The Heart & Pericardium

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Fibrous skeleton

- Dense fibrous connective tissue forms a structural foundation around AV & arterial orifices.
- It is site of attachment to atria & ventricles.
- Musculature of atria & ventricles does not cross this fibrous ring.
- It is also an electrical insulator between atria and ventricles except via AV Bundle/Bundle of His.
Conduction system

- Specialized cardiac muscle fibers
- Self-excitabile
- Repeatedly generate action potentials that trigger heart contractions
- Act as pacemaker & Form conduction system
- Consist of SA, AV Node, Bundle of His & Purkinje fibers
Conduction System

• SA node acts as natural pacemaker
  – Faster than other auto rhythmic fibers
  – Initiates 100 times per second

• Nerve impulses from autonomic nervous system (ANS) and hormones modify timing and strength of each heartbeat
Conduction system

1. Begins in sinoatrial (SA) node in right atrial wall
   • Propagates through atria via gap junctions
   • Atria contact

2. Reaches atrioventricular (AV) node in interatrial septum

3. Enters atrioventricular (AV) bundle (Bundle of His)
   • Only site where action potentials can conduct from atria to ventricles due to fibrous skeleton

4. Enters right and left bundle branches which extends through interventricular septum toward apex

5. Finally, large diameter Purkinje fibers conduct action potential to remainder of ventricular myocardium
Anterior view of frontal section

1. SINOATRIAL (SA) NODE
2. ATRIOVENTRICULAR (AV) NODE
3. ATRIOVENTRICULAR (AV) BUNDLE (BUNDLE OF HIS)
4. RIGHT AND LEFT BUNDLE BRANCHES
5. PURKINJE FIBERS

Frontal plane

Left atrium
Left ventricle
Right atrium
Right ventricle
Coronary Circulation

*Corona*: (Latin) A crown or something like a crown
Coronary Circulation

- **Coronary circulation** is the functional blood supply to the heart muscle itself.
- **Collateral routes** ensure blood delivery to the heart even if major vessels are occluded.
Coronary Circulation: Arterial Supply

- Heart is supplied by TWO CORONARY arteries:
  1- Right coronary artery (RCA)
  2- Left coronary artery (LCA)
- These coronary arteries arise at the root of the aorta.
Coronary artery & their branches

LCA-
- Left Anterior Descending (LAD)/Interventricular artery
- Marginal Artery
- Circumflex Artery
- Atrial

RCA
- Marginal Artery
- Posterior interventricular artery
- Atrial & nodal arteries
Coronary artery & their branches

- LCA supplies ant. and apical parts of heart, ant.2/3rd of interventricular septum via LAD.
- Circumflex branch supplies the lateral and post.surface of heart.
Coronary artery & their branches

RCA supplies:

- Right ventricle
- Interventricular septum (posterior 1/3rd part)
- Inferior part of left ventricle
- Conducting system except Left branch of bundle of His supplied by LCA
Cardiac Dominance

- The right coronary gives posterior interventricular artery & supply conduction system, such hearts are Right Dominance.

- In 10% cases posterior interventricular artery come from circumflex artery which supply posterior interventricular septum as well as AV node, such hearts are Left Dominance.
Venous return of Heart

- Most of the venous blood return to heart occurs through the coronary sinus.
- Venae cardis minimi/Thebesian vein & Anterior cardiac veins directly drain into the right atrium.

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Venous return of Heart

- Great cardiac vein
- Middle cardiac vein
- Small cardiac vein
- Posterior vein of left ventricle
- Right marginal vein
- Oblique vein of left atrium of Marshall
Blood flow to Heart during Systole & Diastole

• During systole when heart muscle contracts it compresses the coronary arteries therefore blood flow is less.

• As we know blood flow to subendocardial surface of left ventricle during systole is not there, therefore, this region is prone to ischemic damage and most common site of Myocardial infarction.
CORONARY BLOOD FLOW

• Coronary blood flow to the right side is not much affected during systole.

   Reason---Pressure difference between aorta and right ventricle is greater during systole than during diastole, therefore more blood flow to right ventricle occurs during systole.
CORONARY BLOOD FLOW

• Coronary blood flow in Humans at rest is about 225-250 ml/minute, about 5% of cardiac output.

• At rest, the heart extracts 60-70% of oxygen from each unit of blood delivered to heart [other tissue extract only 25% of O₂.]
Factors Affecting Blood Flow to CORONARY ARTERIES

- Pressure in aorta
  - Chemical factors
  - Neural factors

✓ NOTE—Coronary blood flow shows considerable Autoregulation.
Moral of the Story

Well-deserved Royalty:

Not just to have a crown....but to have a well-fitting ONE!
Lymphatic Drainage

- Right trunk- to brachiocephalic node
- Left trunk-to tracheobronchial node
Innervation of Heart

- Parasympathetic - Vagus & recurrent laryngeal
- Sympathetic - Upper 4 to 5 thoracic segment of spinal cord
- Both forming superficial & deep cardiac plexus
Innervation of Heart

- The superficial plexus lies in the concavity of the aortic arch, and a deep plexus between the aortic arch and the trachea.
- Both are closely connected.
Innervation of Heart

**superficial plexus**

- It is formed by the superior cardiac branch of the left **sympathetic trunk** and the lower superior cervical cardiac branch of the left **vagus nerve**.
- Its branches are-
  - (a) to the deep part of the plexus;
  - (b) to the anterior coronary plexus; and
  - (c) to the left anterior **pulmonary plexus**.
Innervation of Heart

- The deep cardiac plexus is formed by the cardiac nerves derived from the cervical ganglia of the sympathetic trunk, and the cardiac branches of the vagus and **recurrent laryngeal nerves** except superior cardiac branch of the left **sympathetic trunk** and the lower superior cervical cardiac branch of the left **vagus nerve** which form superficial plexus.
Innervation of Heart

• The branches from the right half of the deep part of the cardiac plexus form the anterior pulmonary plexus, and the anterior coronary plexus.

• Those behind the pulmonary artery to form part of the posterior coronary plexus.

• The left half of the deep part of the plexus is connected with the superficial cardiac plexus, and to the anterior pulmonary plexus, and is then continued to form the greater part of the posterior coronary plexus.
Anatomical basis of referred pain from heart

- The pain sensation is carried by middle and inferior cervical cardiac branches and thoracic cardiac branches of sympathetic chain to thoracic ganglion of sympathetic chain.
- From here, impulses passes via the white rami to thoracic spinal nerve (T-1 to T-5).
- The central process of the neurons in dorsal root ganglion carry impulses to posterior horn of T-1 to T-5 spinal segment mainly of left side.
Anatomical basis of referred pain from heart

- The pain sensation of ischemic myocardium reach the spinal cord, they stimulate the somatic sensory neurons of corresponding spinal segment. Therefore pain is felt in medial side of left arm, forearm & anterosuperior part of chest & back as well.
Applied Anatomy

- Pericarditis & pericadial effusion
- Cardiac tamponade
- Ligation of ascending of aorta & pulmonary trunk through transverse sinus during cardiac surgery
- Dextrocardia (situs inversus)
- Apex shift in Ventricular hypertrophy
- Arrhythmia, tachycardia, bradycardia
Applied Anatomy

Rheumatic heart ds.

- Pericarditis, Myocarditis & endocarditis
- Mitral valve stenosis and regurgitation
- Tricuspid valve stenosis and regurgitation
- Aortic valve stenosis and regurgitation
- Pulmonary valve stenosis

IHD-

- Angina pectoris
- MI
- Angiography & Angioplasty
- Bypass surgery
Question-1

Crista terminalis is a feature of
a. Right ventricle
b. Left ventricle
c. Right atrium
d. Left atrium
Question-2

Right bundle branch (RBB) travels in
a. Triangle of Koch
b. Moderator band
c. Membranous interventricular septum
d. Supraventricular crest
Question-3

The most anterior valve of heart is
a. Tricuspid
b. Mitral
c. Pulmonary
d. Aortic
Question-4

Conducting tissue of the heart is a modification of

a. Epicardium
b. Myocardium
c. Endocardium
d. Nerve fibers
Question-5

The right margin of cardiac shadow in a radiograph is formed by all of the following except

a. Superior vena cava
b. Right atrium
c. Right ventricle
d. Right brachiocephalic vein
An unconscious patient involved in a major car accident was brought to the casualty with an injury of sharp object on his chest in the middle of the sternum at the level of 4th costal cartilage. Which chamber of heart is likely to be punctured?

a. Left atrium
b. Left ventricle
c. Right atrium
d. Right ventricle
Question-7

The acute margin of heart is

a. Inferior
b. Superior
c. Left
d. Right
Thank you...