

ANATOMY / HISTOLOGY

☒ Sheet

☐ Slide

☐ Handout

Number

Lab 4 {Anat. Lab3}

Subject

Valves of heart, coronary arteries & CT
scan

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.....

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Date: 00/00/2016

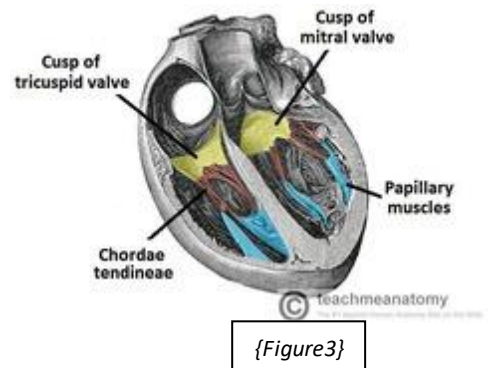
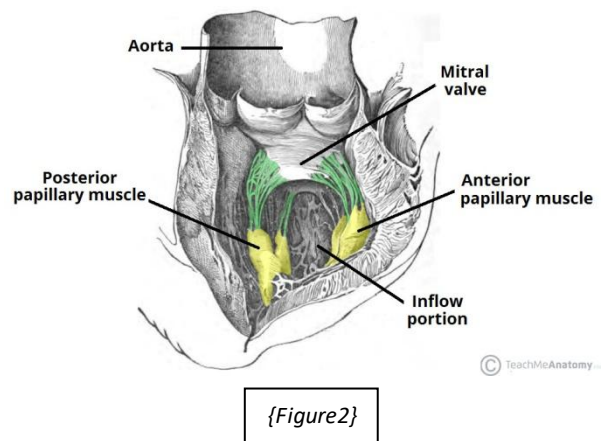
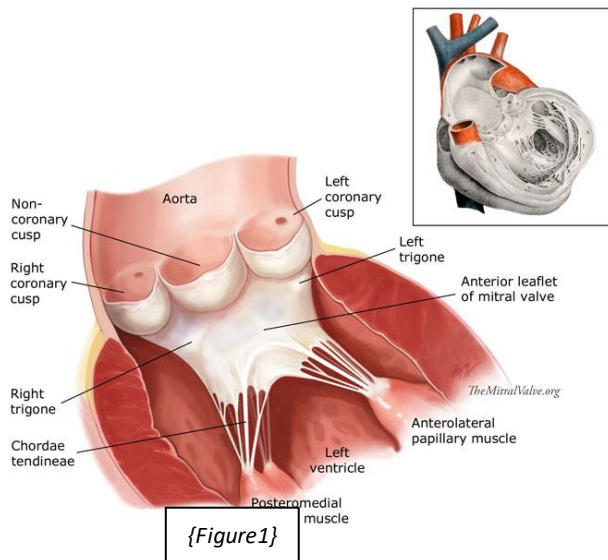
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Anatomy Lab 3 {4th Lab}

- ~ At the end of this sheet some past papers questions for the lab material.
- ~ There is a link for CT scan notes done by last year batch, helpful & enough for the exam.

❖ **Valves of the heart:**

- 1) Atrio-ventricular (AV) valves: Tricuspid & bicuspid “mitral” valves.. {fig.3}
 - 2) Semilunar valves: Aortic & pulmonary valves .. 3 cusps.
- In the anterior position of the heart, you can see the anterior cusp of bicuspid and if we elevate it you will see the posterior cusp of bicuspid.. {fig.1&2}
 - **All valves of heart open and close passively.**
 - Both surfaces of anterior cusp of bicuspid valve are smooth.. {fig.1&2}
 - Anterior cusp of tricuspid is the largest cusp (anterior, posterior & septal)



- Opening of the AV valves (bicuspid & tricuspid):

- Bicuspid for example, in diastole the blood accumulates in the atria “venous return”, then the blood fill the heart “fill the atria”, thus the atria distended and become full of blood, blood pressure increases inside it.
- When the blood pressure in the atria become higher than the blood pressure in the ventricles .. the AV valve will open, atria will send “not pump” the blood to the ventricles, 70% of blood flow to the ventricles by diffusion and the few amount that lift need little atria contraction.
- Opening of the valve doesn't make a sound.

- Closure of the AV valve:

- In systole, the first phase of systole “heart contraction” is the Isovolumetric systole .. the wall of ventricle will contract without any shortening of the fibers,
- This contraction leads to increase in the pressure inside the ventricle, increase the tension in the wall, when blood pressure increases in the ventricles, the first thing to happen is the closure of AV valve, the cusps elevate until they touch each other, then the AV valve close.
- Closure of AV valve is the first sound of the heart (S1) “Lub”.

Q: Why the AV valves close?

- To prevent back flow of blood to the atrium during systole.

- Opening of the Semilunar valve:

- Aortic semilunar is an example of this valve.
- During systole and after the closure of AV, the Semilunar valve will open.
- After the opening of semilunar valve, Blood pressure in the “ventricles at early systole” is higher than blood pressure in the aorta, so the blood will be ejected.
- Ventricles will pump “not send” the blood.
- Opening of the semilunar valve doesn't make any no sound.

- Closure of the semilunar valve:

- When systole ends & diastole begins, little amount of blood will flow back, this blood will fill the semilunar cusps “فتاجين”, then the semilunar valve will close.
- Closure of semilunar will make the second heart sound of heart (S2) “Dub”.

#Lub is the 1st sound (S1) due to closure of AV valve in early systole.

#Dub is the 2nd sound (S2) due to closure of semilunar valve in early diastole.

Q: Is there a phase when all heart cusps are closed?

- Yes. At early systole, in the iso- volumetric contraction phase closure of AV valves & the semilunar valves already closed and not open yet.
- Also in the early diastole “the isometric relaxation phase” all valves are closed too.

Q2: Is there a phase when all valves of heart are open?

- **NO.** If the AV valves are open during systole the blood will flow back to the atria.

~ **Mitral stenosis:**

- In mitral stenosis, blood will accumulate in the left atrium, then blood flow back and accumulate in the lungs, lead to congestion of blood in the lungs & cause **pulmonary congestion.**
- Right ventricle pump blood to the valve less pulmonary trunk & its branches, then to the lungs, the ventricle pumps blood less than the amount it receives, so at the beginning the right ventricle enlarges increasing the pumping power, after a while right ventricle will fail, this is called **right-sided heart failure.**

Q: When the pressure in the right atrium “central venous pressure” increases?

~ **Tricuspid stenosis** or **Right-sided heart failure:**

- In tricuspid stenosis blood will accumulate in right atrium.
- As the pressure increase in the right atrium, the cardiac output of right ventricle decreases, then the cardiac output of left ventricle decreases too, as in deep vein thrombosis DVT, will lead to pulmonary trunk “embolism”, thus the blood that goes to lungs will decrease, the lungs receive low amount of blood, so reduce in the amount of blood that goes to left ventricle, lead to **left-sided heart failure.**

- In Tricuspid stenosis blood will flow back to the veins (S.V.C & I.V.C), brachiocephalic and to internal jugular vein, this will lead to a congested veins (e.g. veins of the neck).

- Blood will accumulate in systemic circulation “in capillaries”, this will lead to edema.
- Blood will accumulate also in liver & spleen.

#**Congested veins** can be seen in the neck of the patient, **Internal & external jugular vein** (the external on surface of sternocleidomastoid muscle “visible”), this could be due to:

- 1) **Right-sided heart failure.**
- 2) **Tricuspid stenosis.**
- 3) Pericardial effusion.

Pericardial effusion: an abnormal accumulation of fluid in the pericardial cavity between the heart and the sac which affects the function of the heart.

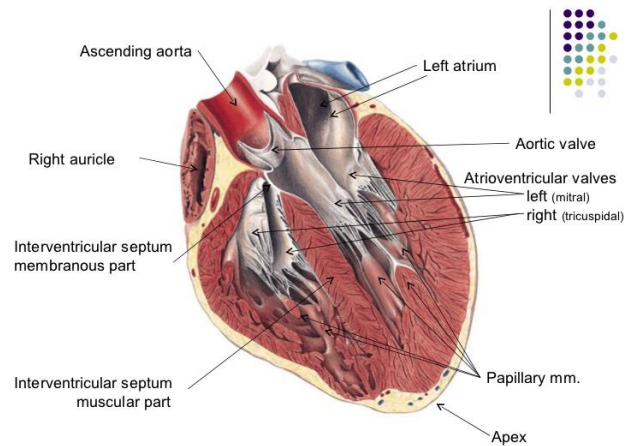
*** The most common cause of right-sided heart failure is the left-sided heart failure !**

- In left-sided heart failure left ventricle output decreases, blood will accumulate in the left atrium, then blood will return back to the lungs “pulmonary congestion”, the right ventricle will

find a difficulty in pumping blood to the lungs this will lead to right-sided heart failure; because of the accumulation of blood in lungs.

❖ Interventricular septum {fig.4}:

- Thick muscular except the upper part “thin membranous”.
- The membranous part located inferior to the aortic valve.
- Interventricular septum is directed obliquely backward to the right in coronal “not sagittal” plane.
- Right atrium & ventricle are anterior and to the right in relation to left atrium and ventricle.
- The heart is rotated 45° , $\frac{2}{3}$ is shifted to the left.



{Figure4}

* 3 facts about the membranous part:

- 1) The anterior part is between the two ventricles .. called Interventricular, Inferior to septal cusp of tricuspid.
- 2) The posterior part is between the left ventricle & right atrium .. Atrio-ventricular, superior to the septal cusp.
- 3) It is susceptible to defect “perforation” VSD ventricular septal defect.

- Septal cusp attached to the septum.. {fig.5}
- #Superior to the septal cusp is the atrium.
- #Inferior to the septal cusp is the ventricle.

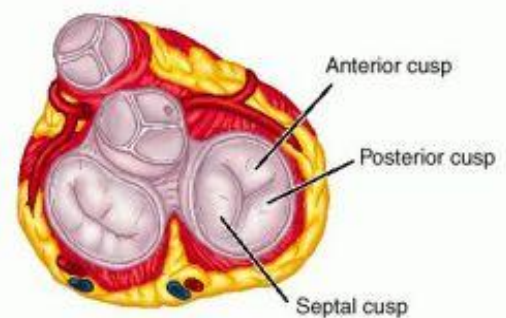
#If the hole was large in VSD, this will lead to shunt, blood flow from higher pressure “left ventricle” to lower pressure “right ventricle”, ONLY in systole, no shunt in diastole.

- Blood pressure in the left ventricle during systole equal that of aorta = 120 mm Hg,

- While in the right side blood pressure in the ventricle & pulmonary = 25 mm Hg.

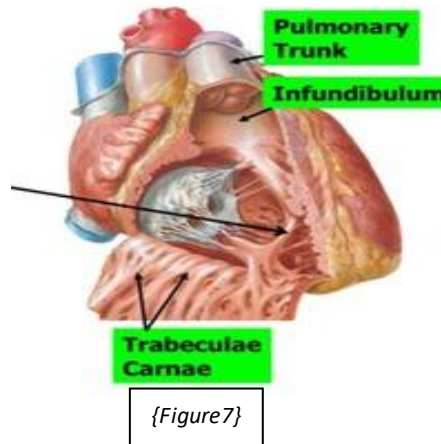
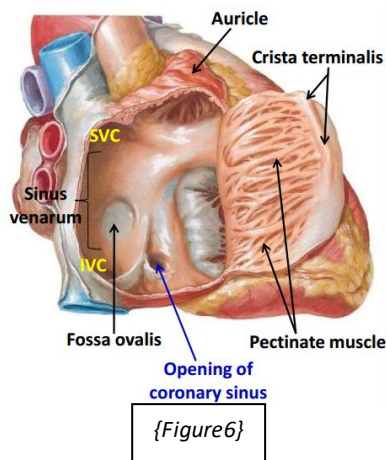
- In diastole, the diastolic blood pressure in the left and right is the same = **0 mmHg**.

#However the pressure “during diastole” in aorta will be (80); because of recoil.



{Figure5}

- The lower part of ventricle wall is rough called trabeculae carneae..{fig.7}
- The upper part is smooth: in the left called aortic vestibule & on the right infundibulum..{fig.7}
- In the right atrium there are crista terminalis & pectinate muscles..{fig.6}
- Pectinate part including the auricle.
- Musculi pectinati: is a series of transverse muscular ridges they arise from crista terminalis.
- Crista terminalis in its upper end is the SA node, it separates the rough part from the smooth part.



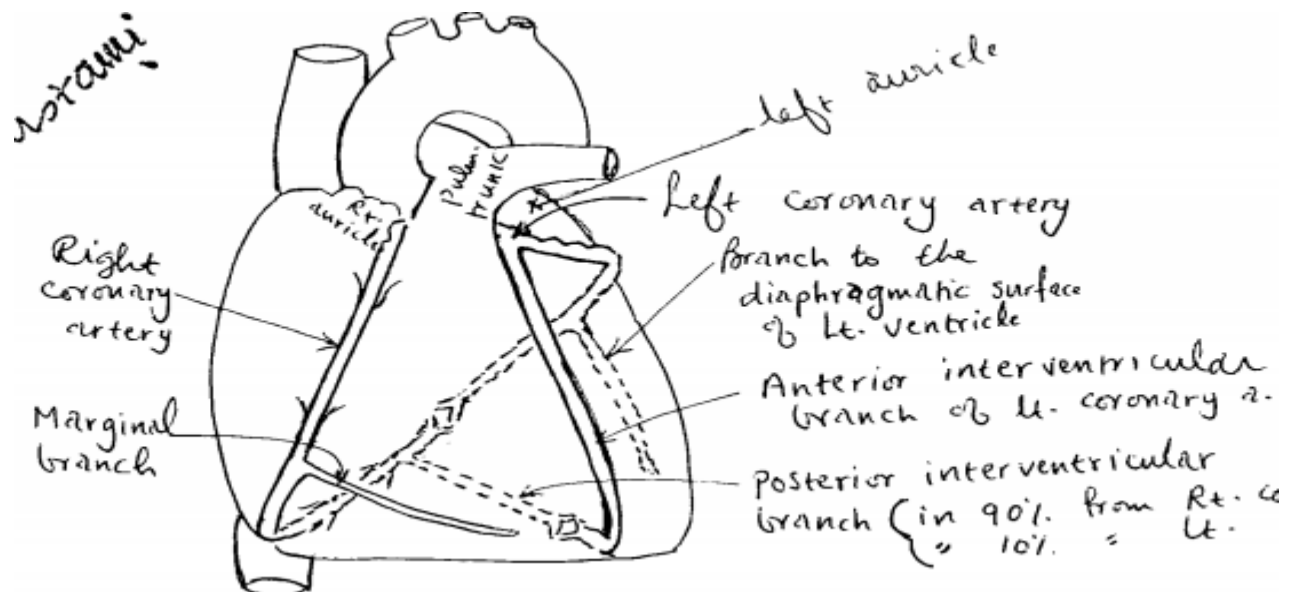
#Bulbus cordis gives the whole right ventricle & aortic vestibule.

#The primitive gives the rough part trabeculated.

#The rough anterior part of the right atrium developmentally it is derived from the primitive atrial chamber.

❖ Right & left coronary arteries:

- Branches of ascending aorta.
 - Left branch “circumflex” anastomose with the right on posterior surface of the heart.
- **Right coronary artery** {fig.8}:
 - From anterior aortic sinus.
 - Descends downward from its beginning and gives the marginal branch.
 - Then runs posterior to anastomose with left coronary artery.
 - Before it meets the left coronary artery it gives the posterior interventricular branch, which supply the AV node & AV bundle.
 - At the beginning it gives the first branch nodal to the SA node.



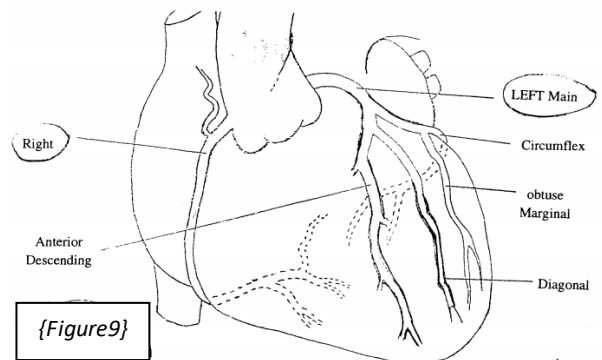
{Figure8}

- **Left coronary artery** {fig8&9}:

- From left posterior aortic.
- Begin inferior to the left auricle.
- On the surface it gives 2 branches, anterior interventricular branch or “LAD” & circumflex branch.
- Circumflex gives obtuse marginal branch.
- When the circumflex runs posterior it gives artery to diaphragmatic surface of left ventricle.
- Circumflex runs posteriorly and anastomose with right coronary artery.

~ **Left anterior descending (LAD)** .. {fig.9}:

- Gives a diagonal branch.
- Runs in the atrio-ventricular groove “coronary groove” and between the ventricles.
- Anastomose with the posterior interventricular branch (mostly a branch from the right coronary artery).



{Figure9}

Q: What controls the blood flow in coronary arteries?

- Blood pressure in the aorta, they are branches from ascending aorta, so when there is high blood pressure in the aorta, will push blood to the branches.

Q2: What resist blood flow?

- 1st The branches inside the muscle “in myocardium”, during systole branches will narrow and coronary branches resist blood flow.
- During diastole the muscle is relaxed the arteries will open and blood will flow.

- 2nd the blood pressure inside the ventricle, during systole the wall of ventricle will contract isometrically, thus blood pressure increases inside it.
- When blood pressure increases inside the left ventricle, this will compress the wall too, so the compression on the arteries inside the wall will resist the blood flow.
- Contraction & the compression on the wall from the inside the 2 factor that resist blood flow !

#Right coronary fill blood in systole & diastole .. thin wall of right ventricle.

#Left coronary fill in the diastole only; because of thick wall of left ventricle.

- **Aorta & pulmonary trunk:**

- ✓ Pulmonary trunk divides inferior to the arch.
- ✓ Posterior to the ascending aorta is the inferior vena cava.

~ Inferior to the arch is the left bronchus.

- Anterior to the esophagus & descending aorta only one structure that is directly related to the esophagus, the left bronchus.

- Left atrium is not directly related to the esophagus there are pericardium and oblique sinus separate the left atrium from the esophagus.

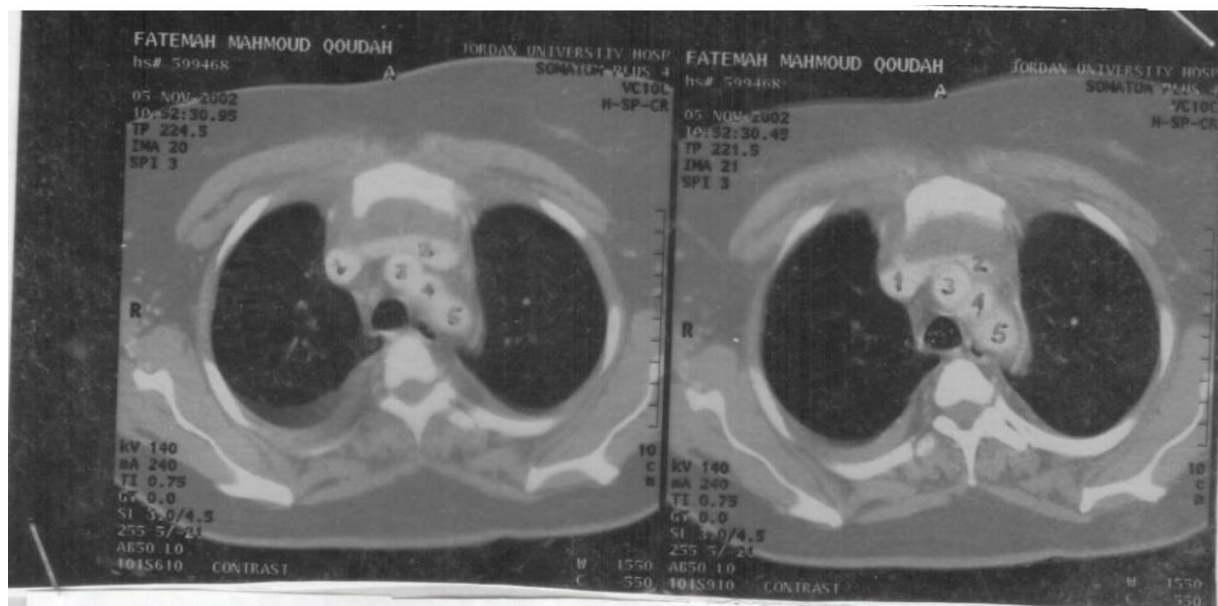
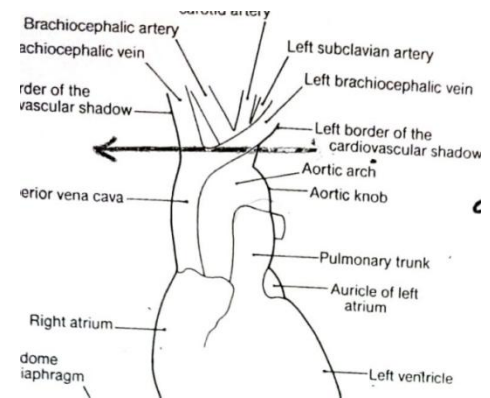
❖ **Left vagus & left phrenic:**

- Left phrenic nerve passes over the pericardium of the left ventricle.
- Left vagus runs anterior to the arch, gives left recurrent laryngeal nerve.
- Left recurrent laryngeal nerve related to 4 structures:
 - ✓ **Inferior to the arch.**
 - ✓ **Posterior to the ligamentum arteriosum.**
 - ✓ **Between trachea & oesophagus.**

❖ **CT scan** * VERY IMPORTANT*:

❖ **Cross section superior to the arch .. {CT1}:**

- Notice the arrow in the figure, indicates the level of the cross section.
- The section cuts the brachiocephalic “appear like a ring”, and the left common carotid.
- Anterior to them left brachiocephalic runs coronally.
- 3 branches of the arch appear.

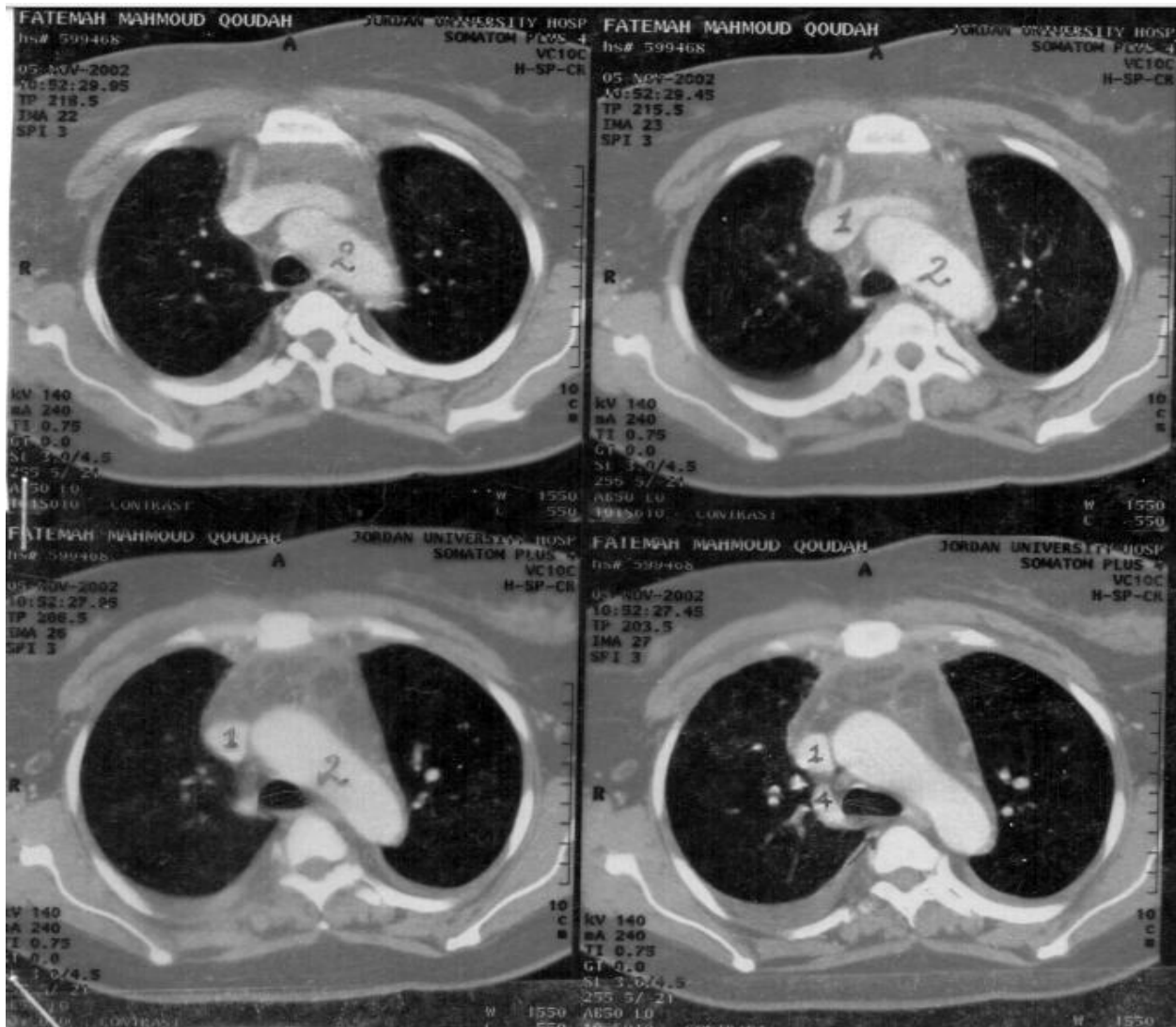
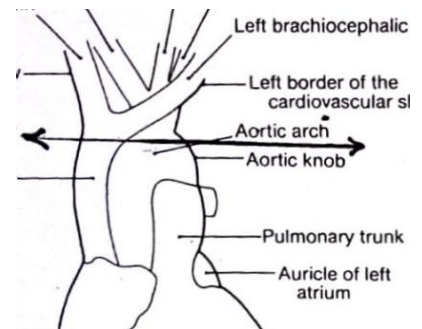


CT1: Superior to the arch.

- 1) Right brachiocephalic vein.
- 2) Left brachiocephalic vein.
- 3) Brachiocephalic trunk.
- 4) Left common carotid artery.
- 5) Left subclavian artery.

❖ **Cross section through the arch .. {CT2}:**

- Notice the arrow.
- The beginning of the arch is anterior & the end posterior.



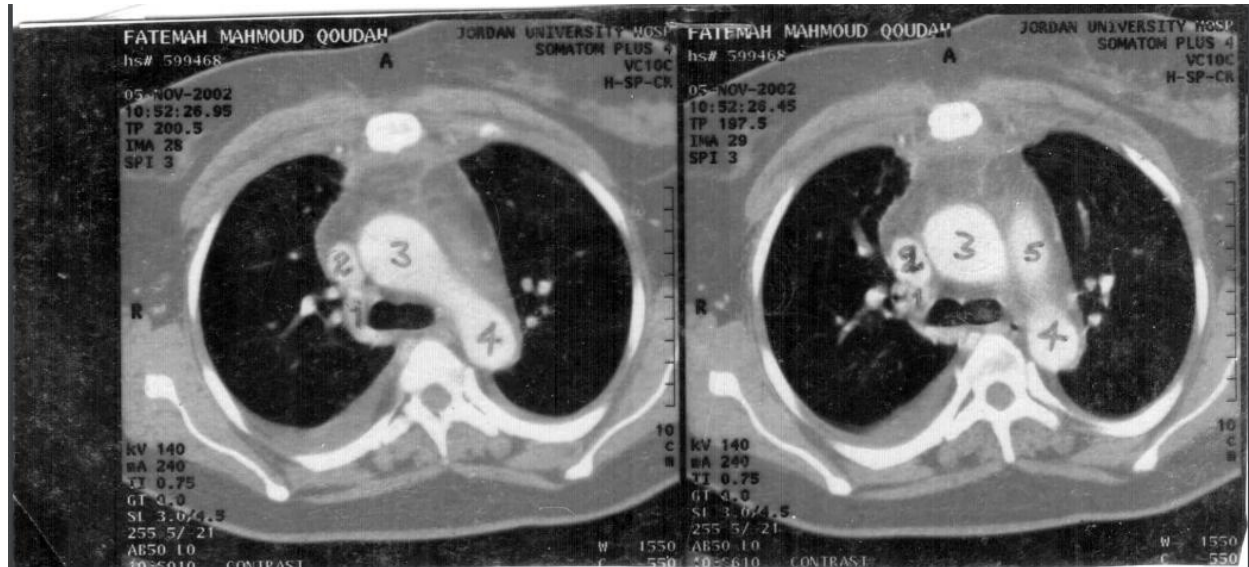
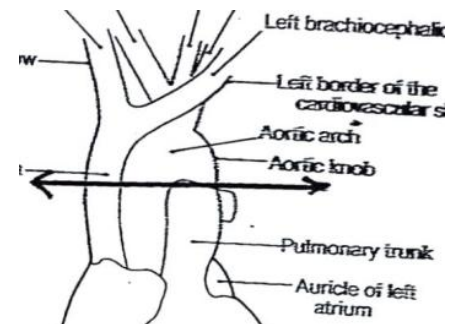
CT2:Through the arch.

- 1) Union of left & right brachiocephalic veins to form S.V.C.
- 2) Aortic arch.

❖ **Cross section in the upper part of the heart (lower to the arch) .. {CT3}:**

- Beginning of ascending aorta is posterior to right ventricle.

Ascending aorta runs out from left ventricle and goes to the right so it will run posterior to the right ventricle.

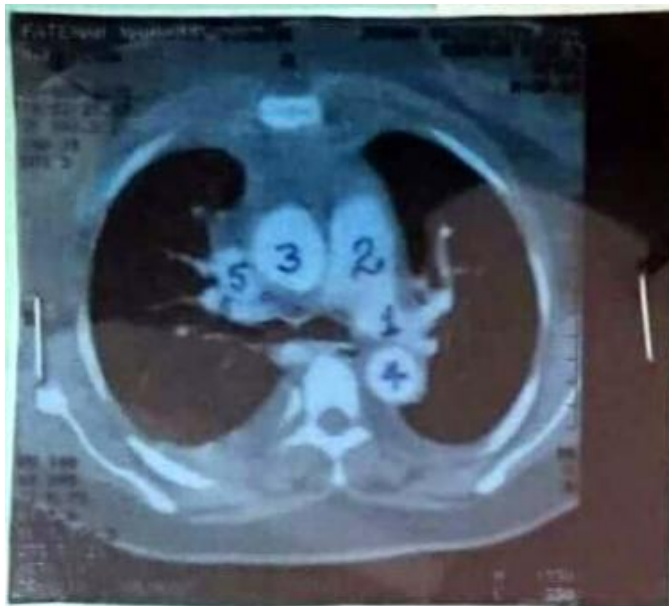
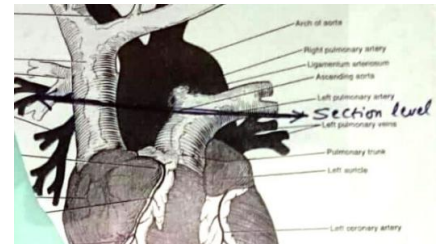


CT3: Lower to the arch.

- 1) Azygos vein: arching over right primary bronchus.
- 2) Superior vena cava.
- 3) Aortic arch: near its origin.
- 4) Aortic arch: near its termination.

❖ **Cross section in the ascending aorta .. {CT4}:**

- The pulmonary trunk appears with its left branch “short”, this is decided by the lungs position, lungs position decide the vessels position.
- The descending aorta appears posteriorly.
- Oesophagus appears.
- Bifurcation of the pulmonary trunk appear.



CT4: In the ascending aorta.

- 1) Left pulmonary artery.
- 2) Pulmonary trunk.
- 3) Ascending aorta.
- 4) Descending thoracic aorta.
- 5) Superior vena cava.

- CT scan sections are very important, make sure to understand them, please refer to {Handout 3}.

~ In this link CT scan notes by Amer Abuahnab (4th year student):

https://dl.orangedox.com/EwFOOw1z0F4Jr0ScIk/CT%20scan%20of%20the%20heart%20and%20the%20related%20structures_BY_AmerABUShanab.pdf }

~ CT scan notes by 5th year student:

{ http://msg2018.weebly.com/uploads/1/6/1/0/16101502/ct_scans.pdf }

❖ Past papers:

- 1- A CT scan – What is true – Both (ascending aorta supplies blood to the heart muscle and descending aorta supplies little blood to the lungs)
- 2- A CT scan – What is true – 1 is the pulmonary trunk and its right branch (the wrong is that we see the beginning and the termination of the arch of aorta at this level)
- 3- A CT scan – What is true – Both (increase in the right atrial pressure decreases the venous return to it and the left ventricle receives more blood during diastole)
- 4- A CT scan – What is wrong – in a large ventricular septal defect, blood flow to the ascending aorta increases
- 5- A picture of the open right ventricle pointing at the anterior papillary muscle – What is true – all (attached by chordae tendinae to two cusps and its rupture can cause acute heart failure)
- 6- A picture of the internal jugular vein – Which causes increase in blood inside it – both (right heart failure and tricuspid regurgitation)
- 7- A picture of the open right atrium pointing at fossa ovalis – What is true – none (floor is made from septum secundum and upper margin from septum primum)
- 8- A picture of the open right atrium pointing at crista terminalis – What is true – all (in the embryo it separates the right atrium from the right horn of sinus venosus and at its upper end the SA node is found)
- 9- A picture of the open left ventricle pointing at the membranous part of the interventricular septum – What is true – none (it is closed after birth and is related to the AV node)
- 10- A picture of the mediastinum pointing at the ligamentum arteriosum – What is true – if it was left patent the pressure inside the arch of aorta and pulmonary artery would be equal (it is attached to the middle of the arch and to the pulmonary trunk)
- 11- A picture of the coronary vessels in an X-ray from the left side pointing at the anterior interventricular branch of the left coronary artery – What is true – both
- 12- A section of a vessel media – Which is not found in this vessel – none (smooth muscle, collagen and elastic fibers)
- 13- A picture of the myocardium – What is true – none (each muscle fiber is one cell and the branching helps distribute the action potential)
- 14- A picture of the auscultatory areas of the heart valves – From which is the blood flowing from the left ventricle – 1 (the right second intercostal space)

1. CT scan asking about aorta and left atrium :
- a. structure 1 is the ascending aorta
 - b. structure 2 receives blood from SVC and IVC
 - c. A and B
 - d. None of the above

2. CT scan asking about SVC and the branches of aorta :
- a. structure 1 lies in sup and inf mediastinum
 - b. structure 2 is brachiocephalic trunk
 - c. A and B
 - d. None of the above

3. CT scan showing pulm. trunk bifurcation :
- a. structure 2 is the Rt. pulmonary artery



- b. beginning and ending of aortic arch
- c. A and B
- d. None of the above

4. CT scan asking about SVC and aortic arch :
- a. structure 1 is SVC
 - b. Rt bronchus related inferiorly to structure 2
 - c. A and B
 - d. None of the above

5. X-ray :
- a. structure 1 is aortic nodule
 - b. structure 2 is Rt. atrium
 - c. gases can be normally present at structure 3
 - d. A and B only
 - e. all of the above

6. picture shows ligamentum arteriosum :

- a. this structure lies between the end of Lt. pulm artery and end of aortic arch
- b. this structure is related to the recurrent laryngeal nerve
- c. A and B
- d. None of the above

7. picture shows surface marking of the valves, what is the number of pulmonary valve (the question has sth about Rt. ventricle not directly asked about pulm. valve) ?

- a. 1
- b. 2
- c. 3
- d. 4

8. picture about foramen ovale :

- a. the ridge is septum primum
- b. the floor is septum secundum
- c. when this structure is still open after birth ,blood shunts from Rt. atrium to Lt. atrium
- d. none of the above

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9. picture about papillary muscle of tricusped valve :

- a. this structure opens and closes the valve
- b. cut of one of papillary muscles affects the competency of the valve
- c.
- d.

10. picture about Lt. coronary artrey :

- a. this structure is the ant branch of Lt.coronary (or ant interventricular)
- b. this structure at muscular exercise
- c.
- d.

11. picture about external jugular vein :

- a. Tricusped stenosis
- b. ...
- c. pericardial effusion
- d. all of the above

12. picture about crista terminalis :

- a. this structure is crista terminalis
- b. SA node lies at its upper margin
- c. in embryo it separates pirimitive atria about right horn of sinus venosus
- d. all of the above

13. CT scan about ascending and descending aorta:
- a. structure 1 supplies the heart
 - b. structure 2 supplies the lung
 - c. A and B
14. A CT or picture:
- a. at this level trachea ends
 - b. aortic arch related to upper half of manubrium <<< WRONG
 - c. A and B
 - d. none of the above

***Histo:**



15. vasodilation of which one of these vessels causes decrease in arterial pressure:
- a. 1
 - b. 2
 - c. 3
 - d. 4
 - e. 5
16. elastic artery (aorta) in trichrome stain :
- a. this vessel is rich in elastic fibers
 - b. this vessel expands during systole and recoils during diastole
 - c. A and B
 - d. None of the above
17. vein (Trichrome stain)
- a. this vessel is rich in collagen
 - b. this vessel has little smooth muscles and elastic fibers
 - c. A and B
 - d. None of the above
- 18.heart:
- a. each muscle fiber has one cell
 - b. branches spread the excitation...
 - c. A and B
 - d. None of the above

*** Other past papers:**

- { <http://jumed14.weebly.com/uploads/5/8/7/5/58753271/important-lab-pastpapers.pdf> }
- { <http://jumed14.weebly.com/uploads/5/8/7/5/58753271/important-lab-pastpapers-2.pdf> }

- Sorry for any mistake I may have made.
- Good luck <3