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A patient is being evaluated for recurrent urinary tract infections. Her abdominal CT scan is shown below.



Which of the following most likely prevented the proper ascent of the anomalous organ seen on the CT scan?

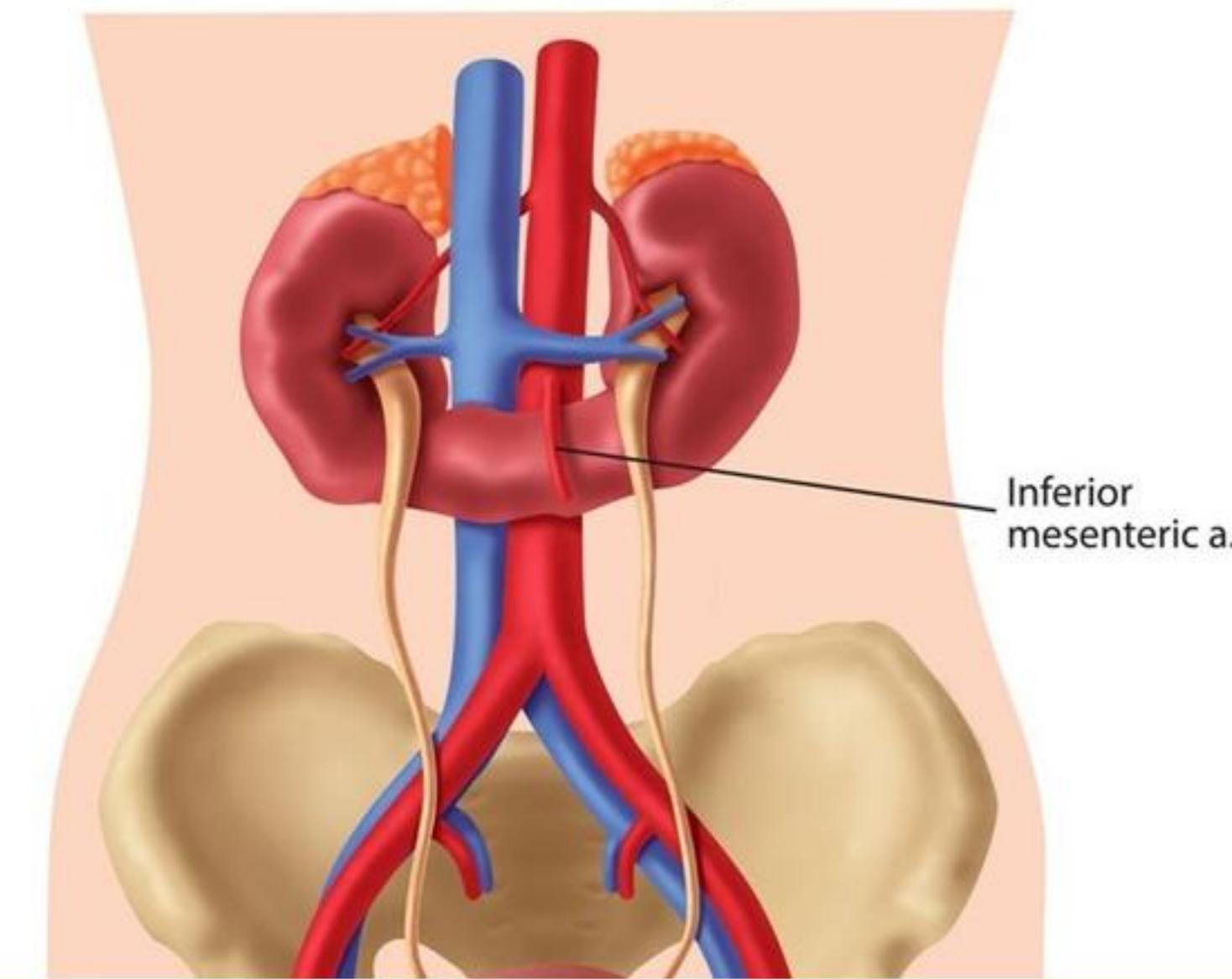
- A. Superior mesenteric artery [13%]
- B. Vitellointestinal duct [4%]
- C. Persistent urachus [6%]
- D. Inferior vena cava [2%]

- A. Superior mesenteric artery [13%]
- B. Vitellointestinal duct [4%]
- C. Persistent urachus [6%]
- D. Inferior vena cava [2%]
- E. Inferior mesenteric artery [74%]

Explanation:

User Id: 477875

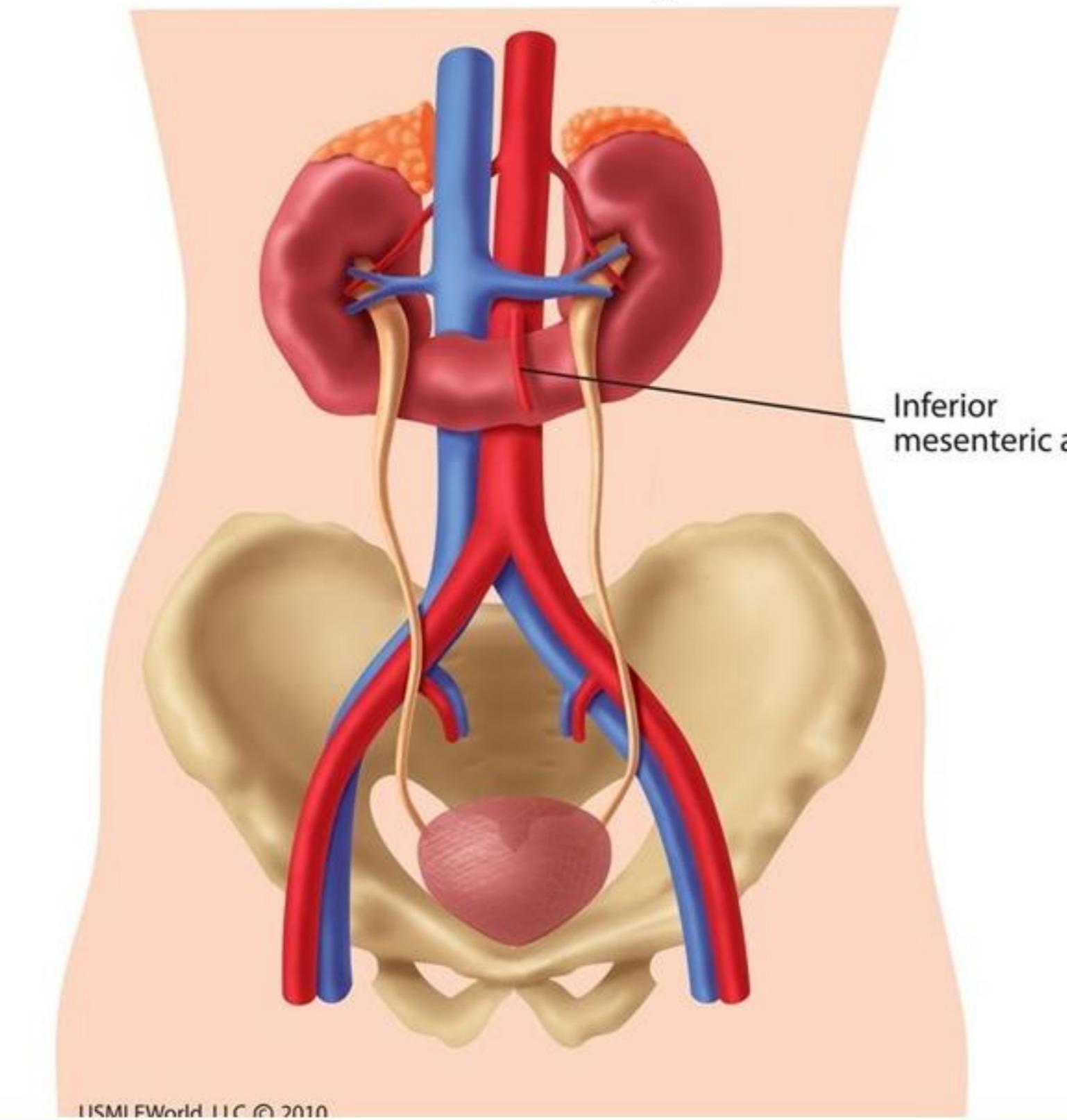
Horseshoe kidney



Explanation:

User Id: 477875

## Horseshoe kidney



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The **abdominal CT scan** shows the kidneys joined at their lower poles. This is the most common variant of horseshoe kidney, occurring in 90% of cases. In the other 10%, fusion occurs at the upper poles. Horseshoe kidney is found in approximately 1 out of every 500 autopsies and may lead to urinary tract obstruction and the development of hydronephrosis.

During embryogenesis, kidney development proceeds through the pronephros, mesonephros, and metanephros stages. The fetal metanephros is initially located in the sacral region. In adults the mature kidneys are located at vertebral levels T12-L3 (the kidney is slightly lower on the right compared to the left side). The relative ascent of the kidneys from the sacral region to their normal anatomic position results from the disproportionately rapid growth of the caudal part of the embryo.

When fusion of the lower or upper poles of the kidney occurs, the central part of the newly formed horseshoe kidney lies across the midline anterior to the great vessels. This centrally located isthmus is trapped by the inferior mesenteric artery during the ascent of the kidney.

**(Choice A)** The superior mesenteric artery is located above the inferior mesenteric artery. It leaves the aorta at the level of L1 and does not serve as an obstacle for the ascent of a horseshoe kidney.

**(Choice B)** When the **vitelline duct persists**, a connection is formed between the intestinal lumen and the outside of the body at the umbilicus. Discharge of meconium from the umbilicus will be seen in this condition.

**(Choice C)** A direct connection between the bladder lumen and the outside of the body at the umbilicus is called a persistent urachus or urachal fistula. This condition would likely have been identified earlier in the patient's life.

**(Choice D)** The inferior vena cava lies posterior to the isthmus of a horseshoe kidney and would not obstruct its ascent.

**Educational objective:**

In horseshoe kidney, both kidneys are fused together at the poles in early embryonic life. The isthmus of horseshoe kidney usually lies anterior to the aorta and inferior vena cava and posterior to the inferior mesenteric artery. This centrally located isthmus becomes trapped behind the inferior mesenteric artery during the relative ascent of the kidney.

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A 52-year-old homeless man is being evaluated for two episodes of painless hematuria. An axial computed tomography (CT) image of his abdomen is shown below.



Which of the following statements best describes the structure indicated by the arrow?

- A. It joins the splenic vein to form the portal vein [14%]
- B. It drains into the left subclavian vein in the thorax [5%]
- C. It is formed by the union of the common iliac veins [60%]
- D. It is drained by the cystic duct into the common duct [12%]
- E. It gives rise to the right and left renal arteries [8%]

**Explanation:**

User Id: 477875

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- B. It drains into the left subclavian vein in the thorax [5%]
- C. **It is formed by the union of the common iliac veins** [60%]
- D. It is drained by the cystic duct into the common duct [12%]
- E. It gives rise to the right and left renal arteries [8%]

**Explanation:**

User Id: 477875

This axial CT image shows the abdomen at approximately the level of L1. At this level, we see the renal arteries originating from the aorta and the inferior vena cava (IVC) lying just anterior to the right renal artery and to the right of the aorta. The IVC is formed by the union of the right and left common iliac veins at the level of L4-L5 and drains into the right atrium just above the level of the diaphragm at T12. The IVC returns venous blood from the lower extremities, portal system, and abdominal and pelvic viscera to the heart.

**(Choice A)** The superior mesenteric vein (SMV) joins the splenic vein to form the portal vein. The SMV is not obvious on this cross-sectional image.

**(Choice B)** The thoracic duct drains lymph from all regions inferior to the umbilicus and from all gut structures, enters the thorax through the aortic hiatus, and empties into the left subclavian vein.

**(Choice D)** The cystic duct drains bile from the gallbladder into the common duct. This plane of section is too high to see the gallbladder, but in lower cross-sectional images it can be seen in the anterior right abdomen below the liver.

**(Choice E)** This image shows the abdominal aorta giving rise to the right and left renal arteries. The abdominal aorta lies posteromedial to the IVC within the abdomen.

**Educational Objective:**

The inferior vena cava is formed by the union of the right and left common iliac veins at the level of L4-L5. The renal arteries and veins lie at the level of L1. The IVC returns venous blood from the lower extremities, portal system and abdominal and pelvic viscera to the right atrium of the heart.

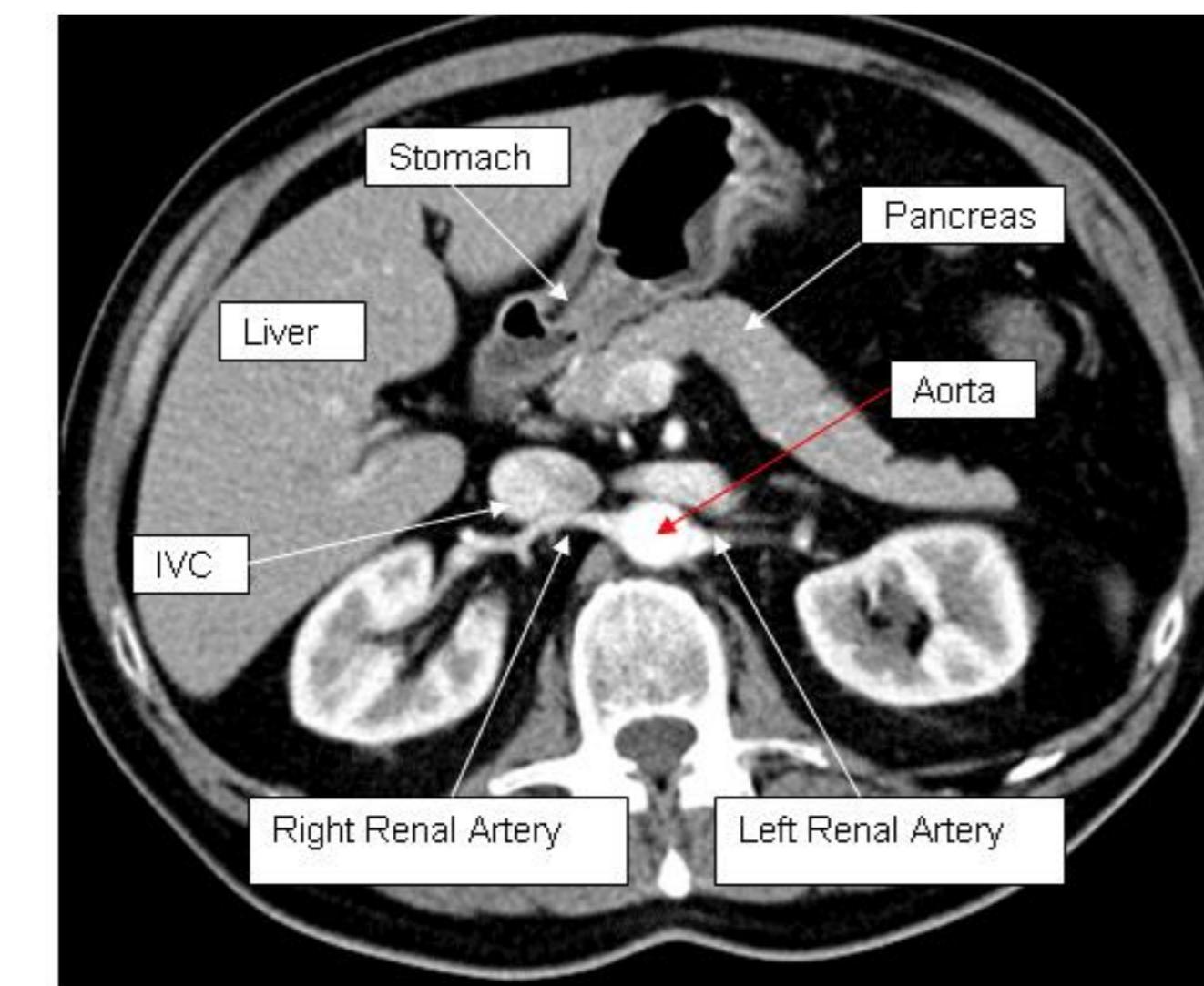
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Last updated: [11/10/2011]

## Explanation:

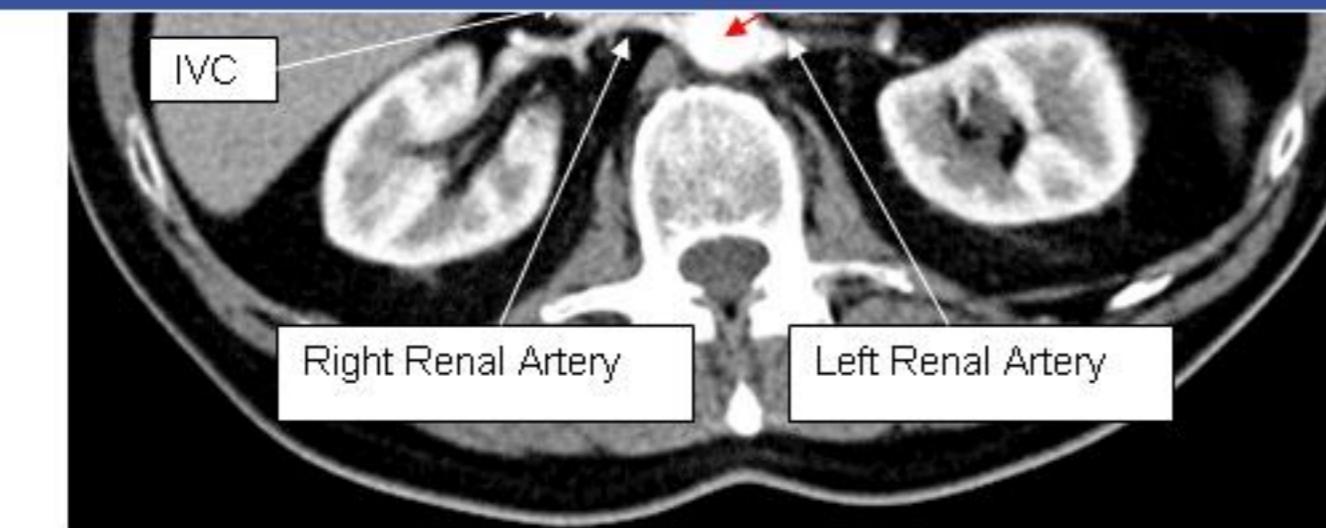
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The inferior vena cava is formed by the union of the right and left common iliac veins at the level of L4-L5. The renal arteries and veins lie at the level of L1. The IVC returns venous blood from the lower extremities, portal system and abdominal and pelvic viscera to the right atrium of the heart.

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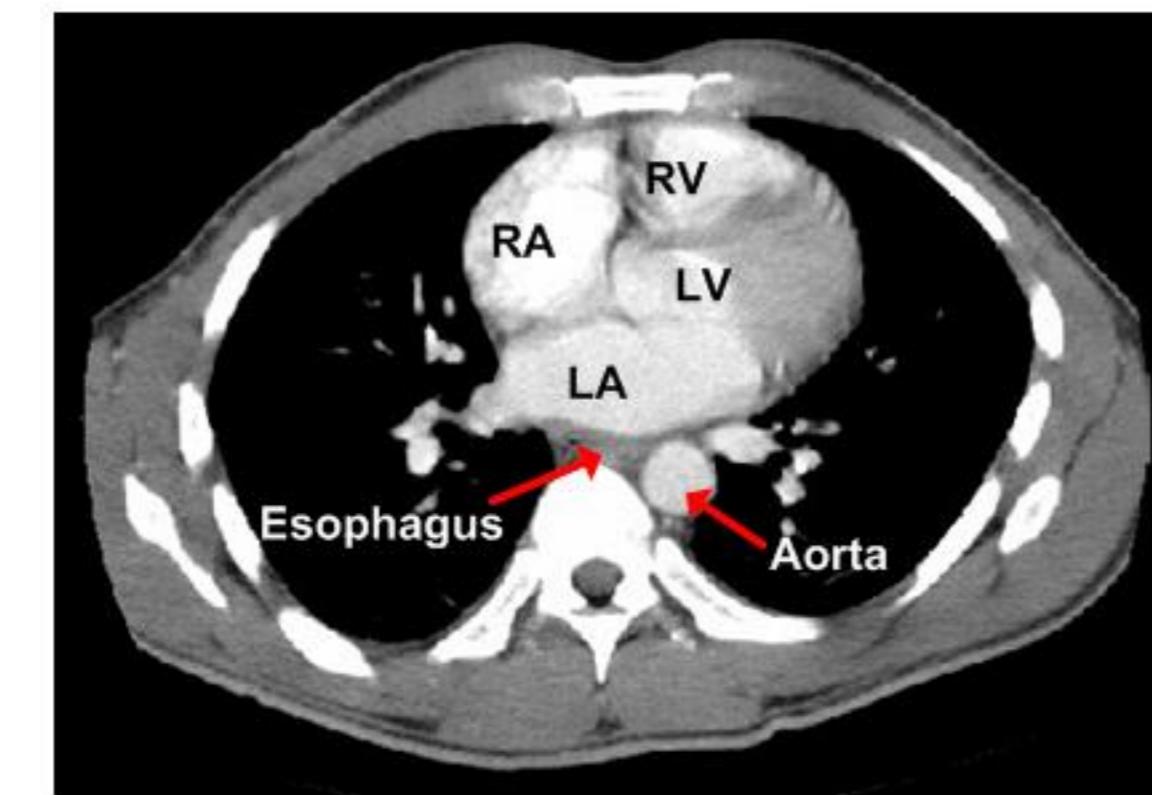
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Last updated: [11/10/2011]

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A 23-year-old male is rushed to the emergency room after being involved in a street fight. Physical examination reveals a stab wound at the left sternal border in the fourth intercostal space. Which of the following structures is most likely to have been damaged?

- A. Pulmonary trunk [7%]
- B. Right ventricle [64%]
- C. Left atrium [8%]
- D. Left ventricle [18%]
- E. Inferior vena cava [2%]

**Explanation:****User Id: 477875**

A penetrating injury at the left sternal border in the fourth intercostal space (level of the nipple) will pass through the following layers:

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A penetrating injury at the left sternal border in the fourth intercostal space (level of the nipple) will pass through the following layers:

1. Skin and subcutis
2. Pectoralis major muscle
3. External intercostal membrane
4. Internal intercostal muscle
5. Internal thoracic artery and veins
6. Transversus thoracis muscle
7. Parietal pleura
8. Pericardium
9. Right ventricular myocardium

It is important to know that the right ventricle composes the majority of the anterior surface of the heart. The left lung would not be punctured by a stab wound in this location because there is no middle lobe on the left side, and the superior lobe of the left lung is displaced laterally by the cardiac impression.

**(Choice A)** The pulmonary trunk could be pierced by a penetrating injury to the second intercostal space at the left sternal border.

**(Choice C)** The left atrium is located at the base of the heart and makes up most of the heart's posterior surface. Only the auricle of the left atrium is visible anteriorly (protruding between the pulmonary trunk and the left ventricle).

**(Choice D)** The left ventricle composes the left lateral aspect of the heart. A stab wound in the fourth intercostal space in the midclavicular line could potentially strike the left ventricle, but only after passing through the bulk of the left lung.

**(Choice E)** The inferior vena cava passes through the right side of the central tendon of the diaphragm at the level of T8. A stab wound to the back to the immediate right of the vertebral bodies could strike the IVC, but the injury described above would be unlikely to.

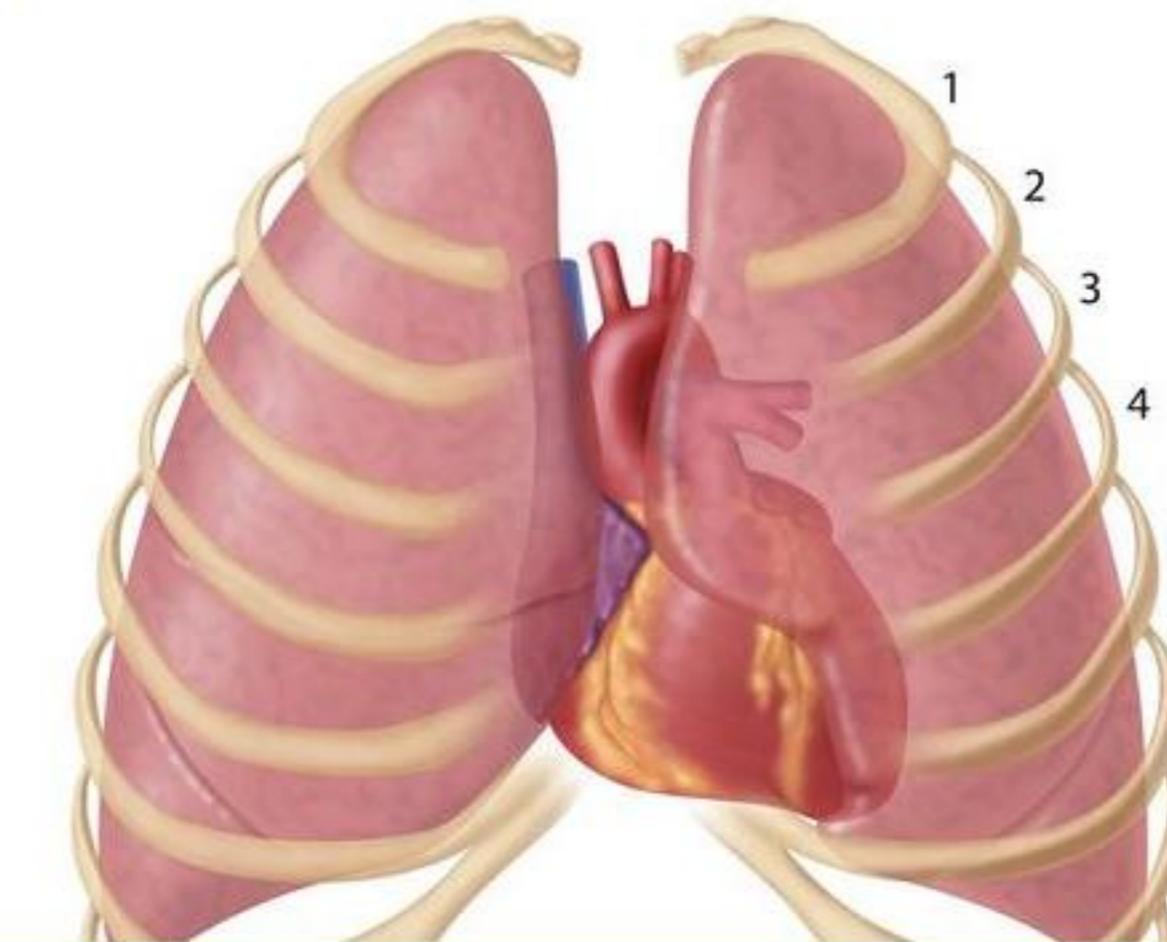
**Educational Objective:**

A penetrating injury at the left sternal border in the fourth intercostal space would puncture the anterior surface of the heart. The right ventricle composes most of the heart's anterior surface.

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A 23-year-old male who has been previously healthy is brought to the ER by his friends after a street fight. They tell you that they were "walking down the street minding their own business when a guy jumped out from behind a dumpster and stabbed him in the chest". They state that they disarmed the man after his single attack and that he ran off into an alley. The patient is conscious but in distress. Physical examination reveals a stab wound at the fifth intercostal space along the left midclavicular line. Which of the following is most likely punctured in this patient?

- A. Azygous vein [1%]
- B. Inferior vena cava [1%]
- C. Left atrium [8%]
- D. Left lung [50%]
- E. Right ventricle [39%]

**Explanation:****User Id: 477875**

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Most of the volume of the thoracic cavity is occupied by the lungs. The apex of each lung extends into the neck approximately three to four centimeters above the first rib. The lung bases are in direct contact with the diaphragm, which separates the right lung from the right lobe of the liver, and the left lung from the left lobe of the liver, the stomach, and the spleen. The mediastinal surface of each lung has a cardiac impression that accommodates the heart.

The heart is located behind the sternum and its anterior surface is partially covered by the lungs. The apex is formed by the left ventricle and is covered by the left lung. It lies behind the fifth left intercostal space at the left midclavicular line. The sternocostal (anterior) surface of the heart is formed chiefly by the right ventricle. The diaphragmatic (inferior) surface is formed by left and right ventricles, and is in contact with the central tendon of the diaphragm. The posterior surface of the heart is formed mainly by the left atrium.

Penetrating injury involving the fifth intercostal space at the left midclavicular line would most likely injure the left lung. Penetration of the left lung at this location could lead to injury of the apex of the heart (left ventricle) as well, *if the wound were deep enough*. All other heart chambers lie medial to the left midclavicular line and would not be affected.

**(Choice A)** The azygos vein lies in the posterior mediastinum immediately to the right of the midline. It drains blood from the posterior intercostal veins into the superior vena cava.

**(Choice B)** The inferior vena cava is located in the mediastinum, lies to the right of midline, and drains into the right atrium.

**(Choice C)** The left atrium is located posterior to the left ventricle and forms the base of the heart.

**(Choice E)** The right ventricle forms the anterior (sternal) surface of the heart and the majority of its inferior border. It lies medially to the left midclavicular line.

**Educational Objective:**

The left ventricle forms the apex of the heart and reaches as far as the fifth intercostal space at the left midclavicular line. All other chambers of the heart lie medial to the left midclavicular line. The lungs overlap much of the anterior surface of the heart.

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A 34-year-old female is being evaluated for progressive exertional shortness of breath. She has no past medical history and does not take any medications. She does not use tobacco, alcohol or drugs. An echocardiographic study suggests coronary sinus dilation. Which of the following best explains this finding?

- A. Aortic dissection [7%]
- B. Coronary artery disease [10%]
- C. Hypertrophic cardiomyopathy [25%]
- D. Pulmonary hypertension [57%]

**Explanation:**

User Id: 477875

The coronary sinus serves as the endpoint of venous drainage from the coronary blood supply. Since it contains deoxygenated blood it drains into the right atrium. The coronary sinus is usually not visible by echocardiography in most normal, healthy patients. The most common cause of coronary sinus dilatation evident on echocardiography is elevated right-sided heart pressure secondary to pulmonary artery hypertension. Since the coronary sinus communicates freely with the right atrium, it will become dilated by any factor that causes dilatation of the right atrium.

**(Choice A)** Aortic dissection often occurs in patients with hypertension. Such patients might have elevated left heart pressures, but not elevated right-sided heart pressures to cause dilatation of the coronary sinus.

**(Choice B)** Coronary artery disease typically results in less coronary artery flow, meaning less blood in the coronary sinus and hence a smaller size. The only mechanism by which coronary sinus dilatation might result from coronary artery disease would be if myocardial ischemia culminated in pulmonary artery hypertension and thus elevated right heart pressures.

**(Choice C)** Complications from hypertrophic cardiomyopathy often stem from left ventricular outflow obstruction. Coronary sinus dilatation should not occur unless there is superimposed heart failure.

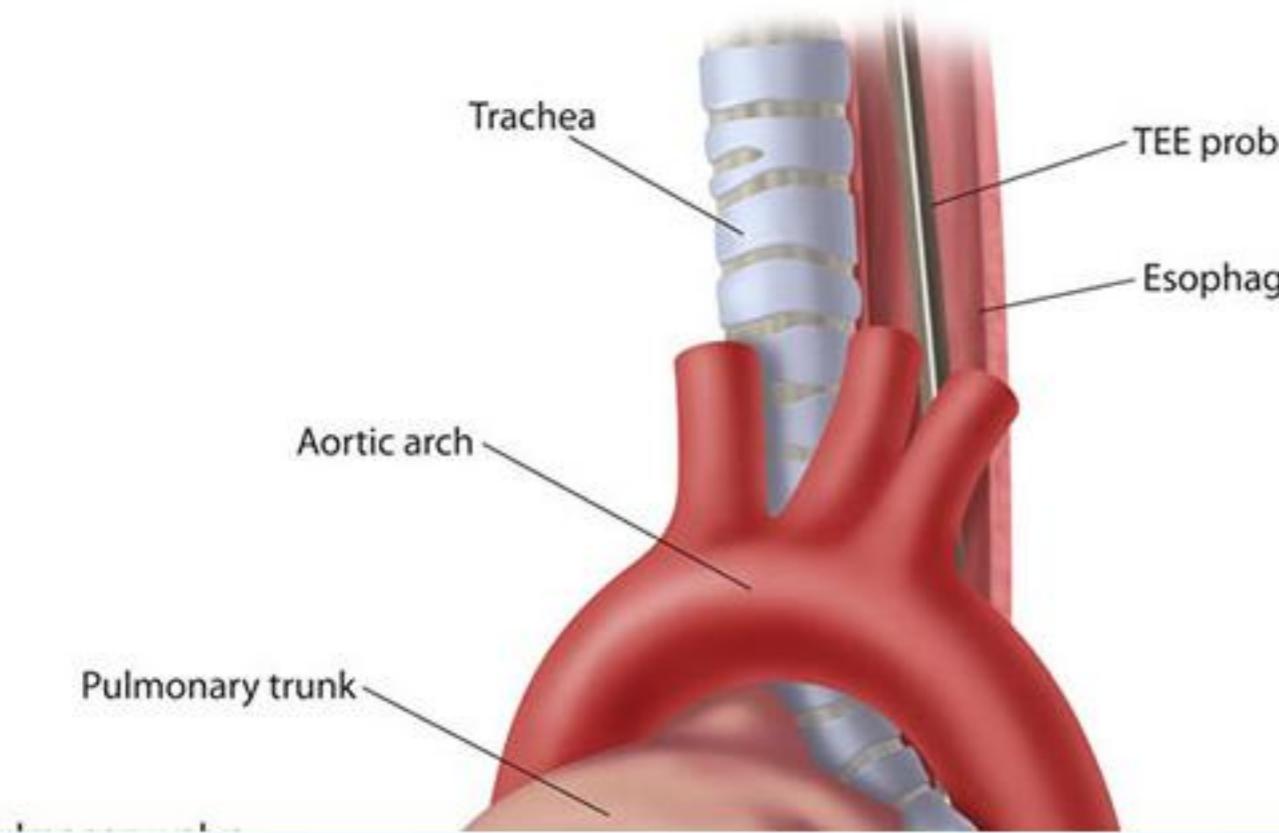
**Educational objective:**

The coronary sinus communicates freely with the right atrium and therefore may become dilated secondary to any factor that causes right atrial dilatation. The most common such factor is pulmonary artery hypertension, which leads to elevated right heart pressures.

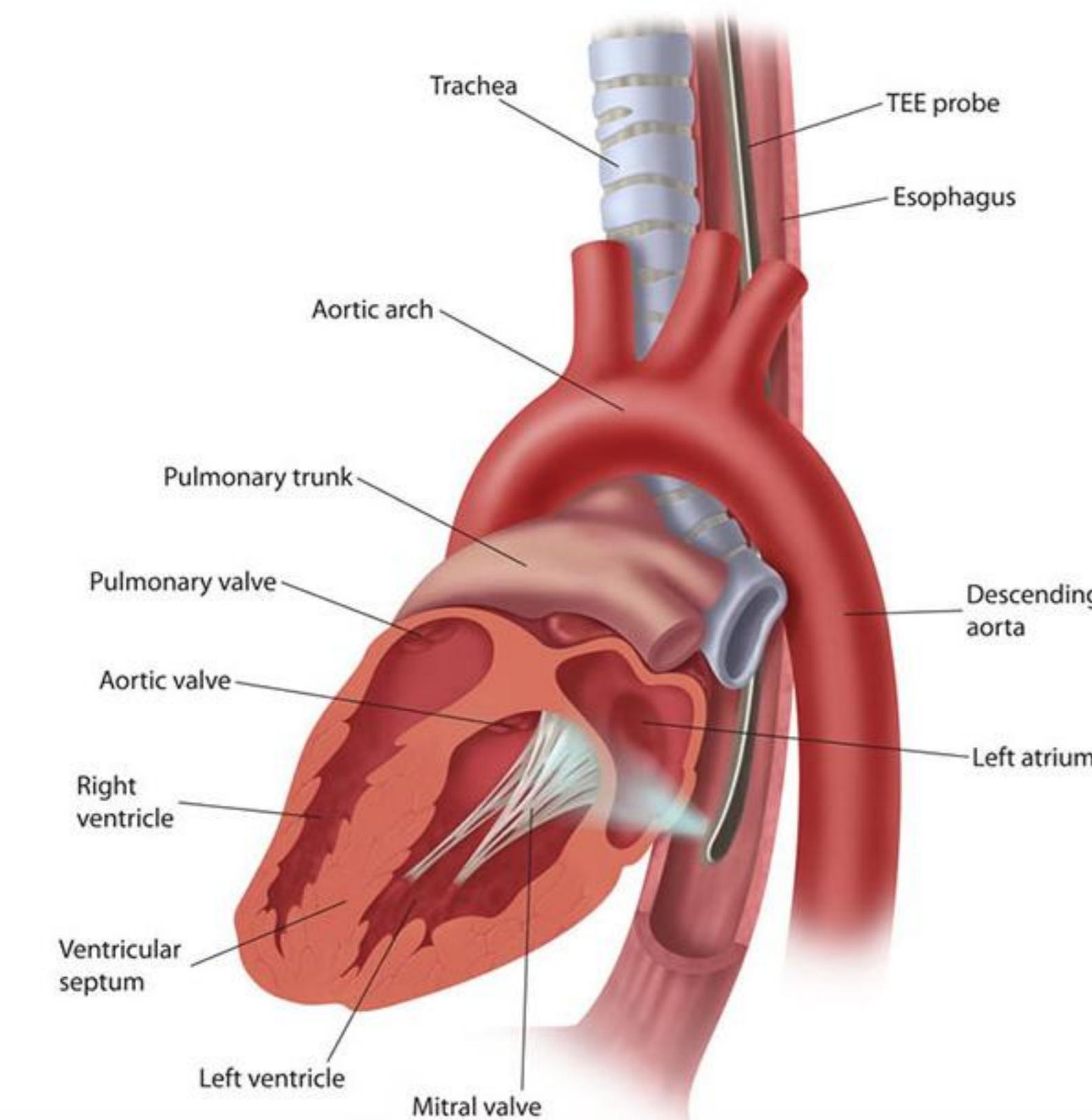
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A 52-year-old man is brought to the emergency department for evaluation of fever, chills, and malaise. Cardiac examination reveals a new holosystolic heart murmur that radiates toward the axilla. Blood cultures are obtained and he undergoes transesophageal echocardiography. The ultrasound probe is placed in the mid-esophagus facing anteriorly and cardiac chambers are interrogated. Anatomically, which of the following chambers is closest to the probe?

- A. Left atrium [75%]
- B. Left ventricle [6%]
- C. Right atrium [13%]
- D. Right ventricle [6%]

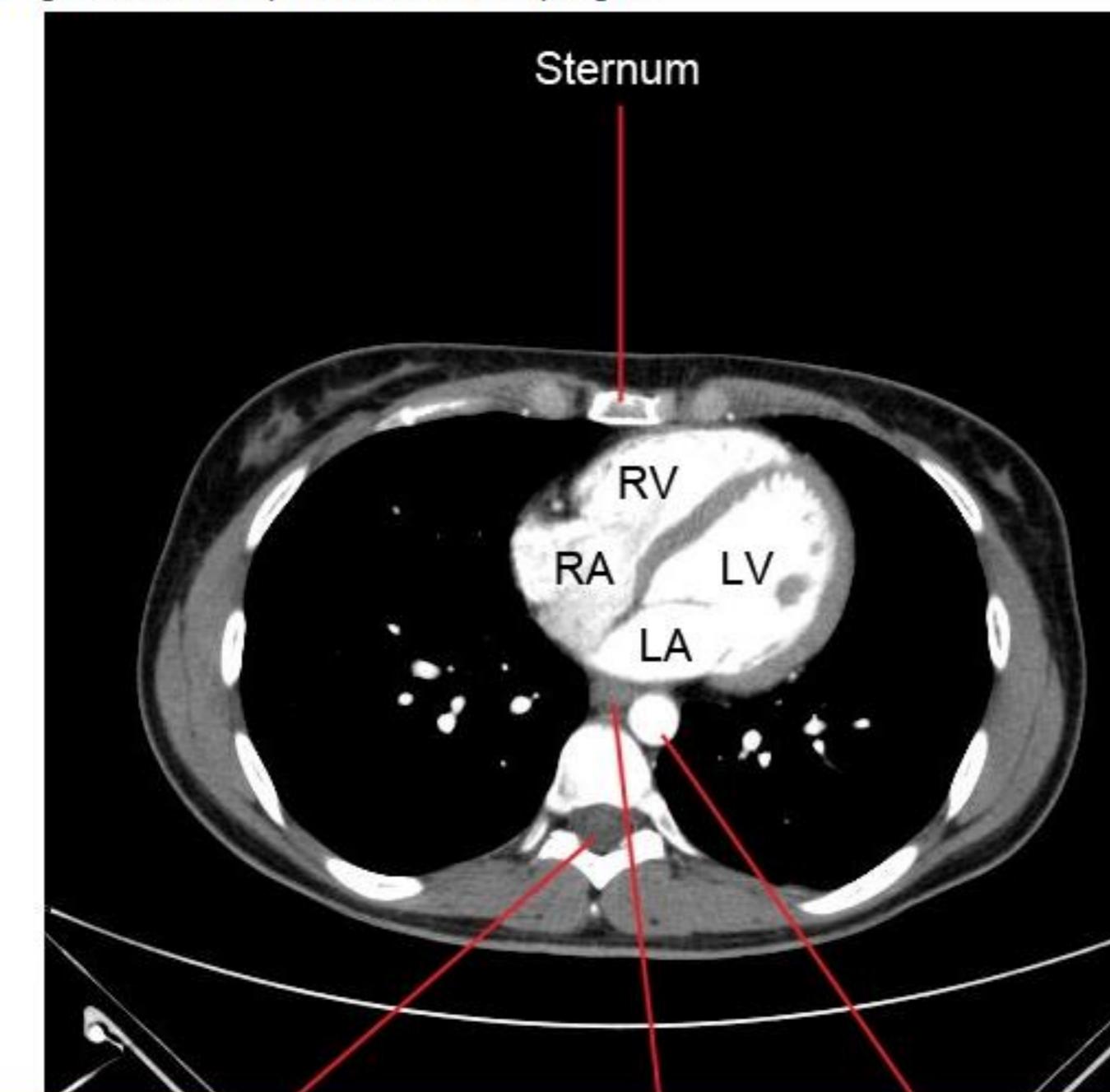
**Explanation:****User Id: 477875****Transesophageal echocardiography (TEE)**

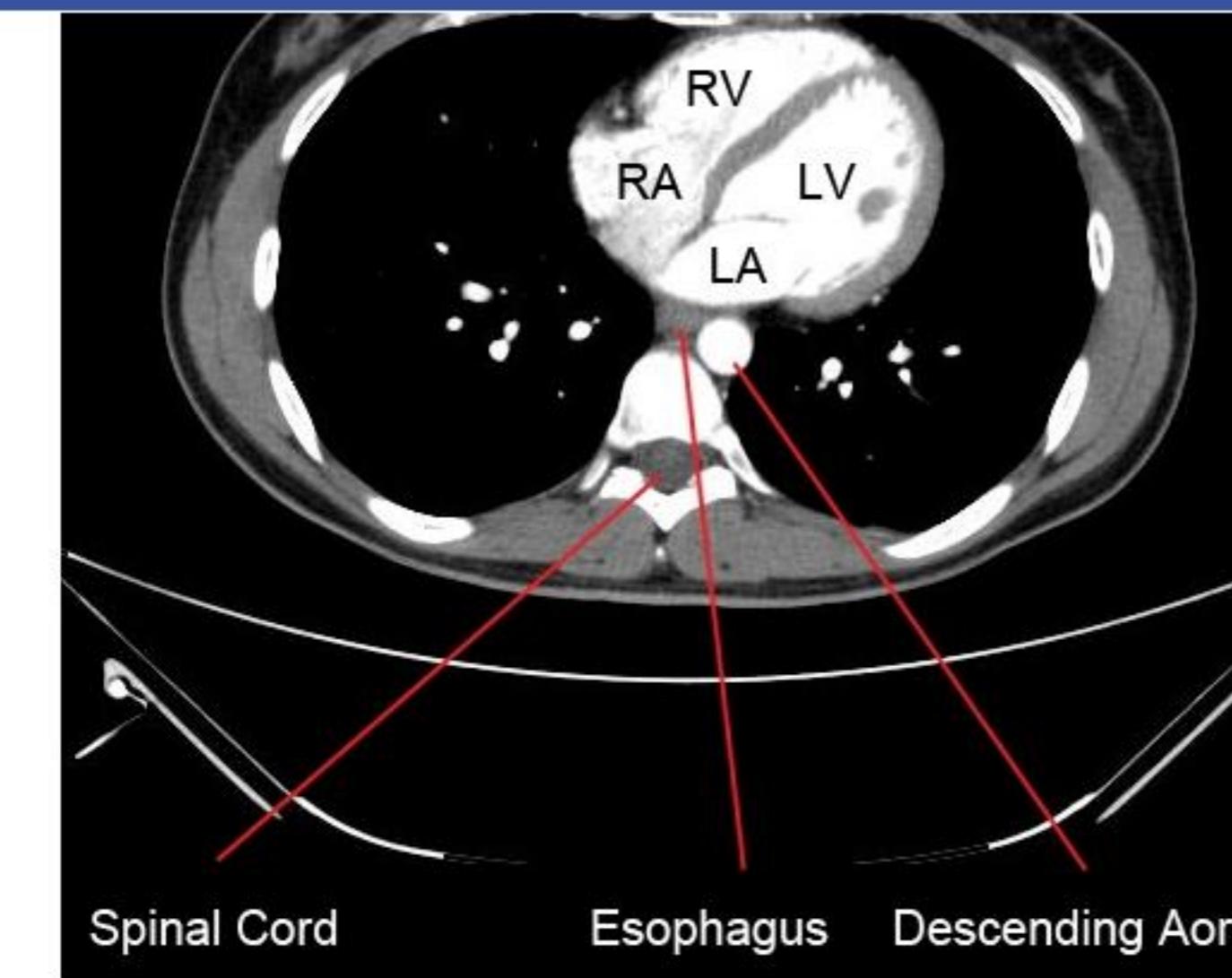
## Transesophageal echocardiography (TEE)



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This patient's presentation suggests acute endocarditis, with confirmation pending the results of the blood cultures and cardiac imaging. Transesophageal echocardiography (TEE) uses ultrasound waves generated from within the esophagus to produce clear images of the neighboring cardiac structures. The left atrium makes up the majority of the heart's posterior surface, with the esophagus passing immediately posterior to the heart. Therefore, the esophagus lies within **closest proximity** to the left atrium. This allows the left atrium, atrial septum, and mitral valve to be particularly well visualized on TEE. Due to its adjacent proximity, conditions that result in left atrial enlargement (eg, atrial fibrillation, mitral stenosis) can cause dysphagia through external compression of the esophagus.





**(Choice B)** The left ventricle forms the apex and left border of the heart on frontal chest x-ray.

**(Choice C)** The right atrium, along with the superior vena cava, forms the right lateral cardiac border on frontal chest x-ray.

**(Choice D)** The right ventricle forms the anterior (sternal) surface of the heart and the majority of its inferior border.

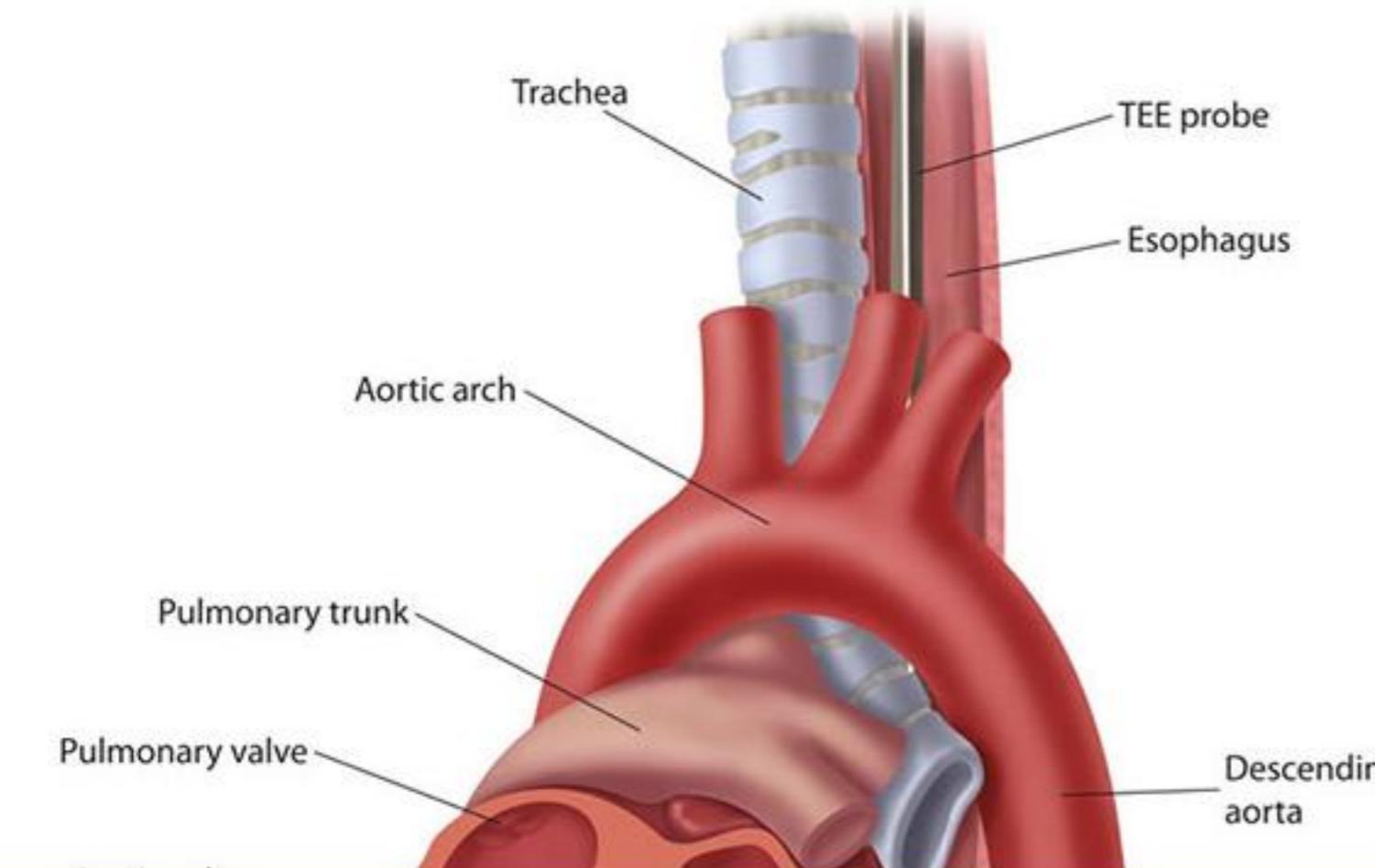
**Educational objective:**

The left atrium forms the majority of the posterior surface of the heart and resides adjacent to the esophagus. Enlargement of the left atrium can compress the esophagus and cause dysphagia.

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In the same mid-esophageal position, the probe is rotated so that it now faces posteriorly. Anatomically, which of the following will be best interrogated in this position?

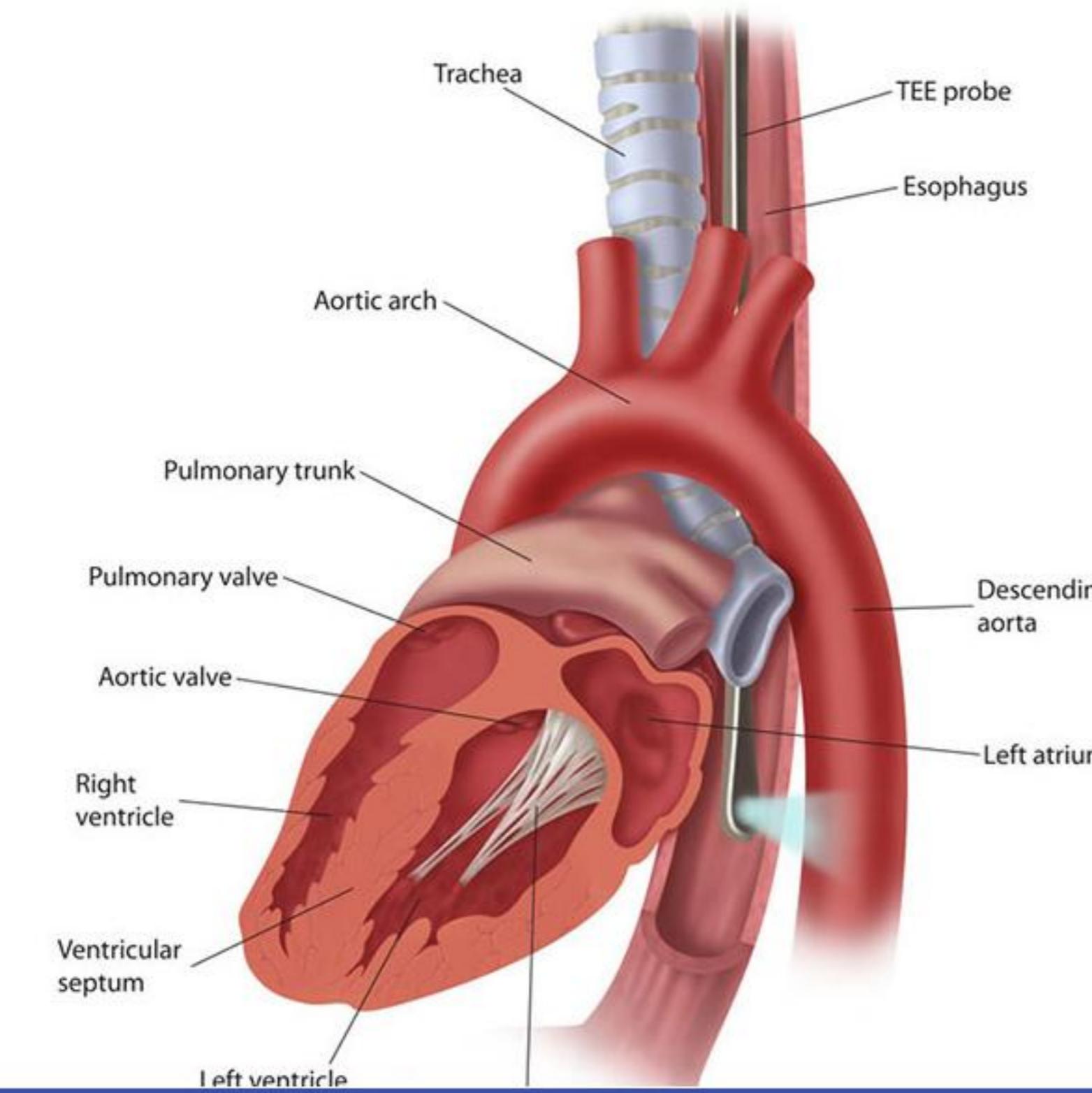
- A. Descending aorta [69%]
- B. Pulmonary artery [8%]
- C. Pulmonary veins [10%]
- D. Superior vena cava [11%]
- E. Tricuspid valve [2%]

**Explanation:****User Id: 477875****Transesophageal echocardiography (TEE)**

Explanation:

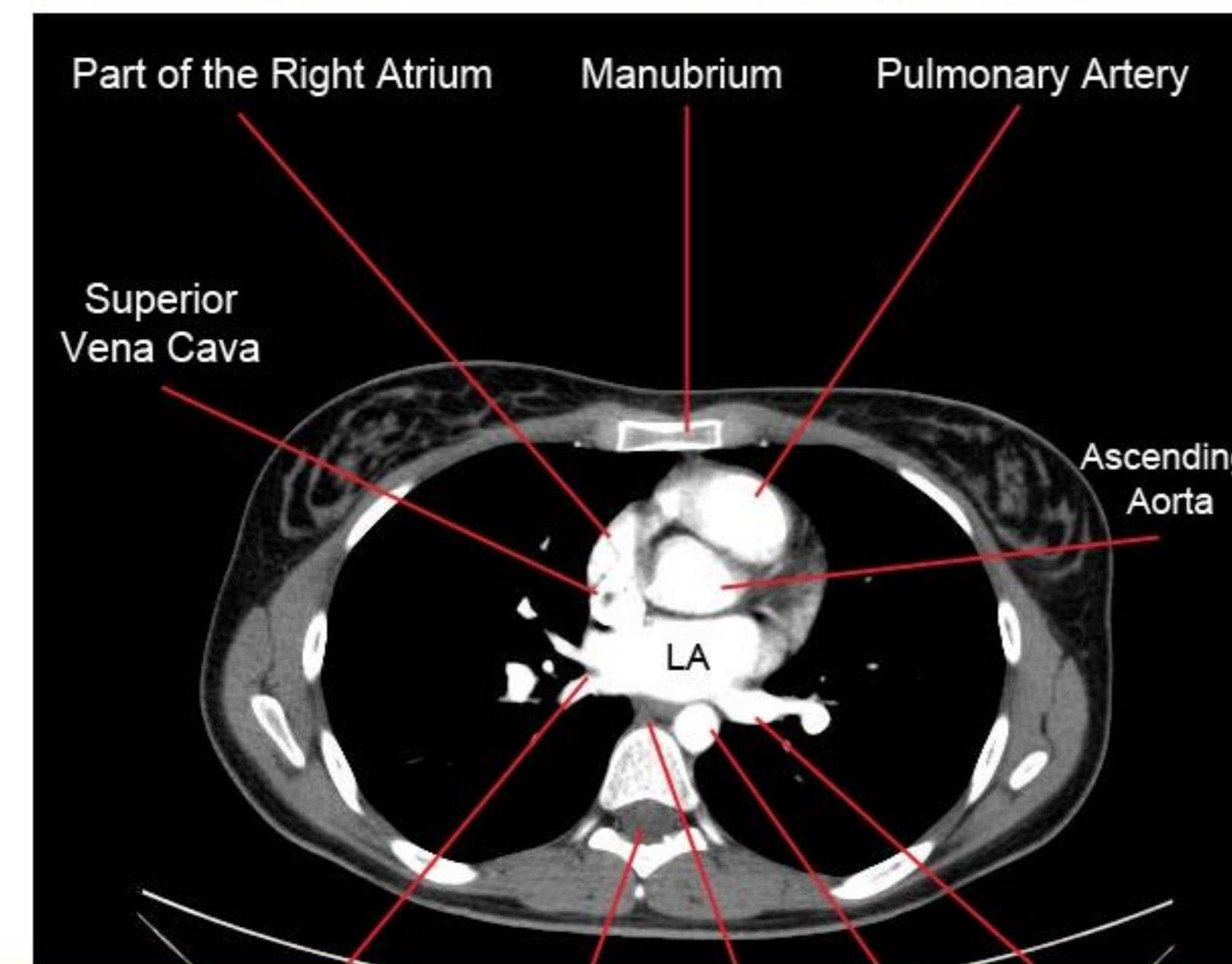
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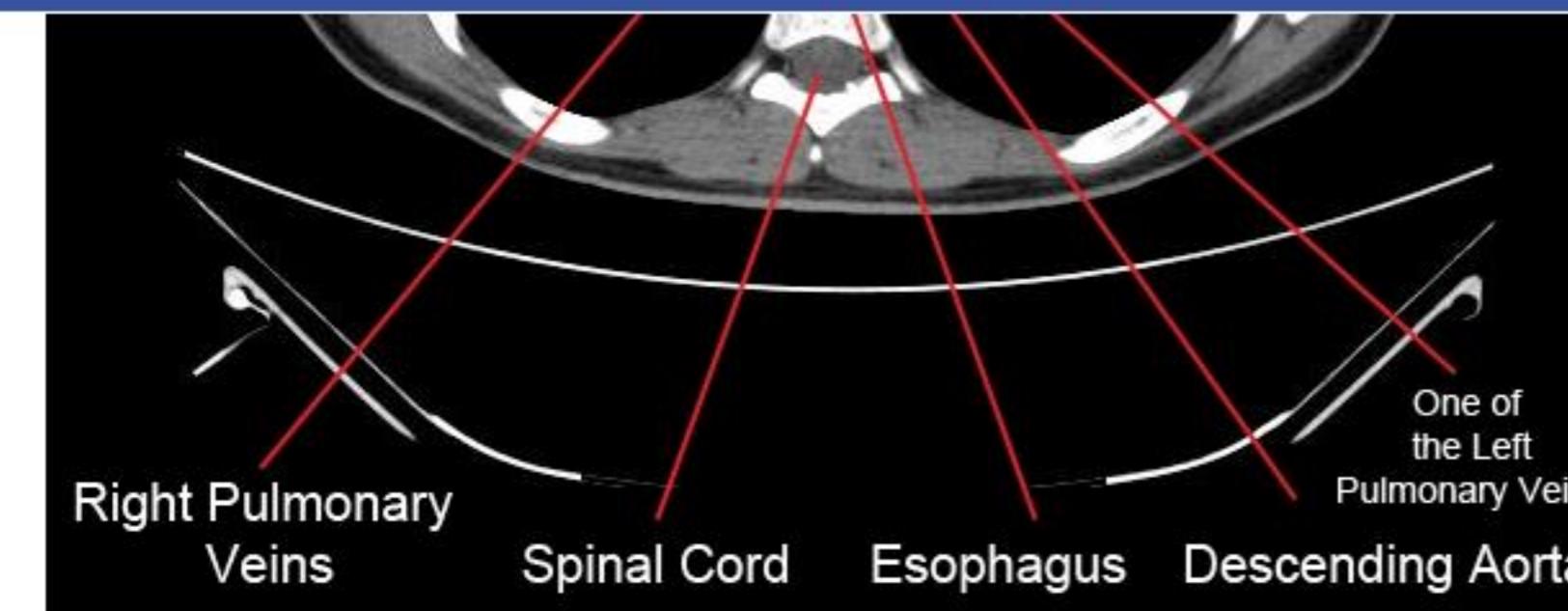
## Transesophageal echocardiography (TEE)



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The aorta has four major divisions: the ascending aorta, the aortic arch, the descending thoracic aorta, and the abdominal aorta. The ascending aorta lies posterior and to the right of the main pulmonary artery. The aortic arch travels above the right pulmonary artery and the left bronchus. The brachiocephalic, left common carotid, and left subclavian arteries originate (in that order) from its superior aspect. The descending thoracic aorta abuts the left anterior surface of the vertebral column and lies **posterior** to the esophagus and the left atrium. This permits clear visualization of the descending aorta during transesophageal echocardiography (TEE), allowing for the detection of abnormalities such as dissection or aneurysm. The descending thoracic aorta continues to travel down the left anterior surface of the vertebral column, becoming the abdominal aorta as it crosses the diaphragm and eventually branching into the common iliac arteries.





**(Choice B)** The main pulmonary artery ascends anteriorly and to the left of the ascending aorta and is directed toward the left shoulder. After the pulmonary artery bifurcates, the right pulmonary artery travels horizontally under the aortic arch posterior to the superior vena cava and the left pulmonary artery courses superiorly over the left main bronchus.

**(Choice C)** The superior and inferior pulmonary veins arise bilaterally from each lung and enter the left atrium. The proximal 2-3 cm of the pulmonary veins contain cardiac muscle within the media and function like sphincters during atrial systole.

**(Choice D)** The superior vena cava (SVC) is formed behind the right 1<sup>st</sup> costal cartilage by the merger of the right and left brachiocephalic veins. It returns blood from the head, neck, and upper extremities to the right atrium of the heart. Mediastinal neoplasms can compress the SVC and result in SVC syndrome.

**(Choice E)** The tricuspid valve is located between the right atrium and right ventricle and is composed of 3 valve leaflets, the annulus, supporting chordae tendineae, and the papillary muscles. It is commonly infected (endocarditis) in IV drug users.

#### Educational objective:

The descending thoracic aorta lies posterior to the esophagus and the left atrium. This position permits clear visualization of the descending aorta by transesophageal echocardiography, allowing for the detection of abnormalities such as dissection or aneurysm.

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A 63-year-old male with a history of stroke and resultant severe oropharyngeal dysphagia develops a right lower lobe pneumonia after an episode of vomiting. This type of aspiration pneumonia commonly affects the right lower lung lobe because:

- A. The right main bronchus is longer than the left main bronchus [2%]
- B. The right main bronchus is straighter than the left main bronchus [94%]
- C. The right main bronchus is narrower than the left main bronchus [1%]
- D. The right lower lobe receives a richer blood supply than the left lower lobe [1%]
- E. Vascular resistance is higher in the right lower lobe than the right upper lobe [1%]

**Explanation:****User Id: 477875**

The right main bronchus is more prone to foreign body aspiration than the left main bronchus because the right main bronchus has a larger diameter, is shorter, and is oriented more vertically than the left main bronchus. This fact can be remembered using the mnemonic, "Swallow a bite, goes down the right."

**Educational objective:**

Aspirated or inhaled particles are most likely to become lodged in the right main bronchus or its branches because this bronchus is shorter, wider and more vertically oriented than the left main bronchus.

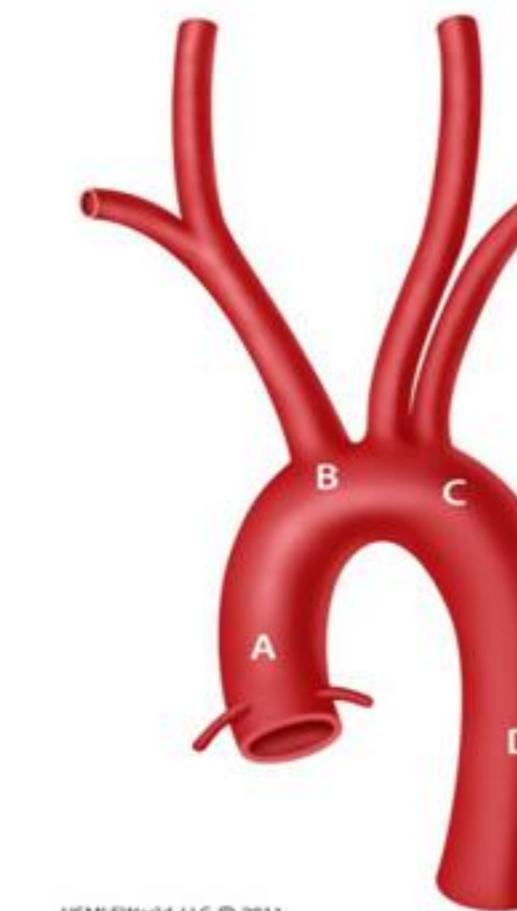
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A 47-year-old man is brought to the emergency department after being involved in a motor vehicle accident. He was a restrained driver and rear-ended a slowly moving car on a highway. He complains of chest pain, abdominal pain, and shortness of breath. His other medical problems include hypertension, asthma, and type 2 diabetes mellitus. His initial blood pressure is 98/54 mm Hg and pulse is 121/min. He becomes unresponsive and loses his pulse 30 minutes after arriving at the hospital. His EKG monitoring demonstrates sinus tachycardia. The patient dies despite resuscitation efforts.



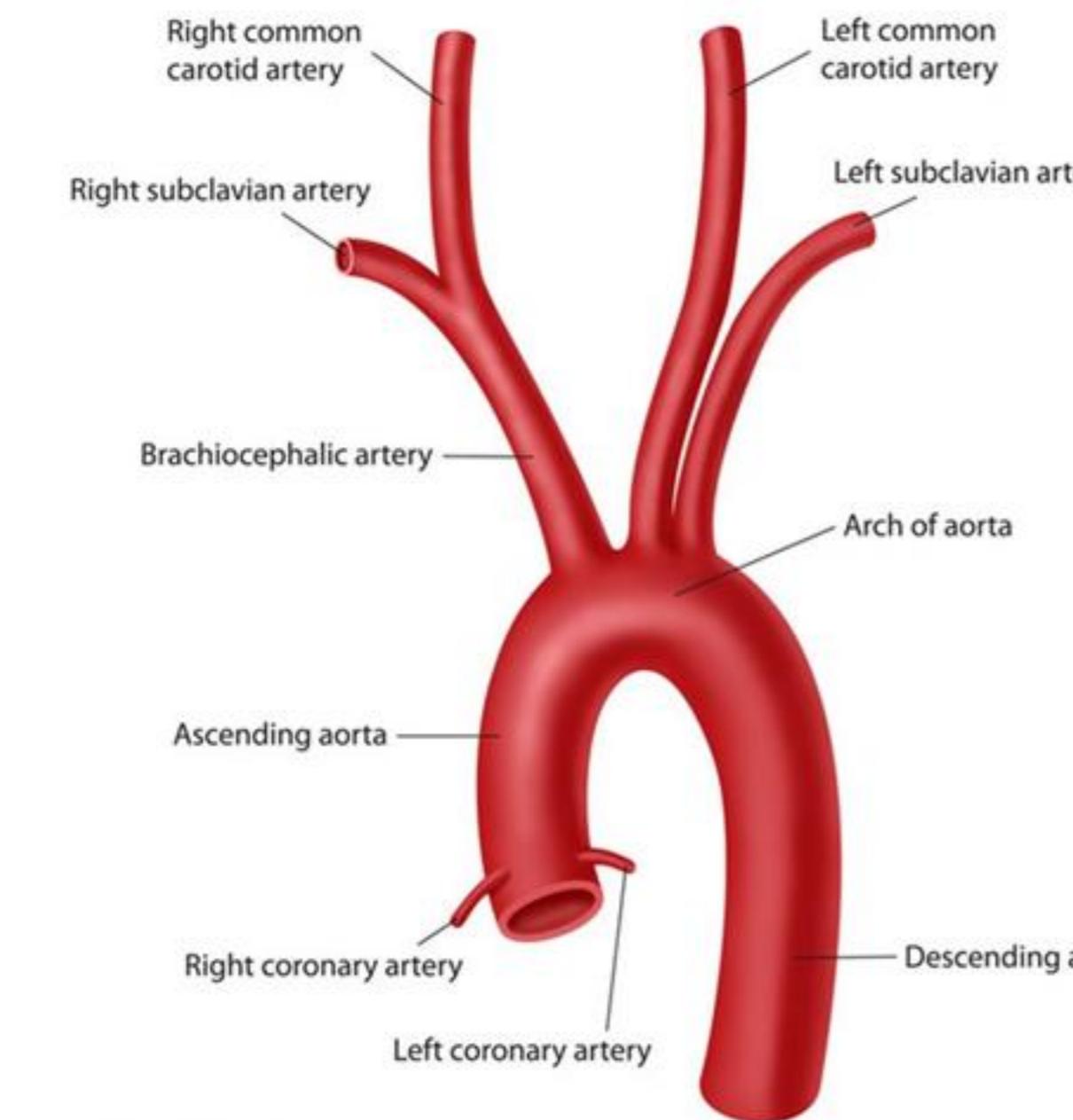
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Which of the following identifiers from the above figure indicates the site most likely to have an aortic injury on autopsy?

- A. A [26%]
- B. B [16%]
- C. C [23%]
- D. D [35%]

## Explanation:

User Id: 477875



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This patient presents after trauma with signs/symptoms consistent with likely aortic rupture, which is most commonly caused by motor vehicle accidents. A motor vehicle accident with sudden deceleration can cause different rates of deceleration between the heart (in a fixed position) and the aorta. The most common site of injury is the aortic isthmus (site C on the figure), which is the connection between the ascending and descending aorta distal to where the left subclavian artery branches off the aorta.

Patients typically present with chest pain, back pain, or shortness of breath. However, there can be significant



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This patient presents after trauma with signs/symptoms consistent with likely aortic rupture, which is most commonly caused by motor vehicle accidents. A motor vehicle accident with sudden deceleration can cause different rates of deceleration between the heart (in a fixed position) and the aorta. The most common site of injury is the aortic isthmus (site C on the figure), which is the connection between the ascending and descending aorta distal to where the left subclavian artery branches off the aorta.

Patients typically present with chest pain, back pain, or shortness of breath. However, there can be significant rupture, causing instant death after the trauma. Patients who survive the initial rupture may have a widened mediastinum on chest x-ray.

**(Choice A)** Site A on the figure shows where the coronary arteries come off the aorta. This is not a usual location for aneurysm or rupture.

**(Choice B)** Site B on the figure shows where the right brachiocephalic artery branches off the ascending aorta. This is a common site for aortic aneurysms from other causes, such as hypertension, syphilis, or vasculitis. It is a less common site for traumatic rupture.

**(Choice D)** Site D represents the descending aorta. Traumatic rupture can occur here; however, it is a less common site for rupture than is the aortic isthmus.

#### Educational objective:

Aortic rupture is most commonly due to motor vehicle accidents, and the most common site of injury is the aortic isthmus, which is the connection between the ascending and descending aorta distal to where the left subclavian artery branches off the aorta.

#### References:

1. [Blunt thoracic aortic injuries: an autopsy study](#)

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A 67-year-old woman with metastatic lung cancer complains of recent hoarseness and difficulty swallowing. On examination, there is loss of the gag reflex on the left side and uvula deviation to the right when the patient is prompted to say "ah." There is also weakness of her left sternocleidomastoid and trapezius muscles. A lesion involving which of the following anatomical structures is most likely responsible for the patient's symptoms?

- A. Cribiform plate [1%]
- B. Foramen ovale [4%]
- C. Foramen rotundum [5%]
- D. Hypoglossal canal [14%]
- E. Internal acoustic meatus [2%]
- F. Jugular foramen [74%]

#### Explanation:

User Id: 477875

	Skull foramen	Traversing structures
Anterior cranial fossa	Cribiform plate	CN I olfactory bundles
Middle cranial fossa	Optic canal	CN II, ophthalmic artery, central retinal vein
	Superior orbital fissure	CN III, IV, V <sub>1</sub> , VI, ophthalmic vein, sympathetic fibers
	Foramen rotundum	CN V <sub>2</sub> (maxillary)
	Foramen ovale	CN V <sub>3</sub> (mandibular)

## Explanation:

User Id: 477875

	Skull foramen	Traversing structures
Anterior cranial fossa	Cribriform plate	CN I olfactory bundles
Middle cranial fossa	Optic canal	CN II, ophthalmic artery, central retinal vein
	Superior orbital fissure	CN III, IV, V <sub>1</sub> , VI, ophthalmic vein, sympathetic fibers
	Foramen rotundum	CN V <sub>2</sub> (maxillary)
	Foramen ovale	CN V <sub>3</sub> (mandibular)
	Foramen spinosum	Middle meningeal artery & vein
Posterior cranial fossa	Internal acoustic meatus	CN VII, VIII
	Jugular foramen	CN IX, X, XI, jugular vein
	Hypoglossal canal	CN XII
	Foramen magnum	Spinal roots of CN XI, brain stem, vertebral arteries

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	Foramen ovale	CNV <sub>3</sub> (mandibular)
	Foramen spinosum	Middle meningeal artery & vein
Posterior cranial fossa	Internal acoustic meatus	CN VII, VIII
	Jugular foramen	CN IX, X, XI, jugular vein
	Hypoglossal canal	CN XII
	Foramen magnum	Spinal roots of CN XI, brain stem, vertebral arteries

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This patient's symptoms are consistent with a lesion involving the **jugular foramen**, a large aperture located in the base of the skull behind the carotid canal. It is formed by the petrous portion of the temporal bone and the occipital bone. Passing through the jugular foramen are CN IX, X, and XI. Lesions of the jugular foramen (from tumors, trauma, or infection) can result in jugular foramen (Vernet) syndrome, which is characterized by CN IX, X, and XI dysfunction. Symptoms are related to the nerve affected:

- Loss of taste from the posterior 1/3 of the tongue (CN IX)
- Reduced parotid gland secretion (CN IX)
- Loss of gag reflex (CN IX, X)
- Dysphagia (CN IX, X)
- Dysphonia/hoarseness (CN X)
- Soft palate drop with deviation of the uvula toward the normal side (CN X)
- Sternocleidomastoid and trapezius muscle paresis (CN XI)

#### Educational objective:

Lesions of the jugular foramen can result in jugular foramen (Vernet) syndrome, which is characterized by the dysfunction of CN IX, X, and XI.

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Last updated: [4/22/2013]

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A 22-year-old male is brought to the emergency room after being involved in a fight in a nearby bar. His blood pressure is 100/70 mmHg and his heart rate is 100/min. Physical examination reveals a penetrating right-sided neck injury just above the clavicle and lateral to the manubrium sterni. Which of the following structures was most likely injured?

- A. Inferior thyroid artery [12%]
- B. Ansa cervicalis [11%]
- C. Lung pleura [53%]
- D. Accessory nerve [9%]
- E. Carotid body [15%]

**Explanation:**

User Id: 477875



The patient likely has a tension pneumothorax, a condition where air enters the pleural cavity during inspiration



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The patient likely has a tension pneumothorax, a condition where air enters the pleural cavity during inspiration but is not expelled during exhalation. An increasing volume of air accumulates within the pleural space, ultimately causing deviation of the lungs and mediastinum to the opposite side of the chest. The increased pressure within the chest cavity causes decreased systemic venous return to the heart leading to decreased cardiac output. Signs and symptoms of tension pneumothorax include tachycardia, hypotension, tachypnea, hypoxia, and absence of breath sounds and hyperresonance to percussion on the affected side. A chest X-ray will confirm the diagnosis; treatment is emergent needle thoracostomy or chest tube.

In patients with neck injuries, it is important to remember that the lung apices and cervical pleura extend above the clavicle and first rib through the superior thoracic aperture into the neck. As the above radiograph illustrates, stab wounds immediately above the clavicle and lateral to the manubrium can puncture the pleura and cause pneumothorax, tension pneumothorax or hemothorax.

**(Choice A)** The inferior thyroid artery arises from the thyrocervical trunk, which itself arises from the subclavian artery. The inferior thyroid artery courses posterior to the carotid artery and jugular vein and supplies the inferior pole of the thyroid gland.

**(Choice B)** The ansa cervicalis arises from the C1, C2 and C3 nerve roots and innervates the sternohyoid, sternothyroid and omohyoid muscles of the anterior neck. Penetrating trauma to the neck superior to the cricoid cartilage might injure this nerve.

**(Choice D)** The accessory nerve (CN XI) innervates the sternocleidomastoid and trapezius muscles. This nerve may be injured during surgery involving the posterior triangle of the neck (a region bounded by the sternocleidomastoid muscle, trapezius muscle, and clavicle).

**(Choice E)** The carotid body, which contains O<sub>2</sub>, CO<sub>2</sub> and H<sup>+</sup> chemoreceptors, lies at the bifurcation of the common carotid artery (just inferior to the hyoid bone).

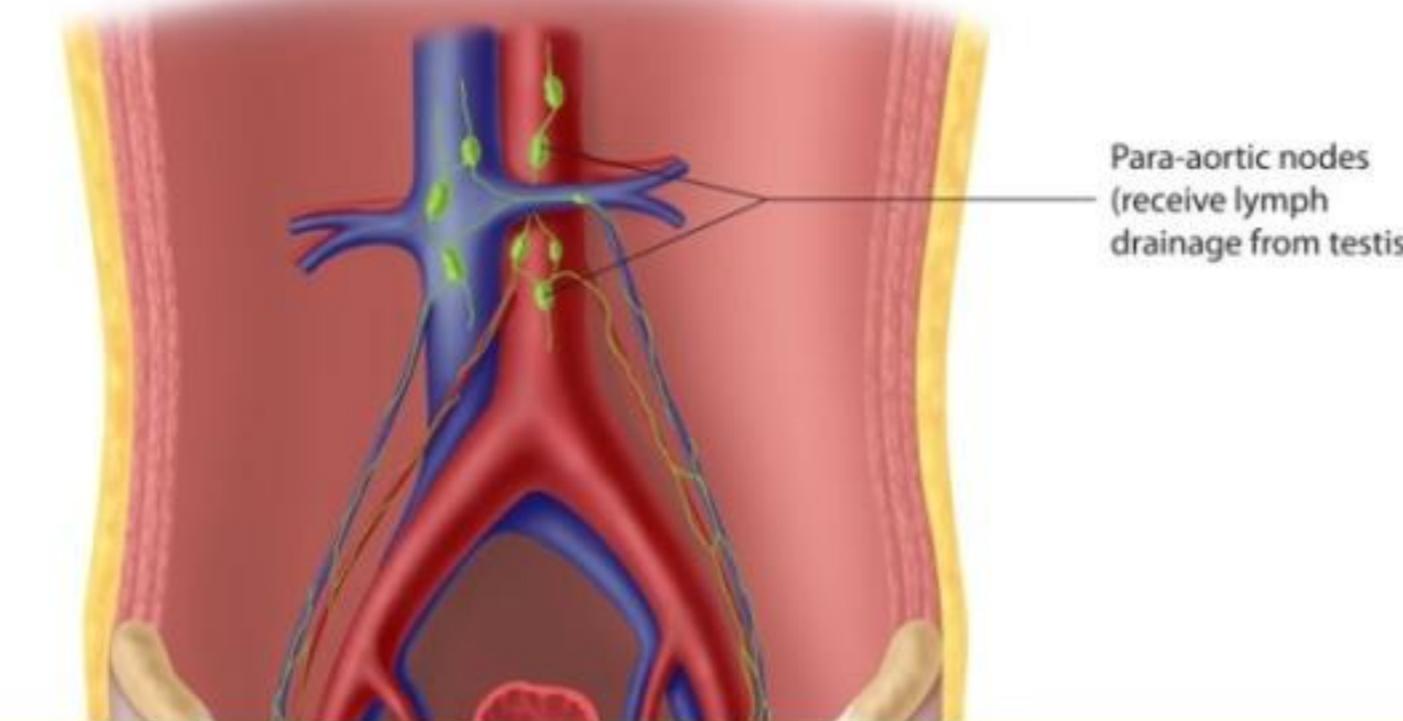
#### Educational Objective:

The lung apices extend above the level of the clavicle and first rib through the superior thoracic aperture. Penetrating injury in this area may lead to pneumothorax.

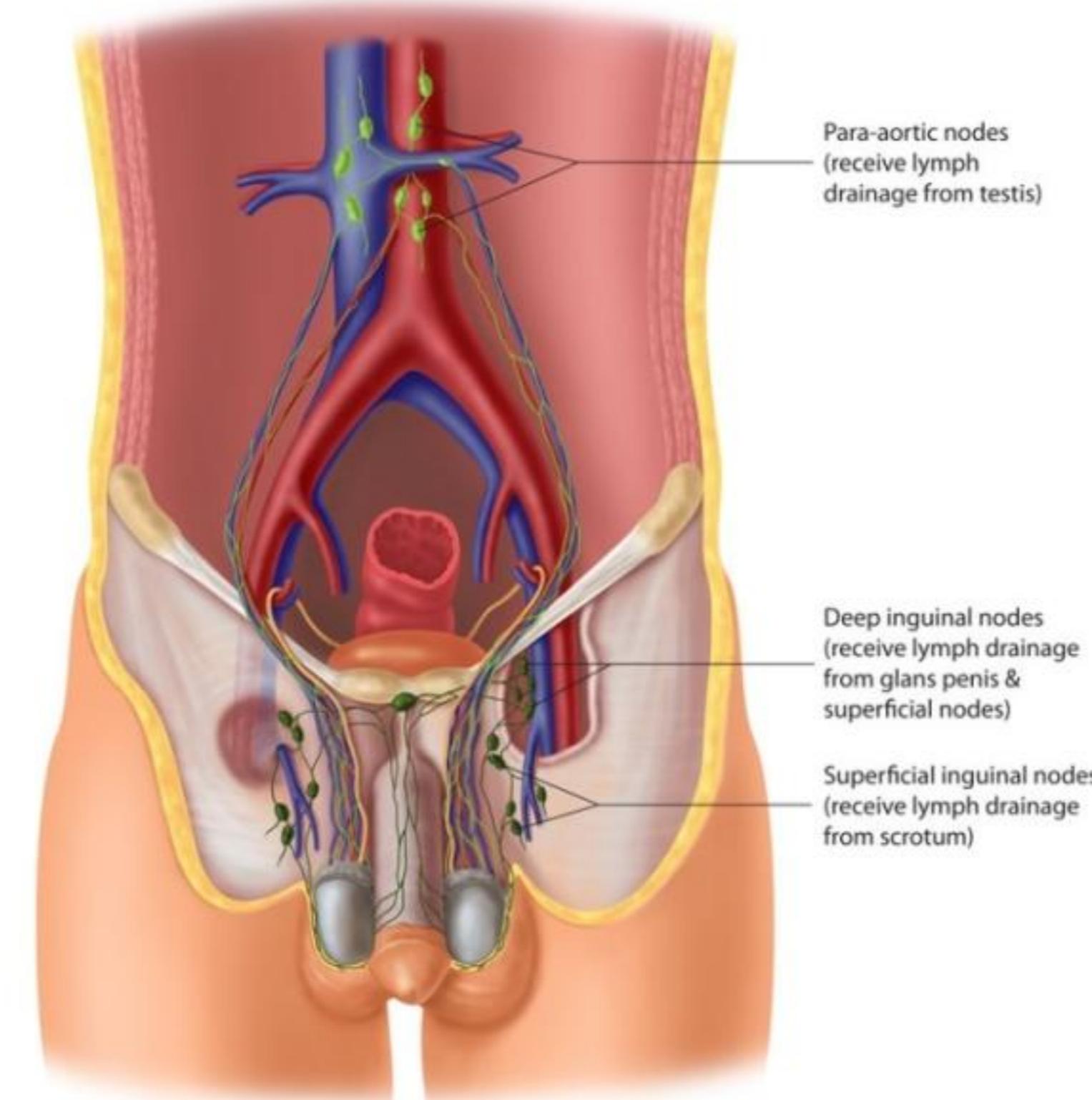
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A 23-year-old man comes to the physician complaining of right-sided testicular swelling. He first noticed the swelling 1 week ago while getting ready for work. He denies any testicular pain or history of trauma. However, he has noticed a heavy, pressing sensation involving his scrotum and lower abdomen. Physical examination reveals asymmetric swelling of the right testis, and subsequent ultrasonography shows a solid testicular mass. If malignant, this patient's tumor is most likely to spread to which of the following lymph node groups?

- A. Superficial inguinal [10%]
- B. Deep inguinal [9%]
- C. External iliac [2%]
- D. Common iliac [2%]
- E. Inferior mesenteric [2%]
- F. Para-aortic [75%]

**Explanation:****User Id: 477875****Lymph vessels & nodes of male genitalia**

## Lymph vessels &amp; nodes of male genitalia



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In general, the lymph drainage from a particular organ follows the path of the arterial supply to that site. During fetal development, the testes originate within the retroperitoneum and establish their arterial supply from the abdominal aorta. The testes subsequently descend through the inguinal canals into the scrotum, taking with them their arterial, venous, and lymphatic supplies. Thus, lymph from the testes drains through lymph channels directly back to the para-aortic (retroperitoneal) lymph nodes.

**(Choice A)** The superficial inguinal lymph nodes are located on the anterior thigh inferior to the inguinal ligament. These nodes drain nearly all cutaneous structures inferior to the umbilicus, including the external genitalia and the anus up to the pectinate line.

**(Choice B)** The deep inguinal nodes reside under the fascia lata on the medial side of the femoral vein. They receive afferents from the superficial inguinal nodes and deep lymphatic trunks along the femoral vessels. The lymphatics from the glans penis and clitoris also drain directly to these nodes.

**(Choice C)** The external iliac nodes drain the superficial and deep inguinal nodes and the deep lymphatics of the abdominal wall below the umbilicus.

**(Choice D)** The common iliac nodes are located alongside the common iliac artery and drain the internal and external iliac nodes.

**(Choice E)** The inferior mesenteric nodes drain the structures supplied with arterial blood by branches of the inferior mesenteric artery (eg, the left colic, sigmoid, and superior rectal arteries). Thus, these nodes drain the descending and sigmoid colon as well as the upper part of the rectum. Their efferents drain to pre-aortic nodes.

**Educational objective:**

Lymph from the testes drains through lymph channels directly back to the para-aortic lymph nodes. In contrast, lymph from the scrotum drains to the superficial inguinal lymph nodes.

Time Spent: 1 seconds

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Last updated: [2/27/2013]

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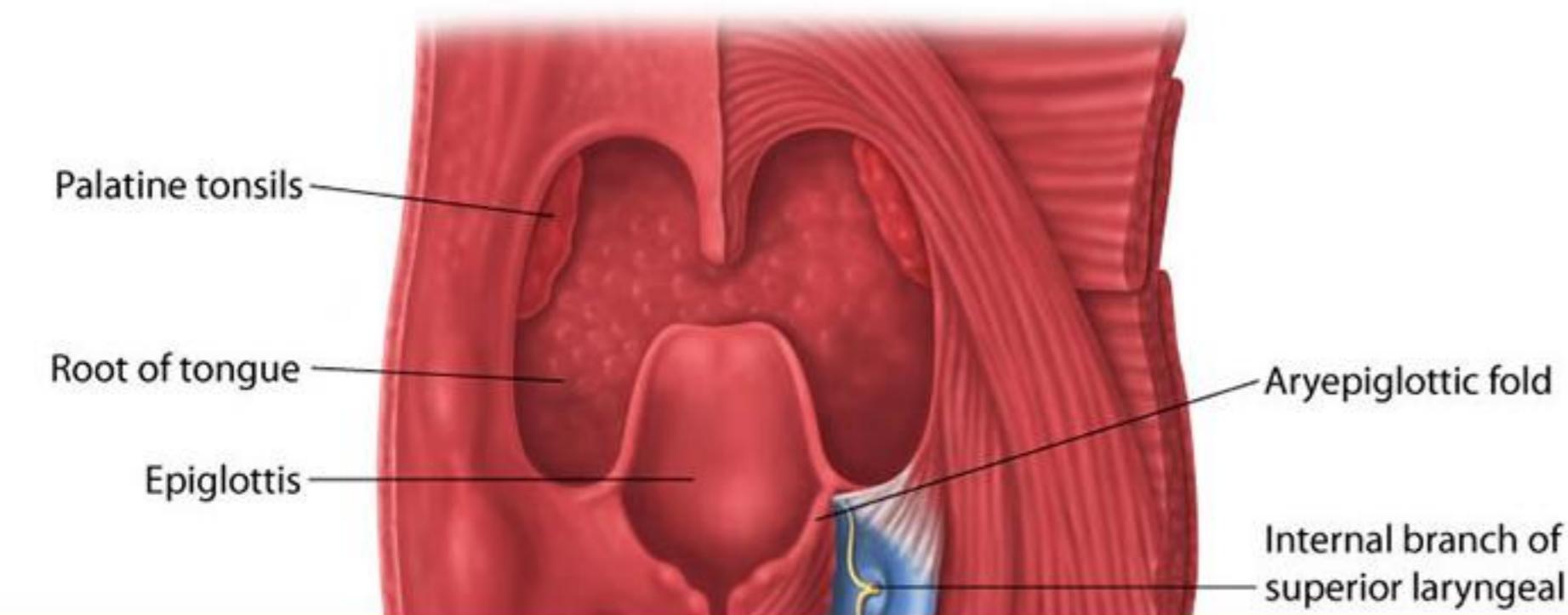
A 23-year-old man comes to the emergency department complaining that he has food stuck in his throat. His symptoms started 2 hours ago after eating fish at a local seafood restaurant. He has tried coughing and swallowing multiple times in an attempt to clear the food, but has so far been unsuccessful. The patient denies any difficulty with breathing. He does not appear to be in any distress on physical examination. Laryngoscopy reveals a fish bone lodged in the left piriform recess. During an attempt to retrieve the fish bone, a nerve is injured deep to the mucosa overlying the recess. Which of the following is most likely to be impaired in this patient?

- A. Cough reflex [35%]
- B. Gag reflex [54%]
- C. Mastication [2%]
- D. Salivation [3%]
- E. Taste sensation [6%]

Explanation:

User Id: 477875

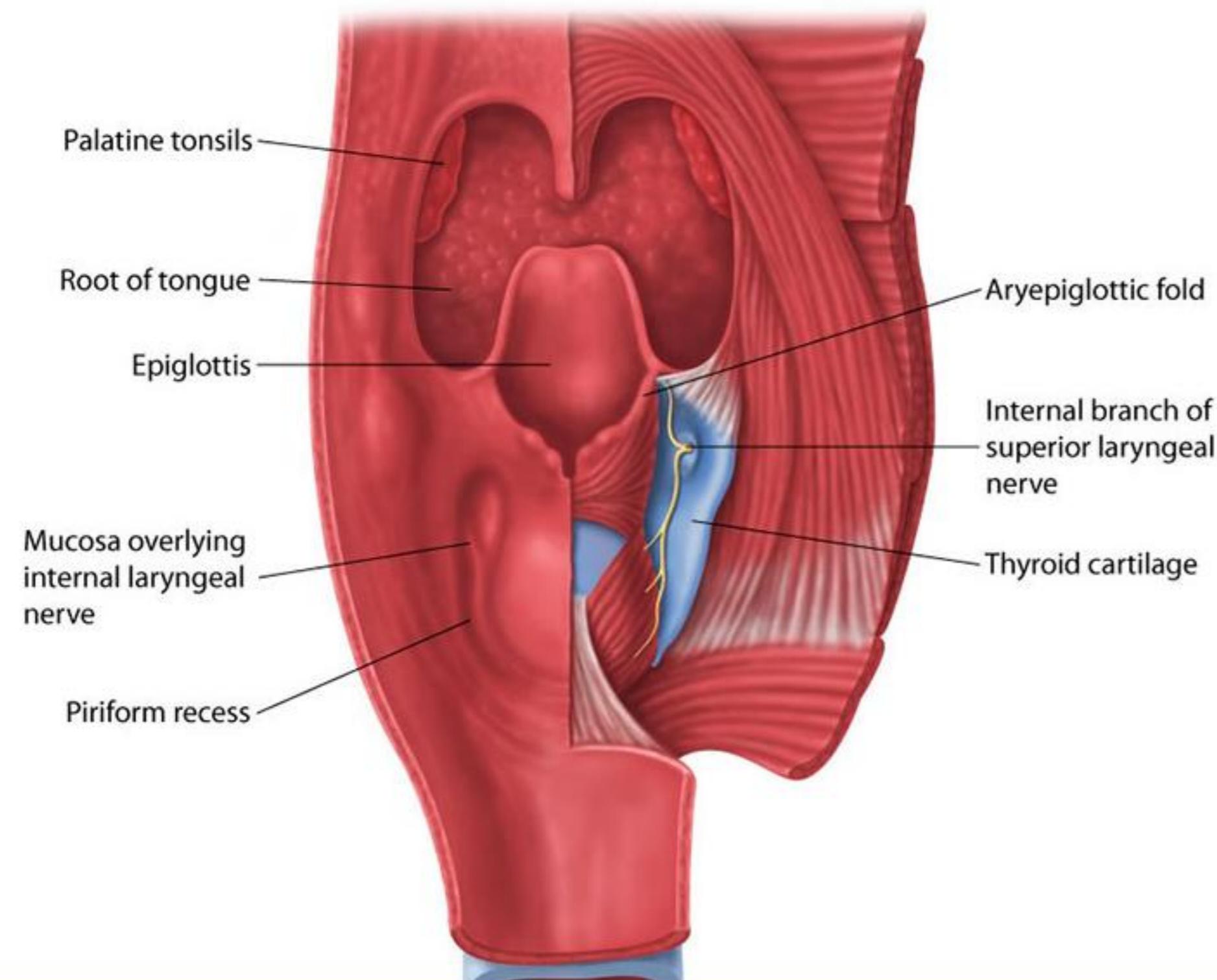
### Posterior view of pharynx



Explanation:

User Id: 477875

## Posterior view of pharynx





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The piriform recesses are small cavities that lie on either side of the laryngeal orifice. They are bounded medially by the aryepiglottic folds and laterally by the thyroid cartilage and thyrohyoid membrane. During normal swallowing, food is diverted by the epiglottis laterally through the piriform recesses into the esophagus without endangering the airway.

A thin layer of mucosa overlying the piriform recess is all that protects the superficially coursing internal laryngeal nerve, a branch of the superior laryngeal nerve (CN X). Unlike the recurrent and external laryngeal nerves that carry motor fibers to the muscles involved in vocal cord function, the internal laryngeal nerve contains only sensory and autonomic fibers. It mediates the afferent limb of the **cough reflex** by carrying sensation from the mucosa superior to the vocal cords. Foreign bodies, such as chicken or fish bones, can become lodged in the piriform recess. The internal laryngeal nerve can be damaged by the sharpness of these objects or attempts to retrieve them.

**(Choice B)** The afferent limb of the **gag reflex** is mediated predominantly by the glossopharyngeal nerve (CN IX), while the efferent limb is carried by the vagus nerve (CN X). The internal laryngeal nerve does not carry motor fibers and mediates sensation mainly from larynx and epiglottis (stimulation of these areas induces coughing, not gagging).

**(Choice D)** Salivation is mediated in part by parasympathetic fibers originating from the glossopharyngeal nerve. These fibers synapse on the otic ganglion, and postganglionic fibers travel via the auriculotemporal nerve to reach the parotid gland.

**(Choice E)** Taste from the base of the tongue is mediated by the glossopharyngeal nerve (CN IX); taste from the anterior two-thirds of the tongue is mediated by the facial nerve (CN VII).

#### Educational objective:

The internal laryngeal nerve mediates the afferent limb of the cough reflex above the vocal cords. Foreign bodies (eg, chicken or fish bones) can become lodged in the piriform recess and may cause damage to the nerve, impairing the cough reflex.

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Last updated: [4/17/2013]

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A medical resident performs a diagnostic procedure on 32-year-old male. He inserts a needle along the upper border of the 10<sup>th</sup> rib at the right midaxillary line. Which of the following is most likely to be punctured as a result of the intervention?

- A. Right lower lung lobe [27%]
- B. Liver [51%]
- C. Intercostal artery [7%]
- D. Intercostal nerve [13%]
- E. Hepatic veins [2%]

#### Explanation:

User Id: 477875

To avoid complications while performing a thoracentesis, it is necessary to remember the location of the lungs, pleura, and other organs of the chest and upper abdomen. The portion of pleura that covers the surface of the lung is called the visceral pleura. The parietal pleura lines the inner surface of the chest wall and the diaphragm, and is innervated by somatic sensory nerves. The diaphragm is bound to the inferior margin of the thorax, and the portion of parietal pleura that covers the diaphragm extends to the following levels:

Lower border of the pleura	Midclavicular line	Midaxillary line	Paravertebral line
Right	7 <sup>th</sup> rib	Upper border of 10 <sup>th</sup> rib	12 <sup>th</sup> rib
Left	7 <sup>th</sup> rib	Lower border of 10 <sup>th</sup> rib	12 <sup>th</sup> rib

The lower border of the lung is usually located two intercostal spaces above the respective pleural border. Thoracentesis, therefore, should be performed between 5<sup>th</sup> and 7<sup>th</sup> ribs along the midclavicular line, the 7<sup>th</sup> and 9<sup>th</sup> ribs along the midaxillary line, and 9<sup>th</sup> and 11<sup>th</sup> ribs along the paravertebral line. If the needle is inserted higher, there is a risk of lung injury. Insertion of the needle below the 9<sup>th</sup> rib at the middle axillary line on the right may cause liver injury (**Choice B**).

**(Choice A)** The lower border of the right lung is located two intercostal spaces above the pleural border. The lung is not likely to be injured by insertion of a needle into the 10<sup>th</sup> intercostal space at the midaxillary line as

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To avoid complications while performing a thoracentesis, it is necessary to remember the location of the lungs, pleura, and other organs of the chest and upper abdomen. The portion of pleura that covers the surface of the lung is called the visceral pleura. The parietal pleura lines the inner surface of the chest wall and the diaphragm, and is innervated by somatic sensory nerves. The diaphragm is bound to the inferior margin of the thorax, and the portion of parietal pleura that covers the diaphragm extends to the following levels:

Lower border of the pleura	Midclavicular line	Midaxillary line	Paravertebral line
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**(Choice A)** The lower border of the right lung is located two intercostal spaces above the pleural border. The lung is not likely to be injured by insertion of a needle into the 10<sup>th</sup> intercostal space at the midaxillary line as described.

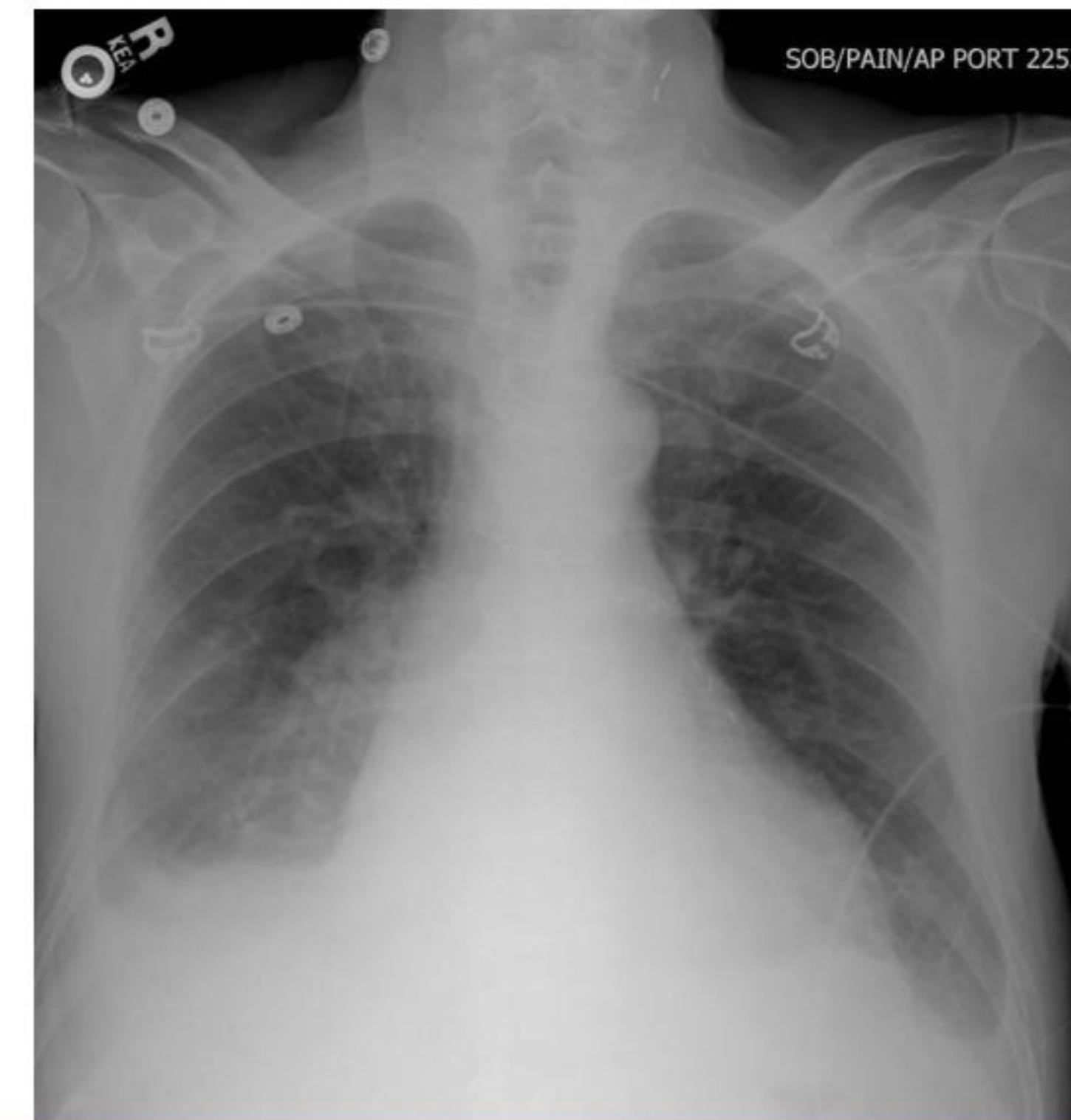
**(Choices C and D)** The intercostal vein, artery, and nerve lie in the subcostal groove on the lower border of the rib. Thoracentesis should be performed along the upper border of the rib to prevent injury to these structures.

**(Choice E)** Hepatic veins are not likely to be injured during thoracocentesis.

#### Educational Objective:

Thoracocentesis should be performed above the 7<sup>th</sup> rib in midclavicular line, the 9<sup>th</sup> rib along midaxillary line and the 11<sup>th</sup> rib along posterior scapular line. Insertion of a needle lower than these points increases the risk of penetrating abdominal structures, and insertion of the needle on the inferior margin of the rib risks striking the subcostal neurovascular bundle.

A 54-year-old man is brought to the emergency department due to worsening shortness of breath for the last 2 days. His symptoms occurred initially with exertion, but now they occur even at rest. He says that he could not sleep last night because of a suffocating cough that occurred each time he tried to lie down. He has a family history of asthma. His blood pressure is 172/110 mm Hg, pulse is 72/min, and respirations are 26/min. His chest x-ray is shown below.



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Which of the following is the most likely explanation for this patient's symptoms?

- A. Acute respiratory distress syndrome [7%]
- B. Idiopathic pulmonary fibrosis [6%]
- C. Left ventricular failure [71%]
- D. Obstructive bronchial disease [6%]
- E. Primary pulmonary hypertension [7%]
- F. Tension pneumothorax [2%]

**Explanation:****User Id: 477875**

This patient presents with progressive dyspnea and orthopnea (cough when lying down). His chest x-ray shows cardiomegaly (heart > 1 hemithorax in size), increased vascular shadowing (alveolar edema) in a "batwing" peri-hilum pattern, and blunting of the costophrenic angles (pleural effusions). These findings are characteristic of acute left ventricular failure, and result from increased left atrial and ventricular filling pressure (increased preload). This increased pressure is transmitted to the pulmonary capillaries, causing fluid transudation into the pulmonary interstitial and alveolar spaces (cardiogenic pulmonary edema).

Common triggers for acute heart failure include myocardial infarction, severe hypertension, arrhythmias (eg, atrial fibrillation), and drug use (eg, cocaine). Patients with acute heart failure complain of cough, dyspnea, and fatigue, which can rapidly become more severe. They are typically tachypneic and may be using accessory muscles to breathe. Chest examination usually reveals crackles and sometimes wheezing (cardiac asthma) due to edema of the bronchial airways. The chest x-ray can also show **Kerley B lines**, short horizontal lines situated perpendicularly to the pleural surface that represent edema of the interlobular septa.

**(Choice A) Acute respiratory distress syndrome** (ARDS) results from endothelial injury and leakage of fluid from capillaries. It has an acute onset and is characterized by bilateral patchy airspace disease on chest x-ray. It is caused by an inciting factor such as sepsis, aspiration, pneumonia, or trauma. ARDS can be distinguished from cardiogenic pulmonary edema by the absence of jugular venous distension and cardiomegaly.

**(Choice B)** The chest x-ray in **idiopathic interstitial fibrosis** (referred to histologically as usual interstitial pneumonia) shows reticular, net-like, opacities involving the lung bases. Most patients present with slowly progressive dyspnea and a nonproductive cough.



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characteristic of acute left ventricular failure, and result from increased left atrial and ventricular filling pressure (increased preload). This increased pressure is transmitted to the pulmonary capillaries, causing fluid transudation into the pulmonary interstitial and alveolar spaces (cardiogenic pulmonary edema).

Common triggers for acute heart failure include myocardial infarction, severe hypertension, arrhythmias (eg, atrial fibrillation), and drug use (eg, cocaine). Patients with acute heart failure complain of cough, dyspnea, and fatigue, which can rapidly become more severe. They are typically tachypneic and may be using accessory muscles to breathe. Chest examination usually reveals crackles and sometimes wheezing (cardiac asthma) due to edema of the bronchial airways. The chest x-ray can also show **Kerley B lines**, short horizontal lines situated perpendicularly to the pleural surface that represent edema of the interlobular septa.

**(Choice A)** **Acute respiratory distress syndrome** (ARDS) results from endothelial injury and leakage of fluid from capillaries. It has an acute onset and is characterized by bilateral patchy airspace disease on chest x-ray. It is caused by an inciting factor such as sepsis, aspiration, pneumonia, or trauma. ARDS can be distinguished from cardiogenic pulmonary edema by the absence of jugular venous distension and cardiomegaly.

**(Choice B)** The chest x-ray in **idiopathic interstitial fibrosis** (referred to histologically as usual interstitial pneumonia) shows reticular, net-like, opacities involving the lung bases. Most patients present with slowly progressive dyspnea and a nonproductive cough.

**(Choice D)** Obstructive pulmonary diseases such as asthma and **chronic obstructive pulmonary disease** are associated with hyperinflated lungs and a flattened diaphragm.

**(Choice E)** The chest x-ray in **primary pulmonary hypertension** reveals enlargement of the pulmonary arteries and right ventricle, which is not evident in this patient.

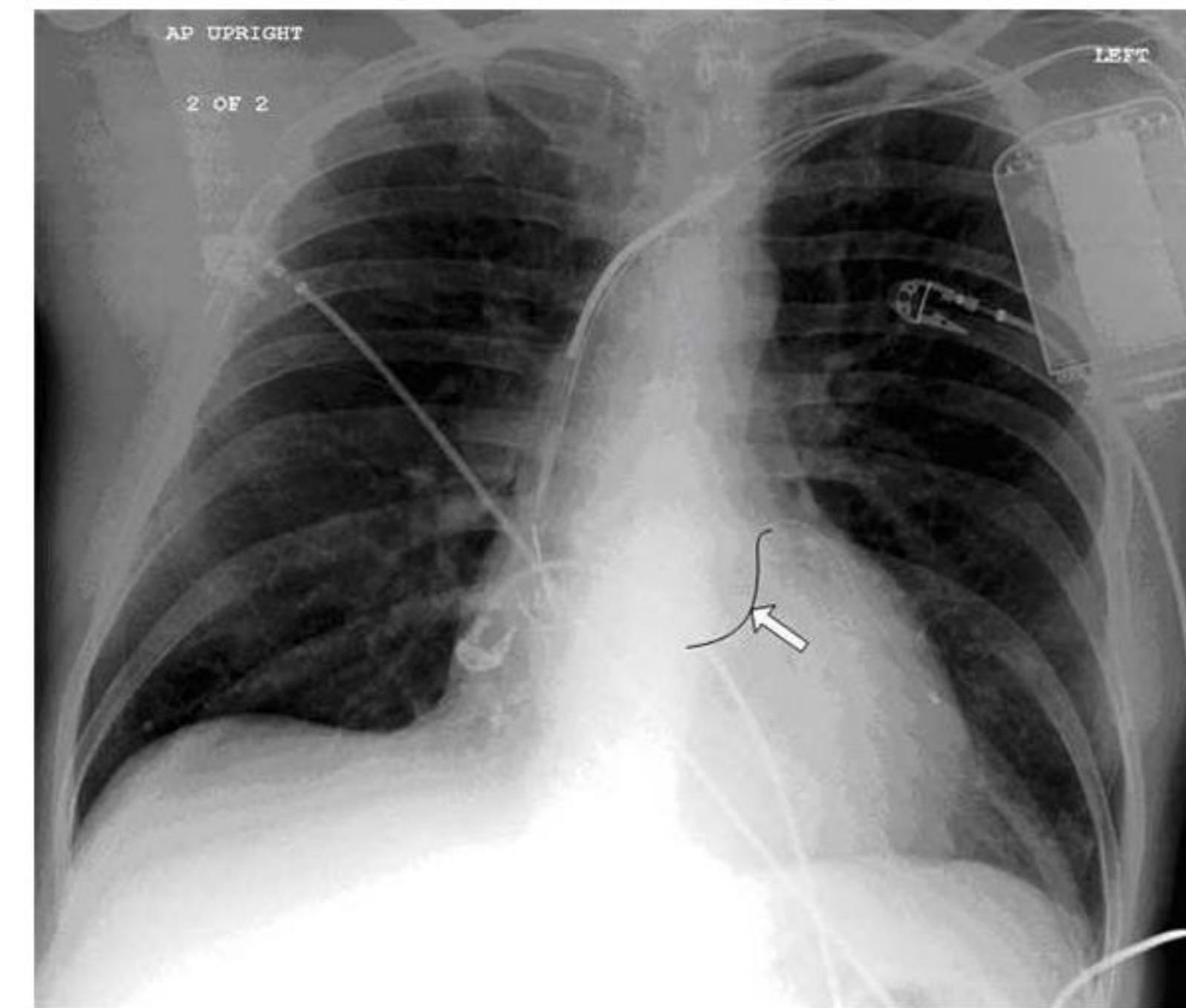
**(Choice F)** The diagnosis of **pneumothorax** is confirmed by the presence of a white visceral pleural line on chest x-ray. Pulmonary vessels are not visible beyond the visceral pleural boundary. The mediastinum is often shifted away from the affected side.

#### Educational objective:

The chest x-ray in acute left ventricular failure with pulmonary edema shows cardiomegaly (heart > 1 hemithorax in size), pleural effusions, Kerley B lines, and increased vascular shadowing (alveolar edema) bilaterally.

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A 65-year-old man with a history of coronary artery disease comes to the physician complaining of progressive exertional shortness of breath, fatigue, and lower extremity swelling. His medical history is significant for a myocardial infarction 5 years ago and an electronic pacemaker implanted 2 years ago. His chest x-ray is shown below. A segment of one of the leads is highlighted (arrow).



The highlighted segment most likely lies within which of the following structures?

A. Anterior interventricular sulcus [8%]

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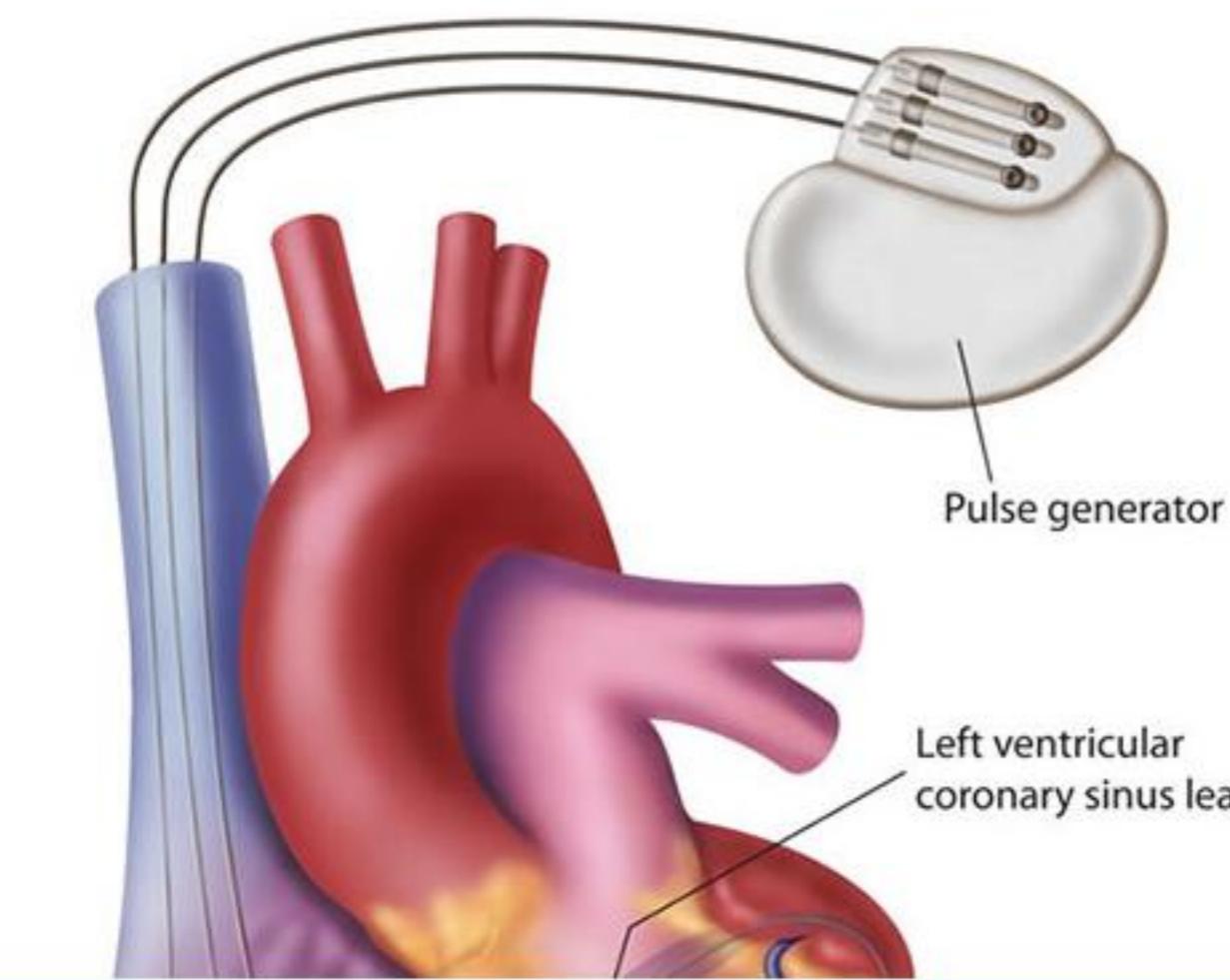
The highlighted segment most likely lies within which of the following structures?

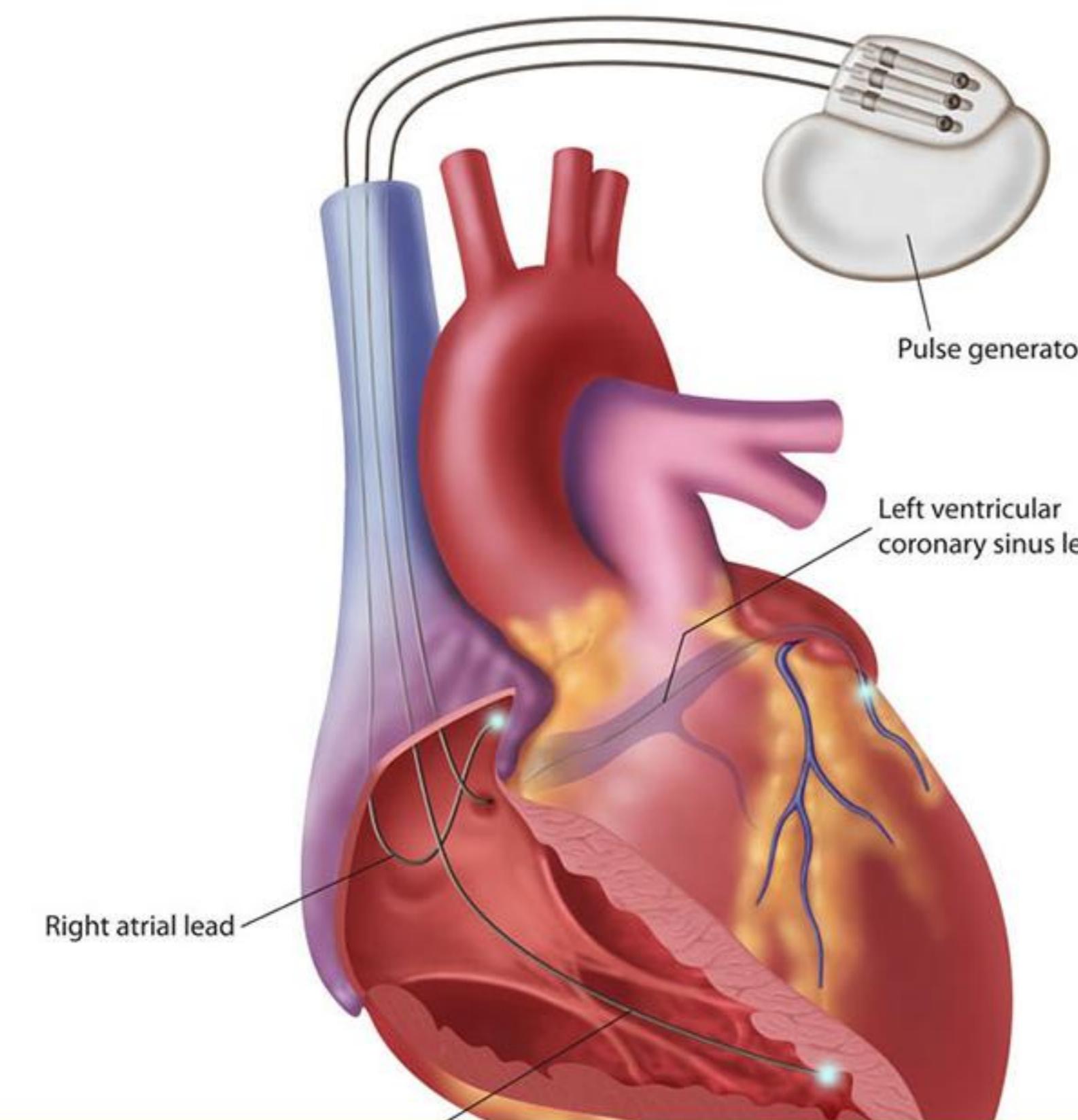
- A. Anterior interventricular sulcus [8%]
- B. Atrioventricular groove [46%]
- C. Pulmonary artery [9%]
- D. Right atrium [23%]
- E. Right ventricle [14%]

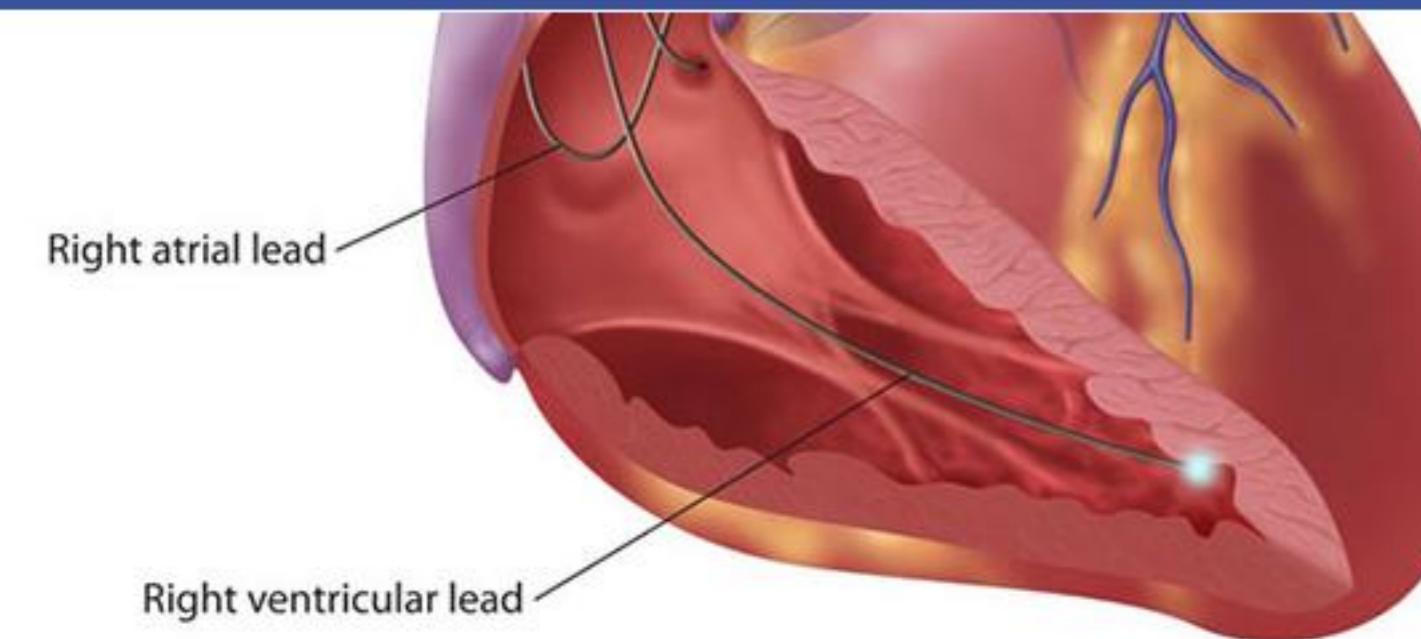
Explanation:

User Id: 477875

### Biventricular pacemaker







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This patient has a biventricular pacemaker, a device that requires 2 or 3 leads. If 3 leads are used, the first 2 are placed in the right atrium and right ventricle. The third lead is used to pace the left ventricle. Right atrial and ventricular leads are easy to place as they only need to traverse the left subclavian vein and superior vena cava to reach these cardiac chambers. In contrast, the lead that paces the left ventricle is more difficult to position. The preferred transvenous approach involves passing the left ventricular pacing lead from the right atrium into the coronary sinus, which resides in the atrioventricular groove on the posterior aspect of the heart. It is then advanced into one of the lateral venous tributaries in order to optimize left ventricular pacing.

**(Choice A)** The anterior interventricular sulcus courses toward the apex of the heart on its anterior surface. The anterior descending vessels lie in this sulcus.

**(Choice C)** The pulmonary artery lies just to the left of center on the anterior surface of the heart. It courses from the right ventricle toward the aortic arch. Swan-Ganz catheters traverse the pulmonary artery.

**(Choices D & E)** The right atrium and ventricle are visible on the rightmost section of the cardiac silhouette.

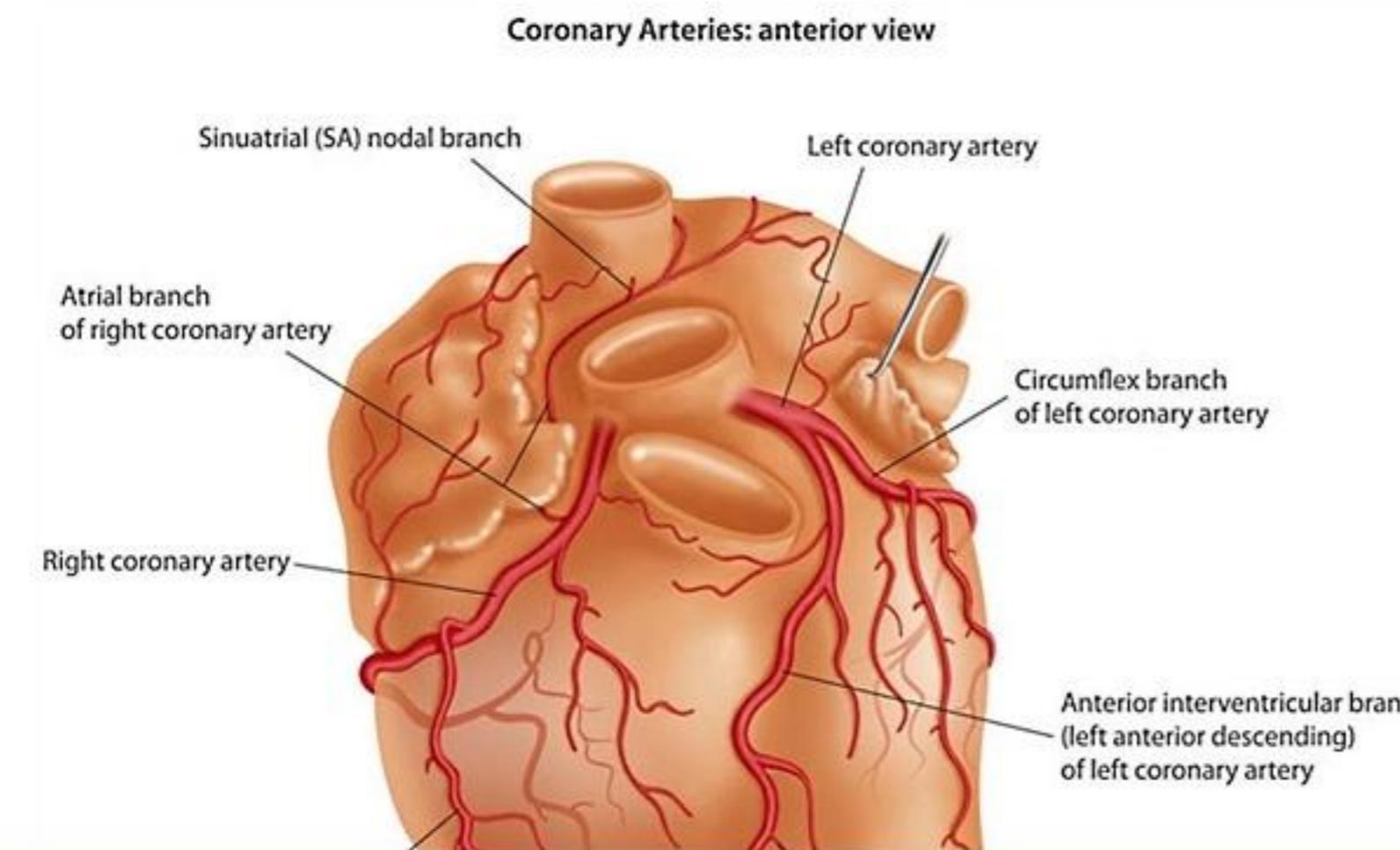
**Educational objective:**

Left ventricular leads in biventricular pacemakers course through the coronary sinus, which resides in the atrioventricular groove on the posterior aspect of the heart.

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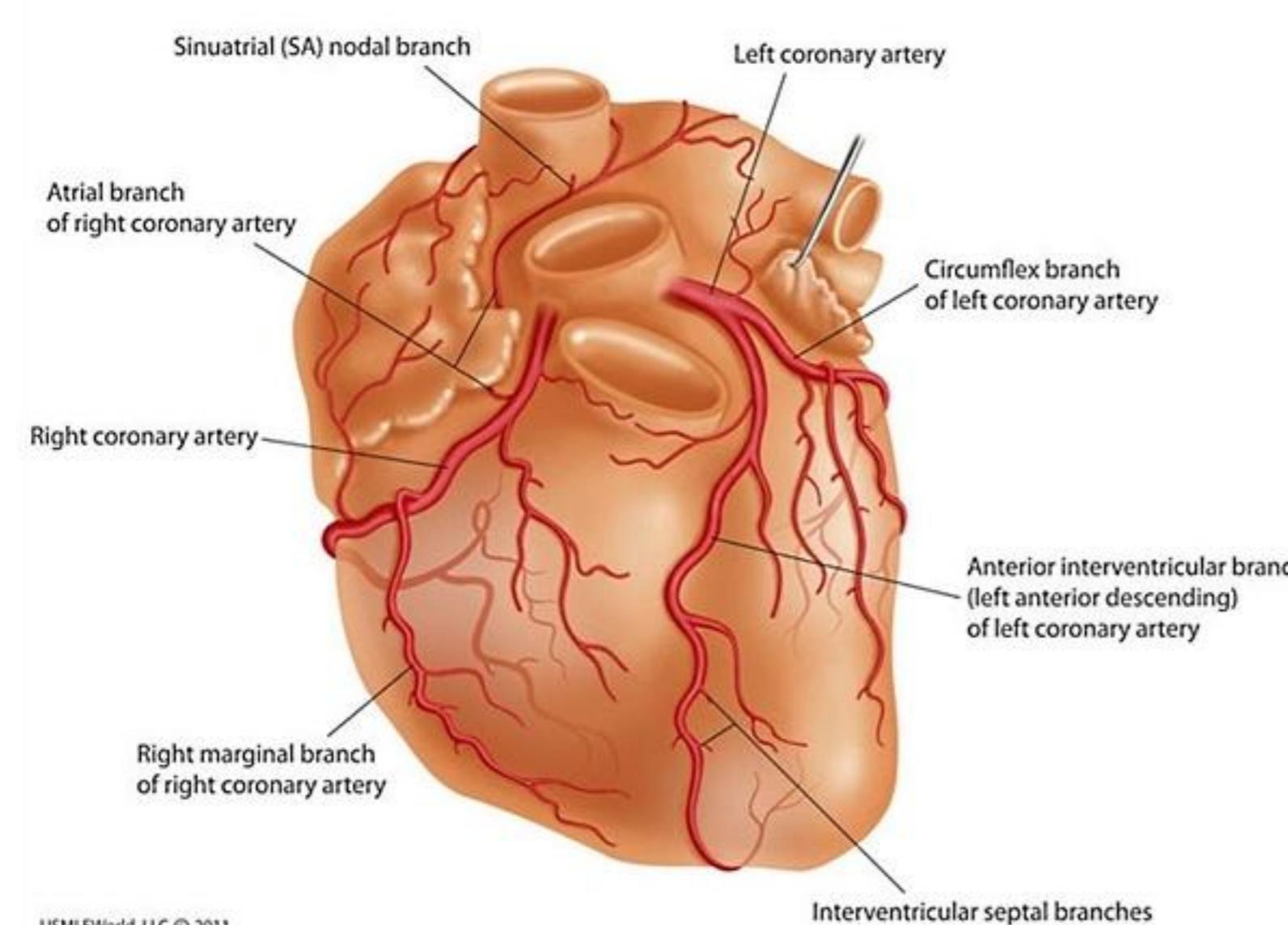
A 54-year-old male presents to your office complaining of periodic, tight, burning substernal chest pain. A thallium stress test shows hypoperfusion of the cardiac muscle forming the diaphragmatic surface of the heart. Which of the following coronary arteries is most likely occluded in this patient?

- A. Left anterior descending coronary artery [27%]
- B. Left circumflex coronary artery [12%]
- C. Left main coronary artery [3%]
- D. Right coronary artery [49%]
- E. Acute marginal branches [8%]

**Explanation:****User Id: 477875**

Explanation:

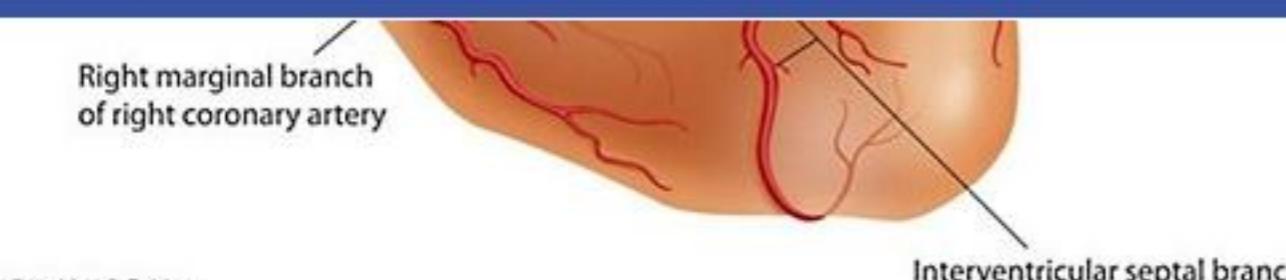
User Id: 477875



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[Click here for posterior view.](#)

The right and left main coronary arteries arise directly from the root of the aorta and provide the blood supply to the heart. The left main coronary artery divides into the left anterior descending (LAD) and circumflex coronary arteries, which supply most of the anterior and left lateral surfaces of the heart. In 85-90% of individuals, the right coronary artery gives rise to the posterior descending artery. These patients are said to have right dominant coronary circulation. In approximately 10% of patients, the posterior descending artery arises from the circumflex branch of the left main coronary artery; these patients have left dominant circulation. The posterior descending artery supplies most of the inferior wall of the left ventricle, which forms



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[Click here for posterior view.](#)

The right and left main coronary arteries arise directly from the root of the aorta and provide the blood supply to the heart. The left main coronary artery divides into the left anterior descending (LAD) and circumflex coronary arteries, which supply most of the anterior and left lateral surfaces of the heart. In 85-90% of individuals, the right coronary artery gives rise to the posterior descending artery. These patients are said to have right dominant coronary circulation. In approximately 10% of patients, the posterior descending artery arises from the circumflex branch of the left main coronary artery; these patients have left dominant circulation. The posterior descending artery supplies most of the inferior wall of the left ventricle, which forms the diaphragmatic surface of the heart. The right coronary artery also gives rise to the SA and AV nodal arteries in most patients.

**(Choice A)** The LAD coronary artery normally supplies the anterior 2/3 of the interventricular septum (septal branches), the anterior wall of the left ventricle (diagonal branches), and part of the anterior papillary muscle.

**(Choice B)** The left circumflex coronary artery supplies the lateral and posterior superior walls of the left ventricle via obtuse marginal branches.

**(Choice C)** The left main coronary artery gives rise to the LAD and left circumflex coronary arteries. It only gives rise to the posterior descending artery in about 10% of individuals, and thus is not the artery most likely occluded here.

**(Choice E)** The acute marginal branches arise from the right coronary artery to supply the wall of the right ventricle. They may provide collateral circulation in patients with LAD occlusion.

#### Educational Objective:

The inferior wall of the left ventricle forms most of the diaphragmatic surface of the heart. The posterior descending artery supplies this area. In 85-90% of individuals, the posterior descending artery derives from the right coronary artery.

Time Spent: 1 seconds

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Last updated: [12/19/2012]

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A 26-year-old male presents to the ER with a sharp pain in his neck and shoulder. He has some breathing difficulty secondary to pain with inspiration. His past medical history is not significant except for a mild respiratory disease a few days ago. His blood pressure is 120/70 mmHg and his heart rate is 100/min. The pain experienced by this patient is most likely carried by which of the following nerves?

- A. Phrenic [72%]
- B. Accessory [13%]
- C. Vagus [9%]
- D. Superior epigastric [1%]
- E. Long thoracic [5%]

#### Explanation:

User Id: 477875

Pleuritic chest pain can result from any condition that causes inflammation of the pleura. The pleura is divided into segments, as follows:

1. **Visceral pleura:** The visceral pleura, or pulmonary pleura, covers all surfaces of the lungs, including the surfaces within the pulmonary fissures.
2. **Parietal pleura:** This represents the remainder of the pleura that is not in contact with the lungs and can be subdivided as follows:
  - **Costal pleura:** Covers the thoracic wall including the ribs, sternum, intercostal spaces, costal cartilages, and the sides of the thoracic vertebrae.
  - **Mediastinal pleura:** Covers the mediastinum
  - **Diaphragmatic pleura:** Covers the surface of the diaphragm located within the thoracic cavity
  - **Cervical pleura:** Extends with the apices of the lung into the neck.

The parietal pleura is innervated by somatic sensory (sensory afferent) nerves, which allow the sensation of sharp and localized pain. The phrenic nerve, which is derived from the C3-C5 nerve roots, delivers motor innervation to the diaphragm and additionally carries pain fibers from the diaphragmatic and mediastinal pleura. Irritation of the pleura in either of these areas will cause a sharp pain worsened by inspiration that will be "referred" to the C3-C5 distribution, which lies at the base of the neck and over the shoulder. Sensory innervation of the remainder of the parietal pleura is accomplished by intercostal nerves.

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**(Choice B)** The spinal accessory nerve is the 11<sup>th</sup> cranial nerve and provides motor innervation to the sternocleidomastoid and trapezius muscles.

**(Choice C)** The vagus nerve is the 10<sup>th</sup> cranial nerve and is the major source of parasympathetic innervation to the viscera of the chest wall and the foregut.

**(Choice D)** There is no superior epigastric nerve. The superior epigastric artery and vein course over the superior half of the abdominal wall and anastomose with the internal thoracics and the inferior epigastrics.

**(Choice E)** The long thoracic nerve innervates the serratus anterior. Damage to this nerve causes winged scapula.

#### Educational Objective:

Irritation of the mediastinal or diaphragmatic parietal pleura will cause sharp pain, worse on inspiration, in the C3-C5 distribution. Pain sensation from these areas is carried by the phrenic nerve.

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A 21-year-old football player is brought to the emergency room complaining of back pain. An X-ray shows a fractured 12<sup>th</sup> rib on the left side. Which of the following structures is most likely to be lacerated by the broken rib?

- A. Left kidney [50%]
- B. Spleen [38%]
- C. Liver [2%]
- D. Visceral pleura [6%]
- E. Pancreas [3%]

**Explanation:**

User Id: 477875

The 12<sup>th</sup> rib overlies the parietal pleura medially and the kidney laterally. Recall that the 11<sup>th</sup> and 12<sup>th</sup> ribs are "floating" ribs, meaning that they are not bound to the anterior rib cage by cartilage as are the more superior "false" ribs. For this reason, the distal tip of the left 12<sup>th</sup> rib can be displaced into the retroperitoneum when fractured, lacerating the left kidney.

**(Choice B)** The spleen lies in the posterior superior portion of the left abdominal cavity. The left 9<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup> ribs overlie the spleen.

**(Choice C)** The liver occupies much of the right upper quadrant of the abdominal cavity. The 8<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup> ribs overlie the liver's posterior surface on the right. The positions of both the liver and spleen shift slightly with diaphragmatic movement during inhalation and exhalation.

**(Choice D)** The visceral pleura envelop the lungs. At rest, the inferior margin of the left lung lies at the level of the 10<sup>th</sup> rib in the midscapular line. During maximal inhalation, the lung may descend to the level of the most medial portion of the 12<sup>th</sup> rib, but fractures of the 1st through 6<sup>th</sup> ribs have the greatest chance of damaging the visceral pleura.

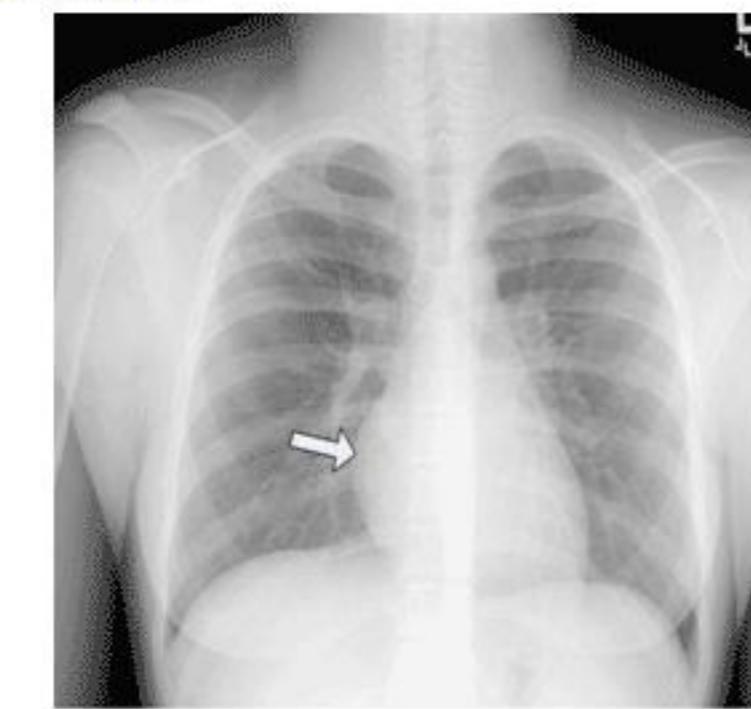
**(Choice E)** The pancreas is a partially retroperitoneal organ that overlies the body of the second lumbar vertebra. Classically, crushing abdominal trauma is the injury that causes pancreatic damage.

**Educational Objective:**

The left kidney lies immediately deep to the tip of the 12<sup>th</sup> rib on the left.

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A 32-year-old female complains of periodic dyspnea, dizziness and sharp chest pain. Her chest X-ray is shown below.



The arrow points to which structure?

- A. Superior vena cava [2%]
- B. Coronary sinus [2%]
- C. Right ventricle [22%]
- D. Inferior vena cava [3%]
- E. Right atrium [69%]
- F. Pulmonary artery [2%]

**Explanation:****User Id: 477875**

The arrow on the chest X-ray above points to the right atrium. On postero-anterior (PA) chest X-ray projections, the right atrium composes most of the right side of the cardiac silhouette. The right atrium receives venous blood from the superior and inferior vena cavae, which compose the superior and inferior

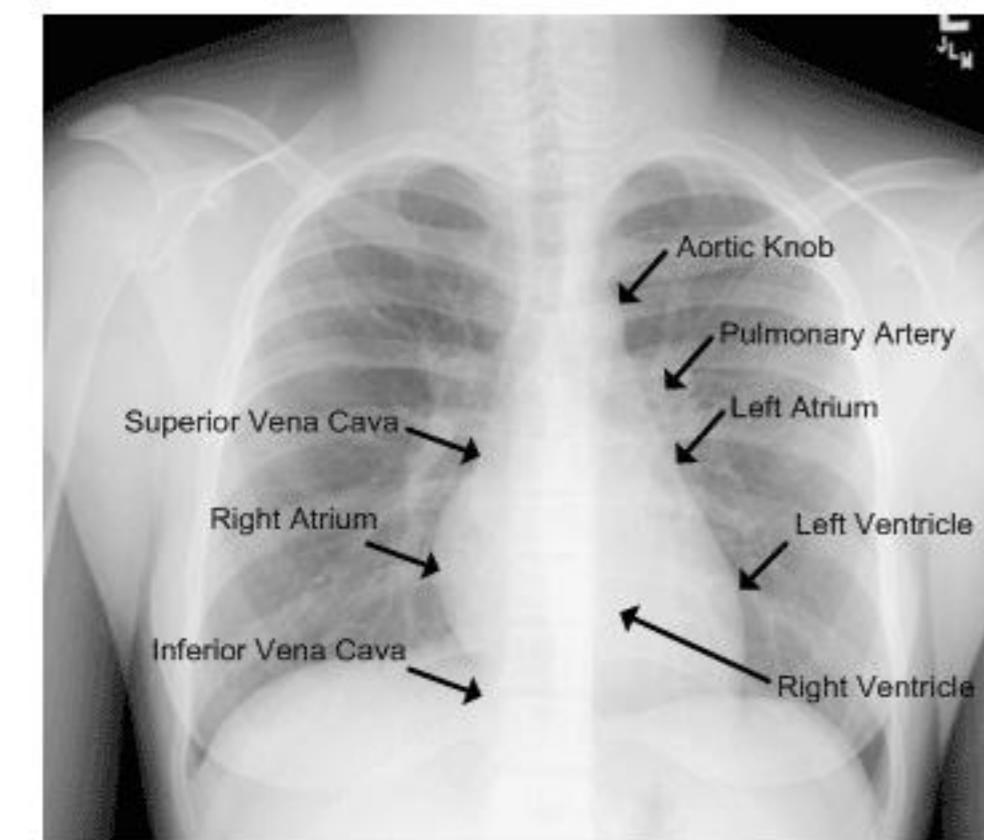
F. Pulmonary artery [C70]

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**Explanation:**

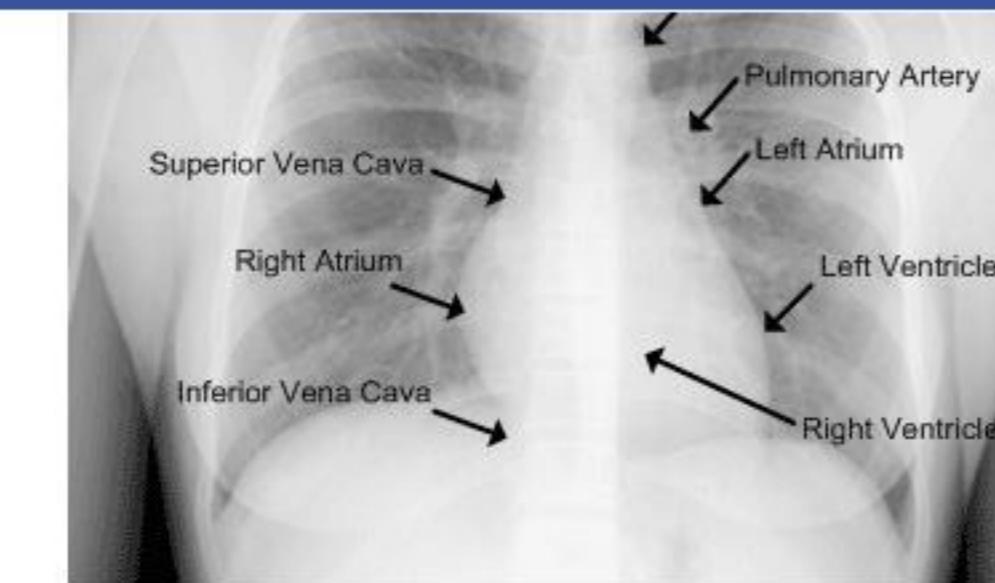
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The arrow on the chest X-ray above points to the right atrium. On postero-anterior (PA) chest X-ray projections, the right atrium composes most of the right side of the cardiac silhouette. The right atrium receives venous blood from the superior and inferior vena cavae, which compose the superior and inferior portions of the right cardiac silhouette on this type of film.

**Normal Chest Radiograph Anatomy:**

**(Choice A)** The superior vena cava is formed behind the first costal cartilage by the confluence of the right and left brachiocephalic veins. On PA chest X-ray, it is the flattened opacity parallel to the vertebral column that terminates inferiorly at the right atrium.

**(Choice B)** The coronary sinus receives most of the venous drainage from the cardiac circulation. It courses posteriorly around the heart in the coronary sulcus to empty directly into the right atrium. It is difficult to visualize on standard chest X-rays.



**(Choice A)** The superior vena cava is formed behind the first costal cartilage by the confluence of the right and left brachiocephalic veins. On PA chest X-ray, it is the flattened opacity parallel to the vertebral column that terminates inferiorly at the right atrium.

**(Choice B)** The coronary sinus receives most of the venous drainage from the cardiac circulation. It courses posteriorly around the heart in the coronary sulcus to empty directly into the right atrium. It is difficult to visualize on standard chest X-rays.

**(Choice C)** The right ventricle forms the anterior wall of the heart and is best seen on lateral chest X-rays.

**(Choice D)** The inferior vena cava receives venous blood from the lower extremities and abdomen and empties into the right atrium in the thorax. It composes the most inferior edge of the right border of the cardiac silhouette.

**(Choice F)** The pulmonary artery can be seen on an PA chest X-ray on the left side of the cardiomedastinal silhouette just below the aortic arch.

**Educational Objective:**

The right atrium receives venous blood from both the superior vena cava and the inferior vena cava. The right atrium makes up the majority of the right border of the heart on PA chest films. The right ventricle forms the anterior wall of the heart and is best seen on lateral chest X-rays. The SVC and IVC compose the superior and inferior borders of the cardiac silhouette on the right side.

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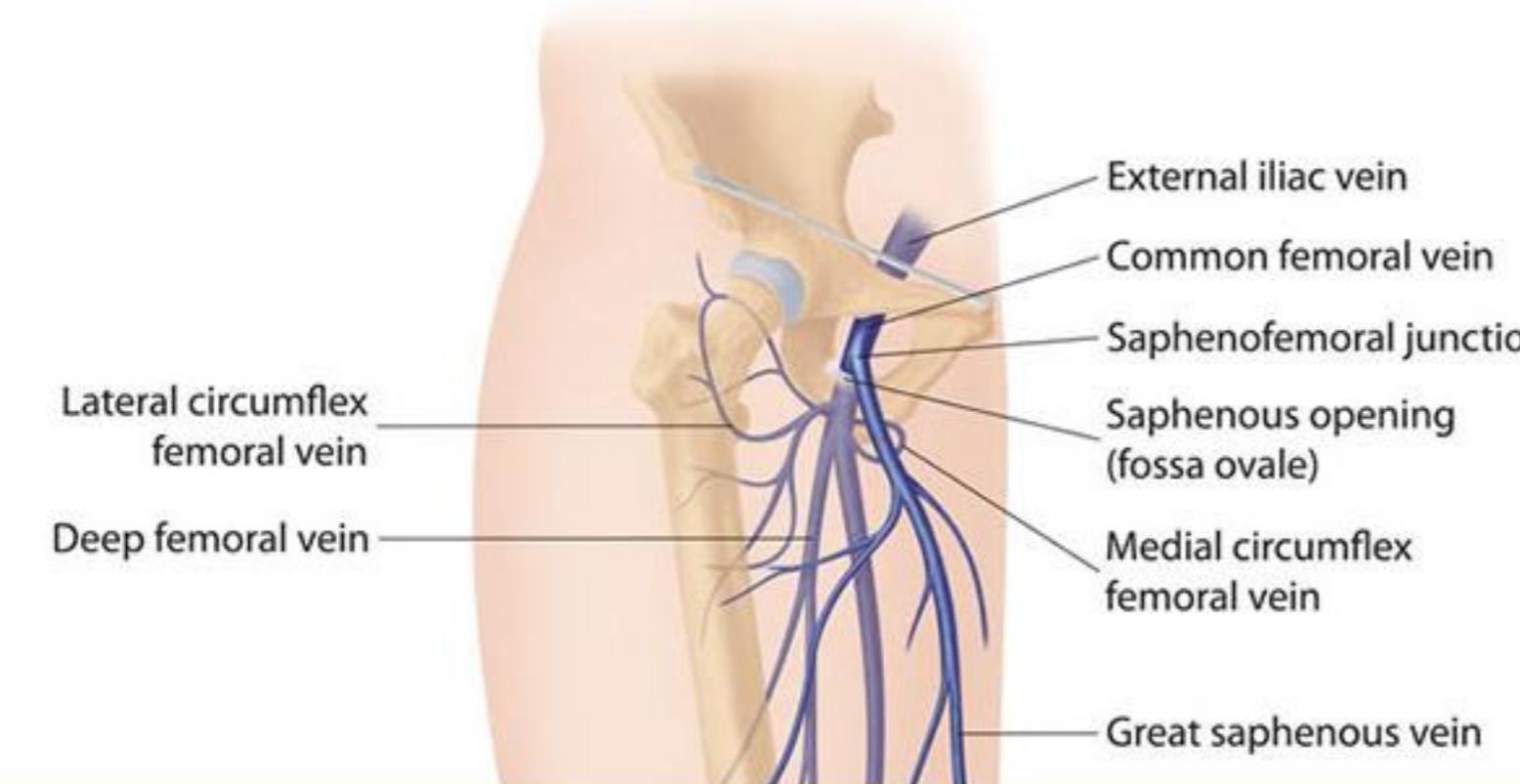
A 54-year-old man comes to the physician for evaluation of exertional chest pain. He undergoes coronary angiography and is found to have severe stenosis of the right coronary artery, left anterior descending, and circumflex coronary arteries. He is referred to a surgeon for coronary artery bypass grafting. During the procedure, a portion of his great saphenous vein is removed and grafted to 1 of his diseased coronary arteries to bypass its atherosclerotic narrowing. The saphenous vein can be best harvested from which of the following sites?

- A. Just superior to the inguinal ligament [3%]
- B. Just inferior to the anterior superior iliac spine [8%]
- C. Just inferolateral to the pubic tubercle [34%]
- D. At the midline of the popliteal fossa [35%]
- E. Over the lateral aspect of the foot [20%]

Explanation:

User Id: 477875

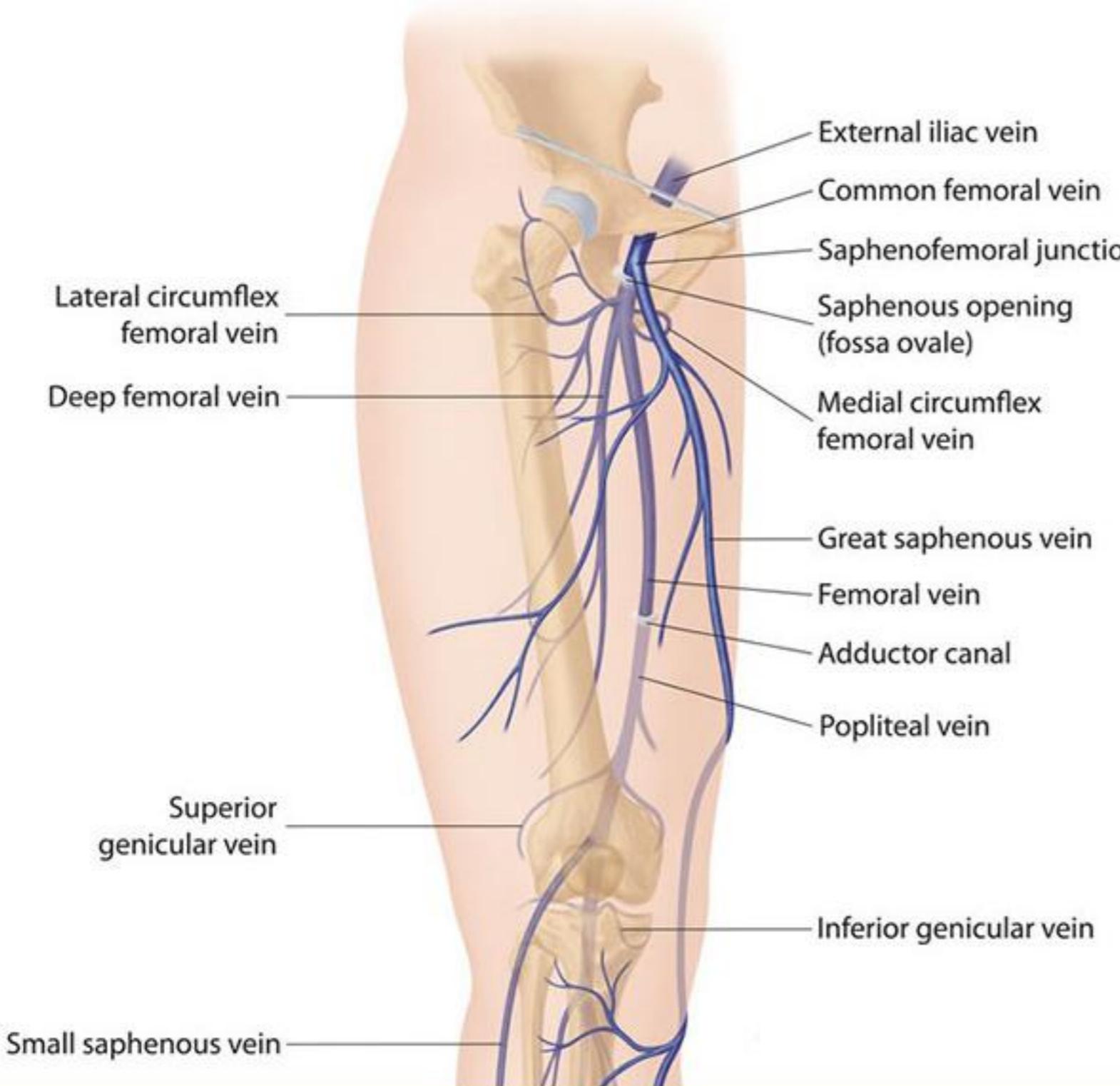
### Superficial & deep veins of leg

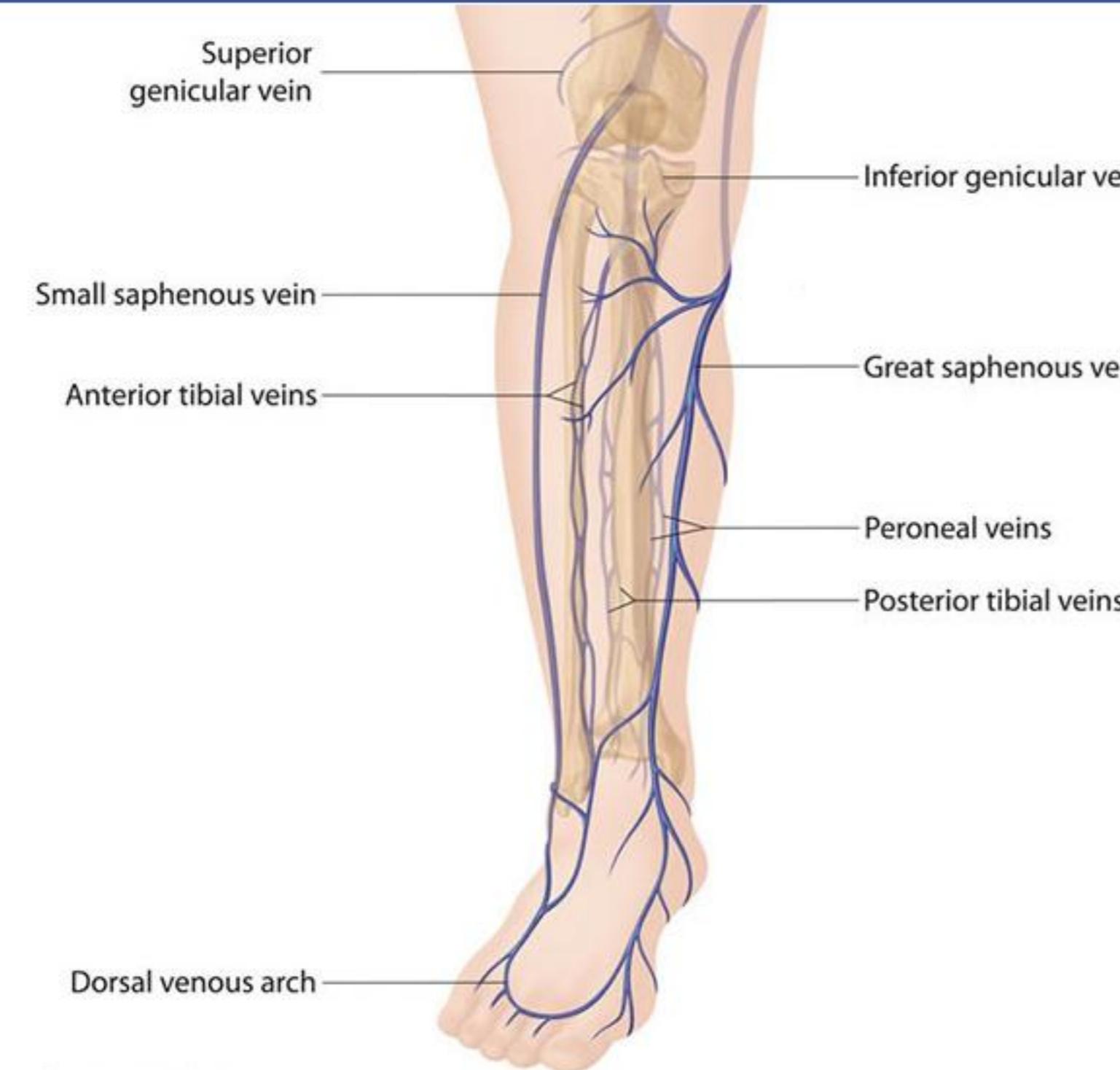


Explanation:

User Id: 477875

## Superficial &amp; deep veins of leg





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When the left anterior descending artery (LAD) alone is occluded by an atherosclerotic plaque, the left internal mammary artery (left internal thoracic artery) is the preferred vessel for bypass grafting because it has superior short- and long-term patency rates compared to saphenous vein grafts. For cases in which there are multiple coronary arteries or vessels other than the LAD requiring revascularization, saphenous vein grafts

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When the left anterior descending artery (LAD) alone is occluded by an atherosclerotic plaque, the left internal mammary artery (left internal thoracic artery) is the preferred vessel for bypass grafting because it has superior short- and long-term patency rates compared to saphenous vein grafts. For cases in which there are multiple coronary arteries or vessels other than the LAD requiring revascularization, saphenous vein grafts are routinely used.

The great saphenous vein is located superficially in the leg and is the longest vein in the body. It courses superiorly from the medial foot, anterior to the medial malleolus, and up the medial aspect of the leg and thigh. In the proximal anterior thigh 3-4 centimeters inferolateral to the pubic tubercle, the great saphenous vein dives deep through the cribriform fascia of the saphenous opening to join the femoral vein. Surgeons commonly access the great saphenous vein in the medial leg or at its point of origin in the upper thigh near the femoral triangle. The femoral triangle is bordered by the inguinal ligament superiorly, sartorius muscle laterally, and adductor longus muscle medially.

**(Choice A)** The deep circumflex iliac vessels course parallel to and just superior to the inguinal ligament. The superficial and inferior epigastric veins course above the midportion of the inguinal ligament.

**(Choice B)** No major vessels are located immediately inferior to the anterior superior iliac spine (ASIS). The ASIS serves as the superior attachment of the inguinal ligament, and a penetrating injury to the region below the ASIS could damage the lateral cutaneous nerve of the thigh.

**(Choice D)** The popliteal artery and vein course centrally through the popliteal fossa together with the tibial nerve. Common medical problems that occur in the popliteal fossa include popliteal artery aneurysms, which account for the majority of peripheral artery aneurysms, and synovial (Baker) cysts, which are commonly associated with arthritis.

**(Choice E)** The small saphenous vein can be found at the lateral aspect of the foot. This vein courses posteriorly to drain into the popliteal vein.

**Educational objective:**

The great sphenous vein is a superficial vein of the leg that originates on the medial side of the foot, courses anterior to the medial malleolus, and then travels up the medial aspect of the leg and thigh. It drains into the femoral vein within the region of the femoral triangle, a few centimeters inferolateral to the pubic tubercle.

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A 53-year-old man who has not seen a physician in years presents to your office complaining of abdominal distention. He states "Last month my stomach started to swell up and it hasn't gotten any better". He has no other medical problems. The patient admits to drinking 10-12 beers a day for the last 20 years. His temperature is 36.7 C (98 F), blood pressure is 116/72 mm Hg, pulse is 78/min and respirations are 20/min. On examination his abdomen is distended with engorged paraumbilical veins. There is also palmar erythema and multiple spider angiomas are present. You decided to place him on a low-salt diet and start therapy with furosemide and spironolactone, with subsequent improvement of his abdominal distention. Before beginning this patient's treatment, which of the following structures labeled on the image below is expected to have an increased pressure?



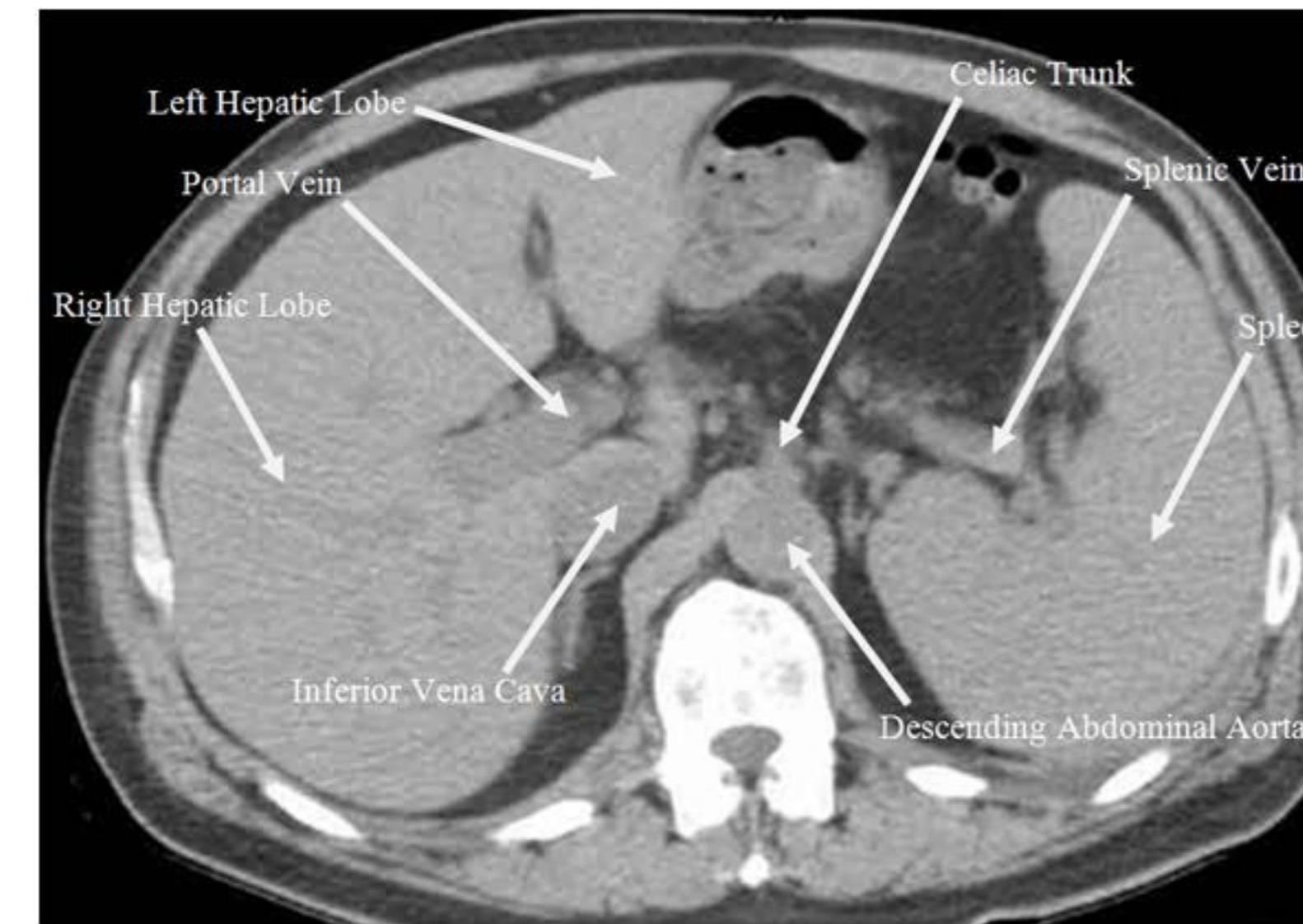
- A. A [3%]
- B. B [200/1]

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- A. A [3%]
- B. B [20%]
- C. C [71%]
- D. D [6%]

**Explanation:**

User Id: 477875



The patient described in the question stem is likely suffering from alcoholic cirrhosis. Alcoholic cirrhosis is a form of micronodular cirrhosis associated with hepatocyte death followed by fine fibrosis of the liver. As cirrhosis worsens and the number of functioning hepatocytes decreases, the functional ability of the liver

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The patient described in the question stem is likely suffering from alcoholic cirrhosis. Alcoholic cirrhosis is a form of micronodular cirrhosis associated with hepatocyte death followed by fine fibrosis of the liver. As cirrhosis worsens and the number of functioning hepatocytes decreases, the functional ability of the liver diminishes. In advanced disease, portal blood has an increasingly difficult time passing through the liver because the vasculature becomes compromised by the progressive fibrosis, causing portal hypertension. Of the structures identified on the image above, only the portal and splenic veins are part of the portal venous system. In this patient, high pressure would be expected throughout the portal system, including the superior mesenteric, portal, and splenic veins. The effects of prolonged portal hypertension include varices at the four sites of portacaval anastomoses (esophagus, rectum, umbilicus, and retroperitoneal), as well as ascites.

The pathogenesis of ascites in patients with cirrhosis is complex. In addition to mechanical compromise of portal vein flow by fibrotic tissue, vasoactive agents also play a role by causing dilatation of the splanchnic arterial vasculature and further intrahepatic vasoconstriction. These processes result in increased portal vein hydrostatic pressure leading to ascitic fluid formation, as well as decreased systemic perfusion pressure. The kidney senses the decreased perfusion pressure (accentuated by renal vasoconstriction in hepatorenal syndrome) and responds with avid retention of sodium and water, thus promoting further increase in ascitic fluid formation. Treatment of ascites secondary to cirrhosis involves restriction of sodium intake combined with diuretics. The most commonly prescribed initial therapy is a combination of furosemide and spironolactone.

**(Choice A)** The descending abdominal aorta will have elevated pressures in patients with systemic hypertension.

**(Choice B)** The inferior vena cava experiences increased pressure in cases of heart failure. This patient does not present with the typical symptoms associated with heart failure, such as lower extremity edema and shortness of breath.

**(Choice D)** The celiac trunk emerges from the aorta at this level (T12 / L1).

**Educational Objective:**

The portal vein can be identified on cross-sectional scans lying medial to (or just within) the right lobe of the liver and anterior to the inferior vena cava. The pressure in the portal system is elevated in liver cirrhosis.

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A 23-year-old female is examined by an obstetrician in the delivery room. Starting intravaginally, he injects lidocaine solution near the tip of the ischial spine. Which of the following nerves is most likely blocked by the injection?

- A. Genitofemoral [4%]
- B. Iliohypogastric [2%]
- C. Lateral femoral cutaneous [1%]
- D. Obturator [4%]
- E. Pudendal [87%]
- F. Inferior gluteal [2%]

**Explanation:****User Id: 477875**

A pudendal nerve block is one method of providing anesthesia during childbirth, and this is the block that is described in this scenario. Sometimes this method is used if a woman has progressed too far in labor to receive epidural anesthesia. The pudendal nerve is derived from the S2 - S4 nerve roots and provides sensory innervation to the perineum and genitals (of both sexes) as well as motor innervation to the sphincter urethrae and the external anal sphincter.

When administering a pudendal nerve block, the physician generally palpates intravaginally for the ischial spines and attempts to administer the anesthetic agent in that location.

**(Choice A)** The genitofemoral nerve originates at L1 and L2 and courses on the anterior surface of the psoas muscle. It splits into the genital and femoral branches, innervating the scrotum / labia majora and cutaneously innervating the femoral triangle, respectively.

**(Choice B)** The iliohypogastric nerve is derived from T12 / L1 and courses in that dermatome to innervate the skin overlying the iliac crests.

**(Choice C)** The lateral femoral cutaneous nerve is derived from L2 and L3. It courses deep to the inguinal ligament to innervate the skin on the anterolateral thigh.

**(Choice D)** The obturator nerve is derived from L3 and L4 and serves to provide motor innervation to the medial thigh (adductors).

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- E. Pudendal [87%]  
 F. Inferior gluteal [2%]

**Explanation:**

User Id: 477875

A pudendal nerve block is one method of providing anesthesia during childbirth, and this is the block that is described in this scenario. Sometimes this method is used if a woman has progressed too far in labor to receive epidural anesthesia. The pudendal nerve is derived from the S2 - S4 nerve roots and provides sensory innervation to the perineum and genitals (of both sexes) as well as motor innervation to the sphincter urethrae and the external anal sphincter.

When administering a pudendal nerve block, the physician generally palpates intravaginally for the ischial spines and attempts to administer the anesthetic agent in that location.

**(Choice A)** The genitofemoral nerve originates at L1 and L2 and courses on the anterior surface of the psoas muscle. It splits into the genital and femoral branches, innervating the scrotum / labia majora and cutaneously innervating the femoral triangle, respectively.

**(Choice B)** The iliohypogastric nerve is derived from T12 / L1 and courses in that dermatome to innervate the skin overlying the iliac crests.

**(Choice C)** The lateral femoral cutaneous nerve is derived from L2 and L3. It courses deep to the inguinal ligament to innervate the skin on the anterolateral thigh.

**(Choice D)** The obturator nerve is derived from L3 and L4 and serves to provide motor innervation to the medial thigh (adductors).

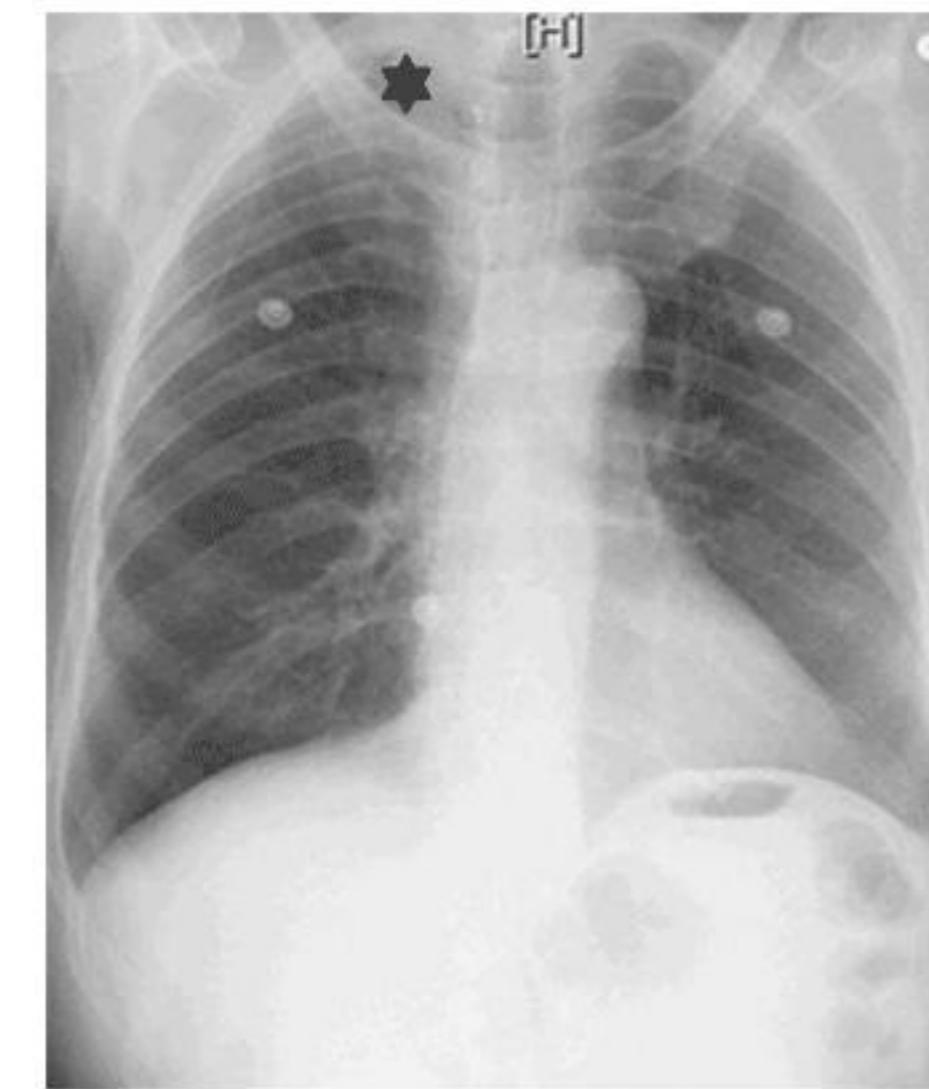
**(Choice F)** The inferior gluteal nerve is derived from L5 - S2 roots and provides motor innervation to the gluteus maximus.

**Educational Objective:**

A pudendal nerve block can be performed by injecting anesthetic intravaginally in the region of the ischial spine. Blocking the pudendal nerve provides anesthesia to the majority of the perineum; additional blockade of the genitofemoral and ilioinguinal nerves would provide complete perineal and genital anesthesia.

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A 56-year-old male smoker is being evaluated for right shoulder pain. You suspect a malignancy in the location marked by a star below.



Which of the following additional findings is likely to also be present in this patient as a result of local tumor extension?

- A. Bitemporal hemianopsia [2%]
- B. Unilateral deafness [2%]
- C. Ptosis [90%]
- D. Horizontal nystagmus [2%]
- E. Anosmia [3%]

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- A. Bitemporal hemianopsia [2%]
- B. Unilateral deafness [2%]
- C. Ptosis [90%]
- D. Horizontal nystagmus [2%]
- E. Anosmia [3%]

**Explanation:****User Id: 477875**

The star on the chest x-ray above marks the pulmonary apex. Apical lung tumors, or Pancoast tumors (named for the radiologist who first described them), can cause a variety of symptoms due to invasion of nearby structures. Most commonly, Pancoast tumors cause shoulder pain due to invasion of the parietal pleura, vertebrae, and superior ribs. Invasion of the brachial plexus can cause weakness and paresthesias of the arm, particularly at sites innervated by the inferior trunk. Superior vena cava (SVC) compression by tumor can cause SVC syndrome, and recurrent laryngeal nerve involvement can cause hoarseness. Horner syndrome, the triad of ipsilateral miosis, ptosis and anhidrosis, occurs in up to 50% of patients with Pancoast tumors, and occurs due to tumor invasion of the paravertebral sympathetic chain.

**(Choice A)** Bitemporal hemianopsia classically results from masses within the hypophysial fossa, such as pituitary tumors. Prolactinomas are the most common pituitary tumors.

**(Choice B)** Unilateral deafness can result from many insults including cerumen impaction, damage to the conductive system, or damage to cranial nerve VIII.

**(Choice D)** Horizontal nystagmus can result from disease of the peripheral vestibular system or severe damage to one of the cerebral hemispheres.

**(Choice E)** Anosmia (loss of the sense of smell) is associated with a variety of potential causes including Kallman syndrome, toxin exposure, malignancy invading the olfactory region of the CNS or nasopharynx, etc.

**Educational Objective:**

Apical lung tumors are called Pancoast tumors. Pancoast tumors can cause Horner syndrome, SVC syndrome, arm weakness, arm paresthesias, and hoarseness.

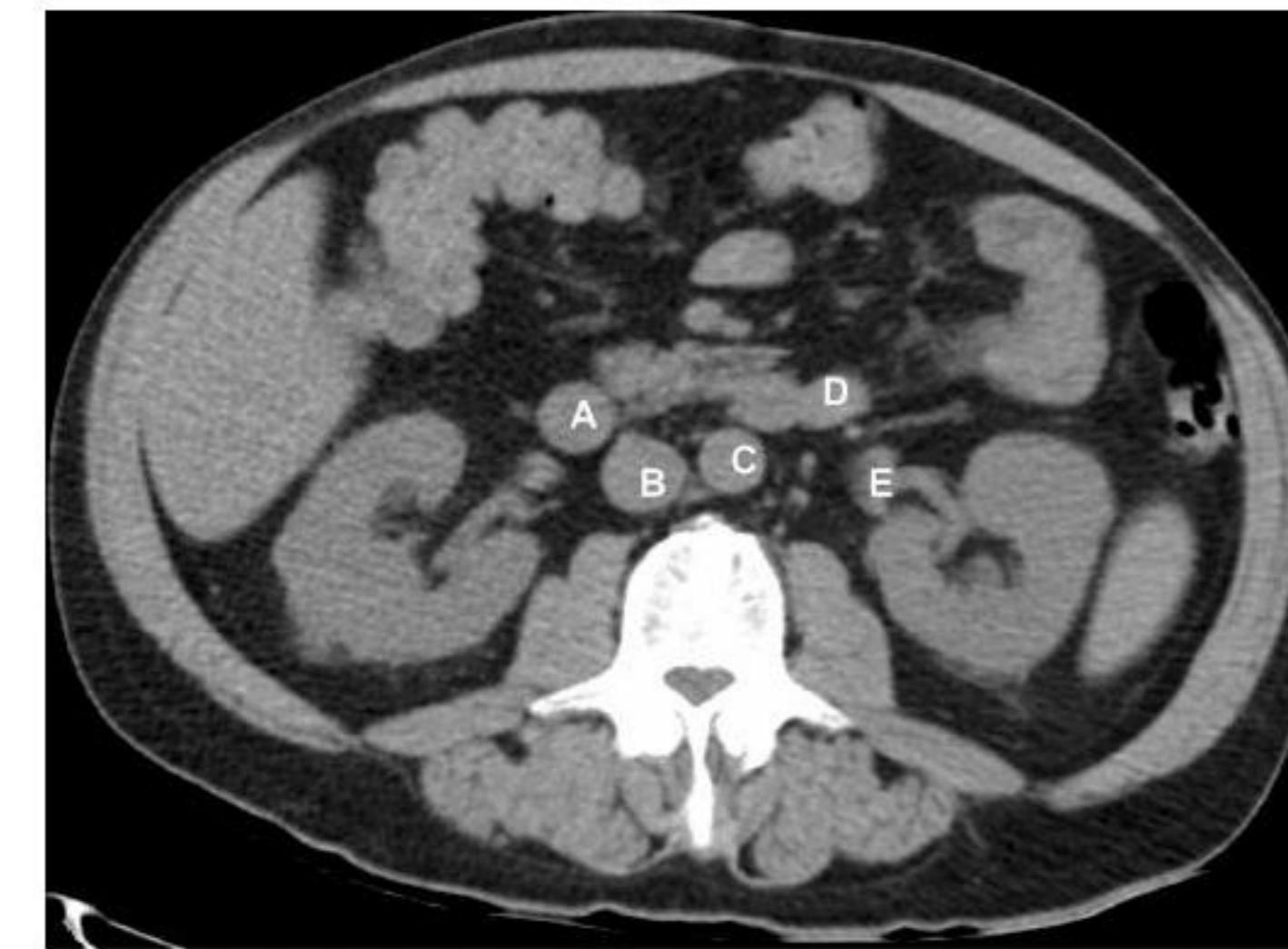
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Last updated: [7/7/2010]

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A 63-year-old male with a history of gastrointestinal bleed has developed a sudden onset shortness of breath. Evaluation shows pulmonary embolism. A filter placement is planned to prevent further embolization. The filter will most likely be placed in which of the following structures?



- A. A [18%]
- B. B [61%]
- C. C [13%]
- D. D [5%]
- E. E [2%]

Evaluation:

Q.Id: 477875

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- A. A [18%]  
 B. B [61%]  
 C. C [13%]  
 D. D [5%]  
 E. E [2%]

**Explanation:**

User Id: 477875

The IVC filter is designed to prevent the travel of deep vein thrombosis from the legs to the lung vasculature. Inferior vena cava filter is used to prevent pulmonary embolism in patients who have contraindications to anticoagulation. This abdominal computed tomography (CT) scan is taken at the level of L2. The bilateral kidneys are viewed in section; the inferior pole of the right lobe of the liver is noted on the left side of the above image anterior to the right kidney and posterolateral to the large bowel.

**Choice A** represents the lumen of the second part of the duodenum, which classically lies at the level of L2.

**Choice B** is medial to the descending part of the duodenum and lies anterior to the right side of the vertebral body. This structure is the inferior vena cava. The right renal vein drains into the IVC near this plane of section.

**Choice C** represents the abdominal aorta. The bifurcation of the abdominal aorta occurs at the level of L4.

**Choice D**, if observed carefully, looks like a figure eight. This structure represents two segments of the ileum lying next to one another.

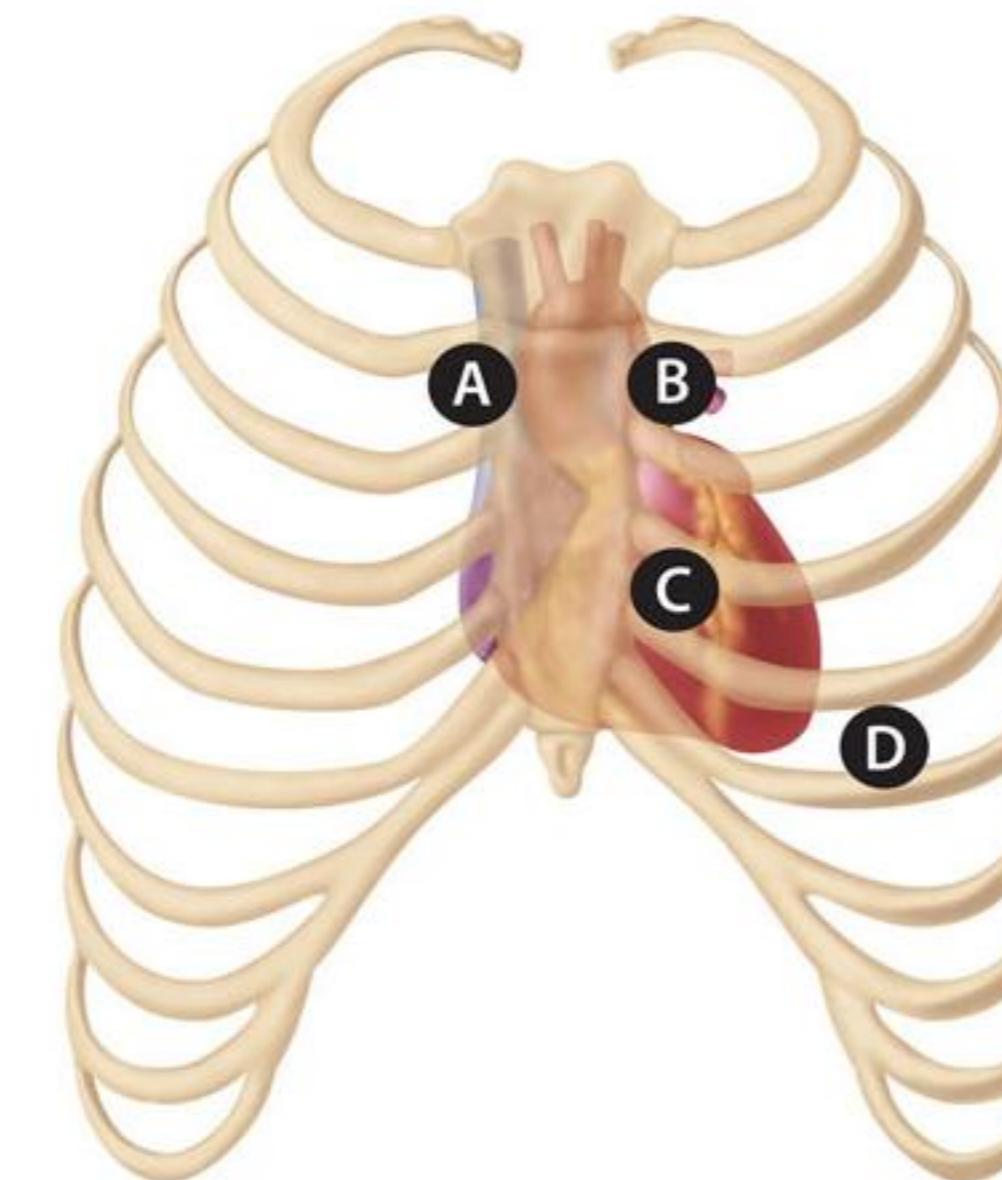
**Choice E** represents the left renal vein. The left renal vein receives drainage from the left gonadal vein and courses anterior to the aorta, but posterior to the superior mesenteric artery, before draining into the inferior vena cava.

**Educational Objective:**

The inferior vena cava courses through the abdomen and inferior thorax in a location anterior to the right half of the vertebral bodies. The renal veins join the IVC at the level of L1/L2, and the common iliac veins merge to become the IVC at the level of L4.

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A 33-year-old man comes to the emergency department complaining of fever, chills, and dyspnea on exertion. He admits to smoking one pack of cigarettes a day, consuming 2-3 alcoholic beverages daily, and using intravenous illicit drugs 2-3 times per week. He is febrile and tachycardic. Blood cultures grow *Staphylococcus aureus*. A diagnosis of infective endocarditis is established. The valve most likely affected in this patient can be best evaluated by auscultation in which of the following areas?

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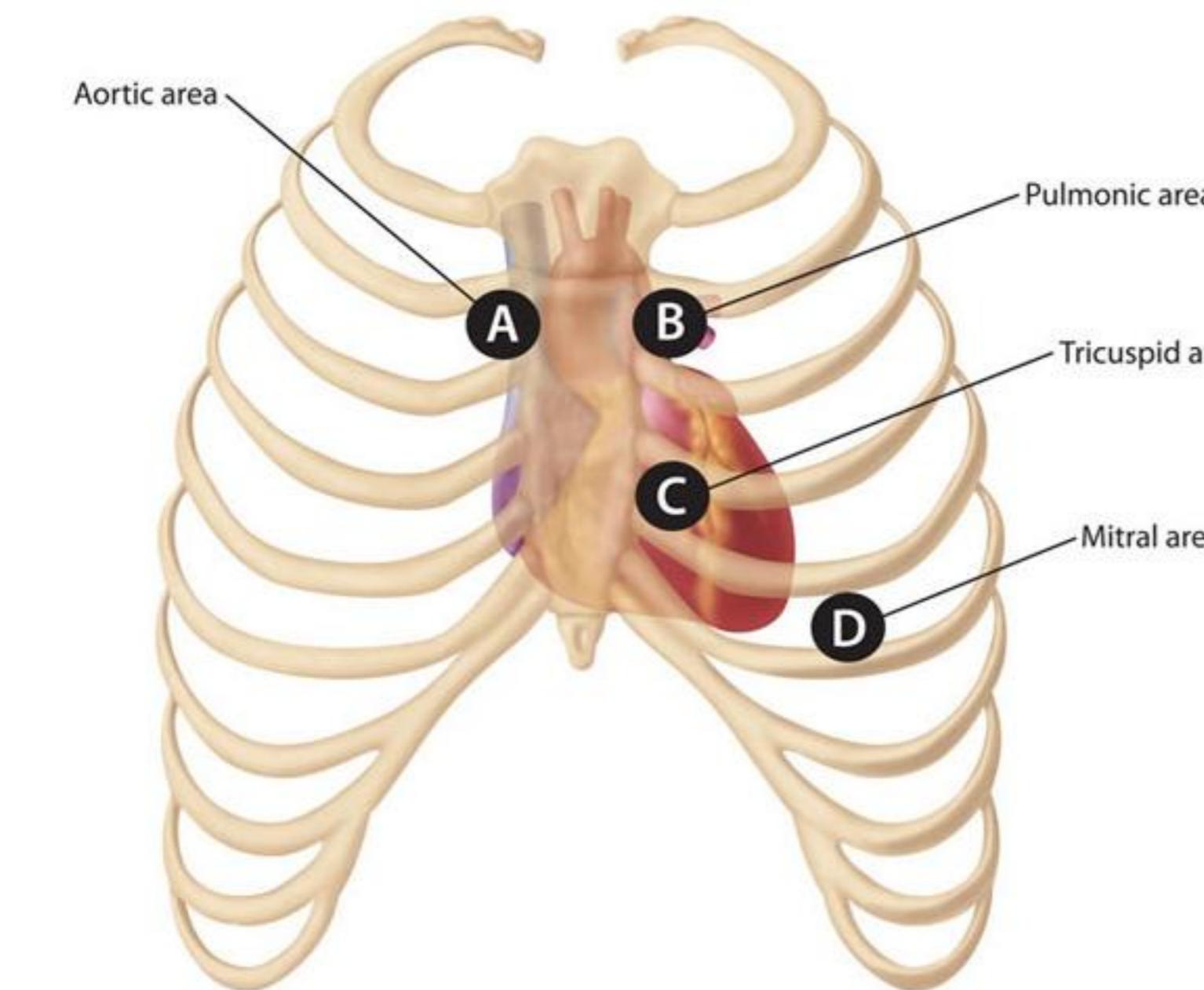
- A. A [3%]
- B. B [3%]
- C. C [64%]
- D. D [20%]

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- A. A [3%]
- B. B [3%]
- C. C [81%]
- D. D [13%]

**Explanation:**

User Id: 477875





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Right-sided endocarditis involving the tricuspid valve commonly occurs in IV drug users and is most often due to *Staphylococcus aureus*. Specifically, infective endocarditis can cause tricuspid regurgitation, which is identified as an early systolic murmur best heard over the left lower sternal border that is accentuated by inspiration.

Heart sounds/murmurs result from reverberation of blood secondary to valve closure. Auscultation to determine function of a valve is performed at the position closest to where the sound waves reverberate and not at the position of the valve.

Valve	Location best heard
Aortic valve	Second right intercostal space at the right sternal border
Pulmonic valve	Second left intercostal space at the left sternal border
Tricuspid valve	Fourth left intercostal space at the lower left sternal border
Mitral valve	Fifth left intercostal space, medial to the mid-clavicular line

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**Educational objective:**

An early systolic murmur best heard over the left lower sternal border that is accentuated by inspiration is most likely due to tricuspid regurgitation.

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