- Appendicitis - most common extrauterine abdominal emergency in pregnancy
  - Pain is felt slightly above McBurney point
  - If perforation occurs → high chance of fetal loss.

Appendicular lump

- Late presentation, bowel becomes adherent → appendicular lump.
- Management: Ochsner Sherren Regimen
(Conservative management of appendicular lump)

- Treatment
  1. NPO
  2. IV Fluids
  3. IV Antibiotics
     (For aerobes + anaerobes)
     mc: Bacteroides
  4. Pain Killers

- Monitor
  1. Vital signs
  2. Temperature
  3. Size of lump
  4. Tenderness

- Outcomes
  - Patient recovers
    - ↓ pain
    - ↓ size of lump
    - ↓ fever
    - Discharge on 3rd - 4th day
    - After 6: Interval / Elective weeks appendicectomy
  - Does not respond
    - ↑ size of lump
    - ↑ pain
    - Fever → Spikes
    - Appendicular abscess
    - Discontinue the regimen
    - Extraperitoneal drainage of abscess
Appendicular tumors

- most common: carcinoid tumor (Appendix most common site)
- most common malignant appendicular tumor → mucinous adenocarcinoma
- management of appendicular carcinoid:
  - if tumor < 2 cm in size & > 2 cm from base \rightarrow \text{simple appendicectomy}
  - if tumor > 2 cm in size or < 2 cm from base \rightarrow \text{Right hemicolecotomy}

- mucinous adenocarcinoma
  - diagnosis: imaging and HPE
  - management: right hemicolecotomy followed by chemotherapy

Pseudomyxoma peritonei

- Jelly like deposition in peritoneal cavity \rightarrow \text{locally invasive}

- Tumors that can give rise to pseudomyxoma peritonei
  1. Primary peritoneal tumors
  2. Secondary to adenocarcinoma of appendix
  3. Secondary to mucinous adenocarcinoma of ovary

- Clinical features
  - Abdominal distension
  - Bowel obstruction
  - Clumped up omentum or caking of omentum

- Diagnosis: Omental biopsy

- Staging - PET CT

- Management
  - R₁ / R₂ resection
    - Cytoreductive surgery (CRS)/
      - Debulking surgery
    - CRS includes: Appendicectomy or Right hemicolecotomy
      (based on the condition of appendix)
      - In females \rightarrow \text{TRH + BSO}
      - Omentectomy
      - Peritonectomy
- HIPEC: Hyperthermic intraperitoneal chemotherapy
  - Administered during surgery
  - Paclitaxel + mitomycin C at 41 - 44°C
- Systemic chemotherapy
  - Paclitaxel + Carboplatin
Surgical anatomy of liver

Functional anatomy - Couinaud

- Middle hepatic vein - MHV
- Left hepatic vein - LHV (lies beneath falciform ligament)
- LPV - Left portal vein
- RPV - Right portal vein

Recent questions on liver anatomy

- Couinaud division in based on hepatic vein and portal veins
- Major fissures: Hepatic veins - 3 major fissures
  - Minor fissures: 3
    - RPV fissure
    - LPV fissure
    - Fissure of Gans

Sectors in the liver - 4
  1) Right posterior
  2) Right anterior
  3) Left medial
  4) Left lateral

Fossa segment 4B is removed in radical cholecystectomy for gall bladder cancer.

Segment 7 - right posterolateral segment - bare area of liver
  - MC site for amoebic liver abscess
Liver resections

Brisbane classification

Left hepatectomy 4A, 4B, a, 3

Right hepatectomy 5, 6, 7, 8

Left trisectorectomy 4A, 4B, a, 3
Left trisectionectomy
Extended left hepatectomy 5, 8

Right trisectorectomy 5, 6, 7, 8, 4A, 4B
Right trisectionectomy
Extended right hepatectomy

Segment 4 – Quadrate lobe
Segment 1 – Caudate lobe (Independent segment)

- Arterial supply both left and right side
- Biliary drainage in both from left & right side
- Venous drainage directly into IVC

undergoes hypertrophy in Budd-Chiari syndrome.

- Segment 1 subdivided into

Segment 9 Spigelian lobe

- Segment 1 – early involvement in hilar cholangiocarcinoma.

Liver pedicle

eternalsoul_494@yahoo.com
At the hilum of the liver, 3 structures.

Dextral CBD HA anterior
PV posterior

A/H/A mickey – mouse view on USG
# Benign lesions of liver

## Liver abscess

<table>
<thead>
<tr>
<th>Pyogenic liver abscess</th>
<th>Amoebic liver abscess</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Polybacterial infection</td>
<td></td>
</tr>
<tr>
<td>MC organism - E. Coli</td>
<td></td>
</tr>
<tr>
<td>MC organism in Asia - Klebsiella</td>
<td></td>
</tr>
<tr>
<td>MC organism children with chronic - S. Aureus granulomatous disease</td>
<td></td>
</tr>
<tr>
<td>a) Spread mainly via the</td>
<td></td>
</tr>
<tr>
<td>- biliary tree → ascending cholangitis</td>
<td></td>
</tr>
<tr>
<td>• Hematogenous</td>
<td></td>
</tr>
<tr>
<td>• Direct extension</td>
<td></td>
</tr>
<tr>
<td>2) Solitary = multiple</td>
<td></td>
</tr>
<tr>
<td>(50%) (50%)</td>
<td></td>
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<tr>
<td>3) CF - fever with spikes, pain more toxic</td>
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<tr>
<td>4) ↑ ALP (m/c)</td>
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<tr>
<td>↑ PT/INR</td>
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<tr>
<td>5) F &gt; m</td>
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<tr>
<td>Elderly</td>
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<td>Immunocompromised</td>
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<tr>
<td>7) IOC: USG / CECT</td>
<td></td>
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<td>8) -</td>
<td></td>
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<tr>
<td>9) Management:</td>
<td></td>
</tr>
<tr>
<td>• Broad spectrum antibiotics</td>
<td></td>
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<tr>
<td>• Early aspiration if patient doesn’t respond</td>
<td></td>
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<tr>
<td>• Pigtail catheter</td>
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<tr>
<td>6) m &gt; F</td>
<td></td>
</tr>
<tr>
<td>3) Usually solitary</td>
<td></td>
</tr>
<tr>
<td>4) Asymptomatic</td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td></td>
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<tr>
<td>Less toxic</td>
<td></td>
</tr>
<tr>
<td>5) ↑ PT/INR (m/c)</td>
<td></td>
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<tr>
<td>↑ ALP</td>
<td></td>
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<tr>
<td>7) IOC: USG / CECT</td>
<td></td>
</tr>
<tr>
<td>Serology can confirm the diagnosis</td>
<td></td>
</tr>
<tr>
<td>8) Anchovy sauce pus</td>
<td></td>
</tr>
<tr>
<td>9) Start metronidazole</td>
<td></td>
</tr>
<tr>
<td>(tissue amoebicide)</td>
<td></td>
</tr>
<tr>
<td>Double strength</td>
<td></td>
</tr>
<tr>
<td>Responds</td>
<td></td>
</tr>
<tr>
<td>2 - 3 weeks</td>
<td></td>
</tr>
</tbody>
</table>

- Flask shaped ulcers in bowel
- Portal vein → Liver.
Management of amoebiasis

- If patient responds
  - Continue for 2-3 hours
- 10 days Diloxanide Furoate (luminal amoebicide)
  - Cavity takes few months to resolve
  - Monitored using monthly USG
- Does not respond to Aspiration/drainage
  - Other indications:
    1. Secondary infections
    2. Impending rupture
    3. Left lobe liver abscess
    4. Pregnant ladies
    5. Large cavity >5 cm

Chloroquine another tissue amoebicide which can be used.

Complications of amoebic liver abscess

1. Rupture
   - MC site: Subdiaphragmatic > pleural > peritoneal
2. Secondary infection.

Hydatid disease

- Organism: Echinococcus granulosus
  - Echinococcus multilocularis (multiple cysts)
  - A/K/A malignant hydatid
- Definitive host: Dog
- Intermediate host: Sheep
- Accidental intermediate host: Human
- MC organ affected: Liver > Lungs

C/F:
1. Asymptomatic
2. Hepatomegaly
3. Pain

Diagnosis
- IOC: USG → Gharbi classification
WHO-IWGE 2001 - Descriptions of Cystic Echinococcus Cysts

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Unilocular unechoic cystic lesion with double line sign</td>
<td>Active</td>
</tr>
<tr>
<td>II</td>
<td>Multisepated, “rosette-like” “honeycomb” cyst</td>
<td>Active</td>
</tr>
<tr>
<td>III</td>
<td>Cyst with detached membranes (water-lily sign)</td>
<td>Transitional</td>
</tr>
<tr>
<td>IV</td>
<td>Cyst with daughter cysts in solid matrix</td>
<td>Inactive</td>
</tr>
<tr>
<td>V</td>
<td>Solid cyst with calcified wall</td>
<td>Inactive</td>
</tr>
</tbody>
</table>

-Serology to confirm diagnosis

Management of hydatid liver disease

1. Albendazole

First line of management of liver ydatid
- P - Percutaneous
- A - Aspiration
- I - Injection
- R - Reaspiration

Hydatid fluid/ hydatid sand

Pericyst (host reaction)

Daughter cyst

Endocyst

Ectocyst

Hydatid fluid

Anaphylaxis

PAIR → under image → Needle → aspirate guidance hydatid fluid

Reaspiration → scolicidal agent

- (MC - 20% hypertonic saline)
- Others - cetiramide

95% alcohol mebendazole solution

Formalin is not used as scolicidal agent
Contraindications for PAIR

1. Dead / calcified cyst
2. Deep seated cyst
3. Impending rupture
4. Extrahepatic cyst
5. Multiloculated cyst
6. Cysto-biliary communication

If scolicidal enters gall bladder

causes chemical cholangitis

Surgery for hydatid cyst

1. Cystopericystectomy
2. Multiple cysts - liver resection
3. Capitonnage - Spiral suturing of cavity
One - liners liver tumors

- MC benign tumor of liver - Hemangioma.
- MC benign tumor of liver - FNH (Focal Nodular Hypoplasia).
- MC malignant tumor of liver - metastasis (from another site).
- MC primary malignant tumor of liver: Hepatocellular cancer.

Liver hemangioma

- MC benign tumor of the liver.
- CF: Asymptomatic.

- Sometimes large hemangiomas can develop:
  
  - Nasabach-Merritt syndrome
  - Consumption coagulopathy (Consumes all platelets)
  - Bleeding

 IOC - CECT

- Arterial phase - Peripheral nodular enhancement
- Washout phase - Homogenous enhancement

- Thin capsule
- Giant liver hemangioma > 5cm

MRI - Light bulb sign

Management - Observation

- If large and symptomatic

  - Angioembolization
Focal nodular hyperplasia

- A benign tumor of the liver
- Females > Males
- 3rd to 5th decade of life

Etiology - unknown
- Proposed mechanisms (vascular insult to liver)

HPE - Hepatocytes
  - Bile duct structure
  - Kupffer cells - Hot spot on Tc 99m scan (sulfur colloid)
  - Unencapsulated

CF - Asymptomatic / Incidental diagnosis

IOC - CECT

Central stellate scar
Due to central arteriole
- No risk of malignant conversion
Management - Observation

Hepatic adenoma

- Females >> Males
- Strongest association with OCPS
- 3rd - 5th decade of life

HPE: Sheets of hepatocytes
  - But no bile duct structures
  - No Kupffer cells

- 10% of patients with adenoma can show malignant conversion

CF:
  - Majority - asymptomatic
  - Incidental diagnosis
  - Abdominal pain
  - Risk of spontaneous rupture
    Non-traumatic hemoperitoneum

IOC - CECT
Management - All liver adenomas need to be resected
**Bordeaux classification**

1. Inflammatory - maximum risk of bleeding
   a. HNF 1 alpha - mutated - maximum risk of being multiple
      - Common in young patients

3. β catenin mutated
   - Max risk of malignant conversion
   - Seen in male patients on anabolic steroids

**Other benign lesions**

1. Multiple liver hamartoma syndrome
   - N/V/A von Meyenburg disease
   - Multiple cystic liver hamartomas (< 1.5 cm)
   - Failure of regression of embryonic biliary duct

Clinical features - asymptomatic

**IOC - CECT**

- **↑ Risk of cholangiocarcinoma.**
- Association with polycystic kidney disease
  - Management - observation

2. Peliosis hepatis
   - Multiple cavernous hemangiomas of liver
   - Immunocompromised
   - Patients on anabolic steroids

**IOC - CECT**

Management - observation

**Hepatocellular cancer**

- **LI-RADS (Liver Imaging Reporting and Data Systems)**
  - LR-1 (100% benign)
  - LR-2 (probably benign)
  - LR-3 (intermediate probability for HCC)
  - LR-4 (probably HCC)
  - LR-5 (100% definite HCC)

- MC, malignant tumor of liver

**Risk factors**

1. Hepatitis B - Earlier Hepatitis B (MC) but due to vaccination
2. Hepatitis C - 17 times

**↓ incidence**
3. DM
4. Obesity
5. Alcohol
6. Cirrhosis of liver
7. alpha 1- antitrypsin deficiency
8. Hemanchromatosis
9. Wilson's disease
10. Thorotrace exposure (↑HCC, Cholangiocarcinoma, RCC)
   - vinyl chloride - ↑Risk of angiosarcoma.

CF
- m > F
- 4th - 6th decade
- MC and earliest feature hepatosplenomegaly
- Abdominal pain
- Jaundice (late sign)

Paraneoplastic syndromes
1. Hypoglycemia (MC)
2. Hypercholesterolemia - MC biochemical paraneoplastic syndrome
4. Hypocalcemia.

Work up of hepatocellular carcinoma

IOC Triple phase CT
- Helps to differentiate HCC from other metastasis

<table>
<thead>
<tr>
<th>Phases</th>
<th>Non contrast</th>
<th>Arterial</th>
<th>Washout</th>
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</thead>
<tbody>
<tr>
<td>HCC</td>
<td>Hypodense</td>
<td>Hyperdense</td>
<td>Hypodense</td>
</tr>
<tr>
<td>metastasis</td>
<td>Hypodense</td>
<td>Hypodense</td>
<td>Hypodense</td>
</tr>
</tbody>
</table>

Tru-Cut biopsy can be used to confirm the diagnosis.

Staging - PET CT
Tumor markers - alpha Fetoprotein (AFP) (MC)
- PIVKA - II (protein induced vitamin K antagonism)
- A/K/A Des - Carboxy prothrombin
- Glycapan
- HepPar - 1
- Neurotensin B (fibrolamellar variant)

alpha FP used to monitor response to therapy -

Child-Pugh (CP) scoring:

<table>
<thead>
<tr>
<th>Clinical and Lab Criteria</th>
<th>Points*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Encephalopathy</td>
<td>None</td>
</tr>
<tr>
<td>Ascites</td>
<td>None</td>
</tr>
<tr>
<td>Bilirubin (mg/dL)</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Albumin (g/dL)</td>
<td>&gt;3.5</td>
</tr>
<tr>
<td>Prothrombin time</td>
<td>&lt;4</td>
</tr>
<tr>
<td>International normalized ratio</td>
<td>&lt;1.7</td>
</tr>
</tbody>
</table>

Model for End Stage Liver Disease (MELD) Score

\[
\text{MELD} = 3.78 \times \log_e \text{serum bilirubin (mg/dL)} + 11.20 \times \log_e \text{INR} + 9.57 \times \log_e \text{serum creatinine (mg/dL)} + 6.43 \text{ (constant for liver disease etiology)}
\]

NOTES:
- If the patient has been dialyzed twice within the last 7 days, then the value for serum creatinine used should be 4.0.
- Any value less than one is given a value of 1 (i.e., if bilirubin is 0.8, a value of 1.0 is used) to prevent the occurrence of scores below 0 (the natural logarithm of 1 is 0, and any value below 1 would yield a negative result).

MELD Na⁺ score - value of serum Na⁺ also included
PELD - Pediatric End Liver Disease score

used for transplant (includes albumin, bilirubin, INR, growth failure, age < 1 yr)

Management of hepatocellular carcinoma

00:34:23

Localised disease

Advanced disease

Principles
1. Functional liver reserve > 25%
   (FLR measured by fibroscan)
a. Tumor resectable or not

Small tumor
Adequate FLR
CP - A/E
\[ \rightarrow \] Resection

CP - B/C
\[ \rightarrow \] FLR
\[ \rightarrow \] Liver transplant
(follow Milan criteria)

- CP - A/E
- Inadequate FLR
- Small tumor

Milan tumor
\[ \begin{align*}
\text{Single tumor} & \leq 5 \text{cm} \\
1 - 3 \text{ tumor} & < 3 \text{ cm} \\
& \text{No distance metastasis} \\
& \text{No lymphovascular invasion}
\end{align*} \]

Embolise portal veins on the side of tumor
Compensatory hypertrophy
Adequate FLR
Nimura’s technique
or
ALPP’s procedure
(Associating Liver Partition and Portal vein ligation for staged hepatectomy)

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Management of advance disease

Only palliative management

1. Sunitinib / Sorafenib / Regorafenib
2. TACE (Transarterial chemo embolisation)
3. TARE (Transarterial radio embolisation, using Yttrium spheres)
4. Radio frequency ablation (tumor < 3 cm)
5. Microwave ablation
6. HIFU (High frequency ultrasonic therapy)
7. Intralesional ethanol - avoided

Most important prognostic factor - stage of disease
Most site of distant metastasis - lungs
Prognostic indicators

**Okuda**
- B - Bilirubin
- A - Ascites
- T - Tumor size
- A - Albumin

**CLIP**
- Tumor size
- child pugh score
- AFP
- portal vein thrombosis

**BCLC**
- Tumor score
- child pugh score
- Performance status
- (Barcelona Clinic Score)

Karnofsky / ECOG score for performance status

Types
- Pushing
- Hanging
- Infiltrating

- good prognosis
- bad prognosis

Fibrolamellar variant

- Young patients
- M = F
- Non cirrhotic liver
- \( \alpha \) FP - 0
- Neurotensin B - Tumor marker

Hepatoblastoma

- Malignant tumor in children
- Tumor of fetal hepatocytes
- Majority present within 18 months

\[ \downarrow \]

Almost all cases < 3 years age
- Associated with FAP syndrome

CF - mass
- Anemia
- Thrombocytosis

TOC - CECT

Management - If localised - completely cured by surgery and chemotherapy
- 50% patients with lung metastasis also respond very well to chemotherapy

Epithelial hemangioepithelioma

- Rare vascular tumor
- Associated with OCP intake
- Vinyl chloride
multiple lesion in both the lobes
  CF - Infants and children - high output cardiac failure
    - Fulminant liver failure
    - Malignant conversion into angiosarcoma

IOC - CECT (Hypervascular tumor)
HPE - Factor VIII staining
management - Resection of lesion
BENIGN PANCREATIC CONDITIONS

Pancreas divisum
- most common congenital anomaly of pancreas
- Failure of fusion of dorsal and ventral pancreatic buds
- Increases the risk of pancreatitis

Management:
- Asymptomatic → no management required
  → Diagnosis: MRCP / ERCP
- If increased risk of pancreatitis:
  → Sphincterotomy

Annular pancreas
- Malrotation of ventral pancreatic bud
- Encasement of duodenum (usually second part of duodenum)
- Clinical features: Projectile vomiting
  → non bilious vomiting is more common than bilious vomiting
- X-Ray → Double Bubble sign
  → Diagnosis: CECT (IOC)

Management:
Duodenal duodenostomy is better than Duodenojejunostomy.
- If common channel is present between bile duct and pancreatic duct, it increases the risk of pancreatitis.
- Sphincter of Oddi comprises of four sphincters.

**Sphincter of Oddi dysfunction**

- Biliary pain
- Post cholecystectomy syndrome
- More common in females compared to males
- Diagnosis: ERCP with manometry (IOC) (more than 40 mmHg)
  - MRCP with secretin stimulation

**Milwaukee classification**

*Type I (MC): Pain + abnormal hepatic or pancreatic enzymes on a fixed occasion + dilated common bile duct / pancreatic duct.*

*Stenosis*

*Type II: Pain + either abnormal enzymes or dilated common bile duct / pancreatic duct.*

*Type III: Pain alone.*

**Management:**

*Type I: Best response to ERCP and sphincterotomy*  
  - Botox injection → high recurrence rate.  
  - Advantages → good candidate for ERCP and sphincterotomy.

**Acute pancreatitis**

**Causes:**
1. Gall stone induced pancreatitis, (MC)
2. Alcohol (second most common)
3. Trauma (MC in children)
4. Iatrogenic → post ERCP
5. Drug induced pancreatitis → Thiazide Diuretics
   → ACT
   → Chemo Drugs
   → Azathioprine

6. Hyper parathyroidism
7. Increased triglyceride
8. Pancreas divisum
9. Idiopathic
10. Scorpion bite

Clinical Features:
- More common in males as compared to females
- Epigastric pain - radiates to back and is relieved by bending forward.
- Nausea and vomiting.
  - Signs: Severe acute (hemorrhagic pancreatitis)
  - Cullen’s sign → Discolouration around umbilicus
  - Grey Turner’s → Discolouration in the flanks
  - Fox sign → Discolouration in inguinal region.
  - Bryant’s sign → Discolouration in the scrotum

Acute pancreatitis: investigations

First → Serum amylase and serum lipase
↓
   → Sensitive but not specific
   → Increases serum amylase
     - Acute pancreatitis (4 times the normal value)
     - Mesenteric ischaemia
     - Bowel perforation
     - Volvulus
     - Torsion
   → Rises late
   → More sensitive and more specific

Serum amylase and serum lipase values are not predictive of severity of attack.

Non specific signs:
- Sentinel loop sign
- Colon cut off sign
- Gas less abdomen
Colon cut off sign

- IOC → CECT (Ideally done after 72 hours)
  - If done before 72 hours, it can underestimate amount of necrosis.

Glasgow criteria → 3 or more than 3 → severe pancreatitis

Ranson's criteria → Different for alcohol and gall stone
  (1 point each)

On admission:
- WBC more than 16,000 / ml
- Age more than 55 years
- Glucose more than 200 mg / dL
- AST more than 250 IU / L
- LDH more than 350 IU / L

Within 48 hours of admission:
- Hct decrease more than 10%
- BUN increase more than 5 mg / dL
- Serum calcium more than 8 mg / L
- Arterial pO₂ less than 60 mmHg
- Base deficit more than 4 meq / L
- Fluid needs more than 6 L

Ranson score less than 3 → 0 - 3% mortality
Ranson score = 3 - 5 → 11 - 15% mortality
Ranson score more than equal to 6 → 40% mortality
  - more than or equal to 3 → severe pancreatitis.

BISAP score: (0 point each)
- BUN more than 2.5 mg / dL
- Impaired mental status
- IRRS
- Age more than 60
- Pleural effusions

BISAP score less than 2 → 0 - 0.5% mortality
BISAP score = 2 → 2% mortality
BISAP score more than equal to 3 $\rightarrow$ 5 = 20% mortality
  - more than or equal to 3 $\rightarrow$ severe pancreatitis

$\rightarrow$ C - Reactive protein value more than 150 IU / L
  - Severe
  - APACHE $\rightarrow$ Acute physiology and chronic health evaluation, score $\rightarrow$ 8 or more than 8
    - Severe

- APACHE - O (obesity)
- SAPS $\rightarrow$ Simplified acute physiology score
- MAPS $\rightarrow$ Harmless acute pancreatitis score
- Modified Marshall score $\rightarrow$ 2 or more than 2 denotes organ dysfunction.

Balthazar grade $\rightarrow$ CT Severity index (BES) $\rightarrow$ 6 or more than 6
  - Severe pancreatitis.

- Normal pancreas
  - Focal or diffuse enlargement of the pancreas
  - Pancreatic gland abnormalities and peripancreatic inflammation
  - Fluid collection in a single location
  - Two or more collection and/or gas bubbles in or adjacent to pancreas

Pancreatitis necrosis
  - No necrosis
  - Necrosis of one third of the pancreas (less than 30%)
  - Necrosis of the one half of the pancreas (30 - 50%)
  - Necrosis of more than one half of the pancreas (more than 50%)

Atlanta classification: Local complication
- MILD $\rightarrow$
- MODERATE $\rightarrow$
- SEVERE $\rightarrow$

Organ dysfunction
- Transient (< 48 hours)
### Management of acute pancreatitis

- **Nil per oral (NPO)**
- **I. V. fluids**
- **I. V. antibiotics** → only used if → necrosis ☺ → injection ☺
  - Antibiotic of choice → meropenem
- **Early initiation of Enteral nutrition**.
  - → Nasojejunal route preferred
  - → reduces mortality.
- **Gall stone pancreatitis**:
  - → If patient has severe jaundice which is not resolving
  - → Symptoms more than 48 hours
    - ERCP and Sphincterotomy
- Patients with gall stone pancreatitis should undergo cholecystectomy before discharge.
Complications of acute pancreatitis

Local
- Acute peripancreatic collection
  → External drainage with pigtail catheter
- Acute necrotic collection
  → External drainage or surgical necrosectomy
  → Beger’s technique (very high mortality rate)
- Pseudocyst
  → Walled-off necrosis
    → External drainage
- Splenic vein thrombosis → left sided portal hypertension
- Splenic artery pseudo aneurysm
  → m. c. vessel involved
- Left pleural effusion

Systemic
- SIRS
- Sepsis
- Septic shock
- ARDS
- CHF
- MODS

Pseudocyst

→ Lined by granulation tissue
→ more common in chronic pancreatitis than acute pancreatitis
→ Most common site → Lesser sac
  but can be seen anywhere in abdomen.

D’Egedio classification
Type I → Acute pancreatitis → no communication with main pancreatic duct.
Type II → Acute an chronic pancreatitis → may or may not have communication with main pancreatitis duct.
Type III → Chronic pancreatitis → usually have communication.

Clinical features:
→ Epigastric pain
→ Fullness
→ Nausea, and vomiting
→ IOC → CECT

Management:
→ Majority of pseudo cysts resolves spontaneously
→ Indications for intervention
  1. Cyst is more than 6 weeks old
  2. More than 6 cm in size
  3. Wall thickness is more than 6 mm.
Interventions:
- External Drainage
  → Pigtail catheter is used
- Internal Drainage

Indications:
- Infection
- Hemorrhage inside cyst
  rule out communication
  with main pancreatitis duct
  before external drainage.

Complications of pseudocyst surgery:
1. m. c. → Hemorrhage
2. Infection
3. Injury to adjacent structures

Complications of pseudocyst
1. m. c. → Infection
2. Hemorrhage inside cyst
3. Rupture
   Mimic a cystic neoplasm of the pancreas
   - CEA values in cyst fluid are less than 400 ng/ml

Chronic pancreatitis
→ Due to acute pancreatitis
  ↓
  Stimulation of myofibroblasts
  TGFβ activation

Causes:
- TIGGIR - O classification
  T → Toxins → Alcohol
  I → Idiopathic → Dietary
  G → Genetic / Hereditary → Spink 1 & PRSS gene → Tropical
  A → Autoimmune (Ig G4) → Calcific pancreatitis
  R → Recurrent (AC) → Kerela cassava
  O → Obstruction
Diagnosis - HISORT criteria
H → Histology - lymphocytic infiltration
I → Imaging
S → Serology → Ig G4
O → Other organism
RT → Response to steroids

Clinical Features:
- Exocrine Insufficiency → ↓ Pancreatic enzymes → ↓ Insulin
  - malabsorption
  - steatorrhea
- Endocrine Insufficiency → ↓ Insulin → DM

Investigation:
- Fecal fat analysis
- Fecal elastase analysis
- NBT - PABA

Management:
- Exogenous supplement → Insulin or oral hypoglycemic agents
- Analgesics and no interventions till patient responds to Analgesics

ERCP → Chain of lakes

Pain:
→ ineffective drainage
→ Stones in MPD
  - Calcium Carbonate stones
  - IOC → MRCP with secretin stimulation
  - Gold standard → ERCP

→ Stays responding intervention →
Drainage procedure

Diameter of MPD

Less than equal to 6 mm
  -> ERCP with Sphincterotomy

More than 6 mm
  -> Duval
  -> Puestow

DUVAL

PUESTOW

End to end
Pancreatico
Jejunal anastomosis

Longitudinal
Pancreatico
Jejunostomy

Resective:

If restricted to head

Beger’s Procedure
Duodenal preserving
Pancreatic head
resection

Puestow + Beger -> Frey’s procedure.

If restricted to tail

Distal pancreatectomy
MALIGNANT PANCREATIC DISORDERS

Pancreatic ductal adenocarcinoma

Risk factors: -
1. Obesity
2. DM
3. African, American
4. Alcohol consumption
5. Hereditary pancreatitis → PRSS1 gene (50 - 70 times)
6. Tropical calcific pancreatitis → SPINK1 gene.
7. Chronic pancreatitis
8. Syndromes:
   - Peutz-Jeghers syndrome - ↑ 100 times
   - BRCA2 mutations
   - HNPCC
   - FAP → periampullary cancers
   - Familial atypical melanoma syndrome.
   - Most common gene mutated → K - RAS
   - Most common histology → Pancreatic ductal adenocarcinoma.

Periampullary cancer
→ Group of 4 cancers which are situated within 2 cm of ampullary opening.

Duodenal adeno -

- carcinoma
  - (gastric outlet obstruction)
  - Ampullary variety (working and waning)
  - Double impaction of stone

Distal CBD cholangiocarcinoma.
- Jaundice is severe.
- Most common head of pancreas
  - Pain is common feature
Most common presentation →
- I. Obstructive jaundice (progressive)
- a. Distended gall bladder

Courvoisier’s Law → obstructive jaundice with palpable gall bladder is seldom due to stone disease.

Exceptions to Courvoisier’s law →
(Stone disease cause obstructive jaundice and palpable gall bladder)
1. Double impaction
2. Oriental Cholangio hepatitis
3. Primary CBD stones

- migratory thrombophlebitis (Trousseau syndrome)

Investigations :
- IOC → CECT
- MRCP/ERCP → Double duct sign.

- X-ray → widening of c loop.
- Duodenography → Fosberg inverted 3 sign.
- IOC for staging → PET - CT.

<table>
<thead>
<tr>
<th>T1</th>
<th>Tumor limited to the pancreas, ≤ 2 cm in greatest dimension.</th>
<th>≤10 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>Tumor limited to the pancreas, more than 2 cm in greatest dimension.</td>
<td>≤ 4 cm</td>
</tr>
<tr>
<td>T3</td>
<td>Tumor extends beyond the pancreas but without involvement of the celiac axis or the superior mesenteric artery</td>
<td>≤ 4 cm</td>
</tr>
<tr>
<td>T4</td>
<td>Tumor involves the celiac axis or the superior mesenteric artery (unresectable primary tumor)</td>
<td>Tumor involves the celiac axis, common hepatic artery or the superior mesenteric artery, Adjacent structures.</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>N0</td>
<td>No regional lymph node metastasis.</td>
<td>No regional lymph node metastasis.</td>
</tr>
<tr>
<td>N1</td>
<td>Regional lymph node metastasis.</td>
<td>Metastasis in 1-3 regional lymph nodes.</td>
</tr>
<tr>
<td>N2</td>
<td>-</td>
<td>Metastasis in more than regional lymph nodes.</td>
</tr>
<tr>
<td>M0</td>
<td>No distant metastasis</td>
<td>No distant metastasis</td>
</tr>
<tr>
<td>M1</td>
<td>Distant metastasis m. c. site → LIVER</td>
<td>Distant metastasis</td>
</tr>
</tbody>
</table>

**Management:**

Varadhachary - Katz Criteria.

- AJCC
- Celiac
- Superior mesenteric artery involvement
- SMV-PV Junction
- Common Hepatic artery

1/II

III Abutment

III Encasement more than

Other criteria:
- Malignant ascites
- Distant metastasis
- Peritoneal disease / omental disease.

Resectable → Diagnostic Laparos → Unresectable

Tail or Distal body surgery

- Whipple’s surgery → Classical

Distal (Pancreatico-pancreatectomy duodenectomy) → l. If Duodenum
Resectable

Tail or Distal body surgery
Tail or Distal body surgery
- Whipple's - Classical

Distal pancreaticoduodenectomy
- Modified Whipple's /
pylorus preserving /
Longmire and Traverso procedure
- Incision: Chevron/Roof top

Unresectable

only done

1. If Duodenum is involved
2. If negative margin can not be achieved by pylorus preserving Whipple's.

Complications of Whipple's:
1. Most common: Impaired gastric emptying
2. Hemorrhage.
   Most common: Pancreatico jejunostomy can be managed conservatively.
4. Cardiovascular complications
5. Recurrence
- Chemotherapy
- Nodal disease present
- T<sub>3</sub>/T<sub>4</sub>
- Gemcitabine
- Gemcitabine + capecitabine
- NAB - Paclitaxel
  (Albumin bound)
- Radiotherapy → pancreatic bed
- most important prognostic factor → stage

Unresectable: Palliative in nature

- Jaundice / Jaundice / Pain
- Pruritus + Coeliac
- (ERCP) obstruction ganglion
- Stenting block
- Triple bypass
  - Gastro - Jejunostomy
  - Hepatico - Jejunostomy
  - Jejuno - Jejunostomy

Cystic neoplasm of pancreas

Serous cystic
- more common in females than males
- Older
- Decreased CEA
- Glycogen rich cells.
- Bubble wrap
- Small microcystic
- Multiloculated
- Benign
- CT Scan: Central stellate
  Scar / Sunburst appearance

Mucinous
- more common in females than males.
- Premenopausal
- Increased CEA
- Ovarian like stroma
- Uniloculated or multiloculated
- Malignant
- CT scan: Hypodense
  and wall calcification
  Mucin present
  ↓ Resection

Management:
- Less than 3 cm → Observation
- More than 3 cm → Enucleation

Surgery • v2.0 • Marrow 4.0 • 2020
Intraductal papillary mucinous neoplasm

- IPMN
- Males are more commonly affected than females.
- Certain studies have found both genders are equally affected.

Diagnosed by ERCP

\[ \text{Ohashi triad:} \]
- Dilated hepatopancreatic duct
- Fish mouth deformity
- Mucin extruding from opening

- Branch duct type
  - Management: Observation
- Main duct type
  - Multifocal
  - Malignancy
  
  All lesions should be resected.

- Most commonly seen in head of pancreas.

Solid pseudopapillary tumor/Gruber Frantz/Hamoudi tumor & Endocrine tumor

- Females
- Child bearing age
- \( \beta \) Catenin/ vimentin mutation
- Tail \( \rightarrow \) Malignant, slow progression
- Management \( \rightarrow \) Resection

Endocrine tumor

- Insulinoma
- Most common endocrine tumor
- \( \beta \) cells of islets of Langerhans
- Evenly distributed throughout pancreas.
- Benign (> 90%)
- Encapsulated
Clinical features:
- Whipple's triad → Fasting hypoglycemia
- Blood glucose less than 40 mg/dl
- Rapid resolution on giving glucose

Diagnosis:
- Gold standard → 72 hours fasting test
- Increased fasting insulin levels
- Insulin : glucose → more than 0.3
- C-peptide analysis → raised in insulinomas
- Localization: Best → intra-op USG

Management:
- Less than 2 cm in size → malignant
- Benign
- Enucleation → Radical surgery can be done
- Liver most common site

- Diaxoxide → decreases insulin secretion

Gastrinomas

- Zollinger Ellison syndrome
- Most common pancreatic endocrine tumors in MEN 1 syndrome.
- Most common site → wall of first part of duodenum.

Gastrinoma triangle/passaro triangle → is bounded by:
- Junction of cystic duct with common hepatic duct
- Junction of second and third part of duodenum
- Junction of head and neck with the body of pancreas
- Gastrinoma which lie outside the triangle are more aggressive, poor prognosis.

- More than 70 – 80 % gastrinomas are malignant.

Clinical features:
- Zollinger Ellison triad
  - ↑ gastrin
  - ↑ acid output
- Non β cell tumor
- Multiple and recurrent peptic ulcer disease (most common pain)
- Peptic ulcers at atypical locations
  → 0, 9, Jejunum
- Diarrhoea

**Diagnosis:**
- Serum gastrin more than 1000 pg/ml (diagnostic)
- Sometimes less than 1000 pg/ml
  → Secretin/pentagastrin.

Pre test

\[
\text{value : } x \quad \text{more than } x + 200 \text{ pg/ml}
\]

- Gastric pH less than 2
- Basal gastric output → less than 15 IU/hour.

- Localization → SRS → somatostatin receptor scintigraphy
- EUS → Best
- All patient with ZES should be tested for MEN 1 syndrome

**Management:**

Resectable

- Less than 5 mm → Enucleation
- More than 5 mm → Remove full thickness wall

Unresectable/metastatic

- Streptozocin + 5 Fluorouracil
- High dose PPI
- Octreotide

Pancreatic ZES → Larger tumors → poor prognosis
- If complete resection → excellent survival.

---

**Glucagonoma**

- Tumor of α cells of islets of langerhans
- Diabetes mellitus
- Dermatitis → migratory rash (necrolytic)
- Angular stomatitis
- Anaemia

VIPoma: - vasoactive intestinal peptide.
- Malignant tumors
  - Whipple syndrome/verner morison syndrome
  - WD: watery diarrhea
  - H: hypokalemia
  - A: achlorhydria.
  - Acidosis
- More common in males than females
- Elderly
- Tail/distal part

**Warning:** Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with marrow edition 4 videos.

**Non functional pancreatic endocrine neoplasm**

- Non - functional
- 30 - 50 %
- Elderly
- Malignant
- Most commonly: head

**Clinical features:**
- Abdominal pain
- Jaundice
- Pancreatitis (rarely)

**Difference between functional vs Non functional**

\[ \rightarrow \text{Chromogranin A} \]
\[ \rightarrow \text{Synaptophysin} \]

**Difference between Pancreatic Cancer vs Non-functional Tumors**
- Less than 5 cm
- -
- Hypodense
- More than 5 cm
- Chromogranin A
- Hyperdense
- Calcification can be seen

Somatostatin receptor: Negative
Scintigraphy: Positive
Management: Resection → Radical Surgery
- m. c. Site → Liver
- Metastatic disease → Streptozocin,
  5 fluorouracil, interferon
Surgical anatomy of Gall Bladder and Biliary tree

- **Calot Triangle**
  - Bound by:
    - Cystic Artery
    - Cystic Duct
    - Common Hepatic Duct

- **Cystic Lymph Node of Lund**: 1st draining lymph node in Gall Bladder cancer

- **Moynihan Hump**:
  - Tortuous Right Hepatic Artery in calot's triangle
  - Injured during cholecystectomy

- **Phrygian cap / phrygian Gall Bladder**
  - Gall Bladder assumes shape of a phrygian cap
  - Not an indication of surgery

---

GALL BLADDER AND BILIARY TREE - 1
• Gall Bladder:
  → Lacks submucosa.
  → Subserosal Lymphatics → Drain into Liver capsule
  → Valve of Heister at Gall Bladder neck.
  → Functions:
    1. Concentration of Bile
    2. Reservoir of Bile
    3. Secreting mucus.

Gall stones

Pure cholesterol stones 
→ 80 - 90% cholesterol 
→ Solitary

Mixed stones
→ mc stone (Overall)

Pigment stones
→ <40% cholesterol
→ mc stones in Asia

→ Black
→ Brown

→ In Haemolytic Disorders:
  - G6PD Deficiency
  - Sickle cell anemia
  - Spherocytosis

→ Composition:
  - Insoluble bilirubin pigment polymer
  - Ca BiCarbonate
  - Ca Phosphate

→ Infected bile
  - Cholangitis
  - Clonorchis
  - Cirrhosis

  - Ca Bilirubinate
  - Ca Palmitate
  - Ca stearate

• Risk Factor
  → F > m
  → Obesity
  → OCP / Clofibrate
  → Ileal Resection
  → Rapid weight loss
  → Post vagotomy
  → Inflammatory Bowel Disease

• 90% → Radioluscent
• 10% → Radiopaque
Seagull sign
(Biradicate sign)

Mercedes Benz sign
(Triradicate sign)

Radiopaque

- IOC: USG → Post Acoustic shadow

Post Acoustic Shadow

Gall Bladder Polyp
No post acoustic shadow

Presentations of gall stones

1. Asymptomatic stones
   → Management: Conservative
   → Indications for cholecystectomy in asymptomatic stones
     1. Diabetes mellitus
     2. Stones and Gall Bladder polyps
     3. Stone with porcelain Gall Bladder
     4. Stone > 2 cm in size or multiple small stones
     5. In patients undergoing bariatric surgery
     6. Salmonella Typhi carrier
     7. Endemic zone of Gall Bladder cancers

2. Acute cholecystitis
   → Clinical Features: Right upper quadrant pain
      Nausea and vomiting
   → On Examination: Tenderness in Right upper quadrant
   → Murphy's sign: Patient catches his/her breath when pressed in Right Hypochondrium.


- Goal's sign: Hyperesthesia in the region of 12th Rib
- IOC: USG Abdomen

- Gold Standard: HIDA (Hepatobiliary iminodiacetic Acid) scan
  - Higher Accuracy than ultrasonography
  - In 90% patients dye reaches gall bladder in 30 min, bowel in 1 hour
  - In Acute cholecystitis: Non visualisation of Gall Bladder
  - Also used to diagnose Biliary Atresia.

Management of acute cholecystitis

- Based on Tokyo consensus Guidelines

Grade III: Severe
cholecystitis + Organ dysfunction

Grade II: Moderate Acute Cholecystitis +
Any one:
- WBC > 18,000
- Duration of symptoms > 72 hours
- Gangrenous cholecystitis
- Emphysematous
- Pericholecystic Abscess

Grade I: Mild cholecystectomy

- Management: → NPO (Nil Per Oral)
  → I. V Fluids
  → I. V Antibiotics: Gram negative coverage
  - Anaerobic coverage
  → Analgesics
Presentation

If patient presents within 2 - 3 days of attack

Emergency Cholecystectomy (Higher conversion of Lap → open)

After 72 hours

Conservative management

Discharge the patient

After 6 weeks:
Interval/Elective cholecystectomy

Other presentations of gall stone

Acalculous cholecystitis

→ Seen in: ICU patients
  → Total parenteral nutrition
→ Clinical features: Right hypochondriac pain
  Nausea and vomiting
  Sepsis

→ Diagnosis: USG
→ Management: Supportive care
  Surgery if condition does not improve

Chronic cholecystitis

→ IOC: USG
  → Wall echo shadow sign (WES)
  → WES is specific for chronic>acute

Emphysematous cholecystitis

→ Common in Diabetic and immunocompromised patients
→ M. C organism: Clostridium
→ Emphysematous pyelonephritis → E. coli

→ Gas in gall bladder and gall bladder wall

→ Diagnosis: USG
→ IOC: CECT
- **Management:**
  - NPO
  - IV fluids
  - IV Antibiotics
  - Emergency cholecystectomy
  - Sometimes patient is too sick to undergo surgery

  Tube cholecystostomy

  If patient recovers

  Cholecystectomy

**Mucocoele**

- Mucus filled gall bladder
- Stone impaction at neck

- Bile absorbed
- Aseptic dilatation of gall bladder due to impaction of stone at neck
- Diagnosis: **USA**
- Management: Cholecystectomy
- If mucocoele is infected → Empyema of Gall Bladder

**Mirizzi Syndrome**

- Due to inflammation, gall bladder becomes adherent with common bile duct.

Stone pushes against the CBD

Obstructive Jaundice

Final stage: Fistula between gall bladder and common bile duct.

- Clinical features: pain
- Jaundice
> Diagnosis: MRCP (Magnetic Resonance Cholangio Pancreatography)
> management: Cholecystectomy

Gall stone ileus:
> Dynamic bowel obstruction because of Gall Bladder stone

Note: Gall bladder and duodenum becomes adherent → Formation of cholecystoduodenal fistula → stone directly comes down into duodenum and obstructs the bowel → gall stone ileus

→ MCU site: Terminal 60 cm of ileum / distal ileum
→ Sometimes: Stone can cause Gastric outlet obstruction

Bouveret syndrome

→ Rigler's Triad
  1. Pneumobilia
  2. Features of small intestine obstruction
  3. Radiopaque shadow in Right lower quadrant

→ IOC: CECT
Choledocholithiasis

- Stone in CBD is called choledocholithiasis
- Clinical features:
  1. Asymptomatic
  2. Obstructive jaundice
  3. Cholangitis:
     - Charcot triad: • Intermittent pain
     • Intermittent fever
     • Intermittent jaundice

Reynolds pentad
Charcot triad
+ Septic shock
+ Altered mental status

→ IOC: MRCP
→ IOC for common bile duct microliths: Endoscopic ultrasound

→ Management:

CBD stone and Gall Bladder
Stone detected
before surgery

ERCP + Sphincterotomy → Followed by Cholecystectomy after 7-10 Days

1. History of jaundice
2. ↑ ALP
3. USG: Dilated CBD

CBD stones detected during
Cholecystectomy
CBD stones after cholecystectomy

- Residual CBD stones
  → found within 2 years of surgery

- Recurrent CBD stones
  → > 2 years
  → Only 10% are first CBD stones
  - Brown pigment stones
    - Clonorchis
    - Cholangitis
    - Ascariasis
  → management:
    - ERCP + Sphincterotomy + Removal of stone (< 1.5 cm)
    - If large stone (> 1.5 cm) and ERCP fails
      Transduodenal sphincterotomy
      Fails or stone is impacted
      Supraduodenal choledochotomy

- In CBD:
  → Incision: Longitudinal
  → Not made at 3 and 9 O’clock
  → Sutured using:
    - Absorbable (Vicryl / PDS suture)
    - Knots on outside of lumen

Gall stone pancreatitis
Associated with gall bladder cancer
Laparoscopic and open cholecystectomy

Laparoscopic cholecystectomy
- Surgery for gall stones
- Laparoscopic cholecystectomy is surgery of choice
- Position: Reverse Trendelenburg & right side up
- Surgeon: Left side
- Assistant: Left side
- Conventional Laparoscopic cholecystectomy:

5 mm Right hypochondrial Port
- Blunt grasper
  → Left hand

5 mm Right lumbar port
- Toothed grasper
  → Assistant

5 mm/10 mm Right epigastric port (Maryland dissector)
- Right hand

10 mm Intraumbilical port (Camera)

• SILS (Single Incision Laparoscopic surgery) → 1 rates of umbilical hernia.

Critical view for cholecystectomy

• If Calot's triangle anatomy not properly defined
  ↓
  Fundus - first cholecystectomy

Complications of Laparoscopic cholecystectomy:
1. Hemorrhage
2. Injury to bile ducts
3. MC complication: Right shoulder tip pain (retained CO₂ beneath right dome of diaphragm)
4. Stricture: MC Common hepatic duct (Laparoscopic cholecystectomy)
   MC Common bile duct (open cholecystectomy)
5. Post cholecystectomy syndrome

Cause:

1. Retained CBD stones
2. Biliary dyskinesia.
3. Sphincter of Oddi dysfunction (SOD)

- Frozen calot’s → 4 - 5%

Open cholecystectomy
→ Right subcostal incision (Kocher’s incision)

Bile leak

- Surgeon identifies injury during surgery.
- Detected after surgery
- Partial injury, transaction with loss of segment but no loss of segment
- Conservative management.
- Anastomose over T-tube, hepatico-jejunostomy with closure of distal end
- If patient present within 48 - 72 hours
  1. USG guided pigtail catheter drainage
  2. Antibiotics
  3. ERCP and Stenting
- If patient has minor leak from liver bed
  → Stable
  → No sepsis
  → Jaundice
- Patient has:
  → Abdominal pain
  → Sepsis

- Long term complication of bile duct injury: stricture
- MC bile leak after laparoscopic cholecystectomy is from:
  Cystic duct stump
### Strasberg classification for bile duct injury

<table>
<thead>
<tr>
<th>Types</th>
<th>Nomenclature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Bile leak from the cystic duct/accessory duct/small ducts in liver bed without loss of continuity</td>
</tr>
<tr>
<td>Type B</td>
<td>Occlusion of an aberrant duct with loss of continuity with the common bile duct</td>
</tr>
<tr>
<td>Type C</td>
<td>Complete transection of the aberrant right hepatic duct with loss of continuity with the common bile duct</td>
</tr>
<tr>
<td>Type D</td>
<td>Partial lateral wall injury to the CHD or CBD</td>
</tr>
<tr>
<td>Type E1</td>
<td>CHD injury, beyond 2 cm from the primary confluence</td>
</tr>
<tr>
<td>Type E2</td>
<td>CHD injury, less than 2 cm from the primary confluence</td>
</tr>
<tr>
<td>Type E3</td>
<td>Injury at the confluence; confluence is intact</td>
</tr>
<tr>
<td>Type E4</td>
<td>Injury at the confluence; confluence separated</td>
</tr>
<tr>
<td>Type E5</td>
<td>Injury to the aberrant right posterior sectoral duct along with stricture of the CBD</td>
</tr>
</tbody>
</table>

### Gall bladder cancer

- **Risk factors:**
  1. Gall stones (>90% patients with gall bladder cancer have associated stones)
  2. Salmonella typhi carrier
  3. Gall bladder polyps: Adenomatous polyps
     - Porcelain gall bladder: >1 cm in size [multiple]
     - Calcified gall bladder: >60 years

- **Cholesterosis**
  - Strawberry gall bladder: Deposition of cholesterol crystals in gall bladder wall.
  - Not a risk factor for gall bladder cancer.
5. Abnormal pancreaticobiliary duct junction (APBDJ)
   - Gall bladder cancer
   - Cholangiocarcinoma

6. Endemic zone

7. Alcohol
   - HPE: Adenocarcinoma
   - Mc Type: Infiltrating
   - Mc site: Fundus
   - Clinical Features: Clinical Presentation: Gall bladder mass
     - Not going to retain shape
     - Mobility is restricted
   - Jaundice—late feature
   - Liver is most common site of metastasis.

**Investigation and management of gall bladder cancer**

- IOC: CECT
- Staging: PET-CT
  - T stage:
    - T<sub>1</sub> → T<sub>A</sub>: Above muscle layer
      - Involves muscle
    - T<sub>2</sub>: Perimuscular connective tissue
    - T<sub>3</sub>: Adjacent structures → Liver, duodenum
    - T<sub>4</sub>: Involvement of hepatic artery, portal vein.

- Management:
  - T<sub>1</sub> → A: Simple cholecystectomy
    - B: Radical cholecystectomy
  - T<sub>4</sub> → Radical cholecystectomy

- Removal of:
  - Gall Bladder
  - Lymph node along hepatoduodenal ligament
  - Segments 4B and 5 of Liver
  - ± CBD → only removed if involved.

T<sub>3</sub>, T<sub>4</sub> → Neoadjuvant chemotherapy
   (Gemcitabine based chemotherapy)

Good response
   - Surgery
Poor response
   - Chemotherapy
      (Palliative)
• If patient undergoes laparoscopic cholecystectomy:
  TA Gall bladder cancer
  (incidentally)
  • Nothing is detected
  • No role of laparoscopic port site excision in T1 GB cancer.
  TB Gall bladder cancer
  Radical cholecystectomy

• Tumour marker: CA19-9
• Most important prognostic factor: ‘T’ stage/Depth of invasion.

Cholangiocarcinoma

• Risk:
  1. Choledochal cyst
  2. Anomalous pancreaticobiliary duct junction (APBDJ)
  3. P. Sclerosing cholangitis: Inflammatory condition
     • Associated with IBD (ulcerative colitis)
     • Antinuclear and anti smooth muscles antibodies
     • M > F
     • Multiple strictures in biliary tree
     • ↑ Risk of cholangiocarcinoma.
     • Clinical features: Obstructive jaundice
     • Diagnosis: MRCP/ERCP

  • Primary sclerosing cholangitis

  • Gives rise to multifocal tumors
  • Doesn’t resolve after colectomy

  4. Periampullary
  5. Alcohol
  6. Thorotrast
7. Clonorchis
   - MC site: Hilum

- Bismuth–Corlette classification:

<table>
<thead>
<tr>
<th>Type</th>
<th>Bismuth–Corlette Classification of Perihilar Tumors</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Tumor involves common hepatic duct</td>
</tr>
<tr>
<td>II</td>
<td>Tumor involves bifurcation of the common hepatic duct</td>
</tr>
<tr>
<td>IIIa</td>
<td>Tumor involves the right hepatic duct</td>
</tr>
<tr>
<td>IIIb</td>
<td>Tumor involves the left hepatic duct</td>
</tr>
<tr>
<td>IV</td>
<td>Tumor involves both right and left hepatic ducts</td>
</tr>
</tbody>
</table>

- IOC: MRCP
- Staging: PET-CT
- MC site of distant metastasis: Liver
- Management:
  - Resectable:
    - Surgery
    - Chemotherapy (Gemcitabine)
  - Unresectable:
    - Palliative Jaundice/Pruritis
    - ERCP and Stenting
    - PTBD (Percutaneous Transhepatic Biliary Drainage)

Active space

Distal CBD (Whipple surgery)

Klatskin tumor

(Portoenterostomy/Kasai)

Supraduodenal CBD (Hepaticojejunostomy)
Choledochal cyst

- Dilatation of biliary tree

  ineffective drainage of bile

  Risk of cholangiocarcinoma.

- Todani / modified Alonso-Lej classification:

  Type I:
  - mc: Diffuse dilatation
  - Ib: Pancreatic extension

  Type II:
  - Diverticulum of CBD

  Type III:
  - Dilatation of intraduodenal portion (choledochocoele)

Type IV

- A:
  - Intrahepatic + extrahepatic ducts dilated

  Only extrahepatic ducts dilated

Type V:

- Dilatation of only intrahepatic ducts (Carol's Disease)

- Sign: Central dot Sign
- Clinical features: Lump
  - Pain
  - Jaundice
  - 10% Risk \(\rightarrow\) cholangiocarcinoma.

- IOC: MRCP
- Management:
  - Type I: Roux-en-Y hepaticojunostomy
  - Type II: Cut diverticulum + repair CBD
  - Type III: ERCP + sphincterotomy
  - Type IV A, Type V: Transplant
  - Type IV B: Kasai procedure (portoenterostomy)

Extrahepatic biliary atresia

- Inflammatory fibrosis of biliary tree.
- 1 in 12,000 live births
- M = F
- Fibrosis of biliary tree
  - Atresia.
  - Cirrhosis \(\rightarrow\) Liver failure
- Associations:
  - Situs inversus
  - Cardiac lesions
  - Absent inferior venacava
  - Polysplenia
  - Preduodenal portal vein
- Clinical features:
  - Jaundice at Birth
  - Pruritis
  - Pale stools
  - Liver failure
• ↑ ALP
• Extrahepatic atresia
  → IOC : HIDA Scan
  → Gold standard : intraoperative cholangiogram

• Intrahepatic atresia
  → Liver biopsy
  → USG : Triangular cord sign
  → Helps to differentiate it from neonatal hepatitis

• Types of Biliary atresia:

• Management:
  → Type I : Roux-en-Y hepaticojejunostomy
    • Progressive fibrosis after surgery
    • Best result-surgery done < 8 weeks
  → Type II and III : Kasai procedure
    • If fibrosis : Liver failure
      → Transplant

Haemobilia and bilhemia

Haemobilia
• Bleeding from biliary tree
• Rare cause of upper GI hemorrhage
• Conditions:
  → Iatrogenic
    → post ERCP
    → post Percutaneous transhepatic biliary drainage
  → Trauma
• Clinical features: Quinkeke’s triad
  → Jaundice
  → Upper GI Hemorrhage (melaena)
  → Pain
• Diagnosis: CT Angiography
• Management: Usually self limiting
  • If progressive: Transarterial embolisation
Gallbladder
- Transit of bile into blood circulation
- Fistula between biliary tree and vein
- Clinical features: Rapidly progressive jaundice
- Conditions: - Post trauma
  - Interventions
- IOC: ERCP
- Management: ERCP and stenting or Embolisation

**Warning:** Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

**Congenital portosystemic shunts**

Abernethy malformations

**IOC:** CT Angiography

<table>
<thead>
<tr>
<th>Types</th>
<th>I: Complete</th>
<th>II: Partial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1: Complete</td>
<td>11: Partial</td>
</tr>
<tr>
<td></td>
<td>→ Cirrhosis</td>
<td>→ Encephalopathy</td>
</tr>
<tr>
<td></td>
<td>→ Encephalopathy</td>
<td>→ Focal nodular hyperplasia</td>
</tr>
<tr>
<td></td>
<td>Management: Transplant</td>
<td>Management: Embolisation</td>
</tr>
</tbody>
</table>
BARIATRIC SURGERY

Bariatric surgery

Indications
1. BMI more than 40 kg/m²
2. BMI more than 35 kg/m² with obesity related complication:
   - DM type II
   - Hypertension
   - CAD
   - Osteoarthritis
   - Obstructive sleep apnea (OSA)
   (Pickwickian syndrome)
3. Patient who fails to lose weight despite lifestyle changes, pharmacotherapy and psychotherapy
4. For Asian population:
   - more than 37.5 kg/m²
   - more than 32.5 kg/m² with complications
5. Patient is motivated to carry out dietary changes after surgery
6. Patient should be on a liver shrinkage diet at least 2 weeks before surgery
   -> Low carbohydrate.
   -> High protein
7. Cessation of smoking
8. Chest physiotherapy encouraged
9. Patient's with Obstructive Sleep Apnea (OSA) should be given oxygen
   -> OSA -> independent risk factor for anastomotic leak.

<table>
<thead>
<tr>
<th>Obesity surgery mortality risk score (OS - MRS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk factors</td>
</tr>
<tr>
<td>Arterial hypertension</td>
</tr>
<tr>
<td>Age more than 45</td>
</tr>
<tr>
<td>Male gender</td>
</tr>
<tr>
<td>Body mass index more than equal to 50 kg/m²</td>
</tr>
<tr>
<td>Risk factor for pulmonary thromboembolism</td>
</tr>
<tr>
<td>Risk group</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>A (low risk)</td>
</tr>
<tr>
<td>B (moderate risk)</td>
</tr>
<tr>
<td>C (high risk)</td>
</tr>
</tbody>
</table>

- Another score - Edmonton score
- Older technique
- Biliopancreatic division (BPD)
  - gastric pouch, gastroileal anastomosis.
  - 50 cm of tract for food & bile
  - ↑ malabsorption

- duodenal switch variant (DS)
  - sleeve
  - 100 cm of tract for food & bile

- BPD and DS → max weight loss
  - maximum resolution of obesity related complications
  - but maximum surgical complication
  - not done these days.

Roux-EN Y gastric bypass (RNY) 00:12:55

- most acceptable
  - Roux limb length 75 - 150 cm
  - Longer roux limb → more weight loss

- very obese patient → 150 cm

Complication:
1. Nutrition → iron deficiency (m & b)
   - vitamin B12 ↓
   - calcium ↓
2. Anastomatic leak.

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3. MC cause of mortality after bariatric surgery → pulmonary embolism

**Mini gastric bypass**

- single anastomosis bypass.

Purely restrictive surgeries
- most commonly performed bariatric surgery
  - Lap sleeve gastrectomy

32-36F Bougie

→ Removed → Reduced capacity
  ↓
  Early satiety (eat less)
  ↓
  weight loss

Complication:
1. most common → Bleeding from staple line
2. most distressing → Leak from angle of His
3. Nutritional complication
4. Re- distention of gastric pouch/sleeve.
   → weight gain ↓

**ROSE** → Restorative obesity surgery endoluminially
- Example of NOTES procedure.

**POSE** → primary obesity surgery endoluminially.
Restrictive

Lap adjustable gastric banding (LAGB)
- gastric band around 6 cm from GE junction
- subcutaneous injection port in umbilicus

Deflate balloon again → Restriction goes away
Hungry again → weight gain

Reversible bariatric surgery
complications of LAGB:
1. Nutritional
2. DVT / pulmonary embolism
3. Most common - prolapse
4. Band can erode through stomach
5. Rupture

Intragastric balloon placement
- Reversible bariatric surgery procedure.
- No scars.

**metabolic surgery → Better name for bariatric surgery**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Protein / Caloric Malabsorption</th>
<th>3-Year % EWL</th>
<th>3-Year % Diabetes Remission</th>
<th>HTN Remission</th>
<th>Hyperlipidemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric Band</td>
<td>No</td>
<td>40-50%</td>
<td>20%</td>
<td>15-40%</td>
<td>20-45%</td>
</tr>
<tr>
<td>Gastric Bypass</td>
<td>No</td>
<td>50-60%</td>
<td>50%</td>
<td>35-40%</td>
<td>55-60%</td>
</tr>
<tr>
<td>Sleeve Gastrectomy</td>
<td>No</td>
<td>50-60%</td>
<td>50%</td>
<td>35-40%</td>
<td>55-60%</td>
</tr>
<tr>
<td>BPD/DS</td>
<td>Yes (max) 70%</td>
<td>70%</td>
<td>70%</td>
<td>40-45%</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>SG</td>
<td>AGB</td>
<td>RYGB</td>
<td>BPD</td>
<td>BPD-DS</td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>Ghrelin</td>
<td>Decreased</td>
<td>No change</td>
<td>Decreased</td>
<td>No change</td>
<td>Decreased</td>
</tr>
<tr>
<td>GLP-1</td>
<td>No change</td>
<td>Increased</td>
<td>Increased</td>
<td>Increased</td>
<td>Increased</td>
</tr>
<tr>
<td>GIP</td>
<td>Not known</td>
<td>No change</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Not known</td>
</tr>
<tr>
<td>PYY</td>
<td>Increased</td>
<td>No change</td>
<td>Increased</td>
<td>Increased</td>
<td>Increased</td>
</tr>
<tr>
<td>CCK</td>
<td>Increased</td>
<td>Not known</td>
<td>Increased</td>
<td>Not known</td>
<td>Not known</td>
</tr>
<tr>
<td>OXM</td>
<td>Not known</td>
<td>Not known</td>
<td>Increased</td>
<td>Not known</td>
<td>Not known</td>
</tr>
<tr>
<td>Leptin</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Not known</td>
<td>Not known</td>
</tr>
<tr>
<td>Bile acid</td>
<td>Decreased</td>
<td>Increased</td>
<td>Not known</td>
<td>Increased</td>
<td>Not known</td>
</tr>
</tbody>
</table>

OXM: Oxyntomodulin, CCK: Cholecystokinin; PYY: Peptide tyrosine tyrosine,
GIP: Gastric Inhibitory polypeptide, GLP-1: Glucagon like peptide-1, SG: Sleeve Gastrectomy, AGB: Adjustable gastric banding, RYGB: Roux-en-Y gastric bypass,
BPD: Bilio-pancreatic diversion, BPD-DS: Bilio-pancreatic diversion with duodenal switch

Follow up after bariatric surgery is very important
→ Initially → 3 monthly
→ After 2 years → 6 monthly/yearly
MINIMALLY INVASIVE SURGERY

Advantages:

- Cosmetically better
- Faster recovery
- Early return to activity
- Pain
- Better visualization

- The basic principles of Minimally Invasive Surgery (MIS)
  1 - Insufflate
  V - Visualise
  I - Identify
  T - Triangulation - Improve efficiency, more ergonomic design.
  R - Retract the tissue while operating
  O - Operation
  S - Seal

Pneumoperitoneum

- Gas used: CO₂
- O₂ & Air - not used - because both are combustible gases.
- Pressure achieved: 10 - 14 mmHg - For abdominal surgeries
  5 - 8 mmHg - For mediastinal surgeries

Physiological effects of pneumoperitoneum:

- Pneumoperitoneum
  Peritoneal stretching
  Vagal stimulation
  Sinus bradycardia (MC Arrhythmia in lap)

- Pressure in the abdomen
- Venous return
- Cardiac output, Systolic BP
- Heart rate

- Prolonged surgery → CO₂ gets absorbed → Acidosis
- Pneumoperitoneum
  - Diaphragm pushed up
  - Thoracic volume
  - Vital capacity, total lung volume
  - Total Lung Capacity, FRC
  - Thoracic pressure
    - Airway resistance
    - PEEP - used to deliver O₂ to lungs by anaesthetist

  - Pneumoperitoneum
    - Renal artery is compressed
    - Renal Blood Flow
    - GFR
    - Urine Output
    - Aldosterone → Na⁺, H₂O retention

Creation of pneumoperitoneum

- Pneumoperitoneum
  - Closed
  - Open
  - Veress needle
  - Hasson's method
  - Inserted

  - Infraumblically: Palmer's point
    - 3 cm below the left costal margin in the midclavicular line.
    - Useful in patients with previous abdominal surgeries.
  - During insufflation, the rate of flow of CO₂: 1-4 L/min
  - In obese patients → Longer veress needle used

Open / Hasson's method:
  - Incision under vision (infraumblically)
  - Incise the peritoneum and insufflate CO₂
  - More time consuming than veress needle.
  - Useful in patients with previous surgeries / adhesions

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**Blunt trochar**
- used in open / Hasson's method

**Sharp trochar**
- used in veress needle technique

- Only the first trochar is inserted blindly, all the other trochars inserted under vision.

- If there is trochar injury to the bowel
  - Immediately convert it into an open surgery
  - Keep the trochar in the same position to locate the site of injury.

**Optiport / Visiport**:
- End of it is transparent

- Even the first trochar can be inserted under vision

- Incidence of bowel injury

- Useful in - Adhesions of previous surgery,
  - Obese patients

**Laparoscopic instruments**
- Black coating around the instruments
  - Insulation: prevents current leakage

- If insulation breaks
  - Current leaks out and passes to trochar
As trocar is metallic, it passes the current and it burns the abdominal walls.

This is known as Capacitance.
To prevent capacitance: proper insulation.
  - use completely plastic trochars

Capacitance coupling / Direct coupling:
  - If one instrument carrying the current is in contact with the other instrument which is in contact with the bowel, this leads to passage of current from one instrument to the other end resulting in burning of bowel.

  - Triangulation helps to prevent this.

Problems of laparoscopy

- Time consuming
- Control of bleeding is difficult.
  - If there is bleeding from the operative site
    - Apply pressure to the site of bleeding using gauze
    - Topical Hemostats - Surgicel, Botro clot

- If there is bleeding from trochar site

  - Elongate the incision and do direct control of bleeding
  - Insert a Foley’s through trochar site and inflate balloon

- 2D vision
- Loss of tactile feedback.

Conventional laparoscopy

- Multiple ports are used.
  - Eg: Lap cholecystectomy - 4 Ports
  - Lap appendectomy - 3 ports

SILS:
- Single Incision Laparoscopic Surgery
  - One port inserted by 15 mm
Infraumbilical incision (3 ports):
  - Cosmetically better
  - A/V/A Single Port Access Surgery

Disadvantages:
  - High rate of incisional hernia.

Hand assisted laparoscopic surgery:
  - A port to insert hand without leakage of gases
  - Prevents the problem of loss of tactile feedback.

Notes:
  - Natural Orifice Transluminal Endoscopic Surgery.
  - Oral cavity
  - Rectum
  - Bladder
  - Vagina / uterus
  - No incision on abdomen.
  - Oral cavity → POEM - Per Oral Endoscopic Myotomy
    (Done for Achalasia)
    - Cystogastrostomy
    - TOGA - TransOral Gastroplasty
    - ROSE - Restorative Obesity Surgery Endoluminal
    - POSE - Primary Obesity Surgery Endoluminal.
  - Rectum → TaTME - Trans anal Total Mesorectal Excision.
  - Bladder → Varicocele surgery
  - Umbilicus instead not used in notes.

Robotic Surgery

  - Da Vinci Robotic Systems are used.
  - Works on the principle of master and slave concept.

Advantages:
  - Tremor reduction.
  - 3D Vision
  - More freedom of movement - 7 degrees of freedom → Better dissection and fine suturing.
  - Scaling of movement

Disadvantages:
  - Very expensive
  - Longer learning curve.
  - Loss of tactile feedback.
TRANSPANT SURGERY

• Source of organs:
  - Dead brain donors
  - Dead circulatory donors
  - Live donors
    → Kidney
    → Liver
    → Lung

Maastricht classification and organ stage

<table>
<thead>
<tr>
<th>Maastricht classification</th>
<th>Presentation of death</th>
<th>DCD situation</th>
<th>Organs procurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Dead on arrival</td>
<td>Uncontrolled</td>
<td>Tissue (heart valves, cornea)</td>
</tr>
<tr>
<td>II</td>
<td>Unsuccessful resuscitation</td>
<td>Uncontrolled</td>
<td>Kidney</td>
</tr>
<tr>
<td>III</td>
<td>Anticipated cardiac arrest</td>
<td>Controlled</td>
<td>All organs except heart</td>
</tr>
<tr>
<td>IV</td>
<td>Cardiac arrest in brain dead donor</td>
<td>Controlled</td>
<td>All organs except heart</td>
</tr>
<tr>
<td>V</td>
<td>Unexpected cardiac arrest in a hospital inpatient</td>
<td>Uncontrolled</td>
<td>All organs except heart</td>
</tr>
</tbody>
</table>

• In type II Maastricht classification, organs procurable are:
  - Kidneys + tissue (heart valves, cornea)

Organ storage
• Organs are stored in UW solution (University of Wisconsin)
• Stored in double/triple plastic bags
• Kept in solution at 4°C
• Key constituents of UW solution:
  → Adenosine → energy
  → Glutathione
  → Allopurinol → free radical scavengers
  → Lactobionase → stabiliser
• Each organ has its own cold-ischemia time
  (maximum period for which the organ can be kept in solution)
  → Maximum and optimal cold storage times (appropriate...
<table>
<thead>
<tr>
<th>organ</th>
<th>optimum (hours)</th>
<th>safe maximum (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney</td>
<td>&lt; 18</td>
<td>36 (maximum)</td>
</tr>
<tr>
<td>Liver</td>
<td>&lt; 12</td>
<td>18</td>
</tr>
<tr>
<td>Pancreas</td>
<td>&lt; 10</td>
<td>18</td>
</tr>
<tr>
<td>Small intestine</td>
<td>&lt; 4</td>
<td>6</td>
</tr>
<tr>
<td>Heart</td>
<td>&lt;3 (Least)</td>
<td>6</td>
</tr>
<tr>
<td>Lung</td>
<td>&lt;3</td>
<td>8</td>
</tr>
</tbody>
</table>

(Assuming zero warm ischaemic time and organs obtained from a non-marginal donor)

Renal Transplant

MC Indication

Adults:
  - Diabetic nephropathy

Children:
  - Glomerulonephritis

pancreatic islet transplant

simultaneous kidney and pancreatic transplant (SKP)

- Pancreas after kidney transplant (PAK)

- In pancreas transplant:
  - Anastomosis:
    - Artery → common iliac artery
    - vein → inferior vena cava / iliac vein
    - Exocrine secretions from pancreas

Duodenum

Bladder

→ monitor graft function by urinary amylase
Extended/Expanded donor criteria for renal transplant:

- A fit patient > 60 years
  - or
  - > 50 years with 2 or more:
    - Death due to stroke
    - History of hypertension
    - Serum creatinine > 1.5 mg/dL

- Kidneys which are harvested from marginal donors → slightly poor outcome compared to kidneys from healthy donors.

- Left kidney:
  - Preferred donor kidney
  - Longer renal vein

- Investigations carried out in a donor:
  1. ABO compatibility
  2. Rh compatibility: Not very important
  3. HLA compatibility
     → most important HLA: DR > B > A
  4. Kidney function test
  5. USG HUB
  6. Rule out infections
  7. Renal isotope scan
     → Function: MAG 3

     (Total and differential renal function)

- In a recipient

  Orthotopic
  - Graft at same anatomical location

  Heterotopic
  - Different Location
     - Preferred in Renal Transplant
     - Kidney placed in iliac fossa.

- In case of a dead donor, a path of aorta is taken along with renal artery.
Anastomosis (Dead donor):
- Renal Artery → End to side with external iliac artery
- Renal vein → End to side with external iliac vein
- ureter → Bladder

→ Gregor ISH technique
→ Lead better politano technique

Anastomosis (Live Donor)
- Renal Artery → End to End fashion with internal iliac artery.

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Complications of renal transplant: rejection

1. Rejection
   - Loss of function and histological changes (BANFF Classification)
   - Biopsies of organs:
     - Kidney, Liver → Needle biopsy
     - Bowel → Endoscopic mucosal biopsy
     - Heart → Subendocardial biopsy (Jugular vein)
Other complications of renal transplant

- Infection
  - Maximum incidence: within 6 months
  - First month: bacterial infections more common
  - Overall: viral infections are more common
  - MC organism: CMV
  - BK virus can infect kidney transplant patients
  - In India: TB is also common in kidney transplant patients

- Malignancy
  - MC: skin cancer (squamous cell carcinomas)

- PTLD (Post Transplant Lymphoproliferative Disorder)
  - EBV
  - High mortality rate
Liver transplant

- Indications
- Before transplant following scores are checked:
  - child - pugh score (CTP)
  - model for end stage liver disease score (MELD)
  - Pediatric end stage liver disease (PELD)
- HLA matching is not important
- HCC patients can get transplants provided they meet Milan criteria.
- Types:
  - orthotopic liver transplant
  - Donor organ is taken from a person suffering from systemic disease.
  - done in patient's segment: A9, left lobe goes to child.
  - 4, 5, 6, 7, 9B (right lobe) goes to adult.
  - Auxiliary orthotopic liver transplant (APOLT)
  - A9 segment goes to child.
- Sequence of anastomosis:
  1. Suprahepatic IVC
  2. Infrarehepatic IVC
  3. Portal vein
  4. Hepatic artery
  5. Bile duct

- King's College criteria for transplant in patients with Acute Liver Failure:

<table>
<thead>
<tr>
<th>Acetaminophen-induced ALF</th>
<th>Nonacetaminophen-induced ALF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial pH &lt; 7.30 after fluid resuscitation</td>
<td>Prothrombin time &gt; 100 sec (INR &gt; 6.5)</td>
</tr>
<tr>
<td>Or all of the following:</td>
<td>Or any 3 of the following:</td>
</tr>
<tr>
<td>• Prothrombin time &gt; 100 sec (INR &gt; 6.5)</td>
<td>• Non-A, non-B viral hepatitis, drug-induced or indeterminate etiology of ALF</td>
</tr>
<tr>
<td>• Serum creatinine &gt; 3.4 mg/dL.</td>
<td>• Time from jaundice to encephalopathy &gt; 7 days</td>
</tr>
<tr>
<td>• Grade 3 or 4 hepatic encephalopathy</td>
<td>• Age &lt; 10 years or &gt; 40 years</td>
</tr>
<tr>
<td></td>
<td>• Prothrombin time &gt; 50 sec (INR &gt; 3.5)</td>
</tr>
<tr>
<td></td>
<td>• Serum bilirubin &gt; 17.4 mg/dL</td>
</tr>
</tbody>
</table>

- Complications:
  1. Rejection
     - No hyper acute rejection
     - Acute rejection → within 6 months → chronic rejection → vanishing duct syndrome
  2. Infections
  3. Malignancy
  4. PTLD
  5. MC vascular complication: Hepatic artery thrombosis
     - Sudden decline in LFT
     - Majority require retransplant
  6. Biliary strictures

Heart transplant, lung transplant and GVHD
Pulmonary / Lung transplant

Isolated

Postero - lateral thoracotomy

Combined Heart and Lung

Anastomosis:
1. Pulmonary vein along with a cuff of left atrium (Donor)

Left atrium (Recipient)
2. Bronchial anastomosis
3. Pulmonary artery anastomosis

GVHD (Graft vs host disease)
- small intestine transplant (active lymphocytes)
- Typical rash on palm / sole
- GI dysfunction
- Liver abnormalities.
PLASTIC SURGERY, WOUNDS AND CLEFT LIP

Graft and skin graft

- Types of Grafts
  - Autograft
  - Isograft
  - Allograft
  - Xenograft

  - Graft from same person
  - Graft from identical twin
  - Graft from same species
  - Graft from different species

Skin graft

Two types

- Split thickness skin graft
  - Thin, Thiersch graft
  - Epidermis + part of dermis

- Full thickness skin graft
  - Thick, Wolfe's graft
  - Epidermis + entire dermis
### Skin graft - donor site differences

<table>
<thead>
<tr>
<th>Split - thickness</th>
<th>Full - thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>m/C donor site - thigh &gt; buttocks</td>
<td>m/C donor site - postauricular skin, supra/infra clavicular fossa</td>
</tr>
<tr>
<td>The skin graft is raised using Humby knife</td>
<td>axillary skin is never used</td>
</tr>
<tr>
<td>Electric dermatome</td>
<td></td>
</tr>
<tr>
<td>If punctate hemorrhage points are seen when graft is raised, it indicates right thickness of the graft</td>
<td></td>
</tr>
<tr>
<td>After raising graft → meshing/scoring of graft is done</td>
<td>Suture the donor site</td>
</tr>
<tr>
<td>↓ i) Surface area ~ 1.5 times</td>
<td>Donor site cannot be reused</td>
</tr>
<tr>
<td>ii) Prevents fluid accumulation beneath the graft</td>
<td>primary contracture ( \propto ) amount of dermis</td>
</tr>
<tr>
<td>Only dressing is required</td>
<td>The graft shrinks immediately after cutting it</td>
</tr>
<tr>
<td>Donor site can be reused later</td>
<td>↑ ↑ with full thickness graft</td>
</tr>
<tr>
<td>Secondary contracture inversely proportional amount of dermis</td>
<td></td>
</tr>
<tr>
<td>The graft shrinks after it is placed on recipient site</td>
<td></td>
</tr>
<tr>
<td>↑ ↑ with split-thickness graft</td>
<td></td>
</tr>
</tbody>
</table>

**Plastic Surgery**
- Humby knife
- Electric dermatome

**Skin Grafts**

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Scanned with CamScanner
**Skin graft - recipient site differences**

<table>
<thead>
<tr>
<th>Split-thickness skin graft (STSG)</th>
<th>Full thickness graft</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Survival/take up - better</td>
<td>• more resistant to trauma</td>
</tr>
<tr>
<td>• Uses in burns patients</td>
<td>• Cosmetically better (Colour matching is better)</td>
</tr>
<tr>
<td>• In skin banks - STSG can be stored for 2-3 weeks at 4°C</td>
<td></td>
</tr>
</tbody>
</table>

- **Graft survival - 3 methods**
  - Imbibition
    - for 24-48 hrs
  - Inoculation
    - for 2-4 days
  - Neovascularisation
    - after 4 days
    - The capillaries from the graft go into recipient bed and draws nutrients and fluid
    - donor and recipient vessels anastomose

- **Graft failure**
  - MC cause - collection or hematoma beneath the graft
  - Infection
    - β-hemolytic streptococcal infection
    - hence, recipient site should be free of infection before grafting
  - Movement
    - Constant shearing movement
  - Poor recipient bed
    - • Excessive granulation tissue
    - • Lacks periosteum
Flaps - random flap

- The flap is rotated but not based on named blood vessel.
- The length to width ratio

  Ideal - 1.5:1 (maximum - 3:1 \(\rightarrow\) risk of failure)

Types of random flap

- **v-y plasty**
  - A 'v' shaped incision is made
  - Sutured in a 'y' shape
  - Causes elongation of wound
  - Uses - Post burn contracture, cleft palate, ano-plasty

- **z-plasty**
  - 'z' shaped incision is made
  - Two triangle created
  - The triangles are transpositioned
  - Causes elongation of wound
  - Ideal angle - 60°
  - Leads to 1.75 times elongation of the wound
  - Uses - Post burn contractures

- **Rhomboid flap**
  - n/n/a Limberg flap
  - Used in - Pilonidal sinus or Jeep driver's disease

- **v-plasty**
  - Bilobed flap
  - For tip of nose reconstruction
  - Eg - in basal cell carcinoma over tip of the nose

- **bipedicled flap**
  - For eyelid reconstruction
Flaps - axial flaps

- The flap is rotated on a named blood vessel
- In head and neck reconstruction

i) MC used - Pectoralis major myocutaneous flap
   - Incision given on pectoralis major (medially)
   - The pedicle - pectoral branch of thoracoacromial artery
   - The flap is lifted and swung up on the pedicle

ii) Deltopericostal flap
   - The blood supply is from - perforators of internal mammary vessels
   - Incision given laterally over the muscle
   - Lift the muscle medially and swing it up
Abbe-Estlander flap
- A/V/A - Lip switch flap
- blood supply - Labial vessels
- Two components

Abbe  Estlander
used for midline used for commissural reconstruction
lip reconstruction and angle of mouth

Flap - axial flaps - breast reconstruction

Breast reconstruction
- Latissimus dorsi flap

The latissimus dorsi muscle is dissected and is placed anteriorly
to do breast reconstruction.

- TRAM flap - MC used for breast reconstruction

Transverse rectus abdominis myocutaneous flap
An elliptical incision over the lower abdomen
blood supply - Superior epigastric vessels
muscle moved up & reconstruct the breast
**Disadvantage** - abdominal wall weakness
- Free TRAM
  - Blood supply - inferior epigastric vessels
  - TRAM flap + free TRAM flap - Super charged TRAM

**Flaps - free flap**

- Disconnected from donor site and microvascular anastomosis done at recipient site.
- DIEP flap - Deep inferior epigastric artery perforator flap
  - Elliptical incision over the lower abdomen
  - Skin and fat is dissected, muscle is not dissected
  - Microvascular anastomosis to axillary vessels
  - Breast reconstruction.
- DIEP flap - best method for breast reconstruction.

**Head and neck free flap reconstruction**
- Free fibular flap - MC for mandibular reconstruction based on peroneal vessel.
  - Also used for Andy Gump deformity

- Radial artery forearm flap.

Radial artery flap  
Free fibular flap
Flaps - composite, conjoined, chimeric

- Composite flap
  - more than one element
  - Skin, fat, muscle

- Conjoined flap
  - There are two territories supplied by different vessels

- Chimeric
  - Different territories
  - Not joined to each other
  - But with same mother blood supply and are joined at the skin
  - Separate perforator but mother vessel is same

*Angiosome - Anatomical territory supplied by a vessel*
Bed sore / pressure sore

- Occurs due continuous \( \bullet \) in pressure
- Pressure \( > 30 \) mm Hg
- MC site - ischium

Staging of Bed sore

**Stage 1** - Non-blanchable erythema without a breach in the epidermis

**Stage 2** - Partial-thickness skin loss involving the epidermis and dermis

**Stage 3** - Full thickness skin loss extending into the subcutaneous tissue but not through underlying fascia

**Stage 4** - Full thickness skin loss through fascia with extensive tissue destruction, may be involving muscle, bone, tendon or joint.

Pressure sore frequency in descending order

- Ischium
- Greater trochanter
- Sacrum
- Heel
- Malleolus (lateral then medial)
- Occiput

Management

**Stage I**
- \( \times \)  
- Keep area dry
- Frequent change of position

**Stage II, III**
- \( \times \)  
- Debridement
- Dressings

**Stage IV**
- \( \times \)  
- Debridement & flap
- Tensor Fascia Lata (TFL) flap

- Based on lateral circumflex femoral vessels

Tensor Fascia Lata (TFL) Flap

Lateral Circumflex Femoral

Pre-operative

Post-operative
Bed sore prevention
- Keep area dry
- Frequent change of position

For bed bound patient
- Every 2 hrs
- Air / water mattress
- Provide good nutrition

For wheelchair bound patient
- Lifted for at least 10 sec every 10 mins

Dressings

- Alginates & foam
- Hydrocolloid & hydrogel
- Collagen

- Highly absorbent
- Used for exudative wounds
- Occlusive, water proof
- But cannot absorb
- Uses-clean wound
- e.g. Duoderm dressing
- In burns - if wound is clean
- Non infective wound (because collagenases are released in infective wound)
- Use- burns

Vacuum Assisted Closure (VAC)
- Negative pressure dressing
- An occlusive dressing is placed over the sore
- It is connected to VAC - generates - 125 mm Hg of pressure
- Sucks exudate (✓ wound healing)

Uses
1) Chronic non healing wounds
2) Venous ulcer (without slough)
3) Diabetic ulcer (without osteomyelitis)
4) Burns wound (without eschar)
5) Bed sore
Dressing- tegaderm, steri-strips, tissue glue

Tegaderm
- transparent film dressing / opsite
- Occlusive, water proof dressing
- Can see through the dressing

Steri strips
- Paper strips
- used when needle scar by suturing is not preferred
- used for approximation of skin edges

Tissue glue
- cyanoacrylate
- used for approximation of skin edges in lobuloplasty

Wound healing

- Phase of wound healing

Hemostasis
- Occurs 1st
- occurs hours to days

Inflammatory
- Occurs - days to weeks

Proliferative
- Type I collagen replaces type III
- Only 80% of the strength is regained

Remodelling
Meloids and hypertrophic Scar

<table>
<thead>
<tr>
<th>Keloid</th>
<th>Hypertrophic Scars</th>
</tr>
</thead>
<tbody>
<tr>
<td>• MC site - Sternum, earlobe, shoulder</td>
<td>• In extensor surface</td>
</tr>
<tr>
<td>• Racial - Dark skinned people</td>
<td>• Common in children</td>
</tr>
<tr>
<td>• Don't subside with time and pressure</td>
<td>• Grow within the boundary of the scar and subside with time and pressure</td>
</tr>
<tr>
<td>• Raised, red &amp; itchy</td>
<td>• Use of silicone pads/gels - ↓ chances for scar formation</td>
</tr>
<tr>
<td>• Grow beyond the boundary of the scar</td>
<td></td>
</tr>
<tr>
<td>• Management - intralesional Triamcinolone</td>
<td></td>
</tr>
</tbody>
</table>

Wound healing by primary, secondary, tertiary intention
Primary intention ➔ Secondary intention ➔ tertiary intention ➔
- better scar formation
- • more wound contracture
- • ↑ granulation tissue
- • Delayed primary closure
- • Initially wound is left open ↓ dressing done ↓ once infection subsides ↓ granulation tissue formation occurs ↓ Resuture the wound

Cleft lip and cleft palate

- Seen in 1 in 600 live birth
- Males > Females
- MC defects - Combined lip + palate
- Risk factors - Environmental - Maternal epilepsy, drug during pregnancy - Phenytoin, Steroids, Strong genetic predisposition
- Associated with Pierre Robin syndrome
  - • Retrognathia
  - • Posterior displaced tongue
  - • Isolated cleft palate

Documenting cleft lip and cleft palate

L A H S A L
↓ ↓ ↓ ↓ ↓
Lip Alveolus Hard palate Soft palate Alveolus Lip of (other side) other side

- Capital- ‘L’. denotes complete cleft
- Lower case- ‘I’ - denotes partial cleft
- E.g La sa
  ↓
  complete lip, partial alveolus on same side, partial soft palate, partial alveolus on other side
Cleft lip and cleft palate - problems and management

Problems
1) Cosmetic
   a) Speech abnormalities
   b) Difficulty in feeding
   c) Incidence of middle ear infections

Management
- Surgery

Cleft lip  
  - within 3-6 months
  - Millard repair (MC)

Cleft soft palate  
  - within 3-6 months
  - Z-plasty

Cleft hard palate  
  - wait for 9-12 months
  - Surgery is deferred for 15 months
  - Wardill-Kilner (V-Y plasty)
  - Unipedicle repair
  - Von Langenbeck
  - Bipedicle repair

Complication of Surgery
1) Hemorrhage
   a) Infection
   b) Malaligned cupid's bow

   Require resurgery
   - Velopharyngeal insufficiency (the palate moves like a flap)

   - Causes speech abnormalities
   - Require resurgery

- If all three abnormalities are present in a child

  1st surgery at 3-6 months: repair cleft lip and soft palate
  and surgery at 9-12 months: repair cleft hard palate

Tissue expander
- Used to expand a contracted tissue, after expanding enough,
  an implant is placed, eg-for breast reconstruction
NEUROSURGERY

Tumors in neurosurgery

- MC brain tumor : Metastasis.
- MC organ metastasizing to brain : Lungs (to cerebral hemispheres).
- MC cancer which metastasizes to leptomeninges : Breast.
- Features : Headache, seizures, focal neurological signs.
- IOC : MRI with Gadolinium contrast.

Management of brain metastasis

- ↓ Intracranial tension : Steroids (vasogenic cerebral edema)
- Surgery : For solitary brain metastasis → whole brain radiotherapy (WBRT)
- Stereotactic radiosurgery / Gamma Knife / Cyber Knife : multiple precisely directed beams of radiotherapy to tumor (less collateral damage)
- Chemotherapy not useful, except in Seminomas, small cell lung Ca.
- MC primary brain tumor : Meningioma > Gliomas
- MC primary brain tumor in children : Medulloblastoma.

Glial tumors - types

- Astrocytoma, oligodendrogloma, ependymoma.

- Astrocytoma : Adults : Supra-tentorial
  Children : infra-tentorial
  MC posterior fossa tumors in children

WHO Classification of astrocytomas

- Grade I : Pilocytic astrocytoma:
  - As a mural nodule, no infiltration;
  - MC astrocytoma in children ; Low grade → : Best prognosis
  - Diagnosis : MRI - discrete, contrast enhancing cystic lesion with a mural nodule.
  - Management : Surgical excision.
- Grade II: Low grade, diffuse astrocytoma: in children/young adults.
  Nuclear atypia, low cellularity; Present with seizures.
  If low grade, PIK3CA/CDKN2A mutated \rightarrow Converts to high-grade tumor.

  Diagnosis: MRI
  Management: Surgery followed by WBRT.

- Grade III: Anaplastic astrocytoma: Present with seizures, personality changes - if in frontal lobe.
  Diagnosis: MRI - irregular enhancing lesion.
  Management: Surgery followed by external beam radiotherapy (EBRT) (brain RT).

- Grade IV: Glioblastoma multiforme (GBM): Most aggressive, crosses midline sometimes \[= \text{Butterfly tumor}\]. Common in elderly, seizures.
  HPE: necrosis, Pseudopalisading pattern.
  MRI: Ring enhancement with central necrosis.
  Management: Surgery followed by EBRT.
  Oral Temozolomide has improved survival in GBM patients.

**Warning**: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

**Oligodendroglialoma**

- Loss of heterozygosity on Chromosome 19q > 1p (if this mutation; good response to Temozolomide).
- In white matter - frontal lobe. Presents with seizures.
- Diagnosis: MRI: Shows calcifications.
- Brain tumors showing calcifications on MRI:
  Craniopharyngioma (MC) > Oligodendroglialoma > Meningioma.
- HPE in oligodendroglialoma: Fried egg cytoplasm
  \(= \text{Halo around nucleus}\)
  Chicken wire vascularities.
  Microscopic calcifications.
- Management: Surgery followed by chemotherapy.
  Chemotherapy: - Procarbazine
  - Lomustine
  - Vincristine
  - Oral Temozolomide
  (Mutations have good prognosis.)
Ependymoma

- MC: myxopapillary ependymoma (from filum terminale of spinal cord)
- Present with hydrocephalus
- Can spread via CSF.
- MRI: Diffusely enhancing mass.
- HPE: Pseudo-rosettes
- Management: Surgical followed by EBRT
  - If CSF spread → Craniospinal radiation given

Meningioma

- Arise from meningeal cells/ arachnoid cap cells.
- MC: primary brain tumor, in adults (female > male)
- Slow growing, well encapsulated.
- Intra cranial, extra axial, dural based
- Diagnosis: MRI, HPE - Psammoma bodies
- Chromosome 22 mutation
- Express progesterone receptors: ↑ growth during pregnancy
- Management: Surgical excision

Primary CNS lymphoma

- Usually non-Hodgkin lymphomas: ↑ incidence: HIV/AIDS and transplant recipients
- Features: seizures, ↑ ICT
- Called ghost cell tumors: partial, quick resolution of tumor with steroids
- Diagnosis: Stereotactic biopsy
- Management: steroids, chemotherapy - methotrexate (intra - thecal), cytarabine; EBRT

Medulloblastoma

- 3-4 yrs age mainly.
- Can be associated with Turcot syndrome (variant of FAP syndrome): APC mutation.
- Highly malignant; usually infra tentorial and present in cerebellum in children - tend to occur in vermis present with ↑ ICT.
- Exhibit **Drop metastasis through CSF**
  - Metastasis outside brain: Bone, liver, lymph nodes
- **Diagnosis:** MRI
- **Management:** Surgery, highly radio sensitive
  - Chemotherapy: Carmustine and vincristine.

### Syndromes in Neurosurgery

- **NF 1 - 17q:** Neuroma, Schwannoma, Optic glioma, Meningioma
- **NF 2 - 22q:** Schwannoma, Glioma, Ependymoma
- **Li Fraumeni syndrome - p53:** 17p - Malignant gliomas
- **Turcot syndrome - APC:** 5q - Medulloblastomas
- **MEN 1 - 11q:** Pituitary adenoma
- **VHL - 3p:** Hemangioblastoma of retina
  - Pheochromocytoma.

### Acoustic Neuroma

- **MC involves inferior vestibular nerve > superior vestibular nerve**
- **Situation:** At CPA (Cerebellopontine angle) commonly
- **Benign, encapsulated, slow growing**
- **Features:** Unilateral sensorineural hearing loss (SNHL) with tinnitus (MC VII, X, XI cranial nerve involvement
- **Diagnosis:** MRI
- **Management:** Surgery
- **MC spinal tumors:** metastasis
- **MC primary spinal tumor:** Nerve sheath tumors
- **MC intra - medullary tumor:** Astrocytoma
- **MC location of spinal tumors:** Intradural extramedullary
- **Tumors that can "spread through CSF":** Pinealoblastomas
  - CNS lymphomas
  - Medulloblastoma
  - Germ cell tumors
Herniation syndrome

Herniation syndromes

A) Uncal (lat transtentorial): Ipsilateral III palsy ("blown" pupil) + contra hemiplegia/posturing (Kernohan notch phenomenon)
   temporal lobe mass → medial temporal lobe under tent. cerebelli

B) Central transtentorial: Coma + b/l small pupils
   → decorticate → decerebrate posturing + rostral →
   caudal loss brainstem reflexes
   diffuse cerebral edema → ↓ displacement
diencephalon

C) Subfalcine: Coma + contra. weakness → posturing
   esp leg ± ACA stroke
   frontal/parietal mass → cingulate gyrus
   under falx

D) Cerebellar (↑ or ↓): Cerebellar SIs/Sx + medullary
dystk → coma + b/l posturing

Meningocele

- Posterior vertebral arch defect
- Herniation of meninges, but spinal cord is normal. Can be associated with tethering of spinal cord
- Features: Fluctuant mass, is "brilliantly transilluminant"; Commonly situated in lower back and well covered by skin
- Diagnosis: X-ray
- Management: If skin cover intact, patient normal: Delayed surgery.
  If CSF leak(+) : Immediate surgery.
  If spinal cord tethering(+) : Detether the cord.

Spina bifida occulta

- Occult spina bifida. Sometimes tuft of hair at site
- Incidental finding.
- If patient normal: No intervention required

Meningomyelocele

- Severe neural tube defect - meninges and cord both herniate out.
- Genetic predisposition: If one child affected - 5% higher risk
  If two children affected - 10% higher risk
- Folate deficiency in mother.
- Women on trimethoprim, phenytoin, phenobarbital, valproic acid are at higher risk of developing neural tube defect
- MC location: lumbo - sacral region.
- If in sacral region - child can have bowel and bladder incontinence, anesthesia in perianal region
- If in mid - lumbar region - Paraplegia
- Management: Surgery
  - Even after surgery, residual neurological deficits may persist.

**Arnold Chiari Malformation**

<table>
<thead>
<tr>
<th>Chiari I</th>
<th>Chiari II</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Displacement of cerebellar tonsils (&gt;5mm) into cervical canal</td>
<td>- Elongation of hind brain and kinking of brain stem</td>
</tr>
<tr>
<td>- In adult life</td>
<td>- Hydrocephalus +</td>
</tr>
<tr>
<td>- Not associated with hydrocephalus.</td>
<td>- X-ray: Small posterior fossa, widened cervical canal</td>
</tr>
<tr>
<td>- Neck pain and spasticity +</td>
<td>- Management: Surgical decompression/hydrocephalus correction</td>
</tr>
<tr>
<td>- Syringomyelia +</td>
<td></td>
</tr>
</tbody>
</table>

**Dandy Walker Malformation**

- Cystic 4th ventricle expansion and midline cerebellar hypoplasia.
- Triad - hypoplasia of vermis
  - Enlarged posterior fossa
  - Rotation of vermis and dilatation of 4th ventricle.
- MC posterior fossa malformation
- Features: Macrocephaly (MC), Hydrocephalus, ataxia, delayed motor development
- IOC: MRI
- Management: Treat hydrocephalus (shunting);
  Poor prognosis.

**Berry Aneurysm**

- Saccular aneurysms
- Pre-disposing factor: HTN, smoking
- ↑ risk in: Adult polycystic kidney disease, Marfan’s syndrome,
  Ehler-Danlos syndrome
- Multiple (30-30%)
- MC location: Junction of anterior cerebral artery and anterior communicating artery (30%)
• Wall:
  Thickenened hyalinized intima.
• Usually rupture at apex.
• Cause both sub-arachnoid and intra-arachnoid hemorrhages.

Sub arachnoid hemorrhage (SAH)

• Spontaneous SAH: Features:
  - Severe excruciating head ache / worst headache of life / Thunderclap headache.
  - Transient loss of consciousness.
  - Vomiting and neck stiffness.
  - Focal neurological signs - usually “absent”.
• Terson syndrome: SAH + vitreous hemorrhage.
• MCA aneurysm: Pain behind the eye.
• Aneurysm at TCA and ICA junction: 3rd nerve palsy.
• Inferior cerebellar artery: Occipital and posterior cervical pain.

WFNS grading of SAH

• WFNS [World Federation of Neurosurgical Societies]:

<table>
<thead>
<tr>
<th>Grade</th>
<th>GCS</th>
<th>Focal deficits</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>(ii)</td>
<td>13 - 14</td>
<td>-</td>
</tr>
<tr>
<td>(iii)</td>
<td>13 - 14</td>
<td>+</td>
</tr>
<tr>
<td>(iv)</td>
<td>7 - 12</td>
<td>+/-</td>
</tr>
<tr>
<td>(v)</td>
<td>3 - 9</td>
<td>+</td>
</tr>
</tbody>
</table>

Hunt - Hess Scale - SAH

• Grade 1: Mild headache, normal mental status.
• Grade 2: Severe headache, normal mental status.
• Grade 3: Confused, mild motor deficit.
• Grade 4: Stupor, moderate - severe motor deficit.
• Grade 5: Coma.
• Diagnosis of SAH: NCCT (early)
  if late presentation: CSF tap - xanthochromia.
• Management of SAH: surgery → Clipping of aneurysm (or)
  → Angiographic coiling
  → Shunt surgery

• Complications post surgery:
  • Re-bleeding
  • Hydrocephalus (usually communicating)
  • Delayed ischemic Neurologic deficit (DIND):
    3-10 days post-surgery
    Can progress to infarction if not managed early.
    Nimodipine can be used to prevent vasospasm.

**Triple H therapy - SAH**

• Hypervolemia.
• Hemodilution
• Hypertension
Abdominal wall defects in children

Omphalocele
- Defect through the umbilicus
- Bowel remains outside; is covered by a peritoneal sac
- Bowel → malrotation
- Cardiac defects
- No viscera other than bowel is exposed
- A type of physiological hernia

Gastrochisis
- Defect adjacent to the umbilicus (Common on right side)
- Bowel → exposed (No sac covering the bowel)
- Bowel → exposed → dry → inflammed
  Perforation
- Liver → can be exposed as well

Management of abdominal wall defects:
1) Look for other abnormalities.
2) Correct dehydration.
3) SILO → made out of a mesh to cover the defect

Anorectal malformation

Surgery • v2.0 • Marrow 4.0 • 2020
males:
- No anal opening
- Fistula \(\rightarrow\) between rectum \& urinary tract.

Female:
Either Fistula (+)
(or)
Anal \& vaginal opening are close to each other

\[
\begin{array}{|c|c|}
\hline
\text{Male} & \text{Female} \\
\hline
\text{High} & \text{Rectovesical fistula.} & \text{Rectovaginal fistula.} \\
\text{Intermediate} & \text{Rectourethral fistula.} & \text{Rectovestibular fistula.} \\
\text{Low} & \text{Anal stenosis} & \text{Anal agenesis without fistula.} \\
\text{Miscellaneous} & \text{Rare malformations} & \text{Rare malformations} \\
\hline
\end{array}
\]

Clinical features:
- No anal opening
- Fistula (+)

Diagnosis of ano - rectal malformation

1. Invertogram
- Done after 24hrs [Time required for gas to reach lower part of rectum]
- Radio - opaque marker - placed on proposed anal opening site
  Distance between rectal bubble & skin marker - measured

  Distance > 2 cm
  High defect

  Distance < 2 cm
  Low defect

a. CT / MRI → Provides better delineation of soft tissue

Rule out other congenital anomalies

  V - Vertebral defect
  A - Anorectal defect
  C - Cardiac defect
  T - Tracheo- esophageal
  R - Renal defect
  L - Limb defect

Management of ano rectal malformations

- Classification given by Pena

<table>
<thead>
<tr>
<th>Males</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perineal fistula</td>
<td>Perineal fistula</td>
</tr>
<tr>
<td>Rectourethral fistula</td>
<td>Vestibular fistula</td>
</tr>
<tr>
<td>Bulbar</td>
<td></td>
</tr>
<tr>
<td>Prostatic</td>
<td>Persistent cloaca</td>
</tr>
<tr>
<td>Rectovesical fistula</td>
<td>&lt;3 cm common channel</td>
</tr>
<tr>
<td>Imperforate anus without fistula</td>
<td>&gt;3 cm common channel</td>
</tr>
<tr>
<td>Rectal atresia</td>
<td>Imperforate anus without fistula</td>
</tr>
<tr>
<td></td>
<td>Rectal atresia</td>
</tr>
</tbody>
</table>

- Management:
  - Surgery → PSARP (posterior sagittal Anorectoplasty)

  Low anomaly → Single stage PSARP
  - Perineal approach

  High anomaly → 2 stage procedure
  - Abdominal + perineal approach
  - Colostomy - initially
- Complications of surgery
  - Fecal incontinence
  - Urinary incontinence
TESTICULAR DISORDERS

Undescended Testis

Genital ridge
( Retroperitoneum )

3 months of
intrauterine
life

Trigger Factors :
1 • Differential abdominal
wall growth ( m/l )
2 • Pull of gubernaculum
( least )
3 • Hormonal

6 months
iliac fossa.

7 months inguinal
canal

8 months superficial
ring

9 months scrotum

• Left testis descends earlier
• Preterm: higher incidence
• Descent can occur till 4-5 months after birth.

Incompletely descended / undescended

• Testis is arrested along normal path of descent
• If bilateral → cryptorchidism
• Right > left
• M. C site → inguinal canal
• Changes :
  → ↓ Volume
  → ↑ Risk of ITGCN ( intra-tubular germ cell neoplasm )
  → Sertoli cell are more affected → Spermatogenesis suffers
  → Leydig cells are affected less → Testosterone normal

Normal secondary sexual features

• Higher the testis → ↑ Histological changes
• Clinical features:
  On Examination: If inguinal testis → Palpate
If intraabdominal testis → IOC: Diagnostic laparoscopy

**Diagnostic Laparoscopy**

- Testis is located
  - Orchidopexy
- Testis is not located
  - Look at deep ring
    - (search for testicular vessels)
      - Positive
        - Keep searching
      - Negative
        - Intraperitoneal torsion
          - (vanishing testis)

**Undescended testis: management and complications**

- Management: surgery
  - Orchidopexy
- Ideal time: 6-12 months
- Limiting factor: Length of testicular vessels
- Techniques:
  1. Stephen Fowler technique
     - 2 stage technique
     - First stage: High ligation of testicular vessels and bring testis in
       inguinal canal
     - Second stage: Scrotum
  2. Keetley Torek Procedure
  3. Silbar Procedure
     - Best results
     - Disconnect testicular vessel and testis is brought to scrotum,
       microvascular anastomosis of vessels with branch of internal
       iliac vessel.

**Complications**

- Mnemonic: Testis
  - T → Torsion
  - E → Epididymo-orchitis
  - S → Sterility: orchidopexy doesn’t reverse sterility
  - T → Trauma
  - I → Indirect inguinal hernia (m.c)
S → Seminoma.
   ↓ 6-9 times higher
   → Risk of cancer doesn't reduce with orchidopexy, but favours early detection.

**Ectopic testis and retractile testis**

Ectopic Testis
- Testis deviates from normal path of descent
- M.C site: superficial inguinal pouch
- Management: orchidopexy

Retractile testis
- Normal variant
- Normally testis in scrotum, but occasionally testis jump into inguinal canal
- Management: Reassurance

**Torsion**

- Risk factor:
  1. Testicular inversion
  2. Bell - clapper testis
     → ↑ investment of tunica vaginalis
  3. Undescended testis
  4. Torsion of cyst of morgagni
     → Same clinical features as torsion
     → Blue dot sign
- Clinical features:
  → Young males
  → Acute scrotal pain and swelling
  → Differential diagnosis: acute epididymo-orchitis
     → History of UTI
     → Acute scrotal pain and swelling
- Clinically differentiating between torsion and epididymo-orchitis
  → Prehn sign
  → Lift involved testis
  → Deming sign
  → Testis which has undergone torsion, at higher level
  → Angel sign
  → Testis which has undergone torsion, is transversely placed
**Epididymo-orchitis**

- Clinical diagnosis, supported by doppler
- Management:
  - Scrotal exploration
    - Testis viable
      - If exploration is done within 6 hours
      - 100% salvage rate
      - De rotate and do orchidopexy
    - Testis necrosed
      - 720° turn
      - Late presentation
      - Orchidectomy
    - Prophylactic orchidopexy on contralateral side in the same sitting.

**Epididymo-orchitis**

- M. C organism < 40 years: Chlamydia
- M. C organism > 40-45 years: E. coli (a° to UTI)
- Clinical features:
  - Differential diagnosis: Torsion
- Management:
  - Antibiotics
  - Scrotal support

- Spermatocele
  - Unilocular swelling
  - Involves epididymal head
  - Sperm transport mechanism (cyst forms there)
  - Barley coloured fluid
  - Sperm Ø
  - If patient is symptomatic
    - Excision

- Epididymal cysts
  - Multiloculated (bunch of grapes)
  - Cystic degeneration of epididymis
  - Crystal clear fluid (brilliantly transluminant)
    - Chinese lantern pattern
      - If patient is symptomatic
        - Excision
        - But it can interfere with sperm transport
**Hydrocele**

- Accumulation of fluid tunica vaginalis.
- Types:
  - **Vaginal**: m/c
  - **Hydrocele**

Vaginal hydrocele

- **P** vaginal
- **A** vaginal

  - m/c overall
  - A° to epididymo-orchitis (m/c for A°)
    - Trauma
    - Tumor

- Defective absorption of fluid
- Tense swelling
- Testis is not palpable
- Clear fluid (Transilluminant)

- In a vaginal hydrocele, can get above swelling:
  - Scrotal swelling

- ↑ secretion of fluid
- ↑ lax swelling
- Testis is palpable
- Turbid fluid
management of vaginal hydrocele: Surgery

Small hydrocele

↓

Lord's plication

→ Jaboulay procedure
    (Eversion of Sac)

→ Infantile hydrocele
    • Extends till superficial ring
    • Not able to get above swelling
    ↓
    Inguinoscrotal swelling

→ management: Eversion of Sac +
    Excision of excess sac

Encysted hydrocele of the cord
    • Cystic swelling along the cord

Congenital hydrocele
    • Patent processus vaginalis
    • Have a hernial sac invariably
    • Management: Herniotomy
        (2-3 years of age)

Varicocele

• Dilated tortuous pampiniform plexus of veins.
• Common cause of male infertility
• Left > Right:
1. Left testicular vein \( \rightarrow \) longer
2. Opens at right angles to renal vein
3. Sigmoid colon can press on left testicular vein
4. Left adrenal vein opens opposite to opening of left testicular vein

- Normal scrotal temperature is \( 1^\circ \text{C} \) less than abdominal temperature
- When varicocele occurs \( \rightarrow \) Scrotal temp \( \uparrow \uparrow \)
  \[ \text{Spermatogenesis suffer} \]
- Clinical features: Asymptomatic
  - Dull pain in scrotum
  - Swelling in scrotum
  - Infertility
- On examination: ‘Bag of worms’ consistency
- IOC: Doppler
- Grading:
  1 \( \rightarrow \) Impalpable, but positive on doppler
  2 \( \rightarrow \) Palpable
  3 \( \rightarrow \) Visible
- Management: Only symptomatic patients require management

\[ \text{Embollisation} \quad \text{varicocelectomy} \]

1. Open
   \[ \rightarrow \text{inguinal method} \]
   \[ \downarrow \]
   \[ \rightarrow \text{Ivanisevic method} \]
2. Retroperitoneal
   \[ \rightarrow \text{A/V/A Paloma procedure} \]
   \[ \rightarrow \text{Transvesical route} \]
   \[ \rightarrow \text{High ligation of veins} \]

NOTES - Natural Orifice Transluminal Endoscopic Surgery
- High recurrence rate due to dual blood supply
- Only 20-30% patients show improvement in sperm count

**Testicular tumors**

- Mc Testicular tumor:
  \[ \rightarrow \text{Children: Yolk sac tumor} \]
  \[ \rightarrow \text{Adults} \]
  \[ \left\{ \begin{array}{l}
  \text{Seminoma} \\
  \text{Overall}
  \end{array} \right. \]
  \[ \rightarrow \text{Elderly:} \]
  \[ \left\{ \begin{array}{l}
  \text{Lymphoma} \\
  \text{Mc Bilateral}
  \end{array} \right. \]
• Risk Factors:
  → undescended testis (↑ risk by 6–9 times)

• Clinical Features:
  → painless testicular mass (m.c.)
  → Abdominal lumps (Retroperitoneal lymph node mass)
  → Feminisation → Sertoli cell tumours
  → masculinisation
    Precocious puberty → Leydig cell tumors
  → Cannon ball metastasis to lungs
  → Hurricane → Rapidly progressive tumor
    → Choriocarcinoma
    → Median survival: 6 months
    → CNS metastasis
    → Spontaneous regression

• Diagnosis:
  Imaging: CECT
  Tumor markers: β HCG, LDH, AFP
  → Lot of times there is absence of a clear finding which indicates the presence of tumor

  Suspecting Testicular Tumor
  Chivassu manoeuvre
  → High inguinal incision
  Deliver the testis through the incision
  Soft clamp on cord, split testis and send frozen section.

  Positive cancer
  Crushing clamp on cord and do a high inguinal orchidectomy
  No cancer
  → No further surgery

• Transscrotal biopsy / FNAC should not be done in suspected testicular tumors
Staging of testicular tumors

- Staging for testicular tumors: TNM
  - **s** → value of tumor markers (post orchidectomy value)
  - 1st draining lymph nodes: Regional lymph nodes

  ![Diagram of lymph nodes]

<table>
<thead>
<tr>
<th>N</th>
<th>Regional Lymph Nodes - Clinical</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX</td>
<td>Regional lymph nodes cannot be assessed</td>
</tr>
<tr>
<td>N0</td>
<td>No regional lymph node metastasis</td>
</tr>
<tr>
<td>N1</td>
<td>Metastasis with a lymph node mass 2 cm or less in greatest dimension and 5 or fewer positive nodes, none more than 2 cm in greatest dimension</td>
</tr>
<tr>
<td>N2</td>
<td>Metastasis with a lymph node mass more than 2 cm but not more than 5 cm in greatest dimension; or more than 5 nodes positive, none more than 5 cm; or evidence of extranodal extension of tumour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>pT</th>
<th>Primary Tumour</th>
</tr>
</thead>
<tbody>
<tr>
<td>pTX</td>
<td>Primary tumour cannot be assessed (see note 1)</td>
</tr>
<tr>
<td>pT0</td>
<td>No evidence of primary tumour (e.g. histological scar in testis)</td>
</tr>
<tr>
<td>pT1</td>
<td>Intratubular germ cell neoplasia in situ</td>
</tr>
<tr>
<td>pT2</td>
<td>Tumour limited to testis and epididymis without vascular/lymphatic invasion; tumour may invade tunica albuginea but not tunica vaginalis</td>
</tr>
<tr>
<td>pT3</td>
<td>Tumour limited to testis and epididymis with vascular/lymphatic invasion, or tumour extending through tunica albuginea with involvement of tunica vaginalis</td>
</tr>
<tr>
<td>pT4</td>
<td>Tumour invades spermatic cord with or without vascular/lymphatic invasion</td>
</tr>
</tbody>
</table>

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.
Management of testicular tumor

- Management:
  
  High inguinal orchidectomy

  Seminoma

  Stage I:
  
  Good prognostic features
  
  → Chemotherapy
  
  BEP Regimen

  Non seminomatous tumor

  Stage II:
  
  Stage II: Seminomas are highly radiosensitive
  
  Radiotherapy to para-aortic lymph nodes
  
  (inverted 'Y' field)

  If residual lymph nodes are present:
  
  → Induction Chemotherapy
  
  If residual lymph nodes are present:
  
  → RPLND

  → If residual lymph nodes are present
  
  → Chemotherapy

  → if residual disease present
  
  → Chemotherapy

  → Chemotherapy

  Stage III:
  
  (Lymph node above diaphragm)

  → Radiotherapy
  
  If residual disease is present:
  
  → Chemotherapy
  
  RPLND

  Stage IV
  
  (metastasis)

  → Chemotherapy

  B → Bleomycin
  
  E → Etoposide
  
  P → Cisplatin

  Stage IV
  
  There is a role of metastatectomy → improves survival
Seminomatous tumors and non-seminomatous tumors

Seminomatous tumors
- Show lymphocytic infiltration (good sign)
- Smooth, pinkish looking tumours
- Homogenous
- Types:
  - Anaplastic
  - Spermatocytic
- Show ↑ in: β hCG and LDH
- AFP is never raised in pure seminomas.
- Others markers: FLAP (Placental alkaline phosphatase)
  - CD 117
- Highly radiosensitive

Non-seminomatous tumors
- Earlier than seminomas
- More aggressive
- Show an ↑ in any tumor marker
- Highly chemosensitive
- Most important prognostic factor for testicular tumors: Stage of Tumor

Fournier’s gangrene

- Necrotising fascitis which involve perineal region.
- Synergistic gangrene (aerobic + anaerobic bacteria)

Risk Factors
- Immuno-compromised patient
- Diabetes mellitus
- Starts after trivial trauma

Management
- I.V antibiotics
- I.V fluids
- Supportive care
- Aggressive debridement

- Testis is not involved (Dual blood supply)
Anatomy of urethra

- Female urethra → 3 - 4 cm
- Male urethra → 18 - 21 cm
- 4 parts of male urethra:
  
  ![Diagram of urethra with parts labeled]

  - Prostatic
  - Membranous
  - Bulbar
  - Penile

  → Distal

  → Proximal

- Longest part of male urethra → penile
- Shortest part of male urethra → membranous
- Narrowest part of male urethra → External urinary meatus.
- Most distensible → Prostatic
- Least distensible → membranous.

Posterior urethral valves

- Males
- Young's classification
  
  **Type 1**
  - Most common
  - Occurs when the two mucosal folds extend anteroinferiorly from bottom of verumontanum and fuse anteriorly at lower level.

  **Type 2**
  - Rare
  - Mucosal folds extend along posterolateral urethral wall from ureteric orifice to verumontanum.

  **Type 3 (Cobb's collar)**
  - Circular diaphragm with central opening in membranous urethra.
  - Located below the verumontanum and occurs due to abnormal canalisation of urogenital membrane.

Clinical features:

- UTI
- Uraemia
Diagnosis: Antenatal or postnatal USG
  • Micturating cystourethrogram.
  • Key hole defect.

Management: Initially uremia is tackled
  → Foley's
  → Fulguration of valves

Urethral Trauma

Proximal urethral injury
  → Injury to prostatic or membranous urethra.
  → Mechanism:
    Secondary to pelvic fracture
    → Deep perineal hematoma.
    → Urinary extravasation - but it is restricted to upper one third of thigh

Distal urethral injury
  → Injury to bulb (m.c.) or penile urethra.
  → Straddle
  → Hematoma in scrotum and penis (butterfly hematoma)

Proximal
  On examination
  → High riding prostate /
  Floating prostate
  (vermooten sign)

Distal

Clinical features
  → Inability to pass urine
  → Blood at the tip of meatus.

IOC: → Rectrograde urethrogram (RGU).

Management:
  Emergency management
  → Suprapubic catheterization
    - Definitive management
      - Management of urethral stricture

  Short segment incomplete stricture
    → OU/U/VU (optical/visual internal urethrotomy)
    → Cut at 12 o'clock.
    → 40-50% cure rates

  Short segment complete stricture
    → End to end anastomosis.
Long segment complete / incomplete
- urethroplasty
  - graft used
  - buccal mucosal graft
    (Barbagli technique)
  - penile foreskin

Fracture Shaft Penis & Hypospadias

- Tear in corpora cavernosa.
- Secondary to trauma.
- Erect penis during intercourse.
- Clinical features: popping sound → penis becomes flaccid
  - Hematoma around the penis
  - Egg plant deformity

Management: surgical repair

Hypospadias:
- Urethral opening is ventrally placed.
- Most common congenital urogenital anomaly.
- Seen in 1:450 → associated with undescended testis and micropenis.

Types of hypospadias:

- Clinical features: hooded perineum
  - Chordee → downward bending of penis.
  - More proximal the hypospadias more severe is chordee.
  - Downward directed stream of urine.
  - Chordee → difficulty during intercourse.
management → surgery.
   foreskin is used for reconstruction
   → Circumcision should be avoided.
   Timing of surgery → 6 - 12 months.
   → Before 18 months of age.

Principles of hypospadias repair

1. Chordee correction / Orthoplasty.
   a. urethroplasty.
   3. Glans reconstruction → glanuloplasty
   4. Skin cover → Scrotoplasty
      → Distal hypospadias → single stage
      → Mathieu repair
      → Magni
         (Meatal advancement glanuloplasty)
      → Mustardee repair.
   → Mid hypospadias → Single stage / Two stage procedures
      → TIP → Tubularised incised plate repair
      → Snodgrass repair
   → Proximal hypospadias → Two stage repair
      → Thiersch Duplay
      → Dennis Browne repair

Complications of hypospadias repair

1. Most common → urethrocutaneous fistula.
2. Meatal stenosis.
3. Stricture.
4. Recurrence of chordee.

Ectopia vesicae / Bladder extrophy

→ Deficient abdominal wall below umbilicus.
→ Anterior bladder wall is also deficient.
→ Pubic diastasis → surgery → iliac osteotomy.
→ Male patients can have undescended testis, congenital inguinal hernia.
→ Female patients can have bifid clitoris.
→ Management → multiple surgeries, poor prognosis.

Urethral caruncle

→ Seen in elderly woman
→ Soft, raspberry like swelling → Pedunculated.
Situated in the posterior urethral wall
- Highly vascular → Bleeding
- management → Excision using cautery

Fowler's syndrome: Seen in females with PCOS
- Abnormal myotonic discharge in the striated urethral sphincter.
- Diagnosed by → EMG
- Urinary retention
- management → Urethral dilatation is ineffective
  → Sacral neuromodulation.

**Phimosis**

- Inability to retract the foreskin.
- Physiological adhesions → starts going away by two years of age but can persist till 6 years
- If the problem persists beyond 6 years or if it is symptomatic
  - Phimosis → Difficulty in passing urine, ballooning of foreskin, recurrent UTIs, balanoposthitis (infection of glans and shaft)
- Hydronephrosis, difficulty during intercourse

management: circumcision

- Dorsal incision
- Remove excess foreskin
  - Plastibell
  - Gomco clamp

Complications of circumcision:
1. Most common → bleeding (close to frenulum)
2. Infection
3. Chordee
4. Pain

**Paraphimosis**

- Foreskin forms a constriction ring around the penis.
- Management → conservative

  - Xylocaine jelly
    - Try to reduce the foreskin.
    - Small puncture wounds
- If conservative management fails → Dorsal slit procedure.
Peyronie’s Disease

- Deposition of calcific plaques in corpora cavernosa
  
  Bending of the penis.
  Dorsally towards the abdomen.

Causes:
- Idiopathic
  - IgG4 mediated.
  - Secondary to trivial trauma. → micro hemorrhages in corpora cavernosa.

  Calcification.

Active phase: Bend keeps on increasing (18-34 months) ↓

Afterwards it stabilises (self limiting)

Management:
- Diagnosis: clinically.
  - CT / MRI
- Treatment: calcium channel blockers
  → If progressive → Meshit procedure

Priapism

- Prolonged erection of penis → more than 4 hours
- If more than 6 hours → gives rise to irreversible damage to penis.

Causes

- Increased blood flow in the penis
- Secondary to trauma

- Fistula between artery and sinusoids
- Secondary to spinal injury
- Secondary to papaverine injection.

- Clinical Features:
  - painless
  - penile blood gas analysis shows oxygen in blood.

- Low flow/ ischemia.
  → most common

  → common in children who are suffering from:
    - Leukemias
    - Lymphoma.
    - Sickle cell anemia.

  Antipsychotic medications
  secondary to papaverine injection
  → clinical features:
  - painfull
  → Deoxygenated blood.
  → Diagnosis:
  penile angiography.
management: Sedation
   ↓
   Inj of phenylephrine
   Inj of Adrenaline into the corpora.
   ↓
   fails
   ↓
   Shunt surgery →
   ↓
   Grey halk shunt winter shunt
   - Corporo saphenous - Corporo granular shunt.

Penile cancer

Premalignant condition:
1. Bowen's disease → shaft of penis
2. If they involve glans → Erythroplasia of Queyrat
3. Genital warts → HPV
5. Leukoplakia.

Pathology of penile cancer:
→ squamous cell carcinoma.
→ most common gene → p53

- Buschke Lowenstein tumor → slow growing
  → grows outwards
  → HPV
  → good prognosis

Clinical features of penile cancer:
→ ulceroproliferative growth
→ Foul smelling
→ 50% patients have inguinal lymph node
→ But majority are due to infection

Diagnosis: Incisional biopsy
   → Staging: MRI

TNM staging or Jackson:
T₁ → skin
T₂ → corpora.
T₃ → urethra.
T₄ → Adjacent structures
management:
- Bowen's disease → Topical 5-fluorouracil cream → CO₂ laser ablation
- If early penile cancer → only involving glans → glansectomy
- Surgery → first line

Primary tumor → Lymph nodes

- 1 cm margin

> 2 cm → Partial penectomy
> > 2 cm length → Total amputation of penis and urethra, is put into the perineum

Lymph nodes:
- Infection → resolves after 2 weeks of antibiotics
- Cancer → ilioinguinal lymph node dissection or radiotherapy to lymph node.
- If lymph nodes are not enlarged → Sentinel lymph node biopsy
- Chemotherapy → 5 Fu
  - Cisplatin
  ↓
  metastatic disease
- Most important prognostic factor → inguinal lymph node status
- Most common cause of mortality → Erosion of femoral or iliac vessels due to involved lymph nodes
**BLADDER**

**Foley’s catheters**

French : outer circumference → all

<table>
<thead>
<tr>
<th>Color</th>
<th>Size French</th>
<th>Size millimeter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>10</td>
<td>3.3</td>
</tr>
<tr>
<td>White</td>
<td>12</td>
<td>4.0</td>
</tr>
<tr>
<td>Green</td>
<td>14</td>
<td>4.7</td>
</tr>
<tr>
<td>Orange</td>
<td>16</td>
<td>5.3</td>
</tr>
<tr>
<td>Red</td>
<td>18</td>
<td>6.0</td>
</tr>
</tbody>
</table>

- 3 way Foleys : - Balloon
  - Urine to come out
  - Irrigation
  → used in patients with clot retention

**Rubber** → 7 days
→ Pericatheter leakage : 1. Put in a larger sized Foley’s
   2. Inflate the balloon further
→ Stuck Foley balloon : Use guided suprapubic puncture of the balloon

→ Cystoscopy
   → Remove all the rubber fragments.

**Bladder trauma**

→ Extraperitoneal rupture
  → More common
  → Secondary to pelvic fracture
  → Associated with proximal urethral injury
  → Perineal hematoma

→ Intraperitoneal rupture
  → Trauma to lower abdomen
  → Occur in blunt/penetrating trauma
  → More common in full bladder.
→ Inability to pass urine
→ Blood at the tip of meatus

→ CF - • Syncopal attack
   • Pain
   • Peritonitis.

IOC: CT urography
If patient is unstable → Cystogram

Management:
→ Foley's/Suprapubic catheterisation (SPC) for 7 days
→ Laparotomy
→ Repair the bladder in two layers.
→ Foley's/SPC

Interstitial cystitis / Hunner's ulcers

- Common in women
- Clinical features:
  - Pain
  - Increased frequency
  - Over distension of bladder

- Diagnosis → Cystoscopy
  - Linear ulceration in the mucosa (Fundus)
  - Fibrosis
  - Histopathology: infiltration of lymphocytes into the tissue.

Management: Hydrostatic distension
→ Dimethylsulphoxide.

Bladder diverticulum:

Congenital
→ Seen in region of persistent urachus
→ Present in midline
→ Anterosuperiorly

Pulsion
→ Secondary to increased pressure
→ Seen in BPH/Bladder outlet obstruction
→ Above and to the side of one ureteric orifice
→ Very large diverticulae
→ Ureteric obstruction
IOC → IVU / CT urography

Clinical features:
- Increased frequency of micturition
- Urge to pass urine in rapid succession after changing position.

Complication:
1. UTI
2. Stone formation due to stasis
3. Hydronephrosis

Management: Only symptomatic patients require diverticulectomy.

Bladder cancer

- Transitional cell carcinoma
  - Most common
  - MC in Africa
- Squamous cell carcinoma
  - Smoking
- Adenocarcinoma
  - Seen in the region of persistent urachus
  - Trigone
- Risk factors
  - Cigarette smoking
  - Cyclophosphamide
  - Chemicals- aniline dyes
  - Bilharziasis → SCC

Genetics: NATA and GSTM1

- Consistent germline markers for bladder cancer

Clinical features:
→ Gross painless hematuria

Workup:
→ USG, KUB → growth in bladder
  → Clots
  → Status of kidney
→ Urine test: urine routine and microscopy
→ Cytology → low sensitivity.
Confirm diagnosis: **Cystoscopy**

Resect growth

**TURBT** → Transurethral resection of bladder tumor

Diagnostic and therapeutic once base is reached: **Cold Cup biopsy**

Determine ‘T’ stage

- **Staging** → **pT1**
- **NMP** (Nuclear Matrix Protein Number 211) → Bladder cancer marker

### Staging of bladder cancer

- **TX** → Primary tumor cannot be assessed
- **T0** → No evidence of primary tumor
- **Ta** → Noninvasive papillary carcinoma
- **Tis** → Carcinoma in situ
- **T1** → Tumor invades subepithelial connective tissue (lamina propria)
- **T2** → Tumor invades muscularis propria, bladder wall
  - **T2a** → Tumor invades superficial muscle (inner half)
  - **T2b** → Tumor invades deep muscle (outer half)
- **T3** → Tumor invades perivesical tissue
  - **T3a** → microscopically
  - **T3b** → microscopically (extravesical mass)
- **T4** → Tumor invades any of the following:
  - Prostate, uterus, vagina, pelvic wall, and abdominal wall
  - **T4a** → Tumor invades prostate, uterus or vagina
  - **T4b** → Tumor invades pelvic or abdominal wall

Grade 1 → Well differentiated
Grade 2 → Moderately differentiated
Grade 3 → Poorly differentiated

**pNpLMP** → Papillary urothelial neoplasm of low malignant potential.

### Management: **TURBT**

(Used: **YAG laser**)

**Superficial bladder cancer** → above muscle layer

- **pTa**

**Advanced deep layer** → invading muscle layer

- **pT1**
- **pTis**
Observation or single cycle of intravesical chemotherapy or BCG (mycobacterium bovis) immunotherapy

- Thiotepa
- Adriamycin
- Mitomycin-C

- 3 monthly check cystoscopy
- Multiple
- PT1
- Associated with insitu
- G3

Radical cystectomy • 40-50% progression

Advanced bladder cancer
T2 → Radical cystectomy → radiotherapy
T3, T4 → Neoadjuvant chemotherapy → Surgery → Radiotherapy

m-VAC regimen
methotrexate → Cisplatin
Vinblastine → Doxorubicin

Surgery:
Partial cystectomy
- Tumor at dome
- Not involving ureteric orifice
- Solitary lesions

Radical cystectomy
- Removal of bladder
- Iliac and obturator lymph node
- First lymph node to be involved.
- In females → urethra is removed, sometimes total abdominal hysterectomy done.
- In males → Prostate is removed.
- Followed by urinary diversion

Continent
- Neobladder (ileum)

Non-continent (MC)
- Uretersigmoid anastomosis → Ileal conduit
Complications of ureterosigmoid anastomosis:
1. Increased risk of UTI
2. 100 times higher risk of adenocarcinoma at the site of anastomosis
3. Hypokalemic, hyperchloremic, metabolic acidosis.

Ileal conduit:
- Most common non-continent urinary diversion.
- Most common complication → Stricture at site of anastomosis
- Most important prognostic factor → Depth of invasion or 'T' stage.
Surgical anatomy

- Kidney develops from metanephric bud in the iliac fossa and ascends up to its adult position

- Hilum
  - vein - most anterior
  - Artery
  - Pelvis - Posterior

- Caudal primary buds - Physiological lobulations which can persist in adults

![Diagram of Aorta, Left Kidney, Left Renal vein, and Preferred Kidney for Transplant]

**Nutcracker Syndrome**

Lt renal vein is pressed between aorta and superior mesenteric artery

**Renal Collar**

Lt renal vein splits and encases the aorta.

**Renal agenesis**

- 1 in 500 - 1000 patients
- Usually unilateral
- Patients will also have agenesis of ureter and the hemitrigone on that side
- Males can have undescended testis. Females can have absent fallopian tube on that side
- In some patients ipsilateral adrenal gland absent
Duplication of the system

- Image shows duplication of ureter & pelvis
- Wiegert - Meyer's rule

"Ureter draining the upper pole is going to cross the normal ureter and opens more distally and medial to ureter draining lower pole" 

\[ m \rightarrow \text{urethra} \]
\[ F \rightarrow \text{vagina} \}
Opening

\[ \Delta \text{sis - ivu} \]

Management - Reimplantation of ectopic ureter.

U/L > B/L, Lt > Rt
F>m

Duplication & malrotation of pelvis

Drooping Lily sign
↓
IVU sign

Horseshoe Kidney

- If the lower ends of kidney fused
↓
Horseshoe Kidney
↓
Fails to ascend up to the normal position
↓
thus the fused portion lies at the level of L3- L4
ascent of the kidney is restricted by
Inferior mesentric vessels
↓
But adrenals are normal in position

Clinical features
1. Asymptomatic
2. Dull pain
3. Abdominal lump
4. Stones
5. Hydronephrosis

- Flower vase appearance / Hand shake sign on IVU
- If pelvis is malrotated → ureters kinked → Stone formation and
  Hydronephrosis

\[ m_x \]
If patient is symptomatic
↓
Never cut the fused portion

Exception Horseshoe Kidney + symptomatic abdominal aortic aneurysm

If hydronephrosis - pyeloplasty

• Patients with horseshoe kidney have ↑ risk of upper urinary infections during pregnancy.

Polycystic Kidney Disease

Infantile
• Autosomal recessive
• PMHD gene on chr.6
• Not compatible with life
• Death due to hepatic fibrosis
↓
Adult
• Autosomal dominant

PMHD 1
Chr. 16

PMHD 2
Chr. 4

↓
compatible with life
- cysts in kidney enlarge & press on normal renal parenchyma.

Renal function - impaired
In males progression faster than in females
↓
Symptomatic - 3rd decade of life.
mC clinical feature – Hypertension > mass
> pain > hematuria.

Extrarenal manifestations
1. mC - Hepatic cysts
2. Cysts can be seen in spleen, pancreas, lungs.
3. Colonic diverticulus
4. Mitral valve prolapse
5. Berry aneurysms in circle of Willis

→ Can lead to SAH

Diagnosis
USG - multiple cysts in kidney.
Prenatal - if more than 3 cysts whether U/L or B/L USG or more than 2 cysts in each kidney

→ Polycystic kidney disease

Pain due to hemorrhage inside cysts or renal stones
(mC: uric acid stones)

management
1. Long term dialysis
2. Transplant
3. Rovsing procedure - i.e. Deroofing cyst is not useful
4. mTOR inhibitors / vasopressin analogues

Multicystic dysplastic kidney

- multiple cysts in kidney
- U/L or B/L

→ Not compatible with life.

Abdominal lump at birth

• in adults → Rapid progression to renal failure
  mposes → conservative
  can be associated with
  • atresia of ureter on that side.
Hydronephrosis

Definition: Aseptic dilation of pelvi-calyceal system due to intermittent partial / complete blockade to flow of urine

u/L  b/L

Causes of unilateral hydronephrosis.
1. Intra luminal causes
   A. MC acquired Cause - renal stones
   B. Sloughed papilla [Analgesic abuse Diabetics]
2. Intramural causes
   A. Congenital PUJ obstruction
      MC congenital Cause of hydronephrosis.
      Adynamic obstruction
      No physical obstruction
      Lack of PUJ of contraction / relaxation.

IOC: MAG-3 Scan
management - Anderson Hynes Pyeloplasty.
(dismembered)

B. Transitional cell carcinoma of pelvis
   IVU
   Goblet / Champagne glass appearance

C. Ureterocele
   when lower end of ureter are dilated
   ineffective drainage of urine
   - m > F
   - 10% are b/L
     IVU
     Cobra head / Adder head appearance.
management - Resect the abnormal portion & reimplant ureter
- Endoscopic incision (disadvantage - reflux)
Extraluminal Causes

A. Aberrant renal vessels
   - usually U/L
   - compress pelvis from outside
   - Never cut the vessels
     \[ \downarrow \]
     devascularises the parenchyma
     management - pyeloplasty

B. Advanced cancers
   - Rectal cancer
   - cervical cancer
   - Retroperitoneal sarcomas

C. Retrocaval ureter
   Rt ureter goes behind IVC.
   IVU - Fish Hook / Reverse J ureter.

   management - Lateralise the ureter
   - cut the segment behind IVC
   $ do uretero ureterostomy .

D. Retroperitoneal fibrosis
   - A/K/A Ormond's disease

   causes
   1. Idiopathic
      a. Drug induced
         - methysergide
         - Bromocriptine
      b. IgG mediated.
         (associated with dupuytren contracture & Peyronies disease)
   4. Post radiotherapy

First structure involved in retroperitoneal fibrosis
\[ \downarrow \]
ureter

maiden's waist deformity
management - steroids
- DJ stents (double "J" stents)

Bilateral Hydronephrosis Causes

1. Any unilateral cause on both sides
2. Bladder outlet obstruction
3. BPH
4. Posterior urethral valves
   (Type I - mc)
5. Phimosis
6. Meatal stenosis

Diagnosis

1) IVU
   ![Diagram showing IVU and hydronephrosis]
   -Renal isotope scan
     - DMSA Scan
     - Scarring
     - DTPA
     - MAG-3 best for function
     - MAG-3 scan
       - Total GFR
       - Differential GFR

   If the hydronephrotic kidney contributes > 20% of GFR
   i.e.
   > 20% Total GFR - save

10 - 20% Total GFR - Nephrostomy
   - If function improves
   - Doesn't improve
   - Save
   - Nephrectomy

< 10% Total GFR - Nephrectomy
Vesicoureteric Reflux

- seen in 3-5% girls and 1-2% boys.
- < 3 month MC - boys
  > 3 month MC - girls.

Grading

Normal
1. Reflux into non-dilated ureter
2. Reflux into pelvis but no distension
3. Reflux with mild distension
4. Blunting of calyces / Tortuous ureter
5. Severe distension of ureter along with loss of papillary impressions.

Reflux
→
upper urinary infections
→
pyelonephritis
  If not managed properly with
  adequate antibodies
  chronic pyelonephritis
  +
  scarring of renal parenchyma.
  (usually occurs between day 3 - day 5)

if scarring +

↓
Affects renal Function
↓
chronic pyelonephritis
Secondary to VUR is MCC of renal transplant in children < 19yrs in UK

Hypertension
10-20%
Management of VUR

Investigation
1. MCU - micturating cystourethrogram / IVU
2. DMSA SCAN
   Scarring

I. VUR grade 1-3, age 0-10yrs
   → antibiotic prophylaxis
   → spontaneous resolution

II. VUR grade 4/5, age 0-10yrs
   → antibiotic prophylaxis.

III. Grade 5
   → usually in addition to antibiotics patient requires endoscopic treatment
   → fails
   → open surgery to reimplant ureter

Endoscopic treatment
   → Sting procedure
   → HIT
   → subureteric teflon injection
   → material: DeFlux
   → hydro distension implantation technique
   → now material is injected

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Renal stones

Concentration product:
   → amount of solute in a solution

Saturation product
   → max. amount of solute in a solution

CP > SP → stone
   → but it doesn't happen
   → because of stone inhibiting factors
   → citrate (mC) → most important
Formation product
max concentration of solute in solution after taking into account
stone inhibiting factors

CP > FP ➔ stone

Types of stones

1. Ca\(^{2+}\) oxalate
   - MC renal stones
   - Radio opaque
   - Found in acidic urine
     - Monohydrate (very hard) ➔ Dumbbell shaped
     - Dihydrate (envelope shaped)

   spiculated margins
   Early with pain & hematuria.

   Mulberry stones

Recurrent calcium oxalate stones

Advice
1) ↓ Fat in diet
2) ↑ Ca\(^{2+}\) intake diet
3) Large doses of pyridoxine
4) Cholestyramine
   bind oxalate in gut.
   ↓ incidence

a. Triple phosphate / struvite / staghorn stone

- Ca\(^{2+}\), Mg\(^{2+}\), ammonium PO\(_4\),
- Radio opaque
- Formed in alkaline urine
   Infected with organisms like Proteus
- smooth dirty white surface
  ▼
  increase in size before symptoms appears
- coffin lid crystal

Recurrent struvite stones
  ▼
  Aceto hydroxamic acid (medical management)

3. Cystine stones
   - Radio opaque
   - Acidic
   - Very hard - hard crystalline.
   - Difficult to break by ESWL.

seen in
   a) Cystinuria.

Recurrent stones Treatment - d- Penicillamine

4. Uric acid stones
   - mc radiolucent stones
   - Acidic urine
   - Crystals resembles “Glass shards”.

seen in
   a) Gout
   b) Tumor lysis syndrome

Treatment of recurrent uric acid stones - Allopurinol

Ammonium urate stones
  ▼
  can be seen in inflammatory bowel disease, laxative abuse

Rare Stones & clinical features

1. Xanthine stones - brick red
2. Triamterene stones  ▼ Radiolucent
3. Indinavir stones

Clinical features
- Asymptomatic
- m/c - pain
fixed renal pain  
\[\text{Colekcy pain}\]  
\[\text{Renal angle}\]  
\[\text{Distention of renal capsule}\]  
\[\text{Site of the stone}\]  
\[\text{Pelvis - Loin to groin pain}\]  
\[\text{Upper / mid ureter}\]  
\[\text{Liihypo gastric Nerve}\]  
\[\text{Sometimes obturator nerve}\]  
\[\text{Inner aspect of thigh}\]  
\[\text{Lower ureter - ilioinguinal nerve}\]  
\[\text{Intramural part of bladder}\]  
\[\text{Strangury}\]

- Intense urge to pass urine associated with pain at tip of penis only able to pass 1-2 drops of bloody urine
  
- Hematuria
- Hydronephrosis
- Dietl's crisis

- Stone blocks the pelvis
- Urine accumulates in kidney Pain + palpable mass stone shifts in position Lump subsides and patient passes large quantity of diluted urine

**Investigation & Management**

- IOC - NCCT also IOC for head injury salivary gland stones
- 90% renal stones radiopaque

- Management:
  \[\leq 5 - 6\text{mm - observation (spontaneously pass)}\]
> 5 - 6 mm is symptomatic

1st line of management

ESWL (Extracorporeal shock wave lithotripsy)
(blast wave dynamics)

Directing ultrasonic waves → stone → shatter

Strongest: Dornier apparatus

Complications of ESWL
1. Pain (n/c)
2. Hematuria
3. Stone street (steinstrasse)
4. UTI

Contraindications to ESWL

1. Pregnancy
2. Uncontrolled bleeding disorders
3. Cardiac pacemaker
4. Stone > 15 cm size
5. Children
6. Obese
7. Very hard (cystine > Ca oxalate monohydrate)
8. Obstructed system
9. Lower calyx stone

Fragment needs to travel against gravity

If ESWL contraindicated

PCNL
Percutaneous nephro lithotomy

RIRS
Retrograde intra-renal surgery aka rencoscopic lithotripsy
1. Dormia basket
2. Lasers can be used
   Holmium YAG laser

Preferred in obstructed system
Complications of PCNL: Bruising
   Hemorrhage
   Hematuria.
   Injury to colon or spleen
   Injury to pleura.

Summary of management

ESWL
  ↓
  If ESWL C/I

PCNL
  ↓ or RIRS
  Fails

Pyelolithotomy
  Or
Nephrolithotomy

Anatrophic nephrolithotomy
  ↓
incision along Brodel's line (avascular plane in kidney)

Ureteric stones

1. 5 -4mm stone - observation
2. larger stone in ureter

Non impacted
  ↓
Ureteroscopic removal (RIRS) → fails → uretero lithotomy

Impacted
  ↓
Use longitudinal incision (horizontal → sticture)

Suture absorbsable suture
 vicryl
  ↓
PDS
  ↓
DJ stents (double ‘J’)

Surgery • v2.0 • Marrow 4.0 • 2020
Bladder stones

primary

- Non infected urine
- MC in children

Secondary

- infected urine
- secondary to obstruction

MC type - mixed urate stones - po, stones
- Jack stone

(resembles Ca oxalate)

clinical feature
- pain
- hematuria

IOC - NCCT

management 1st line - perurethral removal / cystolithotomy

c/1 of perurethral cystolithotomy
  i) urethral sticture
  a) very large stone
  b) stone in a bladder diverticula
  
  suprapubic cystolithotomy

* Keyhole sign: posterior urethral valve
Renal infections

Renal and genitourinary tuberculosis
- 2° infection
- Hematogenous
- Earliest lesion in kidney papillary ulcer
  
  Heal with fibrosis  outside kidney  Ghost calyx
  
  Pseudo-calculi  perinephric abscess

  caseous necrosis
  ↓
  pyelonephrotic kidney
  or
  Putty kidney
  ↓
  Calcification
  Cement kidney
  ↓
  Stricture & shortening of ureter.
  ↓
  ureteric orifice can remain open
  ↓
  Golf hole ureteric orifice

Earliest sign: paleness of mucosa of bladder
  ↓
when ulcers heal with fibrosis → thimble bladder (↓ capacity)
Prostate - baggy granulomatous prostatitis
  ↓
Watermelon prostate
Epididymoorchitis → vas - beaded craggy epididymis

Clinical Features

1. Pain
2. Hematuria
3. Weight loss
urine examination

Sterile pyuria → pus cells

but culture

Diagnosis: 3 morning samples of urine

↓

ZN staining

Imaging → CT urography

(Earlier IVU most sensitive)

m_x = ATT

- Intervention should be done after 4–6 wks of ATT

Intervention

1. Drain abscess
2. Putty
   - Nephrectomy
   - Cement
3. Kerr’s Kink – DJ stent
4. Shortening of ureter – Boari flap repair
   (Lower end of ureter)
5. Golf hole ureteric orifice – ureter reimplantation
6. Thimble bladder – augmentation cystoplasty (using ileum)
Pyelonephritis

- Infection involving Kidney
  - Hematogenous
  - ascending infection

- F > m
- INC in children
  - Puberty
  - Pregnancy

Clinical Features
1. Pain ( loin )
2. Fever
3. Nausea
4. Vomiting

   urine → pyuria casts

IOC - CECT → To R/O pyelonephrosis
   ↓
   Opacification of affected parenchyma
   ↓
   Patchy / linear distribution

MC organism E. coli

Management - appropriate antibiotic therapy

Special types of pyelonephritis

1. Emphysematous pyelonephritis
   - E. coli
   - MC in immunocompromised, DM

Clinical Features
- Fever
- Pain

IOC CECT - gas in and around kidney.
Management - Antibiotics & drainage
  ↓ Fails
  Nephrectomy
11. Xanthogranulomatous pyelonephritis
   - Proteus > E.coli
   - Exclusively in middle aged females
   - DM

C/F
   - Flank pain
   - Pyrexia
   - Abdominal mass

IOC CECT
   - Non-functioning kidney
   - Low density mass
   - Calculi

Management - Nephrectomy (subcapsular)

Renal carbuncle
   - Renal cortical abscess
   - DM / drug abusers
   - Management - Drain
   - MC organism Staph. aureus

Renal corticomedullary abscess
   - Ascending infection
   - E. Coli
   - Can also form perinephric abscess

Retroperitoneal and renal trauma

Zones of retroperitoneal injury.

- Zone I: All penetrating injuries to zone I exploration
- MC injured zone, managed conservatively.
- Zone III: Pelvic structures

24 - Above superior mesentric vessels.
Grades Of renal trauma

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description of Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contusion: Microscopic or gross hematuria, urological studies normal. Hematoma: Subcapsular, nonexpanding without parenchymal laceration.</td>
</tr>
<tr>
<td>2</td>
<td>Hematoma: Nonexpanding perirenal hematoma confined to renal retroperitoneum. Laceration: &lt;1.0 cm parenchymal depth of renal cortex without urinary extravasation.</td>
</tr>
<tr>
<td>3</td>
<td>Laceration: &gt;1.0 cm parenchymal depth of renal cortex, without collecting system rupture or urinary extravasation.</td>
</tr>
<tr>
<td>4</td>
<td>Laceration: Parenchymal laceration extending through the renal cortex, medulla, and collecting system. Vascular: Main renal artery or vein injury with contained haemorrhage.</td>
</tr>
</tbody>
</table>

*Advance one grade for multiple injuries to same organ.

** IOC for renal trauma: **
- **stable**
  - CT urography
- **unstable**
  - Single shot IVU

**Management:**
- Grade I, II, III - conservative management
- Grade IV
  - Urinary leak +
    - Urinoma
      - Non infected
        - DJ stent
      - Infected
        - Pig tail drainage
  - Vascular injury
    - Renal artery injury
      - Non visualised kidney
      - Pus and retroperitoneal hematoma
      - Exploration after vascular control
    - Renal vein injury
      - Grade IV partial/Total nephrectomy

*Active space*
Complications of renal trauma

1. Hematuria.
2. Urinoma.
3. AV fistula.
4. Renal artery thrombosis → Renal infarct
5. Meteorism
   - Colonic distension seen 24 - 48 hrs after retro peritoneal hematoma
6. HTN

Ureteric injury

- Realised during surgery
  - Fistula
  - No symptoms
- Realised post operative period
  - Anuria (B/L)
  - Pain, fever
  - Loss of function

Management

- Injury but no loss of segment
  - Spatulation of two ends and end to end anastomosis
- Short segment loss
  - Mobilize kidney
  - Psoas hitch
  - Boari flap
- Long segment loss
  - Appendix or ileum to bridge gap
  - Trans ureterostomy

Renal tumors

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Features</th>
<th>Workup</th>
<th>% malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>Simple cyst</td>
<td>Anechoic, imperceptible wall, round</td>
<td>Nil</td>
<td>~0%</td>
</tr>
<tr>
<td>2</td>
<td>Minimally complex</td>
<td>Single thin septation, thin calcification</td>
<td>Nil</td>
<td>~0%</td>
</tr>
<tr>
<td>2F</td>
<td>Minimally complex (need follow up)</td>
<td>Thin septation, thick calcification, hyper dense on CT</td>
<td>USG or CT followup</td>
<td>5%</td>
</tr>
<tr>
<td>3</td>
<td>Indeterminate</td>
<td>Thick or multiple septation, mural nodule</td>
<td>Partial nephrectomy</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>Clearly malignant</td>
<td>Solid mass with cystic spaces</td>
<td>Partial/Total nephrectomy</td>
<td>~100%</td>
</tr>
</tbody>
</table>
Angiomyolipoma
- Benign - blood vessel, muscle and fat
- Arises from perivascular epithelial cells
- 5th - 6th decade of life
- Sporadic > familial

↓
Tuberous sclerosis
- multiple
- Shagreen patches
- Ashleaf macules
- Adenoma sebaceum

C/F
- Asymptomatic
  - Abdominal pain / lump
    Some - massive Retroperitoneal hemorrhage
  ↓
  Wunderlich syndrome

Lenk's triad
- mass
- Pain
- Shock
  IOC - CECT
  ↓
  High fat content

Management

< 4 cm
- Asymptomatic
  ↓
  Observation serial CECT

> 4 cm
- symptomatic
  ↓
  partial nephrectomy
  (Nephron sparing surgery)

Bleeding angiolipoma
  ↓
  Angioembolisation
  ↓
  Partial nephrectomy

IHC → HMB 45©
Oncocytoma

- MC benign tumor of kidney
- Cells rich in mitochondria.

\[
\text{Sporadic} \quad \text{Familial} \\
\begin{array}{l}
\text{Birt Hogg Dube syndrome} \\
\quad \text{chromosome 17} \\
\quad \text{Oncocytomas} \\
\quad \text{Chromophobe RCC} \\
\quad \text{Fibrofolliculomas / tricho dermosas}
\end{array}
\]

C/F: Asymptomatic
- Lump
- IOC - CECT
  - Central stellate scar

Management
- Partial nephrectomy (if diff between oncocytoma and chromophobe RCC is not possible)

Renal cell cancer

- Grawitz tumor / Hypernephroma / Internist's tumor.

Risk factors
1. DM
2. HTN
3. Tobacco intake
4. Thorotrust exposure
5. ↑ Protein intake

Syndromes
1. VHL (von Hippel Lindau) VHL gene (chr.3)
   \[
   \downarrow \quad \text{Clear cell RCC}
   \]
2. Hereditary papillary RCC syndrome - Papillary RCC
3. Birt Hogg Dube syndrome - Chromophobe RCC

Tumors associated with syndromes
- Tend to occur earlier
- Tend to be bilateral
Pathological Types of RCC

1. Clear cell
   - Genetics - del. 3p and 8p
   - PCT
   - Associated with VHL

2. Papillary RCC - Hereditary papillary RCC syndrome
   - Psammoma bodies $\rightarrow$ CMT mutation
   - Site of origin PCT > DCT
   - Micro papillary variant - seen in long term dialysis therapy

3. Chromophobe RCC $\rightarrow$ Loss of multiple chromosome (1, 2, 6, 10, 13)
   - Birt Hogg Dube syndrome
   - Tan mahogany color tumor
   - Typical central stellate scars
   - Plant like cells $\oplus$ resin like nucleus
   - Cytokeratin $\ominus$
   - (Onocytoma - ck $\ominus$)
   - Best prognosis

   - Worst prognosis
   - Genetics - del. 1q, monosomy of multiple chromosome

Medullary RCC

- Patients with sickle cell anaemia.
- Poor prognosis

Clinical features

1. Typical triad - 10-15% patients.

   ![Diagram of hematuria, flank pain, and mass]

Surgery • v2.0 • Marrow 4.0 • 2020
a. mc presentation - gross hematuria.
3. Other / atypical
   a. Spread along renal vein (not mets)
      Lt. sided tumors → secondary varicocele.
   b. Cannon ball mets to lungs.
      (mc site of mets)
4. Paraneoplastic syndromes
   - mc, ↑ ESR

<table>
<thead>
<tr>
<th>Endocrine</th>
<th>Nonendocrine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypercalcemia</td>
<td>Amyloidosis</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Anemia</td>
</tr>
<tr>
<td>Polycythemia</td>
<td>Neuromyopathies</td>
</tr>
<tr>
<td>Nonmetastatic hepatic dysfunction</td>
<td>Vasculopathy</td>
</tr>
<tr>
<td>Galactorrhea</td>
<td>Nephropathy</td>
</tr>
<tr>
<td>Cushing's syndrome</td>
<td>Coagulopathy</td>
</tr>
<tr>
<td>Alterations in glucose metabolism</td>
<td>Prostaglandin elevation</td>
</tr>
</tbody>
</table>

* Neuromyopathy - Lambert Eaton Syndrome
* Non metastatic - Stauffer Syndrome
* Hepatic dysfunction - IL -6
  ↑ Bilirubin
  ↑ ALP
  Values reduce after nephrectomy

- Pulsatile bony metastasis.
  IOC - CECT (diagnosis & staging)
  ↓
  Radiological Diagnosis
  GIST
  Cholangio ca.
  Periampullary tumor.

TNM Staging Of RCC

| T0  | No evidence of primary tumor |
| T1  | Tumor < 7 cm in greatest dimension, limited to kidney |
| T1a | Tumor < 4 cm in greatest dimension, limited to kidney |
| T1b | Tumor > 4 cm but < 7 cm in greatest dimension, limited to kidney |
| T2  | Tumor 7 cm in greatest dimension, limited to kidney |
| T3  | Tumor extends into major veins or invades adrenal gland or perinephric tissues, but not beyond Gerota's fascia |
| T3a | Tumor invades adrenal gland or perinephric tissues but not beyond Gerota's fascia |
| T3b | Tumor grossly extends into renal vein(s) or vein or vein(s) over diaphragm |
| T3c | Tumor grossly extends into vein and vein(s) over diaphragm |
| T4  | Tumor invades beyond Gerota's fascia |

| N0  | No lymph node |
| N1  | w/ve lymph |
|     | (First drained by para. aortic lymph nodes) |
\( m_0 \) - No mets
\( m_1 \) - Lungs are the m/c site of distant metastasis

- Robson's staging can also be used
- Fuhrman grading - Grading system of RCC

Management of RCC

- Surgery is the mainstay of management
- RCC - Chemoresistant
  - Radioresistant

Surgery

- Partial nephrectomy
  - \( T1 \) tumors
  - Restricted to the poles
- \( E/L \) RCC
- RCC in a solitary functioning kidney
- Relative
- RCC in a kidney where other kidney is affected by
  - Hydronephrosis
  - Stones

If metastasis + - Debulking surgery
- mTOR inhibitors - Everolimus
- IL-2 therapy
- Sunitinib / sorafenib

Cryoplation
- Principle of rapid freezing & gradual thawing
- Temperature - 40°C
- Ablative margin with in 3-5 mm of iceball
- Multiple comorbidities
- Palliative measure

Most important prognostic factor - pathological stage.
Wilm's Tumor

- Pediatric age group tumor
- Mc pediatric renal malignancy
- 2nd mc pediatric abdominal malignancy
  (1st - neuroblastoma)

Sporadic > Familial

WAGR
- W - Wilms
- A - Aniridia
- G - Genitourinary malformations
- R - Retardation

Deny's drasch
- Wilms
- Intersex
- Mental retardation

Beckwith weidmann syndrome
- Wilms
- Hemihypertrrophy
- Omphalocele
- Mental retardation

- Can be b/l

C/F
- a-syrs of age
- Abdominal lump → rarely crossing midline
- Hematuria
- Pain

Can also spread along renal vein (not considered mets)
mc mets site → lungs
LN → para aortic

IUC - CECT - peripheral calcification
Differentiate between - intratumoral calcification
Neuroblastoma - Vascular encasement
Staging

National Wilms Tumor Study (NWTS) staging
- Stage I: Tumor confined to the kidney & completely excised
- Stage II: Tumor outside the kidney but completely excised
  - Local tumor spillage during surgery
  - Lymph nodes negative
- Stage III: Non hematogenous disease confined to the abdomen
  - Perioperative rupture of renal capsule
  - Diffuse tumor spillage during surgery
  - Peritoneal implants
  - Positive lymph nodes
- Stage IV: Hematogenous metastases to lungs or liver
- Stage V: Bilateral Wilms' tumor

m_x of Wilms
- Responds to surgery
  - Chemosensitive
  - Radiosensitive
- Surgery principles same as RCC

Staging

NWTS

\[
\begin{align*}
\text{Surgery} & \rightarrow \text{chemo} \rightarrow \text{RT} \\
\text{Neoadj (chemo)} & \rightarrow \text{surgery} \rightarrow \text{RT}
\end{align*}
\]

Chemo - Daclomycin
  - Vincristine
  - Cyclophosphamide.

Most important prognostic factor - histology

HPE

- Epithelial
- Blastemal component

Higher the blastemal component poorer the prognosis
PROSTATE

Surgical anatomy of prostate and related pathologies

- 3 zones:
  - Central Zone (CZ)
  - Transitional Zone (TZ)
  - Peripheral Zone (PZ)

  - MC affected by BPH
  - MC affected by cancer

  - Short
  - Unbranched glands

  - Long
  - Branched glands

Prostatic Calculi

- Endogenous
  - 80%
  - MC composition
  - CaPO₄

- Exogenous
  - Stone from kidney / bladder which gets stuck in prostatic urethra

- Corpora Amylacea
  - Lamellated Bodies
  - Precursor for stones
Prostatitis

- **Acute bacterial prostatitis**
  - MC: E. coli
  - Secondary to UTI
  - Clinical feature:
    - Perineal pain
    - Fever
  - (Digital rectal examination): Tender, boggy prostate
  - Management:
    - Antibiotics (2 - 3 weeks)
- **Chronic bacterial prostatitis**
  - 3 Tube test after prostatic massage
  - Management: Antibiotics (4 - 6 weeks)

---

Lower Urinary Tract Symptoms (LUTS)

- **Storage Symptoms**
  - AUA Irritative Symptoms
  - Frequency (earliest and most common)
  - Urgency
  - Incontinence
  - Nocturia
  - Pain
- **Voiding Symptoms**
  - AUA Obstructive Symptoms
  - Weak stream
  - Hesitancy
  - Incomplete emptying
  - Urinary retention
  - Post micturial dribbling

- Voiding and post micturial LUTS → Bladder outlet obstruction
- Storage LUTS → Neurogenic Bladder
Work up of a patient with prostatic disorder

1. **DRE**
   - **BPH**
     - Firm
     - Rubbery
     - Mucosa: Mobile
   - **Cancer**
     - Hard
     - Mucosa: Fixed

2. **Urine Examination**
   - Routine and microscopic examination
   - Sugar and blood in urine
   - Urine culture and sensitivity

3. **USG PUB**
   - Prostate volume
   - Residual urine
   - Hydronephrosis

4. **Serum prostate specific antigen (PSA): Glycoprotein**
   - 50 - 69 years:
     - Normal value
       - BPH
       - S. PSA > 3-4 ng/ml → BPH, Cancer, Prostatitis
     - Repeat after 6 weeks
   - **Start on BPH management without Biopsy**
     - Trans rectal guided biopsy
       - Tru-cut biopsy
         - Minimum 13 Biopsies
         - Anterior lobe biopsies are difficult
         - ↑ Sepsis
         - Under LA
     - Trans perineal template biopsies
       - Anterior biopsies are easily done.
       - ↓ Sepsis
       - Under GA
       - Indications:
         1. Anterior lobe biopsy
         2. Raised PSA but negative TRUS guided biopsy.
> > 10 - 15 ng/ml : Locally Advanced Cancer

\[\text{Biopsy}\]

> > 25 - 30 ng/ml : Metastatic cancer

> PSA value not affected by DRE

> Free PSA is more sensitive

\[\text{Reduction in } \% \text{ of free PSA is indicative of cancer}\]

> PSA velocity : > 0.75 ng/ml/year

\{

> BPSA \text{ (nicked)}

> IPSA \text{ (intact)}

\} \uparrow \text{ in benign conditions}

Pro PSA : \uparrow \text{ in cancer}

5. Uroflowmetry

\rightarrow \text{Accurate measurement if patient voids : > 800 cc}

\rightarrow 15 - 30 \text{ ml/sec } \rightarrow \text{normal}

\rightarrow 10 - 15 \text{ ml/sec } \rightarrow \text{equivocal}

\rightarrow <10 \text{ ml/sec } \rightarrow \text{Bladder outlet obstruction. (800)}

6. Bladder pressure (cystometry)

\rightarrow > 60 \text{ cm } H_2O \rightarrow \text{High}

\rightarrow 40 - 60 \text{ cm } H_2O \rightarrow \text{equivocal}

\rightarrow < 40 \text{ cm } H_2O \rightarrow \text{Normal}

\rightarrow 800 / BPH \rightarrow \text{Neurogenic Bladder}

\rightarrow \text{High pressure}

\rightarrow \text{Low flow rate}

\rightarrow \text{very low pressure}

\rightarrow \text{Low flow rate}

\rightarrow \text{marion disease}

\rightarrow \text{(Prostatism sans prostate)}
Benign prostatic hyperplasia

- 5th decade of life

2 components

Static
- Stromal hypertrophy
- Testosterone $\xrightarrow{\text{5}\alpha\text{-reductase}}$ DHT

Dynamic
- $\uparrow$ Smooth muscle tone
- $\alpha_1$ receptors

International prostate symptom score (IPSS)

0 - 7 $\rightarrow$ mild $\rightarrow$ Observation

8 - 19 $\rightarrow$ moderate

20 - 35 $\rightarrow$ severe

Management

- Medical
- Surgical

$\downarrow$

$\alpha_1$ A blocker + 5 $\alpha$ Reductase inhibitors

Tamsulosin Finasteride
Alfuzosin Dutasteride
Quick onset $\rightarrow$ slow onset
Effect in few $\rightarrow$ months
Days $\rightarrow$ more sustained effect in 6 months time

75% improvement in IPSS
$\uparrow$ Urine flow rate $\rightarrow$ by 9-18%
after TURP

Indication:
1. Hydronephrosis
2. Acute or chronic retention of urine
3. Multiple episodes of UTI
4. Gross Hematuria
5. Diverticulae secondary to BPH
6. Flow rate $< 10\text{ml/sec}$ and Pressure $> 80\text{cmH}2O$

Reduction in volume

$\downarrow$

25-30 % $\rightarrow$ 50 % reduction in PSA

TURP $\rightarrow$ Transurethral resection of prostate
HOLEP $\rightarrow$ Holmium laser enucleation of prostate
TULIP $\rightarrow$ Transurethral laser incision of prostate
Lasers

KTPA green
Light
- Best laser
- 532 nm
- Vapourisation of tissue
- Haemostatic
- Can be used in patients on anticoagulants

• Lasers help in:
  - Faster surgery
  - ↓ Blood loss

TURP

Invariably bladder neck is rendered incompetent
(↑ risk of retrograde ejaculation)

Transurethral resection of prostate

↓ Transurethral resection of prostate

Verumontanum (Distal limit)

↓ Distal to verumontanum is external urinary sphincter

Damage leads to incontinence

• Irrigating fluids:
  - 5% dextrose
  - Distilled water
  - Hypotonic
  - ↑ Risk of TURP syndrome

Isotonic glycine: Best

NS: can only be used if β - TURP (Bipolar)
Complications of TURP

1. Haemorrhage → mc during surgery

- Badenoch’s arteries: mc cause of bleeding
- Both Badenoch’s arteries and smaller floss arteries are branches of inferior vesical artery

2. Clot retention
- To prevent: 3 way foleys

3. TURP syndrome / water intoxication / dilutional hyponatremia.

URETHRA + Blood vessel

Before surgery
- Na+: X
- Blood volume

After surgery
- Na+: X
- Blood volume ↑↑
- Dilutional hyponatremia

- 20ml/min is the water exchange during surgery (~ 50 minutes)

- Clinical features: within 4-6 hours
  → confusion
  → Disorientation
  → Nausea and vomiting
• Management

IF S. Na. < 130 meq/L
  ↓
  Severe
  → 3% Hypertonic saline
  → gradual correction:
      not more than
      8-10 meq/L/day
  → IF rapid correction:
  ↓
  Central pontine demyelination
  Central pontine myelinolysis

→ Reduction of TURP syndrome:
  • Isotonic Glycine
  • Faster surgery

4. Incontinence
5. Retrograde Ejaculation
  → mC: overall
  → 60-70%
  → Bladder neck injury
6. Re-operation: 5-15%

7. Stricture:
  → mC site: Bladder neck
  → IF large resectoscope used → mC site: meatal stenosis

Prostate imaging reporting and data system

**PI-RADS**

PI-RADS 1 = Very low (clinically significant cancer highly unlikely)
PI-RADS 2 = Low (clinically significant cancer unlikely)
PI-RADS 3 = Intermediate (clinically significant cancer equivocal)
PI-RADS 4 = High (clinically significant cancer likely)
PI-RADS 5 = Very high (clinically significant cancer highly likely)

Prostate cancer

• Risk:
  → ↑ Age
  → ↑ Testosterone
  → African - American males
→ Obesity
→ BRCA 2 > BRCA 1
→ m.C gene : GSTP-1 chromosome 11
→ Alcohol
→ Smoking

• Screening:
  → 50 years
  → Annual
    • DRE
    • PSA
    • DRE + PSA → Best modality

• Gleason score
  → Grading for prostate cancer

  mc occurring gland type  2nd mc occurring gland type

Grade 1 → well differentiated ← 1
  2  2
  3  3
  4  4
  5 → Poorly differentiated ← 5

Minimum : 1H = 2
Maximum : 5+5 = 10

Higher the Gleason's score → Poorer the prognosis

• Updated classification:

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>ISUP Grade Group</th>
<th>Gleason Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Grade Group 1</td>
<td>Gleason Score 6</td>
</tr>
<tr>
<td>Intermediate Favorable</td>
<td>Grade Group 2</td>
<td>Gleason Score 7 (3+4)</td>
</tr>
<tr>
<td>Intermediate Unfavorable</td>
<td>Grade Group 3</td>
<td>Gleason Score 7 (4+3)</td>
</tr>
<tr>
<td>High</td>
<td>Grade Group 4</td>
<td>Gleason Score 8</td>
</tr>
<tr>
<td>High</td>
<td>Grade Group 5</td>
<td>Gleason Score 9-10</td>
</tr>
</tbody>
</table>

→ Gleason score 7 = (3+4) has better prognosis than 7 = (4+3).
• IOC : TRUS or transperineal Tru-cut biopsy
**Staging:** PET-CT

**T stage:**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX</td>
<td>Primary tumor cannot be assessed</td>
</tr>
<tr>
<td>T0</td>
<td>No evidence of primary tumor</td>
</tr>
<tr>
<td>T1</td>
<td>Clinically, the tumor is neither palpable nor visible with imaging</td>
</tr>
<tr>
<td>T1a</td>
<td>Tumor is less than 1 cm in greatest dimension or 1 cm or less of tissue resected</td>
</tr>
<tr>
<td>T1b</td>
<td>Tumor is an incidentally histologic finding in more than 5% of tissue resected</td>
</tr>
<tr>
<td>T1c</td>
<td>Tumor identified with needle biopsy (e.g., because of an elevated PSA level)</td>
</tr>
<tr>
<td>T2</td>
<td>Tumor confined within the prostate</td>
</tr>
<tr>
<td>T2a</td>
<td>Tumor involves one-half of one lobe or less</td>
</tr>
<tr>
<td>T2b</td>
<td>Tumor involves more than one-half of one lobe but not both lobes</td>
</tr>
<tr>
<td>T2c</td>
<td>Tumor involves both lobes</td>
</tr>
<tr>
<td>T3</td>
<td>Tumor extends through the prostate capsule</td>
</tr>
<tr>
<td>T3a</td>
<td>Extracapsular extension (unilateral or bilateral)</td>
</tr>
<tr>
<td>T3b</td>
<td>Tumor invades seminal vesicle(s)</td>
</tr>
<tr>
<td>T4</td>
<td>Tumor is fixed or invades adjacent structures other than seminal vesicles: bladder neck, external sphincter, rectum, levator muscles, and/or pelvic wall</td>
</tr>
</tbody>
</table>

**Partin Tables:**
- serum PSA
- clinical stage
- Gleason score
- Risk of recurrence after radical prostatectomy

**D'Amico classification:**
- serum PSA, clinical stage, Gleason score
- Risk of recurrence
- Jewett/Whitmore classification (old) → staging

---

**Management of early and locally advanced prostate cancer**

- **Management:**

  ![Diagram](image)

  - Early prostate cancer
    
    \[
    \begin{bmatrix}
    T_2 \\
    T_3 \\
    N_0 \\
    N_0
    \end{bmatrix}
    \]

  - \( < 70 \) years
  - \( > 70 \) years
  - expected life span
  - \( \geq G_3 \), \( G_4 \), tumour
  - Radical prostatectomy (robotic)
  - Structure removed:
    - prostate
    - seminal vesicles
    - obturator and
  - active surveillance
    - 3-6 monthly
    - DRE
    - PSA

---

Surgery • v2.0 • Marrow 4.0 • 2020
iliac Lymph nodes Complication: 
- impotence / erectile dysfunction 
- sepsis 
- incontinence

Locally Advanced prostate cancer
\[
\begin{array}{c|c|c|c}
T_{2b} & N_0 & m_0 \\
T_{3} & T_{4} & \text{or} & N_1
\end{array}
\]

\[\rightarrow < 70 \text{ years} \quad \rightarrow > 70 \text{ years} \]
\[\rightarrow > 10 \text{ years life span} \quad \rightarrow < 10 \text{ years life span} \]
\[\rightarrow \xi_1 \xi_2 \xi_3 \downarrow \text{Brachytherapy} \]
\[\text{\( ^{125} \text{i} \text{ palladium} \)} \]
\[68-70 \text{ Gy} \]

\[\rightarrow \text{Good Response} \quad \rightarrow \text{Residual disease} \]
\[\rightarrow \downarrow \text{PSA} \quad \downarrow \mathbb{O} \]
\[\downarrow \text{observe} \quad \text{Radical prostatectomy} \]

Management of metastatic prostate cancer

- m1 disease
- First line: ADT (Androgen deprivation)

\[\rightarrow \text{Surgical Castration} \quad \text{medical castration} \]
\[\rightarrow \text{Bilateral subsapcular orchidectomy} \quad \rightarrow \text{LHRH analogs} \]
\[\rightarrow \text{Goserelin (Zoladex)} \quad \rightarrow \text{Buserelin} \]
\[\rightarrow \text{Degarelix (LHRH Antagonist)} \]
\[\rightarrow \text{LHRH analogs + Anti androgens} \]
- Flutamide
- Enzalutamide (xtandi)
- Abiraterone (zytiga)

- Surge in LH
  \[ \uparrow \text{Testosterone} \quad \downarrow \]
  PSA flare
  within 10 Days

ADT - Androgen Deprivation Therapy
in few years tumour becomes hormone resistant

Treatment options

- Chemotherapy
  \[ \rightarrow \text{Paclitaxel} \]
  \[ \rightarrow \text{Cabazitaxel} \]

- Radiotherapy

- Spleucel-T (provenge)
  \[ \rightarrow \text{T cell vaccine} \]
  \[ \rightarrow \text{CD 54 extract} \]
  \[ \rightarrow \text{Hormone resistant} \]
  \[ \rightarrow \text{Bony metastasis} \]
  \[ \rightarrow \text{Strontium 89} \]
  \[ \rightarrow \text{Radium 223} \]

- Radiopharmaceutical therapy:
  \[ \rightarrow \text{Hormone resistant} \]
  \[ \rightarrow \text{Bony metastasis} \]

- most important prognostic factor: Stage of Disease

Active Space
Definition:
Protrusion of viscus or part of it through wall containing it.

uncomplicated hernia:
Reducibility and cough impulse

obstructed hernia:
Irreducible and no cough impulse but the blood supply is intact.
- obstructed hernia is also k/a incarcerated hernia.

strangulated Hernia:
Obstructed + compromised blood supply.

• Dictum: All obstructed hernias are strangulated unless proved otherwise.

Taxis:
- process of reduction of hernia.
- forceful taxis should be avoided in obstructed and strangulated hernia.

Based on the content of Hernia:

Omentocele
- when omentum is the content.
- On inspection: - No peristalsis
- On palpation: Doughy consistency
- Easy to reduce first part, difficult to reduce second part.
- On percussion: Dull note
- On Auscultation: -
- If Meckel's diverticulum is the content: Litter's hernia.
- Appendix: Amyand hernia.

Enterocoele
- when bowel is the content
- On inspection: visible peristalsis
- Difficult to reduce first part, easy to reduce second part.
- Tympanic note
- Bowel sounds.
Surgical management of hernias

1. Herniotomy:
   - Identify the sac and push the contents inside.
   - Highest Recurrence rate
   - Herniometry is the treatment of choice:
     - Congenital inguinal Hernia
     - Congenital Hydroceles

2. Herniorrhaphy:
   - Step 1 + 2 + 3 \(\rightarrow\) Suture the two edges of the suture together.
   - Cause of failure: Increased tension in the repair
   - Techniques:
     - Bassini's
     - Shouldice
     - Mayo
   - Indications:
     - Infected/strangulated hernias

3. Hernioplasty:
   - Step 1 + 2 + 3 \(\rightarrow\) Put a mesh over the defect.
   - Tension free repair with least recurrence rate
   - Techniques:
     - Lichtenstein's tension free mesh hernioplasty
   - Mesh materials:
     - Synthetic
       - Avoided when there is infection and strangulation
       - E.g.: proline mesh polyester, Vicryl + Prolene
       - PTFE mesh - poly tetra fluoroethylene
     - Biological
       - Can be used when there is infection
       - E.g.: AlloDerm (Acellular Human Dermis)
       - Acellular porcine dermis
Acellular Dermis

Synthetic mesh:
- Solid mesh
- Fixing is needed with sutures / staplers.

Net mesh
- Fibrous tissue grows through these pores
- They can remain in place without sutures being applied.
- Better anchoring.

- Mesh material:
  - MC used: Prolene
    - Strong
    - Hydrophobic

- Polyester: Hydrophilic → increased risk of infection, but due to rapid tissue in growth into the mesh, cellular defences prevent the infection.

- PTFE: solid mesh
  - Adv: Does not become adherent to tissue. → No fistulas
  - It can be used in IPOM: Intraperitoneal placement of mesh.
  - Modification: Fenestrated PTFE

3. Mesh shrinkage
   - Upto 50% shrinkage can occur

Pt - experiences pain because of shrinkage
   - A large mesh should be used, there should at least be 5 cm overlap on site of placement, so it doesn’t give rise to pain.

4. Weight of mesh
   - Low density: ≤ 40 gm/m²
   - Heavy weight: ≥ 80 gm/m²

Best mesh:
- Low weight mesh
  - Thin fibers
  - Large pores

Comfortable for the pt. and less shrinkage
5. Plug mesh:
   - Disadvantage: MESHOMA - Excessive collagen deposition around mesh
     \[ \downarrow \]
     Nerve entrapment
     \[ \downarrow \]
     Pain

Inguinal hernia

- Mc Hernia in both males and females: Indirect Inguinal hernia.
- Hasselbach’s triangle:

   ![Diagram of Hasselbach's triangle with labels]

   - Inferior: Inguinal ligament
   - Medial: Outer border of rectus
   - Superior: Inferior Epigastric vessels

- Any hernia that comes lateral to the triangle → Indirect.
- Through the triangle: Direct.

Isthmopexial orifice of Fruchaud:
- Superior: Arching fibers of internal oblique
- Medially: Outer border of Rectus
- Laterally: Tendon of iliopsoas
- Inferiorly: Pectineal or Cooper’s ligament
- Inguinal, femoral and obturator hernias - opens into this orifice.

Clinical tests:
- Ziemann 3 finger test \{ low sensitivity
- Ring invagination test
- Non-palpable Hernias: USG
- 20% pts can have occult C/L inguinal Hernia.
Management:

- **Surgery**

  - **Open**
    - Herniotomy
    - Herniorrhaphy
      - Bassini: suture conjoint tendon with reflected portion of inguinal ligament.
      - Shouldice repair: 3 layered / 6 layered.
      - 1st layer: double breasting of fascia transversalis.
      - 2nd layer: Double breasting of conjoint tendon with reflected inguinal ligament.
      - 3rd layer: Double breasting of external oblique aponeurosis.
      - 4th layer of Shouldice corresponds to Bassini's repair.
      - Surgery of choice: Lichtenstein's tension free mesh hernioplasty.

  - **Laparoscopic**
    - TEP
    - TAPP

Complication of open inguinal hernia surgery:
- Hemorrhage
- Injury to the vas/cord structure.
- Mc nerve injured during open inguinal hernia. S lies ilioinguinal nerve.
- Mc nerve entrapped beneath the mesh: iliohypogastric nerve.

- Recurrence.
- Wound infection

**Stoppa's repair**
- Open preperitoneal repair.
- Forms the basis for laparoscopic TEP.

**Laparoscopic hernia repair**

- **TEP**
  - Total Extraperitoneal Repair
  - Surgery done above the peritoneum.
  - Peritoneum is never breached.
  - Technically a better repair and more challenging.

- **TAPP**
  - Transabdominal preperitoneal repair.
  - Surgery is done beneath the peritoneum & hence breached.
- Lap repair is specially useful for
  - B/L inguinal hernias
  - Recurrent inguinal hernias.
- During Lap repair two places where staples should not be applied:
  - Triangle of Doom
  - Triangle of pain

- Ext. iliac artery and vein
- Genital branch of GFN

- Mc nerve entrapped in laparoscopic surgery: Lateral cutaneous nerve of thigh.
- Meralgia paresthetica.
- Triangle of pain is also known as Electrical hazard zone.
- Triangle of Doom (medial)
- Triangle of pain (Lateral) \( \Delta \) of doom

**Corona Mortis / Circle of death**

- Abnormal communication b/w external and internal iliac systems
  - External iliac
  - Internal iliac

- Aberrant obturator artery
- Lies close to the pubic tubercle
- Toriental hemorrhage during laparoscopic surgery
Classifications of inguinal hernias:
- Gilbert
- Nijhuis
- European hernia society classification:
  - P - primary Hernia
  - R - Recurrent
  - L - Lateral / Indirect
  - M - Medial / direct
  - F - Femoral Hernia

Defect - is measured in finger breadths.
- 1 finger breadth = 1.5 cms of defect

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Special types of inguinal hernias

2. Pantaloon Hernia: Direct + Indirect Hernia.
3. Sliding Hernia: Hernia en Glissade
   - Commonly seen in elderly males
   - The posterior boundary of the sac is formed by a visceral structure
   - Mc on left side > Rt. side
   - Mc structure implicated: Sigmoid colon > Bladder.
4. Sportsman hernia:
   - Also K/a Gilmore groin
   - Athletes
   - Severe inguinal / groin pain
   - Occurs d/t tear in the posterior wall muscle.
   - Sometimes a very small hernial sac can be there.
   - Usually non-palpable.
   - IOC: MRI
   - M: Rule out other causes of inguinal pain

   Laparoscopic inguinal hernia surgery is done. Pain may not resolve even after the surgery.
Femoral hernia.

- Comes out through the femoral ring
- Superior: Inguinal ligament
- Medial: Lacunar ligament
- Lateral: Septum which separates it from the femoral vein.
- Posteroinferior: Pectineal / Cooper’s ligament
- High chances of obstructions and strangulation in femoral hernia as the ring is surrounded by rigid structures.
- Can be associated with Richter’s hernia.
- F > M, Elderly low weight females are more commonly affected.

On Examination:

```
        Pubic tubercle
         /          \
      Inguinal hernia  Femoral hernia
        ↑
       Above and medial to pubic tubercle
```

Below and lateral to pubic tubercle

Differential diagnosis of femoral hernia:
- Inguinal hernia.
- Psoas abscess.
- Inguinal lymph node.
- Saphena Varix

Management

```
        Surgery
         /          \
      Open         Lap
       High        TEP/TRAP
          ↑          
      Uncomplicated femoral hernia
          ↓
      Better exposure.
      Lockwood’s Repair
      Obstructed / strangulated hernias
```

High repair

- McVay’s Repair
- Lichtenstein’s repair: Inguinal approach.
Special types of femoral hernias:
1. Laugier's hernia:
   - Occurs through lacunar ligament.
   - Prone to strangulation.
2. Narath's hernia:
   - Femoral hernia seen in patients with CDH (Congenital dislocation of hip).
3. Serafini's hernia:
   - Retrovascular hernia, lies behind the femoral hernia, posterior to femoral vessels.
4. Velpeau hernia:
   - Prevascular hernia, lies anterior to femoral vessels.
   - All these 4 special types are prone to strangulation.

Ventral hernias:
- Means abdominal wall hernia.
1. Epigastric
2. Umbilical / Paraumbilical
3. Spigelian
4. Traumatic
5. Lumbar
6. Paraspinous
7. Incisional = MC ventral hernia.

Incisional hernia

- Develops in the region of incision.
- 30-50% open abdominal surgeries - develop incisional hernia.
- 1-5% laparoscopic surgeries → develop incisional hernia.
- Usually a large defect → Strangulation not common
- Obstruction can occur due to adhesions.

Management:

- Surgery
- Very small defect (1-2 cm)
- Mayo's repair (type of herniorrhaphy)
- High recurrence

- Meshplasty
- Open
- LAP (IPOM)
**Onlay**: mesh placed on top of anterior rectus sheath.

**Inlay**: At level of anterior rectus sheath. (or) between anterior sheath and muscle.

**Sublay**: Between posterior sheath and peritoneum in preperitoneal space.

**IPOM**: Intraperitoneal placement of mesh (Tissue separating mesh: Polytetrafluoroethylene mesh)

- Tissue repairs like keel and de Silva are preferred these days.
- Ramirez component separation technique done if incisional hernia volume is > 25% of abdominal volume.

  Relaxing incisions are made laterally in the external oblique aponeurosis

  Avoids the loss of abdominal domain.

**Epigastric hernia**

- **A/V/A fatty hernia of linea alba.**
- **MC in young fit males (M>F)**
- It can occur anywhere between xiphisternum and umbilicus
- **Usually in midline**
- **Single/multiple defect.**
- Not identifying the multiple defect → **MC cause of recurrence.**
- Transverse split in the median raphe

  Elliptical defect (< 1 cm)

  **MC structure which herniates**: Preperitoneal pad of fat

**Clinical features:**

- **Swelling**
- **Cough impulse**
- **Pain similar to peptic ulcer.**

**Management**: Same as incisional Hernia.
Umbilical / paraumbilical hernia

Umbilical
- Causes eversion of the umbilicus
- Large defect: obstruction and strangulation are uncommon.
- Newborn – High incidence in premature babies
- 5 times higher incidence in black babies
- Umbilical hernia in Newborn
  ↓
  Conservative management
  (2-3 yrs)
  ↓
  If Hernia persists after 2-3 years, surgery is done.
- Umbilical hernia is also seen in Cirrhosis / massive ascites

Paraumbilical
- Umbilicus forms one of the boundaries of the defect
- Defect is usually superior and right sided
- $F > M$
- More common in obese patients
- Management: Early surgery.

Omphalocele and gastroschisis

Omphalocele
- Defect through the umbilicus in which bowel fails to return inside.
- Bowel covered with peritoneal sac.
- Large defect, so liver can also herniate

Gastroschisis
- Defect adjacent to the umbilicus
- Bowel is not covered with peritoneal sac.
- Bowel exposed to environment
  ↓
  dry, inflamed & gets perforated
- Narrow defect
• Associated with other congenital anomalies
• Associated with Beckwith-Wiedemann syndrome
• Chromosomal: Trisomy 13, 18, 21
• Management:
  • Done by creating a SILO → Gradual reduction of abdominal contents

Lumbar hernia

• $a^\circ > i^\circ$
• $i^\circ$ lumbar hernias are rare
• $a^\circ$ lumbar hernia: Post renal Surgery
  Trauma

Differential diagnosis:
• Lipoma
• Pseudohernia - muscle bulges out due to weakness.

Injury to subcostal nerve during renal surgery.
• Lumbar hernia comes out through two triangles.

Lumbar hernia
• Inferior Lumbar triangle of Petit
• Superior Lumbar triangle of Grynfeltt

Majority of hernias
• Boundaries:
  • Inferiorly: Iliac Crest
  • Laterally: External oblique
  • Medially: Latissimus dorsi
• Superiorly: 12th rib
• Laterally: Internal oblique
• Medially: Sacrospinals

Management:
• Open or laparoscopy
• Dowd-Ponka repair

Spigelian hernia

• A/K/A intraparietal hernia.
• Defect in Spigelian fascia.
• Sometimes it can pass through internal oblique as well.
• MC location: Below umbilicus and above arcuate line.

• In young patients: Defect is narrow; there can only be preperitoneal fat.
• In adult: large sac
• These hernias are usually detected late, as swelling is not palpable
  Management: Open or laparoscopy

**Obturator hernia**

• AKA: Little old lady’s hernia
• Common in elderly, multiparous woman
• Narrow defect → Increased chances of strangulation & Richter’s hernia.
  Clinical Features:
  • Pain
  • Hip flexed
  • Swelling in the Scarpa’s triangle can be missed because it is covered by pectineus
  • On digital rectal or perivaginal examination: A tender swelling can be felt
  • Howship-Romberg sign:
    Abduction and medial rotation
    ↓
    Shooting pain along the obturator nerve
  Management: Open or laparoscopic (Lap will be TAPP repair)

**Richter’s hernia**

• Can be seen in femoral hernia, paraumbilical hernia and obturator hernia.
• Very narrow defect
  ↓
  Only portion of circumference of bowel herniates
  ↓
  Strangulation occurs and detected late
• Initial features: Similar to Gastroenteritis

**Maydl’s hernia**

• Very large defect
• More than one loop of bowel herniates
• “W” shaped hernia
  → strangulation
• If strangulation occurs
  ↓
  First affected: Connecting portion
  [ Intraperitoneal ]
Congenital diaphragmatic hernia

**Bochdalek**
- **MC**: 65 - 70%
- Left posterolateral hernia
- Occurs due to defective development of pleuroperitoneal canal or membrane
- Contents: Stomach, Spleen, and transverse colon

**Morgagni**
- Right anteromedial
- Defective development of central tendon of diaphragm
- **MC**: Transverse colon

**Defect in diaphragm**
- Bowel will be present in thorax
- Pulmonary hypoplasia = MC cause of death
- Hypoxic vasoconstriction of pulmonary vessels
- Pulmonary hypertension = 2nd MC cause of death

**Clinical Features**:
- Mothers develop polyhydramnios
- Scaphoid abdomen
- Respiratory distress
- Dextrocardia
- If Ryle's tube insertion is attempted, it gets coiled up in the stomach and seen in thorax

**Management**:
- Bag and mask ventilation - Contraindicated
- **Best**: IPPV (Intermittent positive pressure ventilation)
- ECMO (Extracorporeal membrane oxygenation)
- Inhaled nitrates for pulmonary hypertension

**Definitive Management**:
- **Surgery**: Circumferential incision over the diaphragm
  - Reduce the contents and close the diaphragm using mesh
Internal hernia

- Stammer's hernia.
- Petersen's hernia.

Left paraduodenal hernia:
- Through fossa of Landzert
- Develops due to defective fusion of Descending colon mesentry.
- Lies behind inferior mesenteric vessels.
- Left paraduodenal hernia is more common than Right duodenoejunal hernia.

Right duodenoejunal hernia:
- Defective fusion of ascending colon mesentry.
- Lies behind the superior mesenteric vessels.

Mesentery

Mesenteric cyst:
- Presents with Tillaux triad.
- Periumbilical swelling
- Moves at right angles to attachment of mesentery but not along the line of attachment of mesentery.
- Transverse band of resonance over the swelling

IOC: CECT

Types of mesenteric cyst:
- Chylolymphatic cyst - MC
- Enterogenous cyst
- Dermoid

Chylolymphatic cyst
- MC
- Sequestered lymphatic tissue
- It has independent blood supply
- Thin walled with clear fluid

Enterogenous cyst
- Sequestered bowel tissue
- Shares blood supply with bowel
- Thick walled with turbid fluid

Management:
- Enucleation
- Resect and anastomosis.

Misty mesentery:
- Seen secondary to pancreatitis, edema, cancer, hemorrhages.
- Should not be confused with mesenteric panniculitis.
- Mesenteric manifestation of Weber-Christian disease is called as mesenteric panniculitis.
- Misty mesentery means increased fat attenuation on CT.
**ARTERIAL DISORDERS**

**Acute arterial occlusion**

- **Cause -** secondary to an embolus
  - m.C. source of embolus
    - Heart
  - Other sources - Aneurysm
- **Acute phenomena -**
  - No time for formation of collaterals
  - Thrombus forms gradually
  - There is time for formation of collaterals

**I.O.C**

- Duplex
  - Doppler + 'B' mode ultrasound
  - A normal artery on duplex shows triphasic flow

**Management**

- if presents Early
  - 6-8 hrs Presentation
  - Embolectomy
  - Gangrene is formed
  - leads to compartment syndrome
  - Management - Fasciotomy
  - so fasciotomy is prophylactically performed

- if Late
  - Re-perfusion injury
  - Fogarty's Balloon Amputation muscles and tissues
  - can ↑ risk of injury
  - Gangrene is formed

**Acute arterial occlusion**
Chronic arterial occlusion with collaterals

Chronic arterial occlusion

• Cause - Secondary to thrombus.
  ↓
  thrombus grows gradually
  ↓
  there is time for the formation of collaterals
  ↓
  Advantage - some area distal to thrombus survives on complete obstruction.

• C/F - Intermittent claudication
  ↓
  • Cramping pain - on walking certain distance
  • Pain is felt in muscle below the block - mC site - calf muscle

Boyd classification of intermittent claudication
class I - Pain on walking, but pain ↓ on continuation of walking
class II - Pain on walking, continues to walk despite the pain
class III - Pain forces the patient to stop walking
class IV - Pain at rest

Fontaine and Rutherford classification of claudication

<table>
<thead>
<tr>
<th>FONTAINE</th>
<th>RUTHERFORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage</td>
<td>Clinical</td>
</tr>
<tr>
<td>I</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>IIa</td>
<td>Mild claudication</td>
</tr>
<tr>
<td>IIb</td>
<td>Moderate-severe claudication</td>
</tr>
<tr>
<td>III</td>
<td>Ischemic rest pain</td>
</tr>
<tr>
<td>IV</td>
<td>Ulceration or gangrene</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Difference between
  - Intermittent Claudication
    - Pain after walking certain distance
  - Neurogenic Claudication
    - Lumbar canal stenosis
    - Pain varies with posture
    - Relieved by bending forward
  - Osteoarthritis
    - Maximum pain on the first step

- Other C/F - Arterial ulcer
  - Gangrene
  - Loss of muscle volume
  - Sparse hair

Chronic arterial occlusion - investigations

- T.O.C. - Duplex scan
- AbPI - Ankle brachial pressure index
  - Maximum systolic BP at ankle
    - Maximum systolic BP at brachial artery
      - 0.9-1.3 - Normal
      - <0.9 - Intermittent claudication
      - <0.5 - Rest pain
      - <0.3 - Critical Limb ischemia / Imminent necrosis
      - >1.3 - Calcified vessels in diabetic nephropathy

- Gradually ↓ ABPI - Sign of imminent limb loss
- For every 0.1 ↓ in ABPI below 0.9 - Risk of cardiac mortality ↑ by 10%
- If Resting ABPI is normal
  - Still suspecting arterial disease
  - Check post exercise ABPI
- If there is a rate limiting arterial disease
  - Fall of post exercise ABPI more than 30% as compared to resting ABPI
Leriche syndrome
- Cause - block at the aortic bifurcation
- C/F - earliest manifestation - Gluteal claudication
  Impotence

Buerger's Disease and Atherosclerosis

<table>
<thead>
<tr>
<th>Buerger's disease</th>
<th>Atherosclerosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Thromboangiitis obliterans)</td>
<td></td>
</tr>
<tr>
<td>• occur in 3\textsuperscript{rd}/4\textsuperscript{th} decade</td>
<td>• occur in ≥ 5\textsuperscript{th} decade</td>
</tr>
<tr>
<td>• Males &gt; Females</td>
<td>• Males = Female</td>
</tr>
<tr>
<td>• Risk Factor - Smoking</td>
<td>• Involves lower limb &gt; upper limb</td>
</tr>
<tr>
<td>• Involves lower limb &gt; upper limb</td>
<td>• Involves artery</td>
</tr>
<tr>
<td>• Involves Artery, vein, nerve</td>
<td>• Involves large to medium size vessels</td>
</tr>
<tr>
<td>• C/F - superficial thrombophlebitis</td>
<td>• Spread - proximal to distal</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>• Bypass grafting and stenting has a role in treatment of atherosclerosis</td>
</tr>
<tr>
<td>Arterial blockage</td>
<td></td>
</tr>
<tr>
<td>• Involves small to medium size vessels</td>
<td></td>
</tr>
<tr>
<td>• Spread - Distal to proximal</td>
<td></td>
</tr>
<tr>
<td>• No distal target vessel / Distal vessel is narrow</td>
<td></td>
</tr>
<tr>
<td>• No role for Bypass grafting</td>
<td></td>
</tr>
</tbody>
</table>

Management of Buerger's disease

1. Quit smoking
2. Drugs - equivocal role
3. Omentoplasty - no role
4. Conservative amputations
5. If pain present
   \[ \text{Lumbar Sympathectomy} \]
   \[ \text{Indicated only in rest pain} \]
   \[ \text{Contraindicated in intermittent claudication} \]

- Chemical sympathectomy - preferred
- If B/L lumbar sympathectomy is done
  \[ \text{Spare L1 ganglion on one side} \]
  \[ \text{Otherwise - cause impotence in males} \]
- MC structure confused with lumbar sympathetic chain - genitofemoral oral nerve
- On Angiography - Corkscrew collaterals seen.

Management of atherosclerosis

- Bypass grafting or stenting
  - Angioplasty - Ileofemoral disease (preferred)

  Not for blocks beyond this

- Results with bypass grafting is better compared to angioplasty

Bypass grafting

In leriche syndrome

- Block at aortic bifurcation
- Iliac block on one side
- Aortofemoral grafting is done
- MC graft-Dacron

- Suprainguinal grafts - MC graft-Dacron
- If the block is in femoral artery
- Ili popliteal grafting is done
- It is infrainguinal graft

MC graft Best synthetic material

Reverse saphenous vein graft PTFE (Polytetrafluoroethylene)

Aneurysms

- MC vessels involved with aneurysms - circle of Willis
- MC extracranial vessel - infrarenal abdominal aorta.
- MC peripheral vessel - Popliteal artery
- MC visceral vessel - Splenic artery
- MC vessel with mycotic aneurysm - Aorta
- MC organism in mycotic aneurysm - S. aureus
- MC vessel involved in pseudoaneurysm - Femoral artery

Abdominal aortic aneurysm
- MC site - Infrarenal abdominal aorta.
- Most important risk factor - Atherosclerosis

Screening
- Starts at 65 yrs.
- Ultrasound abdomen

  Critical diameter
  ↓
  i) For abdominal aortic aneurysm - 5.5 cm - ↑ chances of rupture
     Surgery is carried out even in asymptomatic patients

  ii) For ascending thoracic aortic aneurysm - 5.5 cm → if 0.5 cm ↑/per yr
     ↓
     Indication for surgery

  iii) For descending thoracic aortic aneurysm - 6.0 cm → if 1 cm ↑/per yr
     ↓
     Indication for surgery

  iv) In Marfan patients - Thoracic aortic aneurysm - 4.5 - 5 cm is the
     critical diameter

- Chances of rupture are higher in females

**Abdominal aortic aneurysm - clinical features, management 00:39:34**

- C/F - Asymptomatic
  - Lump in abdomen
  - Pain
  - Act as source of embolus - Blue toe syndrome
  - If rupture - Very high mortality
    - MC site - Left retroperitoneum

- I.O.C - CT angiography
  - Management - In all symptomatic or
Asymptomatic with diameter ≥ 5.5cm

- Surgery
  - Dacron graft repair
    - Open
    - EVAR (Endovascular Aneurysm Repair)

Abdominal aortic aneurysm - surgery - open and EVAR

<table>
<thead>
<tr>
<th>Open</th>
<th>EVAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>• To expose the aorta</td>
<td>• The device has three parts body, limbs, hooks</td>
</tr>
<tr>
<td>mobilise the descending</td>
<td>• Hooks - help in anchoring the</td>
</tr>
<tr>
<td>color medially</td>
<td>graft to aorta</td>
</tr>
<tr>
<td>known as left medial</td>
<td>keeps in position</td>
</tr>
<tr>
<td>visceral rotation</td>
<td>• these patients - monitored life long</td>
</tr>
<tr>
<td>mattrax procedure</td>
<td>due to complication - Endoleaks</td>
</tr>
<tr>
<td>• If right ascending colon</td>
<td></td>
</tr>
<tr>
<td>mobilized</td>
<td></td>
</tr>
<tr>
<td>medially - Right medial</td>
<td></td>
</tr>
<tr>
<td>visceral rotation - Cattel-</td>
<td></td>
</tr>
<tr>
<td>Braasch maneuver</td>
<td></td>
</tr>
</tbody>
</table>

Note: If duodenum is mobilised, then it is called as Kocherization
**Types of endoleak**

- **Type I**: Occurs due to improper seal
- **Type II**: Retrograde leak from lumbar vessel
- **Type III**: Leak from graft
- **Type IV**: Porous graft
- **Type V**: Increase in maximum aneurysm diameter with no identifiable endoleak

**Abdominal aortic aneurysm - complications following surgery**

1. Cardiovascular causes - leading cause of death
2. Renal Failure
3. Aortoduodenal fistula
4. Colonic ischemia - M.C. on left side
   - Manifests as bloody stools (+)
5. Paraparesis - involvement of artery of Adamkiewicz
   - Supplies anterior spinal artery
Associated with mortality

selective surgery
< 2-3%

emergency (ruptured aneurysm)
>50% (Aims)

Thoracoabdominal and thoracic aortic aneurysms

Crawford classification of thoracoabdominal aortic aneurysm

Type I
- From left subclavian artery to aortic bifurcation
- Most extensive

Type II
- Left subclavian artery to aortic bifurcation

Type III
- Mid-descending aorta to aortic bifurcation

Type IV
- Upper abdominal aorta and all or none of the infrarenal

Thoracic aortic aneurysms
- Risk factors - Atherosclerosis
  - Marfan syndrome
  - Ehlers Danlos syndrome
- Clinical Features - Asymptomatic
  - Due to mass of aneurysm - Compressive symptoms - Hoarseness
  - Dyspnea
  - Dysphagia
- If it ruptures - Left pleural effusion
- Associated with progressive aortic valve insufficiency
- On X-ray - Mediastinal widening seen
- LOC - CT Angiography
- Management - Dacron graft repair
Aortic dissection

- A tear in intimal layer and blood enters between intima and media.
- Most important risk factor - Hypertension
- MC site - Lateral wall of ascending thoracic aorta.
- C/F - Earliest - Chest pain
  \[ \text{radiates to back} \]
  - If aortic root is involved - Myocardial infarction
  - Renal failure
  - Left pleural effusion

- LOC -
  \[ \begin{align*}
  \text{if stable} & \quad \text{CT-angiography} \\
  \text{if unstable} & \quad \text{transesophageal echo cardiography}
\end{align*} \]

Classification of aortic dissection

- **DeBakey I**
  - Ascending + descending aorta involved
- **DeBakey II**
  - Only ascending aorta
- **DeBakey III**
  - Only descending aorta

- **MC type**
  \[ \text{Stanford - B} \]
- **Stanford - A**

![Classification of aortic dissection](image-url)
Management of aortic dissection, popliteal aneurysm, femoral aneurysm

Aortic dissection - management
• 1st line - Beta blocker - esmolol
  ↓
  For permissive hypotension
  ↓
  in DeBakey I, II
  ↓
  in DeBakey III
  ↓
  surgery
  (Dacron graft repair)
  ↓
  monitor
  ↓
  if deteriorating
  ↓
  surgery

Popliteal aneurysm
• m.C - peripheral vessel aneurysm
• Critical diameter - 2cm
  ↓
  surgery even if asymptomatic
  ↓
  seen in males
  ↓
  50% can be bilateral

Femoral pseudo aneurysms
• Cause - trauma, angioplasty or angiography - m.C.C
• If the aneurysm is
  ↓
  < 3cm          > 3cm
  ↓              ↓
  Thrombin injection  Surgery
Raynaud’s phenomena

- Raynaud’s disease - Associated with collagen vascular diseases
- Raynaud’s phenomena
  - mc in - people using vibrating tools
  - A/K/A vibration hand

Vasospasm - 3 phases

Phase -I  Phase -II  Phase -III

Artery + vein - both in spasm

Vein in spasm + Artery relaxed

Artery + vein both relax

Pale

Oxygenated &
Deoxygenated blood mixes

Blue/cyanosed

Causes - Pain

- Management - Avoid precipitating factors - vibrating tools, cold environment

  - Calcium channel blockers - D.O.C

Acrocyanosis

- Seen in Females
- Painless
- Episodic
- Mottled cyanosis → parasthesias
Arteriovenous fistula

- Types of AV fistula
  1) Traumatic
  2) Iatrogenic - MC in renal dialysis
  3) Known as Cimino fistula
  4) Between radial artery and cephalic vein
  5) Congenital - Beckwith - Wiedemann syndrome
     Sturge-Weber syndrome
     Klippel - Treunayan syndrome

- If a congenital fistula is present in a limb - causes hypertrophy of limb
- C/F - pulsatile swelling
  - High output state - high output cardiac failure
- On examination - Bruit (+)
- Nicoladoni - Branham sign - on pressing feeding vessel.
  1) Size
  2) Pulse rate
  3) Systolic BP
  4) Bruit

- I.O.C. - MR angiography
- Management: if asymptomatic - no management
  if symptomatic - 1st line - Angioembolization
  Surgical management
  1) if it fails (or)
     2) there is hypertrophy of limb (or)
     3) Infected fistula (in drug abusers)

Ligate the fistula.

Subclavian steal syndrome, carotid artery stenosis

- Subclavian steal syndrome
- Stenosis / blockage in first part of subclavian artery
- On physical exercise → Reverse flow from vertebral artery
  Causes Dizziness / syncope

- M.C.C. - Atherosclerosis
- Diagnosis - CT angiography
- Management - Angioplasty
Carotid artery stenosis
- MC site of block - at bifurcation
- MCA - atherosclerosis
- C/F - transient ischemic attacks - warning sign for major stroke

- Diagnosis - Duplex scan

Indications for surgery
- >70% or greater carotid stenosis
  - Ipsilateral amaurosis fugax or monocular blindness
  - Contralateral facial paralysis or paresthesia
  - Arm / leg paralysis or paresthesia
  - Hemianopia
  - Dysphasia (if dominant hemisphere)

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

Thoracic outlet syndrome

Through thoracic outlet

artery \[\downarrow\]

subclavian artery

\[\downarrow\]

vein

subclavian vein

\[\downarrow\]

nerve

brachial plexus

- Causes - Cervical rib
- Arthritis
- Tumor

C/F - If subclavian artery - compressed - ↓ pulse

- Embolic phenomena.
- If subclavian vein - compressed - swelling of upper limb
- If brachial plexus - compressed - m.c involved - ulnar distribution

I.o.c - CT angiography
Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Maneuver</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADSON TEST</td>
<td>Affected arm is abducted 30° at the shoulder while maximally extended. While extending the neck and turning head towards ipsilateral shoulder, patient inhales deeply</td>
<td>Decrease or absence of ipsilateral radial pulse</td>
</tr>
<tr>
<td>Elevated Arm</td>
<td>Arms are placed in the surrender position with shoulders abducted to 90° and in external rotation, with elbows flexed to 90°. Patient slowly opens and closes hand for 3 min</td>
<td>Precipitates pain, paresthesia, heaviness or weakness</td>
</tr>
<tr>
<td>Stress Test</td>
<td>(EAST) or ROOS</td>
<td></td>
</tr>
<tr>
<td>Upper Limb</td>
<td>Position 1: arms abducted to 90° with elbows flexed</td>
<td>Positions 1 and 2 elicit symptoms on the ipsilateral side, while position 3 years elicits symptoms on the contralateral side</td>
</tr>
<tr>
<td>Tension Test</td>
<td>(ULTT) or ELVEY</td>
<td></td>
</tr>
</tbody>
</table>

- **Wright/hyper abduction test** - when the arm is abducted
  
  ↓

  * if no symptoms
  
  ↓

  hyper abduction - if symptoms (+) or pulse ↓ - indicates 

  Thoracic outlet syndrome

- **Management** - if cervical rib (+) → Resection 
  
  Majority - respond to - physiotherapy
VENOUS SYSTEM

Deep vein thrombosis

Risk factor:
1. Previous h/o DVT
2. Immobilization
3. Protein C and S deficiency
4. Factor S (Leiden mutation)
5. Pregnancy
6. Malignancy
7. Trauma
8. Surgery

Phlegmasia Cerulea Dolens:
- Painful blue limb.
- Thrombosis of major axial veins.
- Involvement of collaterals.

Phlegmasia Alba Dolens:
- Painful white limb (aka milk leg)
- Thrombosis of major axial veins but collaterals spared.
- Mc veins affected with DVT → Calf / Soleal veins
- M. c DVT to cause pulmonary embolism → Iliofemoral veins.

Clinical features:
- Pain (m. c and earliest)
- Swelling
- If pulmonary embolism → Chest pain, respiratory distress.
Signs: Limb edema.
- Homans Sign: Resistance / Stiffness on dorsiflexion of foot.
- Moses Sign: Pain when calf is squeezed.

IOC: Duplex scan
Clinical scoring: modified Wells score.

Management of DVT

Anti coagulation.
First 5 days: LMWH + Warfarin.
After 5 days: Only Warfarin.

First episode → Anti-coagulation for 3 months
Recurrent DVT → Lifelong.
Warfarin monitoring → INR (International Normalized Ratio)
  \[ \text{INR} = \frac{\text{PT (patient)}}{\text{PT (control)}} \]
  Target INR = 2 - 3

Clinical case:
Young patient with DVT on Warfarin Therapy.

\[ \begin{align*}
\text{PRESENTS WITH SYMPTOMS OF APPENDICITIS.} \\
\text{INR = 1.4} \\
\text{Can be taken up for surgery} \\
\text{Max acceptable INR at which surgery can be done: 1.4.}
\end{align*} \]

Fastest way to ↓ INR 4
- Prothrombin Factor > Fresh Concentrates plasma.

• Note:
  Patient sensitive to Heparin → Fondaparinux
  (Factor Xa inhibitor)
  → Bivalirudin
  (Direct Thrombin Inhibitor)

Novel anti-coagulants (NOAC)
Direct Xa Inhibitors
- Rivaroxaban
- Apixaban.
IVC Filters

Indications:
1. Anticoagulation contraindicated
2. Pulmonary embolism despite anticoagulation
3. Persistent pulmonary hypertension

Dissolution of clots:
- Urokinase
- Streptokinase

Note:
2/3 patients with DVT
Develop post-thrombotic leg within 5 years
Venous hypertension
- Varicose veins
- Lipodermatosclerosis
- Ulceration

Prevention of DVT

Pharmacological methods
- LMWH
- NOAC

> mechanical methods
- Early ambulation
- Pneumatic compression stockings

Risk assessment in DVT

Low risk: Only mechanical prophylaxis
- Minor surgery < 30 minutes; any age; no risk factors
- Major surgery < 30 min; age < 40; no other risk factors
- Minor trauma or medical illness.
**Surgical anatomy of venous system of lower limb:**

- **Superficial venous system (20%)**
- **Deep venous system (80%)**

- **Great Saphenous Vein (GSV)**
  - Medial end of dorsal arch
  - Lies anterior to medial malleolus (site for venous cut down)
  - Medial aspect of knee
  - Drain into Saphenofemoral Junction

- **SSV) Short Saphenous Vein**
  - Lateral end of dorsal arch
  - Runs posteriorly between 2 heads of gastrocnemius
  - Drains into Saphenopopliteal Junction (SPJ)
Saphenofemoral junction:
- constant
- 4cm below & lateral to pubic tubercle

Saphenopopliteal Junction:
- variable location

GSV - associated with
Saphenous nerve below the knee
[ :: If vein stripped below knee → nerve injury ]

Anterior saphenous vein (ASV)
Lateral aspect of knee
Drains into GSV.

Associated with sural nerve all along its course

Vein of Giacomini
Posterior extension of short saphenous vein drains into GSV

Perforators (100/ISO)
- SFJ → Largest
- Dodd → Above knee
- Boyd → Below knee
- Hunterian → Thigh
- 3 Cockett → 5, 10, 15 cm above medial malleolus
- May / Kuster → Heel

Varicose veins

Dilated tortuous veins with defected valves

Risk factors:
1. Post DVT
2. Defective valves
3. ↑ BMI
4. Female > males
5. Pregnancy
6. Klippel-Trenaunay syndrome
7. Prolonged standing
8. Family history

Clinical features:
- a) Asymptomatic
- b) Dilated veins:
  - > 3 mm → varicose veins
  - 1-3 mm → Reticular veins
  - < 1 mm → Thread veins/Dermal flares [Cosmetic blemish]
- c) Pigmentation (due to hemosiderin)
d) Lipodermatosclerosis
   - shiny skin
   - obliteration of fat
   - contractures.

woody feel of the limb
inverted champagne bottle appearance
early feature of varicose veins

e) Coro phlebectatica / malleolar flare.
   - Thread veins around medial malleolus
   - Early sign of advanced venous disease.

f) Atrophie Blanche
   white area surrounded by
dermal flares

Classification and diagnosis of varicose veins

CEAP classification:

<table>
<thead>
<tr>
<th>Clinical Classification (C)</th>
<th>Anatomic Classification (A)</th>
<th>Pathophysiologic Classification (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C_1</td>
<td></td>
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<td>C_2</td>
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</tr>
<tr>
<td>C_3</td>
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<tr>
<td>C_4</td>
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<td>C_5</td>
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<td>C_6</td>
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<td>C_7</td>
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<td>C_8</td>
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<td></td>
</tr>
<tr>
<td>C_9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Etiologic Classification (E):

- E_1: Congenital
- E_2: Primary
- E_3: Secondary (postthrombotic)
- E_4: No venous etiology identified

Anatomic Classification (A):

- A_1: Superficial veins
- A_2: Perforator veins
- A_3: Deep veins
- A_4: No venous location identified

Pathophysiologic Classification (P):

- P_1: Reflux
- P_2: Obstruction
- P_3: Reflux and obstruction
- P_4: No venous pathophysiology identifiable

IOC: Duplex scan - mickey mouse view
Clinical signs:
- Low sensitivity

1. Trendelenburg test
   - To detect competence of SFJ and perforators

2. Modified Perthe's test
   - If DVT or not

3. Multiple Tourniquet test
4. Fegan method
   \[
   \begin{cases} \text{Detect site of incompetent perforators} \\
   \end{cases}
   \]

5. Pratt's test - incompetence of vein

Management of varicose veins

---

**Surgery**

- GSV & SFJ
- SSV & SPJ
- Perforators

**GSV and SFJ incompetence**
- Trendelenburg procedure
  - Flush ligation of SFJ.
  - (Ligate GSV as close to femoral vein as possible).

6 tributaries of GSV - to be ligated literally
- Superficial circumflex iliac vein
- Superficial epigastric vein

medially
- Superficial external pudendal
- Deep external pudendal

Distally
- Accessory anterior saphenous vein
- Posterior medial thigh vein

Stripping \(\rightarrow\) additional procedure
   \(\rightarrow\) done only upto the knee
Latest / Procedure of choice for GSV incompetence

EVLT (Endovenous Laser Therapy) OR RFA (Radio Frequency Ablation)
- 1470 nm
- Heat generated → 60V/cm
  → causes closure of veins

Advantage:
EVLT can be used in any vein including perforators

Advantage:
Standardized management
Safe
Shorter learning curve

Short saphenous vein incompetence

SSV × SPJ incompetence
1. Flush ligation of SPJ
2. No stripping [to avoid injury to sural nerve]

Procedure of choice → EVLT or RFA

Perforator incompetence
1. Traditional → Dodd & Cockett Procedure
   - multiple subfascial ligation of perforators
   - Cosmetically inferior
2. SEPS (Subfascial Endoscopic Perforators Surgery)
3. Latest → EVLT or RFA

Other treatment modalities:
- a) Compression garments → Adjunct to surgery
- b) Trivex → Subcutaneous illuminator
- c) Endovenous glue therapy → Cyanoacrylate glue
- d) Foam sclerotherapy
  - veins < 3 mm in diameter
  - m. sclerosing agents: Sodium tetradecyl sulphate
- Other sclerosing agents: Polidocanol
  - Ethanolamine oleate
  - Sodium morrhuate

Foam created so that: Larger area can be covered, better obliteration, less sclerosant used

Tessari method → used to create foam
Sclerosant: Air → 1 : 3 or
    1 : 4
in one attempt → 10–12 ml sclerosant used.

Disadvantage of foam sclerotherapy → ↑ complications ↓ recurrence

Complications of varicose veins surgery:
most common - wound infection
Bruising
Injury to femoral vessels
Injury to nerves
Recurrent

Complications of varicose veins

1. Bleeding
2. Calcification
3. Pigmentation
4. Lipodermatosclerosis
5. Venous ulcer / varicose ulcer
   most acceptable theory:
   Ambulatory venous hypertension theory
   m.c. location → medial malleolus / gaiter area.
   Features:
   Shallow ulcer
   Sloping edges
   Pale granulation tissue in floor
   pigmentation margins
   Tendency to become non-healing

management:
   Bisgaard regime
   E → Education
   E → Elevation of limb
   E → Elastic compression stockings (grade III)
   Grade I: 14 – 17 mm Hg
   II: 18 – 24 mm Hg
   III: 25 – 35 mm Hg

Regular dressings - VAC dressing
Antibiotics → avoided
Surgery for varicose veins done.
Long-standing venous ulcers / burn scars

- Marginal ulcers
  - (Squamous cell carcinoma)
  - Everted edges

Management:
- Surgery.
- Radiotherapy → not effective.

**Klippel Trenaunay syndrome**

**mesodermal abnormality**
- Non-familial
  - Varicose veins
  - Vestigial veins
  - Soft tissue & bony hypertrophy
  - Naevus

D/D: Park Weber Syndrome

- Varicose veins
- Haemangiomas
- A - V fistulae
- High output cardiac failure.

Management of Klippel Trenaunay:
- Compression stockings
- LMWH (if patient is undergoing surgery)

**Axillary vein thrombosis**
- aka Paget Schroetter disease
- develop after exercise of arm.
- Secondary to - Cervical rib thoracic outlet syndrome

Features: Swelling and Pain of arm.

IOC: Duplex scan

Management:
- Early → Thrombolysis.
- Anticoagulation.
- Surgery for cervical rib (if it is the cause)
LYMPHATIC SYSTEM

Acute lymphangitis
- Inflammation & infection of lymphatic vessels
- Causative agents: S. pyogenes, S. aureus
- Clinical features: Pain & inflammation.
- On examination: Red streak running along the lymphatic vessels
- Management: • Rest
  - Limb elevation
  - IV antibiotics
  - If patient don’t respond for 48 hrs/pus
    Drain

- If not managed adequately → Chronic lymphedema

Lymphedema
- Accumulation of excessive interstitial fluid involving the limbs, usually due to defective drainage

- Types,
  - Primary
    - Lymphedema congenita: Seen since birth till 2 yr of age
    - Sporadic or Familial → Nonne - Milroy syndrome (FLT-4/VEGF)
    - ♂ > ♀, Bilateral (entire limb & face)
    - Lymphedema praecox: 2 - 35 yr ages
      - MC in lymphedema
      - Unilateral, seen in legs (upto knee)
    - Sporadic or Familial (meige syndrome)
      (e.g., −2 gene)
    - ♂ > ♀
    - Lymphedema tarda: > 35 yr age

Surgery • v2.0 • Marrow 4.0 • 2020
- Secondary \( \bullet \) mc overall
  - mc cause of upper limb lymphedema - Post mastectomy
  - mc cause of lower limb lymphedema - Filariasis

Other course → - a² to Radiotherapy
  - Lymph node dissection
  - Lymphangitis
  - a² to cancer

Clinical features:
Brunner's classification

**Clinical Classification of lymphedema**

<table>
<thead>
<tr>
<th>Subclinical (latent)</th>
<th>There is excess interstitial fluid and histological abnormalities in lymphatics and lymph nodes, but no clinically apparent lymphedema</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Edema pits on pressure and swelling largely, or completely disappears on elevation and bed rest.</td>
</tr>
<tr>
<td>II</td>
<td>Edema does not pit and does not significantly reduce upon elevation</td>
</tr>
<tr>
<td>III</td>
<td>Edema is associated with irreversible skin changes, i.e. fibrosis, papillae</td>
</tr>
</tbody>
</table>

- Pain
- Swelling
- Cramping
- Edema

**Chronic lymphedema: Skin changes**
- Buffalo Hump: Concavity lost around the ankle
- Lymphedema in the dorsum of the foot
- Squaring of the toes.

- Stemmer's sign: Inability to pinch the skin over the dorsum of the foot

**Associated malignancy:**
- Stewart Treves Syndrome → Lymphangiosarcoma
  - Bluish reddish nodules
  - Seen usually if lymphedema is > 10 yrs
- Liposarcoma
- Malignant melanoma
- Basal cell carcinoma
- Squamous cell carcinoma
**Lymphangioma:**
- Swelling along lymphedematous limb.
- Collection of lymphatic fluid
  1. If $< 5$ cm $\rightarrow$ **Lymphangioma circumscriptum**
  2. $> 5$ cm diffuse $\rightarrow$ **Lymphangioma diffusum**
  3. Reticular arrangement $\rightarrow$ **Lymphedema Ab igne**

**Management: lymphedema**

- **Investigation:**
  - Gold standard - Direct puncture lymphangiography
    (dorsum of foot between the toes - dye injected)
  - **TC** $\rightarrow$ Sulphur colloid particles (less invasive)
  3 Abnormalities
    - Distal obstruction (mc) $\rightarrow$ 80% cases
    - Congenital hyperplasia
    - Proximal obstruction $\rightarrow$ 10% cases each

- **Limb volume - grade lymphedema.**
  - Excess limb volume
    1. $< 20\%$ - mild
    2. $20\% - 40\%$ - moderate
    3. $> 40\%$ - Severe
  - Gold standard: water plethysmography

**Treatment:**
- Skin care
- Pain control
- Swelling

- **Medical / Conservative**
  - Limb elevation skin care
  - Antibiotics
  - Pain control
  - Manual Lymphedema Drainage (MLD)
  - DLT (decongestive lymphedema therapy)

- **Surgical**
  - Resective procedure
  - Procedure to improve drainage

Surgery • v2.0 • Marrow 4.0 • 2020
DLT (Decongestive Lymphedema Therapy)

Aggressive phase: multilayer
Lymphedema bandaging
Graded compressive pressure

Ankle → 100%
Knee → 70%
Thigh → 50%
Groin → 30%

- Surgical management:
  - Improve drainage:
    - Anastomosis between lymphatics / nodes with veins
    - Neubulowitz procedure
      - Ileal mucosal patch
      - Kinmonth procedure
- Resective procedure -
  - Sistrunk (used done)
    - Wedge of skin/subcutaneous tissue removed
  - Homan's
  - Thompson - Severe filariasis / elephantiasis
    - Cosmetically less preferred procedure

Thompson procedure
Homan procedure
ORAL CANCER

- Site of oral cancer
  - Most common site
    - Overall
      - Lateral border
    - India
      - Buccal mucosa
    - of tongue
  - Pathology of oral cancer
    - Squamous cell cancer (SCC)
    - Most common gene mutation - p 53
  - verrucous cancer
    - Slow growing
    - grows outwards
    - Cause: HPV (Human papilloma virus)
    - Good prognosis

Oral cancer - Risk factors

Risk factor
1. Smoking
2. Alcohol
3. Tobacco
4. Sharp ill-fitting denture
5. Infections → HPV, EBV (Epstein Barr virus) → Nasopharyngeal cancer

Pre-Malignant conditions

High risk
1. Erythroplasia
   (Homogenous / speckled)
2. Proliferative verrucous leukoplakia
3. Chronic hyperplastic candidiasis

Medium risk
1. Oral submucous Abrasion
2. Syphilitic glossitis

Low risk
1. Oral lichen planus
2. Discoid lupus erythematosus
3. Discoid keratosis congenita
Hyperplastic candidiasis
• erythematous border
  ↓
  (classical sign)
• Cannot be rubbed off

→ Leukoplakia
• white patch
• cannot be rubbed off

1. Leukoplakia
• white patch in oral cavity
• cannot be rubbed off
• ↑ Risk of cancer → 3-5 times

Types of leukoplakia

Proliferative verrucous leukoplakia.
• 50% chance of malignant conversion
• rare
• lack typical risk factor of oral cancer
• multifocal
• regular follow up done
• in case of malignancy
  ↓
  management - Resection

Speckled leukoplakia.
• Leukoplakia over erythematous border
• most aggressive type
• High chance of malignancy

2. Erythroplakia
• Red patch in oral cavity
• ↑ risk of cancer → 6-9 times
• most aggressive type → speckled erythroplakia.
• Management - CO₂ laser excision

3. Chronic hyperplastic candidiasis
• Classical sign → erythematous border
• white patch can be rubbed off
4. Oral submucous fibrosis
   - Hypersensitivity reaction to betel nut
   - Fibrous band ⇒ inadequate mouth opening
   - Poor oral hygiene ⇒ ↑ Risk of cancer
   - Management
     - Stop smoking / betel nut consumption
     - Antioxidants
   - Definitive management ⇒ intralesional Triamcinolone injection
     - Intralosalional triamcinolone
       - Used in other conditions - keloid, costochondritis

5. Oral lichen planus
   - Ultracative

6. Syphilis

7. Plummer vinson syndrome
   - Also known as sideropenic dysphagia / Patterson Kelly Brown syndrome
   - Seen in perimenopausal women
   - Clinical presentation: iron - deficiency anaemia
     - Koilonychia
     - Upper esophageal / post - cricoid web
     - Dysphagia
   - ↑ risk of A cancers
     - Pharyngeal cancer
     - SCC of esophagus

Oral cancer - clinical features & diagnosis

1. Field cancerisation
   - multiple tumors can arise
   - site: oropharyngeal, colorectal, bladder
   - type of lesion
     - synchronous
     - metachronous lesion
   - Occurs within 6 month
     - Risk of recurrence ⇒ 15%
     - clinical features: ulceroproliferative lesion
     - Diagnosis
Biopsy
- edge/wedge
- biopsy from centre → contraindicated

CECT - ANS/Neck/Thorax
- IOC (investigation of choice) staging oral cancer

2. TNM - staging of oral cancer

AJCC - 8th (updates)
   i) DOI - depth of invasion
   ii) ENE - Extra nodal extension
   iii) HPV +, p16 + oral cancer

Oral cancer - Management

management

surgery

chemotherapy

Radiotherapy

A. Surgery

1. wide local excision (WLE) of primary tumor margin taken

   2 cm
   (earlier)

   0.5 cm
   (present)
2. mandibular involvement ⇒ mandibular resection

- Segmental
  - Segment of mandible removed
- Hemi - mandibulectomy
  - Half of mandible removed
- Marginal
  - inner/outer table of mandible removed

3. Lymph node involvement ⇒ neck dissection
4. Commando procedure ⇒ 1 + 2 + 3 (above steps)
5. Reconstruction

Flaps used in various cancers

1. Oral cancer

- Deltopectoral (D/P) flap
- Pectoralis major myocutaneous (PMMC) flap
  - most commonly used flap for head & neck surgery ⇒ PMMC flap
  - DP - flap ⇒ Based on perforators of internal mammary

2. Lip & angle of mouth reconstruction

3. Mandibular reconstruction

- Radial artery forearm flap
- Free fibular flap
  - Free Fibular flap (based on peroneal vessels) ⇒ most common flap for mandibular region
    - used for edentulous mandible
  - Iliac crest flap (deep circumferential iliac artery flap) ⇒ dentate mandible
management of lip & tongue cancer

a. Lip cancer

\[ \text{management} \]

\[ \text{Area} < \frac{1}{3} \text{rd} \]
\[ \text{1° resection & closure} \]

\[ \text{Area} > \frac{1}{3} \text{rd} \] \[ \text{Area} > \frac{2}{3} \text{rd} \]
\[ \text{Johansson step ladder approach & Abbe estlander flap} \]

\[ \text{Skin marking for Johansen step reconstruction} \]
\[ \text{Lip closure & labial step} \]

b. Tongue cancer

\[ \text{management} \]

\[ \text{Partial - glossectomy} \]
\[ \text{Hemi - glossectomy + Tongue reconstruction} \]

Oral cancer - Types of approach

a. Visor approach

Provides better exposure of tongue, floor of mouth
b. Intra oral approach

c. Lip split approach

Bilateral (B/L) cervical lymphnode enlargement
   Sites -
      (i) Tip of tongue
      (ii) angle of the tongue
      (iii) Lip cancer \rightarrow crossing the midline

b. Chemotherapy for oral cancer
   - 5 fluorouracil
   - Cisplatin
   Chemotherapy \rightarrow given for cases with lymph node involvement

C. Radiotherapy
   - Radiotherapy \rightarrow given to reduce LRR (locoregional recurrence)
   - Types

      Brachytherapy \quad \text{EBRT (External Beam Radiotherapy)}

      - Combined chemoradiation

      \text{NACT} \quad \text{Adjuvant chemotherapy}
\hspace{1cm} [ Neo adjuvant chemotherapy ]

Note:
   - Oral cancer
     - most important prognostic factor \rightarrow cervical lymphnode status
     - most common metastasis \rightarrow lungs

Anatomy of cervical lymph nodes

\hspace{1cm} AD- Anterior digastric
\hspace{1cm} PD- Posterior digastric
\hspace{1cm} SCM- sternocleidomastoid
\hspace{1cm} SO- Superior Omohyoid
\hspace{1cm} IO- Inferior Omohyoid
Level II - upper deep cervical
Level III - mid deep cervical
Level IV - lower deep cervical
Level V - posterior compartment
Level VI - mediastinal LN

Central compartment - Boundaries:
- Superior - Hyoid bone
- Inferior - Supraclavicular notch
- On either sides - Carotid sheath

The cancers that first drain into level VI lymph nodes are:

i) Laryngeal cancer
ii) Thyroid cancer

Neck Dissection

Types of Neck Dissection
1. Radical Neck Dissection
   - By crile
   - Removal of Level I-V + 3 extra - lymphatic structures
     [ sternocleidomastoid + internal jugular vein + spinal accessory nerve ]
- along with removal of ⇒ Tail of parotid + submandibular gland

2. MRND
- modified radical neck dissection
- Incision ⇒ modified schobinger’s.
- Removal of level I-V but save at least I extra - lymphatic structure
- Functional neck dissection ⇒ all 5 extra - lymphatic structure are saved
- In case of bilateral neck dissection ⇒ save IJV on one side to prevent facial/cranial edema.

3. Selective neck dissection

- CNND
  (Central Neck Dissection)
  - only level VI lymph node removed

- SOHND
  (Supra Omohyoid Neck Dissection)
  - Removal of level I, II, III
  - Extended SOHND
  - Removal of level I, II, III, IV

Complications of Neck Dissection
(i) Hemorrhage
(ii) Injury to nerve
  - marginal mandibular nerve (Ramus mandibularis)
    a branch of facial nerve which supplies angle of mouth
  - lingual nerve
  - Hypoglossal nerve
  - phrenic Nerve

(iii) Seroma
(iv) Flap necrosis
(v) Shoulder dysfunction [Injury to spinal accessory nerve]
(vi) Carotid artery blow out [complication associated with maximum mortality]

Metastasis from an unknown primary to cervical lymph node
- Esophagoscopy
- Bronchoscopy

b. Blind sites where cancer can be missed
   - Tonsillar fossa
   - Retromolar trigone
   - Floor of mouth
   - Pyriform fossa
   - Fossa of Rosenmüller

c. PET scan ↓ incidence

Note:
weber Ferguson incision for maxillectomy
SALIVARY GLANDS

Ranula

- Ranula → Frog's belly
- It is mucous extravasation cyst involving sublingual salivary gland
- Clinical features
  1. Cystic swelling in the floor of the mouth
  2. Fluctuant & brilliantly transilluminant
     Other brilliantly transilluminant swelling: Cystic hygroma, Epididymal cyst, Hydrocele
- Diagnosis
  Based on clinical features
- Management
  - Excision of cyst + marsupialization
  - Sublingual gland
- Most common structure injured during ranula surgery
  → Sub - mandibular duct
- Most common nerve injured → Lingual nerve
- Plunging ranula
  - Mucus retention cyst involving Sublingual & Submandibular gland
  - Swelling in oral cavity & neck
  - Management: Excision of intra-oral swelling
    + Sub-lingual gland
    + Aspiration of neck swelling
- Other conditions
  1. Mucus Retention Cyst
     - Involves minor salivary gland
     - Management: Excision of cyst
  2. Stafne bone cyst
     - Most common site of ectopic salivary tissue
     - No treatment required
Parotid Abscess

- A° to acute parotitis
- Seen in
  - Immuno-compromised children
  - Elderly (dehydrated)
  - A° to parotid duct stone
- Causes: *Staphylococcus aureus*, *Streptococcus*
- Clinical features:
  1. Painful enlargement of gland
  2. Fever
  3. Pus oozing out from parotid duct opening
  4. Trismus
- Diagnosis
  1. Clinical diagnosis
  2. Sialography → Contraindicated

- Fluctuation → late sign
- Management
  - Antibiotics
  - Aspiration
    - Fails
    - Incision & Drainage (19D)
      - Hilton's method - An Abscess close to neurovascular bundle

- Forceps is opened parallel to neurovascular bundle
  - Not perpendicular
  - Prevents damage to the nerve
  - Important in Parotid & Axillary Abscess

Recurrent Parotitis in children
- Common in age - 3-6 yrs
- Repeated attacks of Parotitis
- X-ray → Snow Storm appearance
- Management
  - Antibiotics
  - Repeated wash outs
Sialolithiasis

- Formation of stone in salivary gland
  - more common in Submandibular > Parotid gland
    [ Reason - Submandibular secretions are more viscous
      - Anti gravity drainage ]
  - most common composition → CaPO₄
  - 80% stones → Radio-opaque
- Clinical Features
  - Meal time syndrome - Post-prandial neck swelling (painful)
    ↓
  - Subsides in 1-2 hrs

- Investigation
  - IOC → NCCT
    (Investigation Of Choice)

**Warning:** Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with Marrow Edition 4 videos.

- Management

  Submandibular stone

  Stone ≤ 4 mm
  ↓
  Endoscopic removal using Dormia basket
  ↓
  Nephrolithotomy

  Stone ≥ 4 mm
  ↓
  Lithotripsy → Stone Breakdown
  ↓
  Removal of fragments

  Submandibular stone

  Distal to lingual nerve

  Longitudinal incision over the duct
  ↓
  Removal of stone
  ↓
  Duct - sutured
  [Absorbable suture]

  Proximal to lingual nerve
  (or)

  Endoscopic removal of stone
  ↓
  Close to Gland Parenchyma.

  Endoscopic removal of stone
  (via intra-oral route)
  ↓
  Fails

  Excision of Submandibular gland

  most common nerve injured → lingual nerve during surgery
Salivary gland tumors

<table>
<thead>
<tr>
<th></th>
<th>Benign</th>
<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parotid</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>Submandibular</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Sublingual</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Minor salivary</td>
<td>10%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Parotid Tumor

- Parotid gland
  - Superficial
  - Deep lobe
    - (mostly involved)
- Parotid swelling
  - Classical sign ➔ Swelling + elevation of ear lobe
- Clinical examination
  - Deep lobe enlargement ➔ Tonsillar fossa pushed medially
- Note
  1. Most common parotid tumor overall ➔ pleomorphic adenoma
  3. Most common malignant parotid tumor ➔ mucoepidermoid cancer
  4. 2nd most common malignant parotid tumor ➔ adenoid cystic cancer

Pleomorphic adenoma

- More common in females > males
- Involves superficial lobe of parotid (usually)
- Clinical features
  - Slow growing parotid swelling
  - Superficial lobe
  - Painless
• Diagnosis
  - FNAC
  - Extent of the swelling $\rightarrow$ MRI > CT

• Management
  
  Superficial parotidectomy $\quad$ Extracapsular dissection $\downarrow$

• Recurrence rate
  - High recurrence rate
  - Reason - The growing end of tumor $\rightarrow$ Finger like projections $\downarrow$
    During surgery, if the finger like projections are left behind $\downarrow$
    Recurrence

• Pathology
  - Epithelial + mesenchymal component

• Mixed malignant tumor
  - malignant
  - (i) Pleomorphic adenoma $\rightarrow$ mixed malignant tumor
  - change
  - (ii) Also known as carcinoma ex pleomorphic adenoma
  - (iii) Feature suggesting malignant change
    - Rapid increase in size
    - Involvement of facial nerve
    - Involvement of lymph nodes [LN]
    - Ulceration over swelling
    - Hard swelling
    - Sudden onset of pain
  - (iv) Management
    - Surgery followed by radiotherapy

Warthin’s tumor

• Known as Adenoma lymphomatosum
• 2nd most common Benign tumor
• Male > Females
• 3rd / 4th decade of life
• Associated with smoking & radiation exposure
• 10% $\rightarrow$ Bilateral
  - [... most common Bilateral (B/L) parotid tumor]
• Clinical features
  - Parotid swelling (Tail of parotid)
• Diagnosis
  - FNAC
- Extent of swelling: MRI > CECT

- Management
  - Superficial parotidectomy or extracapsular dissection

**Other parotid swellings**

1. Mucoepidermoid carcinoma.
   - Most common malignant parotid tumor
   - Associated with radiation exposure
   - Seen in infancy

2. Adenoid cystic carcinoma.
   - 2nd most common malignant parotid tumor
   - Perineural invasion
   - Extremely painful
   - ↑ recurrence rate
   - Histopathological examination (HPE)
     "Swiss Cheese" pattern

   - Management
     - Both adenoid cystic & Mucoepidermoid Cancer
     - Surgery followed by RT (Radiotherapy)

3. BLEL
   - Benign Lymphoepithelial Lesion (BLEL)
   - Associated with CMV (Cytomegalovirus)
   - Also known as Godwin's tumor
   - Malignant change - <5% cases
     - Eskimoa.

**Parotidectomy**

- Incision → Modified Blair's / Lazy 's' / Sistrunk's
  - 2 finger breath below the angle of mandible
  - Prevents injury to marginal mandibular nerve

  - Injury to marginal mandibular nerve
  - Drooping of angle of mouth
(ii) Bipolar cautery preferred
   - Prevents nerve injury

(iii) Pointers for facial nerve
   a. Conley's / Tragal pointer (most significant)
      [Nerve - 1 cm inferior & deep to the pointer]
   b. Styloid process
      [Nerve - superficial to styloid process]
   c. Posterior belly of digastric
   d. Retrograde method
      - Incase of re-operation

(iv) Parotidectomy

- Superficial lobe
  (Benign tumor)

- Superficial + deep lobe

- Total conservative parotidectomy

- Total radical parotidectomy

- Excision of superficial + Deep lobe but, facial nerve-preserved

- Facial nerve removal
  - Cable graft - used to bridge the gap

  - Greater auricular nerve
    (best)

  - Sural nerve
    (most common)

  - Sutured using Nylon sutures

- Extracapsular dissection of parotid

- Done for benign tumors of parotid

- Advantage: Same oncological results as superficial parotidectomy with less complication rate

  - Less chance of facial nerve injury
Less chance of Frey's syndrome

- An alternative to superficial parotidectomy [Benign tumors]

Complications of parotidectomy

1. Bleeding
2. Injury to nerve
   - Marginal mandibular nerve → Drooping of angle of the mouth
   - Greater auricular nerve → Anaesthesia over angle of mandible
     (AlMS - May 2019) (parotid)
   - Facial nerve
3. Parotid fistula
   - Low output fistula
     Spontaneous closure
   - High output fistula
     Neumann & Seabrook's procedure of fistula
4. Frey's Syndrome
   - Gustatory sweating
     - Cause: post ganglionic parasympathetic fibres of auriculo-temporal nerve
       Supplies skin glands
     - Gustatory sweating
       - Diagnosis: Starch iodine test
       - Management:
         (i) Antiperspirants
         (ii) Botulinum toxins
         (iii) Definitive management →
           Tympanic neurectomy (Dissection of auriculo-temporal nerve)
   - Prevention
     (i) Extra-capsular dissection
     (ii) Sternocleidomastoid / Digastric muscle flap
       [ to cover parotid bed ]
Submandibular swelling

- Clinical differentiation between Submandibular gland vs LN enlargement
  - Submandibular gland - Hi palpable enlargement
  - LN enlargement - Not palpable bimanually
- Most common Benign tumor & overall - Pleomorphic adenoma
- Most common malignant tumor - Adenoid cystic carcinoma
- Kuttner’s tumor
  - Chronic sclerosing sialadenitis of submandibular gland
- Management of submandibular tumors
  - Excision of the gland
  - If malignant ⇒ Radiotherapy given

Sublingual swelling

- Most common tumor
- Most common tumor of minor salivary gland ⇒ Adenoid cystic tumor
- Most common site of minor salivary tumor → Hard palate
  [Most common tumor of hard palate → SCC (squamous cell carcinoma)]

Note:

multiple
cyst in
parotid

Swiss cheese appearance

- Seen in HIV parotitis
Spleen

Spleenic anatomy

- Long axis of spleen → 10th rib.
- Enlargement of spleen
  - Notch → superior border
  - Downward displacement of spleen prevented by phrenicocolic ligament.
- Splenic artery → (Branch of coeliac trunk)
  ↓
  - Short gastric vessels → lie in gastroplenic ligament.
- Splenic vein joins superior mesentric artery to form portal vein.

Functions of spleen:
1. Immunological
2. Filter
3. Pitting
4. Haemotopoiesis
5. Reservoir function

Spleneculi:
- Accessory splenic tissue
- M.C. site → hilum of spleen
  (50-60%)
- If missed during surgery → recurrence of hematological conditions → ITP

Splenic cysts

- Pseudo cysts
  → M.C. cystic lesion of spleen
  → Post trauma

- True cysts
  → Rare
  → M.C. → hydatid / parasitic cysts
  → Dermoid cysts
  → Epidermoid cysts (10%)
  Common in children.
Splenic artery aneurysm:

- Splenic artery → most common visceral vessel to be involved with aneurysm.
- Most commonly seen secondary to pancreatitis.
- More common in females than males.
- Females of child-bearing age.
- Seen during pregnancy.
- Involve the main trunk of artery.

Clinical features:
- Asymptomatic
  - Rupture
    - Common in third trimester
    - Clinical features similar to splenic rupture
    - Peritonitis
- If rupture occur during pregnancy → high rate of fetal loss.
  - On examination → hear a bruit over aneurysm.
  - IOC → CECT

Management:

- Asymptomatic
  - Angioembolization
    - Surgical ligation
- Symptomatic
  - Embolization
  - Ligation
  - Splenectomy

Splenic infarct

- Hypersplenism.

Clinical features:
- Vague abdominal pain.
- Pain radiates to left shoulder tip.
  - IOC → CECT

Management → Only if symptomatic or abscess develops.

Splenectomy
Spleen abscess:
  ➔ Septic emboli in:
    • Typhoid fever
    • Pancreatitis
    • Otitis media.

Clinical features:
  ➔ Vague abdominal pain
  ➔ Left shoulder tip pain
  ➔ Fever
  ➔ Features of peritonitis

IOC ➔ CECT
management ➔ USG guided ➔ pigtail drainage.

Splenic tumors:
  ➔ Most common benign tumor of spleen ➔ Haemangioma
  ➔ M. C. malignant tumor of spleen ➔ Lymphoma
  ➔ Metastasis is rare.

Splenectomy

Open ➔ Lap

• Ligate short gastric vessels.
• Splenic vessels ligated
• Careful not to injure tail of pancreas.

Complications following splenectomy:

2. Injury to tail of pancreas ➔ pancreatic fistula.

Diagnosis ➔ drained fluid is turbid
  and rich in amylase.
  ➔ Close spontaneously with time.
3. Most common complication:
  • Left lower lobe atelectasis.
    ➔ If not corrected
    ➔ Post operative day 2-3
    ➔ Pneumonia.
4. Haematological changes:

- **Transient**
  - Increase in RBC
  - Increase in WBC
  - Increase in platelets
  - Above 10 lakhs → thrombosis → prophylactic: aspirin
  - Confused with infection

- **Permanent**
  - Howell jolly bodies
  - Basophilic stippling
  - Hypersegmented WBCs
  - Reticulocytes in peripheral smear
  - Persist life long in a splenectomized patient

5. OPSI → opportunistic post splenectomy infections
- Caused by encapsulated bacteria
- MC. organism → pneumococcus
- Other organism → Hemophilus influenzae → meningococcus
- More common in children as compared to adults
- Prophylactic antibiotics → penicillin
  - Continue for 2 years
- First two years after splenectomy → commonly occurs
- More common in hematological conditions as compared to trauma
  (if vaccine is not given)
- High mortality rate

**Prevention of OPSI**

- By using vaccines

  - Elective
    - Best time → 2 weeks before splenectomy
  - Emergency
    - Vaccine is given on post operative day 1 or 2
    - If vaccine is given after surgery
      - Antibody titres are less
- Pneumococcal vaccine should be given after **2 years of age** repeated after 5 years.
- Hemophilus and meningococcal vaccine can be given at any age.
- Hemophilus influenza vaccine repeated after 10 years.
  → If patient has dog, cat or animal bite → OPSI can occur due to *capnocytophaga canimorsus*.
THORAX AND MEDIASTINUM

Surgical Anatomy Of Lung

Right Lung

Posterior

Apical

Anterior

Upper lobe

Posterior

Horizontal fissure

medial

middle lobe

lateral

Oblique fissure

Basal

Posterior

Lateral

Anterior

Lower lobe:

Apical

Left Lung

Posterior

Anterior

Posterior

Apical

Anterior

Superior lingular

Inferior lingular

Oblique fissure

Lower lobe:

Apical

Basal

Anterior

Posterior

lateral

. L Bronchus is more vertical than R Bronchus
if inhaled foreign body → R lung > L lung
if aspiration
Commonly involved segments: 
- Posterior segment of apical lobe
- Apical segment of lower lobe

Lymph node drainage of lung:

Warning: Not all points are covered in the notes, especially conceptual explanations. Please use the notes in conjunction with marrow Edition 4 videos.

Thoraco Score: to assess the morbidity & mortality after thoracic surgery

1) Age
2) Sex
3) ASA Classification (American Society of Anesthesiologists) - (≤ 3, ≥ 3)
4) Severity of dyspnea according to Medical Research (≤ 3, ≥ 3)
5) Performance Status according to Zubrod Scale (≤ 3, ≥ 3)
6) Extent of resection (Pneumonectomy, other)
7) Priority of surgery (elective, urgent / emergency)
8) Diagnosis (malignant, benign)
9) Comorbidity score

Pneumothorax

Spontaneous pneumothorax

- Primary
- Secondary
- Primary spontaneous
  - No underlying lung condition
  - $\sigma > \varphi$
  - Tall, thin males
  - Family history
  - Rupture of apical bleb/bulla $\rightarrow$ Cause $\sigma > \varphi$
  - Tolerated better

- Clinical features:
  - Sharp pleuritic pain $\rightarrow$ Partial Collapse of lung
    - Pain $\uparrow$, breathlessness $\downarrow$
  - Complete Collapse of lung
    - Painless, Breathlessness $\uparrow$

- Management:
  - 1\textsuperscript{st} Spontaneous: Self limiting
    - Aspiration done only if symptomatic
  - 2\textsuperscript{nd} Spontaneous: Aspiration has to be done
    - Narrow chest tube
    - Surgery

Indications for surgical intervention for pneumothorax include:
- Second ipsilateral pneumothorax
- First contralateral pneumothorax
- Bilateral spontaneous pneumothorax
- Pneumothorax fails to settle despite chest drainage
- Spontaneous pneumothorax: professions at risk (e.g. pilots, divers)
- Pregnancy

Rule of Thumb:
- If patient has 1\textsuperscript{st} episode of Spontaneous pneumothorax, there is a
  1/3\textsuperscript{rd} chance of recurrence
- 2\textsuperscript{nd} episode $\rightarrow$ 50% of them will develop pneumothorax
- 3\textsuperscript{rd} episode $\rightarrow$ 100% will develop pneumothorax

Surgical options in pneumothorax:
- VATS (Video Assisted Thoracoscopic Surgery)
- Principles of VATS: Deal with the air leaks
  - Reset the blebs
  - Pleurodesis
    - Talc
    - Tetracycline
  \{ Painful

  \[ Strip the pleura. \]
  \[ Pleurectomy \]

  Abrasive methods to induce inflammation

- Open Surgery

**Empyema**

  - Pus in pleural space.

  - 3 phase:
    - Exudative phase: Thick pus
      - Causative organism: S. Aureus
      - streptococcal
      - Antibiotics to be started
      - Aspiration \( \Rightarrow \) Advised

    - Fibropurulent phase: Thickening of Pleura
      - Pus can thicken further
      - Antibiotics\( + \)
      - Aspiration\( + \)

    - Organised phase: Fibrosis \( \rightarrow \) lung gets trapped
      \[ \downarrow \]
      \[ \downarrow \text{Lung expansion} \]
      - Surgical intervention (VATS \( \Rightarrow \) open)
        - Drain out Collection
        - Pleurodesis
        - Decortication (in severe cases)

**Lung Cancer**

  - Maximum cancer related mortality in both \( \varphi \) \( \varphi \)
  - Only 20% patients come with resectable disease
  - Risk factors: Smoking, pollution, environmental cause, exposures.
- Types

- Small cell (Oat cell)
- Strongest association with Smoking
  $\phi > \phi$
- Poor prognosis
- Highly chemo sensitive
- Maximum Paraneoplastic syndrome
- Lung cancer to give rise to SVC Syndrome (Superior vena cava Syndrome)

- Facial $\&$ cerebral edema
- Hypertention
- Breathlessness
- CT show $\Rightarrow$ Thrombus in SVC
- Management:
  - small cell $\Rightarrow$ Chemo
  - Non small cell $\Rightarrow$ Radiotherapy (TOD)
  - Steroids
- Histopathology: Azzopardi effect
  - Salt $\&$ pepperchromatin
- Immuno histochemical markers
  - NCAN
  - Chromogranin

- Non small cell carcinoma
  1) Squamous cell Carcinoma:
     - Centrally placed
     - Associated with smoking (mc cancer in smokers)
     - $\phi > \phi$
     - Releases PTH related Peptide $\Rightarrow$ Hypercalcemia
     - Lung Cancer to give rise to Pancoast Tumor
       (Apex of the lung)
         $\Rightarrow$ Press On Brachial plexus
Horner's Syndrome  Pain along ulnar nerve
[Ptosis, miosis, anhidrosis, enophthalmos]
  - Histopathology: Keratin pearls
  - Immunohistochemistry: Cytokeratin
    - P40 (New marker)

ii) Adenocarcinoma:
  - $\varphi > \delta$
  - MC lung cancer overall
  - Peripherally placed - slow growing
  - Metastasis $\rightarrow$ Early (lymphnodes $\cap$ distant site)
  - Marker $\rightarrow$ Napsin A
  - Mutations $\rightarrow$ ALK, RAS

iii) Bronchoalveolar Carcinoma $\subset$ Adenocarcinoma in situ.
  - Lepidic pattern of growth (grows along bronchoalveolar lining)
    - Multifocal
      - Can involve other lung
      - Not metastatic $\rightarrow$ Resectable
    - Types

Precursor  Minimally invasive  Frankly invasive

- Xray/CT - Ground glass appearance
- Clinical feature $\rightarrow$ Cough (mc)
  - Hemoptysis
  - Weight loss
  - Pleural effusion
  - Other - SVC syndrome, Horner’s syndrome

- Investigation:
  - Xray (initial)
    - CECT (loc)
    - PET-CT (for Staging)
TNM Staging Of Lung Cancer

| T1 | Tumor in epithelium/bronchial washings but not be assessed in imaging or bronchoscopy |
| T2 | No evidence of tumor |
| T3 | Carcinoma in situ |
| T4 | Carcinoma involving bronchial mucosa and/or submucosal connective tissue |

| T1a | ≤ 1 cm surrounded by lung/visceral pleura, not involving main bronchus |
| T1b | > 1 cm |
| T2a | ≤ 1 cm |
| T2b | > 1 to ≤ 2 cm |
| T2c | > 2 to ≤ 3 cm |
| T3 | > 3 to ≤ 5 cm |
| T4 | > 5 cm |

| N1 | Isolated hilar nodes or ipsilateral perihilar nodes in ipsilateral lung |
| N2 | Isolated mediastinal or hilar nodes |
| N3 | Contralateral hilar or mediastinal nodes |

| M1 | Distant metastasis |
| M2 | Single extrathoracic metastasis, including single non-regional lymph node |
| M3 | Multiple extrathoracic metastases in one or more organs |

- **Tis / N0 / M0** - Amenable to lung resection
- **Management** - Based on the molecular markers

**Investigations:**
- Mediastinoscopy - To assess & take biopsy from mediastinal lymph nodes
- EBUS - Endobronchial ultrasound

**EBUS - FNAC** - Helps to target peripheral lesions (to rule out TB - lymph nodes)

- Surgery for lung cancer:
  - Assess Thoraco score, to see if patient is fit for surgery
  - TNM stage is appropriate for surgery
- Wedge resection
done for early lesions

- Lobectomy - early lesions
- Pneumonectomy
- Anterior segment resection → Sleeve resection done

- Antero lateral Thoracotomy
  - Mc done

Benign Lung Tumors

- Hamartoma.
  - Mc benign tumor of lung
  - X-ray: Coin Shaped / Popcorn calcification
  - Incidental diagnosis
  - Management - Excision

- Mediastinal Tumors
  - Thymoma - Mc Overall mediastinal lesion
    - In Anterior mediastinum
    - Associated with myasthenia gravis
    - Thymectomy even in the absence of thymoma is helpful in myasthenia gravis
    - Clinical feature → . Majority are asymptomatic
    - Compression of adjacent structure
      - Breathlessness
      - Hoarseness of voice
      - Dysphagia
  - Malignant thymoma - Capsular & Vascular invasion.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Macroscopically completely encapsulated</td>
</tr>
<tr>
<td></td>
<td>Microscopically no capsular invasion</td>
</tr>
<tr>
<td>II</td>
<td>Macroscopic invasion into surrounding fatty tissue or mediastinal pleura</td>
</tr>
<tr>
<td></td>
<td>Microscopic invasion into the capsule</td>
</tr>
<tr>
<td>III</td>
<td>Macroscopic invasion into neighbouring organs (pericardium, great vessels, lungs)</td>
</tr>
<tr>
<td>IVa</td>
<td>Pleural or pericardial dissemination</td>
</tr>
<tr>
<td>IVb</td>
<td>Lymphogenous or haematogenous metastasis</td>
</tr>
</tbody>
</table>

Surgery • v.2.0 • Marrow 4.0 • 2020
Management: Thymectomy

- Small lesion
  - Transcervical approach

- Large / malignant lesion
  - Median sternotomy

Other mediastinal masses:

- Lymphoma - mc seen in anterior mediastinum
- Pericardial cyst - mc middle mediastinal mass
- Neurogenic Tumors - mc posterior mediastinal mass
- Germ cell tumors in children

Germ cell tumors:
- mc site for extra gonadal GCT → mediastinum
- Seen at anterior mediastinum
- Types
  - Benign: mc in males
    - 75% benign
    - All 3 cell types - Dermoid
  - Malignant: ↑AFP, ↑β HCG, ↑LDH (markers)

Management - Excision
SKIN TUMORS AND SOFT TISSUE SARCOMAS

Basal Cell Carcinoma (BCC)

Also called rodent ulcers.
Locally invasive
No distant metastasis

Risk factors:
- White population
- UV radiation
- Gorlin syndrome (Basal cell cancer Nevoid syndrome) → chromosome 9.

HPE:
- BCC arises from basal epidermis
- Palisading pattern.

Types:

- Localized
  - Nodular
  - Nodulocystic
  - Pigmented
- Generalised
  - Superficial
  - Multifocal
- Infiltrative morphoeic

Clinical features:
- MC site → Face
- Above line joining angle of mouth to ear lobe.
- Rolled - out pearly white edges

Diagnosis:
- Biopsy

Management:
1. Surgery (wide local excision).
   - Lymph node metastasis → Uncommon
   - Distant metastasis
2. Radiography
   - Results similar to surgery
   - Preferred in elderly patients not fit for surgery

3. Topical 5-Fu creams

   **High Risk lesions**
   - Adequate surgery to be done
   - High local recurrence rate
   - > 2cm in size
   - Present at sites where infiltration leads to cranial extension

   **Recurrent BCC**
   - Develops after immunosuppression
   - Infiltrative / morpheic type

   **management:** Mohs micrographic surgery
   - Remove till no tumour found at base of lesion

   **Advantages:**
   - Less tissue resected
   - Cosmetically better
   - Margins negative
   - Useful in tumors located close to vital structures

   **Disadvantage:**
   - Time consuming surgery

### Malignant melanoma

**Risk Factors:**
- UV radiation
- White population
- Genetic: Familial atypical mole melanoma syndrome (FAMM)

**Types:**
1. **Superficial spreading type** (SSC)
   - Prolonged horizontal phase
   - Young patients
   - In sun-exposed areas
   - Mole melanoma, to develop in a pre-existing mole

2. **Lentigo - maligna (in situ)**
   - In elderly
Best prognosis
aka. Hutchinson’s melanotic freckle

3. Acral melanoma.
   MC melanoma in dark skinned individuals
   Sites: palms, sole.
   Rapid vertical phase (aggressive)

4. Nodular melanoma.
   Present as a nodule
   Early & rapid vertical phase
   Worst prognosis
   Variant → Amelanotic melanoma.

Desmoplastic melanoma
   Head & neck region
   Perineural invasion (PNI) ≥
   Painful, ↑ loco-regional recurrence (LRR)

Diagnosis of malignant melanoma

ABCDE rule for early detection.

Asymmetry
Borders (outer edges uneven)
Color (dark black or multiple colors)
Diameter (>6mm)
Evolving (change in size, shape, color)

Biopsy → to confirm diagnosis

Hutchinson Sign
- due to melanoma below nail bed.
- Superficial Spreading > Acrail

Superficial spreading type

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Scanned with CamScanner
Staging of melanomas - based on depth of invasion

- **Clarkes**
  - I: Intraepithelial
  - II: Papillary dermis
  - III: Dermal papillae invasion
  - IV: Reticular dermis
  - V: Subcutaneous tissue

- **Breslow**
  - I: ≤ 0.75 mm
  - II: 0.76 - 1.5 mm
  - III: 1.51 - 4 mm
  - IV: > 4 mm

Management of melanoma

- Surgery
  - 1st lesion
  - Wide local excision
  - Lymph nodes
    - LN−:
      - Sentinel lymph node biopsy
    - LN+:
      - Lymph node clearance

### Depth of lesion vs Margin

<table>
<thead>
<tr>
<th>Depth of lesion</th>
<th>Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>in situ</td>
<td>0.5 cm</td>
</tr>
<tr>
<td>≤ 1 mm</td>
<td>1 cm</td>
</tr>
<tr>
<td>1 - 2 mm</td>
<td>1 - 2 cm</td>
</tr>
<tr>
<td>&gt;2 mm</td>
<td>2 cm</td>
</tr>
</tbody>
</table>

- metastasis → common
- Most important prognostic factor: **lymph node status**
- Most important prognostic factor in melanomas not involving lymph nodes: **Depth of lesion**
- **m. e site for distant metastasis**: Lungs.

Management of metastatic melanoma:

- Immunotherapy
  - Dabrafenib: BRAF inhibitor
  - Trametinib: against MAPK pathway
  - Ipilimumab: against CD8 receptor inhibitors

Immunohistochemistry

- HMB 45
- S 100
- Melan A
Squamous Cell Carcinoma (SCC)

Precursor lesions:
1. Cutaneous horn
   - increased risk of squamous cell carcinoma
2. Keratoacanthoma
   - in elderly females
   - symmetrical
   - lesion with central crater
   - Rapidly enlarging nodular lesion → resected
3. Marjolin’s ulcer
   - Develops in the region of a long-standing scar (burns / venous ulcer)

Diagnosis: Biopsy
- more aggressive
- Radiotherapy not effective

Soft Tissue Sarcomas (STS)

m. c STS → Liposarcoma
m. c STS in retro peritoneum → Liposarcoma
m. c STS in children
   - Rhabdomyosarcoma → m. c type: Embryonal
   - m. c site: Head & Neck

Spread of STS:
1. Hematogenous spread:
   - m. c site of distant mets
     - overall
     - extremity STS
     - retroperitoneal
     - Lungs
     - Lungs
     - Liver

2. Lymph nodes: mets uncommon
   - LN resection not mandatory, except in:
   - Malignant fibrous histiocytoma
   - Angiosarcoma
   - Rhabdomyosarcoma
   - Clear cell sarcoma
   - Epithelial
   - Synovial sarcoma
LN clearance has to be done

Clinically features of soft tissue sarcomas

- MC → Lump / mass
- Compressive features → Nerve involvement.

Diagnosis: Tru-cut biopsy → insert needle, such that needle mark can be removed in subsequent surgery (prevent recurrence)
FNAC has no role.

Staging: MRI (best for local staging)
for distant mets: PET - CT

Management:

- Surgery
  - Wide local excision (WLE)
    - 2 cm margin

- Radiotherapy
  - Loco-regional recurrence
  - Brachytherapy
  - External beam radiotherapy (EBRT)

- Chemotherapy
  - Methotrexate
  - Adriamycin
  - Ifosfamide
  - Dacarbazine
  - Neo-adjuvant Chemotherapy → help in limb preservation

Most important prognostic feature → Grade of tumour.

Desmoid tumour

- STS over anterior abdominal wall
- Develop in the region of scars
- Associated with: Gardner variant of FAP syndrome

Clinical features:
- Lump
- Compress the abdominal viscera
Diagnosis:
- Tru-Cut biopsy
- MRI/CT → To visualize extent of disease

Management:
- Wide local excision (WLE) (may require complex abdominal wall reconstruction)
- Tamoxifen (desmoid tumours can exhibit ER/PR receptors) to ↓ local recurrence