Anatomy Team
MED 439

MED439
KING SAUD UNIVERSITY

Summary for lecture 1 & 2

Cardiovascular Block

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The lectures included in this file are :
Anatomy 1 : Heart
Anatomy 2 : The Development of the Heart

Lecture 1: Anatomy of the heart

- The Heart lies in the middle mediastinum.
- The Heart is surrounded by a fibroserous sac called pericardium which is differentiated into an outer fibrous layer (Fibrous pericardium) & inner serous sac (Serous pericardium).
- Apex of the heart formed by the left ventricle.
- Sterno-costal (anterior) surface Divided by coronary (atrio-ventricular) groove.
- The 2 ventricles in anterior surface are separated by anterior interventricular groove:
  a- Anterior interventricular artery.
  b- Great cardiac vein.
- The funnel-shaped part of right ventricle just below pulmonary trunk is called infundibulum.
- Diaphragmatic (Inferior) surface Separated from base of heart by posterior part of coronary sulcus.
- The 2-ventricles in Inferior surface are separated by posterior interventricular groove which lodges:
  a- Posterior interventricular artery.
  b- Middle cardiac vein.
- Anterior part of Right Atrium is rough while the Posterior part is smooth.
- Right ventricle wall contains projections called trabeculae carnae.
- Each papillary muscle is attached to the cusps of tricuspid valve by tendinous threads called chordae tendinae.
- Interventricular septum is connected to anterior papillary muscle by a muscular band called moderator band.
- Nerve supply of the heart by sympathetic & parasympathetic fibers.

- The beating of the heart is regulated by the intrinsic conduction (nodal) system.
- The main center is the sinoatrial (SA) node.
- The SA node is called the pacemaker of the heart
- Apex of the heart is formed mainly of “left ventricle” at the level of the 5th intercostal space
- The heart does not rest on its base; it rests on its diaphragmatic (inferior) surface
- Coronary groove= Atrioventricular groove because it separate the atrium from the ventricle
- Diaphragmatic surface Separated from base of heart by posterior part of coronary sulcus
- Coronary sulcus has the posterior coronary sinus
- Base of the Heart is separated from downward by “post.part of coronary sulcus” , which lodges the coronary sinus
- Superior Vena Cava has NO valves according to Gravity
- Wall of the right is thinner than that of left ventricle because of pumping
- 3 papillary muscles “Anterior, Posterior and Septal in the medial side” in the right ventricle while the Left Ventricle has 2 only
- The wall of aortic vestibule in the left ventricle is fibrous and smooth as well as infundibulum in the right ventricle
- Cardiac plexus situated below arch of aorta
- Atrioventricular (AV) bundle (bundle of His)
- Left atrioventricular orifice= Mitral orifice “Bicuspid”
- Right atrioventricular orifice “Tricuspid”
- Pulmonary cusp has 2 Anterior and 1 posterior while the Aortic cusp has 1 Anterior and 2 posterior

Now test yourself

- **What is the name of sac surrounding the heart?**
  Pericardium.
- **At any level Lies Apex of the heart?**
  Left 5th intercostal space.
- **Which part formed mainly the Sterno-costal?**
  Right atrium and the right ventricle.
- **Where is the site of infundibulum?**
  Below pulmonary trunk and it is part of right ventricle.
- **What part separate Diaphragmatic surface from base of heart?**
  Posterior part of coronary sulcus.
- **At which level lies Base of the Heart?**
  Thoracic vertebrae(5-7).
- **What structures Separate Base of the Heart from vertebral column?**
  Descending aorta, esophagus and oblique sinus of pericardium.
- **What is the lower border of the heart?**
  Right ventricle and apical part of left ventricle.
- **What is the function of tricuspid valve?**
  Leaves the blood from right atrium to the right ventricle.
- **What is the opening in right atrium don't have valves?**
  SVC.
- **What projections in the wall of right ventricle?**
  Trabeculae carnae.
- **What is name of muscle arise from the walls of ventricles?**
  Papillary muscles.
- **What connect between papillary muscles and the cusps of tricuspid valve?**
  Chordae tendinae.
- **What connects between anterior papillary muscle and Interventricular septum?**
  Moderator band.
- **What is the thickest chambers of the heart?**
  Left ventricle.
- **How many cusps in Aortic orifice?**
  Three semilunar cusps.
- **Where is from the parasympathetic fibres arise?**
  Vagus nerves.
- **What the main center of the intrinsic conduction system?**
  Sinoatrial (SA) node.
- **Where is the site of Purkinje fibers ?**
  Inside the walls of the ventricles.

Lecture 2: The development of the heart

Event	Date
Heart primordium	18 days
Heart start to beat	22-23 days
Blood flow	During the beginning of the fourth week
Partitioning of: 1- Atrioventricular canal. 2- Common atrium. 3- Common ventricle. 4- Truncus arteriosus 5- Bulbus cordis	It begins by the middle of 4th week. It is completed by the end of 5th week
The ostium primum become smaller and disappears	When the septum primum fuses completely with the septum intermedium to form the AV septum.
Fate of foramen Ovale	At birth when the lung circulation begins and the pressure in the left atrium increases ,So the two septae oppose each other and fuse together.

- The heart is the first functional organ to develop. It develops from splanchnic mesoderm.
- After lateral folding of the embryo the 2 heart tubes fuse together to form a single endocardial heart tube.

The endocardial heart tube has 2 ends:

1. Venous end (Sinus Venosus)
2. Arterial end (Truncus arteriosus).

S-Shaped Heart Tube:

- The atrium and sinus venosus become cranial in position.
- The sinus venosus has developed 2 lateral expansions, (Horns): right and left horns.
- The right horn forms the smooth posterior wall of the right atrium.
- The left horn and body atrophy and form the coronary sinus.
- The atrioventricular canals partially separate the primordial atrium from the ventricle.
- The Septum Primum divides the common atrium into right & left halves.

The two atria are separated by incomplete two septums:

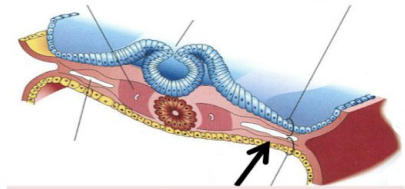
- Septum Primum and Septum Secundum. They form an incomplete partition between the atria, this result in the formation of Foramen Ovale
- Before birth, foramen ovale allows the blood to pass from the right to the left atrium.
- At birth when the lung circulation begins, the pressure in the left atrium increases resulting in closure of the foramen ovale.

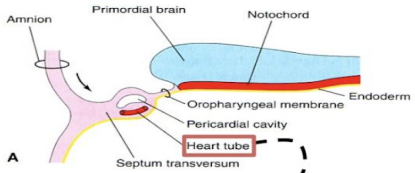
There is five major anomalies :

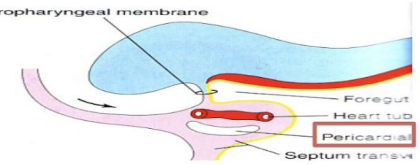
1. ASD: Atrial Septal Defects
2. VSD: Ventricular Septal Defects
3. Tetralogy of fallot
4. TGA: Transposition Of Great Arteries
5. Persistent truncus arteriosus .

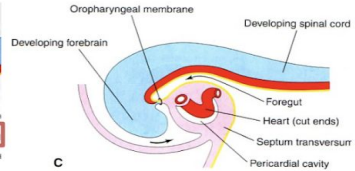
Heart Development

* **CVS** is the first major system **to function** in the embryo.
* The **heart** begins to **beat** at (22^{nd} – 23^{rd}) days.
* **Blood flow** begins during the **beginning** of the 4^{th} week and can be visualized by **Ultrasound Doppler**









Splanchnic Mesoderm

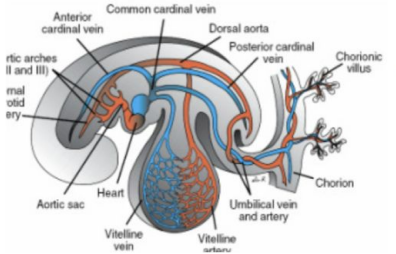
Heart Tube

* Formation of Heart Tube

1.The **heart** is the **first functional organ to develop**.
2.It develops from **Splanchnic Mesoderm** in the wall of the **yolk sac** (Cardiogenic Area): **Cranial** to the **developing Mouth** & **Nervous system** and **Ventral** to the **developing Pericardial sac**.
3.The heart primordium is first evident at **day 18** (as an Angioplastic cords which soon canalize to form the **2 heart tubes**).
4.As the Head Fold completed, the developing heart tubes **change position** and become in the **Ventral** aspect of the **embryo**, **Dorsal** to the **developing Pericardial sac**.

* Development of Heart Tube

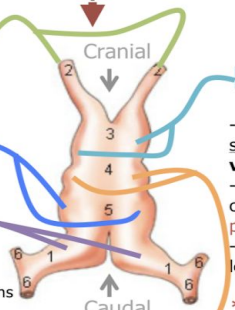
- **After** Lateral Folding of the **embryo**, the 2 heart tubes approach each other and fuse to form a **single Endocardial Heart tube** **within** the **pericardial sac**.
- **Fusion** of the two tubes occurs in a **Craniocaudal direction**.
- The **heart** tube grows **faster** than the **pericardial sac**, so it shows **5 alternate dilations** separated by **constrictions**.



2. Truncus arteriosus (**Arterial** end)

5. Common Atrium

1. Sinus Venous (**Venous** end)



3.Bulbus Cordis.

- The **bulbus cordis** forms the smooth **upper part** of the **two ventricles**.
- **Right Ventricle**: Conus Arteriosus or (Infundibulum) which leads to the pulmonary trunk.
- **Left ventricle**: Aortic Vestibule leading to ascending aorta.

*Bulbus cordis & ventricle **grow faster** than other regions.

4. Common Ventricle

* Veins Draining into Sinus Venosus

Each **horn** of the sinus venosus receives **3** veins
1.**Common cardinal** from the fetal body.
2.**Vitelline** from the yolk sac.
3.**Umbilical** from the placenta.

*Fate of Sinus Venosus

- **Right Horn** → forms smooth posterior part of right atrium.
- **Left Horn & Body** → **atrophy** & **form the Coronary Sinus.**
- **Left Common cardinal vein** → forms the Oblique Vein of Left Atrium.

Right Atrium:
- Rough Trabeculated anterior part (musculi pectanti) of right atrium is derived from primordial common atrium.
- These two parts are demarcated by the crista terminalis **internally** and sulcus terminalis **externally**.

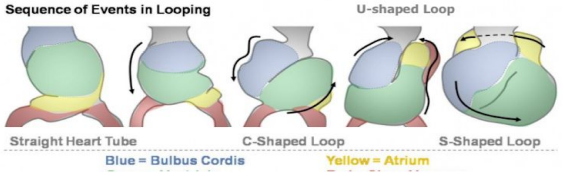
Left Atrium:
- Rough Trabeculated part: derived from the common primordial atrium.
- The **smooth** part: derived from **absorbed Pulmonary Veins**.

What Is the Shape of the Heart Tube?

2 **S-Shaped** Heart Tube (Loop Formation) As the Heart develops it bends upon itself

1 **U-shaped** Heart Tube (Bulboventricular loop) Heart bends upon itself

* Atrium and Sinus venosus become **Cranial** in position & **Dorsal** to the Truncus arteriosus, Bulbus cordis, and Ventricle.
* Sinus venosus (opens in the dorsal surface of the atrium) has developed 2 lateral expansions, (Horns) :Right and Left



A special thanks to team 435

3. Partitioning of Primordial Ventricle:

Muscular part of the interventricular septum.
Division of the primordial ventricle is first indicated by a median muscular ridge, the primordial interventricular septum.It is a thick crescentic fold which has a concave upper free edge.This septum bounds a temporary connection between the two ventricles called Interventricular foramen

2. Partition of the Common Atrium:

Septum Primum: grows from the roof of the common atrium towards the fusing endocardial cushions **(septum intermedium)** So it divides the common atrium into right & left

Ostium Primum:

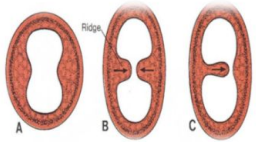
The two ends of septum primum reach to the growing **endocardial cushions** before its central part.
Now the septum primum bounds a foramen called ostium primum.It serves as a shunt, enabling the oxygenated blood to pass from right to left atrium.
The ostium primum become smaller and disappears as the septum primum fuses completely with the septum intermedium to form the AV septum.

Interventricular Septum:

The Membranous part of the IV septum is derived from:
1- A tissue extension from the right side of the endocardial cushion.
2- Aorticopulmonary septum.
3- Thick muscular part of the IV septum

Partitioning of Primordial Heart:

It begins by the middle of 4th week. It is completed by the end of 5th week
- Endocardial Cushions:
They appear around the middle of the 4th week as Mesenchymal Proliferation



1. Partitioning of the atrioventricular

The two AV endocardial cushions approach each other and fuse to form the **Septum Intermedium**.
Dividing the AV canal into right & left canals and separate the primordial atrium from the ventricle.

4. partition of Truncus Arteriosus:

In the 5th week, proliferation of mesenchymal cells (Endocardial Cushions) appear in the wall of the truncus arteriosus ,they form a Spiral Septum:
A. It divides the Lower part of the T A into Right & Left parts
B. It divides the Middle part of TA into Anterior & Posterior parts.
C. It divides the Upper part of the TA into Left & Right parts.

Septum Secundum:

The upper part of septum primum shows gradual resorption forming an opening called ostium secondum.Another septum descends on the right side of the septum primum called Septum Secundum.it forms an incomplete partition between the two atria.Consequently a valvular oval foramen forms, **(Foramen Ovale)**.

Fate of foramen Ovale:

Its site is represented by the Fossa Ovalis:
Its floor represents the persistent part of the septum primum.
Its limbus (anulus) is the lower edge of the septum secundum.

MAJOR CARDIAC ANOMALIES

1. Atrial Septal Defects

Types :
1. Absence of both septum primum and septum secundum, leads to common atrium.
2. Absence of Septum Secundum
3. Large (Patent) foramen ovale : Excessive resorption of septum primum

2. VENTRICULAR SEPTAL DEFECT

Roger's disease:
Absence of the *Membranous* part of interventricular septum (persistent IV Foramen). Usually accompanied by other cardiac defects.
Fallot's Tetralogy:
1-VSD.
2- Pulmonary stenosis.
3-Overriding of the aorta
4- Right ventricular hypertrophy.

3. TRANSPOSITION OF GREAT ARTERIES

due to abnormal rotation or malformation of the **aorticopulmonary septum**, so the right ventricle joins the aorta, while the left ventricle joins the pulmonary artery .It is one of the most common causes of cyanotic heart disease in the

4. Persistent Truncus

It is due to failure of the development of **aorticopulmonary (spiral) septum.**
It is usually accompanied with VSD. It forms a single arterial trunk arising from the heart and supplies the systemic , pulmonary & coronary

A special thanks to team 435

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We wish you all the best

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