MEDICAL EDUCATION RESOURCE

Diaphragm

? Diaphragm

Introduction

- The **diaphragm** is a **thin, dome-shaped musculotendinous partition** separating the **thoracic** and **abdominal cavities**.
- It is the **chief muscle of respiration** — contraction increases thoracic volume, causing inspiration.
- It is convex upward (right dome higher due to liver).
- At rest, its highest point (right dome) reaches the level of the **5th rib**.
- It descends up to **one intercostal space** during deep inspiration.

Gross Anatomy

The diaphragm consists of:

1. **Peripheral Muscular Part**
2. **Central Tendinous Part**

1. Muscular Part

Arises from three main parts:

a. Sternal Part

- From **posterior surface of xiphoid process** (two small slips).
- Separated by small gap — *for superior epigastric vessels*.

b. Costal Part

- From **inner surfaces of lower six ribs and their costal cartilages** (interdigitating with transversus abdominis).
- Forms largest portion.

c. Vertebral Part

- Arises by **crura and arcuate ligaments**:
  - **Right crus:** from bodies of L1–L3 and intervertebral discs.
  - **Left crus:** from bodies of L1–L2.
  - The **right crus** is longer.
- The two crura are connected by **median arcuate ligament** (in front of aorta).

Arcuate Ligaments:

- **Median arcuate ligament** ? over aortic opening.
- **Medial arcuate ligament** ? thickened fascia over psoas major.
- **Lateral arcuate ligament** ? thickened fascia over quadratus lumborum.

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2. Central Tendon

- Strong, trifoliate (three-leafed) aponeurotic sheet.
- Lies opposite **xiphoid process (T8–T9 level)**.
- The **pericardium** is fused to its central portion.

Openings in the Diaphragm

There are **three large openings** and several small ones.

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1. Caval Opening (T8)

- Lies in **central tendon (right leaf)**.
- **Structures passing:**
  - Inferior vena cava.
  - Terminal branches of right phrenic nerve.
- **Mnemonic:** "**V8**" — *Vena cava at T8*.
- Function: enlarges during inspiration ? facilitates venous return.

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2. Oesophageal Opening (T10)

- Lies in **muscular part (right crus)**.
- **Structures passing:**

    - Oesophagus.
    - Vagal trunks (anterior and posterior).
    - Oesophageal branches of left gastric vessels.
- **Mnemonic:** “**Oesophagus Ten (10)**”.
- Function: acts as a sphincter — diaphragm assists in preventing reflux.

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3. Aortic Opening (T12)

- Lies **behind the median arcuate ligament**.
- **Structures passing:**
    - Aorta.
    - Thoracic duct.
    - Azygos vein.
- **Mnemonic:** “**Aortic Twelve (12)**”.
- Function: not affected by diaphragmatic contraction (lies posterior).

Other Small Openings

- **Right crus:** greater and lesser splanchnic nerves.
- **Left crus:** hemiazygos vein.

- **Between crura:** sympathetic trunk.
- **Sternocostal triangle:** superior epigastric vessels.
- **Behind lateral arcuate ligament:** subcostal vessels and nerve.

Relations

Superior (Thoracic) Surface

Covered by pleura and pericardium.

- **Right dome:** related to liver and right lung base.
- **Left dome:** related to stomach, spleen, and left lung base.

Inferior (Abdominal) Surface

Covered by peritoneum, related to:

- Right dome ? right lobe of liver, right kidney, suprarenal gland.
- Left dome ? left lobe of liver, fundus of stomach, spleen, left kidney, suprarenal gland.
- Central tendon ? pericardium (via fibrous layer).

Important Vertebral Levels (Mnemonics)

- **T8 ? Vena Cava (V8)**
- **T10 ? Oesophagus (OesophaTen)**
- **T12 ? Aorta (Aortwelve)**

? Nerve Supply

1. Motor Nerve

- **Phrenic nerve (C3, C4, C5)** — “**C3, 4, 5 keep the diaphragm alive**.”
- Right phrenic nerve supplies the **right half**, and the left phrenic nerve supplies the **left half**.
- The central tendon region of the diaphragm is entirely **phrenic-supplied**.

2. Sensory Nerves

- **Central part:** Phrenic nerve (pain referred to shoulder – C4 dermatome).
- **Peripheral part:** Lower **six intercostal nerves** and **subcostal nerve (T12)**.
- Pain from these peripheral parts is referred to the **costal margins or abdominal wall**.

? Actions of the Diaphragm

1. **Chief Muscle of Inspiration**
    - On contraction, domes descend ? thoracic cavity enlarges ? pressure drops ? air enters lungs.
2. **Expiration (Relaxation Phase)**

- When the diaphragm relaxes, domes rise ? thoracic volume decreases ? air expelled.

3. **Assists in Circulation**
   - Contraction decreases intrathoracic pressure and increases intra-abdominal pressure, aiding **venous return** via IVC and **lymph flow** via thoracic duct.

4. **Acts as a Partition and Sphincter**
   - Through its openings, the diaphragm controls passage of oesophagus, aorta, IVC, etc.
   - The **right crus acts as a physiological sphincter** for the lower oesophagus.

5. **Abdominal Pressurization**
   - With other muscles, helps in **micturition, defecation, parturition, and vomiting** by raising intra-abdominal pressure.

? Dissection Highlights

- The diaphragm is seen from the abdominal cavity after removing abdominal viscera.
- Identify:
  - **Central tendon** – shiny and aponeurotic.
  - **Crura** – muscular slips attached to lumbar vertebrae.
  - **Arcuate ligaments** – median, medial, and lateral.

- **Openings** – IVC at T8 (in tendon), oesophagus at T10 (in muscle), aorta at T12 (behind ligament).

- Observe the **phrenic nerves** descending anteriorly and **sympathetic trunks** posteriorly.

?? Clinical Anatomy

1. Paralysis of Diaphragm

- Due to **phrenic nerve injury** (e.g., neck trauma, mediastinal tumor).
- On X-ray ? **paradoxical movement** (dome moves upward during inspiration).

2. Eventration of Diaphragm

- Congenital thinning or absence of muscle ? one dome balloons upward.
- Commonly on left side; may compress lung.

3. Hiatus Hernia

- Herniation of stomach into thorax through the **oesophageal opening**.
  - *Sliding type*: gastroesophageal junction moves upward.
  - *Paraesophageal type*: fundus herniates beside oesophagus.

4. Congenital Diaphragmatic Hernia (Bochdalek type)

- Due to failure of closure of **pleuroperitoneal canal** (posterolateral defect).

- Abdominal viscera herniate into thorax ? pulmonary hypoplasia in newborn.

5. Morgagni Hernia

- Herniation through **sternocostal triangle (foramen of Morgagni)** – rare, anterior type.

6. Phrenic Pain Referred to Shoulder

- Central diaphragmatic pain ? referred to **shoulder (C4)** via phrenic nerve.
- Peripheral pain ? referred to **costal margins** (intercostal nerves).

7. Subphrenic Abscess

- Pus collects below diaphragm (usually right side) following peritonitis or liver abscess.
- Causes elevation of diaphragm and referred shoulder pain.

8. Accessory Phrenic Nerve

- May arise from **nerve to subclavius (C5)** ? joins phrenic nerve in thorax.
- Damage to both may cause partial paralysis.

? Development of Diaphragm

The diaphragm develops from **four embryonic components**:

1. **Septum Transversum**
    - Forms **central tendon**.

- Lies opposite cervical somites (C3–C5) ? hence phrenic nerve origin.

2. **Pleuroperitoneal Membranes**
   - Close the **pleuroperitoneal canals** on each side posteriorly.
3. **Dorsal Mesentery of Oesophagus**
   - Forms **crura** and **median portion** around oesophageal opening.
4. **Body Wall (Peripheral Muscular Part)**
   - Contributes to **costal portion** of diaphragm.

Timeline:

- Fusion complete by the **8th week** of development.
- Initially cervical in position, descends to thoracic level by 8th week, dragging phrenic nerve downward — explaining its long course.

Clinical Correlation:

- Failure of fusion ? **congenital diaphragmatic hernia** (Bochdalek type).
- Defect in septum transversum ? **eventration** or **Morgagni hernia**.

> **? Mnemonics – Diaphragm**

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1. Openings of Diaphragm (Levels and Structures)

Mnemonic: ? **“I 8 10 Eggs At 12”**

- **I 8 ? IVC at T8** ? Inferior Vena Cava + Right Phrenic Nerve.
- **10 Eggs ? Oesophagus at T10** ? Oesophagus + Vagal Trunks + Left Gastric Vessels.
- **At 12 ? Aorta at T12** ? Aorta + Thoracic Duct + Azygos Vein.

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2. Structures Passing Through Crura

Mnemonic: “Silly Great Lads Hide Behind Crura”

- **S** – Sympathetic trunks.
- **G** – Greater splanchnic nerves.
- **L** – Lesser splanchnic nerves.
- **H** – Hemiazygos vein.
- **B** – Both crura connect via Median Arcuate Ligament.

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3. Arcuate Ligaments (Attachments)

Mnemonic: “L-M-M: Laterally Quadratus, Medially Psoas, Middle Aorta.”

- **Lateral arcuate ligament** ? over **Quadratus lumborum**.
- **Medial arcuate ligament** ? over **Psoas major**.
- **Median arcuate ligament** ? **arches over aorta**.

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4. Functions of Diaphragm

Mnemonic: “AIR PRESS”

A – Aids in **Abdominal pressure** (urination, defecation, parturition).

I – **Inspiration** (main function).

R – **Returns venous blood** to heart.

P – **Partition** between thorax and abdomen.

R – **Reflex control** of breathing via phrenic.

E – **Expulsion** (vomiting, cough).

S – **Sphincter action** at oesophageal opening.

S – **Support** to abdominal viscera.

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5. Components of Diaphragm Development

Mnemonic: “Several Parts Develop Diaphragm.”

- **S** – Septum transversum ? central tendon.
- **P** – Pleuroperitoneal membranes.
- **D** – Dorsal mesentery of oesophagus.
- **D** – Derived muscle from body wall (peripheral part).

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6. Nerve Supply

Mnemonic: “C3, 4, 5 keep the diaphragm alive.”

– Phrenic nerve origin from C3–C5 cervical segments.

> **? Facts to Remember – Diaphragm**

- The **diaphragm** is the **principal muscle of inspiration**.
- It separates the **thoracic and abdominal cavities**.

- Formed of **peripheral muscle fibers** and a **central tendon**.
- The **right dome** lies higher (due to liver) than the **left**.
- **Central tendon** lies at the level of **xiphoid process (T8–T9)**.
- **Three major openings:**
    - **IVC – T8** (in tendon).
    - **Oesophagus – T10** (in right crus).
    - **Aorta – T12** (behind median arcuate ligament).
- **Arcuate ligaments:** median (over aorta), medial (over psoas), lateral (over quadratus lumborum).
- **Right crus** is longer and wider than the left.
- **Nerve supply:**
    - Motor ? Phrenic nerve (C3–C5).
    - Sensory ? Phrenic (central part) and lower 6 intercostal + subcostal (peripheral part).
- **Blood supply:** Musculophrenic, pericardiophrenic, superior and inferior phrenic arteries.
- **Action:** Contraction ? inspiration by lowering domes; relaxation ? expiration.
- During inspiration, the **central tendon descends about 1–2 cm** in quiet breathing, up to 5 cm in deep breathing.

- **Paralysis** of one half ? elevated dome on that side with paradoxical movement.
- **Eventration:** Congenital deficiency causing ballooning of diaphragm.
- **Hiatus hernia:** Protrusion of stomach through oesophageal opening.
- **Congenital diaphragmatic hernia:** Failure of pleuroperitoneal membrane closure (Bochdalek type).
- **Phrenic pain** is referred to the **shoulder (C4)**; peripheral pain to costal margins.
- The diaphragm develops from four embryological sources: septum transversum, pleuroperitoneal membranes, dorsal mesentery of oesophagus, and body wall.
- **Central tendon** derived from septum transversum.
- **Clinical importance:** Vital in respiration and venous return to heart.

?? Clinicoanatomical Problems – Diaphragm

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1. Case of Diaphragmatic Paralysis

A 42-year-old man presents with breathlessness. X-ray shows the right dome of diaphragm elevated and moving paradoxically on inspiration.
? **Diagnosis:** Paralysis of diaphragm due to right **phrenic nerve injury** (C3–C5).

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2. Case of Shoulder Tip Pain After Liver Abscess

A patient with right subphrenic abscess complains of pain over right shoulder tip.
? **Explanation: Referred pain** from diaphragm via **phrenic nerve (C4 dermatome)**.

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3. Eventration of Diaphragm

A child has abnormally high position of the left dome of diaphragm on X-ray, but no rupture.
? **Diagnosis: Eventration** — congenital thinning or partial absence of muscle fibers, causing ballooning.

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4. Congenital Diaphragmatic Hernia (Bochdalek Type)

A newborn has severe respiratory distress immediately after birth. X-ray shows bowel loops in the thorax.
? **Diagnosis: Posterolateral diaphragmatic hernia** due to failure of **pleuroperitoneal canal closure**.

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5. Morgagni Hernia

An elderly woman with chronic cough presents with epigastric bulge near xiphoid process.
? **Cause:** Herniation through **sternocostal triangle (foramen of Morgagni)**.

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6. Sliding Hiatus Hernia

Middle-aged patient with heartburn and regurgitation. Barium swallow shows stomach and gastroesophageal junction above diaphragm.
? **Diagnosis: Sliding hiatus hernia** through oesophageal opening (T10).

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7. Paraesophageal Hiatus Hernia

A patient's stomach fundus is seen herniating beside oesophagus without displacement of gastroesophageal junction.
? **Diagnosis: Paraesophageal hernia** – dangerous due to possible strangulation.

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8. Referred Epigastric Pain

Pain perceived in epigastrium when diaphragmatic pleura irritated (e.g. subphrenic abscess).
? **Reason:** Central diaphragmatic part supplied by **phrenic nerve**, referred to epigastrium.

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9. Bilateral Diaphragmatic Paralysis

After cervical spinal cord injury at C4 level, patient develops respiratory failure.
? **Reason: Phrenic nerve roots (C3–C5)** are affected, diaphragm paralyzed ? ventilatory failure.

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10. Post-operative Respiratory Difficulty

After open heart surgery, patient has raised left dome on X-ray.
? **Cause:** Iatrogenic injury to **left phrenic nerve** (lies on pericardium).

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11. Phrenic Nerve Palsy During Neck Surgery

Patient develops dyspnea after thyroidectomy.
? **Reason:** Accidental ligation of **phrenic nerve** crossing anterior to scalenus anterior muscle.

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12. Congenital Absence of Diaphragm

Neonate with respiratory distress has no separation between thoracic and abdominal cavities.
? **Diagnosis: Agenesis of diaphragm** – failure of all four embryonic components to fuse.

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13. Accessory Phrenic Nerve Damage

Partial diaphragmatic paralysis occurs though main phrenic nerve preserved.
? **Explanation:** Injury to **accessory phrenic nerve** (from nerve to subclavius, C5).

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14. Hiccups (Singultus)

Persistent involuntary contraction of diaphragm causing sudden inspiration with glottis closure.
? **Reason:** Reflex irritation of **phrenic nerve or medullary centers**.

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15. Subphrenic Abscess

Post-appendectomy patient develops fever and shoulder pain.
? **Diagnosis: Subphrenic abscess** beneath diaphragm due to pus collection.
? **Feature:** Elevation of diaphragm and referred shoulder pain (C4).

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16. Abnormal Movement in Fluoroscopy

During inspiration, one dome moves downward but the other moves upward.
? **Diagnosis: Paradoxical movement** – sign of unilateral diaphragmatic paralysis.

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17. Diaphragmatic Rupture After Trauma

A man sustains blunt abdominal trauma; stomach loops visible in left thoracic cavity.
? **Diagnosis: Traumatic rupture of diaphragm** – more common on left side (liver protects right).

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18. Congenital Eventration Mistaken for Hernia

Infant's X-ray shows high dome with gut shadow beneath intact pleura.
? **Differentiation:** Eventration (no rupture) vs hernia (defect present).

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19. Diaphragmatic Hernia in Adults

An adult with chronic cough develops herniation of omentum through **foramen of Bochdalek** (posterolateral).
? **Significance:** Late presentation of congenital defect.

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20. Phrenic Nerve Involvement in Pericarditis

Patient with pericardial irritation develops pain radiating to shoulder tip.
? **Reason:** Common sensory pathway via **phrenic nerve** (C4).

? Frequently Asked Questions — Diaphragm

1. **Describe the origin, insertion, nerve supply, and actions of the thoracoabdominal diaphragm.**

2. **Write short notes on:**

- Major openings of diaphragm and the structures passing through them.
- Minor openings and their contents.
- Diaphragmatic hernia — congenital and acquired types.
- Course and distribution of the phrenic nerve.

3. **Explain why the cardiac end of the stomach is prone to sliding hernia.**
   - Due to weakness of the **phrenico-oesophageal membrane**, allowing the cardiac end to slide through the oesophageal hiatus, disturbing the **valvular mechanism** at the gastroesophageal junction and causing **reflux**.
4. **List the vertebral levels of major openings of the diaphragm and structures transmitted through each.**
   - T8 ? Inferior vena cava, right phrenic nerve.
   - T10 ? Oesophagus, vagal trunks, left gastric vessels.
   - T12 ? Aorta, thoracic duct, azygos vein.
5. **Discuss congenital anomalies of diaphragm development.**
   - Posterolateral (Bochdalek) hernia, Retrosternal (Morgagni) hernia, Eventration, and Complete absence of diaphragm.
6. **What is the nerve supply of the diaphragm?**
   - **Motor:** Phrenic nerve (C3–C5).

- **Sensory:** Central part by phrenic nerve; peripheral part by lower six intercostal nerves.

? Multiple Choice Questions — Diaphragm

1. **Which of the following structures does *not* pass through the diaphragm?**
   a. Oesophagus
   b. Aorta
   c. **Cisterna chyli** ?
   d. Inferior vena cava

To build a complete **exam-ready MCQ section**, here are **additional standard questions** (patterned on BD Chaurasia and AIIMS/NEET PG level):

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2. The diaphragm is supplied by which nerve?

a. Intercostal nerve
b. Vagus nerve
c. **Phrenic nerve** ?
d. Sympathetic nerve

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3. The oesophagus passes through the diaphragm at the level of:

a. T8
b. **T10** ?
c. T12
d. L1

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4. The inferior vena cava passes through diaphragm at the level of:

a. **T8** ?
b. T10
c. T12
d. T6

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5. The aortic opening of diaphragm lies at:

a. T10
b. **T12** ?
c. L1
d. T9

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6. The phrenic nerve arises from:

a. C2–C3
b. C4–C6
c. **C3–C5** ?
d. T1–T3

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7. Which of the following does not pass through oesophageal opening?

a. Oesophagus
b. Vagus nerve
c. Left gastric artery
d. **Azygos vein** ?

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8. The central tendon of diaphragm is derived from:

a. **Septum transversum** ?
b. Pleuroperitoneal membrane
c. Dorsal mesentery of oesophagus
d. Lateral body wall

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9. Which dome of diaphragm is higher?

a. **Right** ?
b. Left
c. Equal
d. Variable

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10. The muscle fibers of diaphragm insert into:

a. Costal arch
b. **Central tendon** ?
c. Vertebral column
d. Linea alba

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11. Which structure is behind the diaphragm?

a. Aorta
b. **Thoracic duct** ?
c. Inferior vena cava
d. Oesophagus

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12. Eventration of diaphragm is due to:

a. Trauma
b. Inflammation
c. **Congenital muscle defect** ?
d. Hernia

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13. Which artery does *not* supply the diaphragm?

a. Pericardiophrenic
b. Musculophrenic
c. **Inferior mesenteric** ?
d. Inferior phrenic

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14. The main muscle of inspiration is:

a. External intercostals
b. Internal intercostals
c. **Diaphragm** ?
d. Scalene

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15. The right crus of diaphragm arises from:

a. L1–L2
b. **L1–L3** ?
c. L2–L4
d. T12–L2

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16. The left crus of diaphragm arises from:

a. L1–L3
b. **L1–L2** ?
c. L2–L3
d. T12–L2

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17. Pain from central part of diaphragm is referred to:

a. Epigastrium
b. **Shoulder (C4 dermatome)** ?
c. Lower chest
d. Back

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18. Posterolateral diaphragmatic hernia is also called:

a. Morgagni hernia
b. **Bochdalek hernia** ?
c. Hiatus hernia
d. Paraesophageal hernia

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19. Which structure passes behind the median arcuate ligament?

a. Inferior vena cava
b. Oesophagus
c. **Aorta** ?
d. Vagus nerve

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20. All the following are openings in the diaphragm except:

a. Caval opening
b. Oesophageal hiatus
c. Aortic hiatus
d. **Renal opening** ?

> **? Viva Voce — Diaphragm**

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1. What is the diaphragm?

A dome-shaped **musculotendinous partition** separating the **thoracic and abdominal cavities**; the **chief muscle of inspiration**.

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2. What are the parts of the diaphragm?

- **Muscular part** – sternal, costal, and vertebral.
- **Central tendinous part** – aponeurotic and trifoliate in shape.

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3. Which dome of diaphragm is higher?

The **right dome**, because it rests on the liver.

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4. What is the nerve supply of the diaphragm?

- **Motor:** Phrenic nerve (C3, C4, C5).
- **Sensory:** Phrenic (central part) and lower six intercostal + subcostal nerves (peripheral part).

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5. What is the mnemonic for openings of the diaphragm?

“I 8 10 Eggs At 12”

- IVC ? T8
- Oesophagus ? T10
- Aorta ? T12

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6. Which opening lies in the central tendon?

Caval opening (T8) for **inferior vena cava** and **right phrenic nerve**.

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7. What structures pass through the oesophageal opening?

- Oesophagus
- Anterior and posterior vagal trunks
- Oesophageal branches of left gastric vessels.

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8. What structures pass through the aortic opening?

- Aorta
- Thoracic duct

- Azygos vein.

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9. Which crus of diaphragm is longer?

The **right crus** (arises from L1–L3) is longer than the left (L1–L2).

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10. What is the function of the crura?

They form a **sling** around the oesophagus and act as a **physiological sphincter** preventing gastric reflux.

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11. Name the three arcuate ligaments.

- **Median arcuate ligament** – arches over aorta.
- **Medial arcuate ligament** – over psoas major.
- **Lateral arcuate ligament** – over quadratus lumborum.

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12. What are the actions of the diaphragm?

- **Inspiration:** Increases thoracic volume by descending.
- **Expiration:** Relaxes and ascends.
- **Abdominal compression:** Assists in defecation, micturition, parturition.
- **Venous return:** Aids blood flow via IVC.

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13. What is the developmental origin of diaphragm?

From **four embryonic sources**:

1. Septum transversum
2. Pleuroperitoneal membranes
3. Dorsal mesentery of oesophagus
4. Muscular ingrowths from body wall.

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14. What is the central tendon derived from?

Septum transversum.

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15. What are the common congenital anomalies of diaphragm?

- **Bochdalek hernia** (posterolateral)
- **Morgagni hernia** (sternocostal)
- **Eventration** (muscle defect)
- **Complete absence** (rare).

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16. What is the vertebral level of the diaphragm's central tendon?

Approximately **T8–T9**.

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17. What is eventration of diaphragm?

A congenital condition where one dome is elevated due to **defective muscular development**, replaced by thin membrane.

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18. What is hiatus hernia?

Herniation of the **stomach** through the **oesophageal hiatus** into thorax; may be **sliding** or **paraesophageal**.

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19. What is referred pain of diaphragm and why?

Pain from the diaphragm is felt at the **shoulder tip (C4)** because both **phrenic** and **supraclavicular nerves** share the same spinal root value.

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20. What is the difference between Bochdalek and Morgagni hernias?

- **Bochdalek:** Posterolateral defect (common).
- **Morgagni:** Anterior retrosternal defect (rare).

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21. What is paradoxical movement of diaphragm?

In unilateral diaphragmatic paralysis, the paralyzed dome moves **upward during inspiration** instead of descending.

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22. Why is right phrenic nerve important surgically?

It's short and runs over the **inferior vena cava**, hence easily damaged during hepatic or pericardial surgery.

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23. What is the blood supply of diaphragm?

- **Arteries:** Musculophrenic, pericardiophrenic, superior & inferior phrenic arteries.
- **Veins:** Drain into azygos, inferior phrenic, and internal thoracic veins.

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24. What are the functions of the diaphragm other than respiration?

Aids in **vomiting, micturition, defecation, parturition**, and **cough reflex**.

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25. What is the Organ of Bochdalek?

Not an organ — refers to **Bochdalek's foramen**, the site of **posterolateral congenital diaphragmatic hernia**.

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26. Which muscle forms the floor of thoracic cavity?

Diaphragm.

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27. What happens if the phrenic nerve is cut?

Paralysis of diaphragm on that side ? elevation of dome and **loss of respiratory function**.

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28. Why does the diaphragm descend during inspiration?

Because of **phrenic nerve stimulation** ? contraction ? increase in vertical thoracic diameter.

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29. What is the function of the oesophageal hiatus in preventing reflux?

The **right crus** forms a sling around the oesophagus acting as an **external sphincter**.

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30. Why is congenital diaphragmatic hernia dangerous in newborns?

It causes **compression of developing lungs**, leading to **pulmonary hypoplasia and respiratory distress**.