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INTERNATIONAL SURGICAL  
ANATOMY TEACHING  
SERIES



**ISATS**  
**HANDOUT**  
**2024/25**

Cardiac Anatomy

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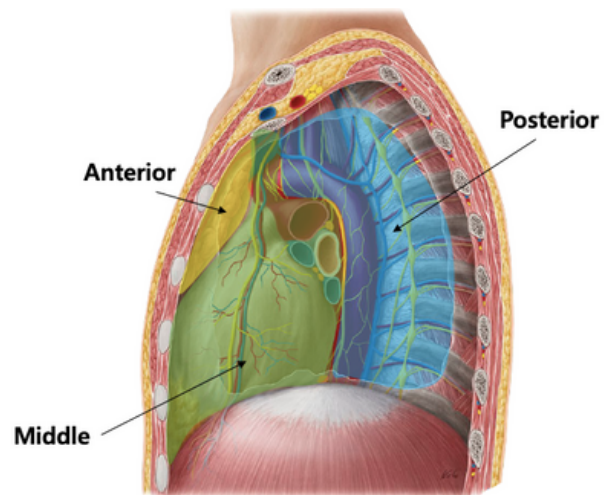
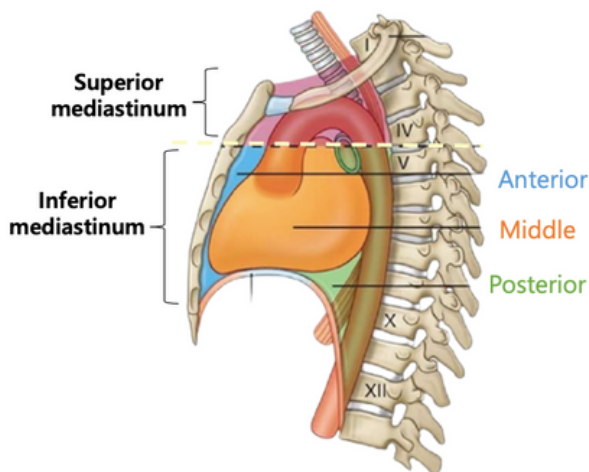
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# CARDIAC ANATOMY

**Objectives:** Understand the anatomy of the mediastinum and pericardium. Understand and recall the detailed anatomy of the cardiac chambers, cardiac valves, coronary arteries and cardiac conduction system and their importance in CABG, valve repair and cardiac transplant procedures.

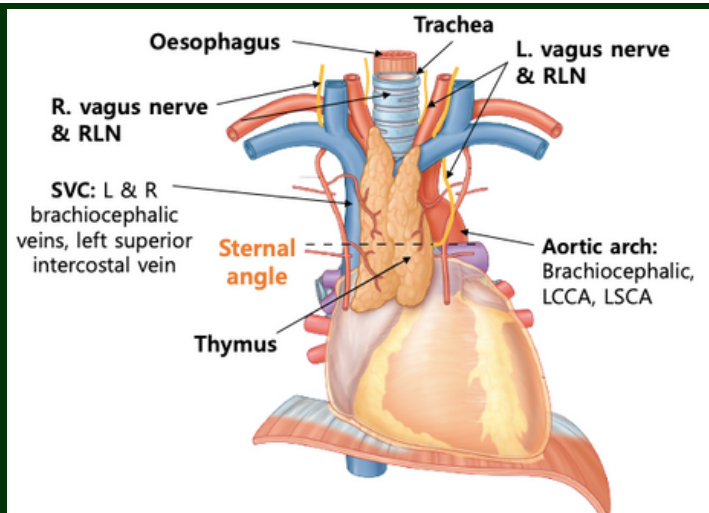
## Mediastinum

- **Mediastinum** – central partition separating pleural cavities laterally.
  - **Superior mediastinum** = thoracic inlet (superior thoracic aperture) to sternal angle
  - **Inferior** = sternal angle to diaphragm
    - Anterior
    - Middle
    - Posterior mediastinum.
- **Sternal Angle of Louis (T4/T5 IV disc):**
  - 2nd costal cartilage
  - Arch of aorta
  - Trachea bifurcation into main bronchi
  - Pulmonary trunk bifurcation
  - **Other:** left recurrent laryngeal nerve, ligament arteriosum, azygous system and thoracic duct



## Contents of the superior mediastinum

- Left and right vagus nerve + recurrent laryngeal nerve
- SVC – right + left brachiocephalic veins
- Aortic arch
- Thymus
- Trachea + oesophagus
- **Other contents:**
  - Phrenic nerve
  - Thoracic duct
  - Small nerves, blood vessels & lymphatics



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## Pericardium

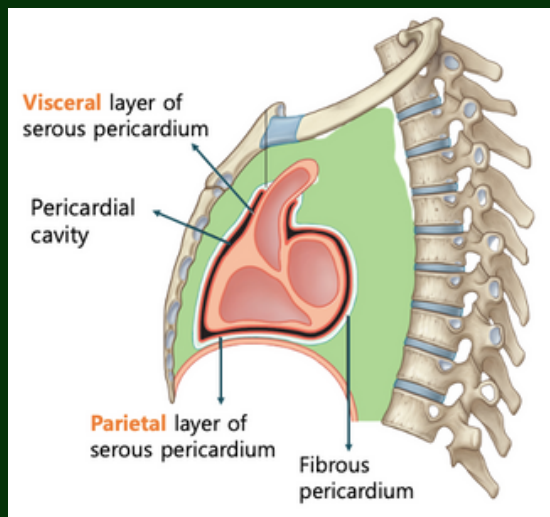
### Fibrous Pericardium

- **Parietal** – lines inner surface of fibrous pericardium
- Base fuses with central tendon of the diaphragm to form the pericardiophrenic ligament
- **Arterial supply:** pericardiophrenic artery
- **Venous drainage:** pericardiophrenic vein
- **Innervation:** somatic innervation via phrenic nerves

### Serous Pericardium

- **Visceral** – adheres to heart (epicardium)
- **Arterial supply:** internal thoracic artery + coronary arteries
- **Venous drainage:** pericardiophrenic vein + azygous venous system
- **Innervation:**
  - Parietal = somatic innervation via phrenic nerves
  - Visceral = autonomic innervation via vagus nerve and sympathetic trunk

### Pericardial Layers

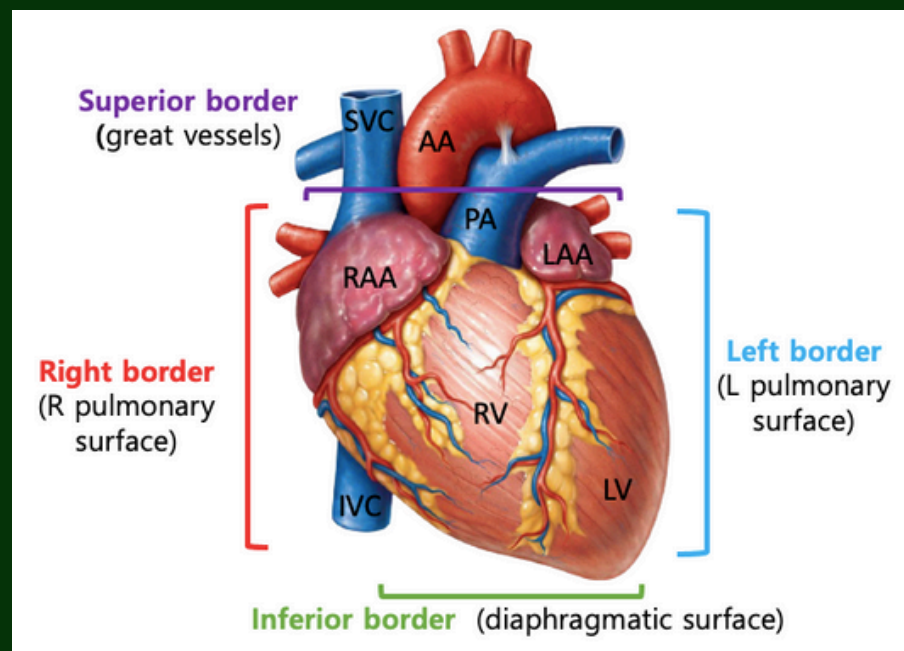


## Cardiac Orientation

- Normal orientation: levocardia + leftward orientated apex
- Long-axis of heart: oblique
- Posterior surface: base (LA)
- Anterior surface: sternocostal surface (RA & RV)
- **General rule**
  - Right chambers = anterior
  - Left chambers = posterior

## Diaphragmatic Openings

1. **T8** – Caval Hiatus – IVC
2. **T10** – Oeseophageal hiatus – oeseophagus
3. **T12** – Aortic hiatus – Abdominal aorta





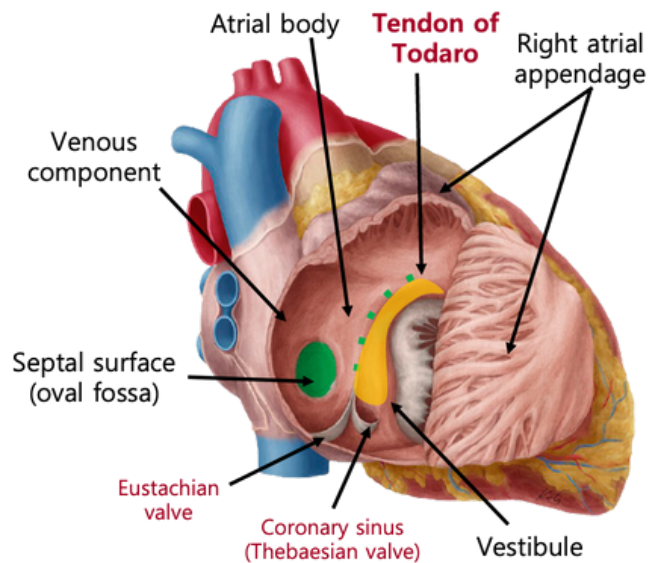
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## Right Cardiac Chambers

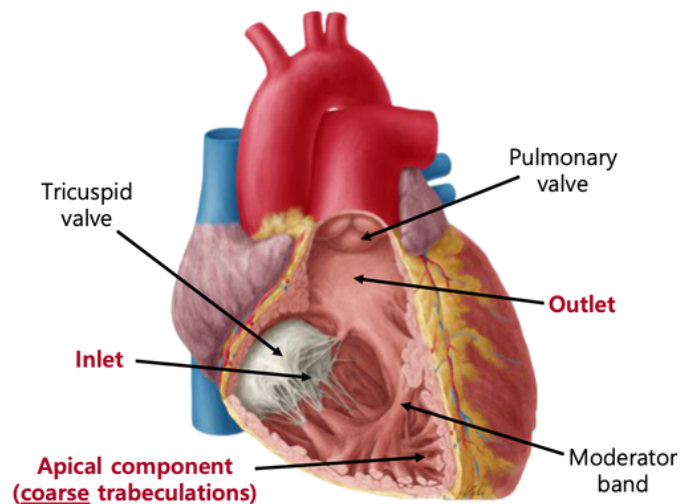
### Right Atrium

- Receives systemic venous return from IVC, SVC and coronary sinus
- 5 components
  - Venous component
  - Septal surface (floor of oval fossa)
  - Atrial body
  - Tricuspid vestibule – inserts into leaflets of tricuspid valve
  - Right atrial appendage – **broad based and triangular**



### Right Ventricle

1. **Inlet component:** support leaflets of tricuspid valve & attachment of valvular tension apparatus
2. **Apical component:** coarse muscular trabeculations
3. **Outlet component:** smooth walled with free standing muscular sleeve or infundibulum.

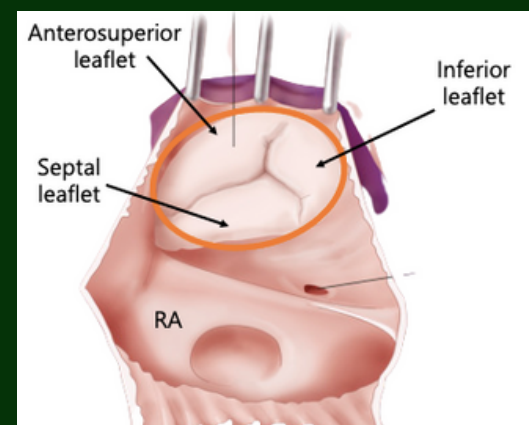


### Tricuspid Valve

- Leaflets: anterosuperior, septal & inferior leaflets
- Annulus (fibrous ring)
- 3 papillary muscles – inferior, anterior (largest) and medial (muscle of Lancisi)
- Septophilic – chordal attachments to ventricular septum

### Pulmonary Valve

- 3 semilunar shaped valves: anterior, left and right
- Zone of apposition – leaflets touch when valve closed



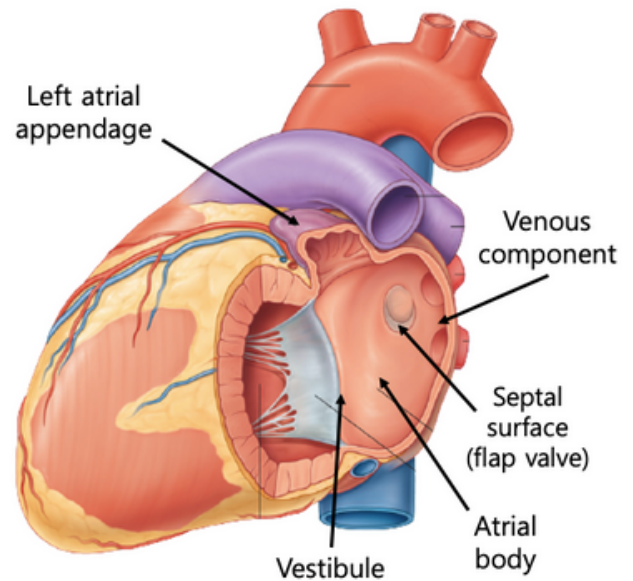
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## Left Cardiac Chambers

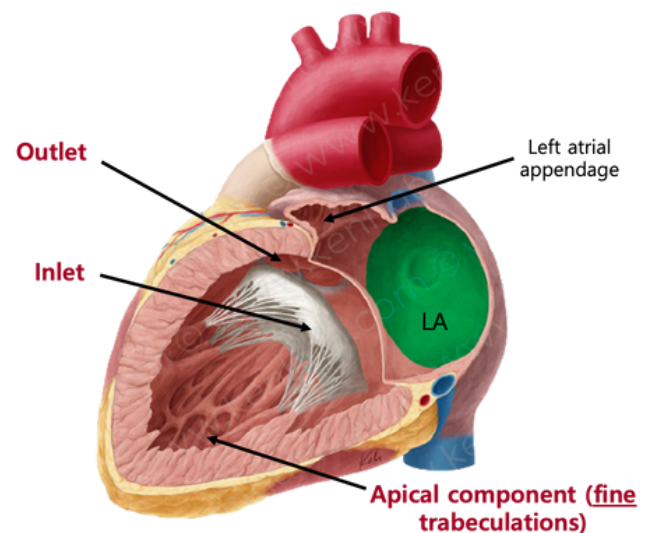
### Left Atrium

- Receives oxygenated blood from pulmonary veins
- 5 components
  - Venous component
  - Septal surface (flap valve of oval fossa)
  - Atrial body (larger than right atrium)
  - Mitral vestibule - inserts into leaflets of mitral valve
  - Left atrial appendage - **narrow and tubular**



### Left Ventricle

1. **Inlet component:** support leaflets of mitral valve & attachment of valvular tension apparatus
2. **Apical component:** fine criss-cross muscular trabeculations, smooth septal surface
3. **Outlet component:** supports aortic valve leaflets.

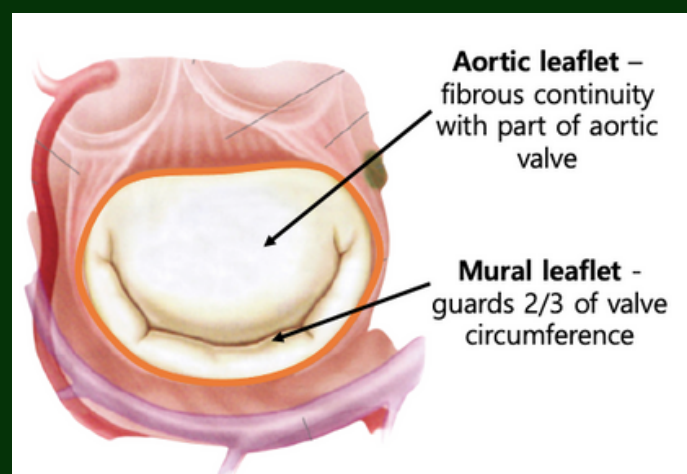


### Mitral Valve

- Leaflets: mural & aortic leaflets
- Annulus (fibrous ring)
- 2 papillary muscles - inferospetal & superolateral
- Septophobic - no septal attachments

### Aortic Valve

- 3 semilunar shaped valves: left coronary, right coronary, non-coronary.
- Aortic sinuses of Valsava - sinuses give rise to coronary arteries.

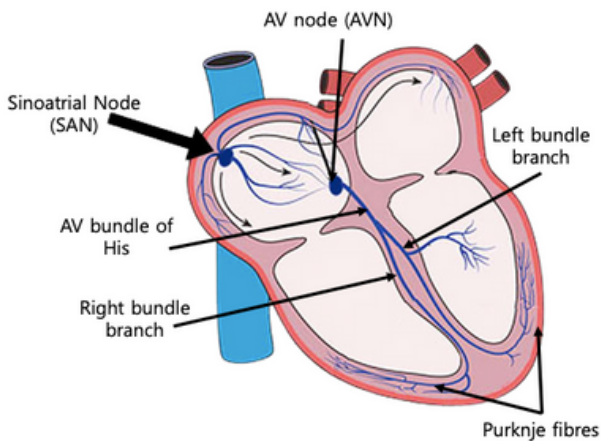


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## Conduction System

- Cardiac fibrous skeleton – dense, fibrous connective tissue (electrical insulation)



SAN node – within terminal groove

Atrioventricular Node – within right atrium

Bundle of His – penetrates membranous IV septum

Left bundle branch – left side of IV septum towards apex

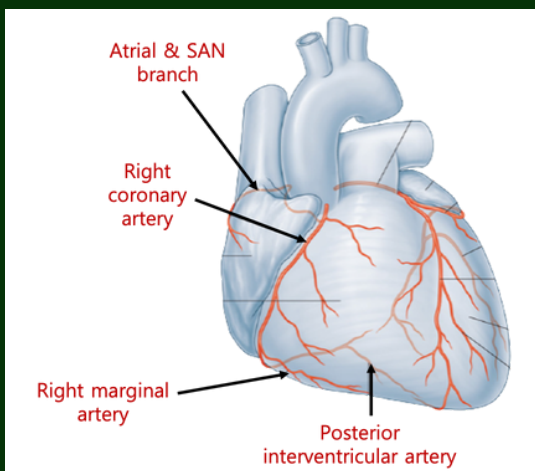
Right bundle branch – right side of IV septum

Purkinje fibres

## Coronary Arteries

### RIGHT CORONARY ARTERY

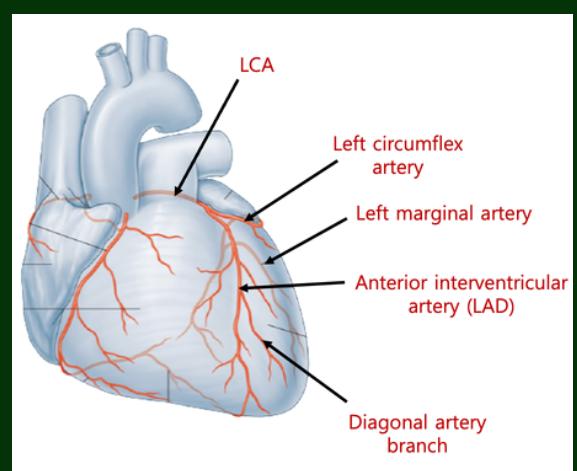
1. Atrial branch – SAN branch
2. Right marginal (acute) artery
3. AV nodal branch
4. Posterior interventricular artery



**Right coronary artery** = RA, RV, SAN, AVN, inter-atrial septum, portion of LA + posterior portion LV

### LEFT CORONARY ARTERY

1. Left anterior descending (LAD) or anterior interventricular artery
  - Diagonal → septal perforating branches
2. Circumflex artery
  - Left marginal (obtuse) artery



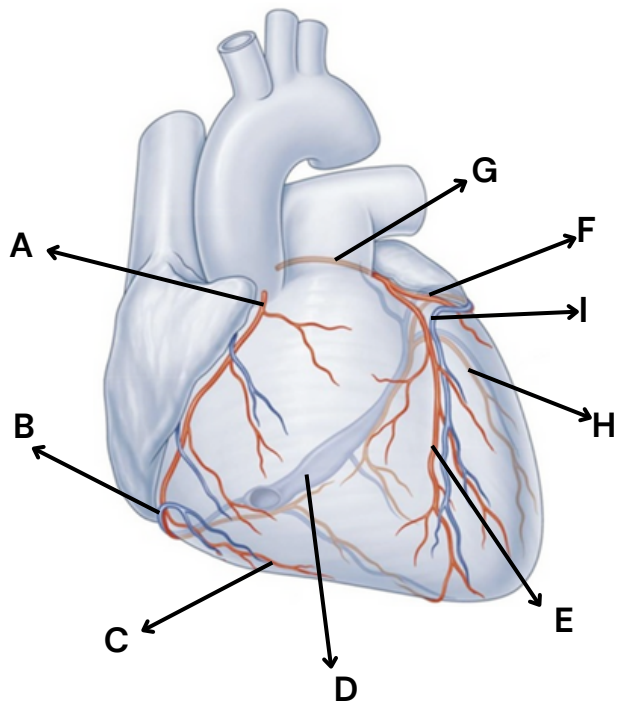
**Left coronary artery** = LA, LV, most of interventricular septum and AV bundles.



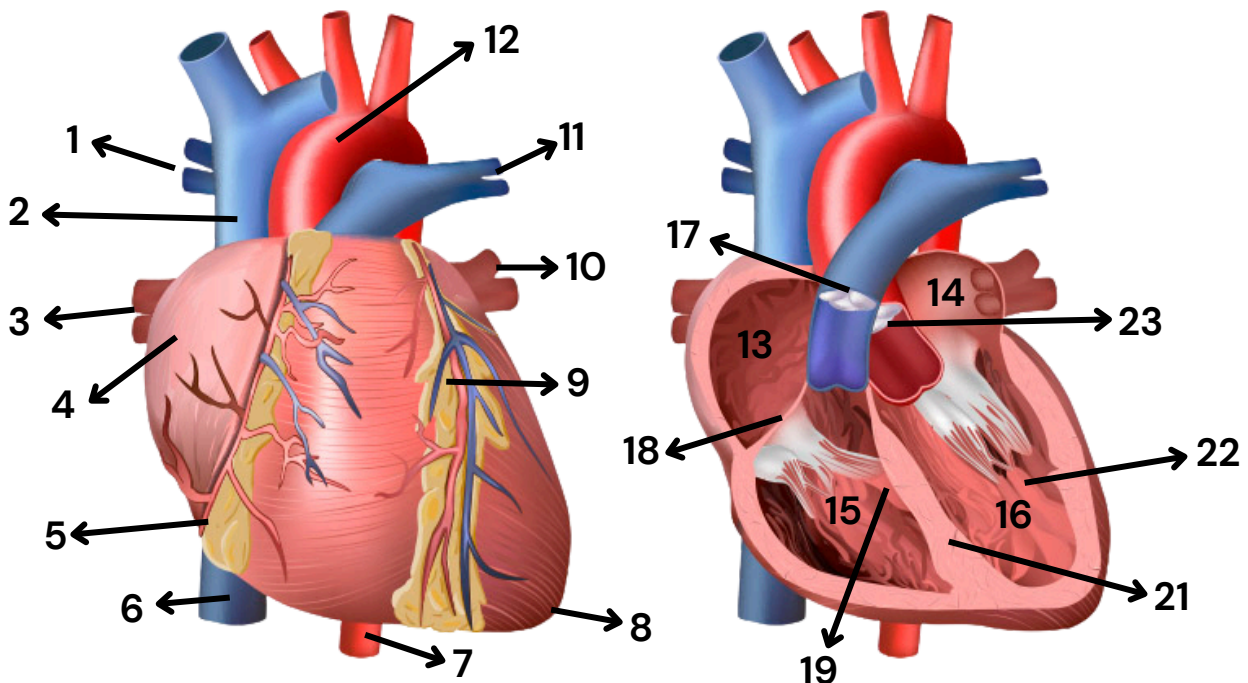
# CARDIAC ANATOMY

## Test yourself

1) Label the coronary arteries of the heart...



2) Label the structures on the external and internal surface of the heart...



# CARDIAC ANATOMY

## Test yourself

### MCQ 1

What innervates the fibrous pericardium?

- A. Phrenic nerve
- B. Pericardiophrenic nerve
- C. Vagus nerve and somatic nerves
- D. Recurrent laryngeal nerves
- E. Somatic nerves only

### MCQ 2

A 55-year-old woman presents to hospital with a myocardial infarction. Damage to the conduction pathways between the sino atrial and atrioventricular (AV) node leads to his ventricles being paced by only the AV node, resulting in a heart rate of 40. Which nerve fibres arise from the left and right bundle branches and innervate the ventricles?

- A. Right and left coronary nerves
- B. Bundles of His
- C. Atrioventricular nerves
- D. Purkinje fibres
- E. Interventricular nerves

### MCQ 3

Which structure in the heart is considered 'septophobic'?

- A. Tricuspid valve
- B. Mitral valve
- C. Pulmonary valve
- D. Aortic valve
- E. Papillary muscles

### MCQ 4

What is the name of the serous reflection situated posterior to the left atrium?

- A. Oblique pericardial sinus
- B. Transverse pericardial sinus
- C. Posterior cardiac space
- D. Anterior cardiac space
- E. Superior mediastinal sinus

### MCQ 5

A 82-year-old man presents with central crushing chest pain. You perform an ECG and notice ST elevation in leads II, III and aVF. Infarction of which coronary artery is likely causing this STEMI?

- A. Right marginal artery
- B. Posterior descending artery
- C. Right coronary artery
- D. Left anterior descending artery
- E. Left Marginal artery

### MCQ 6

Which structure in the heart has broad and triangular pectinate muscle?

- A. Right atrium
- B. Left atrium
- C. Right ventricle
- D. Left ventricle
- E. None



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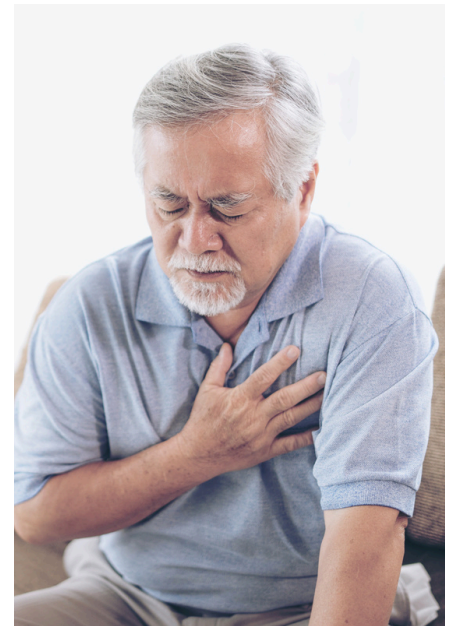
## Test yourself

### OSCE Station – Case Based Discussion

A 69-year-old man develops worsening substernal chest pain after shovelling snow in the morning before work. He says he feels a squeezing pain that is radiating to his jaw and left shoulder. Past medical history is significant for hypertension and he has been told by his doctor that he has borderline diabetes. On examination he is very anxious and diaphoretic. His heart rate is 112 bpm and blood pressure is 159/93 mmHg. The ECG is significant for ST depression in the anterior leads.

Case source:

<https://bestpractice.bmj.com/topics/en-gb/3000113/case-history>



**Q1. What would be the initial management of this patient?**

**Q2. What are the potential differential diagnoses from this presentation?**

**Q3. Which investigations will be useful in confirming a diagnosis?**

**Q4. How will you manage this patient?**

**Q5. What adjunct medication can you give?**

**Answers**  
 MCQs: 1) A, 2) D, 3) B, 4) A, 5) C, 6) A  
 OSCEs: This patient is having a non-ST elevation myocardial infarction (NSTEMI). 1) Give a single dose of Aspirin (unless there is a risk of bleeding) and sublingual GTN. If patient is in pain, give morphine with an anti-emetic. 2) ST-elevation myocardial infarction (STEMI), unstable angina, aortic dissection, panic attack, acute pericarditis, peptic ulcer disease. 3) ECG (showing ST depression or no ST elevation in the anterior leads), troponin (showing elevated serum troponin), FBC, urea and electrolytes. Q4) Percutaneous coronary intervention. 5) Aspirin and clopidogrel/ticagrelor, beta-blockers, ACE-inhibitors