SECOND EDITION

Long Cases in GENERAL SURGERY

R Rajamahendran

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2nd Edition

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Dedicated to

My Teachers, Friends, Parents and my beloved students of
Kilpauk Medical College
and
My dear friend
Late Dr S Karthikeyan, MD (Anesthesia),
he lives in our lives

Foreword to the Second Edition

It gives me immense pleasure to write the foreword for the book *Long Cases in General Surgery* written by Dr R Rajamahendran.

I am proud of Dr R Rajamahendran, who did his post-graduation in my unit in the Department of General Surgery, Kilpauk Medical College, Kilpauk, Chennai, Tamil Nadu, India. I still appreciate and tell my postgraduates of today about his systematic management of his studies and his work at the ward.

His another book *Short Cases in General Surgery* was widely read by the undergraduates and postgraduates.

In his present book, the second edition of *Long Cases in General Surgery,* he has added important topics like Obstructive Jaundice and Peripheral Vascular Diseases for undergraduate and postgraduate students.

I wish him grand success in all his endeavors in his future life.

B Sathya Priya MS
Assistant Professor and Senior Civil Surgeon
Department of General Surgery
Kilpauk Medical College
Kilpauk, Chennai, Tamil Nadu, India

Foreword to the First Edition

It is with considerable pleasure and delight that I am writing the foreword to the *Long Cases in General Surgery* by Dr R Rajamahendran.

He has been associated with me for the past nine years as medical student. He has ventured to bring out a good readable volume in its best contents and outcome for exam-going undergraduate students. The unique feature of the book is the crispy nature of chapters, then long cases presentation.

The author must be congratulated for his efforts to present the book to the medical students which provides them up-to-date guidance with personal and individual emphasis on the preparation for clinical examinations.

I wish Dr Rajamahendran all the success.

D Amudan MS (General Surgery)
Assistant Professor
Department of General Surgery
Thoothukudi Medical College
Thoothukudi, Tamil Nadu, India

Preface to the Second Edition

I am happy to see the extensive response of the first edition of my book *Long Cases in General Surgery* by the undergraduates and postgraduates. The mega hit of the first edition compelled me to make the second edition with utmost care and with recent updates. I had worked with my best efforts to make the second edition reach the needs of the students completely.

The book includes all the recent updates with added cases on Obstructive Jaundice and Peripheral Vascular Diseases which are very important for postgraduates. I made standard references for all the quotes and added more tables and color photographs than the first edition.

When I wrote the first edition, my aim was to bring a "complete impact" about the cases that the students must not go for other reference books for any other details. That is the reason for the success of the book, when I enquired the students. In this second edition, I followed the same principle with more and more viva questions, illustrations and photographs.

The aim of the book is, when students enter the examination hall, they should know all the possible questions that can be asked by various examiners in each and every case.

I am happy to inform the students that the *Short Cases in General Surgery* by me will cover the topics which are not covered in this book. I thank to the students who are about to make the second edition also a great success in future.

Only beaten gold turns into an excellent ornament

So, friends kindly do not hesitate to point out the mistakes in the book. Kindly mail your feedback about the book to *minnalraja@hotmail.com*.

Also, I request students to join in Facebook forum *Final MBBS and MS General Surgery Discussion* created by me in which you can get clarified about your doubts by a team of surgical specialists.

All the best for your examinations.

R Rajamahendran

Preface to the First Edition

When I was studying for my final year examination, I found that although many theory books were excellent in all aspects yet clinical case discussions were not sufficient. So it compelled me to pen down the various clinical points and the relevant theory of the major examination cases, which are the deciding criteria for practical examinations.

I started collecting points from various books, materials and clinical discussions of all professors from various colleges and made a complete study material. Many of my friends and juniors who studied those materials encouraged me to produce it in a book form, which made me bring it to you as *Long Cases in General Surgery*. I hope it will help you to go to the practical examination hall with confidence.

Friends, kindly send your suggestions and opinions to my e-mail: *minnalraja@gmail.com*.

All the best for your examinations.

R Rajamahendran

Acknowledgments

I have to start my acknowledgment for M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India and Mr Jayanandan, (Chennai Branch), who introduced me into the field of book writing and made me a renowned author. So far, I have written five books in different publications for medicos, all the credit will go to only M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India.

- I take this opportunity to thank my teachers first, who tuned me to a Surgeon:
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- I would like to give sincere thanks to my ward friends, who worked with me in postgraduate days:
  - Dr Kumaresh MS MRCS, Registrar, United Kingdom
  - Dr Princess Buelah MS, Assistant Professor, Government Royapettah Hospital, Chennai, Tamil Nadu, India
  - Dr Aravind Kapali, Senior Resident, All India Institute of Medical Sciences (AIIMS), New Delhi, India

  - Dr Palani, Senior Resident, All India Institute of Medical Sciences (AIIMS), New Delhi, India
  - Dr Anandhi, Assistant Professor, Pondicherry Medical College, Puducherry, India
  - Dr Arul, Assistant Professor, Chengalpet Medical College, Chengalpet, Tamil Nadu, India
- I would like to thank my dear colleagues at this stage for their adjustments in doing duties and routine ward works:
  - Dr Sankaralingam MS, Assistant Professor, Government Chengalpet Medical College, Chengalpet, Tamil Nadu, India
  - Dr P Venkateshwar MS, Registrar, Government Villupuram Medical College, Villupuram, Tamil Nadu, India
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I would like to thank all my undergraduate and postgraduate students, for their constant support and motivation throughout my career.

Nothing ends if we fail to thank our friends, who always stand with us in any situation. I would like to thank my best friends Dr Raja Rajan MS MCh (Urology), Stanley Medical College, Chennai, Tamil Nadu, India and Dr Antan Uresh Kumar MS FMAS, Assistant Professor, Government Villupuram Medical College, Villupuram, Tamil Nadu, India, Tamil Nadu Government Doctors Association (TNGDA), District Secretary and my business partner. It is with their strong support, I progress in my life.

I would like to mention a word of thanks to all my friends—Dr Vijay Anand DCh, Dr Dhanasekar MD, Dr Mahendran MD (Anes), Dr Manoj, Dr Gunasekaran MCh (Plastic), Dr CRK Balaji MS ENT, Dr Tele (Elango) DCh, Dr Gowtham MCh (Urology), Dr Priyadarshini DCh, Dr Preetha, Dr Kanchana MD OG, Dr G Karthik (D Ortho), Dr Naveen Choudhry (MS Ortho), Dr Jaya Sai Sekar MS DNB (Urology), and many others I might have missed due to lack of space.

I would like to end my acknowledgment with my wife Dr Shanthi and my little angels Saadhana and Raja Hansa. They miss me a lot in my busy life but they still love me the most in this world.

Contents

1 CASE Inguinal Hernia

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- Surgeries for Hernia
- Herniorrhaphy
- Femoral Hernia Surgery
- Strangulated Hernia
- Miscellaneous
- Dual Hernia
- Ogilvie Hernia
- Consolidation

DEFINITION

Hernia is an abnormal protrusion of a part or whole of the viscus through a normal or abnormal opening through the wall of the cavity that contains it.

HISTORY

Name: Young Age—indirect
Old Age—direct

Age: Most common hernia in females—indirect inguinal hernia
Most common hernia in males—indirect
Femoral hernia most common among—females

Sex: Direct hernia never occurs in females and children

Occupation: Most common in strenous labor

Presenting Complaints

I. About the hernia
II. Due to hernia (Complications)
III. Precipitating factors

About the Hernia

1. Duration
2. *Onset:* Suddenly/gradually
3. *Site of start:* From groin to scrotum (hernia)
   From scrotum to groin (hydrocele and varicocele)

4. *Aggravating factors:*
   - On straining
   - On standing
   - On coughing
5. Relieving factors:
   - By lying down
   - Manually by himself
6. Associated with pain: Usually painless

> Pain in inguinal hernia is usually in the region of the umbilicus due to drag in the root of mesentery as bowel enters the sac

Complications

1. **Irreducibility:**
   i. Crowding of the contents
   ii. Adhesion between sac and contents
   iii. Adhesion between contents
   iv. Adhesion between sac.
2. **Obstruction:**
   Four cardinal features
   i. Colicky abdominal pain
   ii. Vomiting
   iii. Abdominal distension
   iv. Obstipation (Absolute constipation)—not passing flatus and feces.
3. **Strangulation:**
   (Obstruction + irreducibility + Arrest of blood supply)
   i. Colicky abdominal pain if continues and becomes gangrenous pain disappears
   ii. Sudden increase in size of hernia; becomes tense and tender.

History of Precipitating Factors

1. Chronic bronchitis/asthma/TB
2. Difficulty in micturition
3. Difficulty in defecation
4. Weightlifting.

Past History

- History of diabetes mellitus/Hypertension/Ischemic heart disease/Bronchial asthma/Tuberculosis
- History of previous surgery

> **History of appendicectomy:**
> Ilioinguinal or iliohypogastric nerve if damaged by grid iron incision or during keeping the drain; Direct Hernia Occurs
>
> If ilioinguinal nerve is cut in the inguinal canal, direct hernia never occurs
>
> Because the nerve supplies the abdominal muscles before entering the canal

Family History

History of connective tissue disorders in family.

Personal History

History of Smoking: Smoking leads to chronic bronchitis
Collagen deficiency occurs in smokers.

General Examination

- General condition
- Anemia
- Lymph adenopathy
- Blood pressure
- Pulse rate

Cardiovascular System

Respiratory System:
Respiratory infections.

Abdomen

- Mass abdomen
- Malgaigne's bulgings
- Ascites

Malgaigne's bulging
Oval, longitudinal, bilateral bulging produced on straining, in inguinal region or above it; and are parallel to medial half of inguinal ligament

- Present in direct hernia
- Indicates poor muscle tone
- Signifies hernioplasty is the treatment

LOCAL EXAMINATION

Inspection

Patient in standing position

1. Site
2. Size
3. Shape
4. Extent
5. Surface
6. Skin over the swelling
7. Visible peristalsis
8. Cough impulse
9. Draining lymph nodes
10. Penis
11. Urethral meatus
12. Opposite scrotum

Shape
Pyriform—indirect (Fig. 1.1)
Hemispherical—direct (Fig. 1.2)
Retort—femoral

Position
Femoral—below and lateral to pubic tubercle
Inguinal—above and medial to pubic tubercle

Fig. 1.1: Indirect hernia: Pyriform shaped

Fig. 1.2: Direct hernia: Hemispherical

Palpation

1. Temperature
2. Tenderness
3. Site
4. Size
5. Shape
6. Extent
7. Surface
8. Skin over
9. Consistency
10. Reducibility
11. Get above the swelling
12. Cough impulse
13. Invagination test
14. Ring occlusion test
15. Zieman's technique.

Consistency:
Soft elastic—intestine
Doughy granular—omentum

Get above the swelling is a classical feature of hydrocele

Discussion of Palpation

1. **What is taxis? (Do not mention unless asked by the examiner)**

Method of reducing the inguinal hernia
Procedure: Flex the knee, Adduct and internally rotate the hip
↓
Relaxes the abdominal muscles

With the thumb and fingers hold the sac; guide with other hand at superficial ring

Complications of Taxis

- Bowel injury
- Reduction en masse: Reducing the sac with the constriction being present at the neck; thereby making the hernia with obstruction to go into the abdomen
- Sac may rupture at its neck and the contents may be reduced extra peritoneally.

2. **What is cough impulse?**
   `Propulsive and Expansile Impulse on Coughing'
   Can be performed by:
   - Making the child cry
   - Valsalva maneuver
   - Head raising and abdomen contraction

To Demonstrate by Inspection

- No need to reduce the content
- Just ask the patient to stand and cough

Inference

- Swelling increases in size, or
- Impulse seen and swelling reappears

To Demonstrate by Palpation

- Hold the right side of the root of scrotum with your left thumb and index finger without reducing the content and ask to cough.
- You will get expansile and propulsive impulse.
- In Bubonocele—keep your thumb at deep ring.

Absent cough impulse:
- Strangulated hernia
- Incarcerated hernia
- Neck of sac becomes blocked by adhesions

Where else you see cough impulse:
- Varicocele—expansile and thrill like not propulsive
- Morrissey's cough impulse—in case of varicose veins, expansile impulse at saphenofemoral junction
- Laryngocele

3. **Difference between:**

Reducibility	*Compressibility*
After reducing the swelling opposite force is required to make the swelling reappear	Opposite force is not required for reappearing. It appears slowly to its original size
Swelling can be completely reduced	Swelling cannot be completed reduced
For example: Hernia	For example: Hemangioma

On Testing the Reducibility

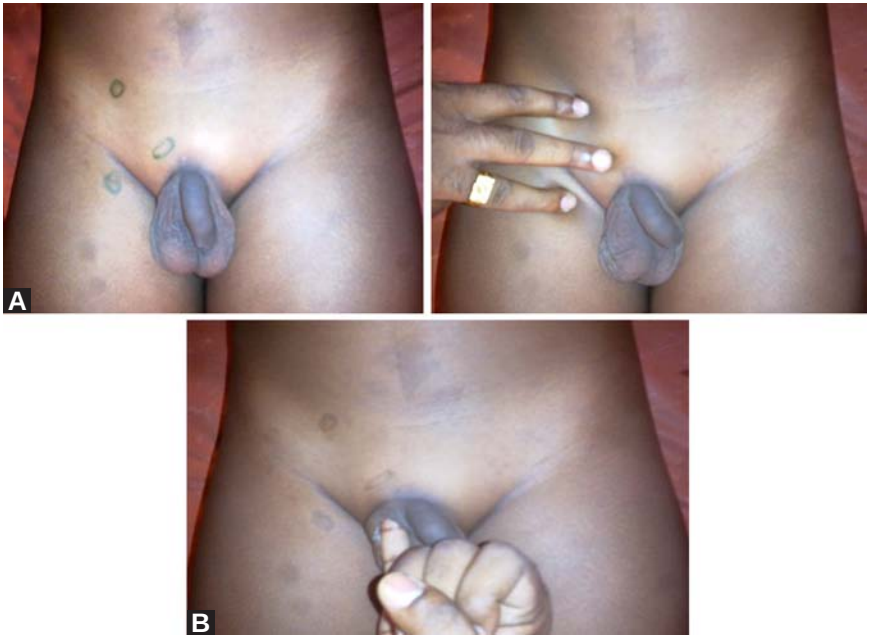
a. Intestine: Last part is easy to reduce; Initial part is difficult to reduce; gets reduced with gurgling sound.
b. Omentum: First part easy to reduce, last part is difficult because omentum adheres to fundus of sac.

4. **How will you demonstrate hernia in children?**
   Gornall's Test
   - Child held from back by both hands of clinician on its abdomen
   - Abdomen is pressed and child is lifted up
   - Hernia appears due to increase in the abdominal pressure exerted.
5. **Zieman's technique (Fig. 1.3A)**
   For right side inguinal hernia, place the right hand
   - Index finger over deep ring
   - Middle finger over superficial ring
   - Ring finger over saphenous opening

   See where the impulse is felt
   - Direct hernia—superficial ring
   - Indirect hernia—deep ring
   - Femoral hernia—saphenous opening
6. **Deep ring occlusion test:**
   After reducing the contents, patient in standing position, occlude the deep ring with thumb. Ask the patient to cough.
   If swelling appears - Direct
   Does not appear - Indirect

Fallacy of deep ring occlusion test (When will you get the swelling even though it is an indirect hernia by deep ring occlusion test?)
- Pantaloon hernia
- Wide deep ring

(Occlude in such cases with index and middle finger together)



Figs 1.3A and B: (A) Zieman's technique (three-finger test), (B) Finger invagination test

7. **Ring invagination test (Fig. 1.3B)**
   Only test in hernia; done in lying position.
   Prerequisite:
   - Swelling should be reducible
   - Lax of skin should be there for invaginating (so this test could not be done in females)

Procedure

1. Reduce the swelling.
2. For right side, invaginate with right little finger into the superficial ring.
3. Rotate the little finger medially so that the pulp faces medially.
4. Note the direction of entry and site of impulse.

Look for:
- Strength of superficial ring: Normal ring admits only the tip
- Direction of canal:
  Direct hernia—directly backwards
  Indirect—goes upwards, backwards and laterally
- Site of impulse:
  Pulp—direct
  Tip—indirect
- Strength of posterior wall
- To find early cases of hernia, impulse felt at tip

Percussion

- Enterocele: Resonant
- Omentum: Dull

Auscultation

Peristaltic sounds occasionally heard.

Others

1. **Testis:** 'Traction Test' to find whether the inguinal swelling is an Encysted Hydrocele of Cord.
2. **Epididymis.**
3. **Penis:**
   - Phimosis
   - Penile strictures
   - Pinhole meatus
4. **Regional nodes.**
5. **Opposite groin.**

Per-rectal Examination

To Rule out:
1. Benign Prostate hypertrophy—micturition difficulty
2. Malignant obstruction
3. Chronic fissure—constipation

Diagnosis
- **Side**—right/left
- **Type**—indirect/direct
- **Inguinal—femoral**
- **Complete/Incomplete**
- **Complicated/Uncomplicated**
- **Content**—enterocele/omentocele

DIFFERENTIAL DIAGNOSIS

Inguinal Swelling	*Inguinoscrotal Swelling*	*Femoral Hernia*
1. Enlarged lymph nodes	1. Encysted hydrocele of cord	1. Inguinal hernia
2. Undescended testis	2. Varicocele	2. Saphenavarix
3. Lipoma	3. Lymphvarix	3. Cloquet's node
4. Femoral hernia	4. Diffuse lipoma of cord	4. Lipoma
5. Saphena varix	5. Inflammatory thickening of cord	5. Femoral aneurysm
6. Psoas abscess		6. Psoas abscess
7. Femoral aneurysm		

INVESTIGATIONS

I. **Routine**
- Hemoglobin
- Bleeding time/Clotting time
- Total count, differential count, ESR
- Urine—albumin, sugar deposits
- Blood—urea, sugar
- Blood grouping/typing—for irreducible hernia/huge hernia

II. **Anesthetic Purpose**
- X-ray chest (Chronic TB, Asthma—precipitate hernia)
- ECG all leads

III. **USG Abdomen and Pelvis**
- In old age group—to find benign prostate hyperplasia calculate post-voidal residual urine. If >100 ml it is significant
- To find any mass

TREATMENT

Treat the precipitating cause of hernia first.
For example:
1. Benign prostate hypertrophy
2. Tuberculosis
3. Stop smoking

Conservative management is indicated only in cases of very old man with direct hernia; since there is no chance of obstruction.

Truss

- Truss is not curative for hernia.
  - It is a special belt devised to keep the hernia reduced at the deep ring or Hesselbach triangle for those who are unfit or unwilling for surgery (Fig. 1.4).

- Hernia should be reducible to wear a truss.
- Contraindicated in cases of irreducible hernia, undescended testis, associated huge hydrocele, unintelligent people.

Do not say about truss in exams as the treatment unless the examiner asks you.

ANATOMY OF INGUINAL HERNIA

(**Author's warning:** Friends do not go to examination hall without knowing anatomy of inguinal canal. Most of the students are failed only because of not answering the anatomy properly).

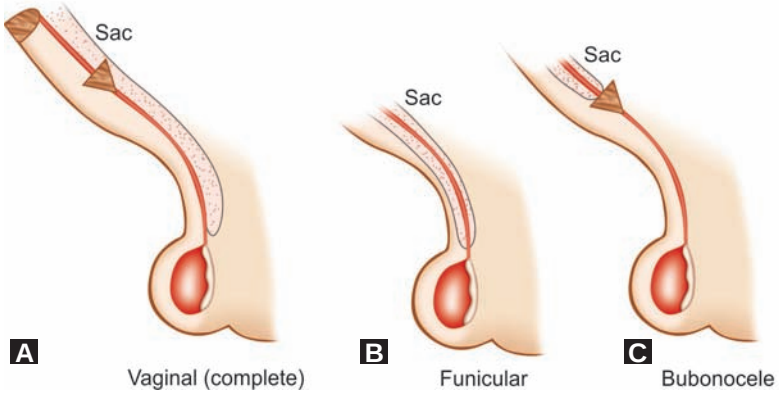
Types of Hernia (Figs 1.5A to C)

1. Vaginal (Complete)—descends up to scrotum base, testis not felt (separately).
2. Funicular—testis felt separately, processus vaginalis closed above epididymis.
3. Bubonocele—inguinal swelling only.

Boundaries of Inguinal Canal (Fig. 1.6)

Anterior Wall: External oblique aponeurosis, arched fibers of internal oblique laterally.

Fig. 1.4: Truss for inguinal hernia



Figs 1.5A to C: Types of hernia

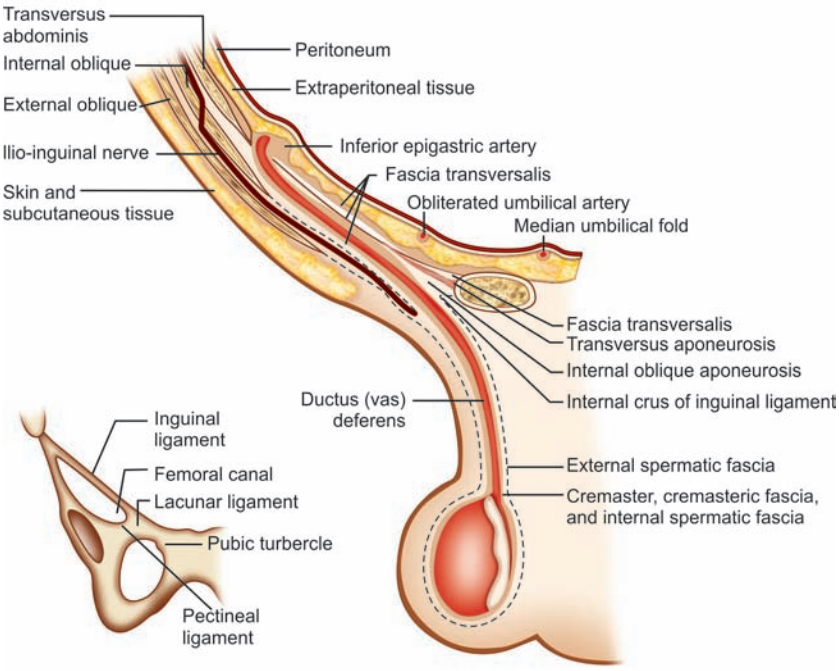


Fig. 1.6: Boundaries of inguinal canal

Posterior Wall: Fascia transversalis, conjoint muscles (tendon) in medial half.

Floor: Grooved part of external oblique aponeurosis; Medial end there is lacunar ligament.

Roof: Conjoint muscles (Internal oblique and transversus abdominis)

Inguinal Canal (House of Bassini)

- 3.75 cm length
- Extends from deep ring to superficial ring
- Deep ring is a semioval opening in the fascia transversalis
- Superficial ring is a triangular opening in the external oblique aponeurosis, guarded by two crura of muscle fibers.

Contents of Inguinal Canal

- Ilioinguinal nerve
- Spermatic cord in male, round ligament in female

Contents of spermatic cord

Arteries	:	Testicular Artery
		Artery of Vas
		Artery to Cremaster
Veins	:	Pampiniform plexus of veins
		Veins corresponding to Arteries

Lymphatics of testis
Testicular plexus of sympathetic nerves
Genital branch of genitofemoral N
Vas deferens

Landmarks (Fig. 1.7)
Deep ring: Half inch above mid inguinal point (Between anterior superior iliac spine and pubic symphysis)
(**Remember here:** Femoral artery is palpated at Midpoint of inguinal ligament- between ASIS and Pubic tubercle)
Superficial ring: Just above pubic tubercle
Saphenous opening: 4 cm below and lateral to pubic tubercle

Mechanisms that prevent hernia when abdominal pressure rises.

1. **Shutter mechanism**—arched fibers of internal oblique
2. **Flap valve mechanism**—oblique canal; approximation of anterior and posterior wall.
3. **Ball valve mechanism**—cremaster contracts, thereby superficial ring plugged by spermatic cord.
4. **Slit valve mechanism**—crura of the superficial ring.

Hesselbach Triangle (Figs 1.8A and B)

Weak spot in anterior abdominal wall through which direct hernia appears.

- **Medial:** Outer border of rectus abdominis
- **Lateral:** Inferior epigastric vessels
- **Below:** Medial part of inguinal ligament
- **Floor:** Fascia transversalis
  - Traversed by medial umbilical fold; (Obliterated Umbilical Artery)

Other names:
Inguinal ligament: Poupart's
Lacunar ligament: Gimbernat's
Iliopectineal ligament: Cooper's
Saphenous opening: Fossa ovalis

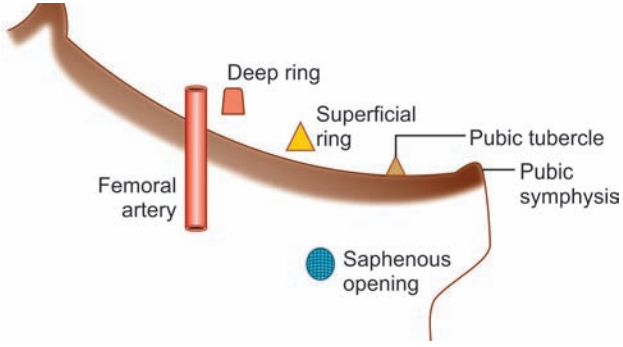
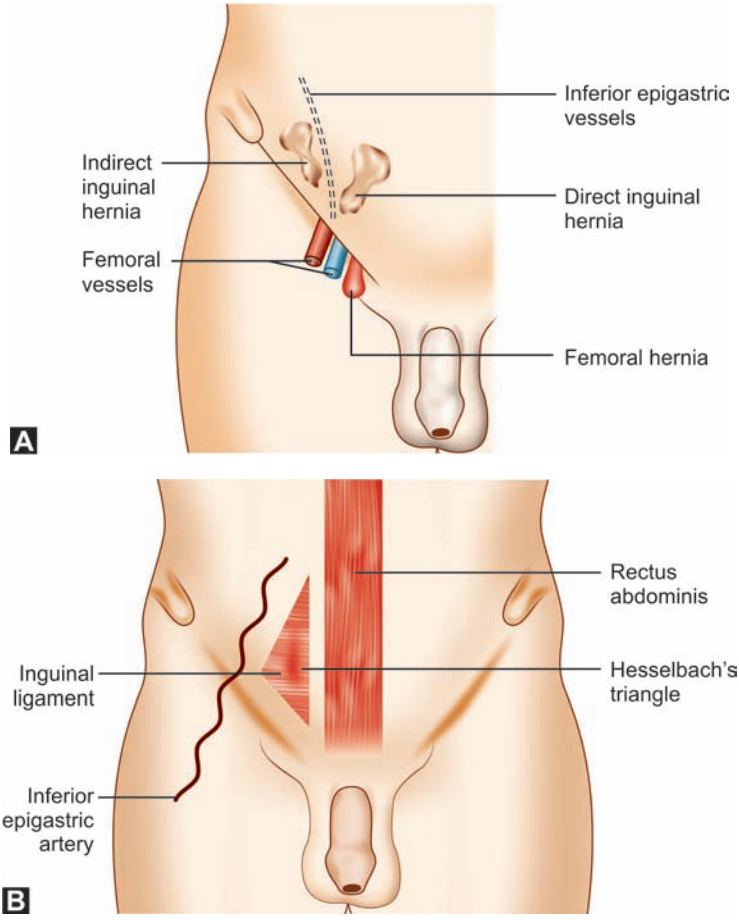


Fig. 1.7: Anatomical landmarks of all the openings



Figs 1.8A and B: (A) Various locations of hernias (B) Hesselbach's triangle—bounded by inferior epigastric artery (lateral), rectus abdominis (medial) and inguinal ligament (below)

COVERINGS OF INGUINAL HERNIA

Indirect Hernia

1. Peritoneum
2. Internal spermatic fascia (from fascia transversalis)
3. Cremasteric fascia (from internal oblique)
4. External spermatic fascia (from external oblique)
5. Scrotum

Direct Hernia

1. Peritoneum
2. Transversalis fascia (from fascia transversalis)
3. External spermatic fascia (from external oblique) usually does not descend into scrotum.

How can you identify the neck of the sac?
- Narrowest part
- Extraperitoneal pad of fat will be present
- Inferior epigastric vessels will be on medial side

What is the color of sac?
- Sac of hernia is **pearly white**
- Sac of hydrocele is **bluish**

Anatomy of hernia
1. Sac
2. Contents
3. Coverings

Sac:
1. Mouth
2. Neck (narrowest past)
3. Body
4. Fundus

Sac that lacks neck:
1. Direct hernia
2. Incisional hernia

Sacless hernia:
Epigastric hernia

How does Ilioinguinal Nerve enter the Inguinal Canal?

Does not enter through deep ring; but enters through the intermuscular plane between internal oblique and transverse abdominis and supplies anterior scrotum, medial side of thigh, root of penis in males, labia majora, and clitoris in females.

Femoral Hernia: Anatomy (Figs 1.9 and 1.10)

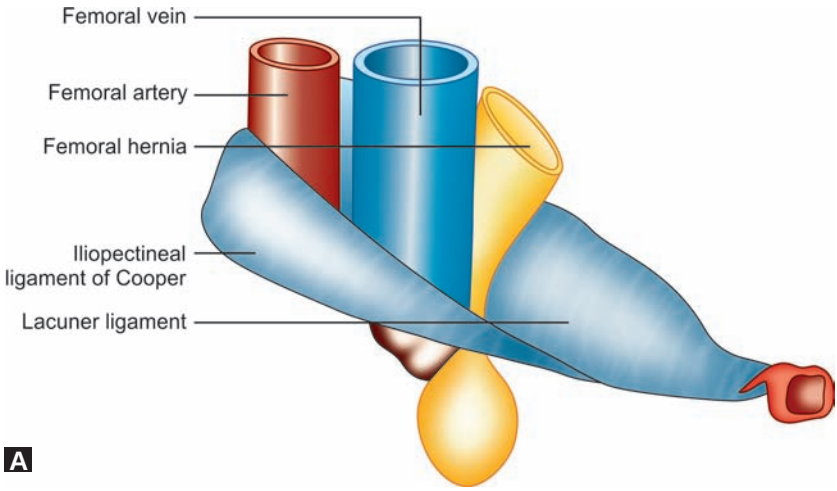
Femoral canal: 2 x 2 cm size
Medial compartment of femoral sheath

Base: Femoral ring
Bounded
Anteriorly—inguinal ligament
Posteriorly—cooper's ligament
Medially—lacunar ligament
Laterally—femoral vein

Contents: Cloquet's node
Lymphatics
Areolar tissue

- Femoral canal is bounded above by femoral ring with extraperitoneal pad of fat; below by saphenous opening covered by cribriform fascia.
- Femoral hernia is Retort shaped: Because as it goes down through saphenous opening Holden's Line prevents the contents going further down. Hence, the contents turns up and enters inguinal canal.

[Holden's Line - Fascia scarpa (deep membranous layer of superficial fascia) attaches firmly with deep fascia (fascia lata)].



Figs 1.9A and B: Femoral hernia

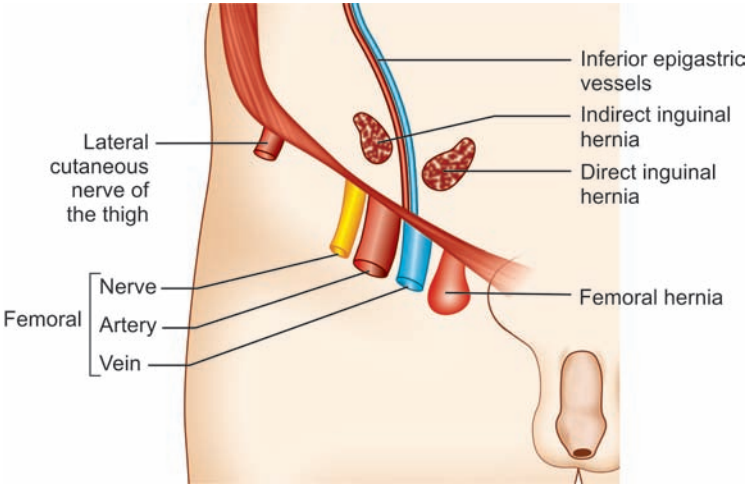


Fig. 1.10A

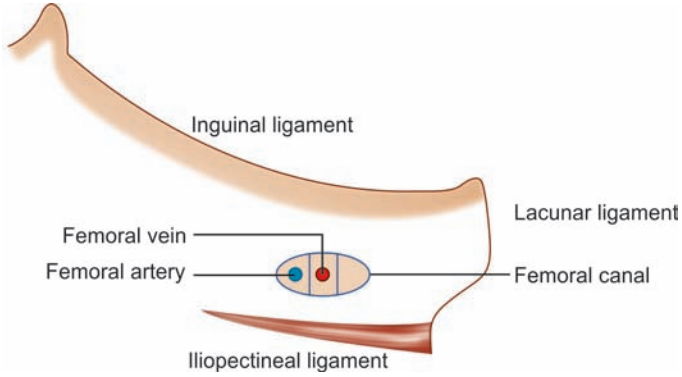


Fig. 1.10B
Figs 1.10A and B: Femoral hernia–anatomy

SURGERIES FOR HERNIA

Herniotomy

1. Separation of sac from cord structures
2. Reducing the content
3. Transfixation and ligation of sac
4. Excise the redundant sac.
   (Don't separate the sac beyond pubic tubercle, as we will damage the scrotal blood supply doing so).

Relation of sac with cord:
Direct sac: Posteromedial to the cord
Indirect sac: Anterolateral to the cord

Herniotomy (transfixation and ligation of the sac) is done only for indirect inguinal hernia. For direct hernia just push the sac back into abdomen without opening

HERNIORRHAPHY

1. Herniotomy
2. Narrowing of the deep ring with 2'0 prolene (Lytle's Repair)
3. Approximation of conjoint tendon with inguinal ligament using 1' polypropylene material (Fig. 1.11).

Color of suture materials:

Prolene (polypropylene)	-	Dark blue
Vicryl (polyglycolic acid)	-	Violet
Silk	-	Black
Catgut	-	Brown
Prolene mesh	-	White

Increasing order of size of materials:
3′0 < 2′0 < 1′0 < 1′ < 2′ < 3′

Hernioplasty

There is already weakness of abdominal wall muscles, so no approximation can be done.

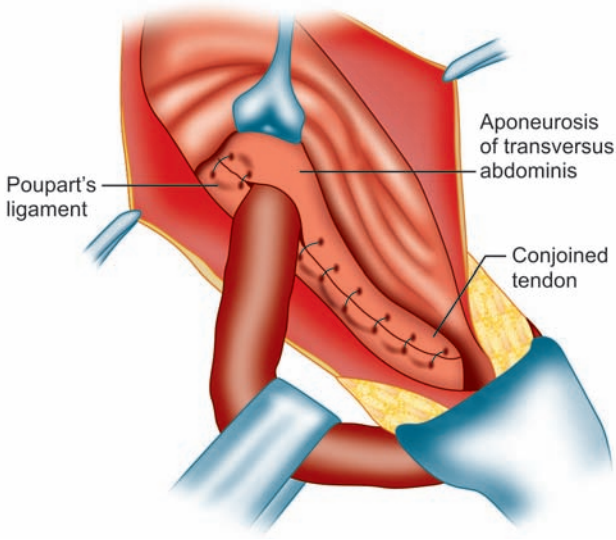


Fig. 1.11: Herniorrhaphy

Classification of herniorrhaphy

Original Bassini	*Modified Bassini*
• He laid opened the fasica transversalis from pubic tubercle to deep ring.	• Fascia transversalis not opened.
• Approximated with interrupted stitches of silk.	• Approximated with continuous locking stitch with Prolene.
• Approximated conjoined muscles (Internal oblique and transversus abdominis) and upper of the fascia transversalis with inguinal ligament and lower leaf of fascia transversalis during each stitch.	• Approximated conjoined tendon with inguinal ligament.
• (3 layers above with 2 layers below for every stitch).	• Getting obsolete slowly (Mesh repair is followed for all types of hernia).
• Not done nowadays.	

Hence we use Prolene Mesh to bridge the gap between inguinal ligament and conjoint tendon (Fig. 1.12).

Herniorrhaphy	*Hernioplasty*
1. Original Bassini	1. Lichtenstein
2. Modified Bassini	2. Gilbert's plug
3. McVay's	3. Prolene hernia system
4. Shouldice	4. Laparoscopic mesh repair
	5. Stoppas repair

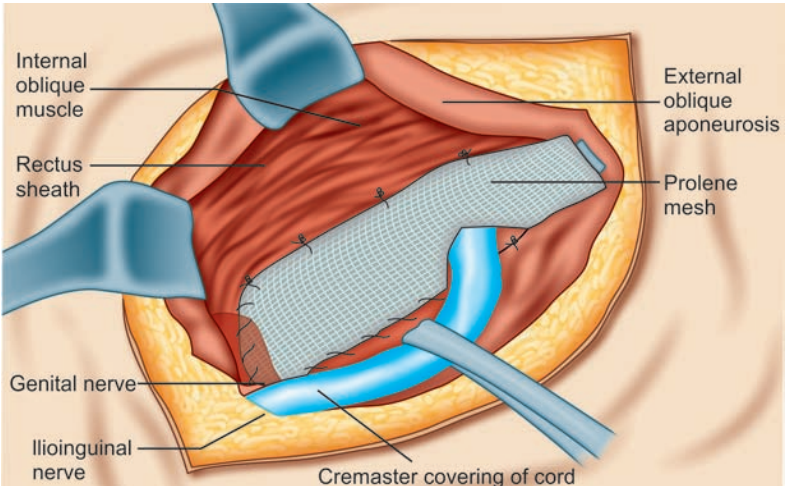


Fig. 1.12: Hernioplasty

Shouldice Technique

- He gave additional strength to the posterior wall by double breasting the fascia transversalis.
- Best among all anatomical repairs (Herniorrhaphy).
- Least recurrence among herniorrhaphy.

McVay's Repair

- Approximated conjoined tendon with iliopectineal ligament of Cooper.
- It prevents both inguinal and femoral hernia.

Tanner's muscle slide
- Basically all the herniorrhaphy are tension repairs
- To avoid tension in the rhaphy site, the incision made curvilinearly over the anterior rectus sheath
- This relaxes the conjoined muscles and thus gets approximated with inguinal ligament without tension

Lichtenstein Hernioplasty

- Prolene mesh 16 × 10 cm size is taken and fixed in the inguinal canal.
- First bite taken from periosteum of pubic tubercle; and fix the mesh to a point beyond the deep ring.
- Fix the mesh with inguinal ligament and conjoined tendon using 1'0 or 2'0 prolene without tension.

Lichtenstein's tension free mesh repair is used for all types of inguinal hernia nowadays for its least recurrence

Gilbert's Plug Repair

- A plug mesh is kept in the deep ring and also to reinforce the posterior wall.

Stoppas Procedure

- For bilateral direct hernia, a modified Pfannenstiel incision made in the lower abdomen and a huge mesh placed in between the peritoneum and the fascia transversalis (Preperitoneal mesh repair).

Darning

- A type of herniorrhaphy which is done by suturing the conjoined tendon with inguinal ligament using 1 prolene without tension.
- The suture material appears like mesh due to multiple crossings.

Kuntz operation	*Hamilton Bailey operation*
• Orchidectomy is done along with the removal of the entire cord and testis.	• Cord is removed from the inguinal canal by ligating at the external and internal ring.
• Posterior inguinal canal repaired.	• Testis is retained for psychological reasons.
• Done in old age patients with recurrent hernias.	• Inguinal canal is repaired.
	• Testis derives its blood supply from the scrotal vessels and survives.

Laparoscopic Hernia Repair (Figs 1.13 and 1.14)

- Most surgeons are now getting trained in laparoscopic hernia surgeries
- Though all the hernias can be done by Laparoscopic method, NICE guidelines for hernia surgery advice the laparoscopic repair for
  - Recurrent hernias
  - Bilateral hernias

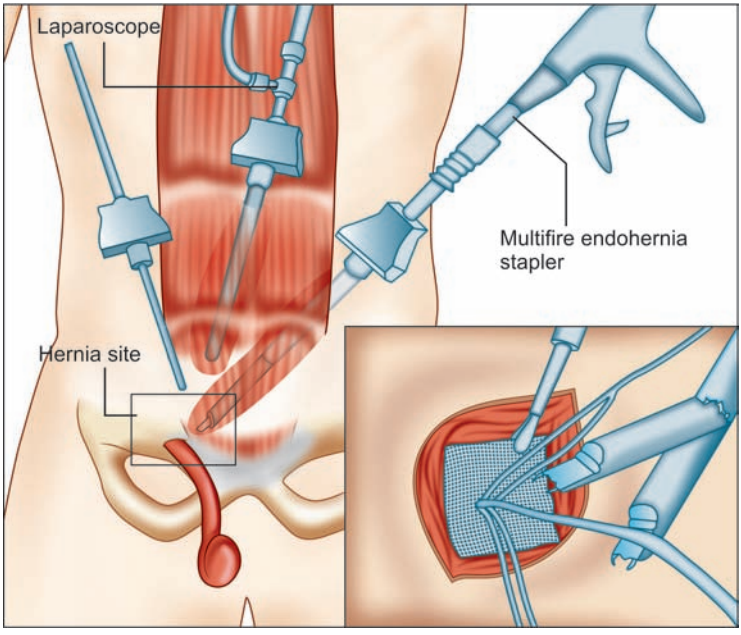


Fig. 1.13: Transabdominal preperitoneal (TAPP) repair

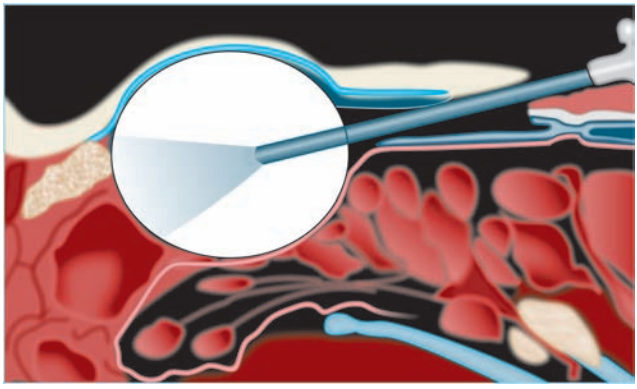


Fig. 1.14: Total extraperitoneal (TEP) repair

Complications of hernia surgery

Intraoperative	*Immediate postoperative*	*Late complications*
1. Injury to the blood vessels (inferior epigastric and femoral)	1. Urine retention	1. Recurrence
2. Injury to bowel and bladder	2. Hematoma	2. Numbness over the local region if the nerve was cut during surgery
3. Injury to ilioinguinal and iliohypogastric nerves	3. Infection	
4. Injury to cord structures	4. Periostitis of pubic tubercle (as the stitch is taken from periosteum)	
	5. Postherniorrhaphy hydrocele (due to obstruction of lymphatics at deep ring when narrowed tightly)	

- There are two methods for laparoscopic hernia repair.
- In both the methods a huge mesh is kept preperitoneal.

TAPP- Transabdominal preperitoneal repair	*TEP- Total extraperitoneal repair*
Approach: By entering the peritoneal cavity	Peritoneal cavity is not entered, we create extraperitoneal space by using balloon or direct inflation to reach the preperitoneal space of lower abdomen
Advantages: • Easy for the beginners • Can be done for those people who had open prostatectomy (where extraperitoneal space is not available)	• As we go totally extraperitoneal no chance of intra-abdominal visceral injuries • Easy recovery
Disadvantage: • Chance of visceral injuries more than TEP	• Difficult training course. Needs a lot of training

Author's Note

For PG standard, you should know everything about the TEP and TAPP and their complications.

FEMORAL HERNIA SURGERY

Basic principle: Approximate Inguinal Ligament with Cooper's Ligament (Iliopectineal ligament).
Three approaches:

1. **Lotheissen's inguinal approach:**
   - Inguinal incision made similar to inguinal hernia.
   - Fascia transversalis opened.
   - Approximate inguinal ligament with iliopectineal and also conjoint tendon with inguinal ligament.
   - Prevents inguinal hernia also.
2. **High approach of McEvedy:**
   - Vertical incision made over the femoral canal continued above to inguinal ligament.
   - Very useful for irreducible and strangulated hernia.
3. **Low operation of Lockwood:**
   - Groin crease incision.
   - Indicated in uncomplicated femoral hernia only.
   - Just approximate inguinal ligament and iliopectineal ligament.
   - Not prevents inguinal hernia.

Operative surgery for inguinal hernias:
Under spinal anesthesia:

- An incision made half inch above and parallel to the medial 2/3 of the inguinal ligament
- Superficial vessels identified and ligated
- Superficial ring identified as a opening in the external oblique aponeurosis
- External oblique aponeurosis laid open from superficial ring to the level of deep ring
- Ilioinguinal nerve and Iliohypogastric nerve may be seen on opening the external oblique aponeunosis—preserve them
- Cremasteric muscle along with cord structures seen
- Cremasteric muscle and fascia opened
- Cord structures identified and they are separated from the sac
- Indirect hernia—sac separated up to the deep ring, transfixation and ligation done at deep ring. Herniotomy done
- Direct hernia—just push back the direct sac into the abdomen and strengthen the posterior wall defect approximating fascia transversalis with 2'0 prolene
- Lytle's repair: Narrow the deep ring with 2'0 prolene
- Herniorrhaphy started after lateralizing the cord
- First bite taken from the periosteum of pubic tubercle and completed at deep ring
- Assuring complete hemostasis cord kept back and layers closed

STRANGULATED HERNIA (FIG. 1.15)

Management

1. Resuscitation: Nasal oxygen, Intravenous fluids.
2. Parenteral antibiotics.
3. Delay should not be made for operation.

'Danger is in delay not in operation'

Don't attempt

1. Taxis
2. Foot end elevation

Take the patient to operation theater

Under General Anesthesia

*Paint with povidone iodine from xiphisternum to midthigh (may need laparotomy for nonviable bowel).

- Inguinoscrotal incision made
- Before separating the sac from cord structures, open the fundus of sac first to release the toxic contents
  If you push the toxic fluid into the abdomen peritonitis may develop
- Constriction is usually seen in 50 percent cases at deep ring and 50 percent cases at superficial ring
- Look for the bowel viability and hold the bowel before releasing the constriction with Hernia Director (Grooved hernia director)
- Normal bowel is pinkish red; peristalsis seen, glistening
- In such cases push the bowel inside and do herniorrhaphy

If Bowel is not Viable; (Gangrenous, Lustureless, No Peristalsis)

1. Keep a warm pad over the bowel.
2. 100 percent oxygen given nasal.

Fig. 1.15: Strangulated bowel

3. Wait for 10 minutes
4. If viable put it back in the abdomen
5. If nonviable; abdomen opened through midline incision.

Nonviable Bowel

Small bowel—end to end resection anastomosis
Omentum—excise the gangrenous part.

Large Bowel

Patients who are unfit for resection and anastomosis the following procedures are done in emergency:

1. Paul Mikulicz's procedure—gangrenous loop excised and proximal colostomy and distal mucus fistula done for a temporary period. 6 weeks later re-anastomosis done.
2. Hartmann's operation—colon is excised and the proximal end is brought out as colostomy and distal end closed and left inside temporarily. 6 weeks later re-anastomosis is done.

Strangulation in Maydl's Hernia

1. Maydl's hernia (Retrograde strangulation) 'W' shaped hernia (Fig. 1.16).
2. Gangrene in the obstructed bowel starts first at the neck of sac; then immediately at the antimesentric border distally.
3. Therefore in Maydl's hernia; the distal antimesentric border is inside the abdomen; which goes for strangulation first.
4. Hence look for the full length of intestine by pulling out the loop inside the abdomen.

Sliding Hernia

Definition

Part of the posterior wall formed not only by the peritoneum but also by part of retroperitoneal structures.

For example: Urinary bladder, cecum, sigmoid colon.

Clinical Features

1. Incompletely reducible
2. Huge scrotal hernia
3. Appears slowly after reduction
4. Old male.

During Surgery

1. Do not dissect the sac from the retroperitoneal structures, just push part of the sac along with them.
2. Hernioplasty is ideal.

Scrotal Abdomen

Very huge hernia, with most of the intestines inside the scrotum.

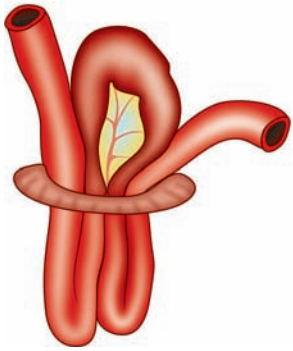


Fig. 1.16: Maydl's hernia

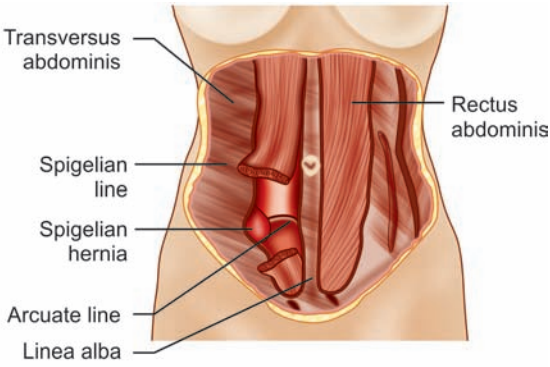


Fig. 1.17: Spigelian hernia

Clinical Features

1. Mostly irreducible
2. Cough impulse—negative

During Surgery

1. Assess the respiratory status, because if you suddenly push the whole bowel into the abdomen he may go for respiratory distress postoperatively.
2. Pneumoperitoneum should be created and the patient allowed to work with it for a few months before surgery.
3. Inguinal incision made as usually and the pneumoperitoneum released; gradually reduce the content.
4. Do hernioplasty.

Spigelian Hernia (Fig. 1.17)

- Type of interstitial (Hernia that comes in between the layers of anterior abdominal wall muscles).
- This occurs through spigelian fascia, thin strip of fascia that runs parallel to the outerborder of rectus sheath from tip of 9th costal cartilage to pubic tubercle.
- This fascia contributes to few fibers of anterior rectus sheath and is wide at the level of ARCUATE LINE, where the hernia occurs and runs in between external and internal oblique muscles.

MISCELLANEOUS

Richter's Hernia

- A portion of the circumference of the intestine becomes the content of the sac.
- Strangulation occurs when associated with femoral or obturator hernia.
- Diarrhea is seen in cases of strangulation.

Unless more than half of the circumference is involved there is no constipation.

Littre's Hernia

Meckel's diverticulum is seen in the sac.

Sacless Hernia

Epigastric hernia of linea alba.

Nyhus classification of hernia

Type I: Indirect hernia with normal deep ring
Type II: Indirect hernia with dilated deep ring
Type III: Posterior wall defect
- a. Direct
- b. Pantaloon
- c. Femoral

Type IV: Recurrent

DUAL HERNIA

(Pantaloon/Saddle Bag)

- Has two sacs.
- Actually a posterior wall defect in which sac comes through Hesselbach's triangle and deep ring.
- Isthmus behind is inferior epigastric vessels.
- If one sac is not treated properly recurrence will occur.
- Ring occlusion test: Not significant.

Gilbert Classification

Type 1 - Small, indirect
Type 2 - Medium, indirect
Type 3 - Large, indirect
Type 4 - Entire floor, direct
Type 5 - Diverticular, direct
Type 6 - Combined, pantaloon
Type 7 - Femoral

OGILVIE HERNIA

- Direct hernias are always acquired. Indirect may be congenital or acquired.
- Only congenital direct hernia is ogilvie hernia; through a rigid circular orifice in the conjoined tendon just lateral to where it inserts into the rectus sheath.

CONSOLIDATION

Factors	*S.No.*	*Direct*	*Indirect*
Age	1.	Older	Young
Sex	2.	Never occur in female	M:F = 20:1
History	3.	Reduced on lying down	Reduced by manipulation
	4.	Mostly bilateral	Usually unilateral to start
Inspection	5.	Hemispherical shape	Pyriform shape
	6.	Malgaigne's bulge (+)	No Malgaigne's bulge
	7.	Incomplete variety	Complete/Incomplete
Palpation	8.	Deep ring occlusion-swelling appears	Swelling not appears
	9.	Finger invagination - impulse felt at pulp of little finger	Impulse at tip of finger
	10.	Zieman's technique - impulse at superficial ring	Impulse at deep ring

Contd...

Contd...

Factors	*S.No.*	*Direct*	*Indirect*
Complication	11.	Strangulation very rare	Common
During surgery	12.	Sac is posteromedial to cord	Sac is anterolateral to cord
		Sac is medial to inferior epigastric vessels	Lateral to inferior epigastric vessels
		Comes through	
		Hesselbach's triangle	Comes through deep ring
		Hernioplasty must be done	Hernioplasty/Herniorrhaphy

2 CASE

Thyroid Gland

- History
- History of Present Illness
- Past History
- Personal History
- Local Examination
- Palpation
- Percussion
- Auscultation
- Features of Secondary Thyrotoxicosis
- Signs of Hypothyroidism
- Signs of Malignancy
- Investigations
- Side Effects
- Modalities of Surgery
- Surgical Anatomy of Thyroid
- Embryology
- Anatomy
- Lobectomy (Hemithyroidectomy)
- Postoperative Complications
- Carcinoma Thyroid
- Multiple Endocrine Neoplasia (Men)
- Toxic Adenoma
- Thyroiditis
- Riedel's Thyroiditis
- De Quervain's Subacute Thyroiditis
- Booster Points

EXAM CASES

- Multinodular goiter
- Solitary nodule
- Carcinoma thyroid

HISTORY

Name
Age
Sex
Occupation
Residence : Endemic goiter

HISTORY OF PRESENT ILLNESS

1. History of complaints
2. History of pressure effects
3. History of toxicosis
4. History of hypothyroidism
5. History of malignancy

History of Complaints

- **Swelling:**
  - Onset
  - Duration
  - Rate of growth

Age factor:

Young age	- Deficiency goiter
	- Dyshormonogenetic
	- Papillary carcinoma
Middle age	- Solitary nodular
	- Multinodular
	- Colloid goiter
	- Hashimotos
	- Follicular carcinoma
Old age	- Anaplastic carcinoma

Sex:

Thyrotoxicosis - 8 times more in females
Carcinoma - 3:1 ratio in females

- **Pain:**
  Goiter is usually painless.
  Pain is seen in cases of:
  - Hemorrhage
  - Malignancy infiltrating the nerves
  - Thyroiditis
  - Anaplastic carcinoma

Dyspnea in thyroid
- Tracheomalacia in long standing MNG
- Retrosternal extension
- Cardiac failure due to secondary thyrotoxicosis
- Infiltration by anaplastic carcinoma.

Hoarseness of voice
- Infiltration of recurrent laryngeal nerve by malignancy
- Edema of vocal cord

History of Pressure Effects

- History of dyspnea or stridor
- History of dysphagia
- History of hoarseness of voice
- History of syncope
- History of suggestive of Horner's syndrome
  - Ptosis
  - Miosis
  - Anhidrosis
  - Enophthalmosis

Sudden onset of thyroid swelling with pain		- Thyroiditis
Sudden increase in size with pain		- Hemorrhage
		- Malignancy developing in a benign swelling
Slow growing	-	Papillary carcinoma Follicular carcinoma
Fast growing	-	Anaplastic carcinoma

History of Thyrotoxicosis

- **History of common to thyrotoxicosis:**
  - Excessive sweating
  - Loss of weight in spite of good appetite
  - Heat intolerance
  - Diarrhea
  - Amenorrhea (decreased menstruation)
- **History of primary thyrotoxicosis**:
  1. Mainly CNS symptoms
     - Tremor
     - Insomnia
     - Muscle weakness
  2. Eye signs are common
     - Exopthalmos
     - Double vision
     - Pain

Thyroid swelling and toxic features appear simultaneously in primary thyrotoxicosis

- **History of secondary thyrotoxicosis:**
  1. **Mainly cardiovascular system symptoms**
     - Palpitations
     - Ectopic beats

Secondary thyrotoxicosis is that which develops in a case of long standing thyroid swelling

- Cardiac arrhythmias
- Dyspnea on exertion
- Chest pain
- Edema of ankle
- Congestive cardiac failure.

History of Hypothyroidism

- Decrease in appetite but increase in weight
- Hoarseness of voice
- Falling hair (lateral eyebrows)
- Constipation
- Cold intolerance
- Menorrhagia followed later by amenorrhea (due to anemia)

History of Malignancy

- Bone pain (Bone)
- Dyspnea; cough with hemoptysis (lung)
- Loss of weight and loss of appetite
- History of Jaundice (liver)

Metastasis in papillary carcinoma
- Lung (most common)
- Bone
- Liver
- Brain

PAST HISTORY

- History of diabetes, hypertension, ischemic heart disease, bronchial asthma;
- History of previous surgery
- History of drugs (Antithyroid drugs, thyroxine, sulfonyl ureas)
- History of irradiation in childhood (leads to papillary carcinoma)

History of irradiation:
Used for treatment of
1. Tinea capitis
2. Thymic enlargement
3. Enlarged tonsils and adenoids
4. Acne vulgaris
5. Hemangioma
6. Hodgkin disease

PERSONAL HISTORY

- History of consuming vegetables (Brassica family, cabbages)
- History of smoking/alcohol.

Menstrual History

- Oligomenorrhea—hyperthyroidism
- Menorrhagia—hypothyroidism.

Family History

- Deficiency goiter
- Dyshormonogenetic goiter
- Medullary carcinoma of thyroid (MEN IIa, IIb).

Thyrotoxicosis factitia	:	Due to consumption of excess thyroxine
Jod Basedow's thyrotoxicosis	:	Due to excess iodide consumption
Wolf-Chaikoff effect	:	Iodides given inhibits the thyroxine and leads to hypothyroidism

General Examination

- General condition
- Anemia
- Nourishment
- Lymph adenopathy
- Blood pressure
- Pulse rate

Criles grading of pulse rate

Sleeping pulse rate measured after giving phenobarbitone

Grade I	:	90 to 100/mt
Grade II	:	100 to 110/mt
Grade III	:	>110/mt

Built of patient

Thyrotoxicosis—thin and underweight
Hypothyroidism—obese and overweight
Carcinoma—anemia and cachexia
Mask like facies—hypothyroidism

LOCAL EXAMINATION

Inspection

- Swelling
- Number
- Site—front of neck
- Size
- Shape—butterfly shaped/Hemispherical (for Solitary nodules)
- Surface
- Skin over the swelling
- Plane of the swelling
- Pulsation
- Movement with deglutition*
- Movement with protrusion of tongue*
- Look for the lower border of swelling*

If lower border is not visible, we should look for retrosternal goiter

Retrosternal goiter (Figs 2.1 and 2.2)
Multinodular goiter can become so much enlarged resulting in the extension of the enlarged gland into the thoracic region and can cause SVC compression
Dilatation of subcutaneous veins over anterior part of upper thorax
Pemberton sign: to diagnose retrosternal goiter compression:
- Raise both arm over head, until they touch the ears
- Maintain the position for a while
- Congestion of face and distress occurs due to obstruction of great veins of thorax

- On stretching the deep fascia by extending the neck, swelling becomes more prominent.
- Look for tracheal position by Trial's sign.
- **Trial's sign** prominence of sternocleidomastoid on the side of deviation of trachea.

Pizzilo's method (Fig. 2.3)
In case of obese and short necked individuals
- Ask the patient to keep the hands behind the head and ask to push head backwards against clasped hand on occiput

PALPATION

Palpate with the patient's neck slightly flexed first from behind and then from front (Fig. 2.4).

Fig. 2.1: Pemberton sign

Fig. 2.2: Retrosternal extension of goiter

Fig. 2.3: Pizzilo's method

Fig. 2.4: Palpate thyroid always from behind first

Fig. 2.5: Lahey's method

Fig. 2.6: Crile's method

Lahey's method (Fig. 2.5)
To palpate right lobe push the right lobe with right hand to right side and palpate with left hand

Crile's method (Fig. 2.6)
Place the thumb on the thyroid while the patient swallows; this method is used to diagnose doubtful nodules

1. Surface : Smooth - Colloid goiter, Grave's disease
   Bosselated - Multinodular goiter
2. Consistency : Soft - Colloid goiter, Graves disease
   Firm - SNG, MNG
   Hard - Carcinoma, Riedel's thyroiditis
3. Mobility : Restricted in malignancy and chronic thyroiditis
4. Palpate the lower border:
5. Pressure effects:
   1. Trachea - **Kocher's test**
      (Slight push on lateral lobes will produce stridor in case of obstructed trachea.)
   2. Carotid artery - Carotid sheath is pushed back by benign swelling where carotid pulsations felt.
   3. Sympathetic trunk - Horners syndrome
      - Enophthalmos
      - Miosis
      - Anhidrosis
      - Ptosis
6. Palpate for thrill

Berry's sign
Malignant thyroid engulfs the carotid sheath completely hence pulsation not felt.

PERCUSSION

Over manubrium to Rule out Retrosternal extension.

AUSCULTATION

Primary Thyrotoxicosis

Systolic bruit may be heard in superior pole outwards due to increased vascularity.

Level I - Submaxillary and submental (Fig. 2.7)
Level II - Upper jugular
Level III - Middle jugular
Level IV - Lower jugular
Level V - Posterior triangle
Level VI - Central neck nodes
Level VII - Anterior mediastinal

- **Lateral aberrant thyroid**: These are metastatic lymph nodes from an occult papillary carcinoma of thyroid.

Features of Primary Thyrotoxicosis

1. Eye signs
2. Tachycardia
3. Tremors
4. Moist skin
5. Thyroid bruit

Eye Signs

1. *Lid retraction:* Overactivity of sympathetic part of levator palpebrae superioris (Muller's muscle)
2. Exophthalmos.

Naffziger's test: Go behind the patient, extend the neck, see through the supraciliary ridge, you can diagnose exophthalmos.

Gifford's test: Test to differentiate exophthalmos from proptosis (where pathology is behind the eyeball).

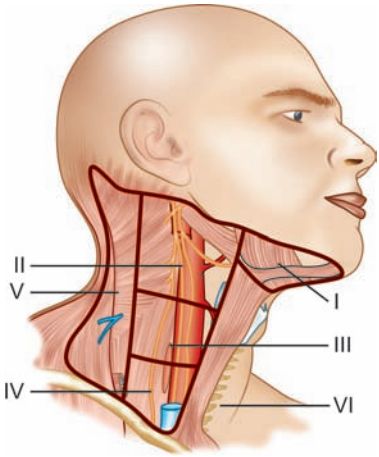


Fig. 2.7: Level of nodes in neck

Evert the upper eyelid. Impossible to do it in exophthalmos due to Muller's muscle hyperactivity. This test is possible in proptosis (Flow chart 2.1).

Stellwag's sign (Fig. 2.8) - Starring look with infrequent blinking and wide palpebral fissures.

von Graefe's sign - Lid lag sign. Tested by asking the patient to look up and down many times fixing the head, you can see the upper lid lags behind.

Joffroy's sign - Absence of wrinkling of forehead. The patient looks the roof of the room without forehead wrinkling.

Dalrymple's - Visible upper sclera due to lid retraction.

Möbius sign - Inability to converge the eyeball.

Jellinek's sign - Increased pigmentation of eyelids.

3. Ophthalmoplegia (malignant exophthalmos, Fig. 2.9)
   - Weakness of ocular muscles due to edema and cellular infiltration of these muscles.
   - Paralysis of superior rectus, inferior oblique and lateral rectus.
   - On paralysis of these muscles, patient is unable to look upwards and outwards.

Fig. 2.8: Stellwag's starring look sign

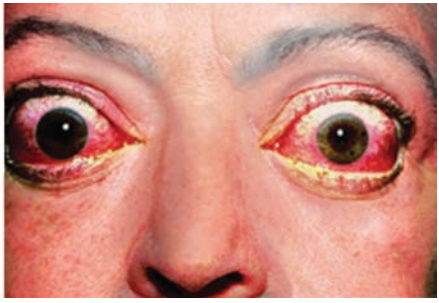
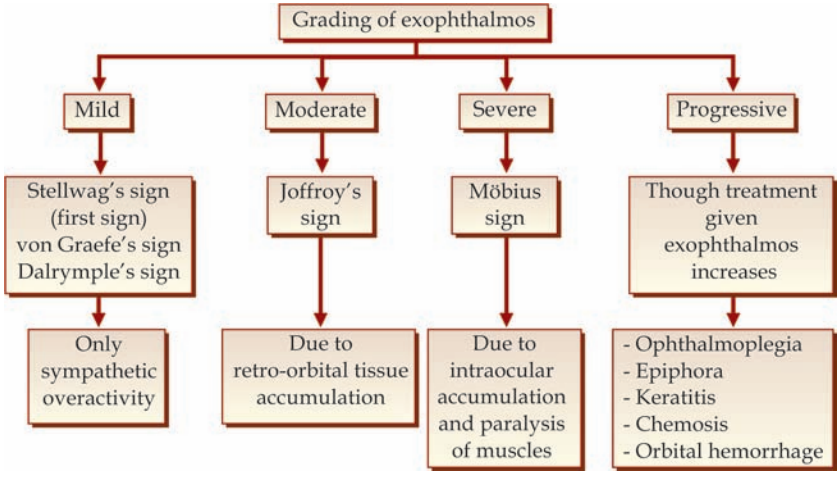


Fig. 2.9: Malignant exophthalmos

Flow chart 2.1: Grading of exophthalmos



4. Chemosis
   - Due to obstruction of venous and lymphatic drainage of conjunctiva by increased retro-orbital pressure.

Tachycardia

Atrial fibrillation.

Tremors

In the tongue (with tongue inside the oral cavity—should not ask the patient to protrude the tongue for tremors) and outstretched hands.

Hot and Moist Palms

Thyroid Bruit

Over the upper and outer pole.

FEATURES OF SECONDARY THYROTOXICOSIS

Complication of multinodular goiter and adenoma.
Signs of cardiac failure:

- Edema of ankles
- Orthopnea
- Dyspnea
- Eye signs

Only lid lag and lid retraction can be seen

- No tremor
- No exophthalmos

Viva: In secondary thyrotoxicosis cardiac manifest is more common than eye manifest. Why?

- Because secondary thyrotoxicosis is already common in old age with aged heart and complications, so the sympathetic over activity affects the heart more. Primary thyrotoxicosis is common in young age.

SIGNS OF HYPOTHYROIDISM

- Obese
- Dry inelastic skin
- Macroglossia
- Mask like facies
- Loss of hair in lateral eyebrow
- Hoarseness of voice
- Pseudomyotonic reflex (delayed ankle jerk); also called 'hung up' reflex.

SIGNS OF MALIGNANCY

- Examine the spine, lung and cranium

- Pulsatile metastasis seen in skull in follicular carcinoma (Pulsatile skull metastasis is also seen in renal cell cancer).

Examination of Other Systems

- Cardiovascular system - Secondary thyrotoxicosis
- RS - To find secondary deposits
- Abdomen - In lymphoma of thyroid, other lymphoid organs in abdomen may be involved.
- Oral cavity - Look for lingual thyroid, macroglossia, tremor of tongue.

Diagnosis

Anatomical diagnosis	:	MNG/SNG/Diffuse
Functional diagnosis	:	Toxic/Euthyroid/Hypothyroid
Pathological diagnosis	:	Benign/Malignant

Discussion

1. What are the swellings that move with deglutition?
   i. Thyroid
   ii. Thyroglossal cyst
   iii. Subhyoid bursitis
   iv. Nodes attached to larynx and trachea
   v. Laryngocele
2. Why does thyroid swelling move with deglutition?
   i. Pretracheal fascia encloses the thyroid and gets attached to hyoid
   ii. Ligament of Berry—thickened pretracheal fascia postero-medially attached above to cricoid cartilage.
   iii. Isthmus has some attachment with trachea directly.
3. Name the conditions where thyroid swelling has restricted movement with deglutition?
   i. Anaplastic carcinoma
   ii. Fixation due to previous surgery
   iii. Retrosternal goiter
   iv. Riedel's thyroiditis

Retrosternal goiter

Common in short neck individuals and males with strong pretracheal muscles

Types

1. Substernal—part of nodule palpable in lower neck
2. Plunging—on increased intrathoracic pressure gland forced into neck
3. Intrathoracic goiter

Treatment

Surgical removal through neck incision or sternotomy

Radioiodine is not accepted

4. **Tell the differential diagnosis of solitary nodule thyroid:**
   Solitary Nodule Thyroid: Differential diagnosis:
   i. Colloid goiter (Most common cause)
   ii. Adenoma thyroid: Autonomous functioning of the nodule without any stimulation by TSH or thyroid stimulating antibodies.
   iii. Dominant nodule of multinodular goiter
   iv. Cyst
   v. Carcinoma thyroid
   vi. Lymphoma
   vii. Thyroiditis-Hashimoto's, Riedel's, De Auervain's
5. **What is the dose of thyroxine given?**
   Thyroxine doses: (T4) Eltroxin tablet: 0.1 mg tablet available
   i. Supplement treatment: (hypothyroidism) — 1 tablet (0.1 mg)
   ii. Substitution treatment: (after thyroidectomy) — 2 tablets (0.2 mg)
   iii. Suppression treatment: (for papillary carcinoma) — 3 tablets (0.3 mg)

Kocher's	*Berry's*
• Incision- Cholecystectomy • Test- Obstructed trachea • Vein- 4th vein of thyroid • Kocherization-Mobilization of 1st, 2nd part of duodenum • Theodor Kocher- Father of thyroid surgery	• Aneurysm-In brain for subarachnoid hemorrhage • Sign–Engulfment of carotid sheath in malignancy • Ligament-Condensation of pretracheal fascia in posteromedial compartment • Picking-Not done now. Picking of involved lymph nodes alone during surgery in cases of papillary cancer.

INVESTIGATIONS

I. Routine
- Hb percent, TC, DC, ESR, BT, CT
- Urine albumin, sugar, deposits
- Blood urea, sugar, blood grouping/typing
- X-ray chest
- ECG all leads

II. Specific
- X-ray neck AP/lateral view
- ENT examination
- Sleeping pulse rate
- USG—neck
- Thyroid assay—(thyroid profile)
- Serum calcium

III. For individual cases
- Fine needle aspiration cytology
- Radioactive iodine uptake study
- Thyroid antibodies
- Thyroglobulin
- Lymph node biopsy—to Rule out malignancy
- Thyroid scan

X-ray of neck

1. Position of trachea
2. Retrosternal extension
3. Cervical spondylosis
4. Calcifications -
   i. Benign dystrophic
   ii. Psammoma bodies
5. Barium swallow X-ray (esophagus compression)
6. Metastasis to skull

USG neck

To differentiate

- Cystic or solid swelling
- Multinodular or solitary nodular
- To find nodes

- Cervical spondylosis if present may lead to limb paralysis if the neck is hyperextended during surgery hence X-ray of neck is important.

Thyroid profile: (Ref Schwartz)

Serum TSH	- 0.5 to 5 micro units/ml
Total T4	- 50 to 150 nanomol/liter
Total T3	- 1.5 to 3.5 nanomol/liter
Free T4	- 12 to 28 picomol/liter
Free T3	- 3 to 9 picomol/liter
Thyroglobulin	- <1 to 35 micrograms/liter

- TSH (Thyroid stimulating hormone) - Decreased in cases of hyperthyroidism.
- Total T4 - Reflects the output from the thyroid gland
- Total T3 - Indicates the peripheral thyroid metabolism.
- Free T4 and Free T3 - Used to find cases of early hyperthyroidism.
- Thyroglobulin - Mainly used to monitor recurrence of thyroid cancer after surgery and to find metastatic, disease.
- Serum calcium - Normal 8 to 10 nmol/L

We are likely to produce hypocalcemia after total thyroidectomy due to parathyroid glands getting loss of blood supply or removal of all 4 glands.

It the patient has 10 nmol/L before surgery and postoperatively has 8 nmol/L then it is hypocalcemia, though the patient is in normocalcemic reference range.

Indirect Laryngoscopy

- Three percent of individuals may have silent paralysis of one vocal cord.
- Other cord may be compensating so far in such cases.
- Medico-legally this must be noted.

Fine Needle Aspiration Cytology

Procedure :
- Using 23G/24 G needle
- 10 ml syringe

- Introduce the syringe into the swelling after having created vaccum in it, do multiple punctures with vaccum in the syringe.
- Tissue can then be spread over the slide and may be either air dried or alcohol dried.

Indications :
- Solitary nodule thyroid
- Multinodular thyroid
- To Rule out malignancy

Contraindication : Thyrotoxicosis

(Do not say FNAC in cases with Bruit/Thrill over the thyroid swelling because it may lead to severe bleeding and even the material will contain only bloody aspirate).

- FNAC becomes therapeutic in certain cases of cyst, where the whole fluid is aspirated. No need to do any further treatment in such cases if the aspirate is clear, completely collapses and never reappears. We can aspirate for minimum three times, if it appears after 3rd time we have to do thyroidectomy.
- If you are planning to do thyroid scan, don't do FNAC first. This is because the FNAC site may be seen as cold nodule due to hemorrhage.
- FNAC cannot differentiate follicular adenoma and carcinoma, because the differentiation is based on capsular invasion.

Trucut Biopsy

- Poor patient compliance, pain and hemorrhage at that site.

Indications

1. Locally advanced surgically unresectable
   i. Anaplastic carcinoma
   ii. Lymphoma
2. To differentiate follicular adenoma and carcinoma

Radioactive Iodine Uptake Study

Indications:
1. Doubtful toxicity
2. Ectopic thyroid
3. Autonomous toxic nodule
4. To L/f secondaries in follicular carcinoma after thyroidectomy.
5. Retrosternal thyroid

Therapeutic uses:
1. Primary thyrotoxicosis >45 years of age.
2. Autonomous thyroid nodule >45 years age.
3. Secondaries in cases of postoperative Follicular carcinoma I^{131} can be given. (Half-life - 8 days - Isolate these patients during this period. Advice them not to spit in public places, avoid urination over land).

Contraindication

- Pregnancy and children
  (Teratogenicity and papillary carcinoma may be predisposed).
- I^{123} and Tc^{99m} can be used as they have very little half-life.

Administration

Avoid for 2 weeks:

1. Iodine containing foods
2. Cough syrup
3. Iodine salt
4. Thyroxine tablets for 6 weeks
5. T3 if given for 2 weeks.

Diagnostic	-	5 microcuries
Therapeutic	-	5 millicuries

Half-life of contrasts—route of administration

I^{131} - 8 days (oral route)
I^{132} - 2.3 hours (oral route)
I^{123} - 13 hours (oral route)
Tc^{99m} - 6 hours (Intravenous)

Mix with milk and drink.
After 24 hours uptake is studied.

Inference

Normal uptake : 16 to 48 percent
Hyperthyroidism : >48 percent of uptake
Hypothyroidism : <16 percent of uptake

- If you give Tc^{99m} IV, you can study in next half hour.
- Dyshormonogenetic goiter is a condition in which there is increased uptake, though there is hypothyroidism.

Thyroid Scan (Figs 2.10 and 2.11)

A thyroid nuclear medicine scan is a diagnostic procedure to evaluate the thyroid gland. A radioactive substance that concentrates in the thyroid is taken orally or injected into a vein (intravenously), or both. A special gamma camera is used to take an image of the distribution of the radioactive substance in and around the thyroid gland.

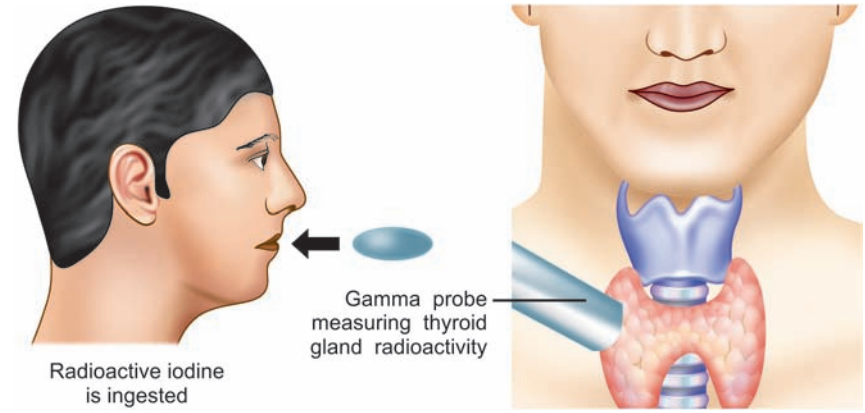
Indications

1. Solitary nodule
2. Retrosternal goiter
3. Ectopic thyroid tissue
4. Thyroglossal cyst—to find whether the normal thyroid is present or the cyst is the only thyroid tissue.

Inference

1. Hot nodule—increased activity than surrounding, e.g. thyrotoxicosis
2. Warm nodule—same activity as in the surrounding.
3. Cold nodule—decreased activity than surrounding

For example: Malignancy, Hemorrhage inside the colloid degeneration, Post - FNAC.



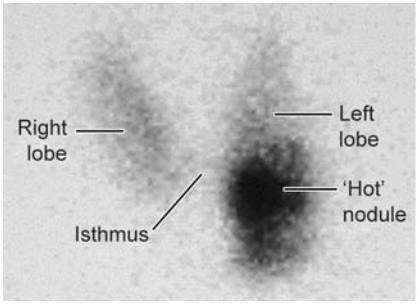


Fig. 2.10: Radioactive uptake study: Hot nodule

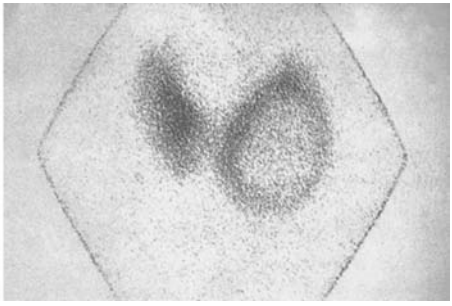


Fig. 2.11: Cold nodule

Treatment Options

1. Antithyroid drugs
2. Radioactive iodine
3. Surgery

Preoperative Preparation of Thyrotoxicosis

Antithyroid drugs:

1. Carbimazole
2. Propylthiouracil
   - Carbimazole: 10 mg TDS is given until the patient becomes euthyroid. Then 5mg TDS can be given as maintenance until surgery.
   - Usually symptoms improve in 2 to 6 weeks.
   - The tablet should be given until the patient becomes euthyroid.

Advantages of Propylthiouracil

- Both drugs cross the placenta; but propylthiouracil has a lower risk of transplacental transfer.
- It inhibits peripheral conversion of T4 to T3, making it useful for thyroid storm.

Treatment in nutshell:
Depending upon the given case:
1. MNG with toxic features:
- Prepare the patient until becomes euthyroid
- Subtotal thyroidectomy
2. MNG with euthyroid: Subtotal thyroidectomy
3. Solitary nodule thyroid: Hemithyroidectomy (Lobectomy + Isthumusectomy) and send the specimen for histopathological examination (HPE).
   If the HPE report is malignancy, then do completion total thyroidectomy.
4. Carcinoma thyroid: Total thyroidectomy with modified radical neck dissection.
5. Undifferentiated anaplastic carcinoma:
- No role for surgery
- Isthumectomy if compressing the trachea
- Palliative radiotherapy and chemotherapy (Doxorubicin)
6. Malignant lymphoma: Highly sensitive to irradiation, no need of radical surgery.
7. Primary thyrotoxicosis (Grave's Disease).
   >45 years age: Antithyroid drugs + radioiodinetherapy
   <45 years age: Subtotal thyroidectomy (because if radioiodine is given in young age, it may lead to papillary carcinoma in long-term)

- Can be used during pregnancy and breastfeeding.
  - If the patient on antithyroid drugs develop sore throat or fever, stop the drugs until the granulocyte count improves.
  - Sore throat is the first indication of drug toxicity.
  - Temporarily stop the drug until the count returns to normal.
- In India carbimazole is routinely used.

SIDE EFFECTS

1. Reversible granulocytopenia
2. Skin rashes
3. Fever
4. Peripheral neuritis
5. Polyarteritis
6. Vasculitis
7. Agranulocytosis
8. Aplastic anemia

Mechanism of Action

- Inhibit iodination and coupling, i.e. hormone synthesis
- Carbimazole is converted to an active metabolite methimazole.

Block and replacement therapy
High dose of carbimazole given and inhibit all T3 and T4 production by giving maintenance dose of 0.1 to 0.15 mg thyroxine daily. This prevents iatrogenic hypothyroidism

Propranolol

- Dose: 40 mg given in the three divided doses.
- The catecholamine response of thyrotoxicosis is alleviated by administering beta-blocking agents.
- It is added with antithyroid drugs for quick preparation of patient to surgery.
- It also inhibits peripheral conversion of T4 to T3.

Recently: Nadolol: 160 mg is used in once single dose.

Contraindications of program of:
Asthma
Block (Heart block)
Congestive cardiac failure
Diabetes

Lugol's Iodine

- Dose: 10 drops TDS for last 10 days before surgery.
- Administered by mixing with milk.
- To decrease the vascularity of the gland (Iodine increases the colloid and thus has tamponade effect on vessels and to make the gland firmer).
- If used beyond 10 days, gland returns back to its original state.

Lugol's Iodine—composition

- 5 percent Iodine+ 10 percent potassium iodide

Radio-Iodine

Dose : I^{131} is administered orally, 8 to 12 millicurie (200–600 MBq)
Mechanism : Destroys the thyroid tissue

Indications:

1. Primary thyrotoxicosis (age > 45 years)
2. Toxic nodule (age > 45 years)
3. Relapse after medial or surgical therapy
4. Patients where antithyroid drugs and surgery are contraindicated.

Contraindications:

Absolute : Pregnant and breastfeeding women
Relative :
i. Young patients and children
ii. Ophthalmopathy
iii. Multinodular goiter with toxicosis

Adverse Effects

1. Progressive development of hypothyroidism
2. Progression of Grave's ophthalmopathy and toxic nodular goiter.
3. Increased risk of thyroid cancer and genetic mutations (But these are not seen at therapeutic doses).
   i. Carbimazole when given should be stopped 48 hours before and restarted after 3 to 5 days.
   ii. The effect of radio–iodine starts after about 3 to 4 months, until then antithyroid drugs are given.

Surgery

Indications:

- Toxicity
- Pressure effects
- Malignancy
- Cosmetic

Toxic thyroid in pregnancy

- RAI is absolutely contraindicated
- Antithyroid drugs can be given but baby may be born hypothyroid
- Subtotal thyroidectomy done in second trimester

Thyroid storm

It is a condition of hyperthyroidism accompanied by fever, central nervous system agitation or depression, cardiovascular dysfunction that may be precipitated by infection, surgery or trauma and occasionally by amiodarone administration.

It is common in inadequately prepared patient for surgery, accompanied by excess thyroid hormone release

Clinical features

Tachycardia, hyperpyrexia, dehydration, hyperexcitability, congestive cardiac failure, atrial fibrillation

Treatment

1. Oxygen
2. Fever—tepid spongings, paracetamol
3. Dehydration—IV fluids, glucose
4. Antithyroid medications :
   i. Lugol's iodine—up to 30 drops
   ii. Sodium ipodate/potassium iodide intravenously
   iii. Propanolol—100 μg IV up to 1 to 2 gm
   iv. Carbimazole—20 mg 6th hourly.
   v. Propylthiouracil—to prevent peripheral T4 to T3 conversion.
5. Steroids: to prevent adrenal exhaustion
   Hydrocortisone: 200 mg stat, 100 mg 6th hourly.
6. Hyperexcitability: Diazepam
7. CCF: Diuretics
8. Atrial fibrillation: Digoxin

When to stop the drugs before surgery?

If the patient is posted for surgery tomorrow morning

1. Stop carbimazole today night
2. Stop Lugol's iodine today night
3. Propranolol to be given tomorrow morning also

After surgery

1. Stop carbimazole and Lugol's iodine
2. Continue the propranolol for 7 days to handle the thyroxine released during surgery and to prevent peripheral T4 to T3 conversion

MODALITIES OF SURGERY

1. Isthumectomy
2. Hemithyroidectomy (Lobectomy)
3. Subtotal thyroidectomy
4. Total thyroidectomy

SURGICAL ANATOMY OF THYROID

Weight: 20 to 25 gms.

EMBRYOLOGY

- Thyroglossal duct develops from the median bud of pharynx. (Floor of primitive pharynx).
- Foramen cecum at the base of the tongue is the vestigial remnant of the duct.
- The duct migrates caudally and passes in close continuity with and sometimes through the hyoid bone.
- Finally divides into two lobes forming the thyroid gland.

From the fourth pharyngeal pouch (ultimobranchial body) develops the Parafollicular 'C' cells. There are cells of neural crest origin that reach thyroid via ultimobranchial body

ANATOMY (FIG. 2.12)

- Situated at the level of C5, C6, C7, T1, vertebra.
- Consists of two lobes connected at the level of second and third tracheal rings by isthmus.
- In 50 percent cases there is a pyramidal lobe superior to the isthmus representing the residual thyroglossal tract.
- Posteriorly the gland is attached to the cricoid cartilage and the superior tracheal rings by dense connective tissue known as Berry's ligament.

Coverings of Thyroid Gland

True capsule: Peripheral condensation of connective tissue of gland.
False capsule: Derived from pretracheal fascia.

Blood Supply (Fig. 2.13)

- Superior thyroid artery (1st branch of external carotid artery).
- Inferior thyroid artery (from thyrocervical trunk of subclavian artery).
- Arteria thyroidea IMA (from arch of aorta)
  - Present in 3 percent individuals.
  - Obliterated part forms the levator glandular thyroides.

Venous Drainage

- Superior and middle thyroid vein drains into internal jugular vein.
- Inferior thyroid veins form a plexus and drain into the brachiocephalic vein (Innominate vein).

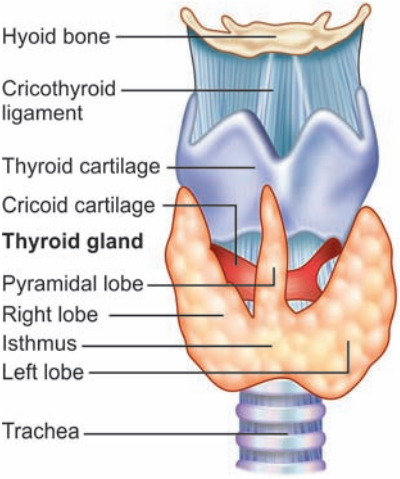


Fig. 2.12: Anatomy of thyroid gland

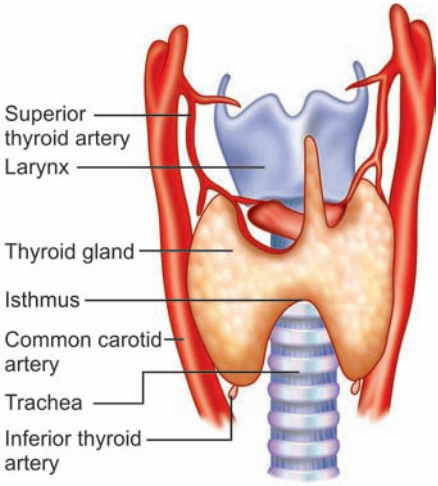


Fig. 2.13: Blood supply of thyroid gland

- Kocher's is the fourth vein of thyroid; present in between middle and inferior thyroid veins. Drains into internal jugular vein.

Lymphatic Drainage

- Pretracheal nodes (Delphic Nodes) (Level 6)
- Prelaryngeal nodes (Level 7)
- Deep cervical (Levels 3, 4, 5)

Vagus Nerve Branches

Nerve Relationship (Flow chart 2.2)

Recurrent laryngeal nerve

- Lies in the tracheoesophageal groove and closely related to the inferior thyroid artery.
- To avoid injury the inferior thyroid artery as far away from the gland.

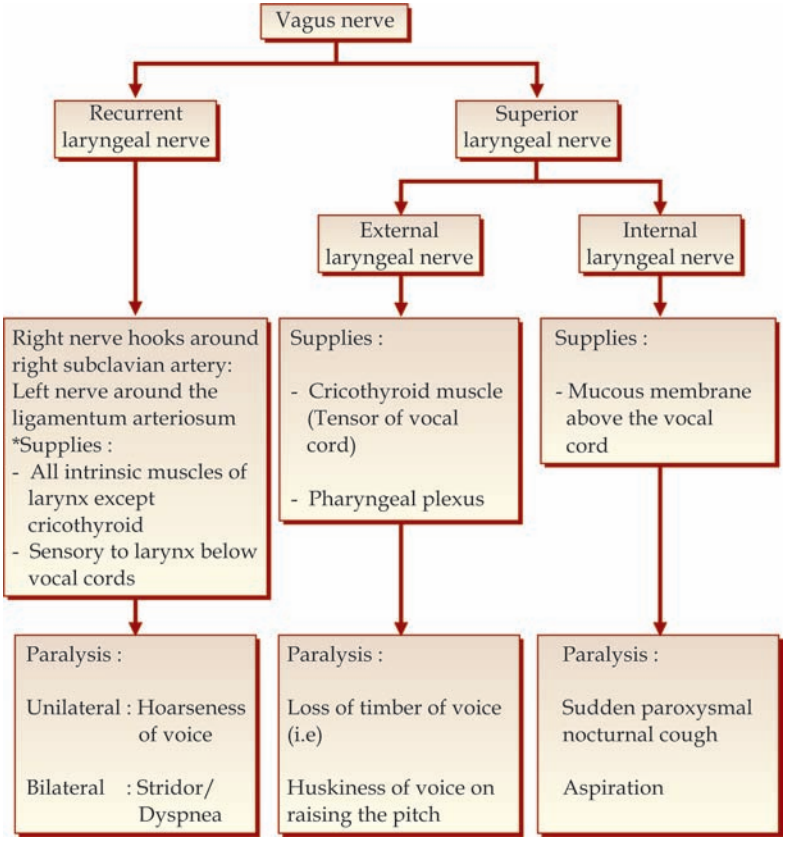
External laryngeal nerve

- Closely related to the superior pole vessels.
- The superior pedicle should not be ligated enmasse, but to be individually divided low on the thyroid gland to avoid injury to the nerve.

Parathyroids

- Four in number, oval in shape, 6 mm in length, weight between 30 to 50 mg each; golden yellow to light brown color
- Position is highly variable
- Superior parathyroid is situated posterior to the recurrent laryngeal nerve close to the posterior border of thyroid
- Inferior parathyroid may be high at the level of hyoid or low within thymus, usually situated anterior to recurrent laryngeal nerve in the lower pole of thyroid gland
- Blood supply: Inferior thyroid artery

Flow chart 2.2: Nerve supply in larynx



Operative surgery

Anesthesia: General anesthesia

Position: Hyperextended neck with sandbag between scapula; Head end may be in higher level (Reverse Trendelenburg position)

Incision: Kocher transverse collar incision/Low skin crease incision

Steps

1. Subcutaneous tissues and platysma are incised sharply and subplatysmal flaps are raised superiorly to the level of thyroid cartilage and inferiorly to the suprasternal notch. Self-retaining retractor applied
2. Incise the investing layer of deep cervical fascia at the midline vertically and the strap muscles are divided in the midline. If the strap muscles are to be divided to gain exposure to thyroid gland, cut them high in order to preserve their innervation by branches of ansa cervicalis
3. Usually the strapmuscles are pushed laterally by blunt dissection to identify thyroid gland
4. If middle thyroid vein is identified, it should be ligated and divided at first
5. Dissect the superior pole vessels and ligate them individually close to the gland to avoid injury to the external laryngeal nerve
6. Inferior pedicle should be ligated as far away below the thyroid gland to avoid injury to recurrent laryngeal nerve
7. If hemithyroidectomy is performed, the isthmus is divided flush with trachea on the contralateral side and suture ligated

Subtotal Thyroidectomy

- Leaving a 4 to 7 g remnant of thyroid tissue in tracheoesophageal groove, to avoid injury to recurrent laryngeal nerve.
- Two methods
  - Bilateral subtotal thyroidectomy
  - Hartley Dunhill procedure.
- **Bilateral subtotal thyroidectomy**
  1 to 2 g thyroid tissue left on both side of tracheoesophageal groove.
- **Hartley Dunhill procedure**
  - Total lobectomy on one side and 4 to 6 g thyroid tissue left on other side.
  - This procedure has fewer complications and requires reentering only one side of neck if recurrence requires reoperation.
- **Near total thyroidectomy**
  Total lobectomy on one side and leaving 1 to 2 g of thyroid tissue other side.

LOBECTOMY (HEMITHYROIDECTOMY)

- Removing one side of lobe along with isthmus.

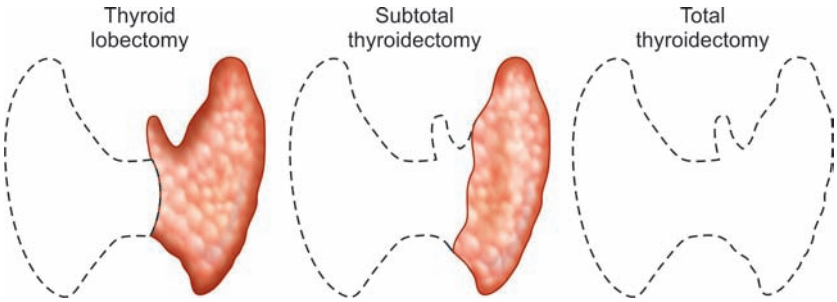
POSTOPERATIVE COMPLICATIONS

Perioperative Complications

- Injury to nerves
  - External laryngeal nerve
  - Recurrent laryngeal nerve
- Hemorrhage
- Thyroid crisis if the patient is inadequately prepared.
- Injury to parathyroid.

Early Postoperative

- Respiratory dyspnea:
  - Hematoma
  - Laryngeal edema due to repeated intubation
  - Tracheomalacia
  - Hypoparathyroidism
  - Bilateral recurrent laryngeal nerve injury.



- **Hematoma:**
  - Due to slipping of a ligature from superior thyroid artery.
  - Hematoma is usually deep to the deep cervical fascia
  - Needs immediate opening of the wound and deep cervical fascia and let out the hematoma.
  - Shift to operation theater for catching the bleeding pedicle.
- **Hypoparathyroidism:**
  - Usually manifests about 4th day of surgery.
  - 90 percent due to inadequate blood supply, and
  - 10 percent due to removal of all glands.
- **Infection**
- **Stitch abscess**

Late Postoperative

- Hypothyroidism
- Keloid

Viva: During surgery how will you confirm whether the tissue is parathyroid gland?
Golden yellow color
- Put it in a cup of normal saline.
- Parathyroids usually sink but fat floats.
  - Implant the parathyroid into the sternomastoid pocket or into the forearm

Hypoparathyroidism
Clinical features:
1. Tetany—due to hypocalcemia; carpopedal spasm
2. Laryngismus stridulus—spasm of vocal cord leading to dyspnea

Subclinical cases
1. **Trousseau's sign**—flexion at Meta carpo phalangeal joint and extension at inter-phalangeal joint on tying the tourniquet at upper arm and raising the blood pressure (Fig. 2.14)
2. **Chvostek's sign**—on taping over the preauricular region, twitching of facial muscles is seen

Treatment
Slow calcium gluconate infusion

CARCINOMA THYROID

Dunhill's Classification of Malignant Thyroid

- Differentiated:
  - Papillary (60%)
  - Follicular (17%)
  - Hurthle cell carcinomas
- Undifferentiated: Anaplastic carcinoma (10%)
- Medullary carcinoma: (5%)
- Malignant lymphoma: Mostly non-Hodgkin's variety- B-cell lymphoma
- Secondaries: From breast, colon, rectum or local spread.

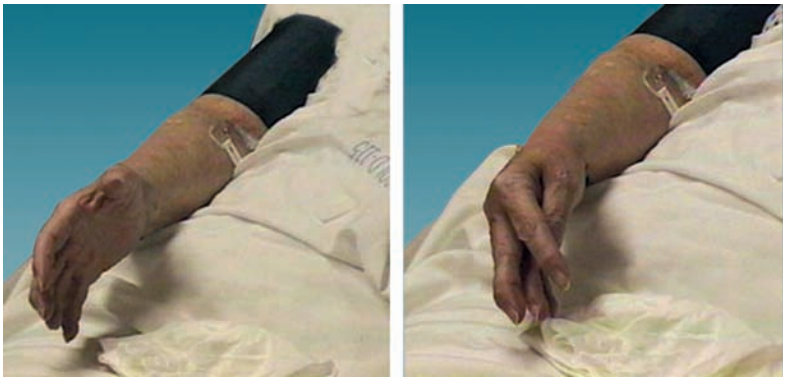


Fig. 2.14: Trousseau's sign

DeGroot's staging of carcinoma thyroid
Class I - Intrathyroidal
Class II - Cervical nodal metastasis
Class III - Extra thyroidal invasion
Class IV - Distant metastasis

Etiology

1. History of irradiation—papillary carcinoma.
2. History of longstanding multinodular goiter—follicular carcinoma.
3. Family History of—medullary carcinoma thyroid.
4. Hashimotos thyroiditis—lymphoma and papillary carcinoma.
5. Thyroglossal cyst—papillary carcinoma.

Familial cancer syndromes:
1. Cowden's syndrome—follicular carcinoma + intestinal hamartomas + Papillary carcinoma + breast tumors
2. Familial adenomatous polyps—papillary carcinoma + colon polyps and cancer, duodenal neoplasms
3. Werner's syndrome—papillary carcinoma, follicular carcinoma, anaplastic carcinoma associated with early aging.

- Werner syndrome—premature aging syndrome (also called as Progeria)
- Wermer syndrome—MEN 1 syndrome

MULTIPLE ENDOCRINE NEOPLASIA

MEN I (Wermer's syndrome)	*MEN II A (Sipple syndrome)*	*MEN II B*
1. Hyperparathyroidism (80%)	1. Hyperparathyroidism (20%)	1. Mucosal neuromas
2. Pancreatic islet cell tumors	2. Medullary thyroid carcinoma (90%)	2. Marfan like habitus
3. Pituitary adenomas	3. Pheochromocytoma (30%)	3. Medullary carcinoma thyroid
	4. Hirschsprung's disease	

Papillary Carcinoma

- 60 percent of all thyroid malignancies
- Mean age of presentation: 30 to 40 years
- More common in females
- More common in iodine—sufficient areas

Age at presentation
Papillary Ca - 30 to 40
Follicular Ca - 40 to 50
Medullary Ca - 50 to 60
Anaplastic Ca - 60 to 80

Predisposing Factors

1. Irradiation
2. Hashimoto's thyroiditis
3. Thyroglossal cyst

Clinical Features

1. Slow growing painless mass
2. Lymphnodal metastasis is more common
3. Lateral aberrant thyroid—denotes a cervical lymphnode from an occult papillary carcinoma.
4. Hard in consistency (may be cystic, firm or variable)

Pathology

- Papillary projections
- Psammoma bodies
- Pale empty (orphan annie) nuclei
  i. Multifocality is common in papillary carcinoma
  ii. TSH levels are high; tumors are TSH dependent, hence follow up with TSH.

Wolman's classification
1. Occult : <1.5 cm
2. Intrathyroidal
3. Extrathyroidal

Prognostic Indicators

Excellent prognosis : 95 percent 10-year survival rate.
1. AGES Scoring : Age, histologic grade, extra thyroidal invasion, size of tumor
2. MACIS Scale : Metastasis, age, completeness of original resection, Invasion of extrathyroidal tissues, size of lesion

Treatment

- Near total or total thyroidectomy with Modified Radical Neck dissection (Functional) for nodes.
- Suppressive dose of L-thyroxine 0.3 mg once daily life-long.
- Berry picking means removal of involved nodes only. It is not followed now-a-days.

Follicular Carcinoma

- 20 percent of thyroid malignancies
- More common in iodine deficient areas.

Clinical Features

1. Predisposed by long-standing multinodular goiter.
2. Hematogenous metastasis is more common than lymphnodal metastasis. Pulsatile secondaries may be seen in skull, ribs, pelvis. (Figs 2.15 and 2.16)
3. Malignancy is defined by the presence of capsular and vascular invasion. Hence FNAC cannot differentiate between follicular adenoma and carcinoma
4. Follicular tumors >4 cm size are more likely to be malignant.
5. Follow-up: Can be done using I^{123} scan or by thyroglobulin estimation. Thyroglobulin levels in patients who have undergone total thyroidectomy should be below 2 ng/ml.

95 percent of patients with persistent or recurrent thyroid cancer of follicular origin will have thyroglobulin levels higher than 2 ng/ml

Treatment

- Total thyroidectomy.
- Prophylactic nodal dissection is not needed because nodal involvement is infrequent.
  (But if nodal involvement is seen, functional block dissection must be done)

Other Modalities of Treatment

1. **I^{131} therapy:**
   i. Metastatic follicular cancer can be detected by I^{131} and treated by therapeutic dose.
   ii. It is also used for recurrent thyroid follicular neoplasms.
2. **External beam radiotherapy:**
   i. Control unresectable, recurrent, invasive disease.
   ii. Secondaries in the bone to prevent fracture and relieve pain.
3. **Chemotherapy:** Adriamycin and taxol are used.

If FNAC shows follicular adenoma; lobectomy is enough because 80 percent of cases are benign. If the biopsy report becomes positive for malignancy based on angio or capular invasion: Completion total thyroidectomy must be done

Figs 2.15A and B: Note the pulsatile swelling in the scalp of this lady—previously operated for thyroid cancer now has come with metastasis in skull osteolytic secondaries from follicular cancer to skull

Fig. 2.16: Osteolytic secondaries from follicular cancer to skull

Hurthle Cell Cancer

- Variant subtype of follicular carcinoma.
- Malignancy is indicated by vascular and capsular invasion like follicular type, hence FNAC cannot differentiate benign and malignant.

Differ from Follicular Carcinoma by

1. Derived from oxyphil cells of thyroid gland
2. More often multifocal and bilateral
3. Do not take up radioactive iodine
4. More likely to metastasize through lymph nodes
5. Higher mortality (20% at 10 years).

Treatment

- Total thyroidectomy with routine central neck node dissection as done in medullary carcinoma.
- Modified radical neck dissection done only if the lateral neck nodes are palpable.
- Though RAI ablation therapy is not effective, they are considered for residual normal thyroid or residual tumors as there is no good alternative.

Medullary Carcinoma

- 5 percent of all thyroid malignancies
- Arise from parafollicular 'c' cells
- Associated with MEN2A and MEN2B syndromes.
- RET—proto-oncogene mutation is seen in familial variety.

Clinical Features

- Cervical lymphadenopathy (15–20%)
- Distant **blood borne metastasis** to liver, bone, lung.

- Medullary carcinoma secretes **calcitonin**, carcinoma embryonic antigen (CEA), histaminases, prostaglandins E2 and F2α and serotonin.
- Diarrhea is seen in about 30 percent cases due to vasoactive intestinal peptides.
- Cushings syndrome is seen in about 2 to 4 percent cases due to ectopic adrenocorticotropic hormone (ACTH).

Pathology

Sporadic variety	:	80 percent unilateral
Familial variety	:	90 percent bilateral and multicentric
FNAC	:	shows amyloid stroma
Tumor marker	:	Serum calcitonin (> 0.08 ng/ml)

- Investigate for pheochromocytoma—24 hours urinary VMA, catecholamines, metanephrine (VMA-vanillylmandelic acid).
- Investigate for hyperparathyroidism—serum calcium.

Treatment

- Total thyroidectomy with bilateral central neck node dissection should be performed routinely.
- Tumors larger than 1.5 cm must undergo ipsilateral modified radical neck node dissection.
- External beam radiotherapy is controversial, but is recommended for unresectable residual or recurrent tumor.
- No effective chemotherapy available.
- **Prophylactic Total Thyroidectomy:** It is indicated in RET mutation carriers. This procedure is to be done in patients before age of 6 years in MEN 2A and prior to age one in MEN 2B patients.

VIVA QUESTION

A patient has come to you with medullary cancer, on further evaluation you found he is also having pheochromocytoma. Which one will you operate first?

If the patient has associated pheochromocytoma, operate it first to avoid hypertensive crisis during surgery for thyroid.

Anaplastic Cancer (Figs 2.17 and 2.18)

- Occurs in elderly people.
- Long-standing neck mass with rapid enlargement and pain; associated with dyspnea, dysphagia, dysphonia.
- Lymph nodes are palpable.
- Tumor is large and fixed.
- FNAC is not sufficient in certain cases, where trucut biopsy or incisional biopsy is needed to confirm.
- Few patients survive beyond 6 months of diagnosis. Hence, the treatment is palliative like isthumectomy or tracheostomy.
- External radiotherapy and chemotherapy are given palliatively.

Lymphoma of Thyroid Gland

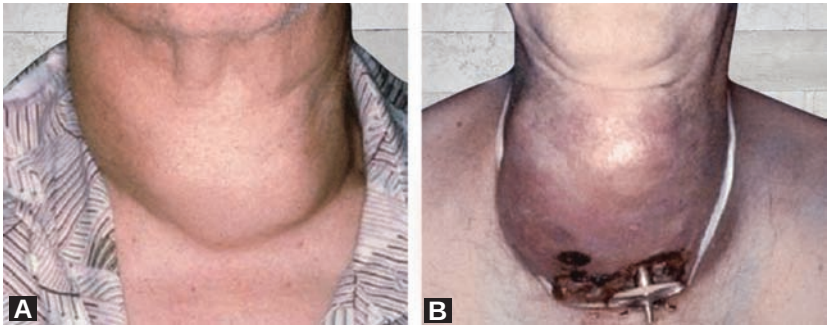
- NonHodgkin's variety is common. (B-cell type is common)
- Rapidly enlarging painless neck mass, may present with acute respiratory distress.

Treatment

- Surgery is not indicated except for relieving respiratory obstruction.
- Chemotherapy: CHOP regimen (Cyclophosphamide, Doxorubicin, Vincristine and Prednisolone).
- Highly sensitive to radiotherapy.

Neck dissection for nodal metastasis

1. Central Neck Dissection:
   - For medullary and Hurthle carcinomas
   - Nodes medial to carotid sheath are removed
2. Modified Radical (Functional) Neck Dissection:
   - For papillary carcinoma thyroid
   - Cervical incision extended laterally to anterior margin of trapezius (MacFee extension)
   - Remove level II, III, IV and posterior triangle (V) nodes
   - Preserve internal jugular vein, spinal accessory nerve, sternocleidomastoid muscle (these are removed in radical neck dissection)

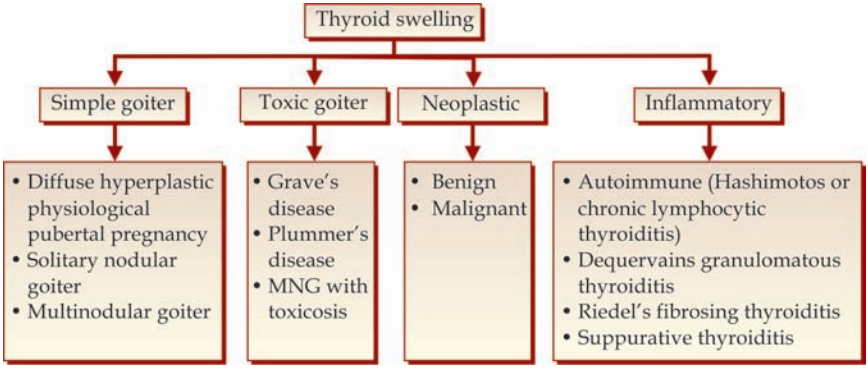


Figs 2.17A and B: Anaplastic cancer grown rapidly—tracheostomy being done

Fig. 2.18: Anaplastic cancer thyroid

Discussion of Thyroid Case (Flow chart 2.3)

Flow chart 2.3: Swellings in thyroid gland



Goiter

- Most nontoxic goiters are thought to result from TSH stimulation secondary to inadequate hormone synthesis and other paracrine growth factors. The thyroid gland enlarges in order to maintain the patient in an euthyroid state.
- Elevated TSH level induce diffuse thyroid hyperplasia, followed by focal hyperplasia resulting in nodules that may or may not concentrate iodine, colloid nodules or microfollicular nodules.
  - Diffuse
  - Solitary nodular
  - Multinodular.

Clinical Features

- Most are asymptomatic
- Pressure symptoms (dyspnea, dysphagia)
- Soft diffusely enlarged (simple goiter)
- Nodules of various size and consistency (Multinodular goiter)
- Tracheal deviation (solitary nodule goiter)

Investigations

Usually euthyroid: Normal TSH and low normal (or) normal free T4 levels.

Treatment

- Endemic goiters—iodine administration.
- Exogenous thyroid hormones to reduce TSH stimulation of gland growth; may result in decrease of goiter size.
- Surgical resection for goiter—indications:
  1. Continue to increase despite T4 suppression.
  2. Cause obstructive symptoms
  3. Have substernal extension
  4. Suspected or proved malignancy
  5. Cosmetically acceptable.

Hyperthyroidism

Grave's Disease (Primary Thyrotoxicosis) (Fig. 2.19)

- Autoimmune disease
- Associated with HLA - B8, HLA-DR3 and HLA DQA1.
- Thyroid stimulating antibodies stimulate the thyrocytes to grow and synthesize excess thyroid hormone, which is a hallmark of Grave's disease.

Clinical Features

- Heat intolerance
- Increased sweating and thirst
- Weight loss in spite of good appetite
- Palpitations, tremors
- Amenorrhea
- Diarrhea
- Cardiovascular complication—atrial fibrillation and congestive heart failure.
- **Ophthalmopathy** : Eye signs, exophthalmos, limitation of upward and lateral gaze (from involvement of inferior and medial recti muscles).
- **Dermopathy** : Glycosaminoglycans deposition in the pretibial region (Pretibial myxedema—name is a misnomer as it is seen in thyrotoxicosis and not in myxedema) (Fig. 2.20)
- **Thyroid acropachy** : Bony involvement leads to subperiosteal bone formation and swelling in metacarpals.

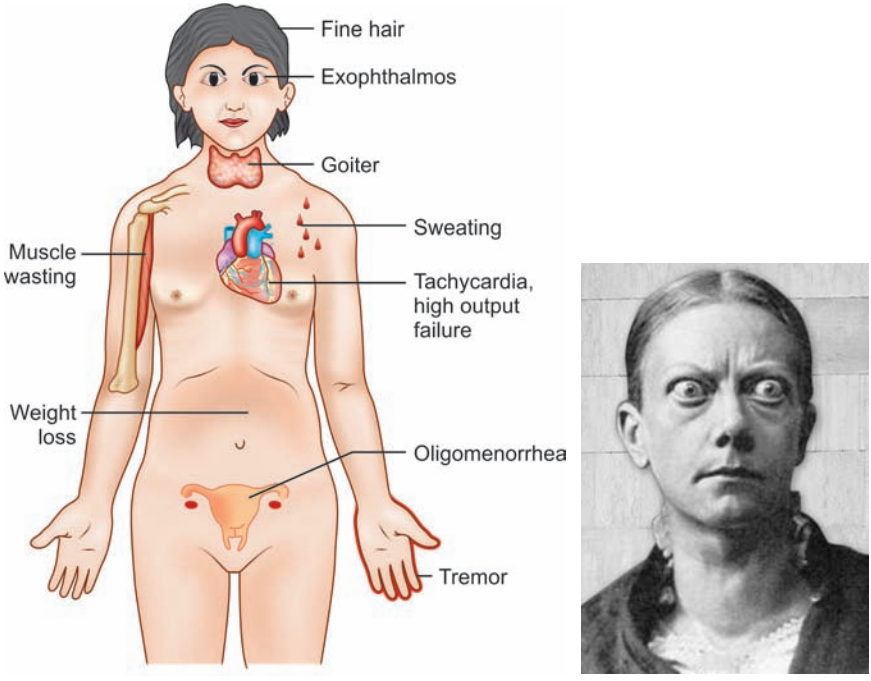


Fig. 2.19: Thyrotoxicosis—manifestations of Grave's disease

Figs 2.20A and B: Thyroid dermatopathy—pretibial myxedema (Name is a misnomer)

Investigations

1. Suppressed TSH and elevated T3 or T4 level.
2. Antithyroglobulin and antithyroid peroxide antibodies are elevated.
3. Elevated thyroid stimulating antibodies are diagnostic of Grave's disease.

Treatment

Prepare the patient to euthyroid state and for

< 45 years	:	Surgery (subtotal thyroidectomy)
> 45 years	:	Radioiodine.

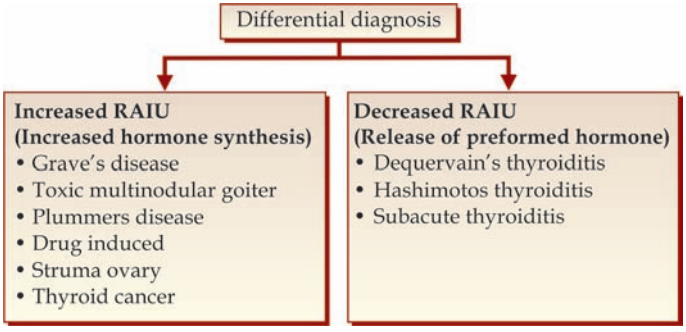
Toxic Multinodular Goiter (Secondary Thyrotoxicosis)

- Occurs in age >50 years age.
- Toxic features arise in a case of long-standing multinodular goiter.
- Symptoms and signs are similar to Grave's disease but extra thyroidal manifestations are rare.

Investigation

1. Suppressed TSH and elevated T3 and T4 level.
2. RAI uptake is also increased showing multiple nodules with increased uptake and suppression of remaining gland (Flow chart 2.4).

Flow chart 2.4: Radioactive iodine uptake study



Treatment

Prepare the patient for euthyroid state and do subtotal thyroidectomy.

TOXIC ADENOMA

A solitary nodule presenting as secondary thyrotoxicosis is also named as **Plummer's disease**.

- Hyperthyroidism from a single hyperfunctioning nodule.
- Young patients.
- RAI uptake shows hot nodule.
- Hemithyroidectomy is indicated for larger nodules and young patients.

THYROIDITIS

Inflammation of thyroid gland.

Types

Autoimmune
- Chronic lymphocytic thyroiditis
- Hashimotos (Most common TYPE)

Granulomatous
- De Quervains thyroiditis (Viral etiology)

Fibrosing
- Riedel's thyroiditis

Infective
- Acute (bacterial, viral, subacute)
- Chronic (tuberculous, syphilitic)

Hashimotos Thyroiditis

- Transformation of thyroid tissue to lymphoid tissue
- Most common Thyroiditis
- Autoimmune process

CD4+ Helper Cells Directed Against Thyroglobulin, Thyroid Peroxidase [Most Common], TSH-R

Microscopy: Lymphocytes present, Hurthle cells\Askanazy cell

Risk of lymphoma, papillary carcinoma

Clinical features
- M:F(1:10)
- Painless anterior neck mass
- Hypothyroidism-20 percent
- Hyperthyroidism-5 percent

Lab investigations
- Increased TSH
- Decreased T4, T3

- Thyroid autoantibodies-confirmatory
- FNAC

Treatment

Hypothyroidism-thyroxine

Surgery
- Suspicion of malignancy
- Pressure symptoms
- Cosmetics

RIEDEL'S THYROIDITIS

- Invasive fibrous thyroiditis
- Associated with autoimmune disease

Features

- Females, 30 to 60 years
- Painless hard anterior neck mass
- Pressure symptom
  Diagnosis:
    Open thyroid biopsy
    FNAC inadequate
    * **Woody nontender thyroid mimics carcinoma**
- Treatment
  - Surgery-wedge resection of isthmus
  - Corticosteroids
  - Tamoxifen and corticosteroids [dramatic response]

DE QUERVAIN'S SUBACUTE THYROIDITIS

- **Post-viral inflammatory response**
- Genetic predisposition-**HLA-B35**
- Females common, 30 to 40 years
- Neck pain, enlarged tender firm gland
- Stages: **Hyperthyroid predominantly** leading to euthyroid-hypothyroid-euthyroid
  - **Increased ESR markedly, decreased RAIU distinguishes it from Graves disease during hyperthyroid state**
- Treatment: Symptomatic-Self-limiting, NSAID,
  - Glucocorticoids
  - Thyroidectomy—unresponsive cases.

Infective Thyroiditis

- Streptococci, anaerobes-70 percent
- Common in children
- Preceded by URI/otitis media

- Severe neck pain, fever chills, odynophagia, dysphagia
- Recurrent-persistant pyriform sinus fistula.

Treatment

- IV antibiotics
- Drainage of abscess

BOOSTER POINTS

- **Tubercle of Zuckerkandl:**
  - It is a posterior extension of the lateral lobes of thyroid gland near ligament of berry
  - Also called "an arrow pointing to the RLN"
- **Common sites of injury to RLN:**
  - Near inferior thyroid artery
  - Near ligament of berry
  - At inferior pole of the gland

Oral cavity examination	*Hand examination*
1. Lingual thyroid 2. Tongue fasciculation 3. Macroglossia 4. Thyroglossal cyst 5. Ganglioneuromas (Medullary cancer)	1. Fine tremors 2. Sweating 3. Acrobachy 4. Coarse hands 5. Carpal tunnel syndrome 6. Pulse rate, rhythm, character

3 CASE

Cancer Breast

- History
- Other History
- Examination of Breast
- Inspection
- Examination of Nipple
- Treatment Modalities
- Hypothesis
- Bloom and Richardson's Grading
- TNM Staging of Breast
- Breast Conservation Surgery
- Autogenous Transplant
- CMF Regimen
- Hormone Therapy
- Tamoxifen
- Selective Estrogen Receptor Modulators (SERM)
- Radiotherapy
- For *In situ* Cancers
- Early Invasive Cancer (Stage I, IIa or IIb)
- Advanced Locoregional Cancer
- Distant Metastasis

HISTORY

- Name
- Age
- Occupation
- Residence
- Socioeconomic status: Ca-Breast common in higher socioeconomic groups

Complaining of

1. Lump
2. Pain
3. Discharge from nipple
4. Retraction of nipple

History of Presenting Illness

1. **Lump:**
   - Duration
   - Onset
   - Rate of growth
2. **Pain:**
   - Elaborate about character and other features of pain
   - Relation to menstruation
3. **Discharge from nipple:**
   - Duration
   - Quality-nature, color, odor
   - Quantity

Painful Conditions of Breast

- Acute mastitis
- Breast abscess
- Fibroadenosis
- Musculoskeletal pain

4. **Retraction of nipple:**

Discharge from Nipple

Blood	–	Duct papilloma carcinoma breast
Pus	–	Breast abscess
Milk	–	Lactation galactocele mammary fistula
Serous/ Greenish	–	Fibroadenosis duct ectasia

Retraction of Nipple (Fig. 3.1)

Circumferential	–	Carcinoma breast
Slit Like	–	Mammary duct Ectasia with periductal mastitis

Fig. 3.1: Nipple retraction

OTHER HISTORY

- History of trauma (to rule out - hematoma, traumatic fat necrosis)
- History of swelling elsewhere
- History of fever (mastitis)
- History of loss of weight/appetite
- History of related to metastasis
  - History of bone pain
  - History of jaundice
  - History of breathlessness
  - History of cough with hemoptysis

Past History

History of major medical illness

(Diabetes, Hypertension, Epilepsy, Tuberculosis, Asthma)

History of surgery

- Hysterectomy
- Dilatation and curettage

History of similar episodes

- Recurrent abscess common in congenital retraction

- Fibroadenosis gives symptoms after a gap
- Tuberculosis of breast may recur

History of drugs/oral contraceptive pills

Loss of weight in breast disease
- Carcinoma breast
- Tuberculosis breast
- TB chest wall causing retromammary abscess

Personal History

- History of smoking
- History of alcoholism
- About the diet (high fat diet)

Menstrual and Marital History

- Age at menarche
- Age at first childbirth
- Marital status
- Breastfeeding
- Age at menopause

Factors Predisposing to Carcinoma
1. Early menarche
2. Late menopause
3. Late childbirth
4. Absent breastfeeding
5. Hormone replacement therapy

Unopposed estrogen without progesterone leads to carcinoma breast.

Remember: Oral contraceptive pills are not a risk factor now. Its only progesterone only (mini pills) pills that have the risk of cancer breast.

Family History

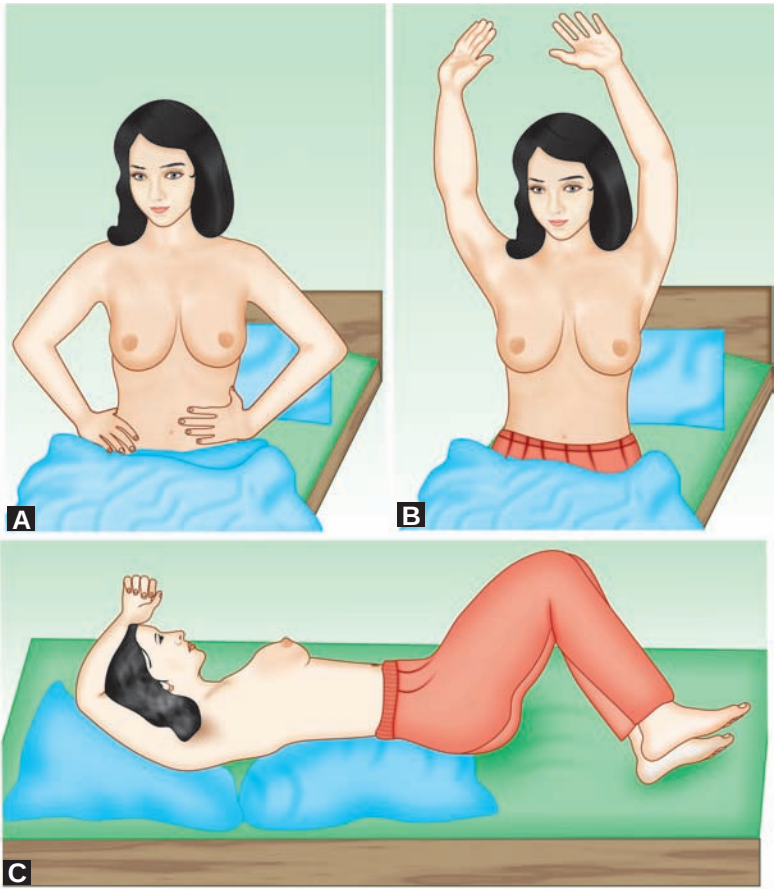
Family history of
- Breast carcinoma
- Ovarian tumors
- Uterine tumors

General Examination

- Built
- Pulse rate
- Nourishment
- Blood pressure
- Pallor
- Temperature
- Icterus
- Respiratory rate
- Cyanosis
- Clubbing
- Pedal edema
- Generalized lymph nodes

EXAMINATION OF BREAST (FIGS 3.2A TO C)

1. Arms by the side of body, patient sitting
2. Arms raised above head
3. Hands over hips alternatively contracting and releasing



Figs 3.2A to C: Various positions of examination of breast

4. Patient leaning forward
5. Lying posture

INSPECTION

I. **Inspection of the patient in sitting posture, arms by the side of her body (Fig. 3.3)**
   1. *Breast*
      - Position compared to opposite breast
      - Size and shape
      - Any mass
      - Ulcer
   2. *Skin over breast*
      - Dilated veins
      - Dimple/puckering/retraction
      - Peau d'orange
      - Nodules
      - Ulceration/fungation

Prominent Veins over Breast
- Rapidly growing sarcoma
- Cystosarcoma phyllodes
- Huge breast abscess

Mondor's Disease
Thrombophlebitis of the superficial veins of the breast and anterior chestwall

3. *Nipple*
   - Presence
   - Position
   - Number
   - Size and shape
   - Discharge
4. *Areola*
   - Color
   - Size
   - Surface
5. *Arms and thorax*
   - Edema
   - Nodules

Cancer en cuirasse

Multiple cancreous nodules and thickened skin like a coat of Armor in arms and thorax.

6. *Axilla*
   - Nodes may be seen
7. *Supraclavicular fossa*
   - Fullness in that region.

II. **Inspection of the patient with arms raised above head**

Look for (Figs 3.4 and 3.5)

1. Peau d'orange
2. Fixity
3. Retraction of nipple

III. **Inspection on leaning forward**

L/F:

- Fixity to chestwall (Breast falls equally on both sides if not fixed)

IV. **Inspection on contracting and relaxing pectoralis major**

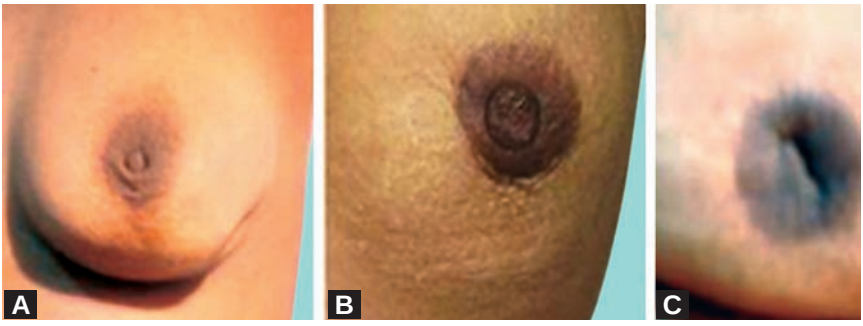
Swelling becomes prominent or not

Palpation

Palpate systemically from areola, concentrically outwards

Fig. 3.3: Sitting posture—examination

Fig. 3.4: Peau d'orange appearance



Tethering of breast | Peau d'orange | Retraction

Figs 3.5A to C: Features that must be seen on inspection

Palpate the normal breast first but while presenting tell the affected side first

1. **Local temperature and tenderness**
2. **Swelling**
   - Number
   - Site
   - Size
   - Shape
   - Margin
   - Consistency
   - Fluctuation (Cystic swellings only)
   - Tenderness

	Carcinoma	*Fibroadenoma*	*Fibroadenosis*
1. Palpation	Easily felt with flat of fingers	Felt with difficulty	Just a sense of lumpiness no definite swelling
2. Margins	Well-defined	Slippery edges	Ill defined
3. Consistency	Hard (Sarcoma-variable)	Firm encapsu-lated	Firm, softy or diffuse Indian rubbery feel
4. Surface	Uneven	Globular	Multiple

3. **Features specific for diagnosis and staging**
   a. Fixity to skin
   b. Intrinsic mobility
   c. Fixity to muscles
   d. Fixity to chestwall
   a. *Fixity to skin*
      - Move the tumor side to side and note the change in the skin
      - Pinch the skin over the tumor

Tethering (Dimpling)

- Infiltration of Astley Cooper's ligament, pulls the skin inwards creating a dimple or puckering over the breast
- Tumor moves independent of skin
- Not considered as skin involvement in staging

Fixity
- Infiltration of skin itself by the tumor
- Tumor cannot be moved, i.e. skin cannot be pinched
- TNM staging: T_4b

Peau D'Orange
Lymphatics of skin being obstructed.
Considered as skin involvement.

b. *Intrinsic Mobility*
   - Moves along with breast tissue (carcinoma)
   - Fibroadenoma moves independent of breast tissue, hence named as breast mouse.

c. *Fixity to muscles*
   - **Pectoralis major:** Place her hand on her hip lightly. The lump is moved in the direction of fibers first and then at right angles as far as possible. Ask her to press her hip as hard as possible, feel the anterior axillary fold made taut. Look for mobility now.
     Inference: There will be total restriction of mobility along the line of muscle fibers if is it fixed to it but slight movement along the right angle of the fibers may be possible.
   - **Serratus anterior:** For swelling in the outer lower quadrant only. Ask the patient to push against the wall and look for restricted mobility.

d. *Fixity to chestwall*
   The swelling is fixed irrespective of contraction of any muscle.

EXAMINATION OF NIPPLE

Look for any tumor deep to the nipple; press and see the tumor for any discharge.

If the nipple is retracted, press gently from sides deep to the nipple; this will evert if the retraction is congenital or spontaneous, if it is due to carcinoma it cannot be everted.

Examination of Axillary Lymph Nodes

1. **Pectoral group of nodes: (Fig. 3.6)**
   - This group is located behind the anterior axillary fold.
   - The patient's arm is elevated and using right hand for left side the fingers are insinuated behind pectoralis major.

Level of Axillary Nodes: (Fig. 3.7)
Level 1-Lateral to lateral border of pectoralis minor
- Anterior (Pectoral)
- Posterior (Subscapular)
- Lateral (Brachial)

Level 2-Behind pectoralis minor
- Central
- Rotters

Level 3-Medial to medial border of pectoralis minor
- Apical (Infraclavicular)

Fig. 3.6: Examination of anterior pectoral nodes

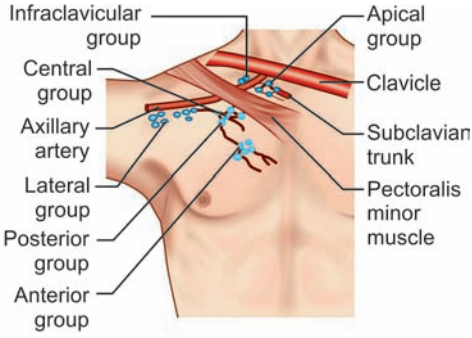


Fig. 3.7: Level of nodes

The arm is now lowered and made rest on the clinician's forearm. This will relax the pectoralis minor. With the pulp of fingers, try to palpate the lymph nodes. The thumb of the same hand is used to push the pectoralis major backwards from in front.

2. **Brachial group:** Felt directly over the upper end of humerus. Use left hand for left side nodes and right hand for right side.
3. **Subscapular group:** Lies in the posterior axillary fold and is best examined from behind. Lift the patient's hand with one hand and palpate the posterior axillary fold with other hand.
4. **Central group:** Examine the left side with right hand. At first the patient's arm is slightly abducted and pass the extended fingers right up to the apex of the axilla directing the palm towards the lateral thoracic wall. The patient's arm is brought to the side of her body and the forearm rests comfortably on clinicians forearm. The other hand of the clinician is now placed on opposite shoulder to steady the patient. Palpation is now carried out.
5. **Apical group (Infraclavicular):** Examination steps are similar as for central group; but push the fingers further upwards and can sometimes be palpated by the other hand kept just below the clavicle.
6. **Supraclavicular group:** Stand behind the patient and dip the fingers down behind the middle of clavicle. Neck may be flexed on that side for easy palpation.

Percussion

- Over sternum for internal mammary nodes.
  - Examination of other breast, opposite axilla, supraclavicular fossa.
  - Examination of other systems
    - Cardiovascular system
    - RS: Pleural effusion
    - Abdomen: Liver metastasis
    - Skull
    - Pelvis and vertebrae
    - PR/PV examination

Diagnosis

- Carcinoma breast
- Right/Left
- Staging TNM

Differential Diagnosis of Carcinoma Breast

- Traumatic fat necrosis
- Chronic breast abscess
- Soft tissue sarcoma
- Antibioma
- Giant fibroadenoma
- Duct ectasia
- Cystosarcoma phyllodes

Investigations

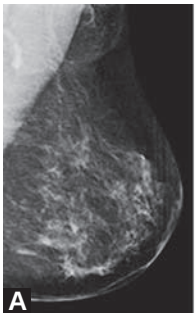
I. **Routine Investigations**
Urine: Albumin, Sugar, Deposits
Blood: Urea, Sugar, Serum creatinine, Hemoglobin, TC, DC, ESR Blood grouping/typing
X-ray chest
ECG all leads

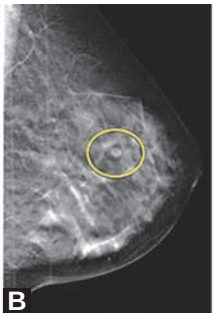
II. **Specific Investigations**
FNAC: Using 23G/24G
Trucut biopsy
Incision biopsy: In cases of big tumor
Excision biopsy: In cases of small tumor
Wedge biopsy: Ulcerated carcinoma
Mammogram/USG breast
*Plan the incision of the skin in these cases such that the scar can be included in future surgery.

III. **Staging Investigations**
1. X-ray chest—pleural effusion
2. Skeletal bone survey—X-ray skull
   X-ray pelvis
   X-ray chest (Look for osteolytic lesions in ribs, pelvis, spine)
3. USG Abdomen—liver secondaries, Krukenberg's tumor, malignant ascites
4. Liver function test
5. CT chest—mediastinal nodes
6. Mammogram of opposite breast
7. FNAC of opposite axillary nodes
8. CA 15-3/CEA are elevated in metastasis

Mammography (Figs 3.8 and 3.9)

- Low voltage, high amperage X-rays
- 300 mA and 40 KV exposed





Figs 3.8A and B: Craniocaudal view taken

Fig. 3.9: Mammography-microcalcification

- Delivers a radiation dose of 0.1 centi Gray (cGy) per study by comparison Chest X-ray delivers only 25 percent of this dose.
- Sensitivity increases with age as breast becomes less dense. (used in age >40 years)
- Two views:
  Craniocaudal
  Mediolateral oblique

Indications

1. Age greater than 50 years
2. Age greater than 40 with risk factors
3. Already operated for one side
4. In the same breast: If we plan for conservative surgery rule out multifocal involvement.
5. For the opposite breast we can screen routinely.
6. Mammography guided biopsy.

Features Suggestive of Cancer

1. Mass effect
2. Architectural distortion
3. Symmetry lost
4. Spiculation
5. Branching calcification
6. Clustering
7. Microcalcification

Gradings in Mammography

Grade I	:	Negative
Grade II	:	Benign lesion
Grade III	:	Probably benign lesion
Grade IV	:	Suspicious of malignancy
Grade V	:	Breast carcinoma

Magnetic Resonance Imaging (Fig. 3.10)

Indicated in

1. Distinguishing scar from recurrence in women who had previous breast conservative surgery.
2. Gold standard for imaging the breasts of women with implants.
3. Evaluating the axilla in both primary breast cancer and recurrence.

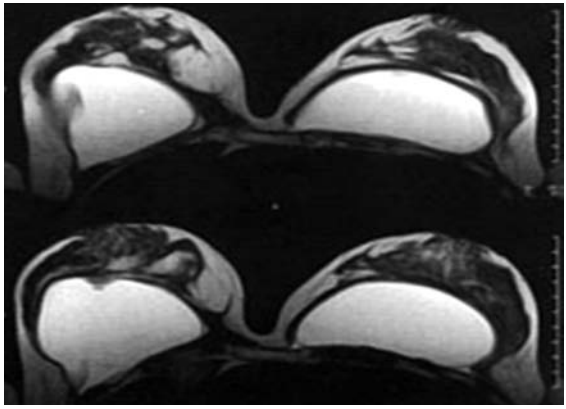


Fig. 3.10: Implant patient—MRI showing cancer breast

Triple Assessment of Breast

1. Clinical examination
2. Radiological imaging
   - USG (young female)
   - Mammography (old age)
3. Pathological examination
   - FNAC
   - Core biopsy

TREATMENT MODALITIES

- You should say in the exam I will give a multimodality mode of management which includes all the following:
  - Surgery
  - Chemotherapy
  - Hormone therapy
  - Radiotherapy

Various Surgeries to be Discussed

- Modified radical mastectomy
- Radical mastectomy
- Quart therapy
- Simple mastectomy
- Toilet mastectomy
- Breast conservative surgery

Discussion of Cancer Breast

- Incidence of carcinoma breast: 8 percent

Incidence of Carcinoma in each Quadrant

- Upper outer : 60 percent
- Upper inner : 12 percent

- Lower outer : 10 percent
- Lower inner : 6 percent
- Central : 12 percent

Types of Carcinoma Breast

Carcinoma in situ

1. Ductal carcinoma (DCIS)
   a. Comedo
   b. Intermediate
   c. Noncomedo
      – Solid
      – Cribriform
      – Papillary
2. Lobular carcinoma (LCIS)

Invasive Carcinoma

1. Paget's disease of nipple
2. Invasive ductal carcinoma
   a. Adenocarcinoma with productive fibrosis (80%), (Scirrhous, Simplex, NST)
   b. Medullary carcinoma (4%)
   c. Mucinous (colloid) carcinoma (2%)
   d. Papillary carcinoma (2%)
3. Invasive lobular carcinoma (10%)
4. Rare cancers
   – Adenoid cystic
   – Squamous cells

***NST/NOS-not otherwise specified is the most common type of Ca breast**

	LCIS	*DCIS*
Age (years)	44–47	54–58
Incidence	2–5 percent	5–10 percent
Clinical signs	None	Mass, Pain, Discharge
Mammographic signs	None	Calcifications
Multicentricity	60–90 percent	40–80 percent
Bilaterality	50–70 percent	10–20 percent
Subsequent carcinoma		
Invasive type	23–35 percent	25–70 percent
Histology of invasive	Ductal	Ductal
	(Thus the subsequent invasive carcinoma that develops is 65 percent ductal origin and not lobular type)	

Invasive Cancers

1. **Paget's disease**
   - Present as chronic eczematous eruption of the nipple, which may be subtle, but may progress to an ulcerated, weeping lesion.

- Paget's disease is usually associated with extensive DCIS or may be associated with an invasive cancer.
- Palpable mass may or may not be seen.
- Pathognomonic of this cancer is the presence of large, pale, vacuolated cells (Paget's cells) in the rete pegs of the epithelium.
- Surgical therapy may involve lumpectomy, mastectomy or modified radical mastectomy depending on the extent of involvement and presence of invasive cancer.

2. **No Specific Type (NST), scirrhous, simplex**
   - Accounts for 80 percent breast cancer
   - Presents in fifth to sixth decades of life as a solitary, firm mass.
   - Poorly defined margins
3. **Medullary carcinoma**
   - Accounts for 4 percent of breast cancers
   - Associated with BRCA - 1 hereditary cancers
   - Grossly it is soft and hemorrhagic
   - Rapid increase in size may occur
   - Younger age group
   - HER 2, ER and PR negative (triple negative cancers)
4. **Mucinous (Colloid) carcinoma**
   - Accounts for 2 percent of breast cancers
   - Elderly population as bulky tumor
   - Most of them express estrogen receptors
5. **Papillary carcinoma**
   - Occurs in 7th decade of life
   - Rarely grow more than 3 cm size
6. **Tubular carcinoma**
   - Long-term survival is 100 percent

Invasive Lobular Carcinoma

- 10 percent incidence
- Small cells with rounded nuclei, inconspicuous nucleoli and scant cytoplasm, special stains may confirm the presence of intracytoplasmic mucin, which may displace the nucleus (Signet-ring cell carcinoma)
- Multifocal
- Bilateral
- Multicentric
- No mammographic finding
- No metastasis

Etiological Factors of Carcinoma Breast

1. Age: 40–60 years
2. Breast cancer syndromes
   i. Li - Fraumeni syndrome
      – P53 gene mutation
      – Autosomal dominant mutation
      – Osteosarcoma, leukemia, soft tissue sarcoma

ii. Cowden's disease
   - Multiple hamartoma syndrome
   - Facial trichilemmoma, papilloma, bilateral breast cancer

iii. Ataxia telangiectasia
   - Hemangioma, breast cancer

3. Chromosomal abnormalities
   i. BRCA-1 gene mutation—chromosome 17q
      - Poorly differentiated
      - Invasive ductal type
      - Hormone receptor negative
      - Associated with ovarian, prostate and colon cancers

   ii. BRCA-2 gene mutation—chromosome 13q
      - Well-differentiated
      - Invasive ductal carcinomas
      - Express hormone receptors
      - Associated with ovarian, colon, prostate, pancreas, gallbladder, bile-duct, stomach cancers and melanoma

   iii. HER-2 Mutation (erbB2, transmembrane growth factor)
      - Invasive breast cancer; up to 80 percent ductal carcinoma
      - Poor prognosis

   iv. P53 Mutation
      - Associated with poor prognosis
      - Resistance to chemotherapy

4. Diet
   Alcohol
   Saturated fats
5. Endocrine causes

Basic pathology behind carcinoma breast is explained by Koreman's Hypothesis.

- Anovulatory cycles are more common when there is unopposed estrogen with no progesterone that are usually present in early menarche and late menopause.
- Hyperprolactinemia is inhibited in early childbirth.

Exogenous Hormones Increase the Risk

Therefore, increased incidence of carcinoma breast is seen in:

1. Early menarche
2. Late menopause
3. Late childbirth
4. Hormone replacement therapy
5. Absent breastfeeding
   - Newer OCP are not found to increase the risk of cancer breast as they contain both estrogen and progesterone in it. But remember progesterone only pills (mini pills) are associated with cancer breast.
6. Family History of
   Familial breast cancer (20–30%)
   Sporadic breast cancer (65–75%)
   Hereditary breast cancer (5–10%)

- Etiological factor for carcinoma endometrium of uterus is same as breast because both are due to increased estrogen.
- Etiology is completely opposite to carcinoma breast and in carcinoma cervix.

BLOOM AND RICHARDSON'S GRADING

Grading of Ca breast is based on:
1. Number of mitosis (1–3)
2. Nuclear pleomorphism (1–3)
3. Tubule formation (1–3)

Nottingham's Prognostic Indices

- INDEX = (0.2 x size in cms) + Stage of axillary nodes + Grade of tumor.

Stage of nodes

1 = no nodes
2 = 1–3 nodes positive
3 = 4 or more nodes positive

Grades (1, 2, 3)

Prognostic groups

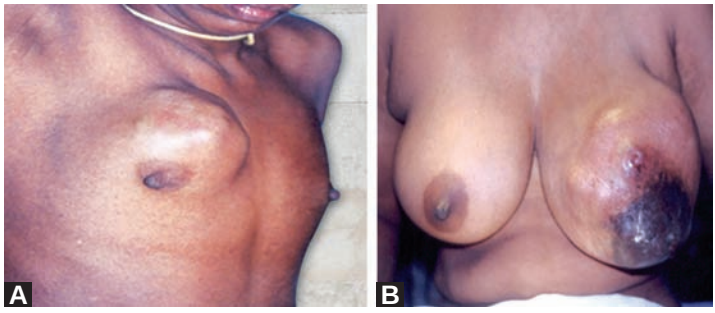
Excellent	:	NPI	≤	2.4
Good	:	NPI	≤	3.4
Moderate I	:	NPI	≤	4.4
Moderate II	:	NPI	≤	5.4
Poor	:	NPI	>	5.4

Grade and points	*Examples*
Low grade : 3–5	Tubular, mucinous
Intermediate grade: 6–7	Medullary, lobular
High grade : 8–9	NOS types

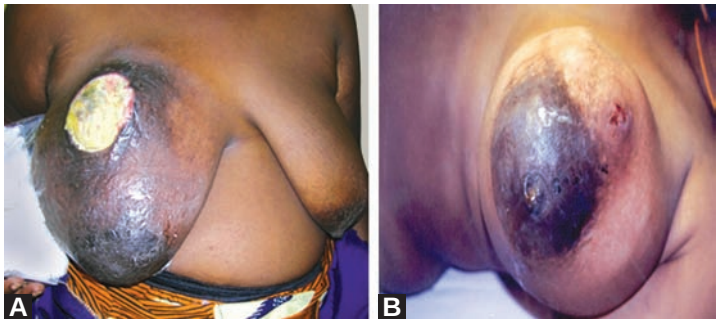
TNM STAGING OF BREAST

To – No evidence of primary
Tis – Carcinoma *in situ* (DCIS or LCIS)
Paget's disease of nipple with no palpable mass
T1 – Tumor < 2 cm in greatest diameter
T2 – Tumor > 2 cm but < 5 cm in greatest dimension
T3 – Tumor > 5 cm in greatest dimension
T4 – Tumor of any size with extension to chestwall or skin
T4a – Extension to chest wall, not includes pectoralis major (Figs 3.11A and B)
T4b – Edema (Peau d'orange), ulceration of skin of breast, satellite skin nodules. (Figs 3.12A and B)
T4c – Both T4a and T4b
T4d – Inflammatory carcinoma

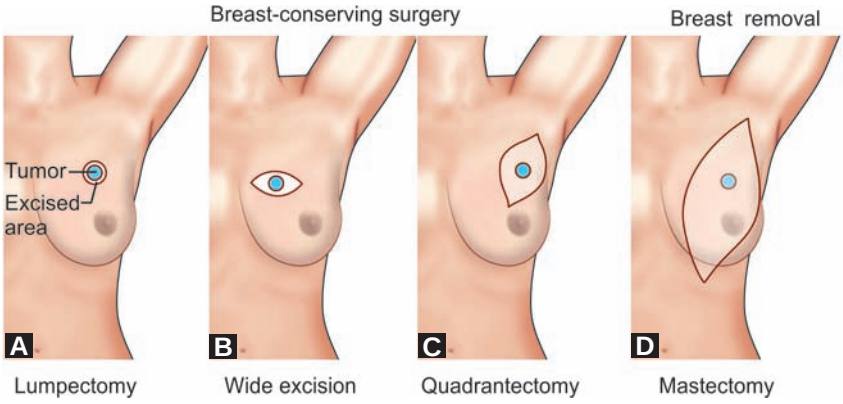
- N1-Metastasis to movable ipsilateral axillary nodes
- N2a-Mets to ipsilateral axillary nodes fixed to one another or other structures.



Figs 3.11A and B: T4 lesions: involvement of chest wall (T4a)



Figs 3.12A and B: Skin ulcerations-T4b



Figs 3.13A to D: Surgeries in breast

- N2b-Mets only in clinically apparent ipsilateral internal mammary nodes in the absence of clinically evident axillary node mets.
- N3a-Mets in ipsilateral infraclavicular lymph nodes with or without axillary nodes
- N3b-Mets in ipsilateral internal mammary nodes and axillary nodes together
- N3c-Mets in ipsilateral supraclavicular nodes with or without axillary or internal mammary nodes

M0-No metastasis in distant like liver, lung
M1-Distant metastasis

• Stage I	–	$T_1N_0M_0$
• Stage IIa	–	$T_0N_1M_0$
		$T_1N_1M_0$
		$T_2N_0M_0$
IIb	–	$T_2N_0M_0$,
		$T_3N_0M_0$
• Stage IIIa	–	$T_0N_2M_0$,
		$T_1N_2M_0$,
		$T_2N_2M_0$
		$T_3N_1M_0$,
		$T_3N_2M_0$
IIIb	–	$T_4N_0M_0$
		$T_4N_1M_0$
		$T_4N_2M_0$
IIIc	–	any T, N_3M_0
• Stage IV	–	any T; any N; M_1

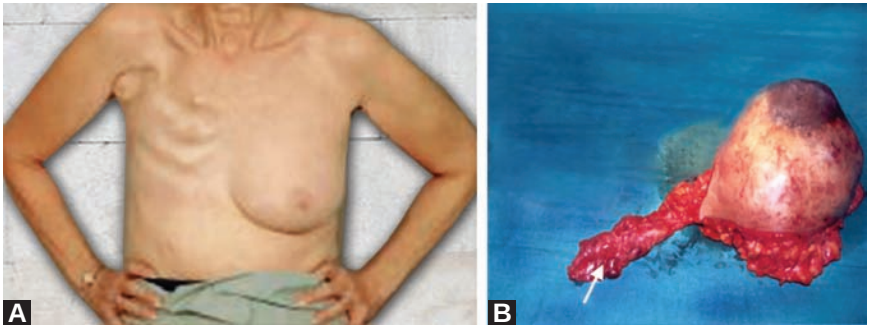
- Early invasive breast cancers: I, IIa, IIb
- Advanced loco regional breast cancers: IIIa or IIIb or IIIc
- Distant metastasis: IV
- There was one more staging Manchester staging for cancer breast which is not used nowadays.

Treatment modality

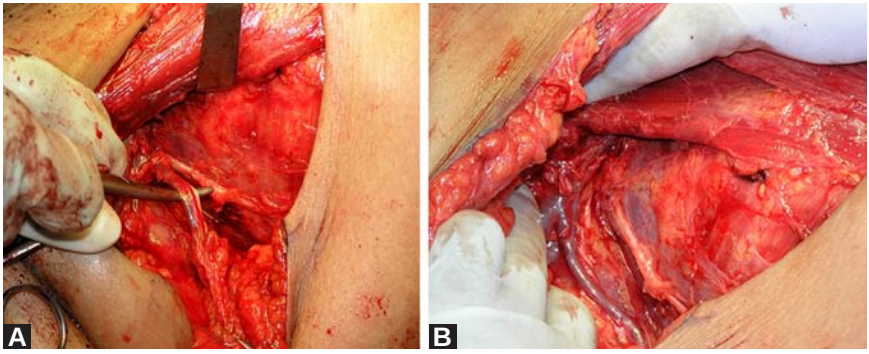
I. Surgery (Figs 3.13A to D)
   1. Simple mastectomy
   2. Modified radical mastectomy
   3. Radical mastectomy
   4. QUART therapy
   5. Breast conservation
   6. Breast reconstruction

1. **Simple mastectomy:**
   Removal of all breast tissue, nipple-areolar complex and skin.
   - Prophylactic simple mastectomy: done in BRCA I and BRCA II mutation.
   - Toilet mastectomy: simple mastectomy done in cases of ulcerated carcinoma breast.

   Extended simple mastectomy:
   Removal of all breast tissue, nipple—areolar complex, skin, level I axillary nodes.
2. **Modified radical mastectomy (Figs 3.14A and B):**
   Removal of all breast tissue, nipple—areolar complex, skin, level I and level II axillary nodes.
   - **Patey's modification**: Divide and remove the pectoralis minor. Level I, II, III nodes can be removed.
   - **Auchincloss modification**: Retract pectoralis minor superomedially. Level I and II only removed.



Figs 3.14A and B: Modified radical mastectomy



Figs 3.15A and B: Axillary dissection (note pectoralis minor retracted-Auchincloss)

- **Scanlon modification:** Divide the tendon at its insertion at coracoid process and put it back. Level I, II, III nodes removed.

Preserve the following in MRM:

- Axillary Vessels (Figs 3.15A and B)
- Bell's nerve
- Cephalic vein
- Nerve to latissimus dorsi
- Pectoralis major

Advantage over radical type

1. Shoulder function preserved
2. Pectoralis major preserved hence a good vascular bed for skin flap
3. Cosmetical as axillary fold is preserved

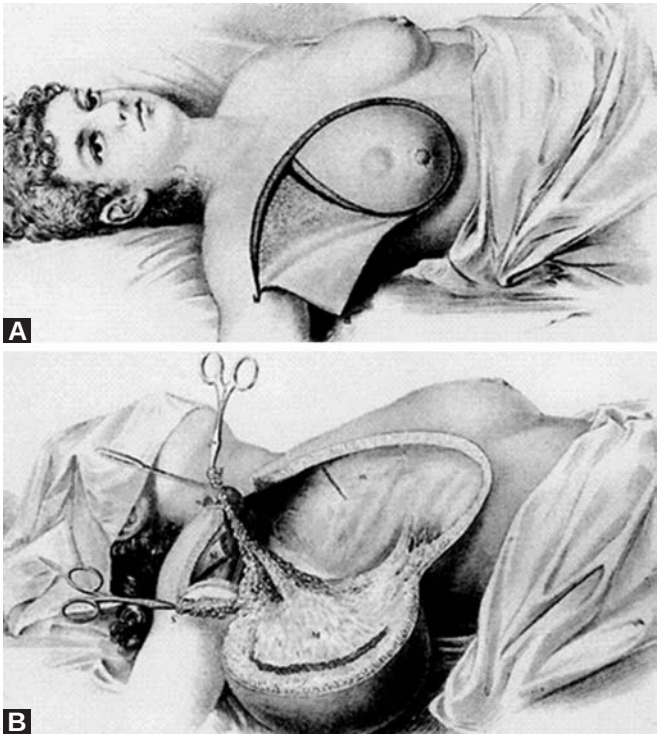
3. **Radical mastectomy**

Halsted's radical mastectomy: (Figs 3.16A and B)

Removal of breast tissue with nipple areolar complex and level I, II, III nodes.

Also remove:

- Pectoralis major
- Pectoralis minor
- Serratus anterior (part)



Figs 3.16A and B: Halsted's radical mastectomy

- Latissimus dorsi
- Subscapularis
- External oblique few fibers
- Upper part of rectus abdominis.

Preserve
- Axillary vessels
- Bell's nerve
- Cephalic vein

Disadvantages
- Mutilating surgery
- No bed for reconstruction
- Lymphedema of arms more common
- Poor cosmetic results

Extended radical mastectomies (not done nowadays)

Urban Type	:	Halstaedt + Removal of internal mammary nodes
Dahl - Iverson Type	:	Urban + supraclavicular node removal

Breast conservative surgery:
- Now the latest trend is towards breast conservative surgery for cancer breast, so we should know a few points about this surgery for exam purpose.

The well known **QUART therapy of Veronesi** is itself a conservative surgery which involves
QU-Quadrantectomy of involved breast quadrant
A-Axillary node dissection
RT-Radiotherapy

BREAST CONSERVATIVE SURGERY (Figs 3.17A and B)

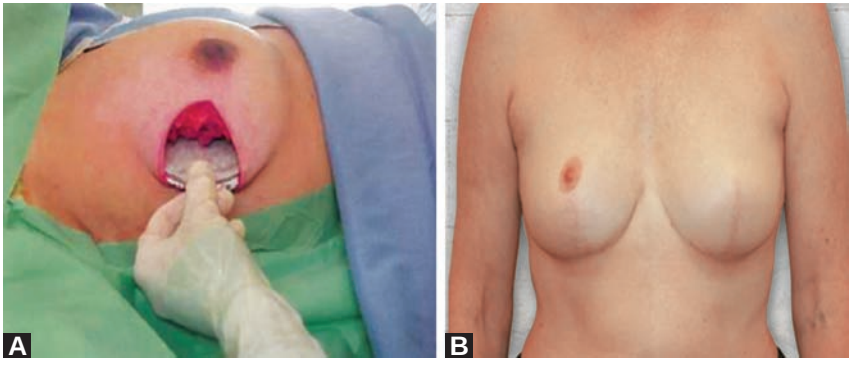
- Involves the following three steps apart from removal of cancer alone:
  1. Removal of tumor with wide margin
  2. Adjuvant radiotherapy
  3. With or without assessment of axillary lymph node status.
- Various surgical procedures employed are—wide local excision, lumpectomy or QUART.
- Its the standard treatment now for DCIS, stage 1 or 2 Ca breast.

Indications

- Solitary cancer
- Possible to excise the tumor with tumor free margins without disrupting the breast cosmetically
- No contraindications to RT (e.g. pregnancy, collagen vascular disorders which may exaggerate the reaction and prior RT to same breast)
- Well motivated patient.

Contraindications

- Presence of two or more primary tumors in separate areas of breast
- Diffuse malignant appearing calcification
- History of prior radiation to breast (will be a contraindication for full breast radiation)
- Persistent positive margins after two attempts.
- **Pregnancy (1st and 2nd trimester)** can be done in third trimester.
- Collagen vascular disorders where RT cannot be given (RT exaggerates the disorder)
- Large tumor in a small breast that does not respond to induction chemotherpy or where chemotherapy is contraindicated.



Figs 3.17A and B: Breast conservative surgery

- Excision resulting in cosmetic irregularity
- Breast size is a relative contraindication—BCS is not indicated if cosmetically unacceptable.
- Especially large/pendulous breasts possess the difficulty of providing uniform radiation.
- Low socioeconomic status (poor follow-up)
- Involvement of skin or chestwall.

Following are not contraindications now:

- Subareolar tumor
- T2 tumor
- Clinically positive axillary nodes
- Extremes of age
- Positive family history
- Presence of breast implants
- Bilateral tumors

Multicentricity—second occurrence in same quadrant
Multifocalty—second occurrence in another quadrant of same breast

Viva Question: What is axillary dissection or clearance?

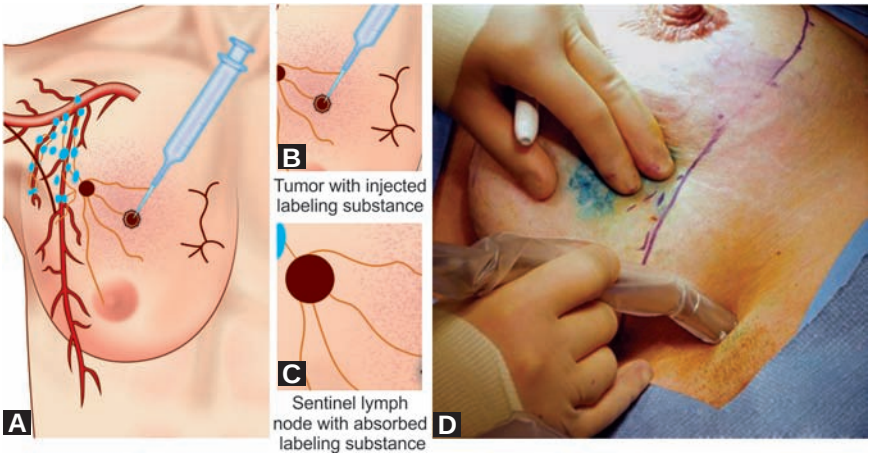
- If axillary dissection is done adequately more than 10 nodes must be removed.
- In such cases do not give radiotherapy to axilla.
- More than 4 positive nodes indicate poor prognosis.

Viva Question: What do you mean by sentinel node and how is the sentinel node biopsy taken? (Figs 3.18A to D)

Sentinel node: 1st node to drain the tumor.

Two methods:

1. On the day prior to surgery, the radioactive colloid (Technetium 99m sulfur or radioalbumin) is injected using a tuberculin syringe into three to four separate



Figs 3.18A to D: Sentinel node biopsy

sites at the cancer area or subdermally proximal to cancer; the node biopsied using hand-held gamma camera peroperatively.
2. During surgery patent blue dye (methylene blue) is injected into the tumor and the sentinel node identified and sent for frozen section biopsy.

Advantage
Unnecessary axillary dissection can be avoided if the node is negative for metastasis.

Breast reconstruction
- Time: Immediate reconstruction is the ideal
- Types of reconstruction:
  1. Autogenous
  2. Alloplastic
  3. Combined

AUTOGENOUS TRANSPLANT

1. Abdominal based flap:
   Transverse rectus abdominis flap: (Most common used) (Figs 3.19A to C)
   - Free flap (based on inferior epigastric A)
   - Pedicle (based on superficial epigastric A)
2. Latissimus dorsi flap (based on thoracodorsal artery)
3. Gluteal flap (based on gluteal arteries)
4. Ruben's flap—based on circumflex iliac vessels
5. Lateral thigh flap

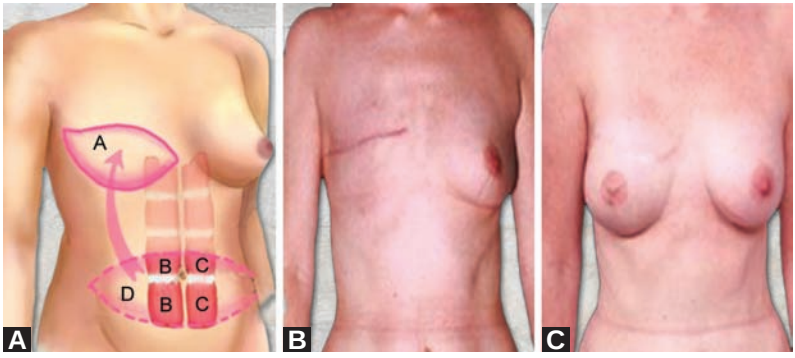
Implants—silicone gel or silicone with saline: (Figs 3.20A to C)
Placed in submuscular plane—beneath pectoralis major, rectus abdominis, serratus anterior.

Indications
1. Bilateral reconstruction
2. Patients who require augmentation
3. Not suited for long surgery
4. Lack of adequate abdominal tissues
5. Unwilling for additional scars

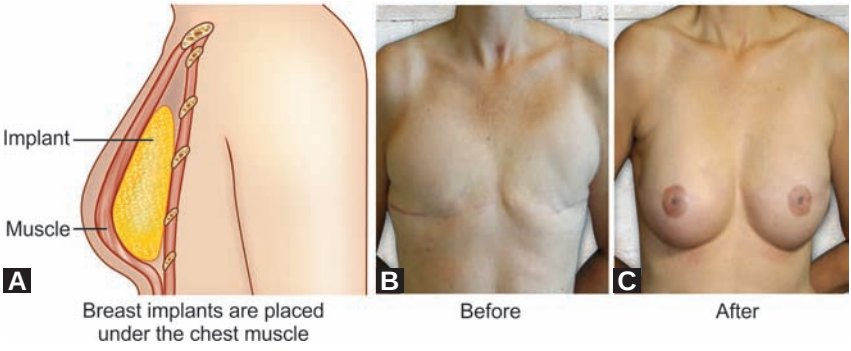
Contraindications
1. Silicone allergy
2. Implant fear
3. Failed implants
4. Need for adjuvant RT (increased risk of capsular contracture)

Chemotherapy

Indication
- For all node positive cancers
- For all cancers that are larger than 1cm in size.



Figs 3.19A to C: TRAM flap reconstruction



Figs 3.20A to C: Silicone implants for breast cancer reconstruction

- For women with hormone receptor negative that are larger than 1 cm in size, adjuvant chemotherapy is appropriate.
- For women with node negative tumor with hormone receptor positive that are 1 to 3 cm size can be provided tamoxifen with or without chemotherapy.
- Adjuvant chemotherapy is one that is given after surgery.

Neoadjuvant chemotherapy

Involves giving chemotherapy before surgery to patients with nonmetastatic primary breast cancer which is potentially operable.

1. It is useful to assess whether the tumor is sensitive to particular regimen (*in vivo* response of whether the tumor is regressing can be identified and that regimen can be continued postoperatively).
2. On satisfactory response the procedure can be modified (Mastectomy can be converted to a breast conservative surgery).

CMF REGIMEN

Cyclophosphamide	–	100 mg/m^2 oral (14 days)
Methotrexate	–	40 mg/m^2 IV (1, 8th day)
5-Fluorouracil	–	400 mg/m^2 IV (1, 8th day)

* For 6 cycles

* Each cycle 28 days

More decrease in recurrence is seen on substituting anthracyclines (Adriamycin or Epirubicin), i.e. FAC or CEF regimens

Adverse Effects

Cyclophosphamide	–	Hemorrhagic cystitits
		Neutropenia
		Bone marrow suppression
Adriamycin	–	Cardiotoxicity
		Alopecia

Chemotherapy for distant metastasis (Stage IV):

- For stage IV; tamoxifen is the preferred therapy but, however, if the tumor is ER negative, chemotherapy may be given.
- Pamidronate may be given in additional for patients with osteolytic secondaries.

HORMONE THERAPY

Estrogen Receptor Status

- Measured from tumor tissue by Histopathological examination
- If the tumor is ER positive it has good prognosis
- Measured in femtomols/mg of cytosols of proteins.
  ER (+): > 10 Fm/mg
  ER (–): < 3 Fm/mg
  Equivocal: 3–10 Fm/mg
- Benefits of this therapy:
  1. Reduces the recurrence rate
  2. Reduces the death rate
  3. Reduces the risk of tumors in the contralateral breast
- Should be given for 5 years
- Should be given only in cases of estrogen receptor positive status.

TAMOXIFEN

- Partial agonist/antagonist
- Antagonist to estrogen only in breast

Advantage

As it is estrogen agonist in other regions, it decreases osteoporosis and blood cholesterol.

Adverse effects

1. Bone pain, hot flushes, nausea, vomiting
2. Thromboembolic manifests
3. Hypercalcemia
4. Endometrial carcinoma
5. Increased cataract surgeries

- Follow-up of the patient for endometrial carcinoma by uterine aspiration and ultrasound. Dose: 10 mg BD for five years.

SELECTIVE ESTROGEN RECEPTOR MODULATORS

- Agonist antagonist with differing spectra of activity.

Ideal SERM

- Blocks the ER in breast, neutral or inhibitory in endometrium, lack procoagulant activity. Acts like estrogen in Cardiovascular system, CNS, skeletal muscle.
- For examples: Raloxifene, Idoxifene, Toremifene
- Tamoxifen is also considered as selective estrogen receptor modulators (SERM)

Ovarian ablation for premenopausal patients

- Medical—LHRH agonists (Buserelin, Goserelin)
- Surgical—Oophorectomy
- Radiation induced

Because adrenal glands are the main site of production of estrogen after menopause we do adrenal suppression by;

1. Medical adrenalectomy—aromatose inhibitors
2. Surgical adrenalectomy

Aromatose inhibitors for postmenopausal patients

- Reversible nonsteroidal : Anastrazole, letrozole
- Irreversible steroidal : Formestane, exemestane
- Nonselective : Aminoglutathemide (inhibits the conversion of androstenedione to estrogen in peripheral tissues).

Anti-HER2 antibody therapy (Trastuzumab, Herceptin)

- Cancers that over express HER2/neu antibody may be benefited
- Recurrent disease may be benefited.

RADIOTHERAPY

Dose

1. Breast is irradiated to a dose of 5000–6000 cGY Units.
2. Axilla with 200 cGY per day when only sampling has been done 5 days per week for 5–6 weeks.

Indications

1. Resected margin is positive for malignancy
2. Breast conservative surgery
3. Pectoralis major involved
4. Axillary clearance not done
5. Tumors in upper and inner quadrant give RT for internal mammary nodes.

Precautions

1. If axillary clearance has been done up to Level III do not give RT to axilla because lymphoedema of arms occurs
2. Hence in cases of MRM: do not give RT to axilla but may be given to chestwall and supraclavicular area to prevent local recurrence.

Adverse effects

1. Lymphedema of arms
2. Cancer-en-cuirasse
3. Lymphangiosarcoma (Stewart—Treves syndrome)

Treatment in consolidation

Treatment is based on the staging:

1. *In situ* breast cancer (DCIS, LCIS)
2. Early invasive breast cancer (Stage, I, IIa or IIb)
3. Advanced locoregional breast cancer (Stage IIIa or IIIb)
4. Distant metastasis (Stage IV)
5. Locoregional recurrence.

FOR *IN SITU* CANCERS

- **Lobular carcinoma *in situ* (LCIS)**
  Because LCIS is considered as a marker for increased risk rather than an inevitable precursor of invasive disease, the current treatment of LCIS is observation with or without tamoxifen. There is no benefit of excising the LCIS as the disease diffusely involves both breasts and risk of invasive cancer is equal for both breasts.
- **Ductal carcinoma *in situ* (DCIS)**
  Widespread disease involving two or more quadrants require mastectomy. For women with limited disease, lumpectomy and radiation therapy are recommended.

EARLY INVASIVE CANCER (STAGE I, IIa OR IIb)

Two modes of treatment are available:

1. Modified radical mastectomy + adjuvant chemotherapy + radiotherapy (our examiners usually expect this)
2. Breast conservation surgery with chemotherapy as indicated (recent trend)

Hormone Therapy for Early Invasive Breast Cancer

- ER (–): Only chemotherapy
- ER (+):
  - Premenopausal: Tamoxifen or ovarian ablation
  - Postmenopausal: Aromatose inhibitors

ADVANCED LOCOREGIONAL CANCER

Operable Stage III a: (two modes)

1. Modified radical mastectomy + adjuvant chemotherapy + radiotherapy
2. Neoadjuvant chemotherapy + MRM or breast conservation may become possible + adjuvant chemotherapy + radiotherapy.

Inoperable Stage IIIa and Stage IIIb: Neoadjuvant chemotherapy is used to decrease the locoregional cancer burden and may permit subsequent surgery possible.

DISTANT METASTASIS

Palliative simple mastectomy or toilet mastectomy if the tumor has ulcerated followed by radiotherapy

- Hormone therapy is sufficient if ER is positive
- Chemotherapy is indicated in:
  1. ER negative cancers
  2. Symptomatic visceral metastasis
  3. Hormone refractory metastasis.
- Bisphosphonates (Pamidronate) considered in cases of bone metastasis

Other Swellings in Breast of Special Interest

1. Phyllodes Tumor (Fig. 3.21)
   (Serocystic disease of Brodie or Cystosarcoma phyllodes)
   Classified into
   Benign, Borderline, Malignant
   - Present at age >40 years.

   Gross examination: Massive tumor with unevenly bosselated surface with areas of infarction and necrosis.

- Mobile on the chestwall
- Skin ulceration may occur
- Most malignant phyllodes contain liposarcomatous or rhabdomyosarcomatous elements.

Treatment

Small phyllodes are excised with 1 cm margin of normal breast tissue and large phyllodes require mastectomy.
No axillary dissection needed as there is no axillary metastasis.

Fig. 3.21: Phyllodes tumor

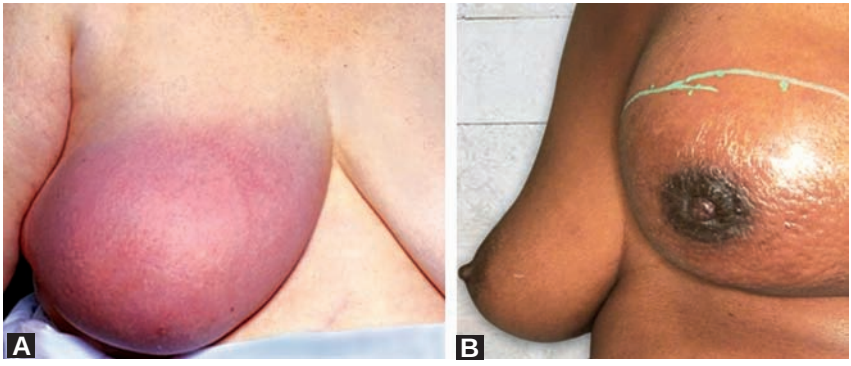
2. Giant Fibroadenoma
   - More than 5 cm in size
   - Enucleation via submammary incision

3. Inflammatory carcinoma breast (Figs 3.22A and B)
   Stage IIIb (T4d)
   - Aggressive type, locally advanced carcinoma
   - Clinically shows brawny induration, erythema, Peau d'orange; tender and inflamed.
   - Permeation of dermal lymph vessels is seen in biopsy.
   - Differential diagnosis: bacterial infection of breast (mastitis)
   - Most of them present with axillary and distant metastasis.

Treatment

- Not responds to hormone therapy
- Treat with neoadjuvant chemotherapy followed by surgery if possible and then subsequent chemo and radiotherapy.
- Five years survival is only 30 percent

4. Sarcomas (Fig. 3.23)



Figs 3.22A and B: Inflammatory breast cancer

Fig. 3.23: Angiosarcoma breast

Fig. 3.24: Stewart-Treves syndrome

- Sarcomas of breast is similar to the soft tissue sarcomas at other anatomic sites.
- Clinical presentation is with large painless breast mass with rapid growth.
- Diagnosis is by core biopsy or incisional biopsy.

Treatment

- Wide local excision
- Mastectomy may be needed
  - Axillary dissection is not needed
  - Lymphangiosarcoma of arms (Stewart-Treves syndrome) may require forequarter amputation. It is a complication of axillary clearance when combined with radiotherapy. (Fig. 3.24)

Exam point for treatment of cancer breast (please tell this for our exams):

Stage I : MRM + Adjuvant chemotherapy + Adjuvant hormone therapy (Based on ER states) + Radiotherapy

Stage II : MRM + Adjuvant chemotherapy + Adjuvant hormone therapy (Based on ER states) + Radiotherapy

Stage III : Operable: MRM + Adjuvant chemotherapy + Hormone therapy + Radiotherapy
Inoperable: Neodjuvant chemotherapy given first

Stage IV : Palliative toilet mastectomy + Chemotherapy (or) Hormone therapy + Radiotherapy

QUESTIONS FROM EXAMINERS

1. **Breast cancer with contralateral node involvement. What is the staging and treatment?**
   - First we have to see whether there is simultaneous cancer in the opposite breast with its node metastasis. (Synchronous tumor)

- If there is no tumor in the opposite breast and if the node has been a metastasis from Ipsilateral breast we say it as metachronous deposit in that side axilla. It is considered as distant metastasis (M1) in staging.
- Only available option in metachronous tumor is chemotherapy. We won't go for extensive mastectomy with axillary dissection in this case.
- This is a question very important for PG standard.

2. **What is the relation between OCP and breast cancer?**
   - There is no increased risk of breast cancer in those who take OCP
   - There is increased risk of cancer in those who take hormone replacement therapy
   - Earlier it was found that breast cancer risk is reduced by breastfeeding, now subsequent studies have not proved this.
3. **What are the malignant lesions where sentinel node biopsy is practiced?**
   - Cancer penis (sentinel node of Cabana)
   - Malignant melanoma
   - Cancer breast
4. **What are the examinations required in the excised breast specimen after MRM?**
   - Histopathological type of tumor
   - Resected margins to be commented (tumor infiltration +/- at the margins)
   - Grade of tumor
   - ER/PR status
   - Her 2 neu status
   - Axillary nodes (number of nodes removed and number involved, extracapsular invasion)
5. **What is the indication of radiotherapy to the axilla if adequate axillary clearance has been given?**
   - As already discussed RT should not be given if adequate axillary dissection has been done because of risk of lymph edema of arms. But if there is extracapsular invasion as given by pathologist we have to give RT to axilla.
6. **If after breast conservative surgery if the resected margin is not free of tumor, what will you do?**
   - We have to re-excise the scar with a margin of 1 cm.
   - If the re-excision done 1st time is also not free of tumor, you have to do total mastectomy.
7. **What is the cause of death in patients treated for breast cancer?**
   - Metastatic disease
   - Most common sites – bones (50–60%), lung (20%), pleura, soft tissue, liver, brain and adrenals.

4 CASE Stomach

- History
- Peptic Ulcer
- General Examination
- Investigations
- Discussion of the Topics
- Cancer Stomach
- Classification
- TNM Staging
- Treatment Modalities
- Reconstruction Procedures after Subtotal Gastrectomy
- Peptic Ulcer Disease
- Complications of Peptic Ulcer Disease
- Viva Questions

You may get two cases commonly:
- Carcinoma stomach (Ca stomach)
- Gastric outlet obstruction (GOO) due to peptic ulcer disease.

HISTORY

Name	:	
Age	:	Gastric ulcer (>35 years); duodenal ulcer (<35 years)
Sex	:	Common in males
Occupation	:	Peptic ulcer common in conductors, businessmen, clerks, etc. due to habituated tea and coffee consumption, excess smoking.

Presenting Complaints

Cancer Stomach

S — Silent
T —Tumor
O — Obstruction
M — Mass/melena
A — Anemia/asthenia
C — Cachexia/constipation
H — Hematemesis

PEPTIC ULCER

- **Pain:** Site, duration, periodicity
  - Radiation
  - Relation to food
- History of vomiting/hematemesis
- History of melena (Black, tarry stools)
- History of ball rolling movements

- History of weight loss:
  Carcinoma stomach—loss of appetite/weight
  Gastric ulcer—loss of weight due to fear of taking food
  Duodenal ulcer—gains weight by consuming more food for relief of pain
- History of consumption of drugs:
  - Antacids: relieves pain
  - Analgesics: aggravates pain.

Vomitus
Coffee ground: Gastric ulcer, Ca stomach due to slow hemorrhage.
Acidic vomiting: Duodenal ulcer
Bilious vomiting: Cholecystitis and intestinal obstruction.
Projectile copious vomiting: Pyloric stenosis (GOO).

Pain Related Viva Questions

Periodicity of pain
- Interval of freedom from pain for past 2–6 months.
- Seen in peptic ulcer
- Pain is common in autumn and winter due to absence of drinking of water more (water is alkaline hence reduces pain).

Site of pain
- Gastric ulcer—midepigastrium or slightly to left
- Duodenal ulcer—pain is seen one inch to the right of midline of transpyloric plane (duodenal point).

Radiation of pain
- Pain radiates to the back in conditions of peptic ulcer penetrating the pancreas.

Relief of pain
- Gastric ulcer- vomitus reduces pain
- Duodenal ulcer-food intake reduces pain.

Past History of

- Chronic consumption of analgesics
- DM/HTN/IHD/BA/TB/epilepsy
- Previous surgery
  - Truncal vagotomy predisposes to carcinoma stomach.

Personal History of

- Irregular diet, spicy foods, spirit, smoking.

Family History of

- Peptic ulcer runs in families.

GENERAL EXAMINATION

- Anemic—due to chronic bleeding
- Malnourished—carcinoma stomach
- Lean patient—gastric ulcer
- Fatty patient—duodenal ulcer
- Jaundiced—liver secondary
- Trousseau's sign—migrating thrombophlebitis in carcinoma stomach.

Examination of Abdomen

Inspection

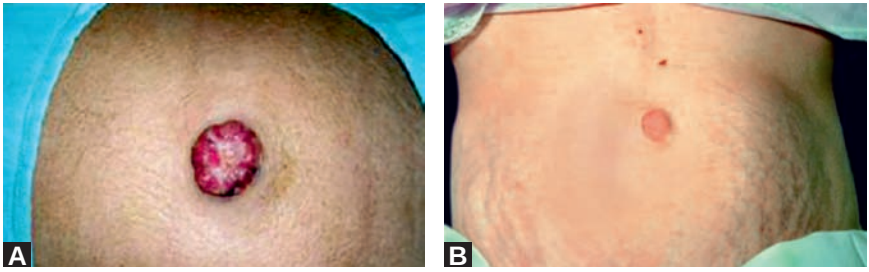
- Any visible epigastric swelling
- Any visible gastric peristalsis (VGP)—by giving about 1 liter water to drink
- Sister Joseph's nodules—transcelomic spread and deposit of malignancy around the umbilicus from carcinoma stomach (Figs 4.1A and B)
- Troisier's sign—left supraclavicular node—Virchows node enlargement.

Virchow's node—medial most node in the (L) supraclavicular groups, (medial, middle and lateral) enlarged in metastasis from Ca Stomach, pancreas, colon, testis (Fig. 4.2).

Palpation

Explain about the swelling:

- Size
- Shape
- Surface
- Extent
- Margin
- Consistency



Figs 4.1A and B: Sister Mary Joseph nodule

Fig. 4.2: Virchow's node

Fig. 4.3: Liver secondaries

- Movement with respiration.
- Palpate for liver secondaries (Fig. 4.3)

Pulsation over the Swelling (Expansile or Transmitted)

1. Keep two fingers over the swelling:
   - Expansile pulse: Lifts and separates the two fingers
   - Transmitted pulse: Only lifts the fingers
2. Knee-elbow position:
   - Transmitted pulsation disappears
   - Expansile pulsation arises from aneurysms
   - Transmitted pulsation is due to enlarged organs over any artery

Plane of Swelling (Parietal or Intra-abdominal)

- Leg lifting test **(Carnett's test)**
- Raising the shoulders with hands folded over the chest **(Rising test).**
- Valsalva maneuver
- Making the child cry.

On doing these tests and making the parietal abdominal muscles taut:

- Parietal swelling becomes more prominent.
- Intra-abdominal swelling becomes less prominent.

Succussion splash:

It should be done before giving water, i.e. before looking for VGP.

- Catch a fold of skin over the epigastric region and shake.
- You can hear a splashing sound without stethoscope.
- Should be done 2 hours after any liquid food and after 3 hours following a solid food

Nicholson's maneuver: Exert pressure on the lower end of sternum with base of left palm. This compels the patient to breathe abdominally as the movement of thorax has been restricted; thereby making various organs easily palpable.

Percussion

- *Ausculto-scrapping:* To find the distension of stomach
  - Keep the bell of stethoscope in epigastric region

  - Scrape from inwards to outwards
  - Note the change in frequency of sound and mark the outline of stomach.
- *Distended stomach:* Impaired resonance.

Per-rectal Examination

Bloomer's shelf: Malignant deposits in the rectovesical pouch.

Clue to diagnosis:
Gastric outlet obstruction with a palpable epigastric mass is due to carcinoma stomach and without a palpable mass is due to chronic cicatrizing duodenal ulcer

Salient features of Gastric Outlet Obstruction

- Visible gastric peristalsis (VGP)
- Succussion splash
- Distended stomach on auscultoscrapping.

Differential diagnosis of gastric outlet obstruction

- Duodenal ulcer with cicatrization
- Prepyloric ulcer with cicatrization
- Antral growth with obstruction
- Carcinoma head of pancreas
- Annular pancreas
- Hypertropic pyloric stenosis (congenital)
- Duodenal atresia in children
- Chronic pancreatitis
- Superior mesenteric artery syndrome (Wilkie's disease) (Fig. 4.4)
  - Duodenum compressed between vertebral column and superior mesenteric artery at 3rd part of duodenum.
  - Common in tall, thin individuals.
- Trichobezoar (Psychogenic hair consumption) (Fig. 4.5)
- Phytobezoar (Psychogenic vegetable consumption).

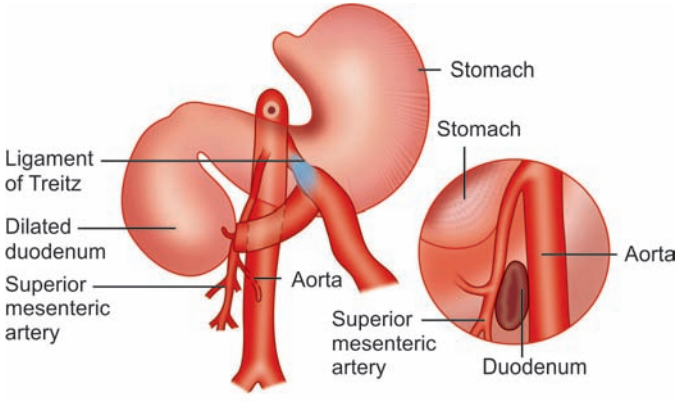


Fig. 4.4: Wilkie's syndrome

Fig. 4.5: Trichobezoar

INVESTIGATIONS

Basic Investigations

- Hemoglobin; TC; DC; ESR
- Blood urea; sugar
- Serum creatinine; electrolytes (Hypochloremic, hyponatremic, hypokalemic, metabolic alkalosis in cases of GOO)
- Blood grouping and typing
- X-ray chest and ECG all leads.

Specific Investigations

- Upper gastrointestinal endoscopy: It can study up to proximal ½ of 2nd part of duodenum (Foregut).
- Flexible upper GI endoscopy is used to:
  - Visualize the gastric mucosa
  - Find the malignant growth
  - Take biopsy.

'J' or 'U' maneuver: To visualize gastric ulcer in fundus area; the tip of the scope is turned upwards.

Viva question: What should you do before sending the GOO patient to UGI scopy?

- Before sending a GOO patient to scopy
  - Gastric lavage should be done using wide bore tube and saline.

Scopy Finding (Figs 4.6 to 4.9)

Benign gastric ulcer	*Malignant gastric ulcer*
• Convergence of mucosal folds towards the ulcer seen	• Loss of convergence of mucosal folds
• Punched out due to acid digestion	• Everted edge ulcer
• Peristalsis seen around the ulcer	• >2 cm in size
	• Slough will be present in floor
	• Local aperistalsis

Fig. 4.6: Benign gastric ulcer

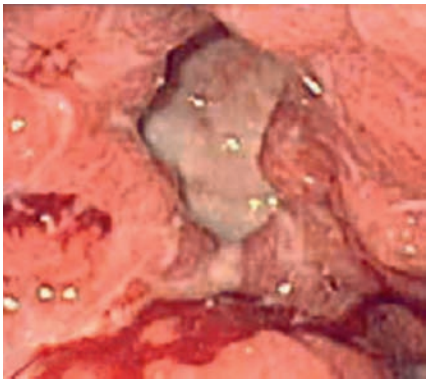


Fig. 4.7: Malignant gastric ulcer

Fig. 4.8: Gastrointestinal stromal tumor (GIST) in antrum

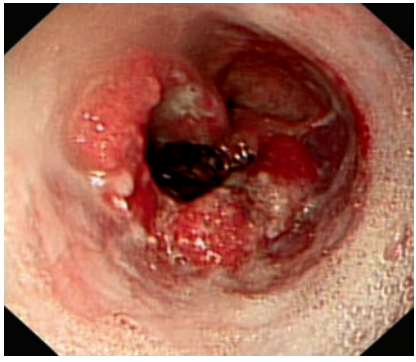


Fig. 4.9: Endoscopy showing antral cancer

Active ulcer
- Bleeding seen
- Surrounding edema
- Angry looking vessels seen

Barium Meal (Figs 4.10 and 4.11)

Endoscopy is preferred first (because biopsy can be taken).

Barium meal in GOO shows:
- Dilatation of stomach
- Deformed duodenal cap (Trifoliate deformity)
- Stasis ulcer
- Distal duodenal normality
- Delayed emptying time
  - Normal stomach empties in 3 to 4 hours
  - >6 hours Hypotonia, pylorospasm
  - >24 hours Organic pyloric stenosis

Endoscopy cannot diagnose the following conditions due to normal gastric mucosa:
- Linitis plastica
- Gastrointestinal stromal tumor (GIST)
- Lymphoma
- Carcinoids

Fig. 4.10: Antral gastric ulcer

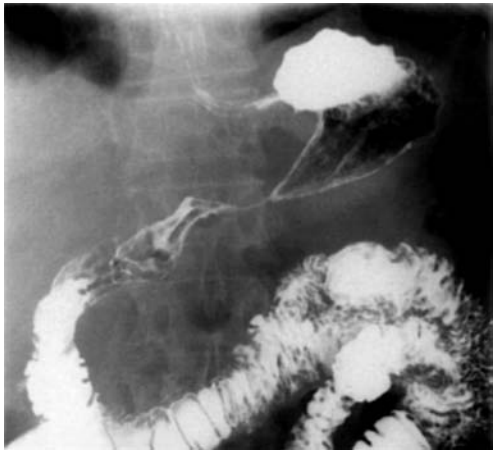


Fig. 4.11: Linitis plastica

Gastric ulcer appears in barium meal as:

- 'Ulcer crater' or 'Niche' usually in lesser curve (Direct sign)
- Indirect signs:
  - Notch (or) incisura on greater curvature.
  - Constant deformity due to chronic cicatrizing
  - Rugal convergence
  - Coarseness and irregularity

  Suspect malignant gastric ulcer:
  i. >1 inch on lesser curve
  ii. Ulcers on greater curve.

Barium meal is highly useful in:

- Linitis plastica
- Hour glass contraction
- Hiatus hernia
- Volvulus of stomach
- Stenosing lesions
- To know stomach dilatation
- Lesions near fundus
- Gastrojejunal fistula.

Trifoliate deformity on barium meal:
1. Deformed duodenal cap
2. Diverticulum
3. Pylorus.

Note: Gastrocolic fistula can be diagnosed only by barium enema as colon is a high pressure compartment. The contrast will pass from the colon to stomach but not vice-versa.

X-ray Abdomen Erect

- **Perforation**: Air under diaphragm seen (Fig. 4.12)
- **Duodenal atresia**: Double bubble appearance (Fig. 4.13)
- **Jejunal atresia**: Triple bubble appearance.

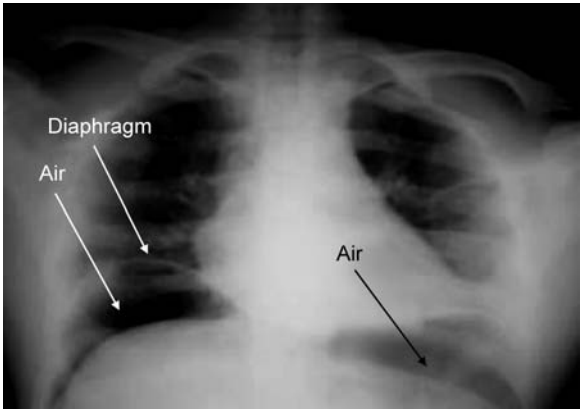


Fig. 4.12: Perforation—Air under diaphragm

Fig. 4.13: Double bubble appearance—duodenal atresia

Staging Investigations

- USG abdomen:
  - Liver deposits
  - Ascites
  - Krukenberg's tumor
  - Pelvis deposits
- CT scan abdomen: Secondary deposits in nodes (Fig. 4.14)
- **Endoscopic ultrasonogram (EUS):** It is done in many advance centers. This is very useful for T and N staging, (Figs 4.15 and 4.16)
- **Diagnostic laparoscopy**:
  - To find liver deposits
  - To see for serosal involvement is Ca stomach.

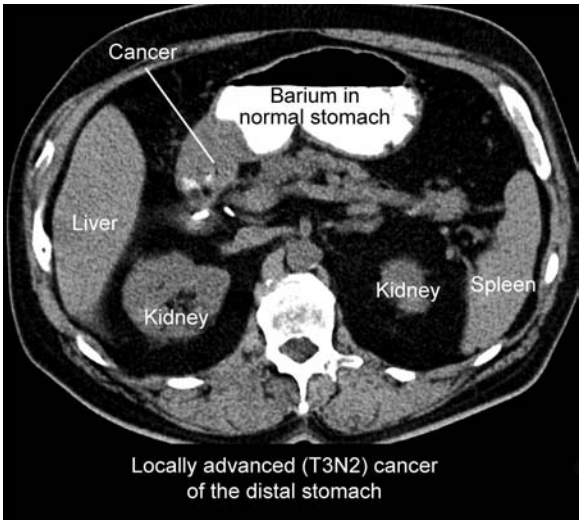


Fig. 4.14: Antral cancer on CT scan with oral contrast

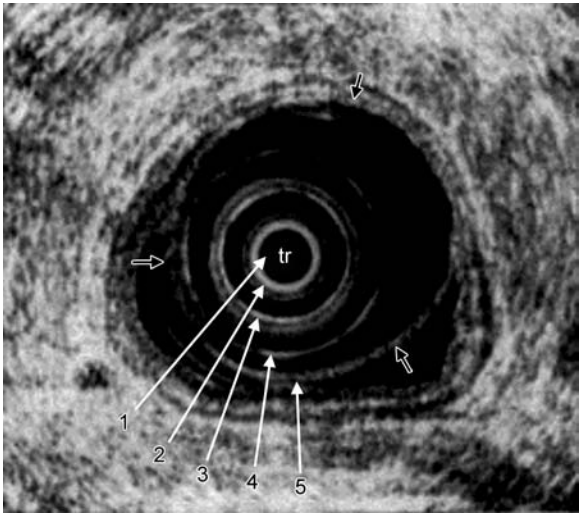


Fig. 4.15: Normal endoscopy USG

Endoscopic ultrasonogram (for Postgraduate standard only):
1, 3, and 5 = first, third and fifth layers, which are hyperechoic (white)
2 and 4 = second and fourth layers, which are hypoechoic (black)

- Mucosa
- Muscularis mucosa
- Submucosa
- Muscularis propria
- Serosa

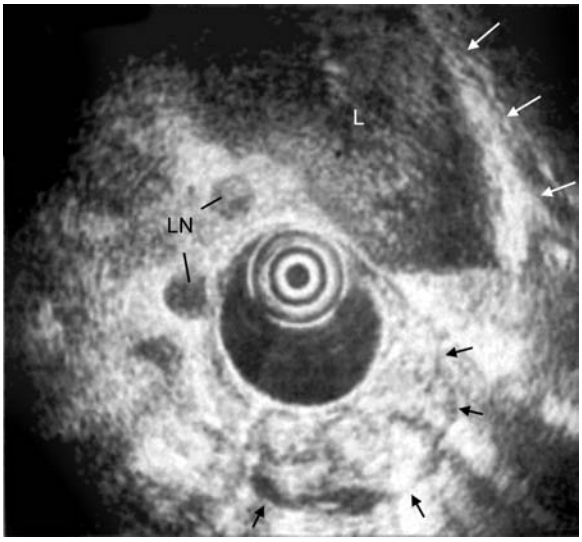


Fig. 4.16: EUS showing tumor and node

Other Investigations (Not Essential to Say in Exams)

H. pylori Infection

- *Rapid urease test:* Most commonly performed using endoscopy biopsy and kits (CLO kits) result in 3 hours.
- *C^{13} breath test:* 100 percent sensitive and 100 percent specific
- Culture
- Polymerase chain reactions
- Giemsa and warthin starry silver staining
- *Serology:* ELISA.

Noninvasive	*Invasive (by endoscopy)*
• Serology—ELISA test of choice for initial diagnosis • Urea breath test (C^{13} and C^{14}) • Method of choice to document eradication	• Rapid urease test—result in hours • Histology by staining with silver, giemsa or genta • Culture takes about 3 to 5 days for result

Gastric Function Tests

Basal and maximal acid output:

- Basal secretion is measured over 1 hour
- Maximal secretion by injecting intramuscular pentagastrin in a dose of 6 µg/kg body weight
- The only indication nowadays is in diagnosis of Zollinger-Ellison syndrome (ZES) and pernicious anemia.

	BAO	*MAO (mmol / hr)*
Normal	2	20–30
Duodenal ulcer	>5	>35
Gastric ulcer	<2	<15
ZES	>60% of maximal output	-

- In ZES, already there is stimulation, therefore, basal secretion will be >10 mmol/L and >60 percent of peak acid output.

Hollander's insulin test:

- To test the efficiency of truncal vagotomy, insulin is given intravenously.
- Soluble insulin 0.2 μ/kg body weight IV
- Rise in concentration in any 15 minutes sample >20 mmol/L the test is positive and indicates incomplete vagotomy.

Plasma gastrin concentration:

- Normal < 200 pg/ml
- ZES > 1000 pg/ml.

Secretin challenge test:

- IV injection of secretin 4 units/kg does not affect antral gastrin but may cause fall
- But in gastrinomas, large release of gastrin occurs.

Dragstedt's night fasting secretion test:

- Ryles tube aspiration done between 9 pm and 9 am
- Volume of hydrochloric acid in this fluid measured.

Total secretion	:	Normal: 400 ml ZES: 1 liter
Free Hydrochloric acid	:	Normal: 10–20 mEq Duodenal ulcer: 60–80 mEq Gastric ulcer: 10–20 mEq ZES: 100–300 mEq

- In gastric acid HCl produced is normal.

Author's request: These gastric function tests must not be mentioned by you in the exam unless the examiner asks you anything about them.

DISCUSSION OF THE TOPICS

Anatomy (Figs 4.17A and B)

Stomach is subdivided into two parts:

- Cardia
- Pylorus by a line drawn downwards and to the left from incisura angularis.

Largest cardiac part is divided into:

- Fundus
- Body

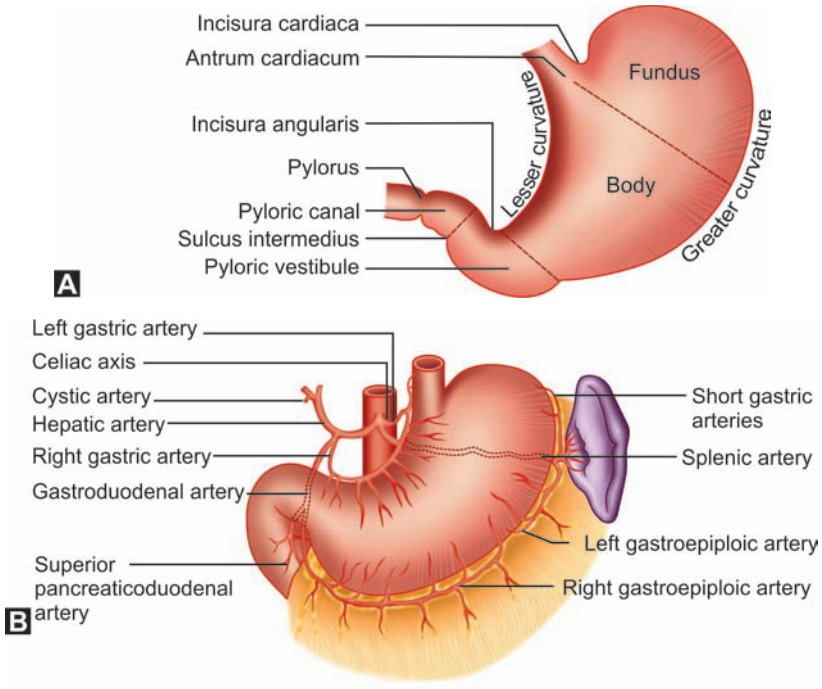
Smallest pyloric part is divided into:

1. Pyloric antrum
2. Pyloric canal

- Incisura angularis is the junction between the vertical and horizontal parts on the lesser curvature side of 'J' shaped stomach.
- Vein of Mayo is the landmark for pyloroduodenal junction.

Blood Supply

1. Left gastric artery (branch of celiac trunk).
2. Right gastric artery (branch of common hepatic artery)
3. Right gastroepiploic artery (branch of gastroduodenal artery)



Figs 4.17A and B: Anatomy and blood supply of stomach

4. Left gastroepiploic artery (branch of splenic artery)
5. 5 to 7 short gastric vessels from splenic artery.

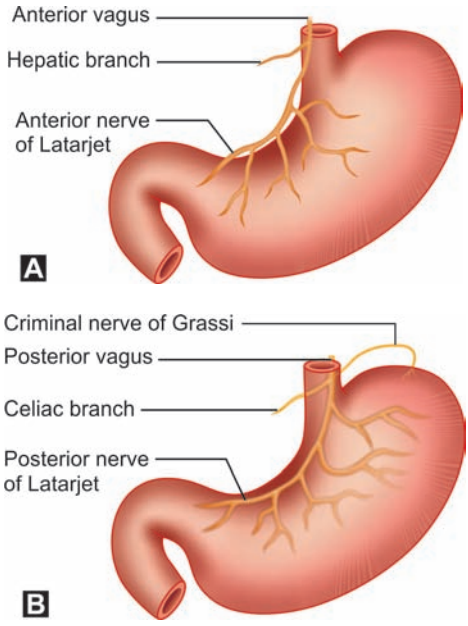
Nerve Supply

Parasympathetic supply Vagus nerve branches (Figs 4.18A and B):

- Anterior gastric nerve (Left)
  - Hepatic branch
  - Gastric branches
  - Crow's foot (Nerve of Latarjet)
- Posterior gastric nerve (Right)
  - Criminal nerve of Grassi
  - Crow's foot
  - Celiac branch.

Lymphatic Drainage

Level 1	*Level 2*	*Level 3*
1. Right cardiac	7. Left gastric	12. Along hepatoduodenal ligament
2. Left cardiac	8. Common hepatic	13. Retropancreatic
3. Lesser curve side	9. Celiac	14. At root of mesentery
4. Greater curve side	10. Splenic hilus	15. Along middle celic vessels
5. Supra pyloric	11. Splenic artery	16. Para-aortic
6. Infrapyloric		



Figs 4.18A and B: Vagus nerve supply

Physiology

Various types of cells in stomach:

- Body : Parietal cells
  Chief cells
- Antrum : Gastrin 'G' cells
- Entire stomach : 'D' cells and 'ECL' cells

Functions of various cells:

- **Parietal cells:** Produce H^+ (acid)
- **Chief cells:** Produce pepsinogen
- **Endocrine cells:**
  - 'G' cells—produce gastrin
  - 'D' cells—produce somatostatin
  - 'ECL' cells—produce histamine.

Various glands in duodenum:

- **Mucus secreting glands:** Brunner's glands
- **Endocrine cells:**
  i. Cholecystokinin: Contract gallbladder
  ii. Secretin: Decrease gastric acid secretion.

Gastric Acid

Stimulators	*Inhibitors*
Gastrin	Somatostatin
Acetylcholine	Secretin
Histamine	Prostaglandins

Phases of gastric acid secretion:

- *Cephalic phase:* Vagus nerve stimulates acid secretion
- *Gastric phase:*
  - Gastrin stimulates ECL cells to produce histamine
  - Histamine acts on H_2 receptors and stimulates proton pumps and H^+ enters the stomach.
- *Intestinal phase:* Secretin inhibits H^+ secretion

CANCER STOMACH

Predisposing Factors

- Smoking
- Spirit
- Spicy foods
- Salted foods
- *Helicobacter pylori*
- Post-gastrectomy/vagotomy (due to achlorhydria)
- Bile reflux (as in Billroth II causes stump carcinoma).

Premalignant Factors

- Atrophic gastritis
- Biliary gastritis
- Chronic gastric ulcer
- Hypogammaglobulinemia
- Group A blood
- Gastrinoma-I
- Adenomatous polyp
- Pernicious anemia
- Menetrier's disease (Fig. 4.19)

Note: Protein losing enteropathy: With hypertrophy of gastric mucosa—Cerebriform pattern of gastric mucosa seen on endoscopy—patient will lose protein. If the condition is worse we have to do gastrectomy

Fig. 4.19: Menetrier's disease

Fig. 4.20: *H. pylori*

***H. pylori* predisposes to (Fig. 4.20):**
- Non-ulcer dyspepsia
- Type 'B' gastritis
- Duodenal ulcer
- Gastric ulcer
- Carcinoma body and antrum (not for carcinoma in cardiac end)
- MALT lymphoma

Site

- Most common in the antrum lesser curve side
- Higher groups it is the most common in the proximal stomach.

Histological Types

- Adenocarcinoma (most common)
- Adenosquamous
- Squamous
- Undifferentiated
- Lymphomas
- Leiomyosarcoma.

CLASSIFICATION

Macroscopic

I. **Advanced gastric cancer**
Borrmann's classification (Fig. 4.21):
   1. Polypoid
   2. Ulceroproliferative

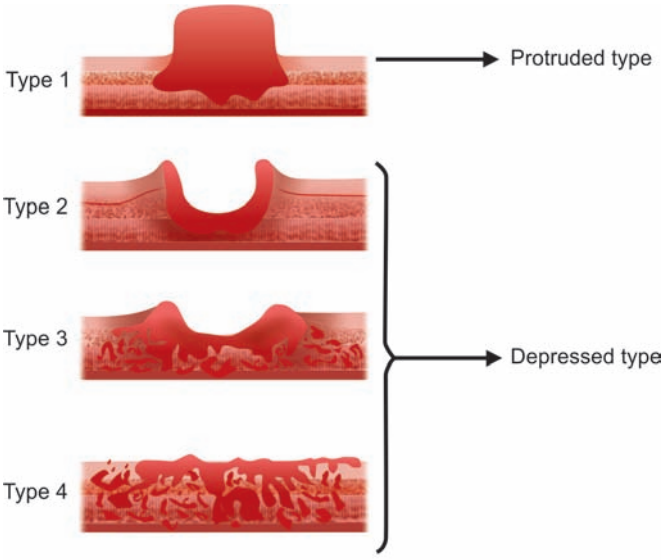


Fig. 4.21: Borrmann's classification

3. Ulcerative
4. Diffuse

II. **Early gastric cancer**

Japanese classification:

1. Protruded
2. Superficial
   a. Elevated
   b. Flat
   c. Depressed
3. Excavated

Microscopic

Lauren's Classification

- Diffuse
- Intestinal
- Others.

	Intestinal	*Diffuse*
Histology	Areas of intestinal metaplasia	Normal gastric mucosa
Early cancer	Protruding	Flat (depressed/excavated)
Infiltration	Localized	Diffuse
Peritoneal dissemination	Infrequent	Frequent
Hepatic metastasis	Nodular	Diffuse
Sex incidence	Males more common	Females more common
Age incidence	Elderly	Young

Contd...

Contd...

	Intestinal	*Diffuse*
Group A	–	+
Pernicious anemia	–	+
Genetic predisposition	–	+
H. pylori association	+	+
Prognosis	Good	Bad

Serological Marker

- The only reliable marker in patients with carcinoma stomach is CA 72-4.
- Most common clinical presentation is recent dyspepsia in a patient aged 45 years and above.

Methods of Spread

1. **Direct spread**
   - Into the layers of stomach wall
   - Into pancreas, colon, liver and diaphragm.
2. **Lymphatic spread**
   - Troisier's sign: Involvement of left supraclavicular node.
3. **Hematogenous spread**
   - First to liver
   - Uncommon in the absence of nodal metastasis.
4. **Transperitoneal spread**
   - Ascites
   - Bloomer's shelf (deposits in the rectovesical pouch)
   - Sister Joseph's nodule (deposits around the umbilicus)
   - Krukenberg's tumor (deposits over the ovary, typically bilateral, cut section shows normal ovary with surface deposits) (Fig. 4.22).

Signs of Inoperability

- Hematogenous metastasis
- Involvement of distant peritoneum
- Ascites
- Fixation to nonremovable adjacent structures (Pancreas, diaphragm).

Fig. 4.22: Krukenberg's tumor

TNM STAGING (FIG. 4.23)

T_1 : Tumor limited to mucosa and submucosa
T_2 : Tumor limited the muscularis propria or subserosa
T_3 : Tumor penetrates the serosa
T_4 : Tumor invades adjacent organs
N_1 : Metastasis in perigastric nodes (<3 cm from tumor)
N_2 : Along the main arterial trunks (>3 cm from tumor)
M_1 : Distant metastasis

	N_0	N_1	N_2	N_3
T_1	I_a	I_b	II	III_a
T_2	I_b	II	III_a	III_b
T_3	II	III_a	III_b	IV
T_4	III_a	III_b	IV	

D_1 resection: Resection of primary group of nodes (1–6 group)
D_2 resection: Resection along main arterial trunks (7–11 group). Needs splenectomy and removal of body and tail of pancreas.
D_3 resection: Resection of groups (12–16) partial colectomy, hepatic lobectomy, subtotal pancreatectomy, pancreaticoduodenectomy.

Note: 'D' resection should exceed the 'N' involvement, for example; if level 1 groups are positive; D_2 resection is the treatment curative.

Viva Question: What do you mean by R_1 resection?

- R_0 – No micro or macroscopic residue margins > 10 mm
- R_1 – Microscopic residue
- R_2 – Macroscopic residue

Note: Remember friends do not get confused between R_1 and D_1

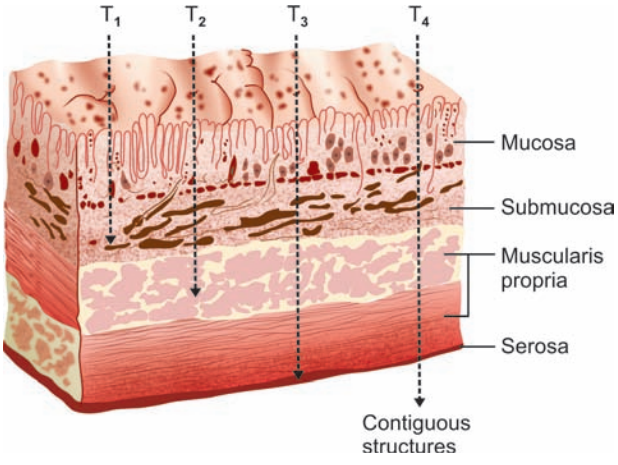


Fig. 4.23: T-staging for cancer stomach

TREATMENT MODALITIES

- Surgery
- Chemotherapy
- Radiotherapy.

Surgical Modalities

Find whether the tumor is operable or inoperable.

Operable

- **Subtotal radical gastrectomy:** Antral growth (Figs 4.24 and 4.25)
- **Total radical gastrectomy:** Body, fundus growth.

Oncology Clearance

- Proximal clearance: 5 cm from growth
- Distal clearance: Up to gastroduodenal junction
  - **Subtotal gastrectomy**—about 80 percent of distal stomach removed—done for cancers
  - **Partial gastrectomy**—about 60–75 percent stomach removed distally—done for benign conditions.

Inoperable

Palliative anterior gastrojejunostomy.

Inoperable Tumors

Palliative procedures are done to relieve outlet obstructive symptoms and make the patient to have food until he lives.

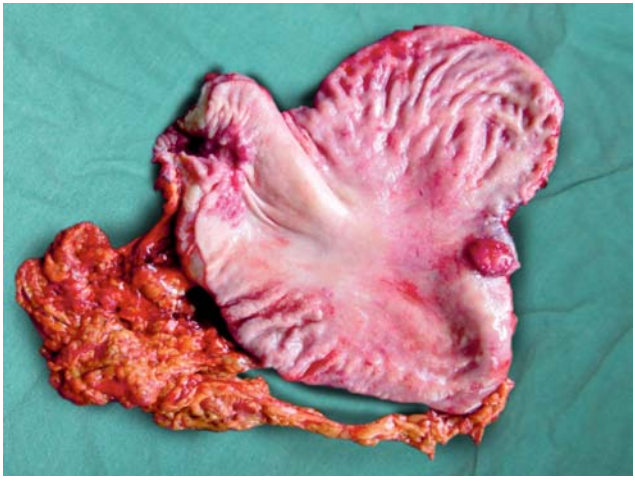
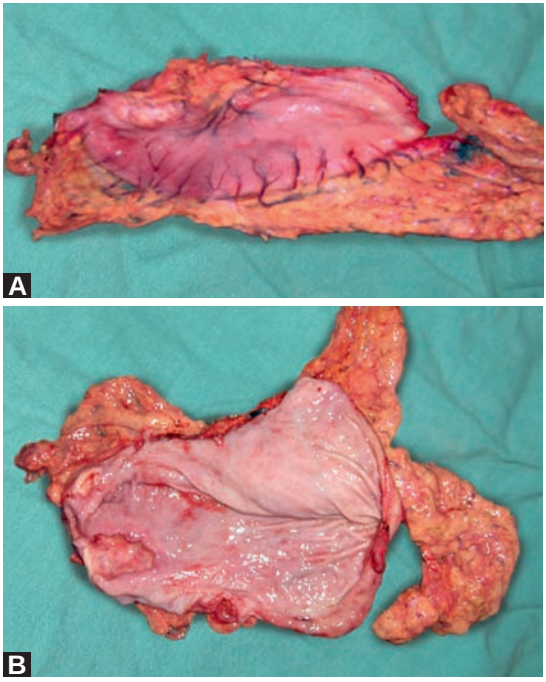


Fig. 4.24: Subtotal gastrectomy—Ulcerative growth in pyloric antrum with associated polyp in the proximal body



Figs 4.25A and B: Ulcerative growth in antrum

I. **Pyloric end**
   1. Tanner's anterior gastrojejunostomy (GJ)
   2. Devines exclusion bypass, leaving tumor as such (not done nowadays).

   Anterior GJ is preferred to posterior because:
   1. Easier to do and redo the surgery.
   2. Posteriorly, if done, nodes when get enlarged may compress the jejunum.
   3. If we want to do posterior GJ, we have to open the transverse mesocolon; thereby connecting supra-and infracolic compartments, hence transperitoneal spread becomes easier.

II. **Cardiac end**
   1. Stent can be kept
   2. Laser luminization
   3. Souttar's tube

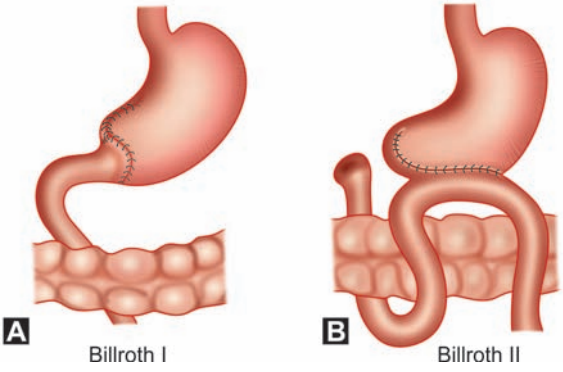
III. **Ultimately inoperable:**
   Linitis plastica—feeding jejunostomy (Fig. 4.26)

RECONSTRUCTION PROCEDURES AFTER SUBTOTAL GASTRECTOMY

Billroth I (Fig. 4.27A)
- Gastroduodenal anastomosis
- Mobilization of 1st part of duodenum (Kocherization)
- Only advantage is maintenance of anatomical continuity.

Billroth II (Fig. 4.27B)
- Gastrojejunal anastomosis (anterior to transverse colon)
- Close the proximal stump.

Fig. 4.26: Linitis plastica



Figs 4.27A and B: Roux-en-Y loop reconstruction (Billroth I and II)

Polya: End-to-side anastomosis.
Adverse effect: **Hypocalcemia** because calcium in diet is absorbed in the 1st part of duodenum and food is by passed.
Disadvantage: Bile reflux gastritis, stump carcinoma.

Reconstructive Procedures after Total Gastrectomy

1. **Jejunal interposition:** Esophagojejunoduodenal anastomosis
   Disadvantages:
   - Bile reflux
   - Food reflux
   - Duodenal stump blow out

   'Pouch formation: Hunt-Laurence pouch'
   Jejunum folded on itself to form the pouch.
2. Roux-en-Y loop (Fig. 4.28):
   - Y loop—afferent loop should be small
   - Roux loop should be 40–60 cm to avoid bile reflux.

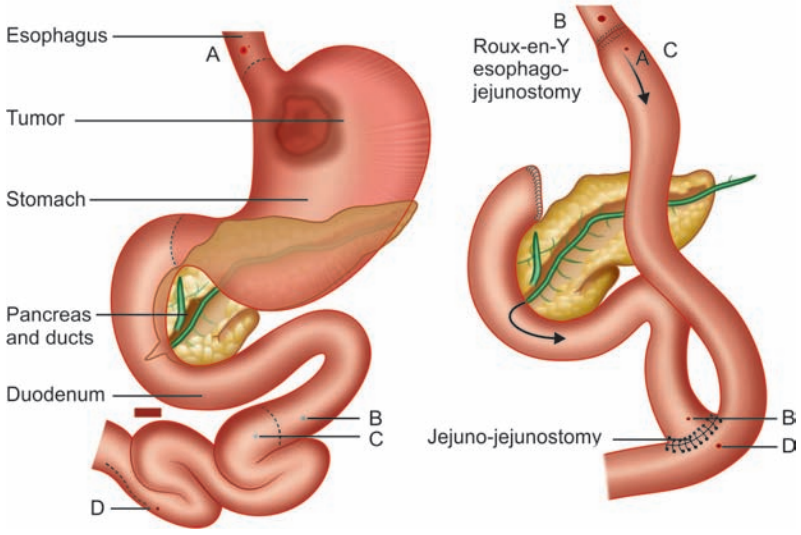


Fig. 4.28: Roux-en-Y reconstruction

Advantages:

- No Bile reflux
- No food reflux.

Chemotherapy

1. **FAM therapy:**
   5-Fluorouracil
   Adriamycin } was considered most
   Mitomycin C } active in past
2. **ECF regimen:** (Cunningham's Royal Marsden regimen):
   Most effective regimen now
   E—Epirubicin
   C—Cisplatin
   F—5-fluorouracil
   E: 50 mg/m^2
   C: 60 mg/m^2 ↕ 3 weekly regimens for 6 cycles.
   F: 200 mg/m^2

Consolidation

1. Ultimately inoperable tumors: Feeding jejunostomy
2. Inoperable tumors in: – Cardiac end: Souttar's tube; stent,
   – Pylorus end—Tanner's anterior GJ.
3. Growth in pyloric and antrum: Subtotal radical gastrectomy with Billroth II
4. Growth in Cardiac end: Total gastrectomy with Roux-en-Y loop reconstruction
5. Distant mets: Chemotherapy only.

PEPTIC ULCER DISEASE

Peptic ulcer is an imbalance between acid, pepsin and mucin.

Sites

- Stomach
- Duodenum
- Lower end of esophagus
- Meckel's diverticulum with ectopic gastric mucosa
- Jejunal site of gastrojejunal anastomosis.

Most Common Sites

Stomach: Lesser curve side of stomach close to incisura angularis.
Duodenum: First 2.5 cm of duodenum.

Classification (Flow Chart 4.1)

Think of Zollinger-Ellison syndrome if there is:

- Unusual ulcer
- Multiple recurrence
- Unusual site (jejunum, post-bulbar)
- Unusual type
- Not responds to treatment.

Differences between

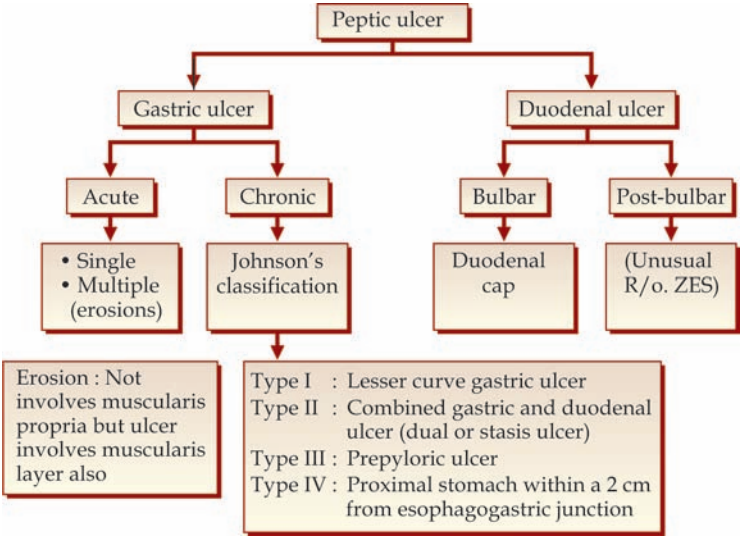
Features	*Duodenal ulcer*	*Gastric ulcer*
Incidence	Common	Less common
Site	First part	Lesser curve
Pain	Relieved by food	Relieved by vomiting
Vomiting	Never occurs unless GOO occurs	Occurs after every meal
Periodicity	Common	Less common
Hematemesis:Melena ratio	40:60	60:40
Built	Well built	Ill built
Tenderness	Duodenal point	Midepigastrium
Malignancy	Never occurs	0.5–5 percent incidence
Surgical treatment	Truncal vagotomy with gastro-jejunostomy	Gastrectomy

Etiology of Chronic Peptic Ulcer

Chronic Duodenal Ulcer

- Hyperacidity
- Neurological: Type 'A' personality with anxiety, hurry, worry characters due to vagal stimulation.
- NSAID
- Genetic causes:
  Blood group O—more prone for Peptic ulcer
  Blood group A—more prone for Ca Stomach
- Food habits: Smoking, spicy foods, spirit precipitate peptic ulcer
- *Helicobacter pylori*
- Endocrinal causes: Zollinger-Ellison syndrome; hyperparathyroidism.

Flow chart 4.1: Classification of peptic ulcer



Chronic Gastric Ulcer

- No hyperacidity is seen, ulcer occurs due to defective gastric mucosal barrier
- NSAID: Damage gastric mucosal barrier
- Food habits: Similar to duodenal ulcer.

Helicobacter pylori

- Gram-negative spiral shaped bacilli.
- Organism gets localized deep beneath the mucus layer closely adherent to the epithelial surface. Here the surface pH is close to neutral and any acidity is buffered by the organisms production of the enzyme urease. Urease enzyme produces ammonia from urea and raises the pH (alkaline) around bacterium. Hence gastric secretion is increased stimulating the acid level though local alkalinity maintained.
- *H. pylori* exclusively colonizes gastric type epithelium and is only found in the duodenum in association with patches of gastric metaplasia.
- Around 90 percent patients of duodenal ulcer and 70 percent of gastric ulcer are infected with *H. pylori*.

Association of H. pylori infection

- Peptic ulcer (Gastric and duodenal)
- Ca stomach
- Lymphoma
- Nonulcer dyspepsia
- Type 'B' gastritis

Not associated with:

- Type 'A' gastritis
- Ca stomach in fundus area.

COMPLICATIONS OF PEPTIC ULCER DISEASE

- Dyspepsia
- Upper gastrointestinal bleeding—melena, anemia

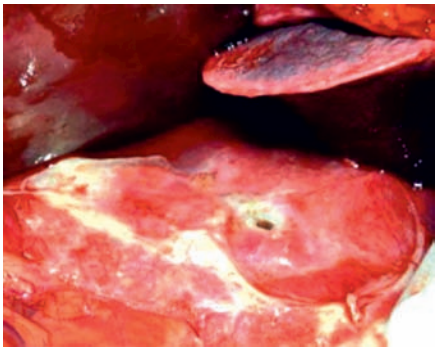


Fig. 4.29: Duodenal ulcer perforation

Fig. 4.30: Teapot deformity

- **Perforation:** Anteriorly located peptic ulcer perforates (Fig. 4.29)
- **Penetration**: Ulcer located posteriorly may penetrate into pancreas or produce hemorrhage (hematemesis):
  - Artery of hemorrhage: **Gastroduodenal artery**
  - If the ulcer is from stomach: The bleeding occurs from **splenic artery**
- **Gastric outlet obstruction:**
  - Peptic ulcer: No mass palpable
  - Ca stomach: Mass palpable.

  Electrolyte abnormality: Hypochloremic, hyponatremic, hypokalemic and metabolic alkalosis with paradoxical renal aciduria (Flow chart 4.2).

  Mechanism

  - Thus acid is secreted though there is metabolic alkalosis, hence known as paradoxical renal aciduria.
- **Deformities of stomach:**
  - **Teapot deformity**: Long-standing lesser curve ulcer (Fig. 4.30)
  - **Hourglass contraction:** Saddle-shaped ulcer in lesser curve (Fig. 4.31)
- **Malignancy:**
  - Gastric ulcer: 0.5 to 5 percent
  - Duodenal ulcer never turns malignant.

Management of Peptic Ulcer

I. ***H. pylori* eradication therapy:**

Triple therapy (for 4 weeks)
- Bismuth
- Metronidazole
- Amoxycillin

Triple therapy (for 2 weeks)
- Omeprazole
- Clarithromycin
- Amoxycillin (or) metronidazole

Dual therapy (for 2 weeks)
- Antibiotics
- Omeprazole

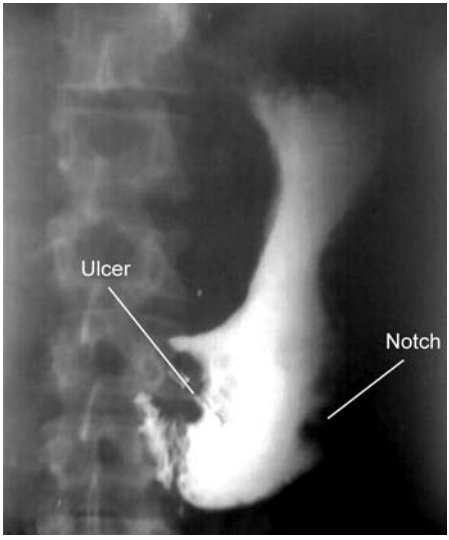
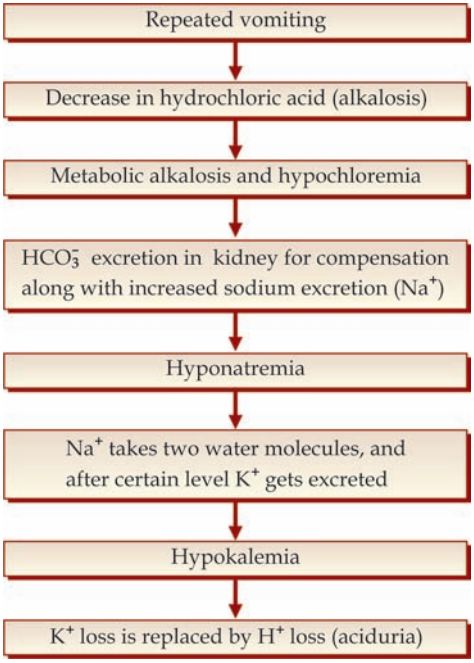


Fig. 4.31: Hourglass deformity

Flow chart 4.2: Metabolic complications in GOO



II. **Medical treatment:**

Peptic Ulcer

1. H_2-blockers:
   - Ranitidine 150 mg bd for 4 to 6 weeks
   - Famotidine, roxatidine

2. Proton pump inhibitors:
   - Omeprazole: 20 mg once a day for 2 weeks or 10 mg bd for 2 weeks.
3. Antacids:
   - Magnesium sulphate
   - Aluminum hydroxide
4. Others:
   - Sucralfate gel
     - Sucrose aluminum phophate
     - Coats the ulcer
     - Prevents acid to come into contact
   - Misoprostol
     - Prostaglandin E_1 analogs
     - Used to antagonize NSAID's induced peptic ulcer.
5. Behavioral treatment:
   - Change lifestyle
   - Treat the insomnia

Gastric Outlet Obstruction

Treatment for GOO:

- Aspirate with Ryles tube
- Maintain input/output charts
- **0.9 percent sodium chloride (isotonic saline) is the fluid of choice** to correct the metabolic abnormality, potassium supplements added.
- Drugs.

III. **Surgeries for peptic ulcer disease:**

- Gastrectomy first performed by Billroth
- Truncal vagotomy first performed by Dragstaedt.

Duodenal Ulcer (Fig. 4.32)

- Truncal vagotomy with gastrojejunostomy (Mayo's GJ)
- Truncal vagotomy with pyloroplasty
- High selective vagotomy
- Taylor's procedure selective vagotomy
- Hill's procedure
- Truncal vagotomy with antrectomy.

Truncal Vagotomy with Posterior Vertical Retrocolic Isoperistaltic no Loop-no-tension Gastrojejunostomy (Mayo's GJ) (Figs 4.33, 4.36A and B)

- Posterior : Anatomosis done in the posterior dependent part of stomach
- Vertical : Stoma is vertical about 4 to 6 cm for drainage
- Retrocolic : Jejunum brought behind the colon
- No-loop : Afferent loop must be small to avoid stasis
- Isoperistaltic : Peristalsis of stomach and jejunum should be in the same direction.

Procedure

- Anterior and posterior trunks of vagus are divided just below the diaphragm and followed by a drainage procedure like a gastrojejunostomy
- Criminal nerve of grassi should be cut without fail.

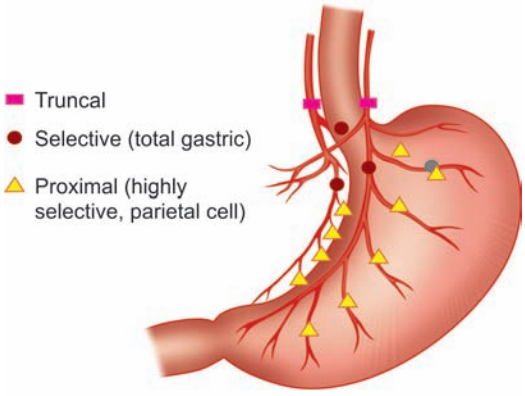


Fig. 4.32: Types of surgery for duodenal ulcer

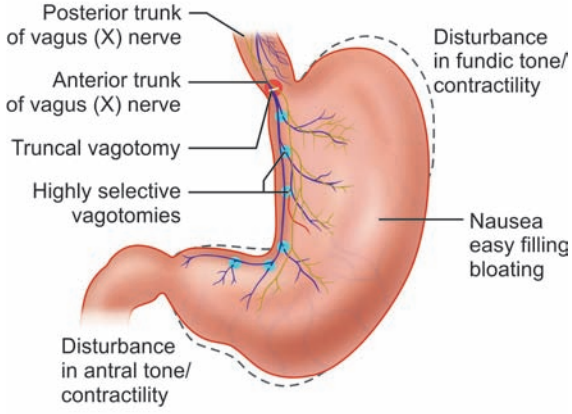
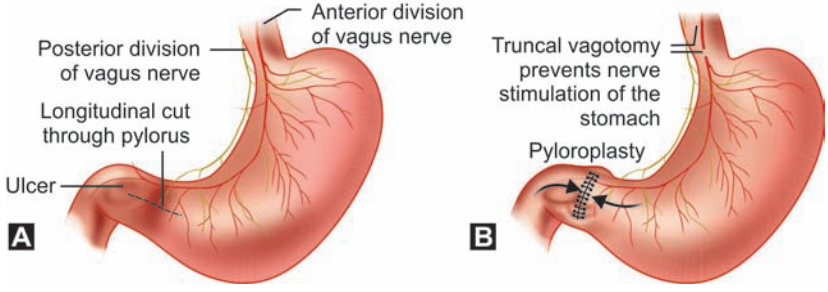


Fig. 4.33: Truncal vagotomy



Figs 4.34A and B: Heinke-Mikulicz pyloroplasty

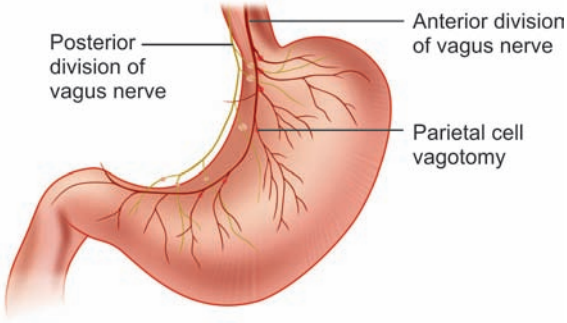
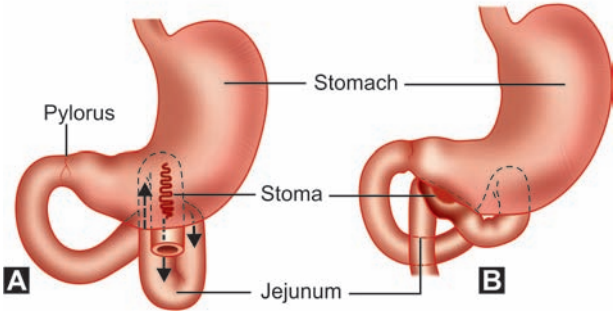


Fig. 4.35: High selective vagotomy



Figs 4.36A and B: Truncal vagotomy (TV) with posterior gastrojejunostomy

VIVA QUESTIONS

1. **Why should you do gastrojejunostomy after truncal vagotomy?**
   - Vagus is secretomotor to stomach and after vagotomy the motility of stomach is lost and gastric stasis occurs. Hence, drainage procedure is a must.
2. **Is there any other drainage procedure other than posterior GJ?**
   - Yes, pyloroplasty—making the pyloric canal opened always.
3. **Why should you prefer posterior GJ?**

Posterior GJ is preferred because it gives a dependent drainage by gravity.

Disadvantages

- Bile stasis
- Gall stones; as the hepatic branches are cut leading to bile stasis in gallbladder and stone formation.

Truncal Vagotomy with Heineke-Mikulicz Pyloroplasty (Figs 4.33 and 4.34)

- It is a drainage procedure instead of GJ
- Pylorus is incised longitudinally and sutured transversely, thus pyloric ring becomes incompetent and wide open.

Disadvantage
Bile reflux gastritis.

High Selective Vagotomy (Fig. 4.35)

In this procedure only the gastric branches (Parietal cell) are cut; preserving the nerve of Laterjet (Crow's foot) supplying the pylorus.

Advantages of high selective vagotomy (HSV)

- More physiological with minimal disturbances
- No drainage procedure is required because pyloric function is preserved
- Nerve supply to gallbladder and liver are not disturbed
- No diarrhea which occurs in 5.8 percent of cases of truncal vagotomy.

Disadvantage
High incidence of recurrence (20%).

Taylor's Procedure

- Posterior truncal vagotomy with anterior lesser curve seromyotomy.
- Seromuscular layer anteriorly along the lesser curve side cut thereby nerve supply to the gastric mucosa is damaged.
- No need of drainage procedure.

Hill's Procedure

Anteriorly highly selective with posterior truncal vagotomy.

Truncal Vagotomy with Antrectomy

- Acid producing antrum itself is removed
- Most effective.

Procedure	*Recurrence*	*Mortality*	*Side effects*
TV with antrectomy	1 percent	1 percent	+
TV with GJ	5 percent	<1 percent	Bile stasis
Selective Vagotomy	5–10 percent	<1 percent	+
HSV	2–10 percent	<0.2 percent	–

Gastric Ulcer

Depending on the Site

Site of benign gastric ulcer	*Procedure*
Cardiac end	Kelling-Madlener procedure
Body	Partial gastrectomy with Billroth II (not subtotal radical)
Antrum	Partial gastrectomy with Billroth I (not subtotal radical)

Viva: What is the difference between partial and subtotal gastrectomy?

- **Subtotal gastrectomy**: About 80 percent of distal stomach removed—done for cancers

- **Partial gastrectomy**: About 60 to 75 percent stomach removed distally—done for benign conditions
- **Antrectomy**: About 35 percent distal stomach removed.

Kelling Madlener Procedure

Resection of stomach done distal to the ulcer. Ulcer heals by itself as the acid producing part is excised. Not done nowadays.

Sequence of Gastric Surgeries

I. Due to vagotomy:

- Bile stasis
- Gallstones
- Postvagotomy diarrhea
- Stump carcinoma:
  Hypoacidity leads to bacterial proliferation and nitrates production.
- Recurrence:
  - Inadequate vagotomy
  - Antral stasis
  - Inadequate gastric resection
  - ZES.

II. Gastric resection and anastomosis:

1. **Weight loss; anemia:**
   i. Iron deficiency anemia due to:
      - Loss of gastric juice for iron absorption
      - Diminished splitting of Fe^{2+} protein complex due to reduced pepsin activity.

   ii. Macrocytic anemia due to:
   Loss of intrinsic factor leading to B_{12} deficiency.
2. **Bone disease (Osteomalacia):** In polya type hypocalcemia occurs; since duodenum is excluded from food absorption.
   (*Note:* Duodenum is the main site for calcium absorption).
3. **Early and late dumping (Post-cibal syndrome).**

Early dumping

- After meals; small bowel gets filled with food stuff. Osmotic overload leads to sequestration of fluid from circulation into gastrointestinal tract. This leads to vasomotor and abdominal symptoms due to hypovolemia.
- Occurs immediately.
- Diagnosed by increased packed cell volume.

Treatment

- Small, dry meals
- Octreotide (analogue of somatostatin)
- Revision surgery: Roux-en-Y reconstruction.

Late dumping

- After meals; carbohydrate load causes a rise in plasma glucose level; results in increased insulin release that leads to *reactive hypoglycemia*

- 2nd hour after meals
- Diagnosed by measuring *blood glucose level*.

Treatment

- Octreotide is effective (Side effect: Gallstone formation).
- Same as for early dumping.

	Early dumping	*Late dumping*
Incidence	5 to 10 percent	5 percent
Relation to meals	Immediately	Second hour
Duration	30 minutes	30 minutes
Relief	Lying down	Food
Aggravated by	More food	Exercise
Clinical features	Epigastric fullness, sweating, tachycardia, diarrhea	Tremor, faintness, prostration

4. Bile vomiting
5. Small stomach syndrome: Early satiety
6. **Diarrhea:**
   i. Frequent loose stools
   ii. Intermittent episodes of short lived diarrhea
   iii. Severe intractable explosive diarrhea.
   - Etiology is uncertain.
7. **Duodenal stump blow out:** most common on 4th postoperative day.
8. **Afferent loop syndrome:** Obstruction of afferent loop that cannot empty its contents.
   – Partial obstruction: Bilious vomiting
   – Total obstruction: Perforation of loop.

Due to Gastrojejunostomy

- Stomal obstruction
- Retrograde jejunal intussusception
- Gastrojejunocolic fistula.

Causes of Recurrent Ulcer

- Incomplete vagotomy
- Gastrojejunostomy alone
- Inadequate gastrectomy
- Narrow stoma
- Zollinger-Ellison syndrome
- Hyperparathyroidism.

Miscellaneous

Zollinger-Ellison Syndrome (Gastrinomas)

- Gastrinomas are most commonly seen in duodenal loop
- Also seen in head of pancreas
- Many are found in 'G' cells of Brunner's glands of duodenum.

Passaro's triangle: Formed by the lines joining
- Junction of cystic duct and common bile duct
- Junction of 2nd and 3rd part of duodenum
- Junction of neck and body of pancreas medially:
  - Outside the triangle tumors have a bad prognosis
  - Tumors are common in this triangle.

Gastrinomas

- Sporadic
- Familial (MEN-I)
  - Most specific and sensitive test is secretin provocative test

Treatment: Omeprazole/surgery.

Gastric Lymphoma

- Stomach is most common site for lymphoma in gastrointestinal tract
- Peak incidence 6th to 7th decade
- Most common site—antrum.

Pathology

- Diffuse large 'B' cell lymphoma (55%)
- MALT (40%)
- Burkitt's lymphoma (3%)
- Mantle and follicular lymphoma (<1% each)
  - Diffuse 'B' cell type and MALT are associated with *H. pylori infection*
  - Burkitt's lymphoma associated with Epstein-Barr virus infection
  - Burkitt's lymphoma is common in younger age group
  - Burkitt's most common in cardia or body.

Complications

- Bleeding
- Perforation.

Treatment

- Treatment is controversial
- Localized disease—surgery alone
- Systemic disease—chemotherapy alone
- There is increased risk of perforation under chemotherapy
- **CHOP regimen**
  - Cyclophosphamide
  - Doxorubicin
  - Vincristine (oncovin)
  - Prednisolone
- Patients with early MALT and limited B-cell lymphoma may be effectively regressed by *H. pylori* eradication alone.

Gastrointestinal Stromal Tumors

Previously termed as leiomyomas and leiomyosarcomas, these terms are not used now.

- Within the GIT, stomach is most common site (70%)
- Histologically arise from ***cells of Cajal***, autonomic nerve related ***gastrointestinal pacemaker cells that regulate intestinal motility***
- They express **CD117-tyrosine kinase receptor**
- This is the tumor which ***bleeds commonly*** than other tumors
- Surgery is the only treatment
- **Imatinib mesylate;** inhibitor of tyrosine kinases is used now in unresectable and metastatic GIST (Gastrointestinal stromal tumors).

5 CASE Obstructive Jaundice

- History
- History of Presenting Complaints
- General Examination
- Investigations
- Diagnostic Laparoscopy
- Discussion of Each Topic
- Carcinoma Pancreas and Periampullary Carcinoma
- Bile Duct Cancers

This is the most extensive case in exam. It deals in detail the whole of hepatobiliary system and discussion may go anywhere all around biliary system. I am trying my best to cover the maximum area involved in discussion.

HISTORY

Before going to history taking you should know the causes of obstructive/surgical jaundice.

- **Congenital**: Biliary atresia, choledochal cyst
- **Inflammatory**: Ascending cholangitis, sclerosing cholangitis
- **Obstructive**: Common bile duct (CBD) stones, biliary stricture, parasitic infestation
- **Neoplastic**: Carcinoma of head of pancreas, periampullary carcinoma, cholangiocarcinoma, Klatskin tumor
- **Extrinsic compression**: Compression by lymph nodes, tumors over CBD.

Presents with Complaints

- Jaundice
- Fever
- Itching
- Weight loss/loss of appetite
- Vomiting
- Urine coloration/passing pale stools.

HISTORY OF PRESENTING COMPLAINTS

- Jaundice
  - Duration
  - Onset
  - Progression—gradual/intermittent
  - Associated with pain or not.

Painless jaundice
- Continuous and progressive—carcinoma of head of pancreas
- Intermittent—carcinoma at periampullary region (due to sloughing of tumor)

Painful jaundice
- CBD stone

- Fever
  - Intermittent/continuous
  - Duration
  - Associated with chills and rigors.
- Vomiting—unrelated to food.

Charcot's triad

Seen in ascending cholangitis:
- Intermittent fever
- Intermittent pain
- Intermittent jaundice

Past History

- Diabetes, hypertension, heart disease, asthma
- History of previous gallbladder surgery—may lead to bile strictures and jaundice.

Note: Examination points are related to jaundice in this chapter.

GENERAL EXAMINATION

- **Jaundice**: Yellow discoloration of sclera, skin, nail bed, under surface of tongue, soft palate
  - Look in natural light
- **Scratch marks**: Over chest and abdomen.

Abdominal Examination

Inspection

Look for fullness in right hypochondrium due to distended gallbladder:
- Can be seen in very thin patients
- See for movement with respiration.

Palpation

When distended it can be felt as tense globular swelling projecting downwards and forwards from below the liver just lateral to the outer border of rectus muscle (Below the 9th rib tip)
- Moves with respiration
- Upper limit continuous with liver
- Can be moved slightly from side-to-side.

Murphy's sign (Fig. 5.1)
- Patient in **sitting posture**
- Place the right hand just below the right costal margin on the lateral border of right rectus and moderate pressure is exerted with finger to palpate gall-bladder

Fig. 5.1: Moynihan's method (in Murphy's sign patient will be sitting)

- Now ask the patient to take a deep breath in, the gallbladder descends and hurts the examining finger, the patient will wince with catching pain if organ is inflamed.

Moynihan's method

- Patient ***lies down*** instead of sitting with same steps as above.

Palpable gallbladder

1. Mucocele
2. Empyema
3. Obstructive jaundice due to carcinoma pancreas
4. Carcinoma of gallbladder

Courvoisiers Law

In a patient with jaundice if there is a palpable gallbladder it is not due to stones.

Explanation (Figs 5.2A to D)

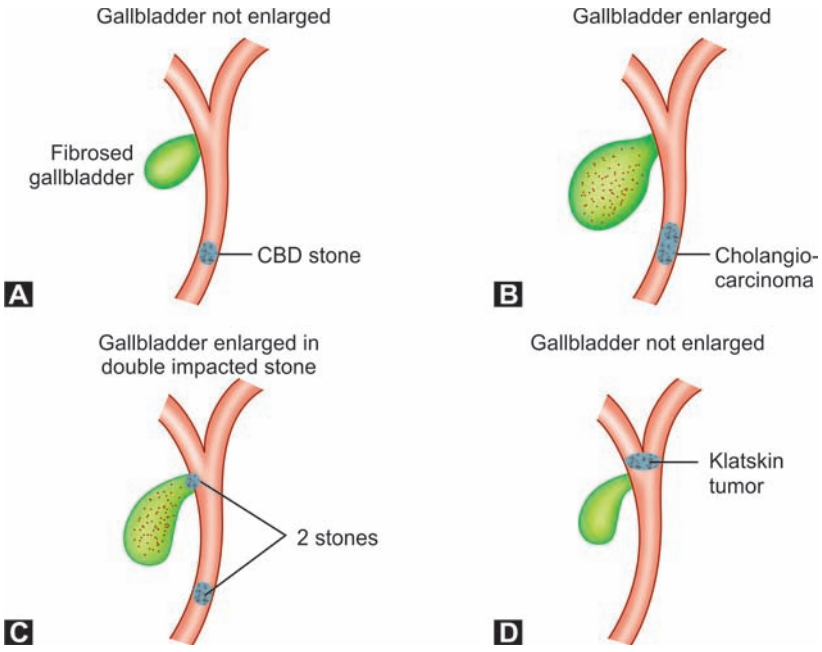
- In pathology of gallbladder like calculus cholecystitis there will be fibrosis of the gallbladder and hence it can not enlarge if there is a distal obstruction
- But if the pathology is there outside gallbladder due to CBD carcinoma, pancreatic carcinoma you can palpate the gallbladder.

Exceptions to this Law

- Double impaction of stone—one in CBD and other in cystic duct
- Oriental cholangiohepatitis
- Pancreatic calculus obstructing ampulla of vater
- Mucocele due to stone in cystic duct.

Diagnosis

This is a case of obstructive jaundice
The site of obstruction probably at (CBD, hepatic duct, ampulla)
And the cause of obstruction due to (stones, cancer)



Figs 5.2A to D: (A and B) Courvoisier's law; (C and D) Exceptions to Courvoisier's law

INVESTIGATIONS

Basic Blood Investigations

- **Serum bilirubin:**
  - Exceeds 2.5 to 3.5 mg/dL (42.8 to 51.3 micromoles/liter)
  - Increased direct bilirubin (Suggests obstructive type)
- **Liver function tests:**
  - Elevated *alkaline phosphatase* > 10 times normal is strongly suggestive of obstruction
  - Simultaneous elevation of *gamma-glutamyl transferase* confirms obstruction (increases up to 40 fold)
- Coagulation profile
- **Prothrombin time** (INR—International Normalized Ratio).

Liver is the main site for synthesis of all coagulation proteins. Abnormalities of these factors can be determined by measuring prothrombin time (PT)—which measures the rate of conversion of prothrombin to thrombin, which requires vitamin K dependent clotting factors (factor 2, 7, 9, 10). Vitamin K is fat soluble vitamin, absorption of which requires presence of bile salts in intestine which is absent in patients with obstructive jaundice.

So, prothrombin time is prolonged—hence, injection of vitamin K should normalize the prothrombin time in obstructive jaundice.

Radiological Investigations

Ultrasonogram—Most Useful Noninvasive Investigation

Advantageous in:

- Distinguishing medical and surgical jaundice (dilatation of intrahepatic biliary radicles indicate obstructive cause)
- Site of obstruction
  - **CT scan**—more specific in detecting the level of obstruction and the cause of obstruction than ultrasound
  - **Magnetic resonance cholangiopancreatography (MRCP) scan** has largely replaced endoscopic retrograde cholangiopancreatography (ERCP) nowadays in detecting various pathologies (Figs 5.3 and 5.4)
  - **Endoscopic ultrasonogram**—best to diagnose the pathologies in low bile duct and **MRCP** for hilar obstruction.

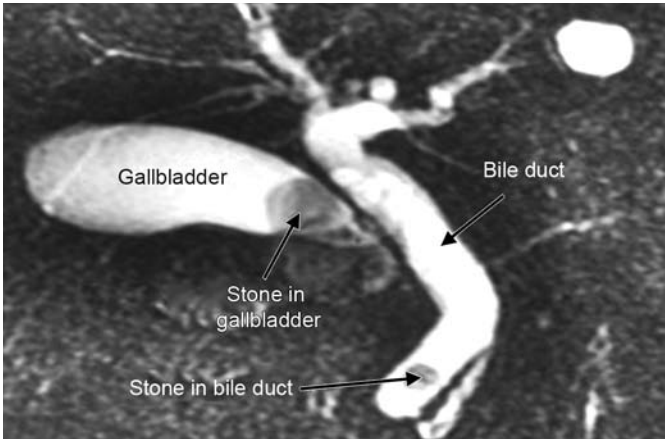


Fig. 5.3: MRCP showing gallstone/CBD stone

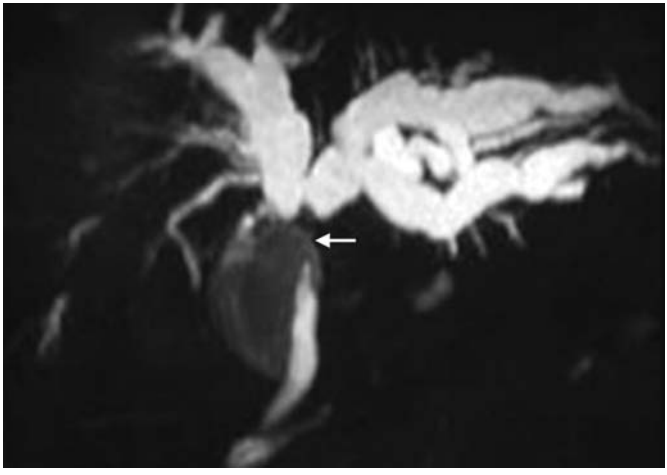


Fig. 5.4: MRCP showing hilar cholangiocarcinoma

Invasive Investigations

ERCP—Gold Standard for CBD Stone Removal

Other uses (Figs 5.5 and 5.6):

- Stenting for inoperable tumors
- Endoscopic basketting and stone retrieval
- Biopsy
- Preoperative bile drainage
- Sphincter of Oddi dysfunction—sphincterotomy.

Fig. 5.5: Normal ERCP

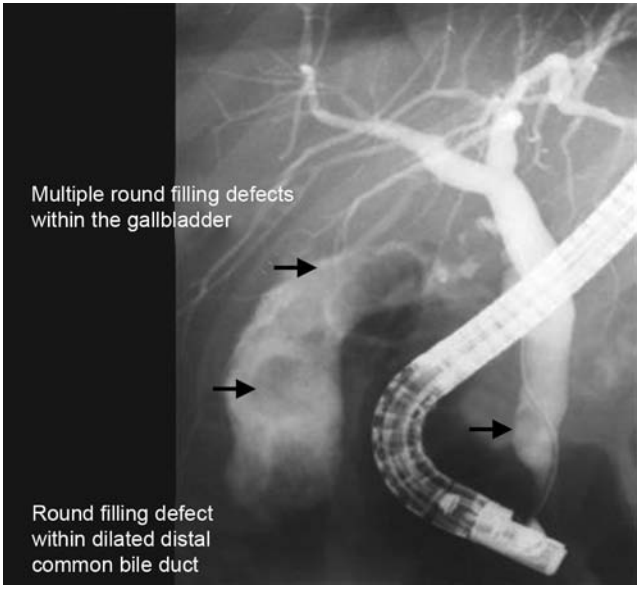


Fig. 5.6: CBD stone/gallstones in ERCP

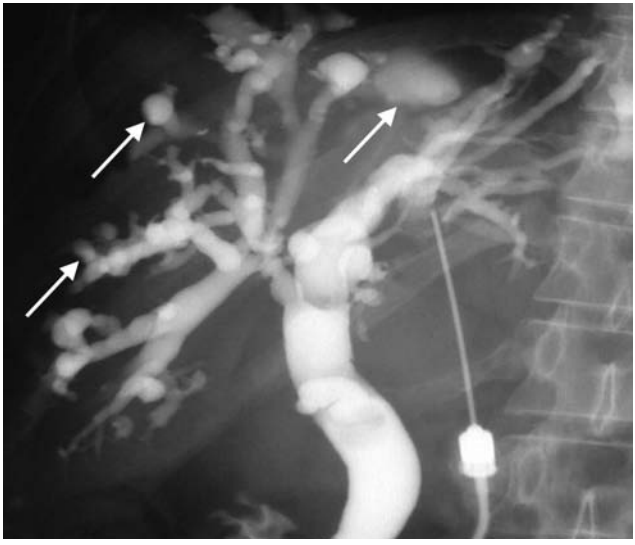


Fig. 5.7: Percutaneous transhepatic cholangiogram (PTC) shows Caroli's disease

Complications of ERCP

- Acute pancreatitis (5%)
- Duodenal perforation
- Hemorrhage
- Infection
- Stent migration.

Percutaneous Transhepatic Cholangiogram (Fig. 5.7)

- To diagnose pathologies in higher level above cystic duct
- Preoperative bile drainage.

DIAGNOSTIC LAPAROSCOPY

Two most essential procedure before coming to a conclusion that a tumor in biliary tract is operable are:

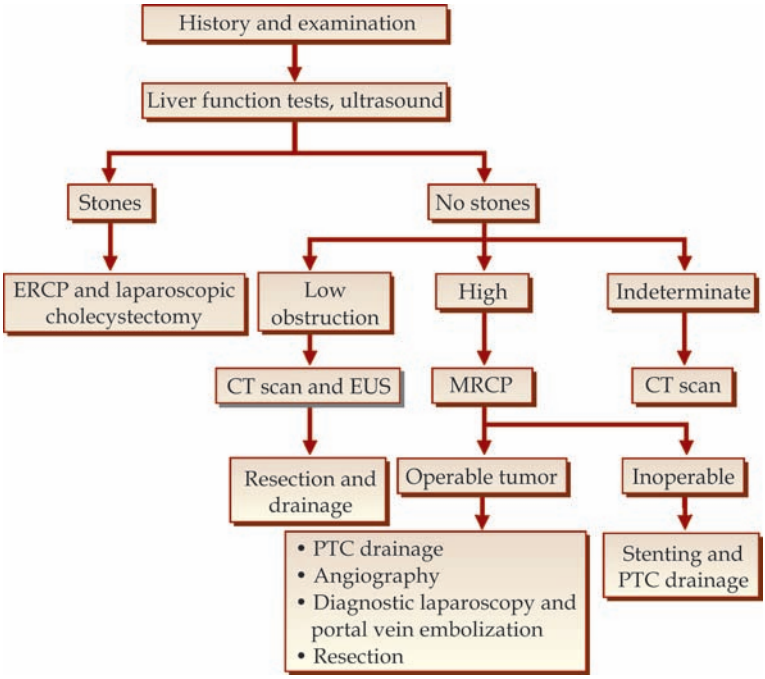
- Diagnostic laparoscopy
- Portal vein embolization to look for portal vein invasion.

It will detect micromets in liver surface and pelvic deposits. Thus prevents unnecessary laparotomy.

Treatment in outline (Flow chart 5.1)

1. Choledocholithiasis causing jaundice—laparoscopic cholecystectomy with laparoscopic CBD exploration and stone removal or ERCP stone retrieval in the same admission following laparoscopic cholecystectomy
2. Biliary stricture—choledochoduodenostomy/choledochojejunostomy
3. Carcinoma head of pancreas and periampullary carcinoma—whipples procedure
4. Cholangiocarcinoma—resection of the tumour and choledochojejunostomy/duodenostomy

Flow chart 5.1: Algorithm for obstructive jaundice



DISCUSSION OF EACH TOPIC

Cholelithiasis

Gall Stones

- Most common type of stone—mixed stone.

Types of Stones

- Cholesterol stones (Fig. 5.8)
- Brown pigment stones
- Black pigment stones
- Mixed.

Pathogenesis

- Lithogenic bile
- Nucleation
- Stasis.

Lithogenic Bile

Bile salts and phospholipids in bile keep cholesterol in solution by forming micelles.

Normal Ratio

Bile acids: Cholesterol = 20:1
Critical ratio = <13:1

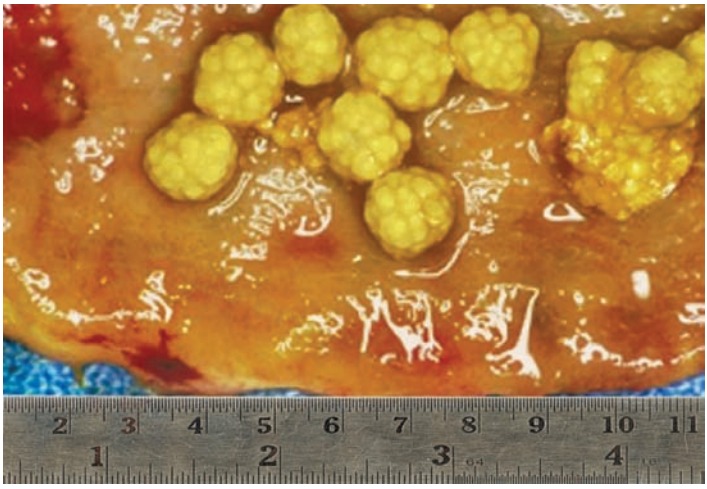


Fig. 5.8: Cholesterol stones

Cholesterol is insoluble in water which is made soluble by bile salts and phospholipids:

Increased Cholesterol

- Obesity
- High cholesterol diet
- Clofibrate therapy.

Decreased Bile Salts

- Primary biliary cirrhosis
- Oral contraceptive pill/Estrogens
- Genetic factors.
  Decreased 7 alpha hydroxylase
  (Converts liver cholesterol to bile acids)

Decreased entero hepatic circulation

- Ileal disease
- Ileal resection
- Cholestyramines
- Deoxycholate.

Nucleation

- Process by which cholesterol monohydrate crystals form and agglomerate to become macroscopic crystals
- **Excess pronucleating factors:**
  - Mucins
  - Nonmucin glycoproteins
  - Infection
- Deficiency of antinucleating factors
- Apolipoproteins A1 and A2.

Stasis

- Prolonged total parental nutrition (TPN)
- Fasting

- Pregnancy
- Drugs—octreotides
- Oral contraceptive pill (OCP)
- Burns, surgery.

Predisposing Factors

- Fat fertile female flatulent fifty (5 F's)
- Diabetes mellitus
- Old age
  - Increased cholesterol level
  - Decreased bile acid pool
  - Decreased bladder motility.

Pigment Stones

Name given when contains <30 percent cholesterol.
Predisposed by:

- Genetic factors
- Chronic hemolysis
- Alcoholic cirrhosis
- Infection—*E. coli*, ascariasis, clonorchis
- Ileal resection/bypass
- Cystic fibrosis.

Black Pigment

- Composition—pure calcium bilirubinate + mucin.

Brown Pigment

- Composition—calcium salts of unconjugated bilirubin + cholesterol + calcium bilirubinate/palmitate/stearate.

Black Pigment (Fig. 5.9)

Most common in hemolytic states

- Hereditary spherocytosis, sickle cell disease
- Heart valves (mechanical)
- Liver cirrhosis
- Gilbert's syndrome
- Cystic fibrosis
- Ileal resection.

Brown Pigment (Fig. 5.10)

- Rare in gallbladder
- Primary bile duct stone formation
- Due to bile stasis and infection
- Most common—*E. coli*
- Most common in presence of foreign body, stents, parasites

Fig. 5.9: Black pigment stones

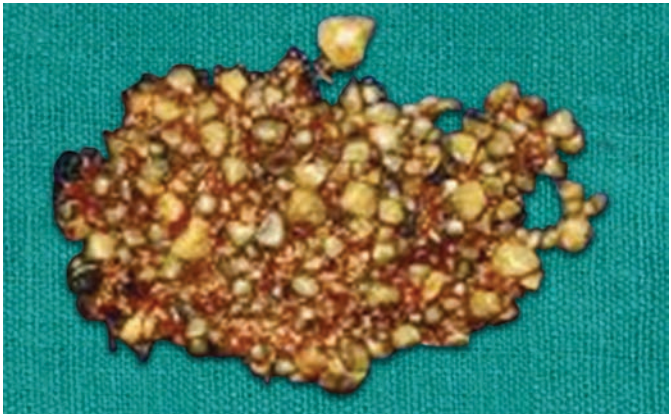


Fig. 5.10: Brown pigment stones

- *E. coli* secretes beta glucoronidase that deconjugates the soluble conjugated bilirubin to insoluble form.

Complications

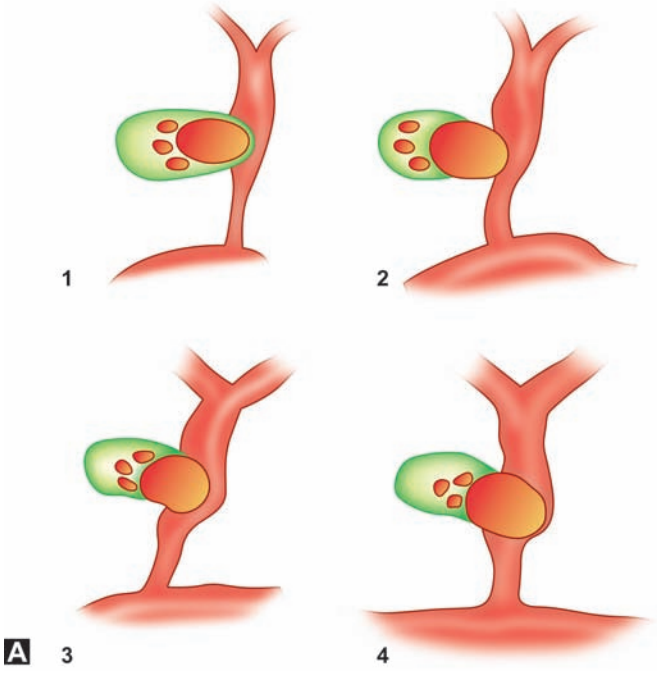
- Silent
- Acute cholecystitis
- Chronic cholecystitis
- Mucocele
- Empyema
- Gangrene
- Carcinoma
- Fistula.

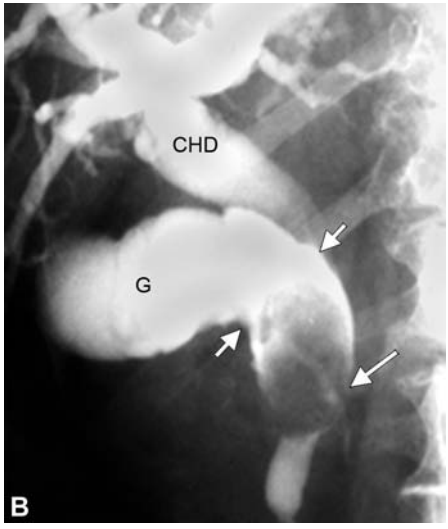
Mirrizi Syndrome (Figs 5.11A and B)

- It refers to the obstruction or stricture of the common hepatic duct as result of extrinsic compression by a gallstone in the Hartmann's pouch.

Types:

- **Type 1 (11%):** Extrinsic compression of CHD by a large stone in Hartmann's pouch





Figs 5.11A and B: Mirrizi syndrome

- **Type 2 (41%):** Stone has now eroded into the hepatic duct to form a fistula involving less than 1/3rd of circumference
- **Type 3 (44%):** Lesions involve 2/3rd of circumference
- **Type 4 (<4%):** Completely destroyed hepatic duct.

Cholecystoenteric Fistula

- Most common site duodenum
- Diagnosis suspicious by presence of air in bile duct
- Complication—gallstone ileus
- Other sites fistula—colon.

Saints triad
- Gallstones
- Diverticulosis of colon
- Hiatus of hernia

Treatment Options

Operate for symptomatic gall stones

For asymptomatic stone surgery must in following situations only:
- 3 cm size or more
- Multiple small stones (can pass to CBD)
- Polyp associated with stone
- Porcelain gallbladder
- Congenitally abnormal gallbladder
- Diabetes with gallstones
- Immunocompromised patients—complications are high and transplant cases.

Common Bile Duct Stones

- **Primary**:
  - Formed in bile duct itself
  - Brown pigment stones
- **Secondary**: Formed in gallbladder and enters CBD (Cholesterol stones).

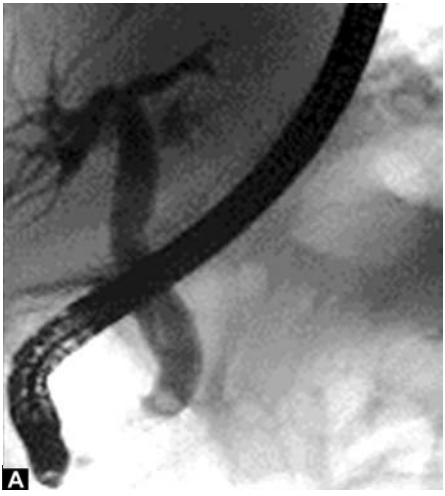
Clinical Features

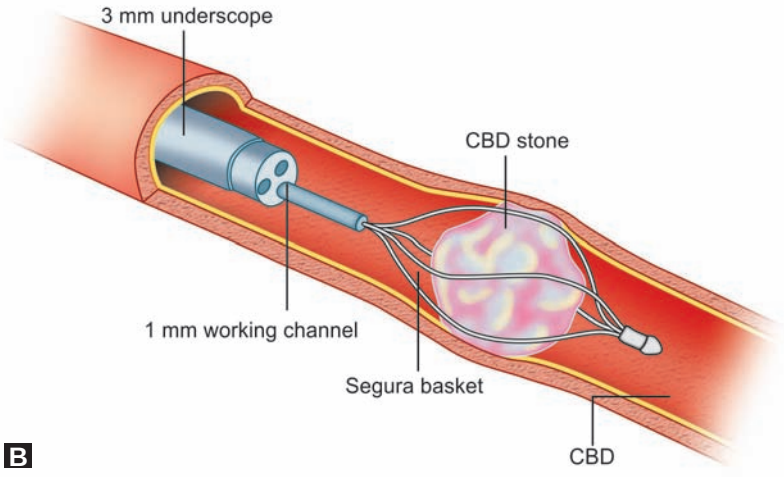
Charcot's triad:

CBD stone causing cholangitis
- Pain
- Jaundice
- Rigors.

Reynolds pentad

It includes charcots + septic shock+ mental status changes:
- Most common organisms: *E. coli*, *Klebsiella, S. faecalis*, bacteroides
- First investigation of choice: USG
- Definitive investigation: ERCP (gold standard for gallstones in CBD)
- Best noninvasive investigation: MRCP.





Figs 5.12A and B: ERCP stone retrieval

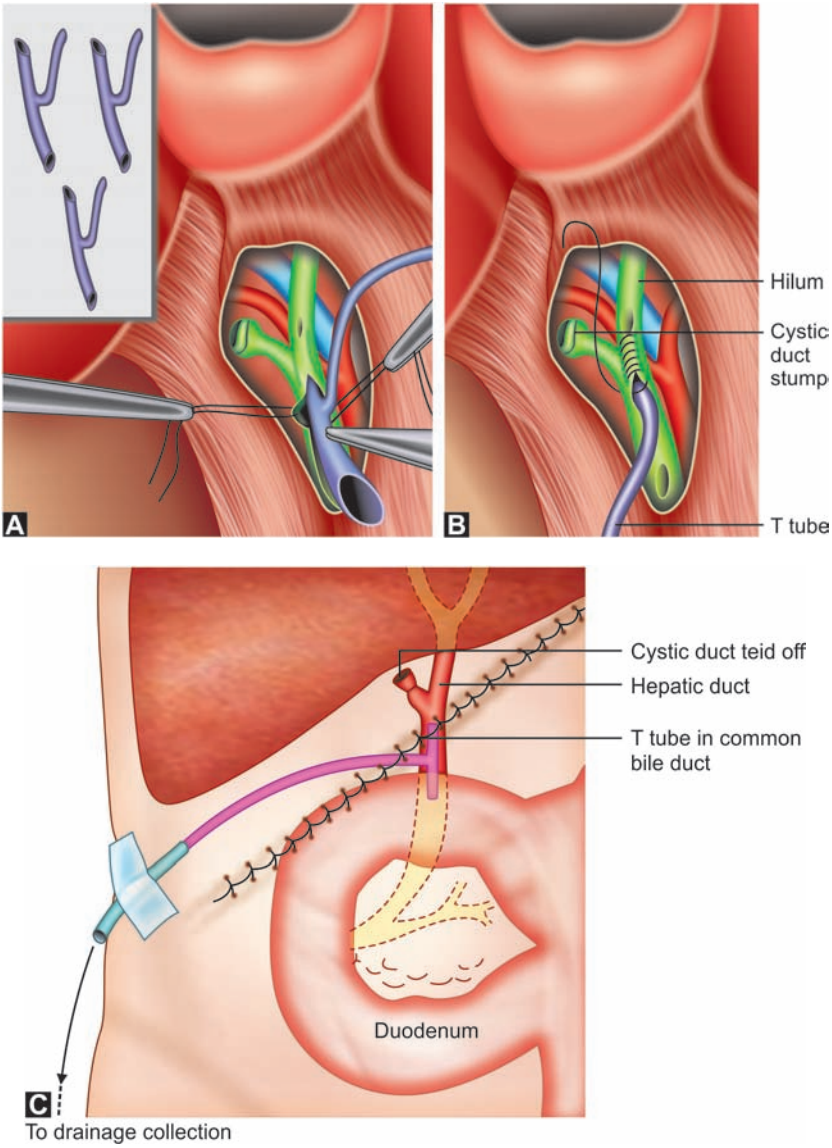
Treatment Options

In presence of cholangitis

- ERCP with sphincterotomy and stone extraction (treatment of choice) (Figs 5.12A and B)
- PTC drainage
  - ERCP failed cases
  - Biliary enteric anastomosis being done
  - Obstruction more proximal
- **Surgical treatment**—only when above two procedures not possible decompression of CBD with T tube.

In absence of cholangitis:

- Laparoscopic cholecystectomy with CBD exploration
- Laparoscopic cholecystectomy with ERCP stone removal later.



Figs 5.13A to C: CBD exploration

CBD Exploration and T-tube Removal (Figs 5.13A to C)

- Postoperative cholangiogram—day 7th pod (Fig. 5.14)
- Remove T tube–8–10 days
- Remove T tube on 2 weeks for diabetes and immunocompromised.

Unexpected ductal calculi after cholecystectomy or routine intraopepative cholangiogram (4-10%):

Laparoscopic cystic duct extraction or immediate postoperative ERCP retrieval.

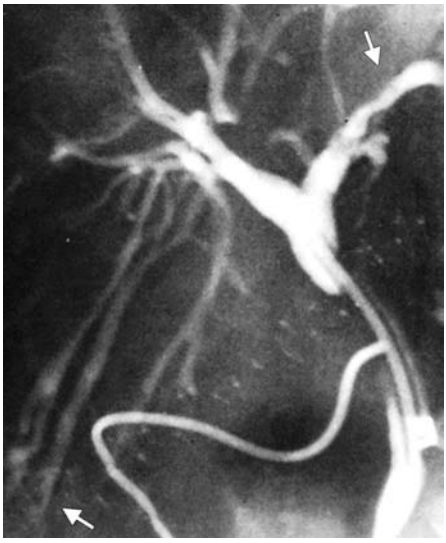


Fig. 5.14: T tube cholangiogram–7th day/remove it on 8–10th days

Missed/Retained/Residual Stones (<2 Years)

If T tube present:

- Flushing with heparinized saline
- Dissolution with **methyl tertbutyl ether**
- Percutaneous stone extraction via T-tube tract after 4 to 6 weeks **(Burhenne technique)**

If T tube absent:

- ERCP stone removal.

Recurrent Stones (>2 Years)

- Most common due to nonabsorbable suture materials, clips
- They get internalized and get covered with calcium bilirubinate to form brown pigment stones
- ERCP—first approach
- If duct dilated >2 cm—choledochoduodenostomy or transduodenal sphincteroplasty.

CARCINOMA PANCREAS AND PERIAMPULLARY CARCINOMA (FIGS 5.15 TO 5.17)

Pancreatic Tumors

- Exocrine—adenocarcioma
- Endocrine—insulinoma, gastrinoma, glucagonoma.

Exocrine Tumors

- Most common type—adenocarcinoma

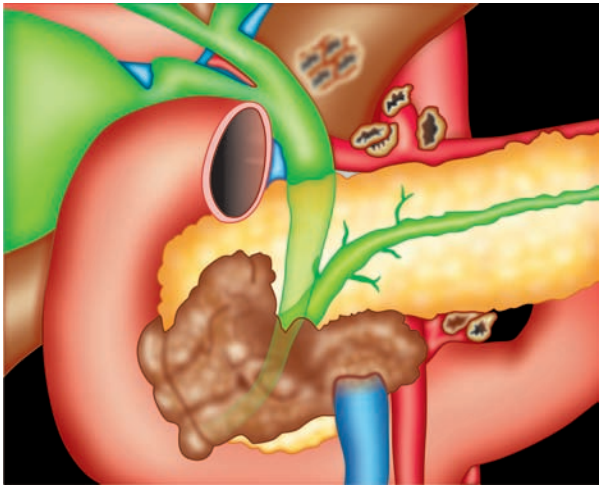


Fig. 5.15: Pancreatic cancer—head of pancreas

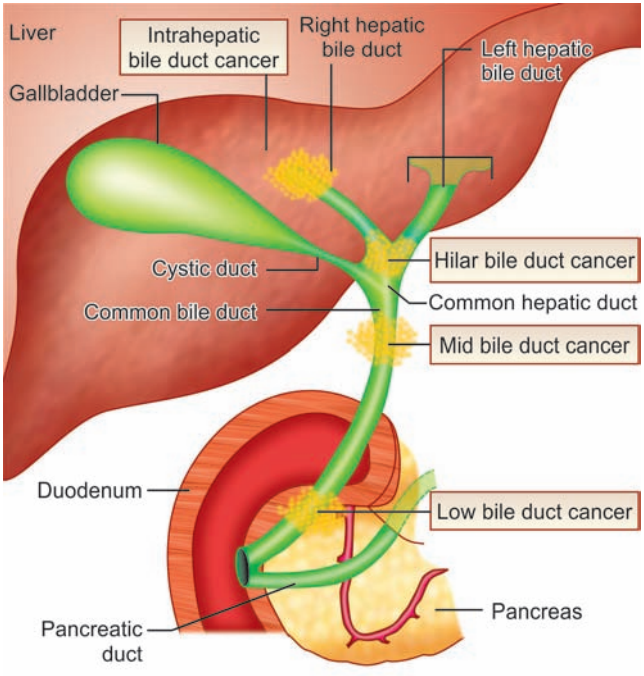


Fig. 5.16: Bile duct cancer

- **Periampullary carcinoma:** Tumors in region of ampulla, lower CBD, duodenum are totally called as periampullary carcinoma (most common presentation is painless jaundice)
- Most common site is the **head of the pancreas**

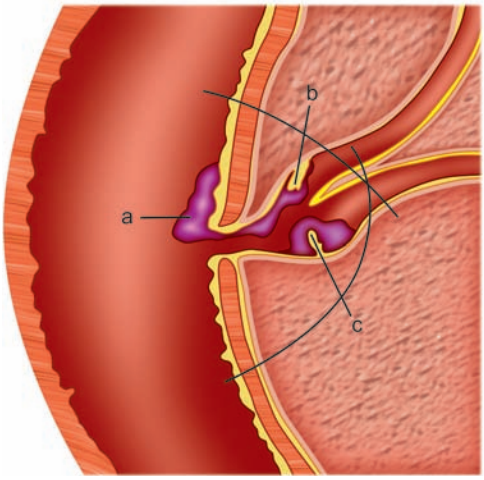


Fig. 5.17: Periampullary cancer: a—Intraduodenal; b—Lower CBD; c—Intra-ampullary

- Necrotic pancreatic tumors increase thromboplastic factors. Thrombophlebitis seen as a result
- No specific blood tests to diagnose
- Elevated amylase, lipase, alkaline phosphatase, bilirubin, CEA, CA 19-9
- CT scan, ultrasonography
- Needle biopsy
- ERCP—most definitive diagnostic test.

Note: We should know the differences between pancreatic head carcinoma and periampullary carcinoma as they are the two common cancers in this region.

Both are adenocarcinomas.

Pancreatic adenocarcinoma	*Periampullary carcinoma*
Most common in head	Common in three regions as noted already
Presents with only weight loss so, presentation is very late	Presents with jaundice so, presentation is early
Because of late presentation prognosis is very bad	Early presentation makes the prognosis is good
Resection rate is very low (only 20–30 percent cases resectable)	Resection rate is good

- **Trousseau's sign**- migratory thrombhophlebitis
- **Troisier's sign**- left supra clavicular node

Whipples Procedure (Fig. 5.18)

- Radical pancreaticoduodenectomy
- Used for cancer of the pancreas head only.

Removal of

- Pancreas head (P)
- Duodenum (D)

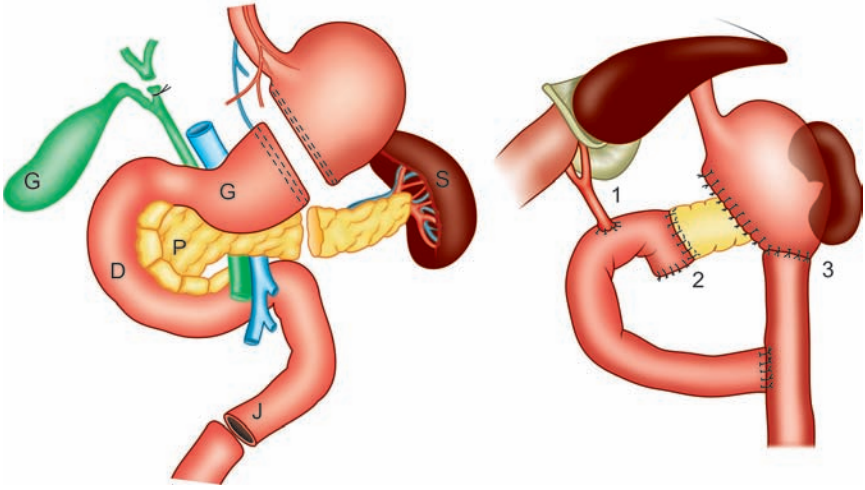


Fig. 5.18: Whipple's procedure—organs removed

- Stomach (G)
- Portion of jejunum (J)
- Gallbladder (Triple anastomosis): Pancreaticojejunostomy (2), choledocho-jejunostomy (1), gastrojejunostomy (3).

Carcinoma Gallbladder

- Most common malignancy of biliary tract
- Most common female elderly
- 70 to 80 percent gallstones associated

Risk Factors

- Gallstones
- Polyps (>10 mm)
- Porcelain gallbladder
- Choledochal cyst
- Anomalous pancreaticobiliary duct junction
- Typhoid carriers
- Sclerosing cholangitis
- Ulcerative colitis
- Cholecysto-enteric fistula
- Drugs-estrogens (not OCP)
- Carcinogens (nitrosamines, azo dyes, rubber industry chemicals).

Clinical Features

- Pain (73%)
- Anorexia and weight loss (63%)
- Jaundice (54%)—poor prognostic sign

- Fever
- Vomiting (mechanical obstruction or malignant gastroparesis)

On examination-mass palpable (50%), hepatomegaly, ascites
Pathology—adenocarcinoma (90%), undifferentiated, SCC.

Investigations

- USG—localized excessive thickening of gallbladder (normal gallbladder thickness is <3 mm)
- CT contrast (CECT)—lymphnodes >10 mm visible
- **MRI + MRCP + MRA** is most useful than all above—helps in planning management
- FNAC—contraindicated in operable tumors (risk of dissemination via tract)
- FNAC is indicated only in inoperable tumors.

Diagnostic Laparoscopy is a Must

- Before curative resection by laparotomy
- 38 percent cases found inoperable among them planned for curative resection after all above investigations
- Tumor markers CEA, CA19-9.

Contraindications for Surgery

- Poor general condition
- Liver metastasis
- Extrahepatic metastasis
- Peritoneal spread
- Distant nodes (celiac, superior mesenteric, para-aortic)
- Portal vein or hepatic artery involved
- Bilateral involvement of secondary biliary radicles
- Extensive duodenal involvement.

Treatment

- Limited to mucosa—simple cholecystectomy
- Reaching muscle—extended cholecystectomy
- Perimuscular conective tissues—extended cholecystectomy + Segment 4b and 5 resection
- Extended right hepatectomy is done for tumors extending to liver.

Cancers Diagnosed in Cholecystectomy Specimens

Except for tumors confined to mucosa re-laparotomy is advised with resection as per staging along with laparoscopic port sites.

Palliative Treatment

- Radiotherapy: role not clear
- Chemotherapy: gemcitabine + cisplatinum regimen.

Pain: Celiac plexus block
Jaundice: Metallic endoscopic stent (patent confluence)

- Percutaneous bile stenting (not patent confluence)
- Segment 3 bypass if surgery is done.

Obstruction (GOO): gastrojejunostomy must not be done as it may lead to nonfunctioning of gallbladder and stasis and cholangitis. Feeding jejunostomy or nasojejunal tube beyond obstruction is advised.

BILE DUCT CANCERS

Risk Factors

- Primary sclerosing cholangitis
- Choledochal cyst
- Ulcerative colitis
- Clonorchis sinensis
- Chronic typhoid carriers
- Biliary enteric anastomosis
- Thorotrast, dietary nitrosamines
- Liver flukes
- Others—methyldopa, isoniazid, asbestos, estrogen pills
- Hepatolithiasis

2/3rd located at hepatic duct bifurcation (Klatskin tumors).

Clinical Features

Most common presentation—painless jaundice.

Bismuth Classification (Fig. 5.19)

- Type 1—at common hepatic only
- Type 2—involving confluence without involvement of secondary ducts
- Type 3a—involving right secondary intrahepatic ducts
- Type 3b—involving left secondary intrahepatic ducts
- Type 4—involves secondary ducts on both sides.

Investigations

- USG intrahepatic biliary radicle dilatation
- CECT to rule out vascular involvement

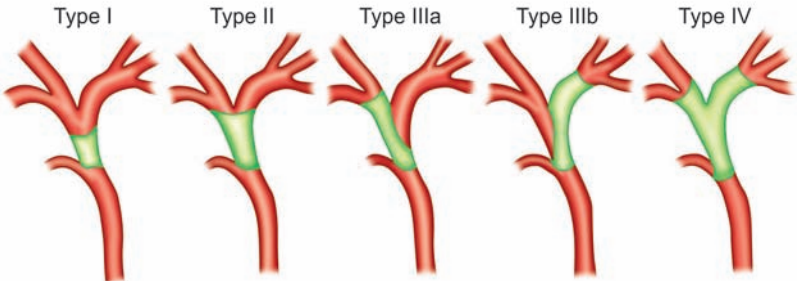


Fig. 5.19: Bismuth classification

- Percutaneous transhepatic cholangiogram PTC
- CA 19-9 tumor marker (follow-up recurrence)
- ERCP is not the best invasive investigation but PTC is best …. Why?

If contrast is injected into the obstructed segment and if obstruction is not relieved completely it will invariably result in cholangitis.

Treatment

Operable Tumors

- Surgery indicated
- Extensive clearance needs caudate lobectomy and removal of CBD up to superior border of head and neck of pancreas
- Hilar, portal, common hepatic, posterior pancreatic nodes and celiac nodes removed
- Portal vein removed if involved
- **Contraindications:** Peritoneal spread, liver metastasis, para-aortic nodes positive.

Inoperable Cancers

- Brachytherapy
- Gemcitabine + 5-flourouracil
- Metallic stents.

6 CASE Right Iliac Fossa Mass

- History
- General Examination
- Discussion
- Viva Questions
- Abdominal Tuberculosis
- Carcinoma Cecum
- Mesenteric Lymph Nodes
- Mesenteric Cyst
- Retroperitoneal Sarcoma
- RIF Mass in Females

HISTORY

- Name
- Age
- Sex
- Occupation.

Complaints of:

- Pain abdomen
- Vomiting
- Palpable lump
- Features of obstruction
- Altered bowel habits
- Fever
- Loss of weight/appetite

History of Present Illness

- Pain:
  - Site
  - Duration
  - Character
  - Aggravating/relieving factors
  - Radiation
- Vomiting:
  - Projectile/nonprojectile
  - Vomitus: Bile stained/associated with blood
  - Duration
  - Frequency
- Altered bowel habits:
  - Recent alteration of bowel habits;
    - Constipation
    - Diarrhea

Note: At this point friends, I want to tell you one thing in this case; there are only three causes that commonly result in mass formation.

- Appendicular mass
- Ileocecal tuberculosis
- Cancer cecum

So you should focus yourself more on these three cases for exam purpose.

History of features suggestive of:

- Acute appendicitis
- Ileocecal tuberculosis
- Carcinoma cecum

- **Acute appendicitis:**
  - Complaints of pain abdomen within 1 week, associated with vomiting and fever followed by features of abdominal lump formation.
- **Ileocecal tuberculosis:**
  - Features of subacute intestinal obstruction
    - Vomiting
    - Distension
    - Colicky abdominal pain
    - Constipation
  - History of suggestive of tuberculosis
    - Loss of weight/appetite
    - History of evening rise of temperature
  - History of chronic cough with expectoration.
- **Carcinoma cecum:**
  - History of anemia, asthenia, anorexia
  - History of gradual development of mass
  - History of vague pain abdomen
  - History of jaundice.

(Right side colonic malignancies usually produce anemia, bleeding and rarely produce obstructive symptoms).

Past History

- History of major medical illness
- History of any surgical illness
- History of similar episodes before.

Family History

- History of tuberculosis
- History of colonic carcinoma in families.

GENERAL EXAMINATION

- Anemia
- Tuberculous lymphadenitis
- Hydration

- Cyanosis
- Clubbing

Vitals:

- Blood pressure
- Pulse rate
- Temperature.

Examination of Abdomen

Inspection

Patient lying down, hips flexed

- Shape
- Movement with respiration
- Umbilicus
- Skin; scars; dilated veins
- Hernial sites
- Genitalia
- Loins
- Supraclavicular nodes.

Palpation

Patient supine; hips flexed

- Site; plane of swelling
- Size
- Extent
- Consistency
- Shape
- Borders
- Mobility
- Pulsation
- Get all around the swelling/below the swelling
- Left supraclavicular nodes.

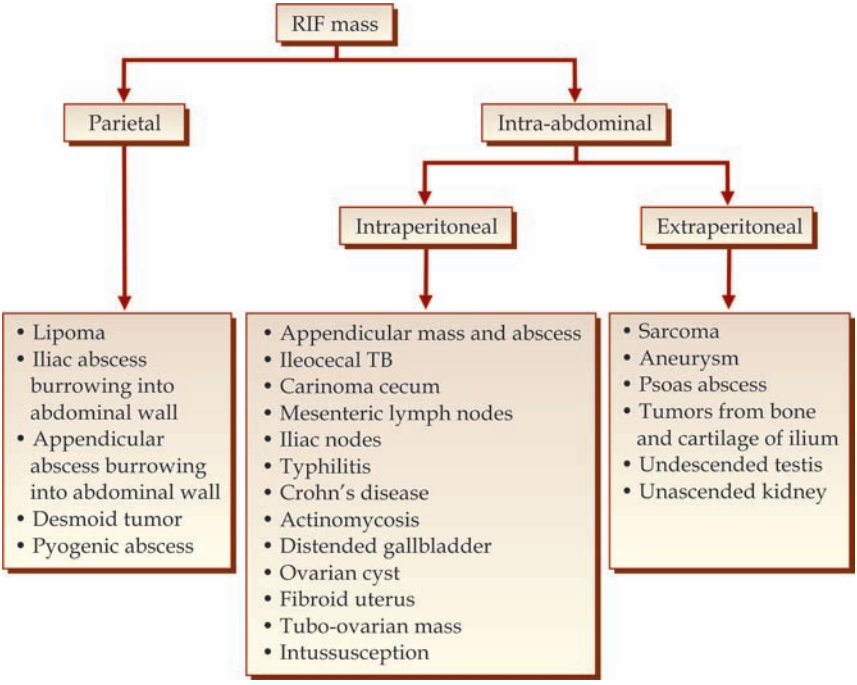
Percussion: Over the mass resonant.

Auscultation

Examination Findings for Each Swelling (Flow chart 6.1)

- **Appendicular lump:**
  Appendicular mass: Irregular, firm, tender and fixed
  Differential Diagnosis:
  Appendicular abscess (remember this case will not be kept in exam as the patient needs emergency surgery, but questions may be asked).
  Variable pyrexia seen:
  - Abscess tends to approach towards the surface with inflammatory signs, i.e. redness and edema of the abdominal wall.
- **Hyperplastic ileocecal tuberculosis:**
  - Pulled up cecum
  - Angle between the cecum and ileum becomes obtuse.

Flow chart 6.1: Differential diagnosis of right iliac fossa (RIF) mass



Retroperitoneal masses:
1. Not move with respiration
2. Not falls forward

Swellings that extend below inguinal ligament:
1. Ovarian cyst
2. Psoas abscess
3. Pelvic abscess

- **Crohn's disease:**
  - Cecum remains in its normal position and not elevated
  - Fistula may be seen in right iliac fossa.
- **Carcinoma cecum:**
  - Hard, irregular and fixed lump
- **Actinomycosis:**
  - Hard, fixed mass
  - Multiple discharging sinuses
  - Discoloration of affected skin.
- **Lymph nodes:**
  - **Secondary nodes:** Hard, nodular, fixed mass
  - **Tuberculosis nodes:** They have the tendency to form cold abscess that burrow through tissues to come more superficial.
- **Iliac artery aneurysm:**
  - Expansile pulsation
- **Iliopsoas sheath:**
  Iliac abscess: There will not be a clear space between the abscess and ilium (Differential diagnosis: appendicular abscess—lower border can be palpated).

Iliopsoas cold abscess:
- Gravitates from thoracolumbar vertebra down to psoas sheath deep to inguinal ligament into the thigh.
- Cross-fluctuation can be demonstrated above and below the inguinal ligament.

- **Intussusception:**
  - Empty right iliac fossa (Le Dance sign)
- **Ovarian cyst:** Per vaginal examination is needed
  - Examination of other system
  - Per vaginal/per rectal examination.

Diagnosis:
- Appendicular mass
- Ileocecal tuberculosis
- Carcinoma cecum

These three cases are commonly kept in examination

Investigations

Routine and Blood Grouping

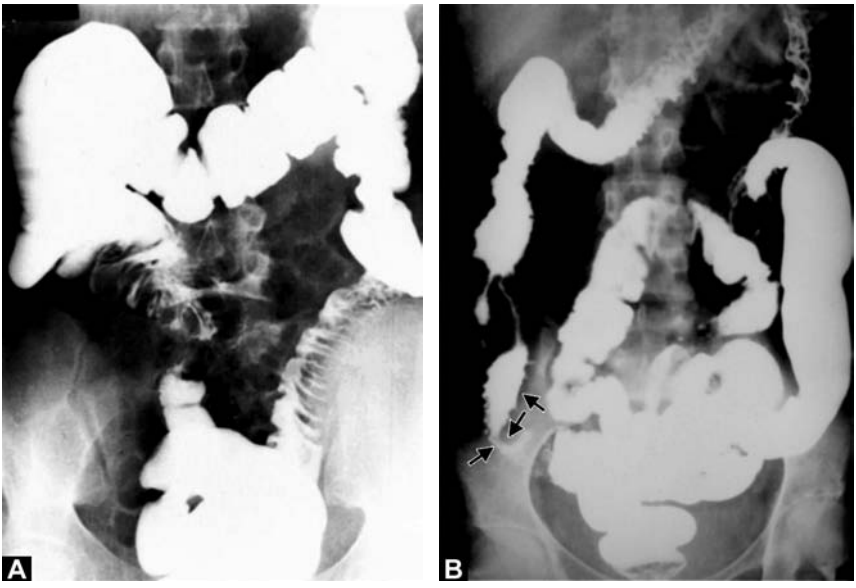
- Blood : Hb percent
  TC, DC, ESR
  Blood urea; sugar
  Serum creatinine, electrolytes
- Urine : Albumin, sugar, deposits
- Stool : Occult blood test (Guaiac test)
- X-ray chest
- ECG all leads
- Blood grouping and typing

Specific

- Ultrasound abdomen
- X-ray abdomen erect
- Barium meal follow through
- CT-scan abdomen.

Investigations

- **Appendicular mass:**
  - Ultrasonogram abdomen
  - X-ray abdomen erect.
- **Ileocecal tuberculosis:**
  - TC, DC, ESR
  - Mantoux
  - X-ray chest PA view
  - X-ray abdomen erect
  - Sputum for acid fast bacilli



Figs 6.1A and B: Ileocecal tuberculosis

  - Laparoscopic peritoneal biopsy: Diagnostic test for abdominal TB (Figs 6.1A and B)
  - Barium meal follow through: Pulled up cecum
- **Carcinoma cecum:**
  - X-ray abdomen erect
  - Tumor markers: CEA, alpha fetoprotein
  - Colonoscopy
  - Double contrast barium enema
  - Barium meal follow through:
    - Normal position of cecum
    - Apple core appearance (Figs 6.2A and B)
    - Irregular and eccentric type of filling defect.

DISCUSSION

Appendicular Mass

History

- Short duration (within 48–72 hours after acute appendicitis)
- History of pain and vomiting.

Examination features:

- Irregular
- Tender
- Soft to firm
- Always fixed
- Not mobile
- After medication not tender.

Figs 6.2A and B: Apple core appearance

Definition

It is the nature's attempt to limit the spread of infection by forming a mass consisting of inflammatory deposits with:

- Omentum
- Terminal ileum
- Cecum with pericecal fat
- Inflammatory edema
- Lymphangitis.

Treatment of Appendicular Mass

- Conservative
- Wait and watch
- Interval appendicectomy.

Conservative regimen: "Ochsner-Sherren regimen"

A - Aspiration with Ryle's tube

B - Bowel care (Do not give purgatives)

C - Charts

- Temperature
- Pulse
- Respiratory rate
- Diameter of mass (marked with skin pencil)

D - Drugs

E - Explorative laparotomy not to be done

F - Fluids (Nil oral for few days)

Criteria for Stopping Conservative Regimen

- Rising pulse rate
- Increasing or spreading abdominal pain

- Increasing size of mass
- Vomiting
- Copious gastric aspirate in Ryles tube.

On Conservative Regimen

- Decreasing pulse rate
- Decrease in mass size
- Decrease in pain
- Passing flatus (Bowel sounds heard)
- Ryles tube aspirate decreases
- Increasing appetite.

Note: Start the oral fluids as soon as bowel sounds are heard.

VIVA QUESTIONS

1. **Why should you not do appendicectomy at the same time for appendicular mass?**
   - Periappendicular phlegmone forms in 48 to 72 hours after appendicitis resulting in dense adhesions and inflammations. In such cases it is difficult to find out appendix there and fecal fistula may occur
   - Hence we allow 6 weeks for inflammation to subside.
2. **If there is no clinical improvement under conservative regimen, then what will you think of?**

Think of appendicular abscess formation; also rule out carcinoma cecum and Crohn's disease.

Surgery is indicated after 6 weeks in cases of appendicular mass (interval appendicectomy)

Types of Incisions for Appendicectomy (Figs 6.3A and B)

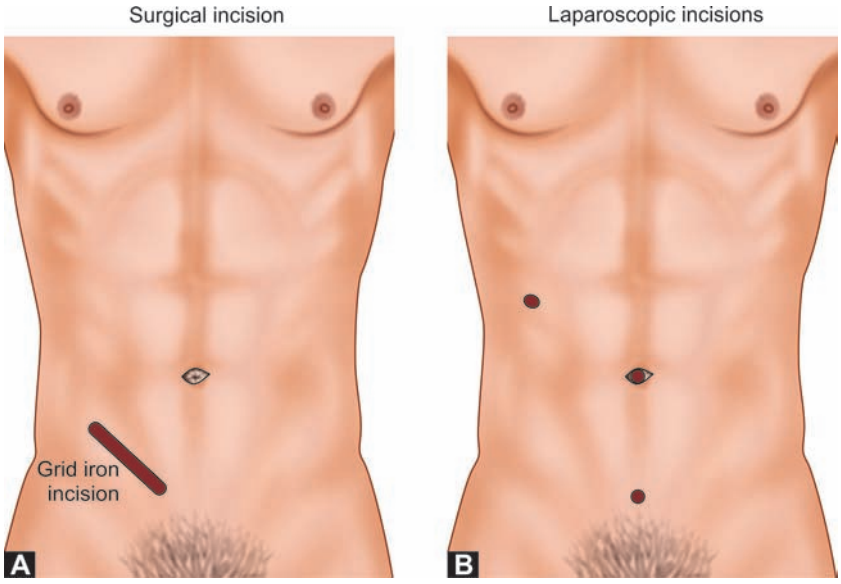
- Grid iron incision (McArthurs)
- Lanz's incision
- Right paramedian

I. **Grid iron incision:**
   - Right angles to McBurney's point (point at the junction of medial 2/3rd and lateral 1/3rd) on the line joining anterosuperior iliac spine and umbilicus.

II. **Lanz incision:**
   - Transverse skin crease incision made 2 cm below umbilius centred on midclavicular to midinguinal line.
   - Exposure is better, extension is easier and cosmetic.

III. **Right paramedian line/lower midline:**
   - If the diagnosis is in doubt this type of incision is made.

IV. **Rutherford Morrison's incision:**
   - Not a skin incision
   - Muscle cutting incision made along the same line as grid iron incision cutting internal oblique and transversus abdominis for better view of field.



Figs 6.3A and B: Incisions for appendicectomy

Operative Steps in Appendicectomy

Anesthesia:

- Spinal anesthesia (adults)
- General anesthesia (children).

Incisions: Grid iron (or) Lanz incision

- External oblique aponeurosis opened
- Internal oblique and transversus abdominis split opened
- Peritoneum opened
- Appendix identified by tracing the convergence of *Taenia coli*.
  (Taenia coli extends from the base of appendix to terminal part of sigmoid colon and continues with longitudinal muscle coat of rectum)
- **Position of appendix**

Retrocaecal	: 74 percent
Pelvic	: 21 percent
Preileal	: 1 percent
Postileal	: 5 percent
Paracecal	: 2 percent
Subcecal	: 1.5 percent

- Babcock's forceps is used to hold the appendix (Fig. 6.4)
- Appendicectomy done by ligating the appendicular vessels at the mesoappendix
- Appendix stump can be buried within the cecum by taking purse string sutures at the *Taenia coli*.
- Layers of abdominal wall closed after assuring complete hemostasis.

Appendicectomy can be done by laparoscopic method by inserting 3 ports as shown in Figure 6.3B.

Fig. 6.4: Appendicitis (Babcock's forceps used to hold appendix)

Features of Acute Appendicitis (Fig. 6.5)

- **Sherren's triangle:**
  - Area of hyperesthesia in the right iliac fossa
  - Formed by line joining spinoumbilical line and iliac bone **(Fig. 6.6)**.
- **Rovsing's sign:** On giving pressure in the left iliac fossa pain arises in the right iliac fossa in these cases due to shift of coils of intestine
- **Blumberg's (release) sign (Figs 6.7A and B):** Rebound tenderness after pressing and taking the hand away from right iliac fossa
- **McBurney's tenderness:**
  - **McBurney's point:** Junction between medial 2/3rd and lateral 1/3rd along the line joining the anterosuperior iliac spine and umbilicus.
  - Tenderness felt on pressure over this point
- **Shifting tenderness (Klein's sign)**
  - To differentiate from acute mesenteric adenitis;
  - Locate the tender point and ask the patient to turn to the left, in acute mesenteric lymphadenitis tenderness shifts away but not in acute

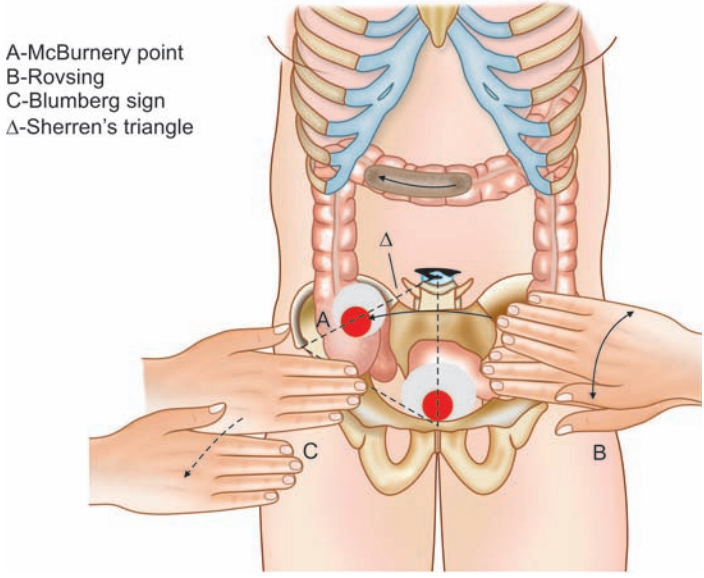


Fig. 6.5: Signs in acute appendicitis

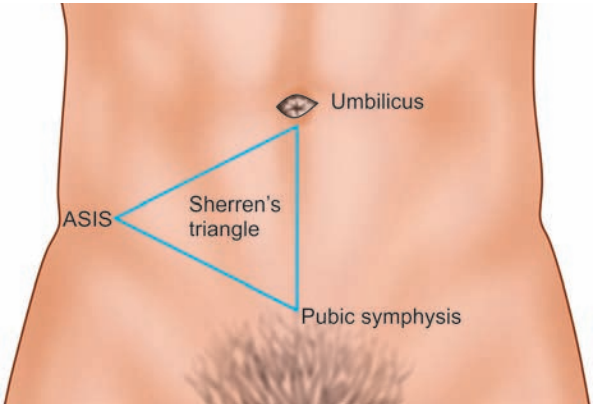
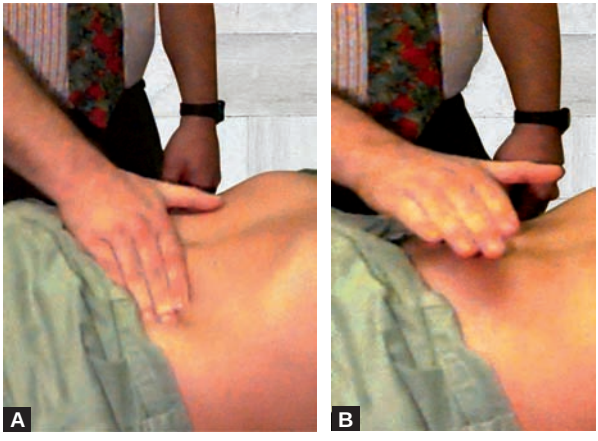


Fig. 6.6: Sherren's triangle



Figs 6.7A and B: Blumberg's sign

appendicitis, this is because of moving of mesentery with postural adjustments along with its nodes

- **Murphy's triad**
  Triad of:
  - Pain
  - Vomiting
  - Fever in cases of acute appendicitis
- **Cope's obturator test (Fig. 6.8):** On flexion and internal rotation of hip pain arises in cases of **pelvic appendicitis**

Murphy's sign:
Tenderness in right hypochondrium in acute cholecystitis
Charcot's triad
Triad of:
- Pain
- Intermittent jaundice
- Rigor in cases of cholangitis

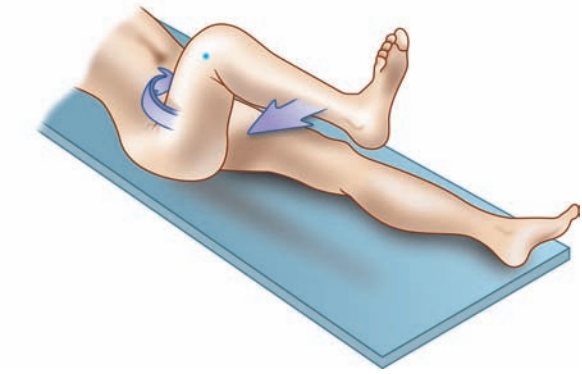


Fig. 6.8: Obturator test for pelvic appendicitis

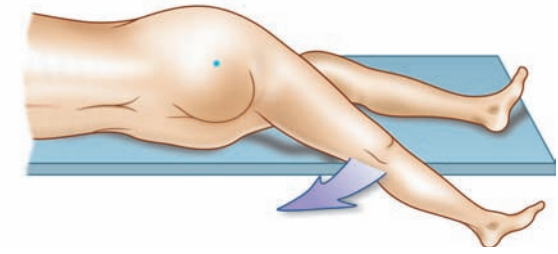


Fig. 6.9: Iliopsoas test for retrocecal appendicitis

- **Cope's Psoas test (Fig. 6.9):** On hyperextension of hip pain arises in cases of **retrocecal appendicitis**
- **Baldwing's test:** Keep the knee straight and ask the patient to flex the hip. Pain arises in **retrocecal appendicitis**.

Appendicular Abscess

Clinical Features

- Soft
- Tender
- Fever
- Chills and rigor.

Following an attack of appendicitis if the infection is not controlled properly, an abscess can occur in relation to appendix.

Types of Appendicular Abscess

- Retrocecal
- Subcecal
- Preileal
- Postileal
- Pelvic/lumbar.

Note: Pelvic abscess—present with diarrhea due to irritation of sigmoid colon.

Carcinoids in appendix (Fig. 6.10)

- Carcinoid tumor of the appendix is the most common appendiceal neoplasm, accounting for 70 percent tumors of this organ
- Majority are found incidentally during appendicectomy at the tip of appendix
- Management of carcinoids:
  - <1 cm diameter: Appendicectomy is curative
  - >1.5 cm diameter: Right hemicolectomy with radical removal of ileocecal nodes is advisable
  - 1 to 1.5 cm diameter: Right hemicolectomy is not needed if the resected margin after appendicectomy is clear of tumor

Treatment

'Drainage of abscess with delayed appendicectomy'.

- Retrocecal Appendicitis: Extraperitoneal approach
  - 5 to 6 cm incision made in right iliac fossa
  - All muscles divided
  - Peritoneum not opened
  - Peritoneum swept medially and pus drained extraperitoneally.
- Preileal/postileal: Drained by opening the peritoneum.
- Pelvic abscess:
  - Per rectal drainage in males
  - Per vaginal drainage via posterior fornix in females.
- Lumbar abscess: Perinephric abscess drained by loin incision.

Note: Delayed appendicectomy—as soon as the abscess dissolves, done during the same admission.

Meckel's diverticulum (Figs 6.11 and 6.12)

- Remnant of the vitello-intestinal duct and is present in about 2 percent of the population; and arises from the **antimesenteric side** of the ileum
- Situated 60 cm (2 feet) from ileocecal valve
- Ectopic gastric mucosa is seen in about 70 percent of cases of Meckel's diverticulum. May also contain pancreatic mucosa

Clinical features

- Inflammation
- Peptic ulceration
- Intestinal obstruction

Diagnosis

- Technetium-99 m scan is used to diagnose Meckel's due to the presence of ectopic gastric mucosa
- Mesenteric angiography may also be helpful in the presence of active bleeding

Treatment

- Excision of Meckel's diverticulum together with a wedge of adjacent ileum
- In some cases however, with extensive inflammation of the diverticulum a limited small bowel resection may be necessary
- If Meckel's diverticulum is found incidentally during the course of a laparotomy;
  - Wide base and soft—no need of removal
  - Narrow neck and nodular—removal is advised

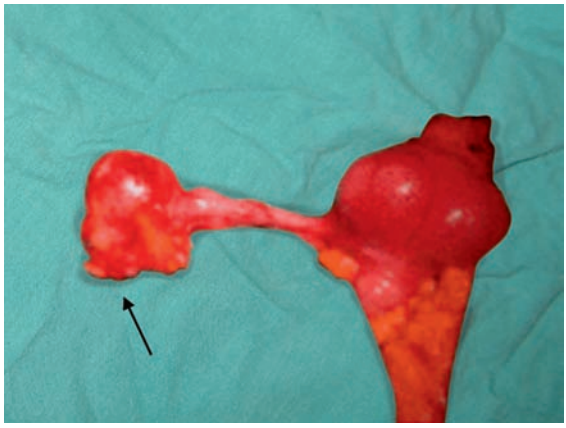


Fig. 6.10: Appendicular carcinoid

Fig. 6.11: Meckel's diverticulum

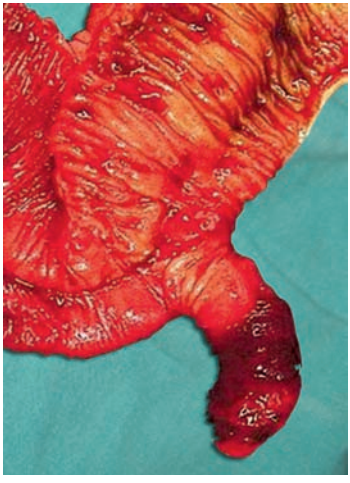


Fig. 6.12: Diverticulitis

ABDOMINAL TUBERCULOSIS

Intestinal Tuberculosis (Flow chart 6.2)

Ileocecal region is commonly involved in tuberculosis because of the following reasons:

- Rich lymphatics in Peyer's patches
- Presence of ileocecal valve precipitates stasis
- Terminal ileum is the area of maximum absorption
- Alkaline medium favors the growth of organisms.

Types (Table 6.1)

- Ulcerative variety
- Hyperplastic variety
- Mixed.

Flow chart 6.2: Abdominal tuberculosis—menifestations

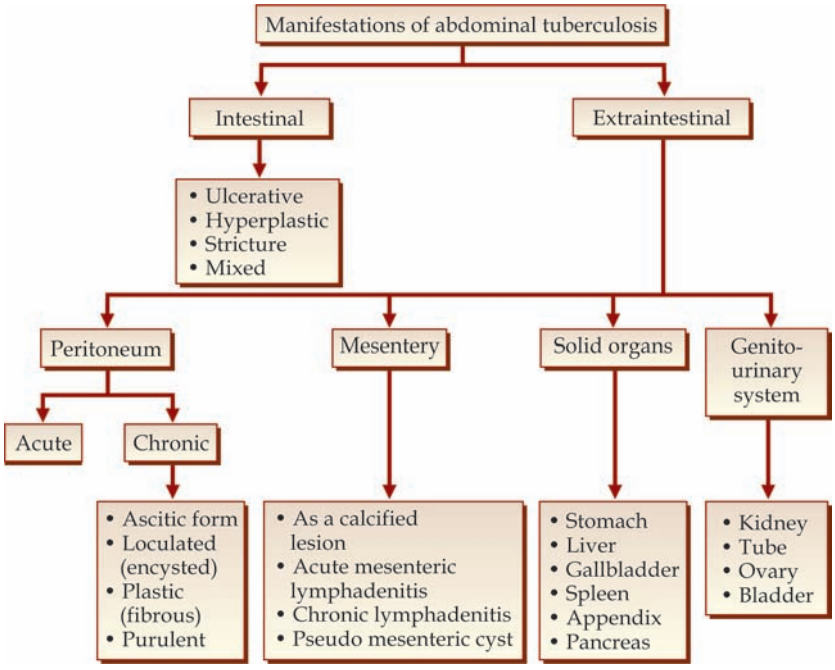


Table 6.1: Differences between ulcerative and hyperplastic TB

S.No.		*Ulcerative variety*	*Hyperplastic variety*
1.	Etiology	• Secondary to pulmonary tuberculosis (TB) • Occurs due to swallowing of TB bacilli	• Primary intestinal TB • Occurs due to *M. bovis*, low grade *M. tuberculosis* infection
2.	Site	Terminal ileum	Ileocecal region
3.	Virulence	Highly virulent	Less virulent
4.	Resistance of body	Very poor	Good
5.	Pathology	Multiple ulcerations in the terminal ileum; transverse ulcers in ileum; the serous coat overlying the ulcer becomes thickened so perforation is rare	Chronic inflammation involving the ileocecal region resulting in cicatrizing granuloma in right iliac fossa
6.	Clinical features	Hemoptysis; emaciation; diarrhea	Abdominal pain and diarrhea. Intestinal obstruction occur
7.	Complications	Strictures	Obstruction
8.	Barium meal follow through	Demonstrates a stricture, or multiple strictures and non-filling or inadequate filling in terminal ileum, cecum and ascending colon	• Contracted cecum • Pulled up cecum • Luminal obstruction • Obtuse ileocecal angle

Treatment

- **With no features of subacute obstruction:**
  - Conservative antituberculous drugs
  - Category 1 (according to latest RNTCP guidelines): 2 HRZE + 4HR (6 months)

  According to RNTCP guidelines latest only 2 categories:
  Category of treatment type of patient
  Category I (New) (2HRZE + 4HR)
  - New sputum smear-positive
  - New sputum smear-negative
  - New extrapulmonary

  Category II (Previously-treated) (2HRZES/1HRZE + 5 HRE)
  - Sputum smear-positive relapse, failure, treatment after default, others.
- **With features of:**
  - Intestinal obstruction: (complete)
  - Perforation
  - Strictures.

Intestinal Obstruction (Complete)

Limited resection with ileocolic anastomosis is the treatment of choice.

- Removal of terminal ileum 20 to 30 cm
- Cecum with appendix
- Diseased part of ascending colon
- Ileocolic anastomosis

Postoperatively: ATT for 6 months.

Strictures

- Solitary stricture—stricturoplasty
- Multiple strictures at long intervals—stricturoplasty
- Multiple strictures within short segment—resection is the ideal treatment.

CARCINOMA CECUM

- Common in females: 40 to 50 years of age
- **Clinical features:**
  - Bleeding per rectal
  - Severe anemia
  - Vague pain
  - Anemia
  - Anorexia
  - Asthenia.
- Right colonic growth not goes for obstruction:
  - Fungating growth is common in right side
  - More capacious
  - Fluid state of contents in the right side.

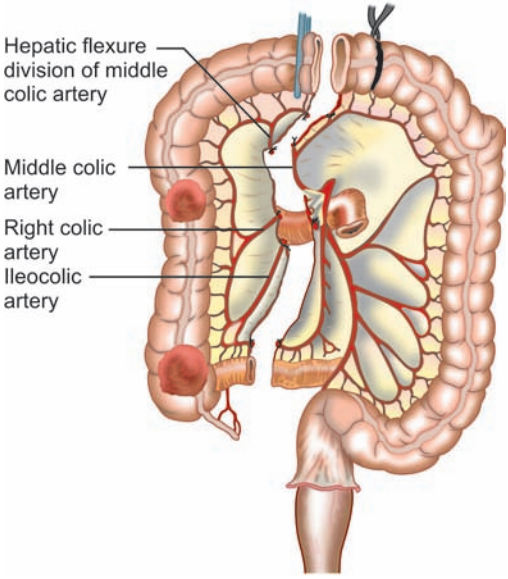


Fig. 6.13: Right hemicolectomy

- *On examination:* Hard, fixed, irregular mass
- *Barium enema:* Apple core appearance due to narrow lumen
- *CT scan:* Look for local invasion.

Treatment: **Right hemicolectomy** is done to provide adequate lymphovascular clearance **(Fig. 6.13)**.

Remove

- Last 30 cm of ileum
- Cecum
- Ascending colon
- Right 1/3rd of transverse colon (up to right branch of middle colic artery).

MESENTERIC LYMPH NODES

- Tuberculous
- Lymphoma
- Secondaries.

Tuberculous Mesenteric Lymphadenitis

Clinical presentation as:

- Calcified lesion
- Acute mesenteric lymphadenitis
- Chronic lymphadenitis

- Pseudomesenteric cyst
  a. Calcified lesion
     - Along the line of mesentery
     - X-ray shows round to oval mottled shadows
     - Treatment: Antituberculous drugs
  b. Acute mesentric lymphadenitis:
     - Common in children
     - Mimics acute appendicitis
     - Characterized by pain in the right iliac fossa, vomiting, fever, rigidity.

     On palpation:
     - Tender mass of swollen lymph nodes
     - Klein's sign: Positive (already explained)

     Treatment:
     - Laparotomy
     - Biopsy of lymph nodes
     - Appendicectomy can be done.
  c. Chronic lymphadenitis:
     - Present as 'failure to thrive' in children
     - Characterized by fever, loss of weight, loss of appetite, emaciation, pallor
     - On clinical examination: Nodes can be palpable.
  d. Pseudo mesenteric cyst
     - Caseation of mesenteric lymph nodes, confined within 2 leaves of mesentery result in cyst formation
     - Due to adhesion intestines may get kinked or twisted leading to obstruction.
- Lymphoma:
  – Lymphoma involving external iliac nodes present as nodular, firm to hard
  – On examination other group of nodes will be seen along with hepatosplenomegaly.
- Secondaries in external iliac nodes:
  – Hard and fixed nodes
  – Primary may be from carcinoma ovary and carcinoma cervix.

MESENTERIC CYST

- It has smooth surface and is mobile across the (opposite) axis of line of attachment of mesentery.

Clinical Features

Tillaux triad
- Soft fluctuant swelling in umbilical region
- Free mobility in direction perpendicular to mesentery
- Zone of resonance all around the cyst

- Recurrent attacks of pain with or without vomiting
- May present as acute abdomen due to:
  - Torsion
  - Rupture of cyst
  - Infection
  - Hemorrhage into cyst.

Root of mesentery

- It is the attached border of mesentery about 15 cm long and directed obliquely downwards and to the right
- It extends from duodenojejunal flexure on the left side of L2 vertebra to upper part of right sacroiliac joint

Classification

- Chylolymphatic cyst
- Enterogenous cyst
- Urogenital remnant
- Dermoid cyst.

Chylolymphatic Cyst (Fig. 6.14)

- The most common variety
- Arises in congenitally misplaced lymphatic tissue that has no efferent communication with lymphatic system
- Thin walled cyst lined by flat endothelium filled with clear lymph or chyle. Cyst is often unilocular than multilocular and solitary usually. Cyst in watery milk or creamy color
- Has a blood supply independent of intestine, hence enucleation is possible without gut resection.

Fig. 6.14: Chylolymphatic cyst

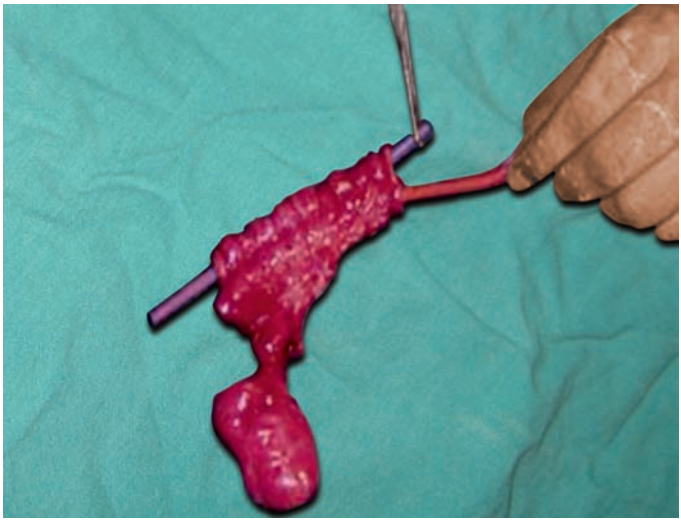


Fig. 6.15: Enterogenous cyst

Enterogenous Cyst (Fig. 6.15)

- Believed to be derived from either of the following:
  - Diverticulum of mesenteric border of intestine that has been sequestrated during embryonic life
  - Duplication of intestine.
- Thick walled cyst with mucous lining
- Cyst is colorless or may be yellow-brown when there is hemorrhage into the cyst
- Has blood supply common to intestine; hence removal is always associated with resection anastomosis of related part of intestine
- If operation is not possible marsupialization can be done but has complications like fistula formation and recurrence.

Other Cysts

- Omental cyst—omentectomy is the treatment
- Cyst of mesocolon
- Cyst from Wolffian and Mullerian remnant are essentially retroperitoneal, but they can project into the mesentery (urogenital remnants)
- Dermoid cysts.

RETROPERITONEAL SARCOMA

Liposarcoma is most common.

Clinical Features

- History of indefinite abdominal pain
- Effects due to compression on:
  - Intestine—subacute intestinal obstruction
  - Inferior vena cava—oedema of limbs
  - Ureter—hydronephrosis (most common organ involved)
- **On examination**:
  - Smooth, fixed mass which is not tender is palpated.
- Investigate by scanning and urography
- Multimodality treatment including:
  - Wide excision of the tumor
  - Radiotherapy
  - Chemotherapy.

  VAC regimen: Vincristine, adriamycin, cyclophosphamide.

RIF MASS IN FEMALES

- **Ovarian cyst:**
  - Cyst starts in pelvis
  - Smooth surface, round borders, can be pushed back into pelvis
  - Per vaginal examination is diagnostic.
- **Tubo-ovarian mass:**
  - Usually tender mass
  - Bilateral in some cases
  - Arises due to pelvic infection
  - History of white discharge (leucorrhea) per vaginum
  - Soft to firm in consistency.
- **Fibroid:**
  - Firm to hard mass in suprapubic region
  - History of menorrhagia/dysmenorrhea.
- **Desmoid tumor (Recurrent fibroid of Paget's) (Fig. 6.16)**
  - Uncapsulated fibroma occurring in the anterior abdominal wall; parietal swelling arising from the muscle of anterior abdominal wall
  - Common is multiparous females
  - Repeated stretching of the abdominal wall due to pregnancy initiates the tumor
  - On examination; firm to hard parietal swelling; becomes prominent on head raising test
  - *Pathology:* It has no capsule and sarcomatous change may occur.
  - *Treatment:* Wide excision of the tumor with anterior abdominal wall reconstruction using mesh.

Rare Lumps in RIF Region

- **Actinomycosis (Ray fungus):**
  - *Actinomyces israelii* is the causative organism
  - Actinomyces never goes through lymph because of its big size; but goes through blood
  - Gram-positive rod shaped bacilli.

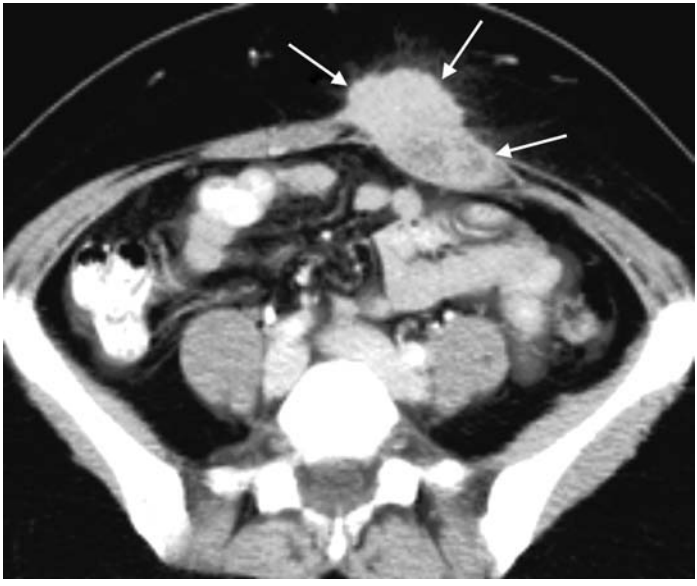


Fig. 6.16: Desmoid tumor

Clinical features:
- Firm, indurated, mass edges are indefinite
- Lymph nodes are not involved
- Discoloration of affected skin.

Types:
- Faciocervical (most common)
- Lungs/pleura
- Right iliac fossa
- Liver
  - Actinomycosis of right iliac fossa is characterized by:
    - History of appendicectomy 2 to 3 months before
    - Woody hard; indurated with multiple sinuses
    - Sinuses discharge sulphur granules.

Treatment: Pencillin or tetracycline.

- **Ameboma (Typhilitis):** Inflammation of cecum due to amebic infection.

Clinical features:
- Patient gives complaints of pain in two places cecum and sigmoid colon.
- On examination; thickened and tender colon palpable.

Complications:
- Hemorrhage
- Fibrous stricture
- Obstruction
- Ischiorectal abscess
- Fistula in ano
- Perforation.

Treatment: Metronidazole (or) tinidazole.

Fig. 6.17: String sign of Kantor

- **Aneurysm:** Iliac artery aneurysm—rare and occurs in old age as pulsatile swelling with thrill and bruit.
- **Crohn's disease:** Regional Ileitis
  Clinical staging:
  - Inflammatory stage
  - Colitis stage
  - Stenotic stage
  - Fistula
    - During the inflammatory stage, Crohn's disease produces right iliac fossa mass, moderate anemia
    - During the colitis stage, Crohn's disease is characterized by occult blood, steatorrhea, fissure *in ano*, perianal abscess, perianal fistula.

Barium Meal Shows

- Loss of peristalsis in a loop (sentinel loop).
- 'String sign of Kantor'—narrowed lumen in the form of cord **(Fig. 6.17)**.
- **Iliopsoas abscess:**
  Etiology: Cold abscess from Pott's disease (TB spine) gravitates from affected thoracolumbar vertebra to psoas sheath, deep to inguinal ligament up to thigh.
  On Examination:
  - Gibbus seen in spine.
  - Cross-fluctuation is seen in the abscess across inguinal ligament.
- **Iliac abscess:**
  Etiology: Due to pyogenic organisms.
  Differential diagnosis: Appendicular abscess. In appendicular abscess there is a clear space between abscess and ilium but in cases of iliac abscess lower border is not felt.

7 CASE

Liver Secondaries
(Topic Focused More on Colorectal Cancers)

- History
- Investigations
- Discussion
- Treatment
- Histology
- Spread of Carcinoma
- Clinical Features

HISTORY

Complaints of:

- Dull-aching and continuous pain in right hypochondrium *(Glisson's capsule of liver)* } Enlarged liver stretches Parietal capsule
- Loss of weight, appetite, asthenia, weakness
- Jaundice—mild, nonprogressive and not associated with pruritus.

History with Regard to Primaries

- Stomach : History of persistent vomiting with or without blood
- Pancreas (Body and tail) : History of severe backache (due to carcinoma pancreas infiltrating the retroperitoneal nerve plexuses)
- Periampullary carcinoma : History of jaundice with itching
- Colorectal carcinoma : History of constipation and bleeding per rectum
- Carcinoma breast : History of lump breast or discharge
- Malignant melanoma : History of wide excision of moles

General Examination

- Anemia (Carcinoma stomach, colon)
- Jaundice (Periampullary carcinoma)
- Bilateral pedal edema (Inferior vena-caval obstruction by enlarged liver)
- Spine tenderness (Metastasis from breast, prostate, bronchus, kidney, etc.)
- Absent testis in scrotum (Seminoma of undescended testis).

Examination of Abdomen

Criteria for Liver Secondaries

- Both lobes enlarged
- Sharp lower border
- Nodular surface

- Hard consistency
- Umbilication (central necrosis of a nodule).

Evidence of Primaries

- Epigastric mass stomach, transverse colon
- Palpable gall bladder—periampullary carcinoma
- Distended colon with feces—carcinoma colon/rectum
- Undescended testis—seminoma
- Evidence of amputation of digit/limb (or) wide excision of mole—malignant melanoma
- Carcinoma breast.

Per Rectal Examination

Position of patient:

- Sim's position (left lateral position)
- Knee elbow position
- Dorsal position (lying supine with knees flexed)
- Lithotomy position.

Procedure:

- Get the consent from the patient
- Good lubricant is used
- Painful spasm of anal sphincter is confirmatory of hidden fissure.

Look for the following:

Intraluminal : Normal—feces
Abnormal—polyp, carcinoma, blood, pus

Intramural : Normal—sphincter muscles, anorectal angle
Abnormal—carcinoma, leiomyoma

Extramural : Normal—Perianal structures (Enlarged prostate or fibroid uterus)
Abnormal—abscess

Bloomer's shelf: Metastatic deposits in pouch of Douglas:

- After withdrawal, finger is examined for mucus, pus, blood, abnormal faces
- Internal hemorrhoids cannot be palpated by per rectal examination unless it is thrombosed.

Diagnosis
Hepatomegaly: Probably secondaries liver, the primary probably in the descending colon (History of constipation, bleeding per rectum)

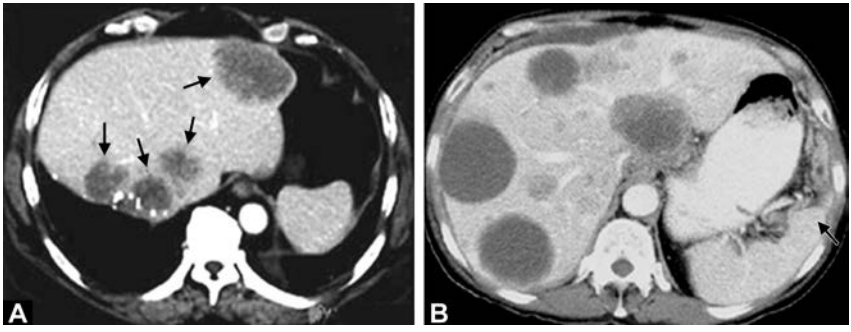
INVESTIGATIONS

- **Basic investigations:**
  - Hemoglobin
  - Total count, differential count, erythrocyte sedimentation rate
  - Blood urea, sugar
  - Serum creatinine, electrolytes
  - Blood grouping and typing.

- **Diagnostic investigations:**
  - *Liver function tests:*
    - SGOT
    - SGPT
    - Serum bilirubin
    - Serum alkaline phosphatase
    - Prothrombin time.
  - *Ultrasound abdomen:*
    - To confirm the diagnosis
    - To know the surface (hypo-or hyperechoic nodule)
    - Umbilication of nodules
    - Porta hepatis
    - Level of extrahepatic biliary obstruction
    - Minimal fluid
    - Pelvic deposits
    - Growth in colonic flexures
    - Detect enlarged lymph nodes—portal, celiac group
    - Seminomas of undescended testis.
  - *CT scan abdomen (Figs 7.1A and B)*: If you have found the primary, no need to prove the liver swelling is secondary, otherwise take USG guided biopsy to prove it is secondary (Vim Silverman's needle for liver biopsy).
- **Investigations to find primary:**
  - Esophagoscopy
  - Upper gastrointestinal endoscopy
  - Sigmoidoscopy
  - Colonoscopy
  - Barium meal follow through
  - Double contrast barium enema.

  If primary is not yet found:
  - Bronchoscopy for bronchogenic carcinoma
  - Acid phosphatase for carcinoma prostate
  - Ophthalmoscopic examination to find malignant melanoma choroid.

Occult blood test: Guaiac test, benzidine test, orthotolidine test. Monoclonal antibody test against hemoglobin (most specific).



Figs 7.1A and B: Liver secondaries on CT scan

Liver function tests:

- Serum bilirubin : 5 to 17 micromol/L (conjugate bilirubin <5 y mol/L)
- SGOT : 10 to 40 IU/L
- SGPT : 10 to 40 IU/L
- Gamma-glutamyl transaminase : 10 to 40 IU/L
- Alkaline phosphatase : 40 to 120 IU/L
- Prothrombin time : 12 to 16 seconds

Colonic Study

Length of:

- Anal canal : 4 cm
- Rectum : 12 cm
- Sigmoid colon : 37 cm
- Descending colon : 25 cm
- Transverse colon : 50 cm
- Ascending colon : 12 cm
- Cecum : 6 cm
- Appendix : 7.5 to 10 cm
- Small intestine : 6 meters
- Duodenum : 10 inches

Length of Each Study

- Per rectal examination—8 cm (up to lower 1/3rd rectum)
- Proctoscopy—12 cm
- Sigmoidoscopy—60 cm (Flexible); 18 cm (Rigid type)
- Colonoscopy—160 cm.

DISCUSSION

- **Types of liver secondaries:**
  - Precocious
  - Synchronous
  - Metachronous.

Precocious	Before primary tumor presents secondary manifests	Carcinoid tumor, rectal cancer
Synchronous	Both primary and secondary present together	Carcinoma stomach
Metachronous	Primary treated already, secondary occurs now	Malignant melanoma of choroid

- **Liver metastasis is through:**
  - Hematogenous:
    - Portal vein (Intestine)
    - Hepatic artery
  - Lymphatic spread

- Contiguous from gallbladder:
  - The most common liver malignancy: Secondaries
  - The most common liver benign tumor: Hemangioma.

Primary may arise from:
- Colon
- Stomach
- Breast
- Prostate
- Lung
- Malignant melanoma
- Pancreas
- Carcinoid tumor
- Ovary
- Testis

Good prognosis: Colon carcinoma and carcinoid tumor

Hepatocellular Carcinoma

Etiology:
- Hepatitis 'B' virus,
- Hepatitis 'C' virus
- Oral contraceptive pills
- Aflatoxin
- Alcohol, smoking
- Diabetes mellitus.

Clinical features:
- Males; >50 years age; alcoholics.
  On examination:
  - Tender hepatomegaly
  - Irregular surface
  - Hard consistency
  - Vascular mass (Thrill palpable).

Metastasis through:
- Direct: Diaphragm
- Lymph: Virchow's node
- Blood: Malignant pleural effusion and hemoperitoneum.

Specific investigations:
- Alpha fetoprotein level:
  - 100 IU (Suggestive)
  - 1000 IU (Diagnostic)

Increased alpha fetoprotein:
- Hepatoma (HCC)
- Carcinoma stomach
- Carcinoma pancreas
- Embryonal cell carcinoma of testis
- Hepatoblastoma

- **CT arterial portography:** Venous phase shows 'tumor blush' (highly vascular).

TREATMENT

- Resection of the liver segment (confined to one segment)
- Systemic chemotherapy (Intravenous doxorubicin)
- Intra-arterial embolization
- Radiotherapy.

Indications for Resection

- The surgical approach should remove the known cancer with a 1 to 2 cm margin of unaffected liver tissue.
  - One lobe or segment involved
  - Rest of liver must be normal—so cannot do in a cirrhotic patient going for hepatocellular carcinoma
  - No metastasis.

Milan's Criteria for Liver Transplantation for HCC

- One nodule < 5 cm
- Two or three nodules all < 3 cm
- No gross vascular invasion
- No extrahepatic spread.

Differences between:

	Primary hepatoma (Hepatocellular carcinoma)		*Secondaries liver*
1.	Less common	1.	More common
2.	Usually solitary (any lobe)	2.	Both lobes affected
3.	Irregular	3.	Nodular, umbilicated
4.	Excess vascularity; bruit or thrill	4.	No bruit or thrill
5.	No evidence of any primary	5.	Evidence of primary
6.	Round edge	6.	Sharp edge
7.	Tender	7.	No tender
8.	Upper border not enlarged (left 5th ICS)	8.	Upper border enlarged
9.	Ascites absent	9.	Ascites seen

Treatment for Secondaries Liver

- Surgery is best modality if possible
- Most of the time it is inoperable.

Indications for Surgery in Secondary Liver

- Only if you are planning for curative resection of primary
- Metastatic nodule confined to one lobe
- Number of nodules less than or equal to three
- There should not be any chronic liver disease.

1. Carcinoma stomach with liver secondaries	1. Palliative gastrojejunostomy if vomiting is present
2. Periampullary carcinoma with secondaries	2. Palliative cholecystojejunostomy to relieve jaundice
3. Carcinoma colon/carcinoid tumors	3. Resect the primary tumor and solitary metastasis in liver is also resected
4. Malignant melanoma: Stage III	4. Chemotherapy: Dacarbazine

Chemotherapy

5-Fluorouracil (5-FU): 500 mg for 5 days
(28 days cycle for few cycles)
if the primary is found in the GIT.

Other Modalities

- **Hepatic artery ligation:**
  - Though portal vein is 60 percent supply, hepatic artery ligated because tumor secondaries receive blood supply through hepatic artery.
  - Not done now-a-days because:
    - All the area supplied by that artery will go for necrosis and form abscess.
    - Collaterals will form to supply secondary tumor.
- **Transarterial embolization:**
  - Coiled silver wire
  - Gelfoam sponge are used.
- **Transarterial chemoembolization (TACE):** Makes the particular site ischemic and deliver the drug at tumor site.
- **Percutaneous ethanol injection:** For small secondaries.
- **Targeted radiotherapy:** One form of brachy therapy.
- **Radiofrequency ablation by percutaneous method.**
- **Cryotherapy.**

DISCUSSION

Cancer Colon and Rectum

Precancerous Lesions

- Familial polyposis coli
- Ulcerative colitis
- Adenomatous polyp
- Crohn's disease
- Hamartomatous polyp.

Pathological Types

- Annular
- Tubular

} Common in ascending colon

- Ulcerative
- Proliferative

} Common in descending colon

Incidence of Colonic Carcinoma (Fig. 7.2)

Most common sites:

- Rectum (38%)
- Sigmoid colon (21%)
- Cecum (12%)
- Transverse colon (5.5%)
- Ascending colon (5%)
- Descending colon (4%)
- Hepatic flexure (2%)
- Splenic flexure (3%)
- Anus (2%).

Histology: Columnar cell adenocarcinoma.

Right sided growth: Ulcerative or proliferative type growth:

- Anemia
- Asthenia
- Pain
- Mass in right iliac fossa
- Melena
- Not goes for obstruction usually.

Left sided growth: Annular or tubular growth:

- Progressive constipation
- No mass
- Altered diarrhea and constipation
- Frank bleeding per rectal
- Early morning spurious diarrhea.

Duke's Classification

A- Cancer confined to bowel wall

B- Cancer penetrates bowel wall

B1- Partially penetrated the muscularis propria

B2- Fully penetrated the muscularis propria

C- Involvement of lymph nodes.

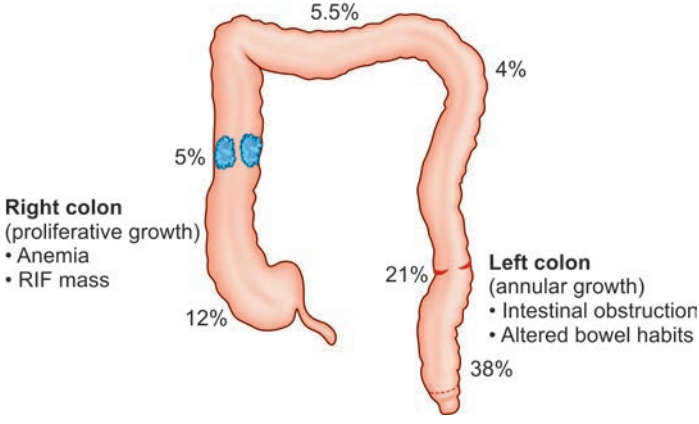


Fig. 7.2: Colonic cancer—presentation

Astler Coller Further Divided the C

C1- Tumor that invaded lymph nodes but did not penetrate the entire wall
C2- Tumor that invaded lymph nodes and penetrated the entire wall.

Modified Duke's Classification (Fig. 7.3)

This classification included all the above with:
D- Distant metastasis

Investigations

- Sigmoidoscopy
- Flexible sigmoidoscopy
- Colonoscopy (Figs 7.4A and B)
- Double contrast barium enema
- Ultrasonogram for liver metastasis
- CT-scan abdomen
- Carcinoembryonic antigen (CEA): Diagnostic if >1000 IU.

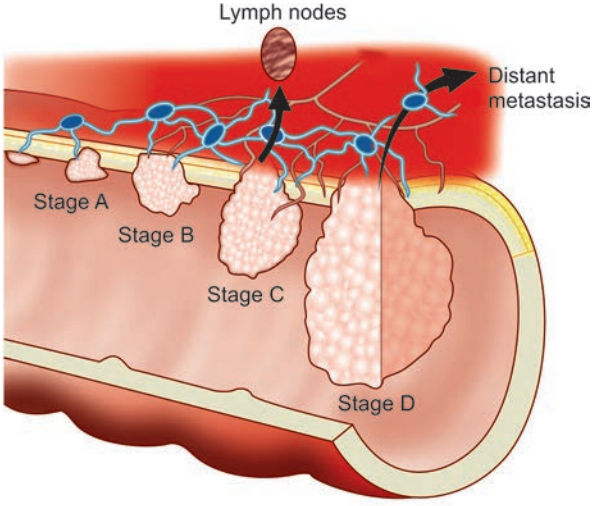
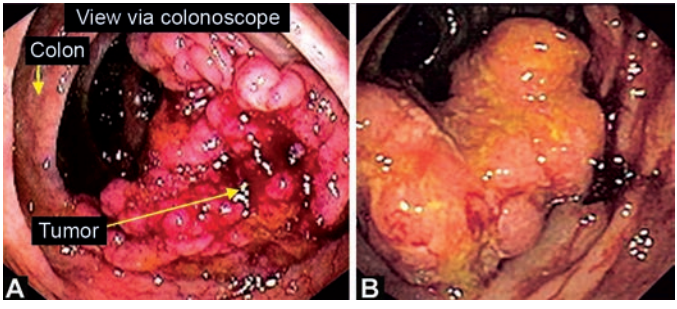


Fig. 7.3: Modified Duke's staging



Figs 7.4A and B: Proliferative growth on colonoscopy

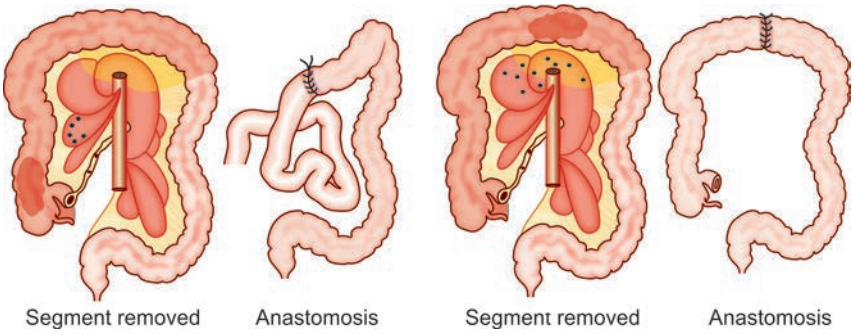


Fig. 7.5: Right hemicolectomy and transverse colectomy

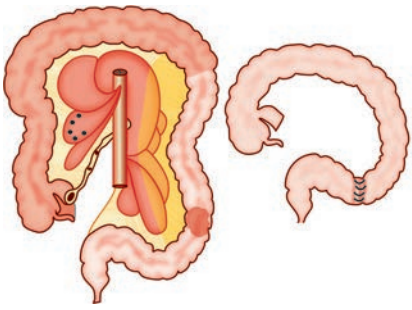


Fig. 7.6: Left hemicolectomy

Treatment

- Carcinoma cecum/right side colon: Right hemicolectomy (Fig. 7.5)
- Carcinoma transverse colon: Extended right hemicolectomy/transverse colectomy
- Carcinoma left colon: Left hemicolectomy (Fig. 7.6).

No Touch Technique of Turnbull

Early division of blood vessels supplying the involved colon before resection can slightly improve the number of curative operations.

Adjuvant Therapy

- Injection 5-fluorouracil
  500 mg rapid IV daily
  for 5 days
- Tablet levamisole 500 mg tds for 3 days in every 2 weeks for 1 year.

Cancer Rectum

Premalignant conditions:

- Adenomas
- Papillomas
- Ulcerative colitis
- Crohn's disease
- Polyps.

HISTOLOGY

- Adenocarcinoma (columnar celled)
- Colloid carcinoma.

Pathological Types (Fig. 7.7)

- Annular: Rectosigmoid junction
- Polypoidal: Ampulla of rectum
- Ulcerative: Growth in transverse direction
- Diffuse infiltrating: Develops from ulcerative colitis (poor prognosis).

SPREAD OF CARCINOMA

- **Local spread:**
  - Occurs circumferentially
  - Takes '6' months for 1/4th circumference and '18' months for whole rectal circumference to be involved.

  Penetrates:
  - Anteriorly—prostate, bladder
  - posteriorly—ureter
  - Laterally—sacrum or sacral plexus
  - Downwards—rare (occurs in anaplastic carcinomas)
- **Lymphatic spread:**
  - Exclusively in upward direction
  - First halting place is 'Pararectal nodes of Gerota'
- **Venous spread:**
  - Liver (34%)

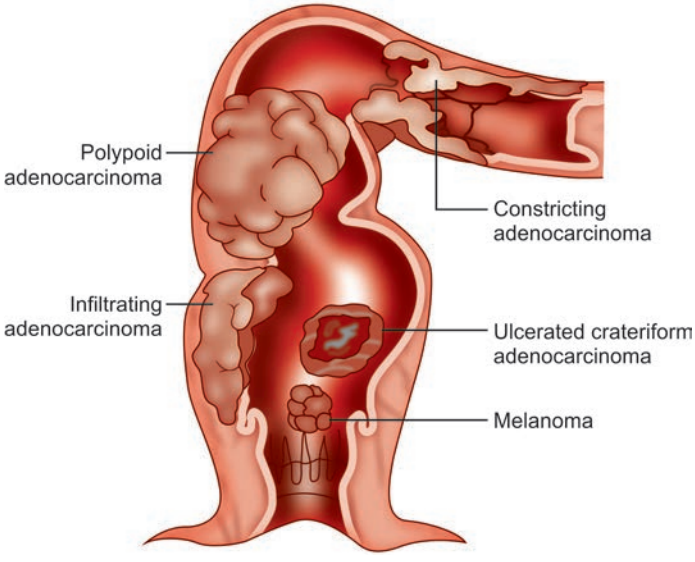


Fig. 7.7: Morphological types of rectal cancers

  - Lungs (22%)
  - Adrenals (11%).
- **Peritoneal spread:** Ascites.

CLINICAL FEATURES

- Bleeding: Earliest and most common symptom
- Sense of incomplete evacuation
- Tenesmus (painful straining)
- Early morning spurious diarrhea: Accumulation of mucus overnight in ampulla of rectum
- Bloody slime: Blood stained mucus
- Constipation: Annular type growth
- Loss of weight and appetite.

Treatment

- Try for sphincter saving operation as much as possible
- Provide a distal margin clearance of 2 cm
- Aim is for curative resection
- Palliative resection is worthwhile though there are secondaries in liver.

Anatomy of rectum and anus (Fig. 7.8):

- To know the treatment of rectal cancers you should know a few points about rectum and sphincter anatomy.
- To preserve the normal continence we should preserve the puborectalis sphincter muscle
- This muscle is located at anorectal junction
- Length of anal canal = 4 cm

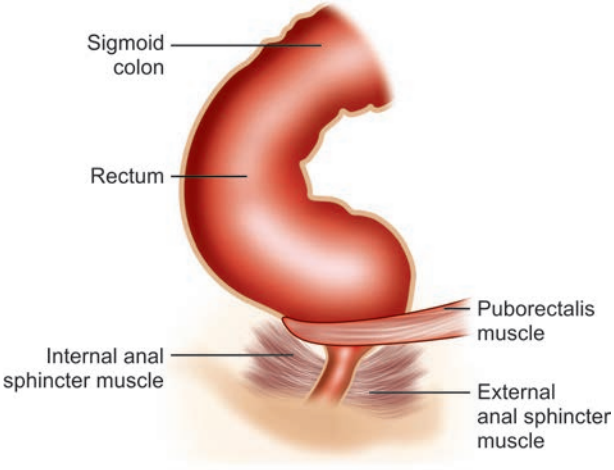
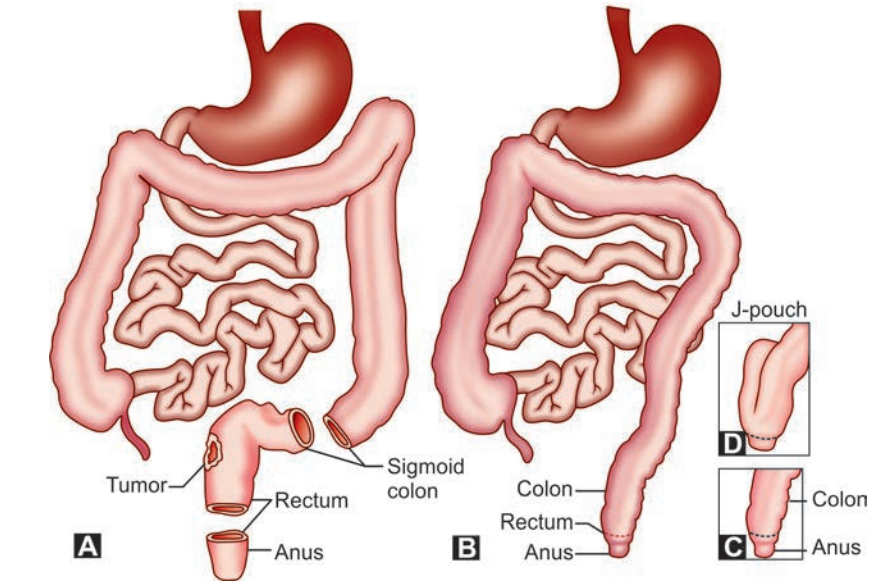


Fig. 7.8: Anatomy of the rectum and anal canal



Figs 7.9A to D: Anterior resection

- Rectum = three parts (upper, middle and lower 1/3rd each 4 cm)
- So when you give distal clearance of 2 cm you will damage the sphincter in lower third rectum cancers hence we opt for APR in lower 1/3rd
- But you can well preserve the sphincter in upper and middle 1/3rd cancers hence we do anterior resection.

I. **Upper 1/3rd growth:** 'Anterior resection' (Figs 7.9A to D)
   i. Wide resection of bowel with its lymphatics followed by end-to-end anastomosis
   ii. Sphincter saved

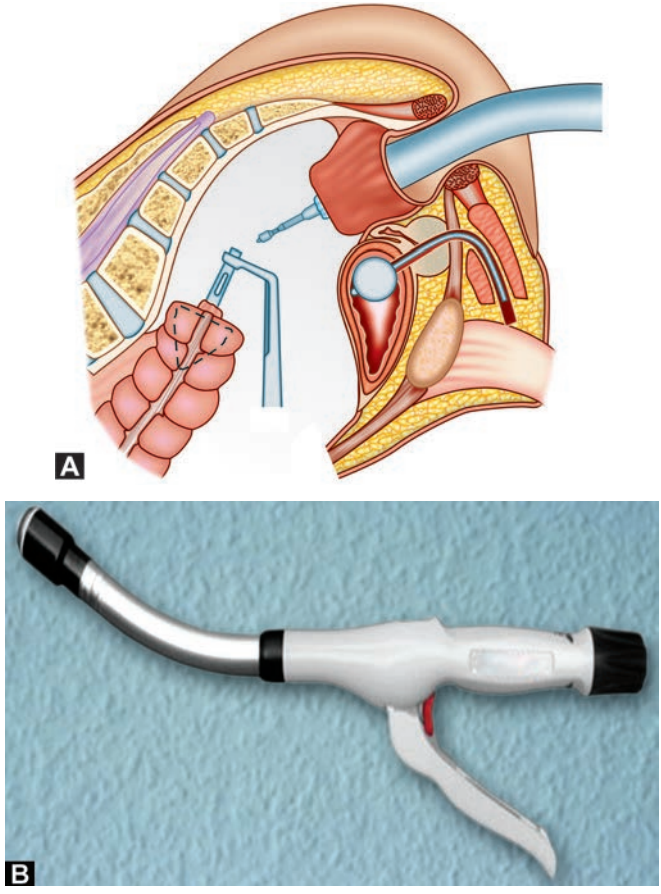
II. **Middle 1/3rd growth:** Low anterior resection' with distal 2 cm clearance
   i. Sphincter can be saved by mobilization
   ii. Staplers had made the continuity more feasible (Figs 7.10A and B)
   iii. If sphincter cannot be preserved do abdominoperineal resection.

III. **Lower 1/3rd growth:** 'Abdominoperineal resection'—Mile's procedure (Figs 7.11 and 7.12)
   i. Trendlenberg lithotomy position
   ii. Two surgeons.

Abdominal Surgeon

- Rectum is mobilized
- Total mesorectal excision
- High proximal ligation of inferior mesenteric lymphovascular pedicle.

Perineal surgeon: Mobilizes the anus and lower rectum. Clamps applied at the proximal colon to avoid transluminal dissemination.



Figs 7.10A and B: Circular stapler in anterior resection

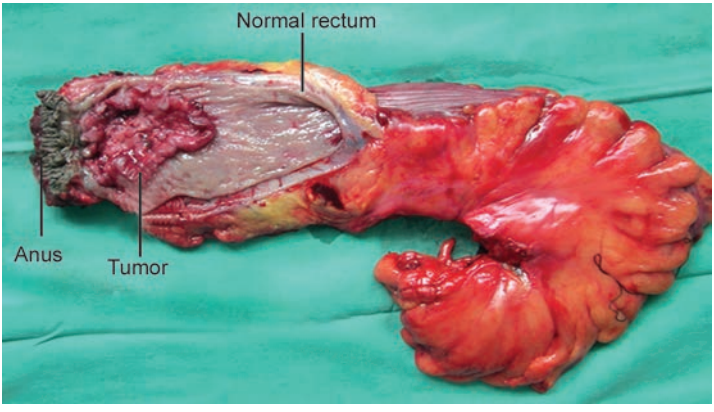


Fig. 7.11: Specimen of abdominoperineal resection (APR)

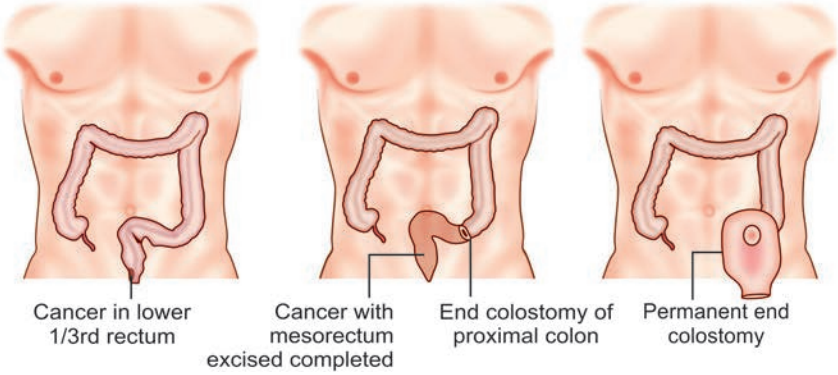


Fig. 7.12: Procedure—anteroposterior resection (APR)

Structures Removed

- Growth with entire rectum and anal canal
- Pararectal nodes
- 2/3rd sigmoid colon
- Mesocolon
- Inferior mesentric artery with lymphovascular pedicle
- Muscles and peritoneum of pelvic floor
- Perianal skin, part of ischiorectal fossa
  - Followed by permanent end colostomy at left iliac fossa
  - Irrigation of colonic or rectal lumen; with canceridal solution like 1 percent cetrimide prevents recurrence.

Radiotherapy

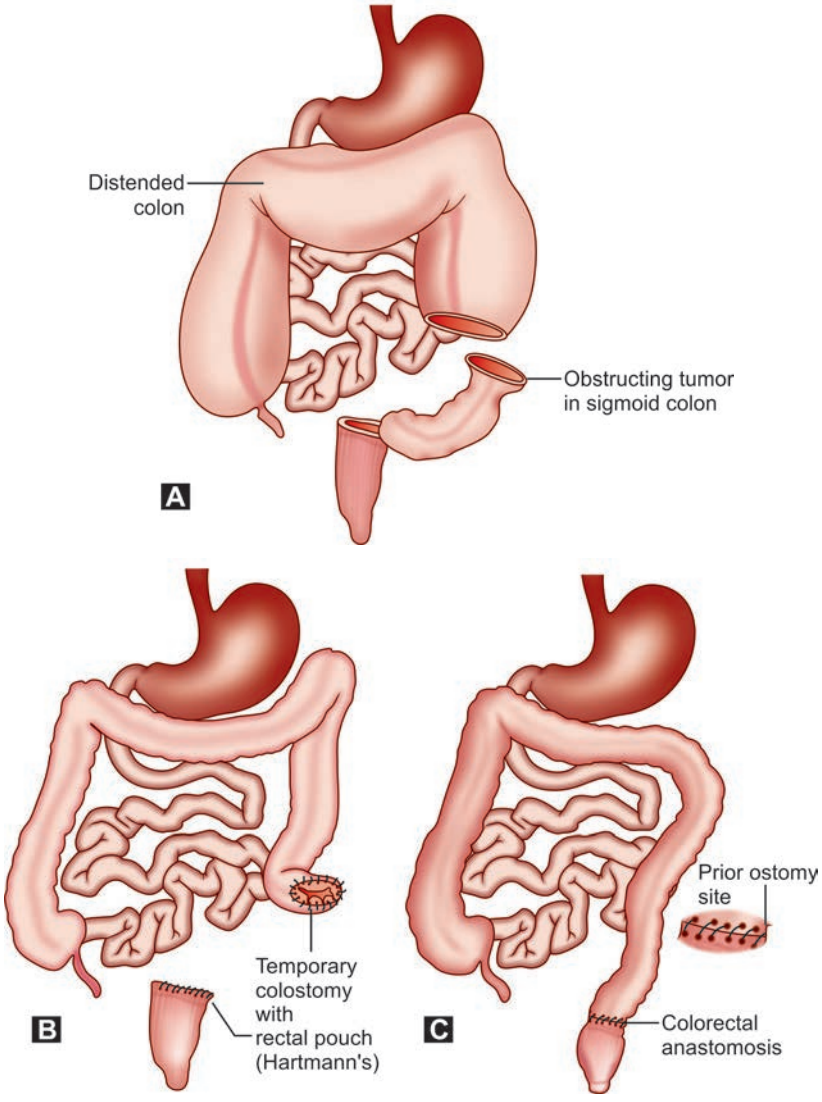
Intracavity irradiation.

Chemo/Immunotherapy

- 5-fluorouracil
- Levamisole
- Folinic acid.

Inoperable Cases

- Hartmann's operation
- Temporary loop colostomy.



Figs 7.13A to C: Hartmann's operations

Hartmann's Operation

Emergency procedure for left side colon obstructions where we do left side colostomy and closure of distal stump followed later after **6 weeks** by definitive procedure (Figs 7.13A to C).

8 CASE

Varicose Veins

- History
- Inspection
- Deep Vein Thrombosis
- Latest Treatment in Varicose Veins

HISTORY

- Name
- Age
- Sex : More common in women 10:1 ratio
- Occupation : More common in jobs having prolonged standing, e.g. policeman, petrol bunk workers, tram drivers, etc.

Symptoms

- Asymptomatic
- Aching pain
- Bursting type of pain while walking (Deep vein thrombosis)
- Ulcers
- Appearance of varicosity.

History of Suggestive Secondary Causes

- History of pregnancy
- History of prolonged immobilization
- History of oral contraceptive pill consumption
- History of constipation.

Past History

No history of diabetes, hypertension, ischemic heart disease, bronchial asthma, tuberculosis.

Personal History

- History of smoking and alcoholism
- History of diet.

Family History

- Similar history in the family.

General Examination

- Anemia
- Cyanosis
- Jaundice
- Clubbing
- Lymph adenopathy.

Examination of Other Systems

Cardiovascular system: Normal heart sound.

RS: Normal vesicular breath sounds.

Abdomen: Palpable mass:

- Pregnancy
- Fibroid
- Ovarian cyst
- Carcinoma cervix or rectum.

CNS: No focal neurological deficit.

Examination of Varicose Veins

- Inspection
- Palpation
- Percussion
- Auscultation.

Before going into the examination, you should have an idea of the anatomy of venous system of legs.

Perforator—Anatomy (Fig. 8.1)

- **Adductor canal perforator :** Between femoral vein and great saphenous vein (1)
- **Below knee perforator :** Between posterior tibial vein and great saphenous vein (2)

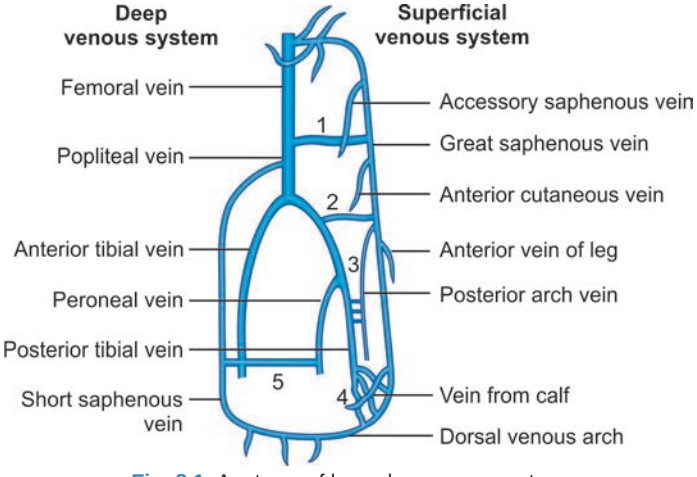


Fig. 8.1: Anatomy of lower leg venous system

- **Lower leg perforators** : Between posterior tibial vein and posterior arch vein (tributary of GSV) (3)
- **Lateral perforators** : Between peroneal vein and short saphenous vein (5).

Perforators of Lower Limb—Landmark (Fig. 8.2)

- **Adductor (Hunterian) canal perforator** : Palm breadth above knee (Dodd)
- **Below knee perforator** : Just below knee (Boyd)
- **Lower leg perforators** : 3 in numbers (Cockett)
  1. Posteroinferior to medial malleolus
  2. 10 cm above medial malleolus
  3. 15 cm above medial malleolus
- **Ankle perforators** : Inconstant (May or Kuster)
- **Lateral perforator**

INSPECTION

Varicose veins: Dilated, elongated and tortuous veins (Fig. 8.3).

- Examine which system is involved:
  - Short saphenous system: Lateral side
  - Great saphenous system: Medial side
- Swelling of the leg:
  - Localized: Superficial venous system is affected
  - Generalized: May be due to deep vein thrombosis
- Skin changes in the leg:
  - Color: Local redness—Superficial thrombophlebitis

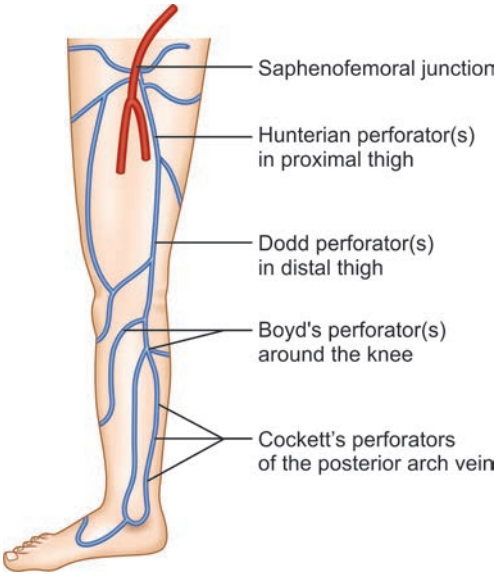
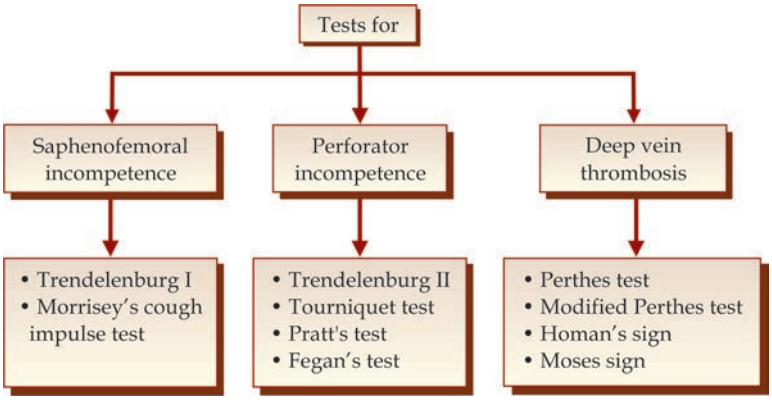


Fig. 8.2: Perforators of leg

Fig. 8.3: Varicose vein

Flow chart 8.1: Tests in varicose vein examination



Phlegmasia alba dolens (white leg):
- Massive edema of involved limb with occlusion of major draining veins of the limb (Ilio femoral thrombosis)
- Pulse may be palpable in these patients

Phlegmasia cerulea dolens (cyanotic mottled skin):
- Massive tight edema of involved limbs due to occlusion of not only the major draining veins but also of the collateral veins
- Ankle pulses may not be palpable
- It may lead to venous gangrene if not treated

– Texture: Stretched skin
Eczema/pigmentation
Ulceration
Scars
Loss of hair } Impending gangrene
Brittleness of nail }

Palpation (Flow chart 8.1)

Examine the lower limb for:
- Thickening of skin
- Pitting edema
- Tenderness
- Temperature
- Redness
- Lipodermatosclerosis
- Varicose venous ulcer.

Lipodermatosclerosis: Progressive sclerosis of the skin and subcutaneous tissue may occur due to fibrin deposition, tissue death and scarring due to chronic venous hypertension (Fig. 8.4).

Fig. 8.4: Lipodermatosclerosis

Venous ulcer (stasis ulcer) (Fig. 8.5):

- **Site:** Lower 1/3rd medial side of leg
- **Size:** Variable
- **Shape:** Oval to circular
- **Margin:** Well-defined
- **Edge:** Sloping edge (healing)
- **Floor:** Formed by deep fascia
- **Surrounding:** Pigmentation, eczema, varicosity
- **Base:** Extend up to periosteum
- **Deformity:** Talipes equinovarus

Fig. 8.5: Varicose ulcer

I. **Brodie Trendelenburg test:**

Test 1. For saphenofemoral incompetence

Test 2. For perforator incompetence

Procedure:

Step 1 : Patient in recumbent position legs raised to empty the vein, may be hastened by milking the veins.

Step 2 : Tourniquet is applied below saphenofemoral (SF) junction (Thumb may be used to occlude the SF junction).

Test 1 :
- Pressure released at the SF junction.
- Varices fill very quickly from above
- Test 1 is positive, i.e. saphenofemoral incompetence is present.

Test 2 :
- Do not release the pressure for one minute
- Gradual filling of veins occur in the lower limb.
- Test 2 is positive, i.e. perforator incompetence is present.

Saphenous opening:
- Just 4 cm below and lateral to the public tubercle
- Closed by cribriform fascia and forms the lower boundary of femoral canal
- Saphenofemoral junction is seen just above the saphenous opening

II. **Three tourniquets test (or) multiple tourniquets test (Fig. 8.6):**

Step 1 : Patient in recumbent position
Milk all the veins

Step 2 : Three tourniquets are applied:
1. Just below saphenofemoral junction
2. Just below mid-thigh
3. Just below knee

- Tourniquets are applied below each perforator.
- Ask the patient to stand.

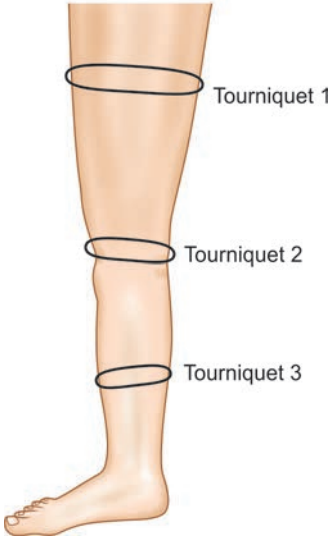


Fig. 8.6: Multiple or three tourniquets test

Inference

- Appearance of veins between tourniquet 1 and 2 is seen in **adductor canal** perforator incompetence
- Appearance of veins between tourniquet 2 and 3 is seen in **below knee** perforator incompetence
- Appearance of veins below the 3rd tourniquet is seen in **lower leg perforators** incompetent.

If the veins above the tourniquet fills up and those below it remain collapsed, it indicates presence of incompetent communicating vein above the tourniquet.

Similarly if the veins below the tourniquet fill rapidly whereas the veins above the tourniquet remain empty, the incompetent communicating veins must be below the tourniquet

- On releasing the tourniquet one by one from below upwards, sudden retrograde filling of veins occurs.
- Some of them use a fourth tourniquet palm breath above medial malleolus; appearance of veins below 4th tourniquet implies lower leg perforator incompetence.

Short Saphenous Venous Incompetence

Method 1

- Apply a tourniquet at the upper thigh, thus blocking the GSV blood to flow into femoral vein and diverting most of the blood into the popliteal vein
- The blood from the popliteal vein backflows into SSV if there is saphenopopliteal incompetence and the SSV becomes more prominent.

Method 2

- Identify the saphenopopliteal junction (usually in the popliteal fossa) and occlude it
- Ask the patient to stand
- Release the pressure at saphenopopliteal junction
- Veins fill rapidly on the lateral side if there is saphenopopliteal incompetence.

III. **Perthes test (Fig. 8.7):**

Steps:

- Wrap the whole lower limb with elastic bandage
- Ask the patient to walk or exercise.

Result: If there is deep vein thrombosis, all the blood on getting diverted into the deep venous system due to collapse of superficial venous system by elastic bandage causes the deep venous system to dilate and results in severe cramps.

- The result is patient dependent and it is hence **subjective**.

IV. **Modified Perthes test:**

- To find deep vein thrombosis
- Important preliminary to do this test is that **there should not be any perforator incompetence to do this test**.

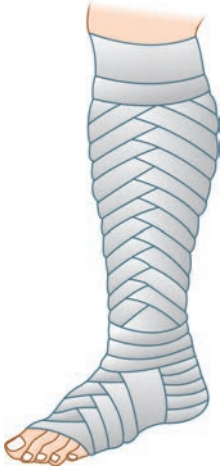


Fig. 8.7: Perthes test: Wrap the elastic crepe bandage from foot to thigh tightly to occlude the superficial venous system

Steps:

- Tourniquet is applied below the saphenofemoral junction (no need to milk the veins before applying tourniquet).
- Ask the patient to walk with tourniquet.

Observation:

- *Shrinking of varicose veins:* Indicates that there is normal deep veins and perforators.
  (*Note:* If there is perforator incompetence there will not be shrinking of veins, hence cannot be done in cases of perforator incompetence)
- *More prominence of varicose veins associated with severe cramp like pain:* Indicates there is deep vein thrombosis.

Note: Advantage over Perthes is that here the result is **objective** (veins becoming prominent) as well as **subjective** (cramp like pain).

V. **Pratt's test:**

- To mark the position of weak perforators (blow outs).

Steps:

- Apply Esmarch elastic bandage from toes to groin to empty the superficial veins.
- Apply tourniquet at groin (below SF junction).
- With tourniquet in position remove bandage gradually from above below and simultaneously apply another elastic bandage from groin to toes in reverse direction.
  Inference: At the position of weak perforators blow outs can be seen. Mark these blow outs with skin pencil.

VI. **Fegan's test:** After marking the blow outs make the patient lie down to empty the veins. You can palpate the defect in deep fascia at these spots **(Fig. 8.8)**.

VII. **Schwartz test:**

- Ask the patient to stand and keep thumb of one hand at the saphenous opening

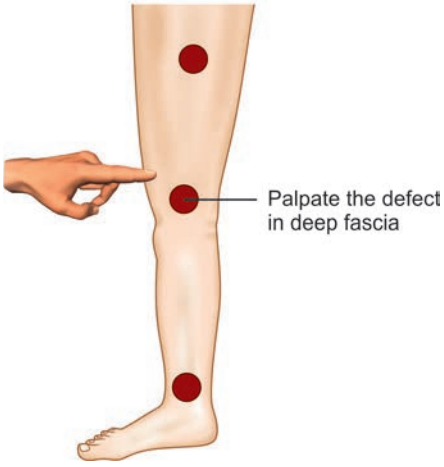


Fig. 8.8: Fegan's test: Palpate the defect in deep fascia

- Tap with other hand along the course of long saphenous vein in the lower part of leg.

Inference: Impulse is felt in the thumb at saphenous opening. This test implies the valves along the GSV are incompletent.

VIII. **Morrissey's cough impulse:**

- Limb is elevated to empty the veins and the limb is then put to bed and the patient is asked to cough forcible
- An expansile impulse is felt at the saphenofemoral junction in cases of saphenofemoral incompetence.

IX. **Tests for deep vein thrombosis:**

- *Homan's sign:* Forcible dorsiflexion of foot with knee extension causes pain in the calf.
- *Moses sign:* Squeezing the calf muscles from side-to-side results in severe pain at the calf.

Note: These tests are not to be done nowadays for the risk of dislodgement of thrombus resulting in pulmonary embolism.

Percussion: 'Schwartz test'

Auscultation: 'Morrisey's cough impulse test'.

Examine:

- Regional nodes
- Other limb
- Measure both limbs circumference above or below a fixed bony point and mention any swelling of affected limb.
- Arterial pulsations.

Diagnosis:
- Primary (or) secondary varicose vein
- Involving great saphenous (or) short saphenous (or) both venous system
- With or without saphenofemoral incompetence (or) saphenopopliteal incompetence
- With or without perforator incompetence
- With clinical class
- With or without complications

Clinical class of chronic venous disease:

Class 0 :	No visible or palpable signs of venous disease
Class 1 :	Telangiectasis/Reticular veins
Class 2 :	Varicose veins
Class 3 :	Edema
Class 4 :	Skin changes ascribed to venous disease (Pigmentation, venous eczema, lipodermatosclerosis)
Class 5 :	Skin changes as described above with healed ulceration
Class 6 :	Skin changes as described above along with active ulceration

CEAP Classification of Varicose Veins

C	Clinical signs (grade 0-6), supplemented by "A" for asymptomatic and "S" for symptomatic presentation
E	Etiologic classification (congenital, primary, secondary)
A	Anatomic distribution (superficial, deep, or perforator, alone or in combination)
P	Pathophysiologic dysfunction (reflux or obstruction, alone or in combination)

Varicose Veins—Discussion

Definition: Dilated, elongated and tortuous superficial veins of the limb are called as varicose veins.

Classification

1. **Primary varicose veins:**
   - Congenital weakness in vessel wall or congenital absence of valves
   - Incompetence of main vein or communicating vein
   - Primary varicosity can also be familial

   Note: These factors in addition to prolonged standing help in varicose vein formation.
2. **Secondary varicose veins:**
   - Obstruction to venous outflow:
     - Pregnancy
     - Pelvic mass (Ovary, fibroid)
     - Abdominal lymphadenopathy
     - Ascites
     - Retroperitoneal fibrosis
     - Iliac vein thrombosis.
   - Destruction of valves due to deep vein thrombosis:
     - Oral contraceptive pills
     - Progesterone

Varicosity is seen in:
- Lower limb
- Esophageal varices
- Hemorrhoids
- Varicocele testis
- Vulval varices
- Ovarian varices
- Gastric varices

- High pressure flow:
  - Arteriovenous (A-V) fistula.

Syndromes associated with varicose veins:

1. **Klippel-Trenaunay syndrome:**
   - Abnormal lateral venous complex (short saphenous)
   - Capillary nevus
   - Bony abnormalities
   - Aplasia of deep veins
   - Limb lengthening
2. **Kasabach-Merritt syndrome:** 'Platelet trapping within hemangiomas'
   - Multiple cutaneous and large visceral hemangiomas
   - Arteriovenous shunt
   - Congestive cardiac failure
   - Skeletal distortion and contour abnormalities
   - Hypopigmentation

Hypothesis for Varicosity

1. **Ambulatory venous hypertension:**
   'Varicose vein is one which permits reverse flow via its faulty valve'.
   Normal pressure in:
   i. Superficial venous system: Rest: 80–100 mm Hg
      Walking: 20 mm Hg
   ii. Deep venous system: Walking: 200–300 mm Hg
      - The failure to decrease the superficial venous pressure to 20 mm Hg on walking is called ambulatory venous hypertension.
2. **Fibrin cuff hypothesis:**
   - Increased superficial venous pressure results in venous hypertension
   - Main focus of damage is in capillaries hence capillaries increase in size and length (glomerulus like)
   - Fibrotic process occurs associated with inflammatory cells (macrophages) and results in perivascular cuff made of fibrin, collagen IV, fibronectin
   - The perivascular cuff acts as a barrier to diffusion of nutrients between capillaries and tissues resulting in ulceration and lipodermatosclerosis.
3. **White cell trapping hypothesis:**
   - Venous hypertension results in leukocyte sequestration.
   - Trapped WBC's activate and release proteolytic enzymes resulting in damage to capillary endothelium and ulceration.

Clinical Features

- Cosmetic: Tortuous dilated veins in the leg
- Symptoms of tiredness and heaviness
- Symptoms of itching and skin thickening
- Bleeding
- Phlebitis
- Eczema, lipodermatosclerosis
- Ulceration.

Blow outs	: Localized dilated segment of vein signifies underlying perforator incompetence
Ankle flare	: Group of veins near the medial malleolus
Reticular veins	: 1 to 3 mm width.
Thread veins	: (Dermal flare) Diameter < 0.5 mm
Saphena varix	: Single varix at SF junction
Champagne bottle leg (Inverted beer bottle appearance)	: Contraction of skin and subcutaneous tissue near the ankle results in the edema of limbs (prominent calf)

Venous Claudication

- Bursting type of pain in calves due to inability of outflow channels to push out the excess blood during exercise.

Complications of Varicose Veins

1. **Due to dilated veins:**
   - Hemorrhage
   - Phlebitis (Thrombosis)
   - Calcification of veins.
2. **Due to ulcer:**
   - Ulcer complicates varicose vein in about 5 percent of the people.
     - *Marjolin's ulcer* : Malignant change in long-standing venous ulcer. **(Fig. 8.9)**
     - *Periostitis tibia* : Occurs in long-standing ulcer on medial surface of tibia.
     - *Equinus deformity* : Walking on toe relieves pain, so he continues walking resulting in shortening of tendo-Achilles. **(Fig. 8.10)**
3. **Skin changes:**
   - Eczema
   - Pigmentation (due to hemosiderin deposition)
     - Due to high venous pressure red blood cell (RBC) is forced into the capillaries resulting in hemoglobin break down to form hemosiderin.
   - Lipodermatosclerosis.

Fig. 8.9: Marjolin's ulcer

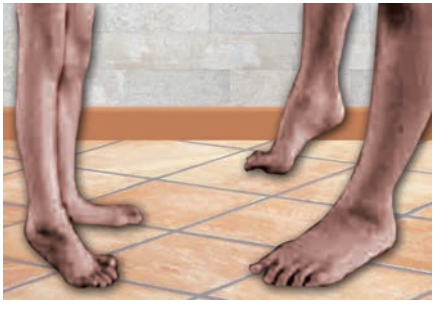


Fig. 8.10: Equinus deformity

Investigations:

1. Routine investigations and blood grouping
2. To clinch the diagnosis:
   - Ascending venogram
   - Descending venogram
3. For operating purpose:
   - Hand held doppler
   - Duplex ultrasound

Discussion

1. **Venogram:**
   - X-ray equivalent of Duplex USG.
   - Dye used: Hypaque

   Procedure:
   - Contrast medium is taken
   - Injected into foot in a canulating vein (ascending venogram)
   - Apply tourniquet above malleoli; this directs blood to deep veins.

   Findings in venography:
   - Any dye in the superficial venous system indicates incompetence.
   - 'Tram line' appearance
   - Filling defects
   - Disfigured vein
   - Complete occlusion (DVT)
   - Collaterals.

   Advantage:
   - Excellent anatomical inference.

   Disadvantage:
   - Less information about the veins where the valves have failed.

   Note: Nowadays useful in cases of suspected deep vein thrombosis in places where Duplex is not available.

   Incompetent veins (saphenofemoral or sapheno popliteal incompetence) are shown by descending venogram - dye is injected into femoral vein.

2. **Doppler ultrasound:**

   Standing position

   Keep the probe in:
   - Saphenofemoral junction
   - Midthigh
   - Saphenopopliteal junction

   Inference:

   Normal: No sound received.

   Abnormal:
   - Obstruction : Continuous sound at that point.
   - Venous reflux : When calf is compressed a 'woosh' sound heard, and if you release the compression you can identify the back-flow through incompetent valves.

   Disadvantage: Only functional study.

3. **Duplex ultrasound imaging:** It uses the high resolution B-mode ultrasound imaging and Doppler ultrasound to obtain.
   - Images of vein
   - Measure flow in vessels.

   Advantage: Both functional and anatomical.

   Procedure and inference: Hand-held probe is used in various sites:
   - Press the calf: Blue color (Normal venous flow)
   - Release the calf pressure:
     - No flow: Normal
     - Red color: Incompetent vein (which indicates back flow).

Treatment:
1. Indications
2. Conservative
3. Definite:
   - For saphenofemoral incompetence: Trendelenberg operation.
   - For perforator incompetence: Subfascial/suprafascial ligation.
   - For saphenopopliteal incompetence: Flush ligation
   - Small varicosities/flares: Sclerotherapy
   - Dilated small veins: Hook phlebectomy
4. Deep vein thrombosis:
   Medical
   Surgical: Paloma operation/valve repairs
   (**Author's note:** Paloma operation is for varicocele testis)
5. Latest treatment modalities:
   - Endovenous laser ablation (EVLA)
   - SEPS

Varicose Vein Surgery

1. **Indications for surgery:**
   - Cosmetic
   - Varicose ulcers
   - Symptomatic cases.
     - Contraindicated in cases of deep vein thrombosis, because dilated superficial veins form the only draining channel for lower leg veins and if it is removed there will not be a channel for backflow of blood and may result in pulmonary embolism from DVT.
2. **Conservative management:**
   Indications:
   - Asymptomatic cases
   - Secondary varicose veins:
     - Pregnancy
     - Deep vein thrombosis
     - Arteriovenous fistula
     - Pelvic tumors.

Venous Ulcer

Varicose ulcers are treated by **'Bissgard's method'**
- Clean the ulcer with normal saline, povidone iodine and hydrogen peroxide

- Remove any slough over the ulcer
- Do not use any topical antibiotics (Antibiotics are given only when the ulcer is infected).
- Rest with elevated limb
- Elastic crepe bandage helps in venous return—tied from below upwards or we can use stockings of pressure gradient 30 to 40 mm Hg
- Active exercises should be taught to the patients (to contract calf muscles)
- Passive exercises
- Teach correct way of walking with heel down first (to prevent equinovarus)
- We can apply partial thickness (Thiersch graft) over the ulcer after granulation tissue is formed
  - The most important factor in achieving healing is the use of high levels of compression.
  - Pressures of 30 to 45 mm Hg applied to the ulcer are much more effective than lower levels of compression.
  - Such pressure is achieved by:
    1. Compression stockings
    2. Four layer bandaging.
  - As soon as the ulcer heals varicose vein surgery must be done.

Definitive Treatment

Sclerotherapy

Indications:

- Small varicosities after operation
- Recurrence
- Dermal flares, i.e. <0.5 mm width
- Cosmetic.

Sclerosants:

- 3 percent sodium tetra decyl (STD)—most commonly used
- Ethoxy sclerol
- 5 percent ethanolamine oleate.

Procedure:

- Empty the vein and give STD immediately into the emptied vein
- Aim is to produce aseptic sclerosis; vein is being replaced by fibrous cord, incapable of recanalization
- Wear compression bandage 3 to 6 weeks after sclerotherapy.

Disadvantage:

- If the dye is injected into unemptied vein thrombophlebitis and recanalization occurs.
- Skin tanning
- Deep vein thrombosis.

Microsclerotherapy:

- Agents used are most diluted STD or polidocanol
- Very fine needle is used for thread veins and reticular varices.

Surgical Procedures

1. **Saphenofemoral incompetence:**
   - 'Saphenofemoral flush ligation'—Trendelenberg procedure **(Fig. 8.11)**
   - Ligate the saphenous vein close to the femoral vein leaving a length of about 3 mm including its tributaries (otherwise collaterals and leak may develop)
2. **Stripping of veins (Figs 8.12 and 8.13)**
   - Babcock stripper
   - Oesch pin stripper.

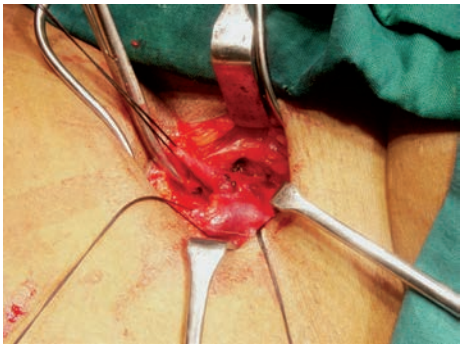


Fig. 8.11: Saphenofemoral flush ligation

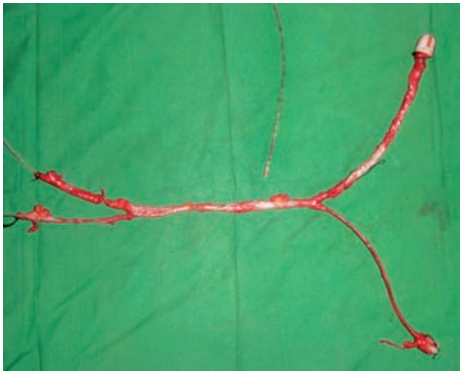


Fig. 8.12: Stripping of veins

Fig. 8.13: Oesch pin stripper

Care during stripping:

- *Great saphenous vein:* Do not strip beyond the mid-calf level because saphenous nerve supplying the great toe may be injured due to its close relation to GSV below the mid-calf level.
- *Short saphenous vein:* Similarly do not strip the SSV beyond mid-calf level because sural nerve related to it, may be damaged.

3. **Saphenopopliteal incompetence:**
   - The termination of short saphenous vein may lie from 2 cm below the knee to 15 cm above the knee.
   - Study the junction by Duplex and mark the site.
   - Do saphenopopliteal flush ligation.
4. **Perforator incompetence:**
   - *Subfascial ligation of Cockett and Dodd:*
     - Preferable in cases of lipodermatosclerosis.
     - Long incision made to open the deep fascia and the perforators are ligated deep-to-deep fascia.
   - *Suprafascial ligation of Linton:*
     - There should not be lipodermatosclerosis.
     - Perforators are ligated above the deep fascia.
     - Easier to do.
5. **Superficial varices:** Remaining superficial veins are removed by Hook phlebectomy for cosmetic purpose.

DEEP VEIN THROMBOSIS

- Conservative
- Surgical.

Conservative

- *Intravenous heparin:* 5 days (monitor activated partial thromboplastin time).
- Commence warfarin by the same time and continue it for 3 to 6 months. Monitor internationalized normal ratio (INR : 2.5–3.5 times).

Surgical

- Palma operation
- May-Husni procedure.

Palma Operation (Fig. 8.14)

- Obstruction at external iliac vein or at femoral vein level.
- Femoro-femoral vein graft—constructed using great saphenous vein of opposite side.

May-Husni Operation

- Obstruction at superficial femoral vein.
- Connection made between popliteal vein and great saphenous vein.

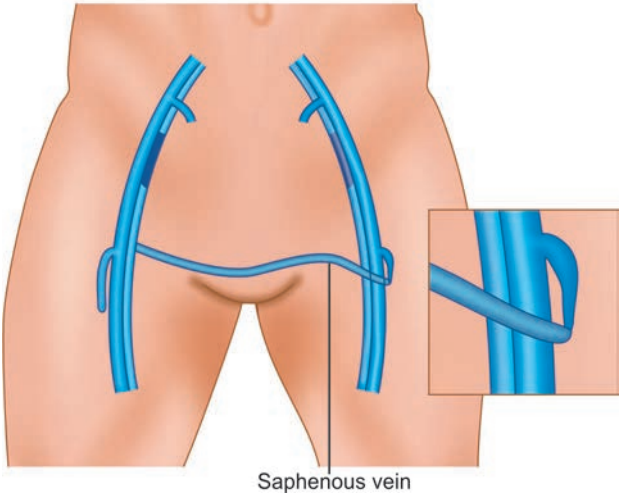
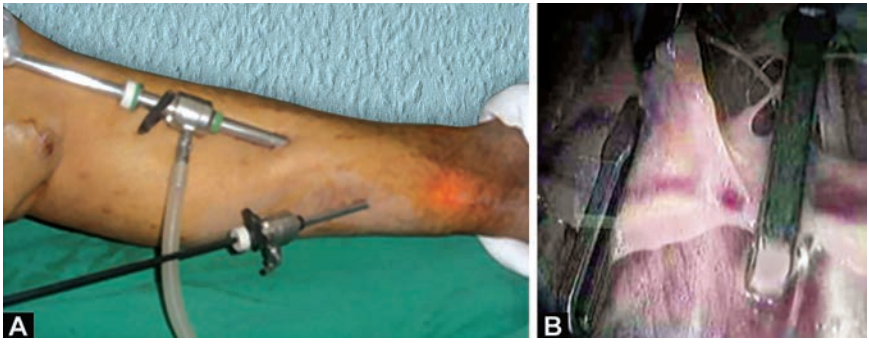


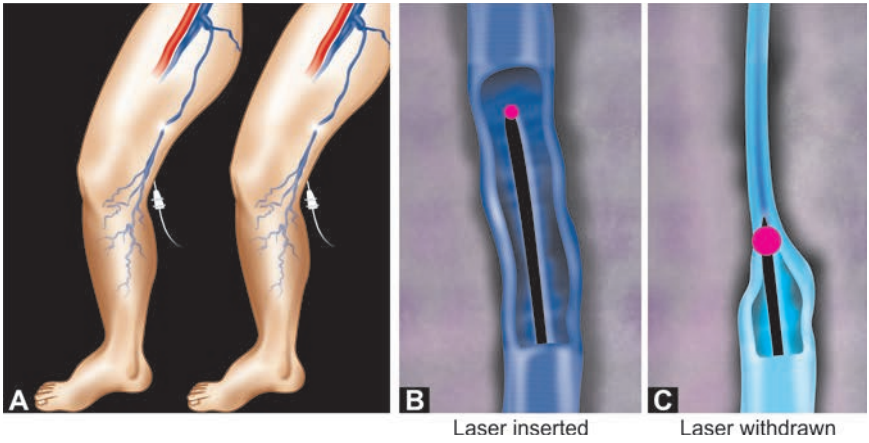
Fig. 8.14: Palma operation

LATEST TREATMENT IN VARICOSE VEINS

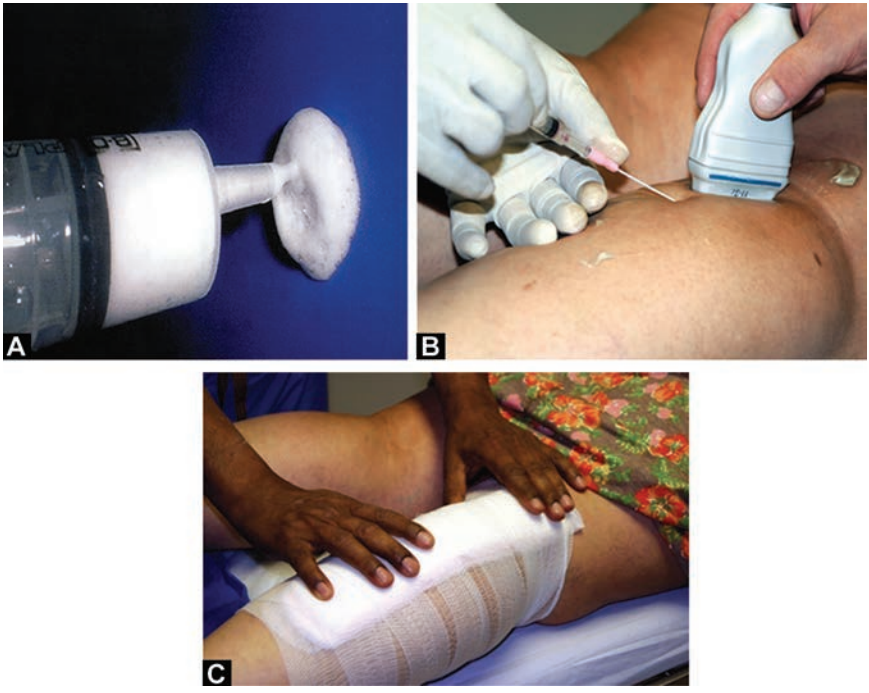
- **SEPS (subfacial endoscopic perforator surgery) (Figs 8.15A and B):** Similar to laparoscope special instruments are used to ligate the perforator beneath the deep fascia.
- **EVLA (endovenous laser ablation) (Figs 8.16A to C):** Endovenous laser ablation of the GSV using radiofrequency (RF) or laser without high ligation is becoming a less invasive alternative to ligation and stripping.



Figs 8.15A and B: Subfacial endoscopic perforator surgery



Figs 8.16A to C: Endovenous laser ablation



Figs 8.17A to C: Procedures in foam sclerotherapy

- **Foam sclerotherapy (Figs 8.17A to C):** The sclerosant agents like polidocanol is made into a foam and injected directly under USG guidance into the dilated veins.

9 CASE Peripheral Vascular Disorders

- History
- Chief Complaints
- Pain
- Palpation
- Others
- Palpation of Pulses
- Discussion
- Chronic Limb Ischemia
- Investigations for PVD
- Applications
- Invasive Vascular Assessments
- Methods
- Diagnostic Catheters
- Balloon Angioplasty Catheters
- Pharmacotherapy
- Prostaglandins

ATHEROSCLEROTIC DISEASES

[Students are requested to read TAO, Gangrene (Critical limb ischemia) and Raynaud's disease in Author's Short Cases in Surgery].

HISTORY

Age : TAO (young males)
Sex : Raynaud's (females young age).

CHIEF COMPLAINTS

- Pain
- Ulceration
- Blackish discoloration

} of lower limb

PAIN

- Site, character, radiation
- Intermediate claudication
- Rest pain-relieving factors
- Progress of claudication
- Claudication distance.

Intermittent claudication is due to the muscle pain as a result of accumulation of 'P' substance owing to inadequate flow

Boyd's classification

Grade I - Patient experiences pain after walking some distance and pain disappears and patient continues to walk (P-substances washed away)
Grade II - Pain persists and still the patient continues to walk with limp
Grade III - Pain compels the patient to take rest

Pain

- Site, onset
- Nature
- Radiation
- Aggravating factors
- Relieving factors
- Rest pain

Ulceration and Gangrene

- History of trauma
- Progress of ulceration
- History of discharge
- History of color charges

Negative History

- History of fever
- History of superficial phlebitis (TAO)
- History of trauma
- History of previous episodes
- History of cardiac problem.

Etiological History

- History of pain following exposure to cold (Raynaud's)
- History of cardiac problems (atrial fibrillation with embolism)
- History of diabetics, smoking (atherosclerosis).

History of Involvement of Other Vessels

- Chest pain (MI)
- Black outs /LOC (CVA)
- Abdominal pain (mesenteric ischemia)
- Impotence (bilateral internal iliac occlusion)
- Blurred visions (ophthalmic vessels).

Past history: History of Diabetes, hypertension and hypercholesterolemia
Personal history: History of smoking
Family history: Atherosclerotic diseases in family
Treatment history: History of surgery before (amputation, sympathectomy).

Local Examination

Inspection

- Attitude of limb
- Bone – Deformity of toes/digits
- Muscle – Wasting
- Vein – Guttering of veins
- Skin – Signs of peripheral ischemia
  1. Thinning of skin
  2. Diminished hair
  3. Lose of subcutaneous fat
  4. Loss of shininess
  5. Trophic changes in nail: Brittle nails transverse ridges develop
  6. Minor ulcerations in pressure areas.
- Color of limb

Gangrene

Line of demarcation, wet or dry, skip lesions, extent.

Tests in Inspection

- Buerger's postural test
- Capillary refilling time
- Venous refilling time

Buerger's postural test

Patient lies supine, raise the legs one after other with knees extended

Normal limb: Remain pink even when raised to 90°

Look for: 1. Onset of pallor

2. Guttering of veins

- Angle at which it appears is Buerger's angle
- Less than 30° implies severe ischemia

Capillary refilling time

- After Buerger's test
- Make the patient sit and hang legs down

Normal limb: Will be pink as it was in elevated position

Ischemic limb: Pallor limb on elevation turns pink in dependent position

- Time taken is noted
- 20 to 30 seconds implies severe ischemia

Venous refilling time

After keeping the limb elevated for a while if it is laid flat on the bed, there will be normal refilling of veins within 5 seconds; but in ischemic limbs it will be delayed.

Guttering of veins

On raising the limb:

- Normal limb—gutter of veins at 90°
- Ischemic limb—gutter at horizontal or raising to even 10°

PALPATION

- Skin temperature
- Capillary refilling: Pressure over the tip of nail or pulp of toe
- Venous refilling **(Harvey's sign)**
- Gangrenous area:
  - Site
  - Sensation
  - Tenderness
  - Local crepitus.

OTHERS

I. **Movements of joints adjacent to gangrenous area**
II. **Examination of nerve:**

Sensory	Motor
• Crude touch/fine touch	• Tone
• Pain sensation	• Power of muscles
• Temperature sensation	• Ankle flexion/extension
• Reflexes	• Knee flexion/extension
• Plantar response	

"On the borderline of gangrene, skin is hyperesthetic"

III. **Examination of inguinal nodes**
IV. **Examination of pulses:**
- Condition of arterial wall
- Tenderness
- Auscultation
- Bruit over major arteries.

Examination of Cardiovascular system, abdomen, spine and cranium

Diagnosis
This is a case of peripheral vascular disease affecting the left lower limb with ischemic gangrene of left great toe probably due to atherosclerotic vascular disease

Viva: Why can not this be Buerger's disease (TAO)?
The following features are seen in this patient:
- Unilateral involvement
- Associated diabetes and hypertension
- Old age
- No history of smoking
- Involvement of femoral artery.

Shionoya creteria for Buerger's disease
- History of smoking
- Onset before age of 50 years
- Infrapopliteal arterial occlusions
- Either arm involvement or phlebitis migrans
- Absence of risk factors for atherosclerosis other than smoking

Viva: What is neurological claudication? How will you differentiate it from vascular claudication?
- Pain in the legs due to some neurological causes (e.g. disk compression) is called as neurological claudication
- Neurologic claudication will have pain from the initial step, relieved only by some posture which relaxes the nerve. It is not related to the distance he walks. Also when you palpate all his peripheral pulses will be present.

PALPATION OF PULSES

- **Common carotid artery:** Medial border of sternocleidomastoid at the level of upper border of thyroid cartilage against c6 carotid tubercle **(Chassaignac's tubercle)** (Fig. 9.1)
- **Superficial temporal artery**: In front of tragus of ear over zygomatic bone
- **Subclavian artery:** Midclavicular point. Patient lifting the shoulder to relax deep cervical fascia
- **Axillary artery:** Lateral wall of axilla in between the two axillary folds
- **Brachial artery:** Front of elbow medial to tendon of biceps brachii (Fig. 9.2)
- **Radial artery:** Lateral border of lower end of radius
- **Femoral artery:** Below the inguinal ligament midway between anterosuperior iliac spine and pubic symphysis (Fig. 9.3).
- **Popliteal artery (3 methods) (Fig. 9.4):**
  - **Supine:** Flexing knee 40°, heel over bed; with thumbs over tibial tuberosity; other fingers are moved sideways to palpate popliteal artery over the posterior aspect of *tibial condyles*.

Fig. 9.1: Carotid artery palpation

Fig. 9.2: Brachial artery—medial to biceps

Fig. 9.3: Femoral artery

Fig. 9.4: Popliteal artery (supine method)

- **Prone (knee flexed):** Popliteal pulse felt over the posterior surface of *lower end of femur.*
- **Fuschig's test:** Crossed legs on sitting, inspect the oscillatory movements sitting on chair (Fig. 9.5).

- **Posterior tibial artery:** Over the medial aspect of ankle at a point 1/3rd of way between tip of medial malleolus and point of heel and slightly inverting the foot to relax flexor retinaculum (Fig. 9.6).
- **Dorsalis pedis artery:** Lateral to EHL tendon at the proximal first intermetatarsal space (Fig. 9.7).
- **Anterior tibial artery:** In front of the ankle midway between two malleoli and lateral to EHL tendon (EHL—extensor hallucis longus).

Disappearing Pulse

After exercising the patient to claudication the pulse previously palpable disappears is a sign of unmasking the preliminary stage arterial occlusion.

Note: If examiner asks you to palpate carotid arteries, palpate it one by one. Do not palpate them simultaneously because patient may go for syncope.

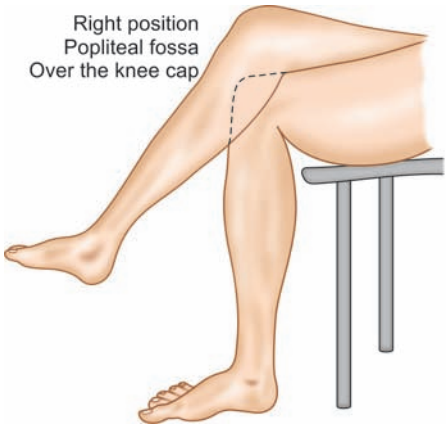


Fig. 9.5: Fuschig's test

Fig. 9.6: Posterior tibial artery

Fig. 9.7: Dorsalis pedis

DISCUSSION

Atherosclerotic Disorders

Risk Factors (Flow chart 9.1)

- Cigarette smoking
- Hyperlipidemia
- Hypertension
- Diabetes mellitus
- Lack of antioxidants—vitamin A, C, E and beta carotene
- Homocysteine increased—deficiency of vitamin B_2 and B_6, enzyme cystathione beta synthase will cause increased homocysteine levels
- Coagulation factors—increased fibrinogen, elevated factor 8, 13, plasminogen and antiplasmin
- Others
  - Sedentary lifestyle
  - Type A personality
  - Men > 45 years age
  - Women > 55 years age
  - Premature menopause with no hormone replacement therapy

Classification of Limb Ischemia

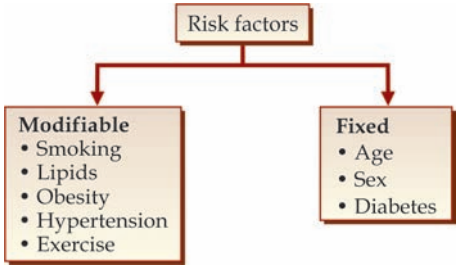
- **Functional limb ischemia :** Blood flow is normal in resting extremity but cannot be increased in response to exercise. Manifest as **claudication.**
- **Critical limb ischemia :** Reduction of peripheral perfusion to the extent that basal metabolic needs are not adequately met. Manifest as **rest pain**.

CHRONIC LIMB ISCHEMIA

"Cramp like pain felt in the muscle, brought on by exertion and relieved by rest"

- Pain is not present on taking first step and typically reproducible by consistent exercise.
- Implies ischemic muscle pain induced by exercise and can be described as:
  - **Calf claudication**: SFA disease with absent popliteal and foot pulses

Flow chart 9.1: Risk factors of peripheral vascular disorder



– **Thigh and buttock claudication**: Aortoiliac disease with absent femoral pulse.

Clinical Categories (For PG Standard)

Grade	*Category*	*Clinical description*	*Criteria*
0	0	Asymptomatic	- Normal treadmill (or) Reactive hyperemia test
	1	Mild claudication	- On Treadmill test completed AP > 50 mm Hg (at least 20 mm Hg less than resting value)
I	2	Moderate claudication	- Between 1 and 3
	3	Severe claudication	- Cannot complete tread mill exercise. AP < 50 mm Hg
II	4	Ischemic rest pain	- AP < 40 mm Hg (Resting value) TP < 30 mm Hg
III	5	Minor tissue loss, nonhealing ulcer focal gangrene	Resting AP < 60 mm Hg TP < 40 mm Hg
	6	Major tissue loss, extending above ankle joint level functional foot, no longer salvageable	
		Grades II and III (4, 5, 6) ⇒ Categorized as chronic critical ischemic	

AP: Ankle pressure
TP: Tibial pressure

Differential Diagnosis (Claudication Like Symptoms)

Popliteal Artery Entrapment Syndrome

'Due to the popliteal artery coursing around the medial head of gastrocnemius rather than between two heads resulting in entrapment'

- Young adults, sportsmen
- 1/3 cases—bilateral
- 10 percent cases—popliteal vein involved
- 60 percent case of claudication in young athletes
- Four types due to developmental anomaly
- Duplex or arteriography.

Treatment

Before occlusion of popliteal artery: Release of compression
After occlusion: Popliteal artery replacement; using vein graft.

Persistent Sciatic Artery

- "Congenital anomaly involving embryonic axial artery of lower limb"—the sciatic artery.

– The artery remains persistent, replacing ileofemoral system bilaterally and presents with intermittent claudication affecting buttock and thigh.

Fibromuscular Dysplasia

- Rare cause in young adults
- Commonly affects renal arteries and carotid arteries
- Rx: Angioplasty.

Cystic Adventitial Disease

- Cystic abnormality of the adventitia of popliteal artery
- On examination: Palpable pedal pulse disappears on flexion of knee with sudden onset claudication
- CT scan: Cystic abnormality of adventitia connected to knee joint synovium
- Arteriogram: '**Smooth hour glass abnormality of popliteal artery'**
- Rx: Surgical excision + Vein replacement

Cauda Equina Compression Syndrome

- Pain associated with change in posture and neurological deficit with normal pulses
- Pain not relieved by standing (Disk compression increases pain).

Osteoarthritis

Pain present from the initial step of walking.

Compartment Syndrome (Skin Splints)

- After prolonged jogging, anterior compartment becomes tender and painful with elevated pressure in young athletes
- Rx: Fasciotomy.

Venous Claudication

- In cases of deep vein thrombosis
- Limping and/or pain due to inadequate venous drainage, poor return of blood by the veins, from the legs
- Excessive collaterals may be seen.

Consolidation

Aorto-iliac obstruction	-	Buttock, thigh claudication absent femoral and distal pulse. Bruit over aorto-iliac region **(Leriche syndrome (impotence)**
Iliac obstruction	-	Unilateral claudication in thigh and back and sometimes buttock. Bruit over iliac region. Absent femoral and distal pulses
Femoral popliteal	-	Unilateral claudication of calf. Palpable femoral artery and absent distal pulses
Distal obstruction	-	Femoral and popliteal pulse present

Morphological Types of Iliac Lesions (For PG Standard) (Fig. 9.8)

Type A : Single stenosis < 3 cm of CIA or EIA (Unilateral/bilateral)
Type B : 1. Single stenosis 3 to 10 cm in length; not extending to CFA

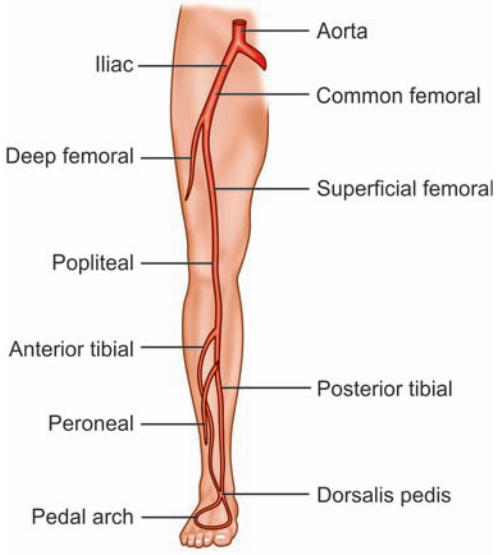


Fig. 9.8: Arterial anatomy of lower limb

2. Two/total stenosis of CIA or EIA (not extending to CFA) (< 5 cm)
3. Unilateral common iliac occlusion.

Type C : 1. Bilateral 5 to 10 cm long stenosis of EIA/CIA not extending to common femoral artery.
2. Unilateral EIA stenosis extending to CFA
3. Unilateral EIA occlusion not extending to CFA
4. Bilateral common iliac occlusion.

Type D : 1. Diffuse, multiple **unilateral involving CIA, EIA and CFA > 10 cm**
2. Unilateral occlusion involving both CIA and EIA
3. Bilateral EIA occlusion.
4. Diffuse disease involving aorta and both iliac arteries.

EIA : External iliac artery
CIA : Common iliac artery
CFA : Common femoral artery

Treatment options
- Type A: Percutaneous transluminal angioplasty
- Type D: Always surgical

"Stenotic lesions are better for correction by angioplasty rather than occlusive lesions. But however once the occlusion has been successfully traversed the outcome is same as stenosis."

Morphological Types of Femoropopliteal Lesion

Type A : Single stenosis < 3 cm (not at origin of SFA or distal popliteal)
Type B : Single stenosis/occlusion 3 to 5 cm (not involves distal popliteal)
Heavily calcified stenosis < 3 cm
Multiple lesions each < 3 cm

Type C : Single stenosis/occlusion > 5 cm
Multiple lesions each 3 to 5 cm, with or without heavy calcifications
Type D : Complete CFA or SFA or complete popliteal or trifurcation occlusions.

INVESTIGATIONS FOR PVD

Blood Investigations

- Blood sugar and urine sugar
- Lipid profile (LDL, HDL, TG, total cholesterol)
- Anemia and conditions causing high blood viscosity (polycythemia and thrombocythemia)
- ESR
- Plasma fibrinogen
- Serum creatinine (hypertension)—to give contrast agents
- Coagulation profile: Prothombin time, bleeding and clotting time.

X-ray Chest

ECG

Echocardiogram
To measure left ventricle Ejection fraction
- Radioisotope ventriculo graphy
- Echocardiogram

Noninvasive Vascular Assessments

Continuous wave Doppler: Ultrasound beams are generated by piezoelectric crystals resonating at a particular frequency and beams are reflected back:

- When reflected from stationary object—have same frequency
- When reflected from moving object—scattered by RBC will be shifted in frequency.
- Hand-held Doppler is inexpensive, portable and has multiple applications.

Pulsed wave Doppler (PWD):

- Transmit short bursts of ultrasound and the receiving crystal can be set to recognize signals retaining after a delay
- Timing of delay allows the user to specify the depth or range from which the returning signal is received
- PWD is generally used for transcranial Doppler evaluations and duplex scans.

Duplex scan: Generates three types of images based on:

1. Gray scale B mode US
2. Color flow
3. Pulsed Doppler spectral analysis

Color Doppler displays as (Fig. 9.9):

- Red: Blood towards
- Blue: Blood away
- Golden yellow/orange: Turbulence

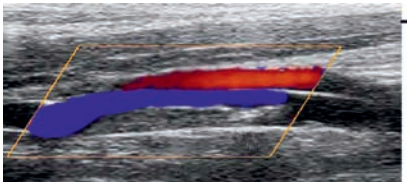
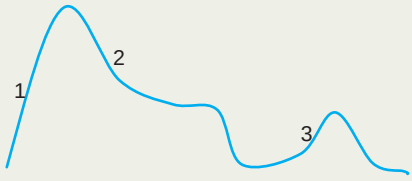


Fig. 9.9: Duplex scan

Duplex scan of aortic and iliac arteries : 2–3 MHZ
Infrainguinal : 5–7 MHZ
Duplex scan may be used to study Doppler wave forms at different sites.

Waveforms with three distinct phases is seen normally:
1. High velocity forward flow: **Systole**
2. Flow reversal: **Early diastole**
3. Low velocity forward flow: **Late diastole**



- This triphasic waveform becomes monophasic distal to tight stenosis or occlusion (lower amplitude antegrade flow with no reversal component).
- **"Spectral broadening" and "loss of end-systolic reversal flow"** are the earliest in diagnosis of occlusion.
- 'Peak systolic velocity at the site of occlusion is the most reliable waveform measurements and the one least subject to inter observe variability'.

APPLICATIONS

Ankle Brachial Pressure Index (Fig. 9.10)

$$\text{Right ABPI} = \frac{\text{Highest right ankle pressure} \quad \text{(PT or DP)}}{\text{Highest brachial pressure} \quad \text{(R or L)}}$$

Normal : 0.9–1.2

- Hand-held Doppler probe is used; held at 60° to direction of blood.
- Arterial compliance reduces with distance from heart. So pedal artery systolic pressure is higher than in arms.
- Calcified arteries (DM and chronic renal failure), artery may be incompressible; so may false high ankle brachial pressure index (ABPI)
  PT: Posterior tibial artery
  DP: Dorsalis pedis artery.

Exercise Tests (Increases Ankle Pressure)

- 'To evaluate asymptomatic lesions'
- 'During exercise increased blood flow to muscle leads to fall in ankle pressure in the presence of arterial disease'
- **Exercise protocol:** Walk on treadmill 3.5 km/hr for 5 minutes ABPI is measured again, fall in ABPI is indicative of degree of ischemia.

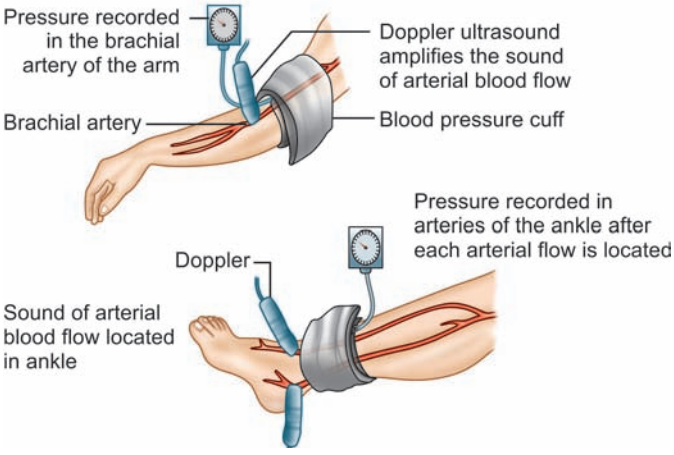


Fig. 9.10: Hand-held Doppler probe used to measure ankle brachial pressure index

- **Normal individuals:** Ankle pressure will raise and ankle systolic pressure will be greater than arm pressure (i.e. ABPI ≥ 1.0–1.2).

Toe/Brachial Pressure

- In the lower limb great toe is generally used
- Normal value: 1.0 to 0.7.
- The flow to pulp is measured using plethysmography.

Types of ischemia	
Mild	: 0.9–0.5
Severe	: 0.5–0.3
Critical	: < 0.3

Segmental Pressure—Lower Limb

- Systolic pressure can also be measured in the thigh and upper calf using appropriate sized cuffs.
- A pressure drop > 20 mm Hg across any segment is clinically significant.

Preoperative Assessment of Amputation Level

An absolute thigh pressure reading **>60 mm Hg** is usually consistent with below knee amputated stump healing.

Lower Limb Assessment

- Identification of stenosis in peripheral vascular disease
- Preoperative marking of great saphenous vein
- Postoperative surveillance of vein grafts.

INVASIVE VASCULAR ASSESSMENTS

Catheter Angiography

Do renal function test/BT and CT before attempting this test. Aim of angiographic assessment:

- Determine vascular anatomy
- Identify possible treatment options
- Endovascular treatment possibilities
- Diagnose underlying vascular entrapment by use of dynamic angiographic assessment.

Routes

- Transfemoral (low complication rate: 1.7%)
- Transaxillary (3.3%)
- Translumbar (2.9%)

Digital subtraction angiography (Fig. 9.11)
"Allows subtraction of background data prior to contrast with that of contrast film"
Advantage: Greater contrast and image definition
But requires patient cooperation and absent involuntary movements (bowel movements)

DSA can be carried with arterial or venous injection
Arterial: Fine catheters, relatively small amount of contrast agent
Venous: Large amount of contrast needed and resulting image is less clear.

- Only advantage is no need to puncture artery mainly used in patients with limited arterial access or high-risk of bleeding
- Can be used sufficient for screening for renal or carotid vessel diseases, follow-up after intervention, examination in patients with difficult femoral access

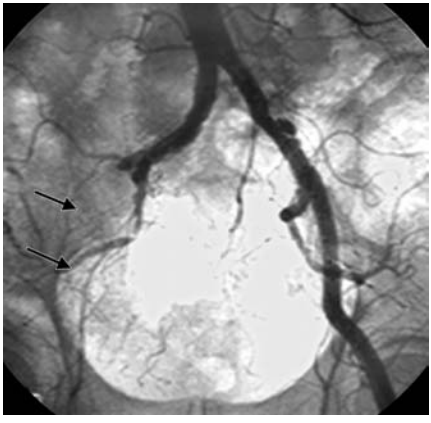


Fig. 9.11: Digital subtraction angiography

METHODS

Percutaneous or Open Approach

Vessel Puncture

- Single wall puncture
- Double wall puncture—two components 'Hollow needle with stylet'
- Two component smart needle—inner stylet is Doppler probe.

Vascular Access Sites

Three common approaches:

1. Retrograde common femoral puncture (Seldinger technique) (Figs 9.12A and B)
   - Ipsilateral retrograde approach is better for iliac vessels
   - Contralateral antegrade approach is better for femoropopliteal disease.

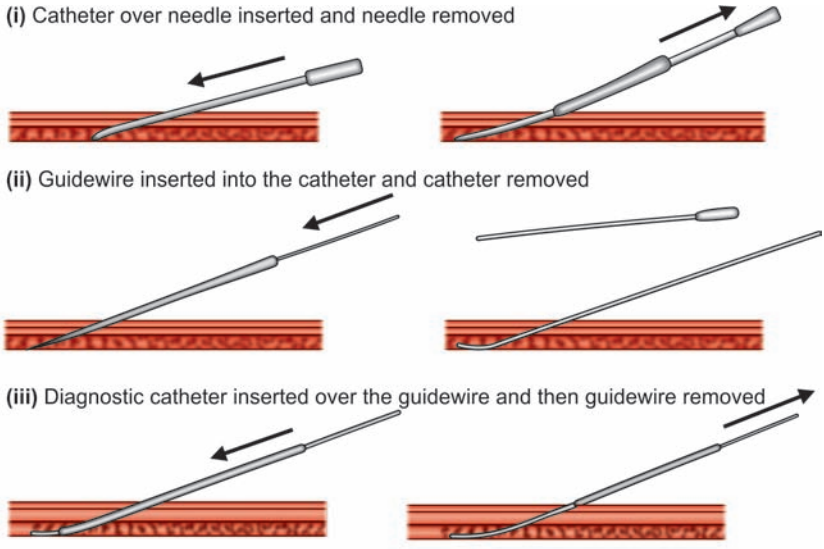


Fig. 9.12A: Steps in seldinger technique

Fig. 9.12B: Seldinger technique

2. Antegrade common femoral puncture
3. Retrograde axillary—brachial puncture.

After a guide wire is in place, the next step is to pass a catheter over the guide-wire into the correct required location:

- Diagnostic catheters
- Balloon angioplasty catheters.

DIAGNOSTIC CATHETERS (FIG. 9.13)

- Facilitate delivery of Radiographic contrast to specific area of vascular system
- Instillation of pharmacologic agents
- Delivery of embolic material
- Sampling of blood from specific locations
- Pressure measurements.

BALLOON ANGIOPLASTY CATHETERS (FIG. 9.14)

- Balloon diameter must be 10 to 20 percent greater than adjacent normal vessel diameter
- Balloon lengths vary accordingly 2 to 10 cm
- Duration of inflation: 30 to 60 sec (2 to 3 times)
- Pain felt at inflation due to stretching of advential nerve fibers, persistent pain implies arterial rupture (Flow chart 9.2).
- Balloon angioplasty is technically successful if there is <30 percent residual stenosis after the procedure.

Other Investigations (Mention Only if Asked)

1. **CT angiography (Fig. 9.15)**
   - 'The area examined give details of both luminal and extraluminal pathologies not seen on catheter angiography'
   - Less useful in assessing the limbs.

Indications

- Thoracic aneurysm (size and extent)
- Ruptured thoracic aneurysm

Fig. 9.13: Diagnostic catheter

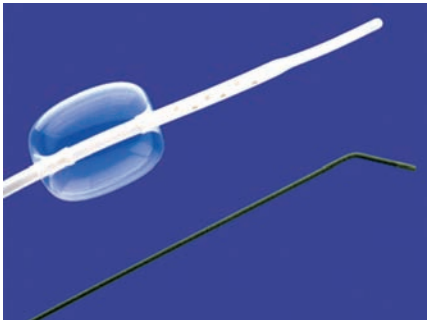


Fig. 9.14: Balloon angioplasty catheter—Fogarty's catheter

Flow chart 9.2: Complications of catheter angiography

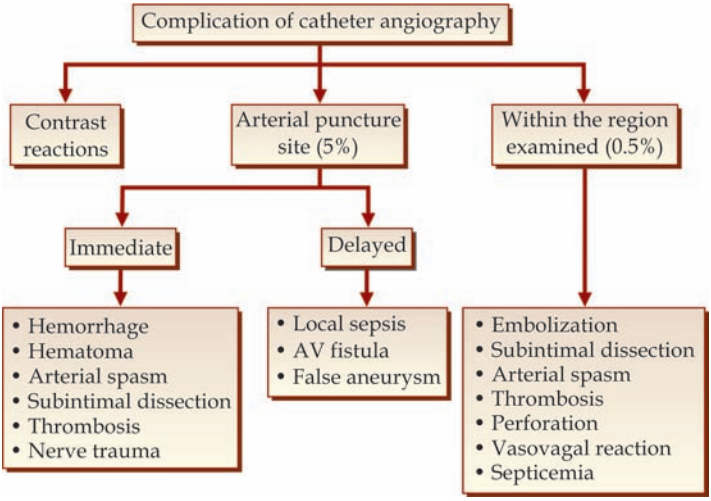


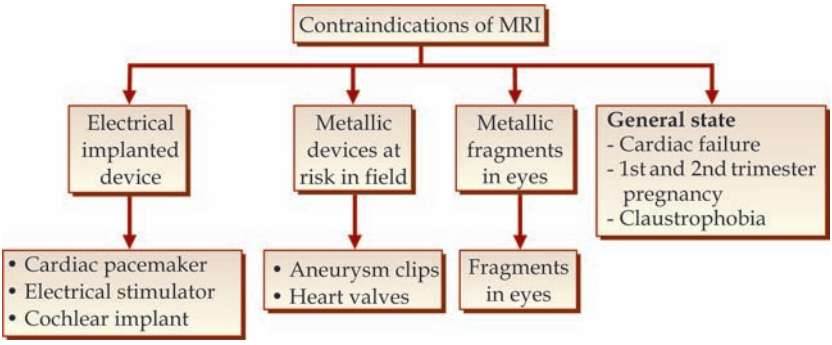
Fig. 9.15: Three-dimensional reconstruction of CT angiography

Fig. 9.16: MR—angiography

- Follow-up graft complications (aorta)
- Investigating pulsatile mass
- Renal and mesenteric CT angiogram
- Pulmonary angiogram
- Quantitatively assessing dimensions of aortic aneurysm for graft stent placement.

2. **Magnetic resonance angiography (Fig. 9.16) (Flow chart 9.3)**
   With additional features of orientation of acquisition in any direction (while CT only in axial direction), there are particular advantages of magnetic resonance angiography (MRA) in vascular territories that are tortuous or are more appropriately examined with nonaxial acquisition.

Flow chart 9.3: Contraindication of MRI angiography



Indications

- Intracranial : Arteriovenous (AV) malformations
  Venous sinus thrombosis
- Carotid : Stenosis/occlusion
  Carotid body tumor
  Pulsatile swelling in the neck
- Upper extremity : Thoracic outlet syndrome, AV malformations
- Aorta : Chronic thoracic dissection
  Coarctation of aorta.
  Aortic aneurysm assessment
- Renal/mesenteric : Stenosis/occlusion
- Iliac : Stenosis/occlusion
  Peripheral : Absent femoral arteries
  Popliteal artery entrapment
  AV malformation
- **Radionuclide imaging** : Radiolabeled WBC to find infected arteries graft
  Radiolabeled RBC to find bleeding in GIT.
- **Intravascular ultrasound** :
- **Angioscopy**

Precautions during angiography

- Renal function test: Rehydrate the patient before procedure
- Stop metformin: 48 hours before for the risk of lactic acidosis and renal failure
- Control hypertension
- Stop oral anticoagulants: 1 to 2 days before and heparinize them

Investigations for arterial disorders (Exam point of view)—Enough for MBBS Standard

I. Blood investigations
   - Rule out diabetes
   - Lipid profile
   - ESR
   - Polycythemia
   - Rule out renal problems
   - Coagulation problems
   - Fibrinogen

Contd...

Contd...

II. Basic cardiovascular system assessment
   - X-ray chest
   - ECG/Exercise ECG
   - Echo

III. Noninvasive
   - Continuous wave Doppler (hand-held)
   - Duplex scan imaging
   - Magnetic resonance angiography

IV. Invasive
   - Angiography (Gold standard for lower limb assessment)
     - Seldinger technique (retrograde)
     - Antegrade technique.
   - Day care procedure
   - Make patient take rest for 2 to 6 hours

Treatment Options for Peripheral Vascular Disease

- Conservative
- Medical
- Surgical—minimally invasive and open.

Surgical Intervention

Endovascular Intervention (Fig. 9.17)

- Angioplasty is best for suprainguinal than infrainguinal and stenosis than obstruction.

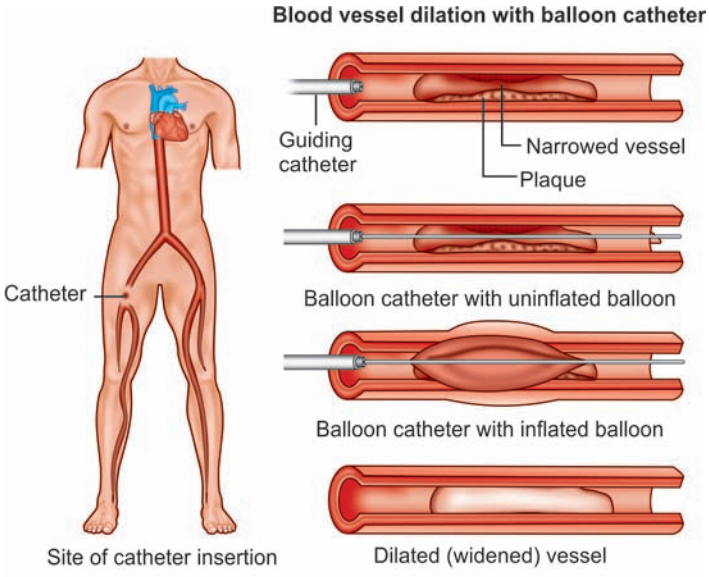


Fig. 9.17: Angioplasty

Indications for surgery in intermittent claudication

- Surgery should be reserved for critical limb ischemia and avoided initially in patients with intermittent claudication
- Surgery should considered in patients in whom other nonsurgical options have failed in the presence of severe disabling claudication

Surgical Options

Suprainguinal Disease (Best Graft—PTFE or Dacron Materials)

- Common iliac occlusion: Aortobifemoral bypass (Fig. 9.18)
- Unilateral iliac occlusion: Femoro-femoral bypass from opposite limb
- In cases of aorta with bilateral common iliac occlusion: Axillobifemoral bypass graft (Fig. 9.19)

Note: PTEE: Polytetrafluoro ethylene.

Infrainguinal Disease (Best Graft—Saphenous Vein)

- Occlusion above popliteal artery: Femoropopliteal bypass (Fig. 9.20)
- Occlusion below popliteal artery: Femorotibial bypass.

Management of PVD

Modify the Risk Factors

- Smoking: To be stopped
- Diabetes control: Maintain normal blood sugar
- Hypertension and heart disease corrected
- Correct hyperlipidemia: LDL < 100 mg/dL: By giving statins

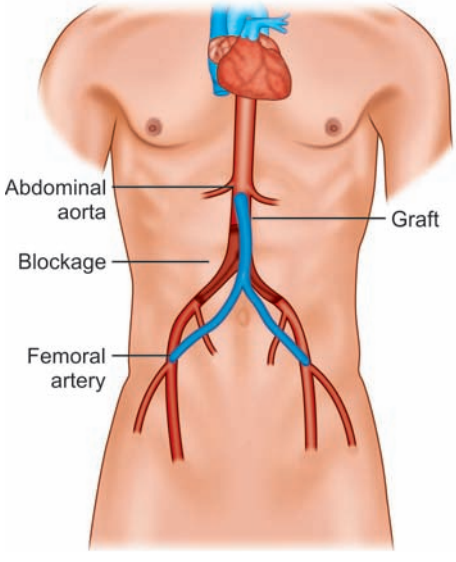


Fig. 9.18: Aortobifemoral graft

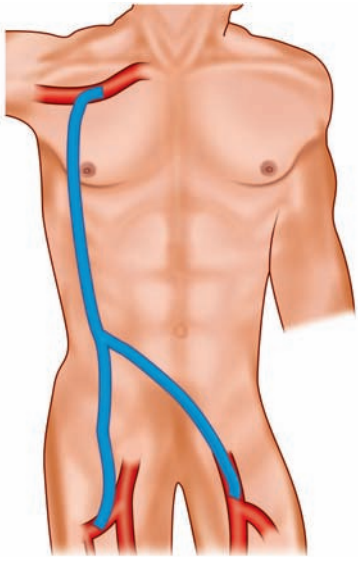


Fig. 9.19: Axillobifemoral bypass graft

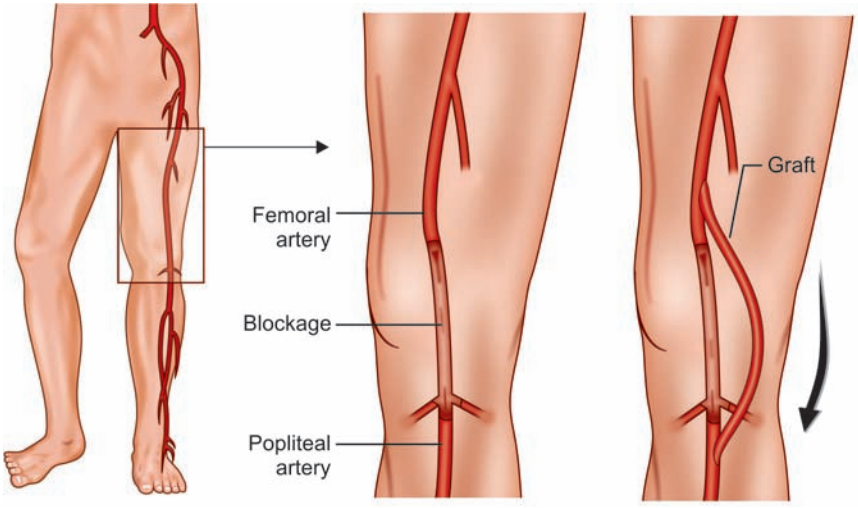


Fig. 9.20: Femoropopliteal graft

- Obesity—weight reduction
- Hyperhomocysteinemia > 5 mmol/L must be considered for treatment: Vitamin B_{12} and folic acid
- Exercise programs: 1 hour/day; 1 to 3 times weekly for 6 months.

PHARMACOTHERAPY (FLOW CHART 9.4)

Established drugs with proven but small benefit in improving claudication:

- **Pentoxifylline** : Improves red cell deformability, lowers serum fibrinogen, reduces platelet aggregation
  No definite evidence to show it is better than placebo.
- **Naftidrofuryl** : 5-hydroxytryptamine antagonist
  Reduces platelet aggregation
- **Cilostazol** : Phosphodiesterase III inhibitor
  Antiplatelet and vasodilator activity

Established drugs with minimal or no benefit in improving claudication:

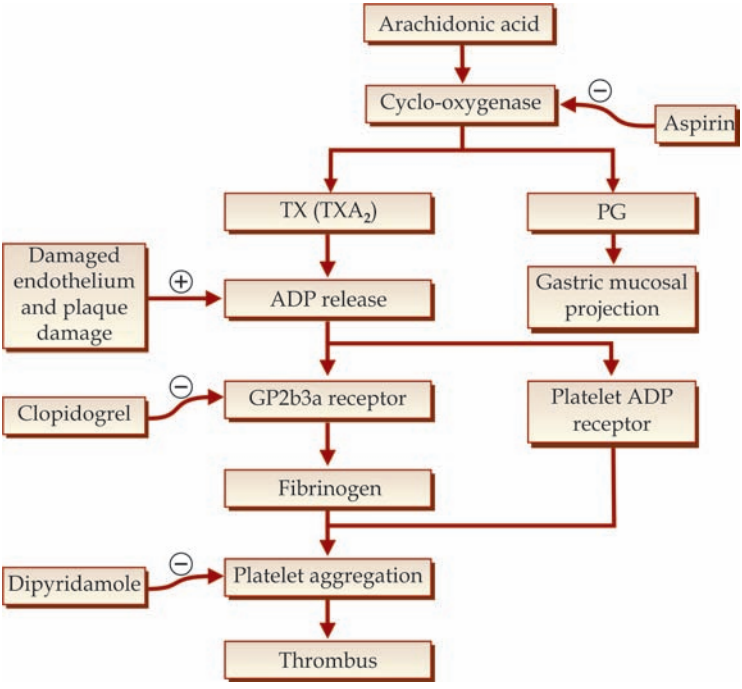
- **Aspirin** : Low dose aspirin still remains the mainstay of therapy
  Inhibits the cyclo-oxygenase
  Thereby decreases ADP release and platelet aggregation
- **Dipyridamole** : Along with aspirin
  Reduces stroke rate in atherosclerotic disease
- **Clopidogrel** : GP2b3a inhibitor
  Prevents platelet aggregation

Thienopyridine Group

- Ticlopidine
- Clopidogrel.

Both have same chemical nature and inhibit P450 enzyme in liver.

Flow chart 9.4: Drugs used in atherosclerosis



PROSTAGLANDINS

Intravenous form (ILO prost) used in treatment of critical limb ischemia.

OTHERS

- **Vasodilators:** Must not be used; vasodilators reduce the systemic pressure leading to reduction in perfusion of limbs
- **Oral anticoagulants:** No role in PVD. Only in patients with atrial fibrillation
- **VEGF is another drug under investigation**
- **Heparins:** Only during perioperative period for surgical or endovascular intervention.

Endovascular Intervention

The primary success and subsequent patency of endovascular intervention depends up on the level of disease:

- Suprainguinal better than infrainguinal (level)
- Stenosis better than obstruction (severity)
- Quality of inflow

Like surgery endovascular intervention for CLI has 10 to 15 percent lower success rate than that for claudication, due to presence of extensive disease.

Extra-anatomical Reconstructions

- Avoids the risk of aortic dissection and clamping but it offers inferior results of patency rates in comparison to aortobifemoral grafts.
  - Five years patency: 35 to 85 percent
  - Reserved for critical limb ischemia cases with severe cardiac or pulmonary disease.
- Femoro-femoro (from opposite femoral artery) bypass is indicated in elderly patient with unilateral iliac occlusion. Five years patency >80 percent.
- Obturator bypass is the procedure of choice in graft infection and crushing injuries to groin.

Infrainguinal

- Infrainguinal bypass in femoropopliteal disease
  - Proximal anastomosis to CFA, but SFA can be used if it is good
  - Occlusion at popliteal A above: Femoropopliteal bypass
  - Occlusion at distal popliteal A: Femorotibial bypass.
    - Veins graft has 4 years patency (76%) compared to (50%) for PTFE
    - Two years patency is same for both.

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