What is the Anatomy and Function of the Diaphragm?

Worksheet

The diaphragm is a skeletal muscle innervated by the phrenic nerve (C3-C5) that, when it contracts, flattens its dome and expands thoracic volume, lowering intrathoracic pressure and drawing air into the lungs during inspiration.

Questions

1. Which nerve innervates the diaphragm?

A) Vagus nerve
B) Phrenic nerve
C) Intercostal nerve
D) Sympathetic trunk

2. At which vertebral level does the esophagus pass through the diaphragm?

A) T8
B) T10
C) T12
D) L1

3. What happens to intrathoracic pressure when the diaphragm contracts?

A) It increases
B) It stays the same
C) It decreases
D) It becomes negative infinity

4. Which structure passes through the aortic hiatus at T12?

A) Inferior vena cava
B) Esophagus
C) Aorta and thoracic duct
D) Phrenic nerve

5. A knife wound at the level of T8, slightly right of midline, damages a structure passing through the diaphragm. What is it and what problem could result?

6. A patient has hiccups (spasms) traced to irritation of a nerve at the neck. Which nerve, and what does it explain?

7. During inspiration, calculate what happens to lung volume and pressure as the diaphragm contracts by increasing thoracic height.

8. Define: What nerve innervates the diaphragm?

9. Define: What are the three major diaphragmatic openings and their vertebral levels?

10. Define: What happens to thoracic volume when the diaphragm contracts?

Answer Key

1. B) Phrenic nerve - The phrenic nerve (C3-C5) is the sole motor supply to the diaphragm.

2. B) T10 - The esophageal hiatus is at T10, carrying the esophagus and vagus nerves.

3. C) It decreases - As thoracic volume increases, pressure decreases (Boyle's Law), drawing air into the lungs.

4. C) Aorta and thoracic duct - The aortic hiatus, behind the diaphragm at T12, transmits the aorta, thoracic duct, and azygos vein.

5. T8 is the level of the caval opening (vena caval foramen) in the central tendon The inferior vena cava passes through this opening Damage here can cause venous return problems or hemorrhage The caval opening is the most anterior and highest of the three main hiatuses

6. The phrenic nerve arises from cervical roots C3, C4, and C5 It travels down through the thorax to innervate the diaphragm Irritation anywhere along its course (neck, mediastinum, pericardium) can trigger diaphragmatic spasms - hiccups This explains referred shoulder-tip pain from diaphragmatic irritation, since C3-C5 also supplies the shoulder skin (via the supraclavicular nerves)

7. Diaphragm contracts, dome descends, thoracic cavity volume increases By Boyle's Law (P1V1 = P2V2), an increase in volume at constant temperature causes a decrease in pressure Intrapleural and intra-alveolar pressure fall below atmospheric pressure Air flows down its pressure gradient into the lungs until pressures equalize

8. The phrenic nerve, from cervical roots C3, C4, and C5 ('C3, 4, 5 keeps the diaphragm alive').

9. Caval opening (T8, for the IVC), esophageal hiatus (T10, for the esophagus and vagus nerves), aortic hiatus (T12, for the aorta, thoracic duct, and azygos vein).

10. It increases - the dome flattens and descends, expanding the thoracic cavity.