

# CARDIOVASCULAR SYSTEM

SUBJECT : Anatomy

LEC NO. : Lecture 2

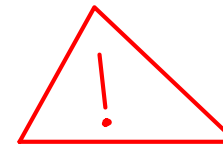
DONE BY : Gaith and ATA 🇸🇵🇸

وَقُلْ رَبِّ زِدْنِي عِلْمًا



SCAN ME!

اختارة الامتحان من السلايد ومن الاسئله العمويه  
بالتالي اي اسئله الدكتور تشرحه بشكل مثله موهوبه بالسلايد مثله داخله وعشان تتأعدوا اخذوا رجاؤكم  
التقريب عند دقيقه 47



CVS....

## Lecture (2)

# Anatomy of the Heart

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# ILOS

1. To describe the internal features of each chamber of the heart.
2. To describe the fibrous skeleton of heart.
3. To identify papillary muscles and describe their locations and importance.
4. To describe the atrioventricular, semilunar (pulmonary and aortic) valves, their position, functional importance, surface marking and ideal sites for their auscultation.
5. To describe different parts of the conductive system of the heart.

# Interior of the right ventricle

Internal Features.

Transverse section

## Cross section

- Has a semilunar cavity.
- Its wall: 1/3 thickness of the wall of the left ventricle.

thickness of right ventricle is less than the left ventricle ال left ventricle بتوصل الدم لجميع انحاء الحسم من خلال ال aorta ، فراح يكون ال force of contraction of left ventricle اقوى ومن ال force of contraction of right ventricle

## A- Has 2 openings:

Tricuspid & Pulmonary.

## B- Has smooth (outflow) part:

- Infundibulum of pulmonary trunk; funnel shaped part of right ventricle toward the pulmonary orifice, separated from inflow part by supraventricular crest.

## C- Rough (inflow) part: shows (3 features)

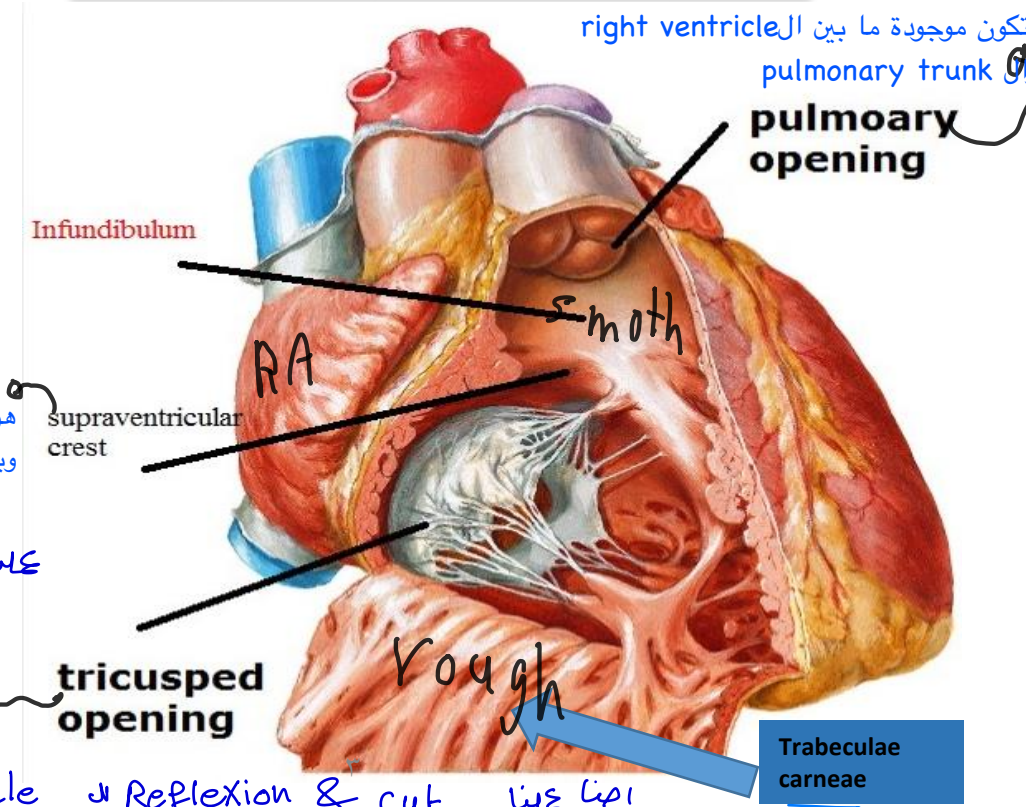
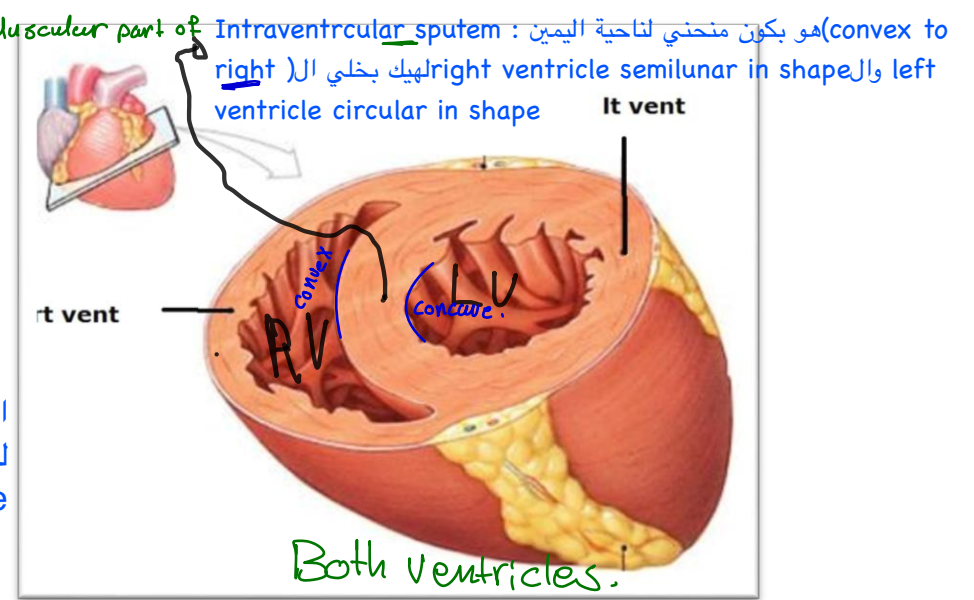
### 1-Trabeculae carneae:

Muscular ridges that freely intercross. and make mesh work

in the inner wall of inlet of R. Ventricle.

right ventricle ال right atrium وال بتكون موجودة بين ال

wall of R.ventricle



refers to structures that are shaped like small, nipple-like projections

## 2-Papillary muscles: three in number in R. ventricles

Anterior, posterior & septal papillary muscles

Shape: conical has:

- **Base:** attached to the ventricular wall.
- **Apex:** gives chordae tendinae that attached to the margins & ventricular surface of cusps of the tricuspid valve.
- **Function:** they prevent prolapse of cusps (eversion to the atrium), holding them in a closed position.

هو عبارة عن tendon يربط بين ال three papillary muscle

↑ pressure في ال Valve تنقلب باتجاه Atrium بسبب

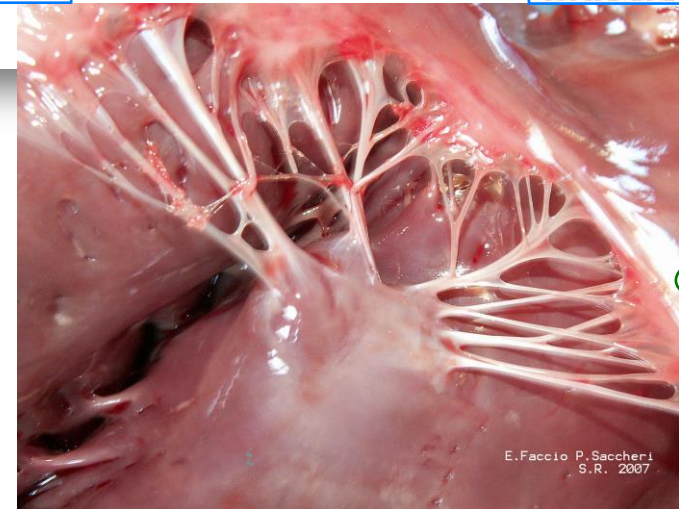
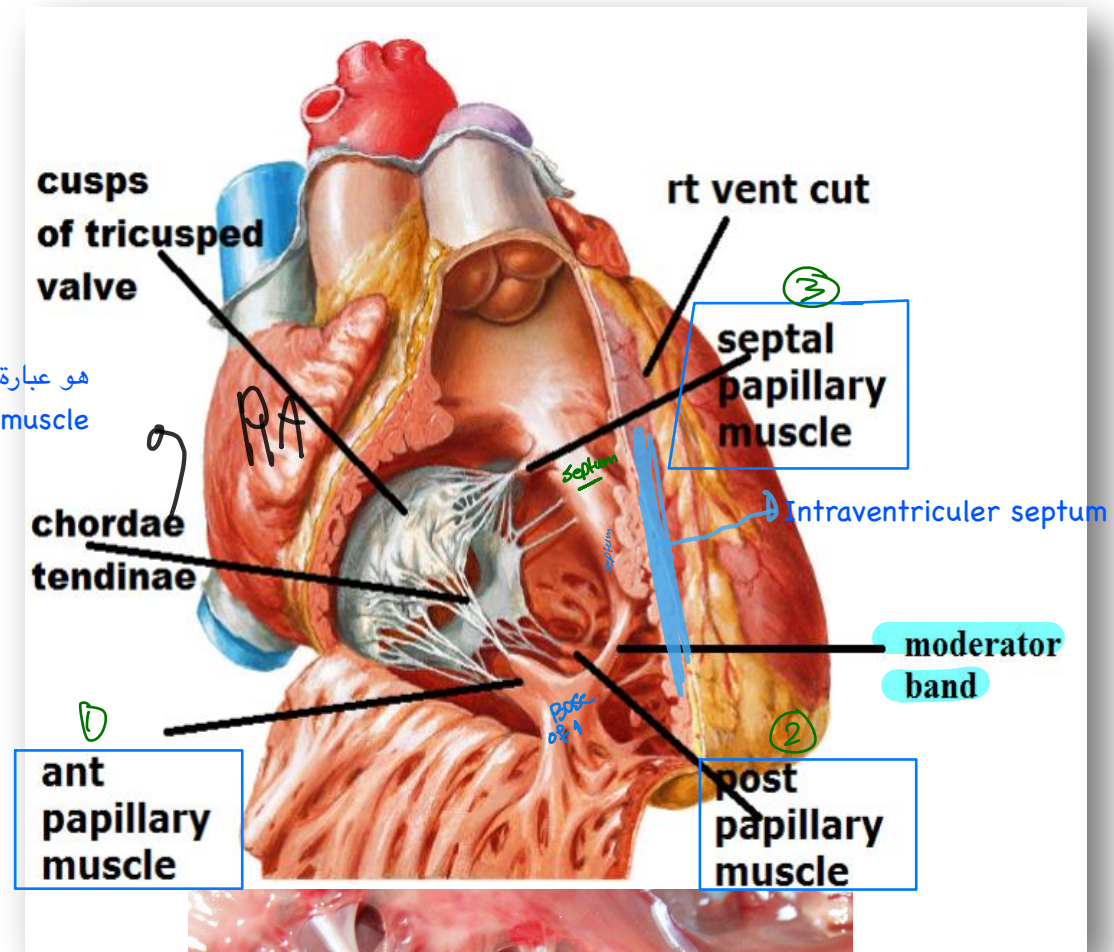
right ventricle contraction بتبدأ تمتلئ بالدم راح يصير ال right ventricle contraction اول right Ventricle contraction  
Papillary muscle هو ال contraction يصر ال عشان يغلق الفجوة الي بين ال R.V. وال R.A. بالتالي يمنع وصول الدم لل right atrium

## 3-Moderator band:

- It is a trabecula from the interventricular septum to the base of anterior papillary muscle.
- **Function:** Transmits the right bundle branch.

طيب مين هاي ال right bundle branch?

هي تعتبر واحدة من اجزاء ال conductive system of the heart



- ① Base of it attach to anterior wall of R. ventricle
- ② Base of it attach to posterior wall of R. ventricle.
- ③ Base of it attach to septum

# Interior of the left Ventricle



السلام هان رع  
ليكون اجهل ما تخافون من - مجمل اع

## Cross section:

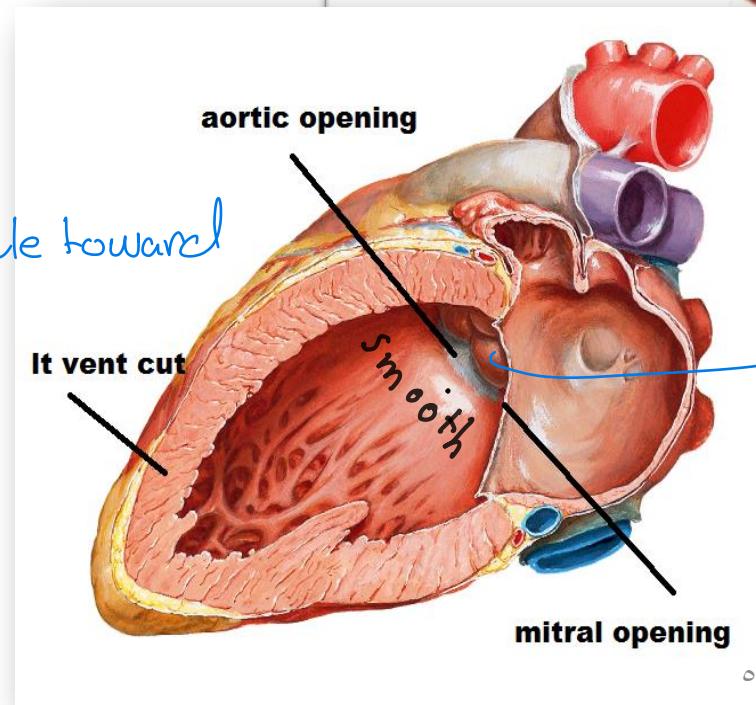
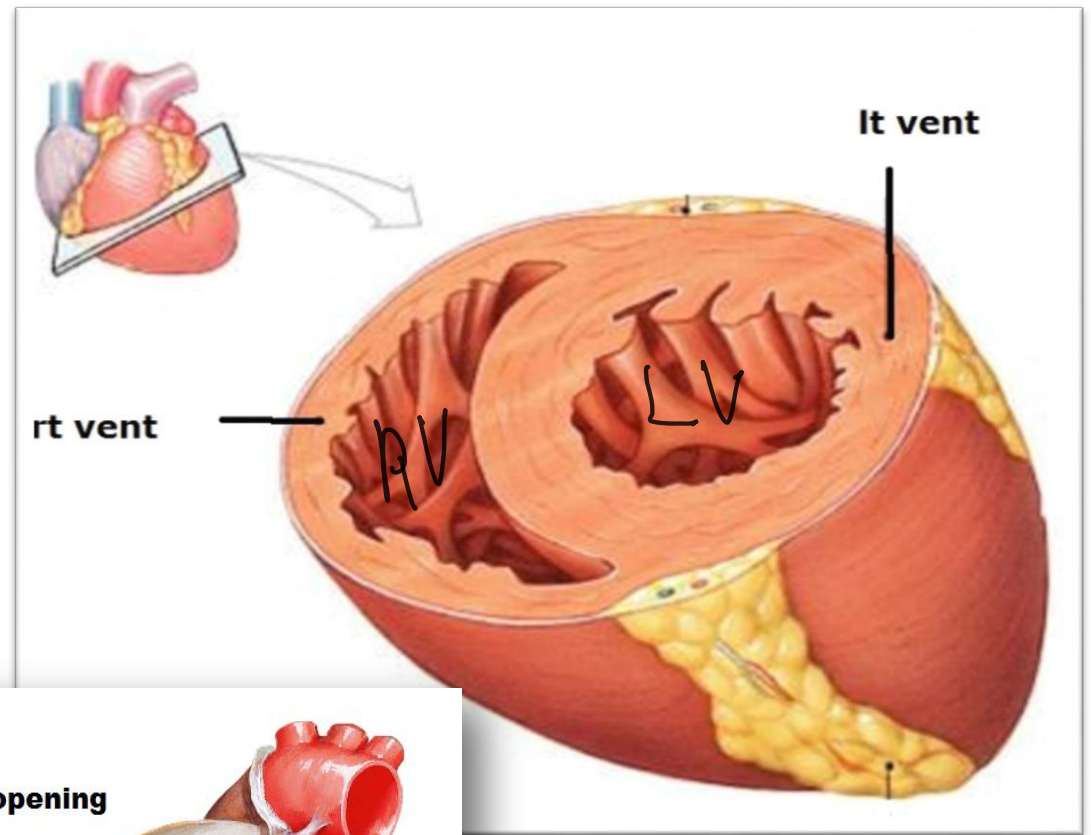
- Has circular cavity.
- Its wall: three times thickness of the wall of the right ventricle. (Thicker than the right)

## A- Has 2 openings:

Mitral & Aortic.

## B- Smooth (outflow) part: part of Lt Ventricle toward Aorta

Aortic vestibule, below the aortic opening.



Aortic Valve.

C- Rough (inflow) part, shows:

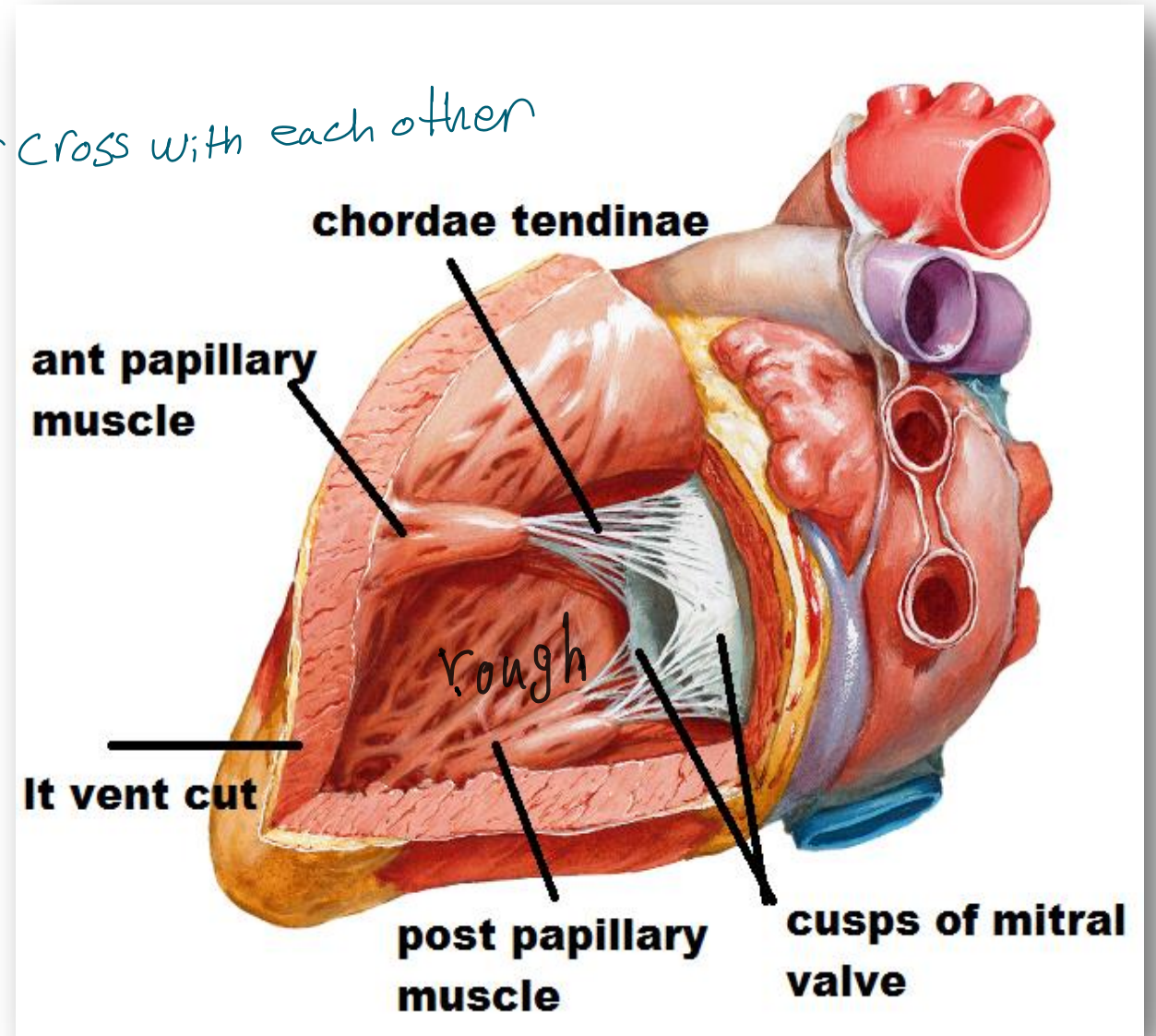
1- **Trabeculae carneae.** → Muscular Ridges inter cross with each other  
mesh work

2- **Papillary muscles:** two in number,  
Anterior & posterior papillary muscles.

**Shape:** larger than that of the right ventricle,  
chordae tendinae are attached to margins &  
ventricular surface of cusps of the mitral valve.

↳ نفس الوصف تجده في R. ventricle

3- **Has no moderator band.**



# Interventricular septum

من اسفله طرف هو وطيفته او



وينصه انه

- The **right ventricle** is anterior & to the right of the septum.

Rotation  
عشان ال  
الاسترخا عنه باول قاسم

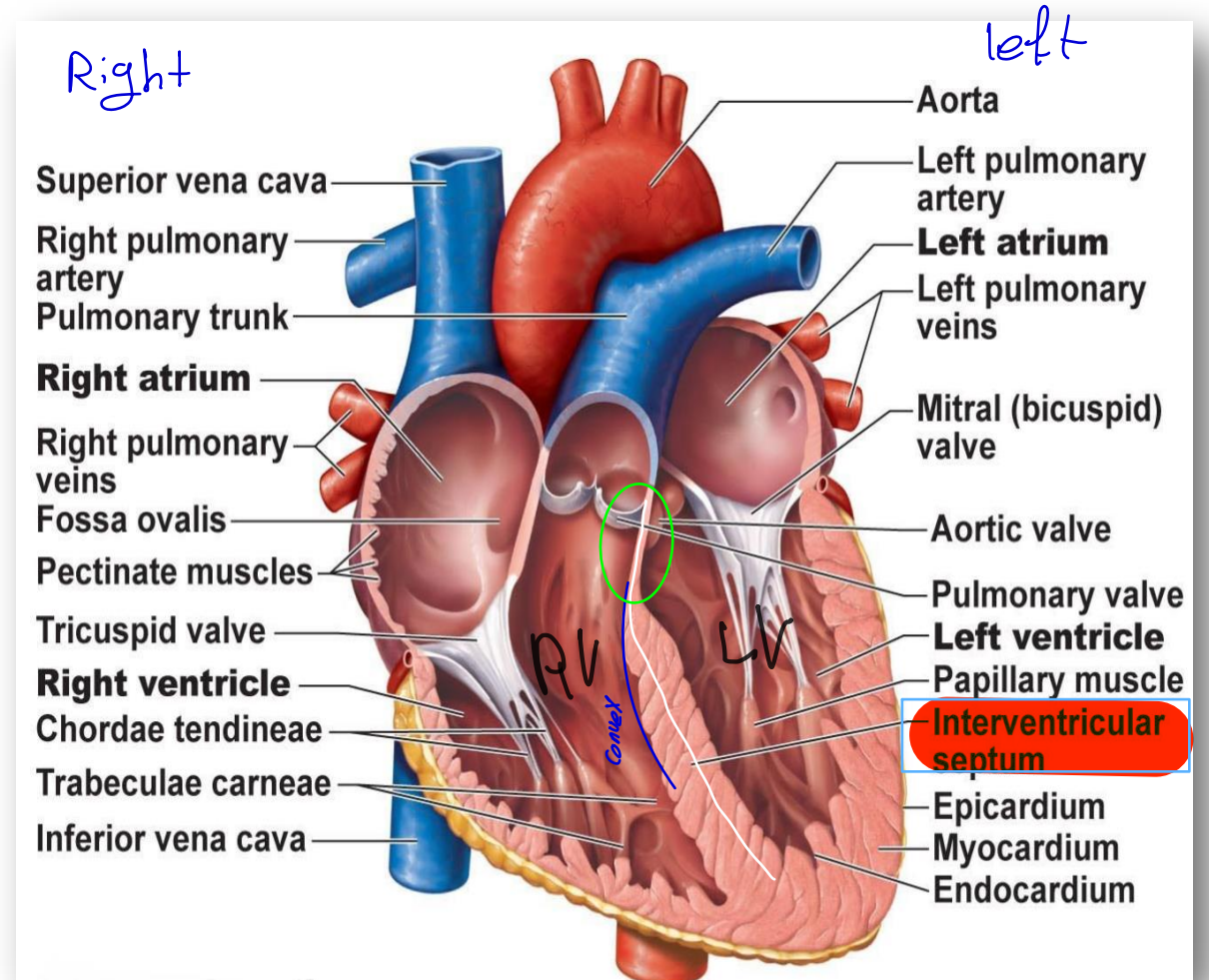
- The **left ventricle** is posterior & to the left of the septum.

- The septum is **convex** towards the right ventricle.

- **Consists of 2 parts** (Lower muscular & upper membranous parts).

1/3

2/3





# Fibrous skeleton of the heart

**Definition:** A rigid framework of dense regular connective tissue located between the atria and the ventricles.

فهم الوجة عشان نقدر نفهم الكلي الكي يعنى؛ كما كان ما في Transverse section من junction ما بيت upper surface of ventricles  
 ال Atria و ventricles و مشا ال Atria و ventricles

## Components:

→ each Ring related to orifice.

- **Four fibrous rings.** 1-tricusped ring. 2-mitral ring. 3-aortic ring. 4-pulmonary ring.
- Right and left **fibrous trigones.** → Fibrous tissue has the shape of  $\triangle$
- **Membranous parts** of the interatrial, interventricular septum.

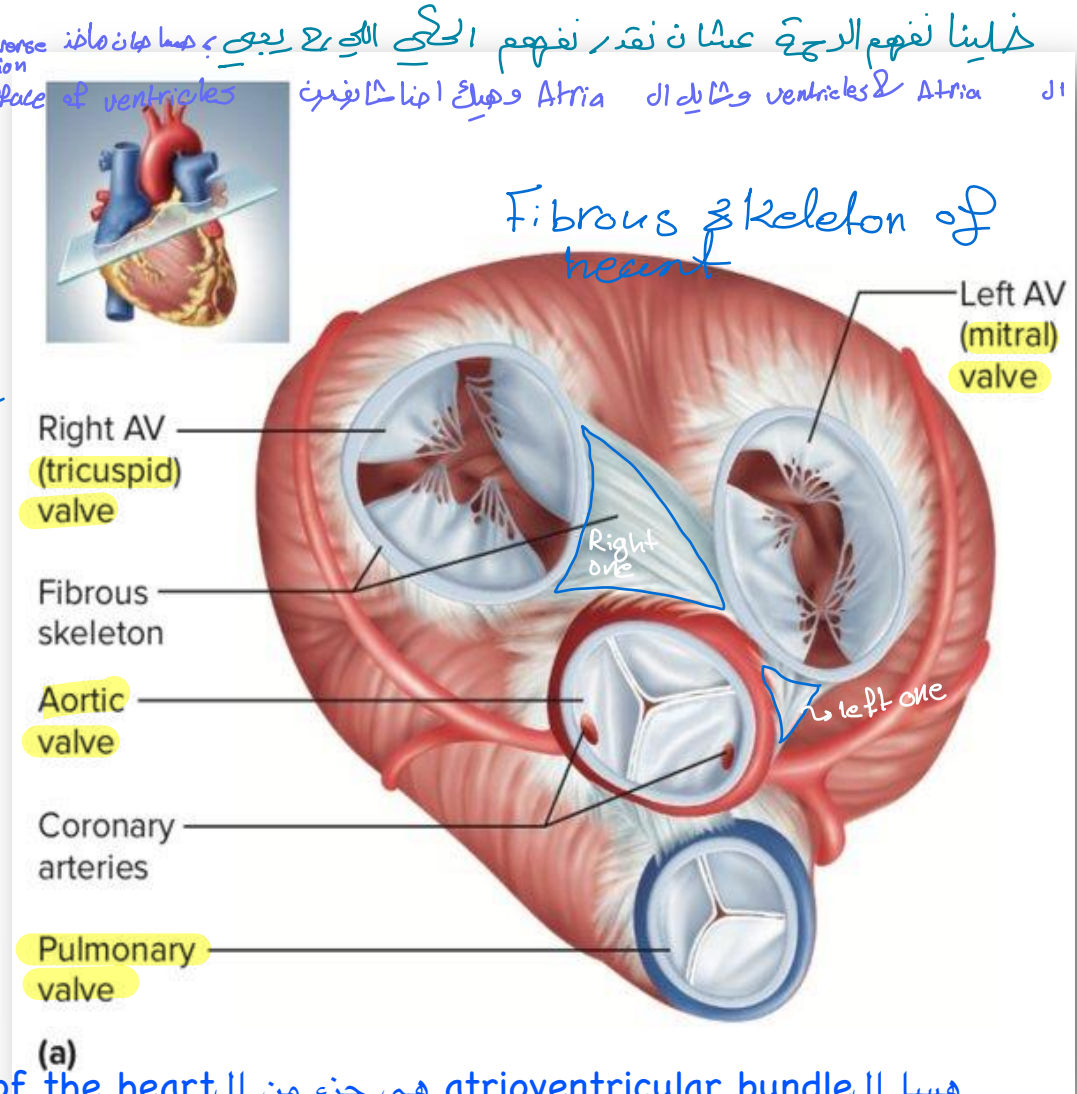
fibrous skeleton يعمل كعازل للكهرباء يعني لما توصل ال cardiac electric implances للقلب بصير اول اشي atrium contraction و بصير empty لل blood و بعدين يصير ventricle contraction ، ما بخليها يصير atrium and ventricle contraction at same time ، بخليها توصل تدريجيا

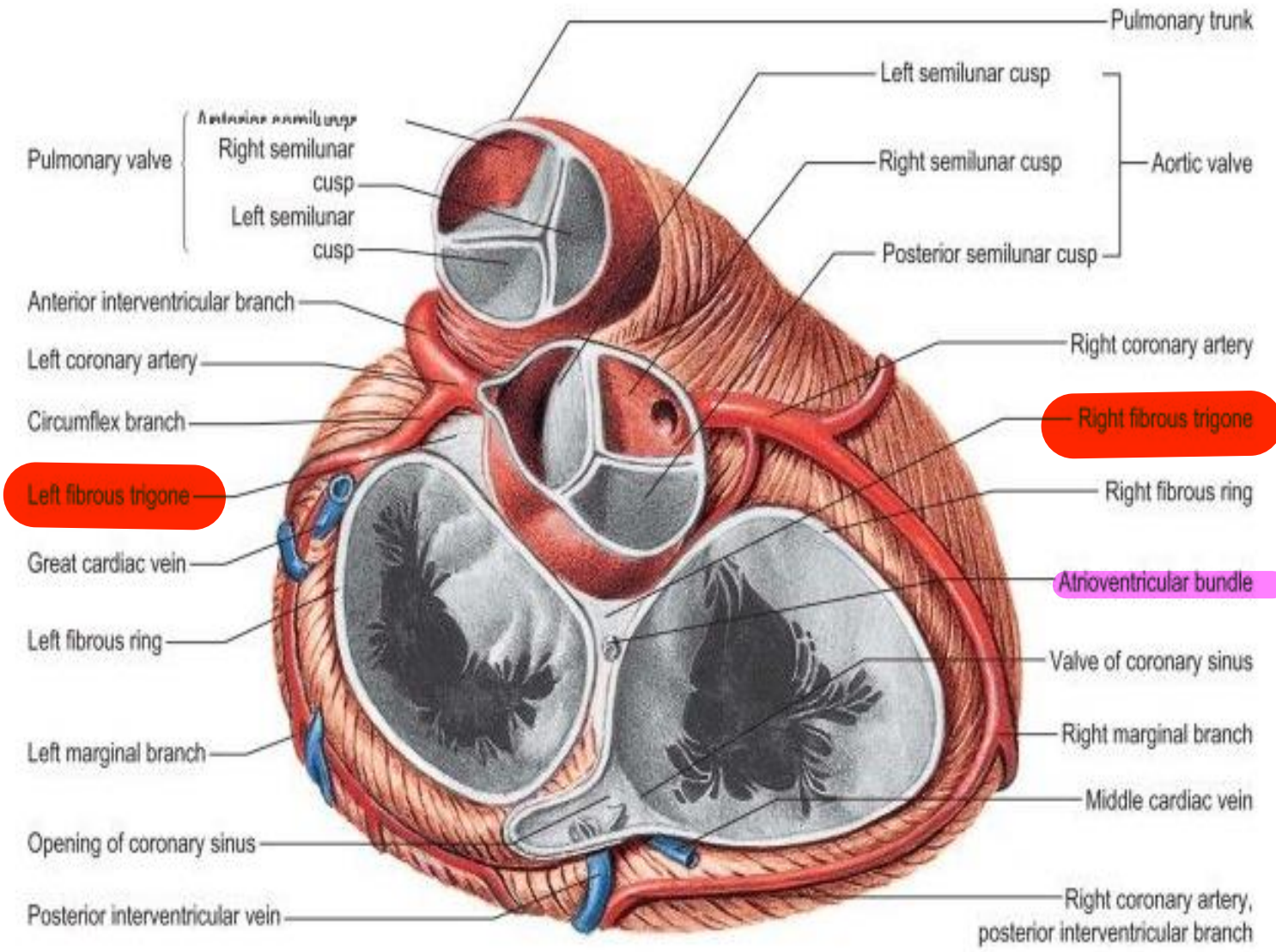
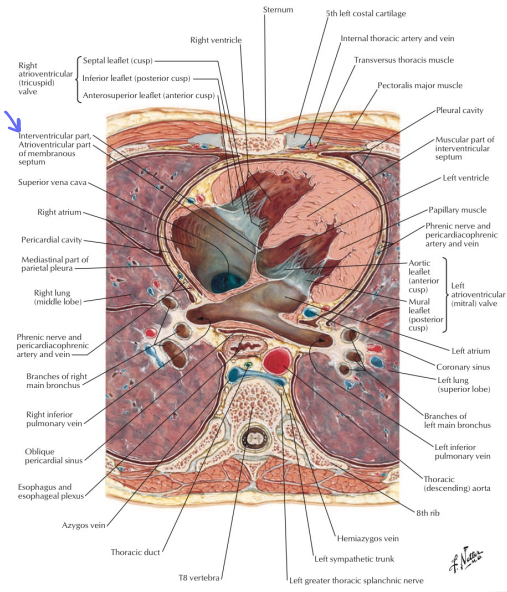
## Functions:

- Maintains **valve orifices open.** مثلا توصل لل R.V بعدين لل R.A وهكذا
- Provides **attachment** for valve cusps & myocardial fibers
- Acts as **an electrical insulator** between the atria and ventricles except at the site of penetration of the atrioventricular bundle. عازل للكهرباء

↓  
Specialized Cardiac Muscle

فهم ال atrioventricular bundle هي جزء من ال conductive system of the heart ، هسا هاي ال atrioventricular bundle تتخطى ال fibrous skeleton of the heart و يربط بين ال atrium و ال ventricle عشان ينقل ال cardiac electric implances





# Orifices at the right side of the heart

orifices=فتحة

لفتحات بتعمل نقل للدم بين كل شغلتين ع حسب مكان وجودها

## 1-Right atrio-ventricular (inlet) orifice:

**Tricuspid orifices:** (هي بتكون موجودة بين ال R.A وال R.V)

- Guarded by **Tricuspid Valve**. لازم يكون فيه صمام عشان يمنع عودة الدم يعني تخليه يمشي باتجاه واحد
- **Surrounded by a fibrous ring**, which gives attachment to **3 cusps (anterior, posterior & septal) of tricuspid valve**.

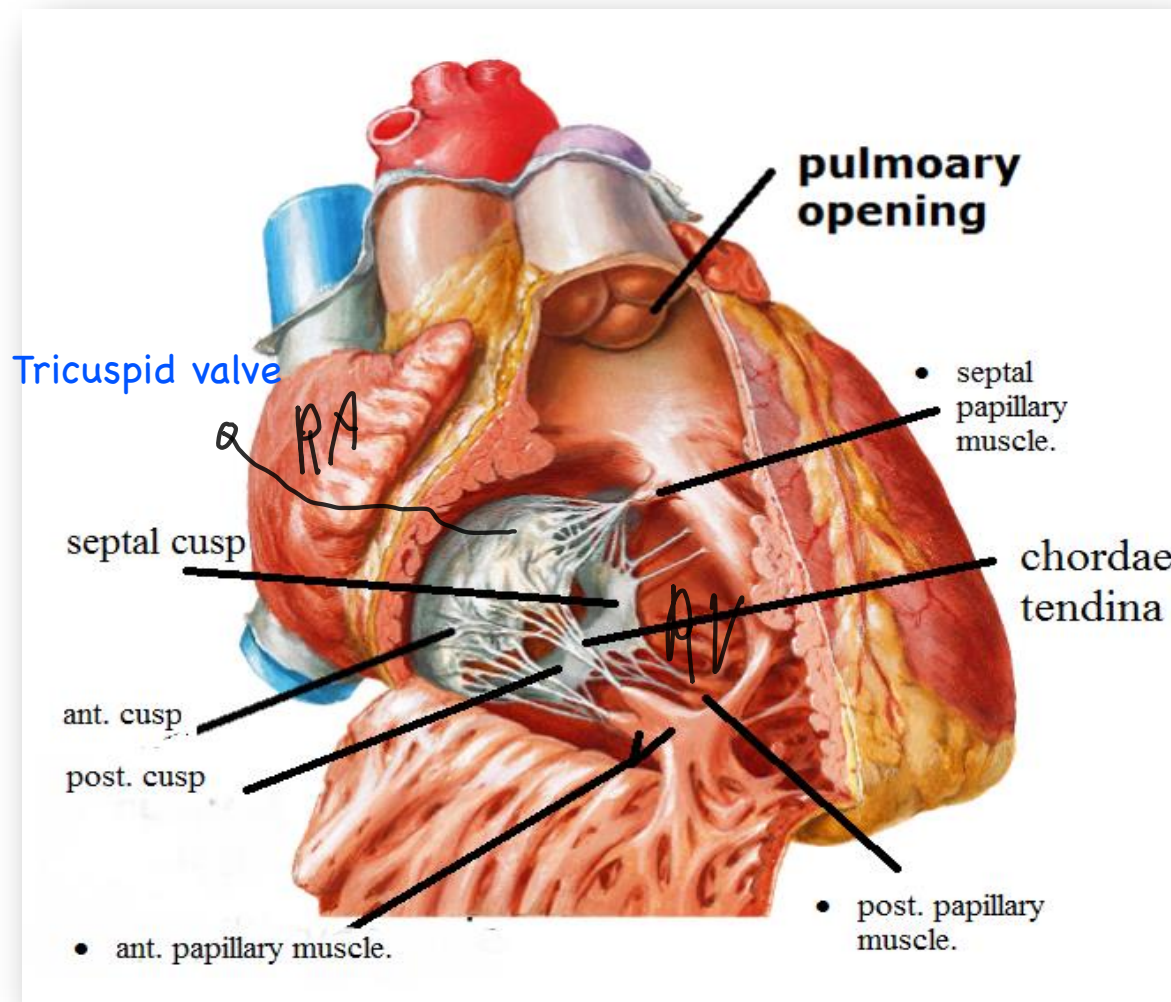
يعني هو عبارة عن double layer of endocardium او fold from endocardium  
رج نعرف تركيبها بمحاضرات الدكتور مصطفى

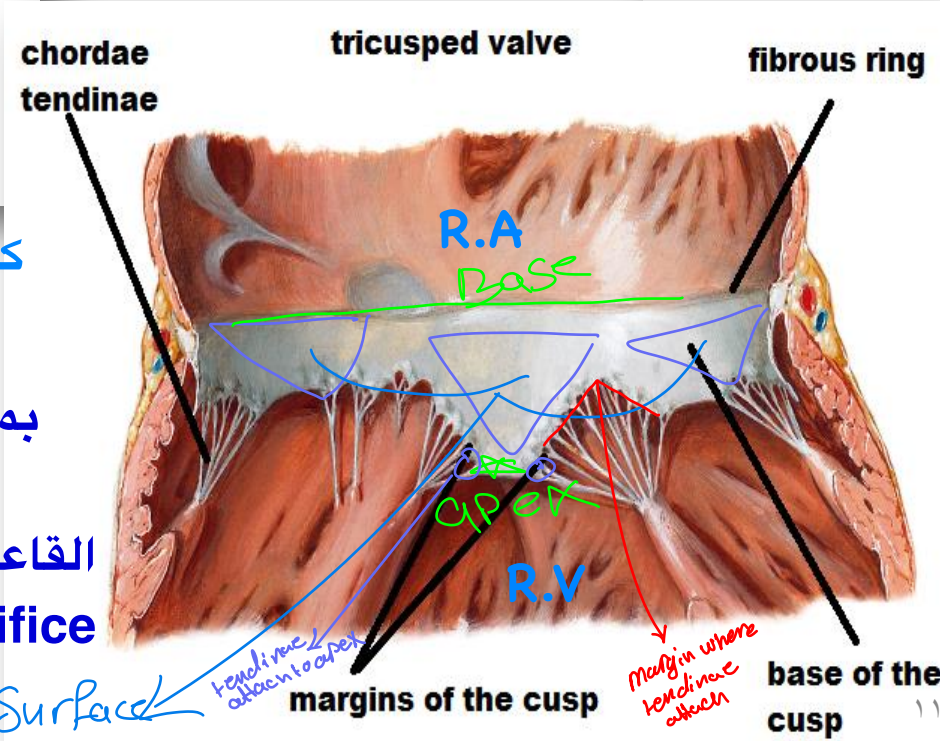
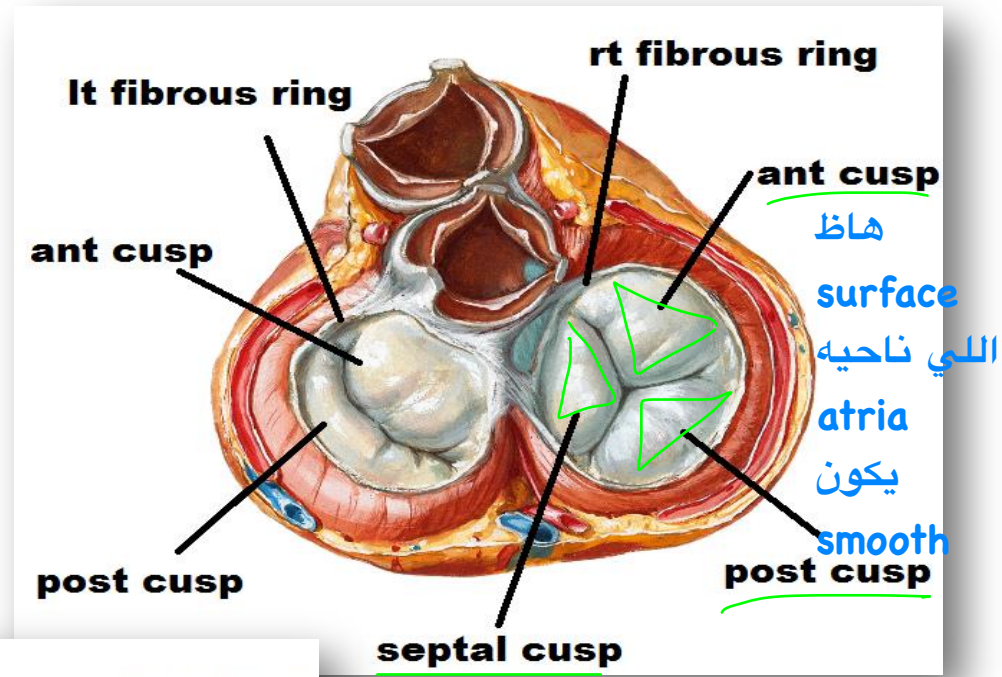
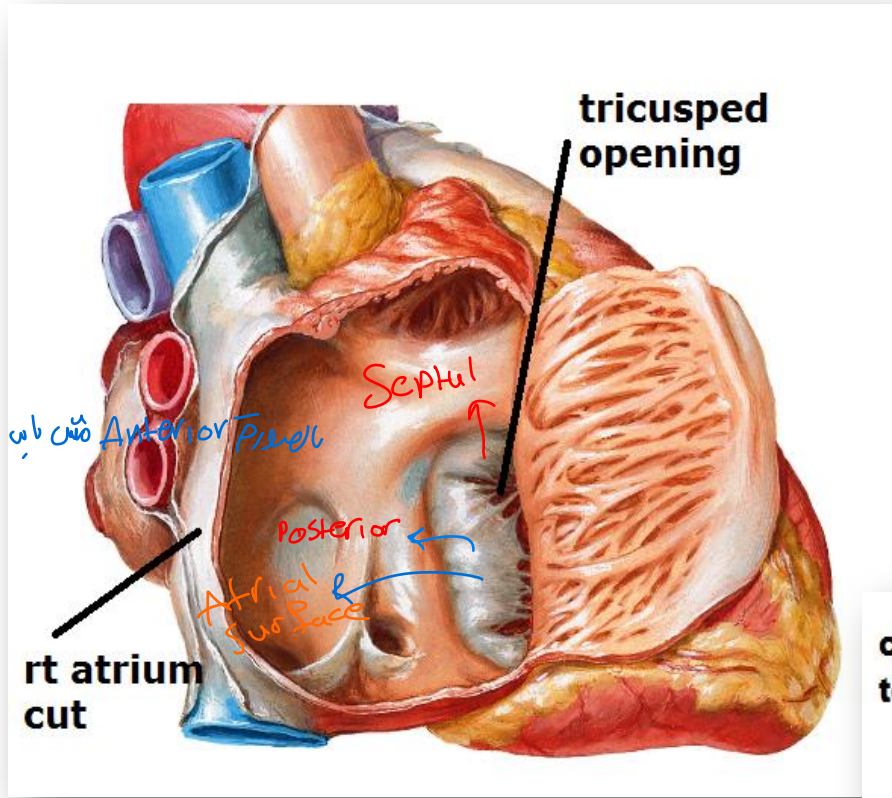
والendocardium هو عبارة ال Inward lining of the heart

Each cusp; is triangular in shape, has:

- **Two surfaces;** smooth atrial & rough ventricular. لانه باصص ناحية ال atria
- **Base;** attached to fibrous ring.
- **Apex & margin;** Chordae tendinae attached to them.
- \* Also Chordae tendinae attached to ventricular surfac.

يعني ال chordae tendinae مرتبطة مع كل من :  
وال ventricular surfac of casps / Apex/margin





خلينا نفهم الرسمة ،  
 هان فاصل اليمين عن  
 اليسار وعامل قطع  
 بالجدار وفتحته ع بعضه  
 فالفتح ما بين البطين  
 والأذين الأيمن هو ال  
 tricuspid وهان طبعا  
 مش ع شكل حلقة لانه  
 انفردت كده ع بعضه  
 بحس طلو ع الصورة  
 احسن من الحكي هاظ  
 🙄🙄

كل cusp عبارة عن شكل مثلث و طبقتين من endocardium

Apex directed downward

بما انه في مثلث بالقصه  
 معناها فيه قاعده هذي  
 القاعده مرتبطه بال fibrous  
 ring of tricuspid orifice

Smooth Surface

## 2-Outlet orifice of the right ventricle: Pulmonary orifice:

- Guarded by Semilunar (valve).
- Surrounded by a fibrous ring, which gives attachment to **3 semilunar cusps (anterior, right & left)** of pulmonary valve.

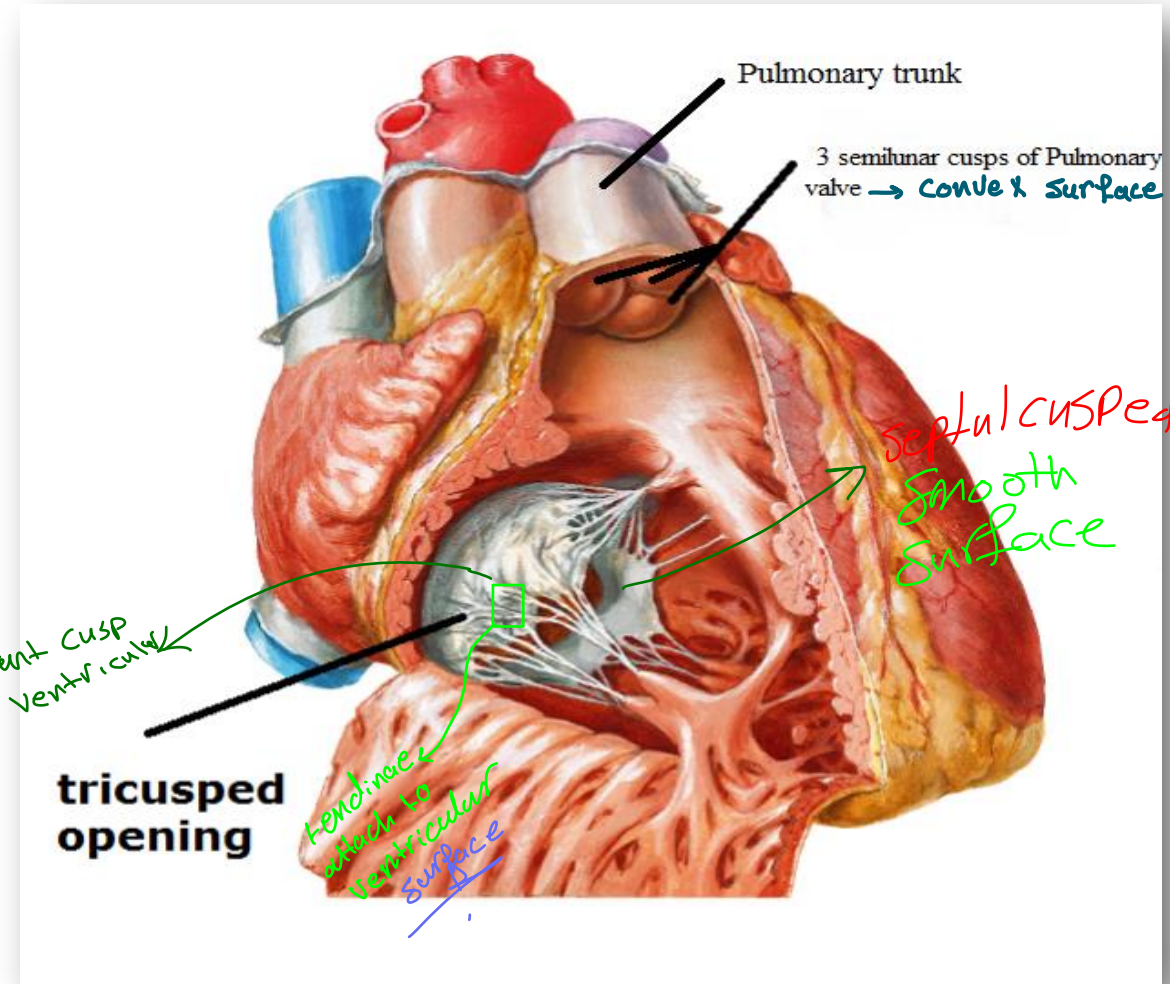
**Each cusp:** formed by folds (reduplication) of endocardium. يعني هو عبارة عن double layer of endocardium والendocardium هو عبارة عن lining of the heart

**Each cusp:** semilunar & has:

- **Concave** upper surface (open mouths) & **convex** lower (ventricular) surface. سميانه ventricular surface عشان اتجاهه نحوه الright
- **Upper margin (free);** shows **thickened nodule** in the middle & **thin lunule** on the sides.
- **Lower margins & sides;** are attached to the arterial wall.

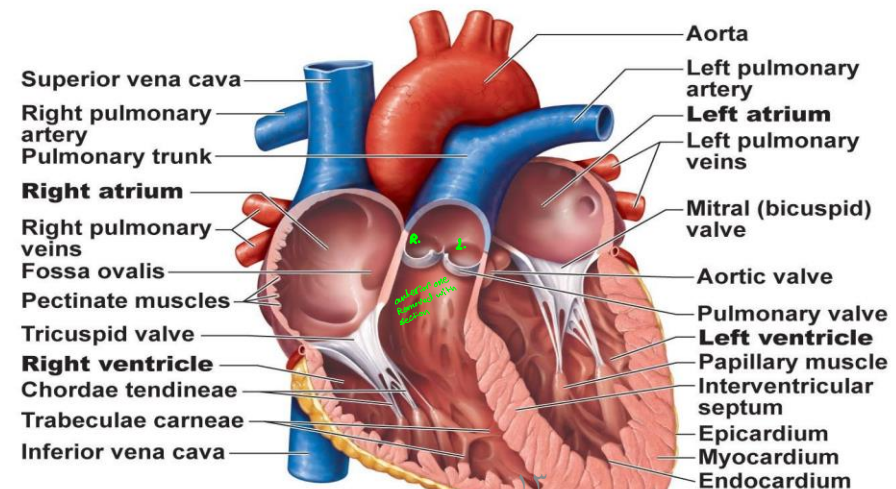
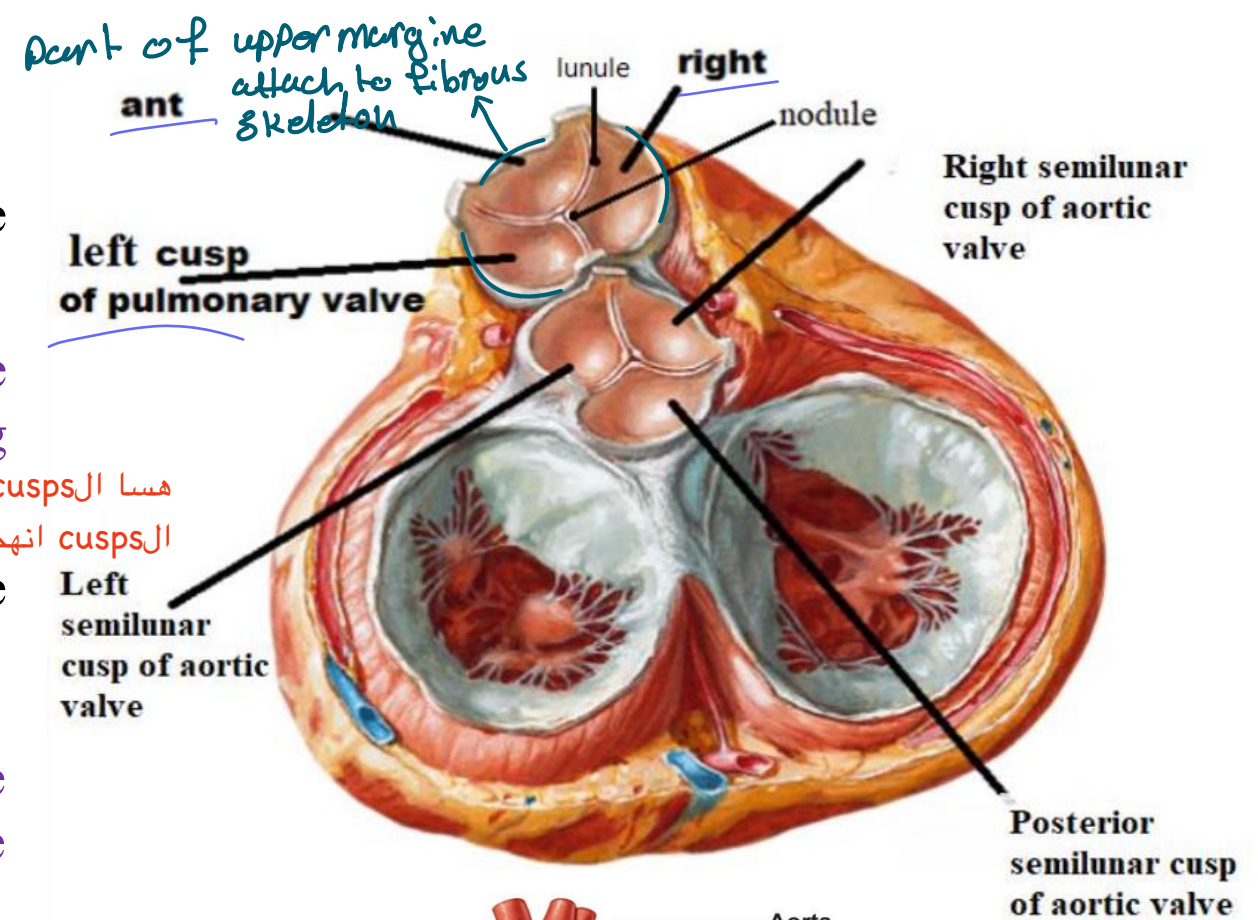
وفيه upper margin اللي تكون بالة بالفibrous skeleton

كان ماستاذة في اني لاني - اني انا بالpulmonary valve و aortic valve  
 اني انا بالpulmonary valve و aortic valve  
 cusp or aortic cusp



## Pulmonary valve:

- No chordae tendinae or papillary muscles are associated with these valve cusps.
- The attachments of the sides of the cusps to the arterial wall prevent the cusps from prolapsing into the ventricle. *هنا الcusps مرتبطة مع الarterial wall وهذا الإرتباط يمنع الcusps انهم يسقطوا نحو الventricle*
- At the root of the pulmonary trunk are three dilatations called the sinuses. *Right*
- During the ventricular systole, the cusps of the valve are pressed against the wall of the pulmonary trunk by the out-rushing blood.
- During diastole, blood flows back toward the heart and enters the sinuses, the valve cusps fill and come into apposition in the center of the lumen, and close the pulmonary orifice.



(e) Frontal section

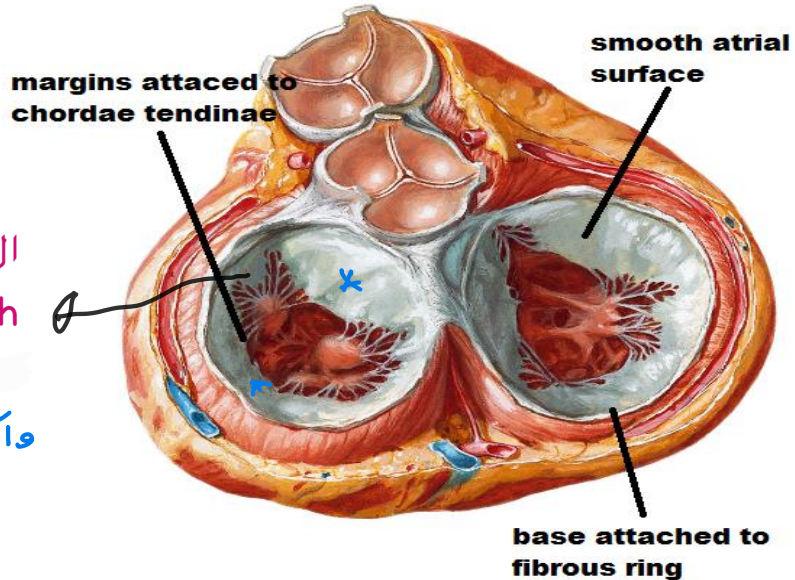
# Orifices of the left ventricle

## 1-Left atrio-ventricular (inlet):

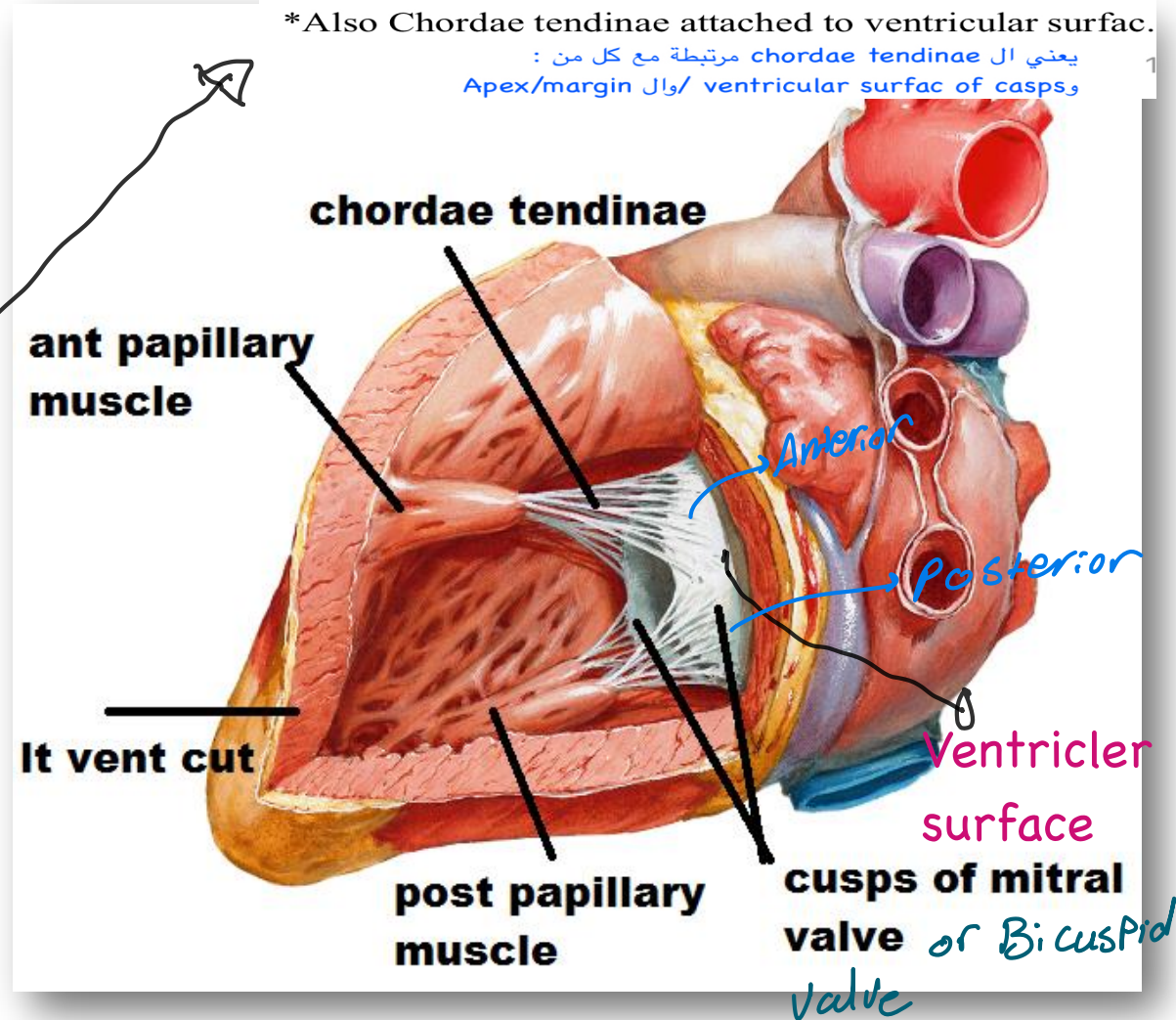
**Mitral orifice** → *اصفحة من Tricuspid*

- Guarded by the Mitral Valve.
- Surrounded by a fibrous ring, which gives attachment to 2 cusps (anterior & posterior) of mitral valve.

**The same description of the tricuspid cusps.**



*Directed downward*



Each cusp; is a reduplication of endocardium.

Each cusp; is triangular in shape, has:

- **Two surfaces;** smooth atrial & rough ventricular.
- **Base;** attached to fibrous ring. of mitral orifice
- **Apex & margin;** Chordae tendinae attached to them

\*Also Chordae tendinae attached to ventricular surface.

يعني ال chordae tendinae مرتبطة مع كل من Apex/margin وال ventricular surface of casps

## 2- Outlet orifice; Aortic orifice.

- Guarded by the semilunar valve.
- Surrounded by a fibrous ring, which gives attachment to 3 semilunar cusps (posterior, right & left) of the aortic valve.

Each cusp: formed by folds of endocardium.

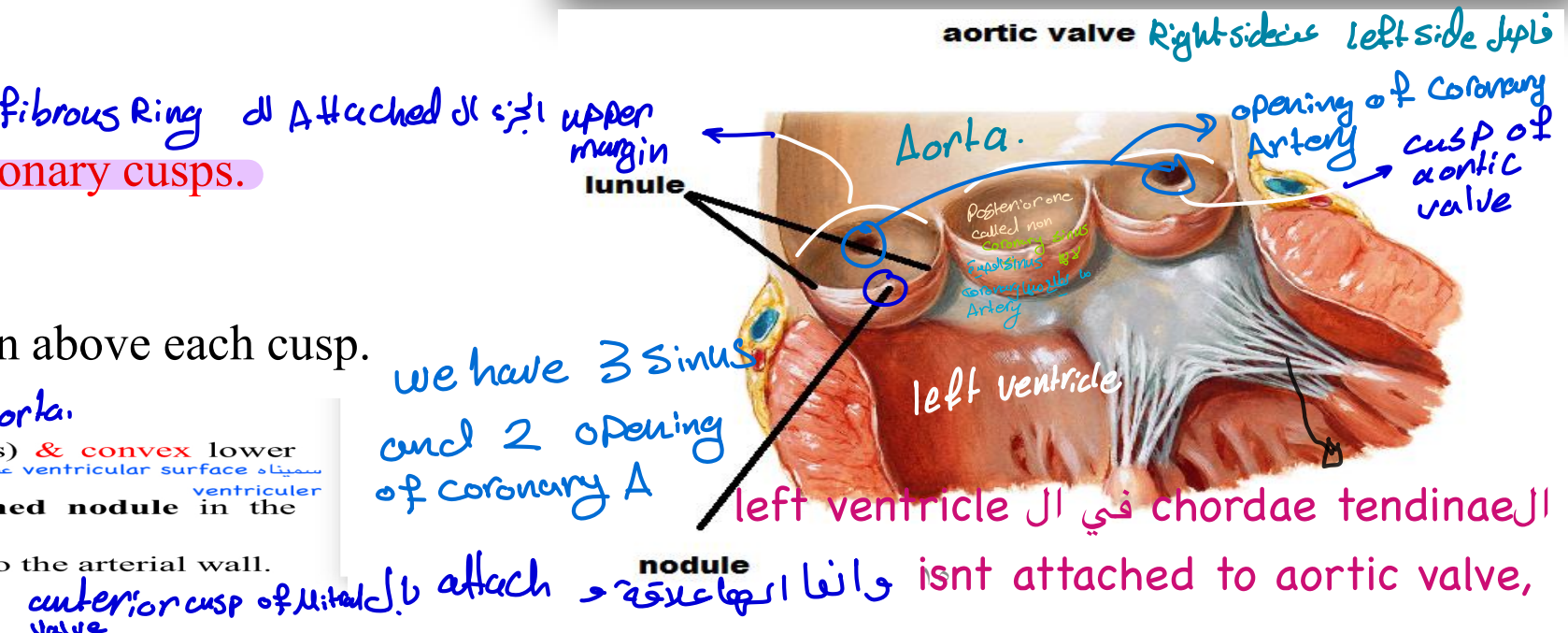
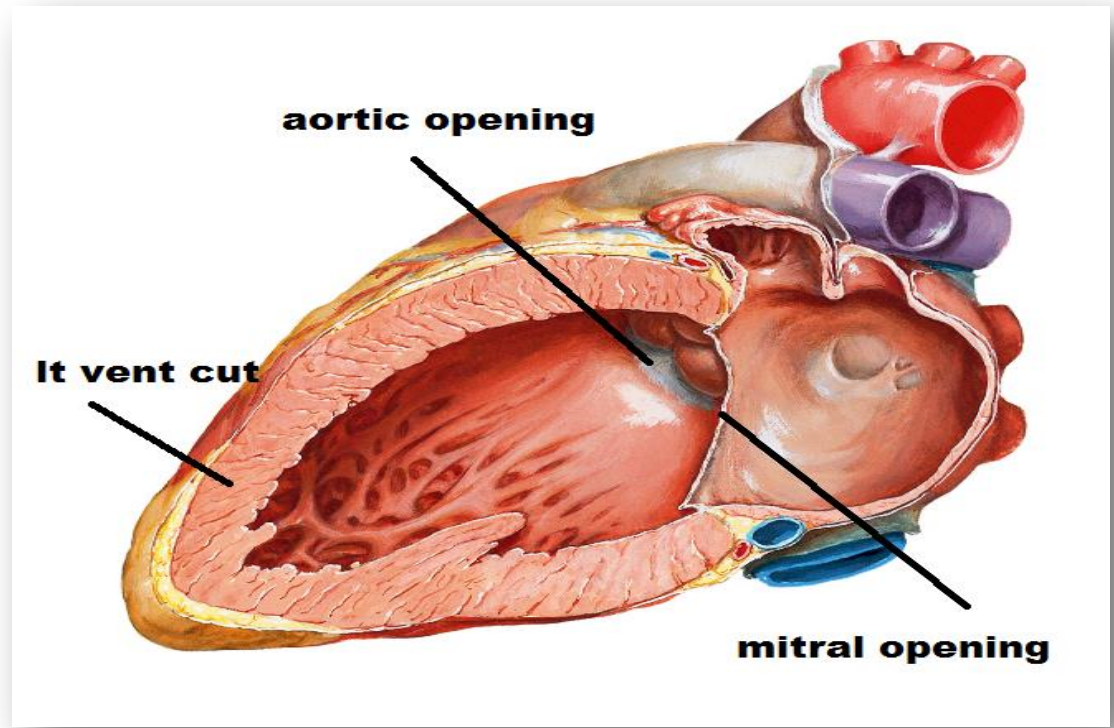
Each cusp: semilunar & has:

The same description of the pulmonary cusps.

- Aortic Sinuses:** slight dilatation above each cusp.

Each cusp: semilunar & has:

- Concave upper surface (open mouths) & convex lower (ventricular) surface.
- Upper margin (free); shows thickened nodule in the middle & thin lunule on the sides.
- Lower margins & sides; are attached to the arterial wall.



we have 3 sinuses and 2 opening of coronary A

left ventricle

chordae tendinae

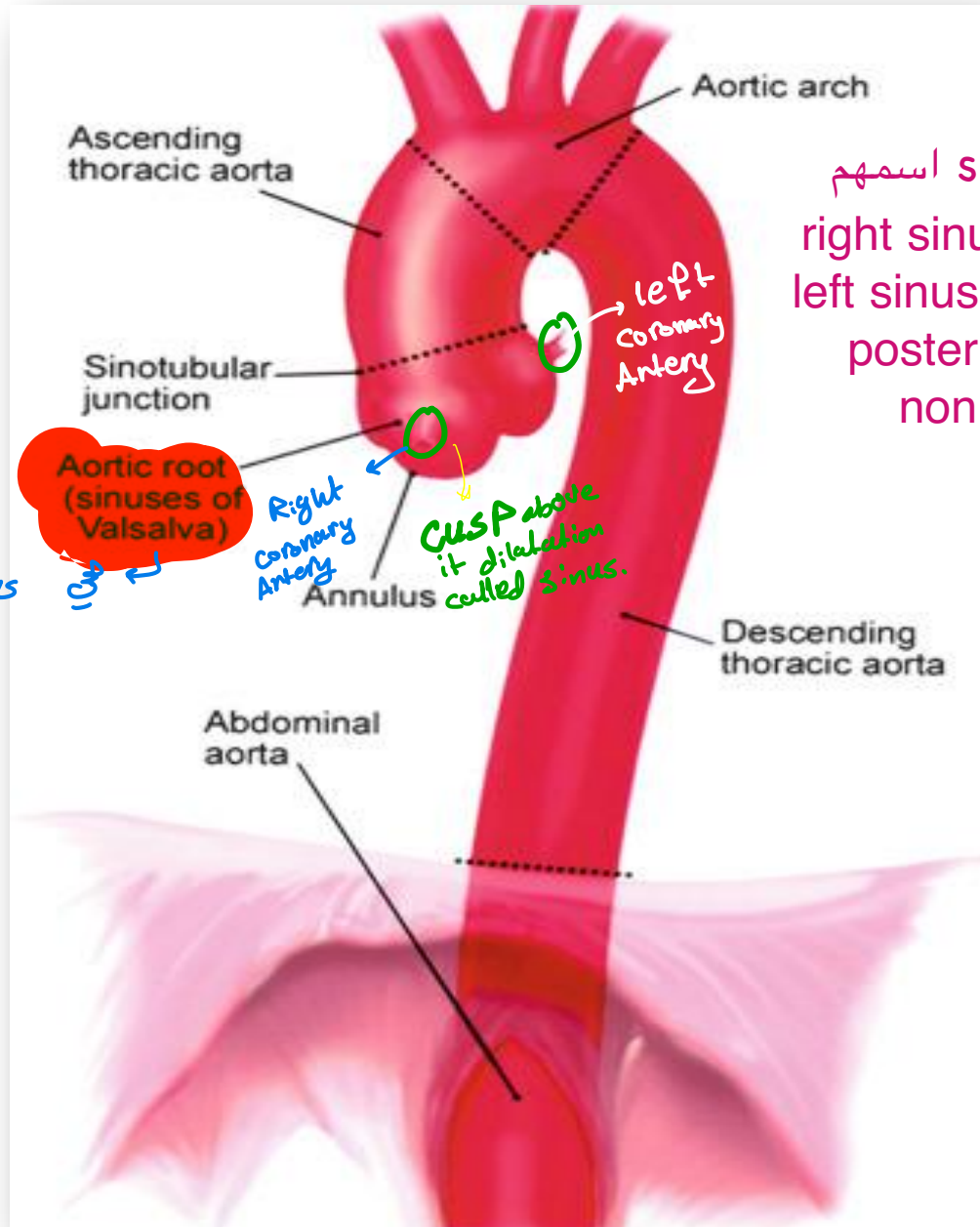
nodule

isnt attached to aortic valve,

attach

anterior cusp of mitral valve





في هاي الصورة بس بوريك انه الثلاثة sinuses اسمهم right sinuses sinuses of valsalva وهم بقسموا الى right sinuses وراح تعطيك right coronary artery ، والى left sinuses وراح تعطيك left coronary artery ، اما ال posterior sinuses احنا بنسميها non coronary sinuses

aorta تَجَدَاد sinus

# Surface anatomy of the valves of the heart

3 3 4 4

احفظهم بالترتيب الآتي

**Pulmonary valve:** Left 3<sup>rd</sup> costal cartilage, close to the sternal margin. ورا ال3 costal cartilage من جهة اليسار

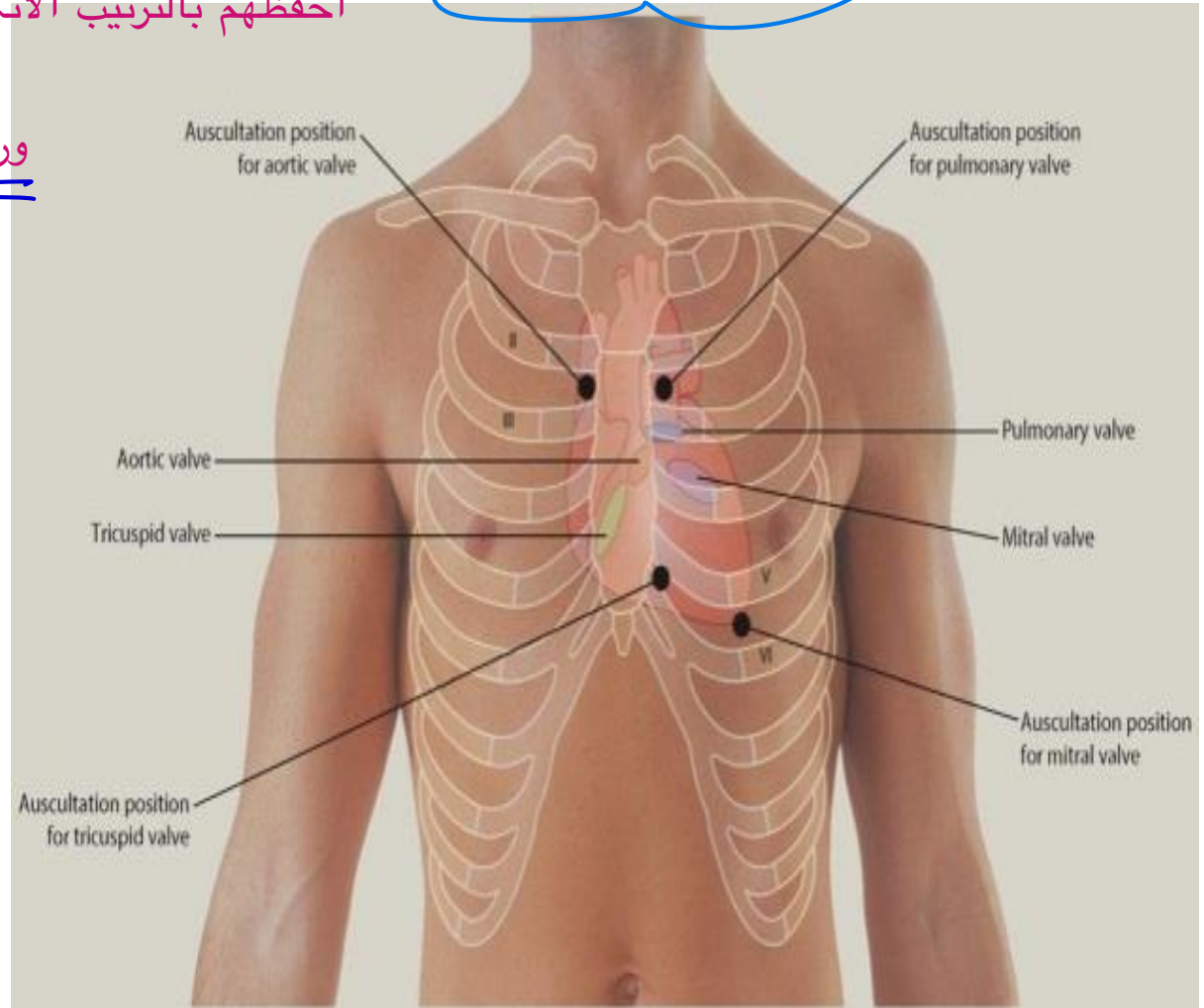
**Aortic valve:** level of Left third intercostal space, behind the left 1/2 of sternum.

ورا ال3 intercostal space من جهة اليسار

**Mitral valve:** Left fourth costal cartilage close to the sternal margin. ورا ال4 costal cartilage من جهة اليسار

**Tricuspid valve:** level of fourth intercostal space, behind the right half of the sternum.

ورا ال4 intercostal space من جهة اليمين من الsternum



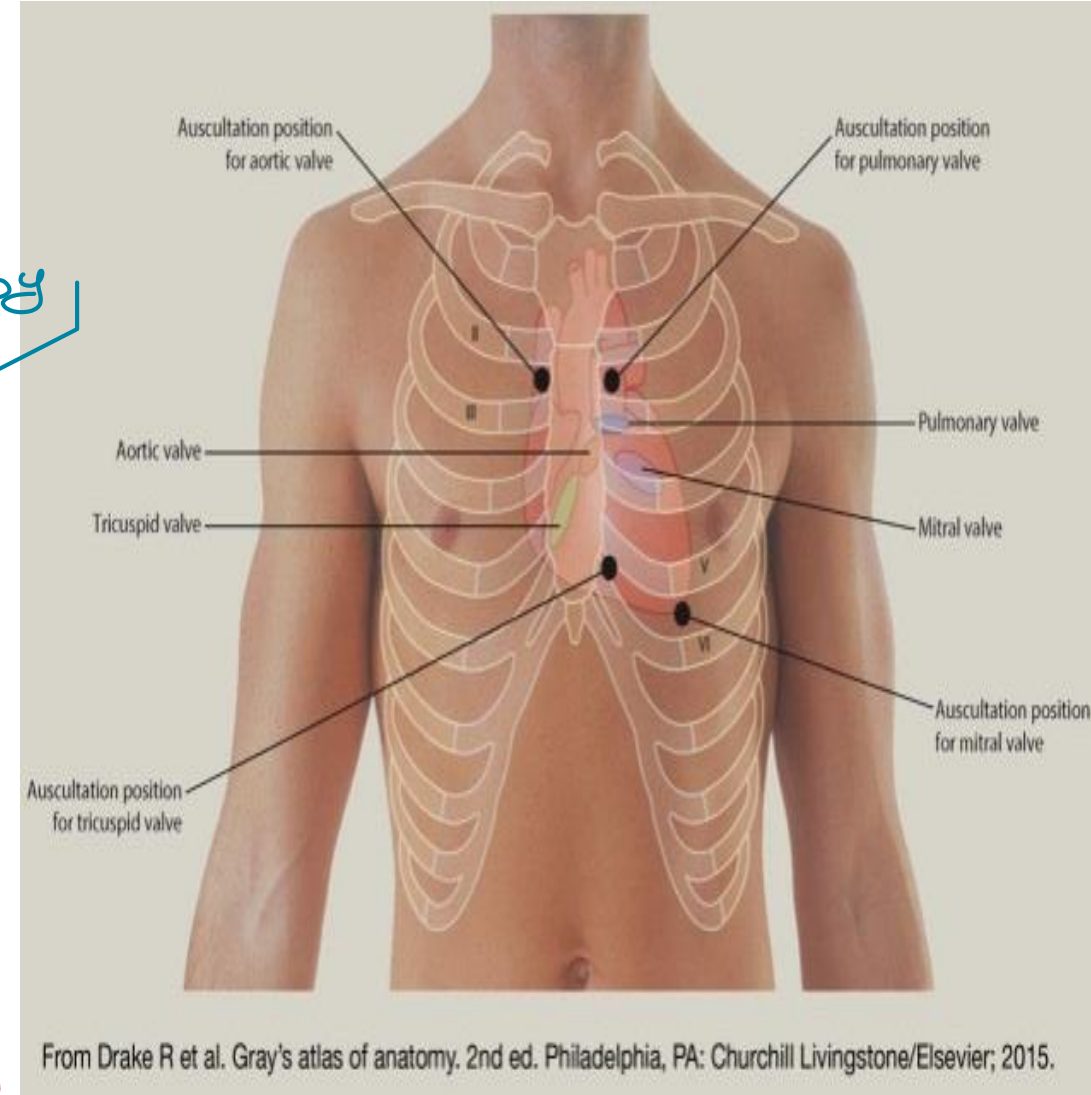
From Drake R et al. Gray's atlas of anatomy. 2nd ed. Philadelphia, PA: Churchill Livingstone/Elsevier; 2015.

# heart sound.

## Auscultation of the valves of the heart

مش من طبقة كل surface anatomy ال valves .

- There are two normal heart sounds, often described as a **lub** and a **dub** that occur in sequence with each heartbeat.
- First heart sound (S<sub>1</sub>)** produced by the closing of the atrioventricular valves. *Mitral and tricuspid closed at the same time* (Lub) بنسمع خلالها then follow by
- Second heart sound (S<sub>2</sub>)**, produced by the closing of the semilunar valves. *closure at the same time of pulmonary and aortic valves* (dub) بنسمع خلالها
- It is important for a physician to know where to place the stethoscope on the chest wall to be able to hear sounds produced at each valve with the minimum of distraction.



From Drake R et al. Gray's atlas of anatomy. 2nd ed. Philadelphia, PA: Churchill Livingstone/Elsevier; 2015.

هسا ليش مهم احنا نعرف النعرف مكان ال valve ?

عشان نحدد المرض مثلا في حالة stenosis هي بتصير من

خلال تضيق في ال pulmonary / aortic valve area فروع يكون

لك closure لك ال valve صوت اكرت من ملاه انه فيه stenosis

او حالة ثابرة! - انه الوقت المفروض يسكر فيه ال valve ما يسكر ← insufficient فاستي باصفا مفرح

صير مشكلة بال flow ل ال B بس اقدر اسوه واميزه .

\* بعضنا area تباغت valve حيث لو طربت  
 السماعة على area دي رح اسمع قفلت valve بشكل  
 واضح، حيث قفلت الصمام الي ليقفل هو بنفسه اللغه ما يكون سامعه بحيث

يكون الصوت  
 specific for only one valve.

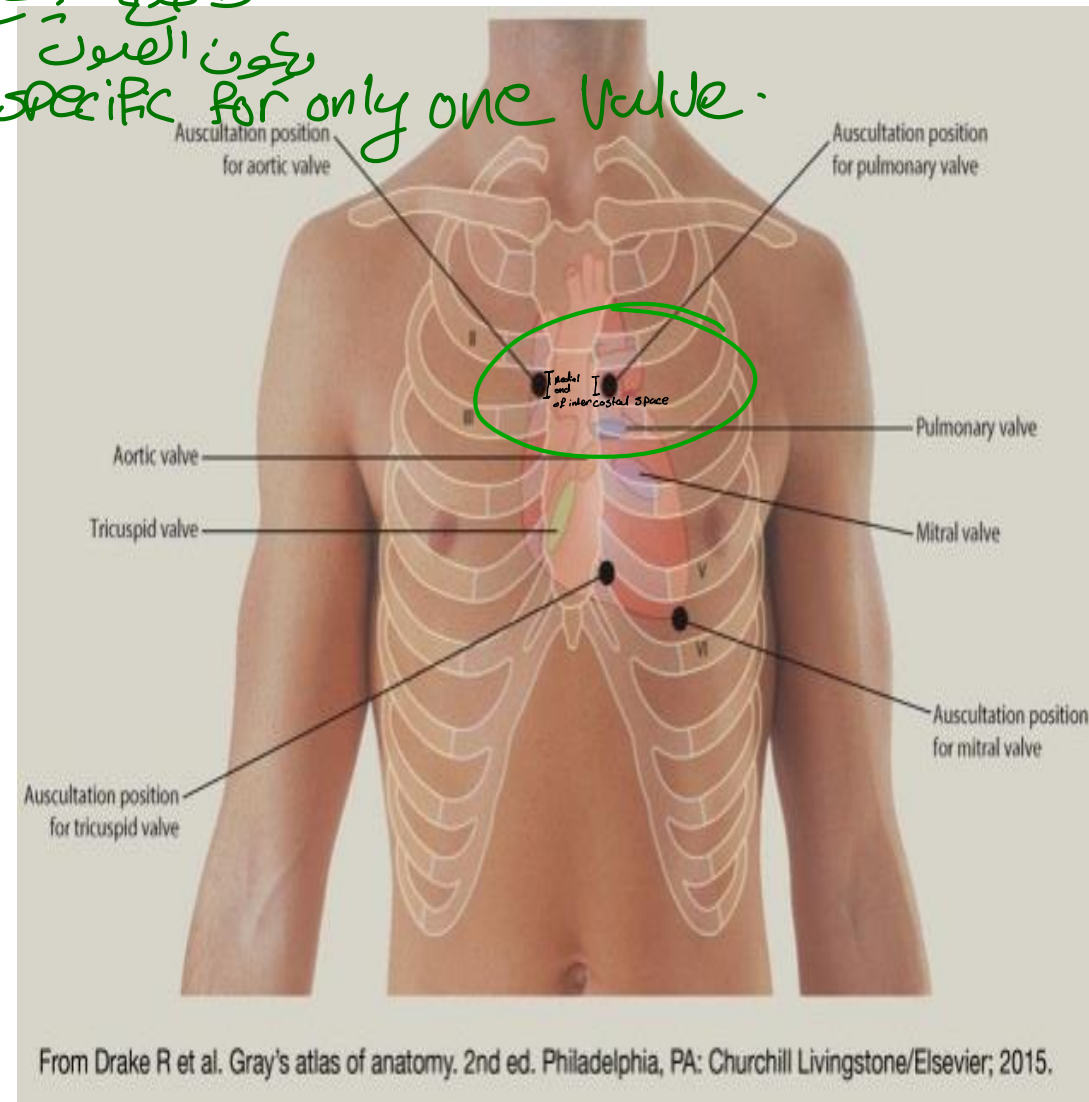
▪ **Pulmonary valve area** is best heard over the **left second intercostal space**, near the sternal border.

▪ **Aortic valve area** is best heard over the **right second intercostal space**, near the sternal border.

▪ **Mitral valve area** is best heard **over the apex of the heart**.

▪ **Tricuspid valve area** is at **fourth & fifth intercostal space**, near the left sternal border.

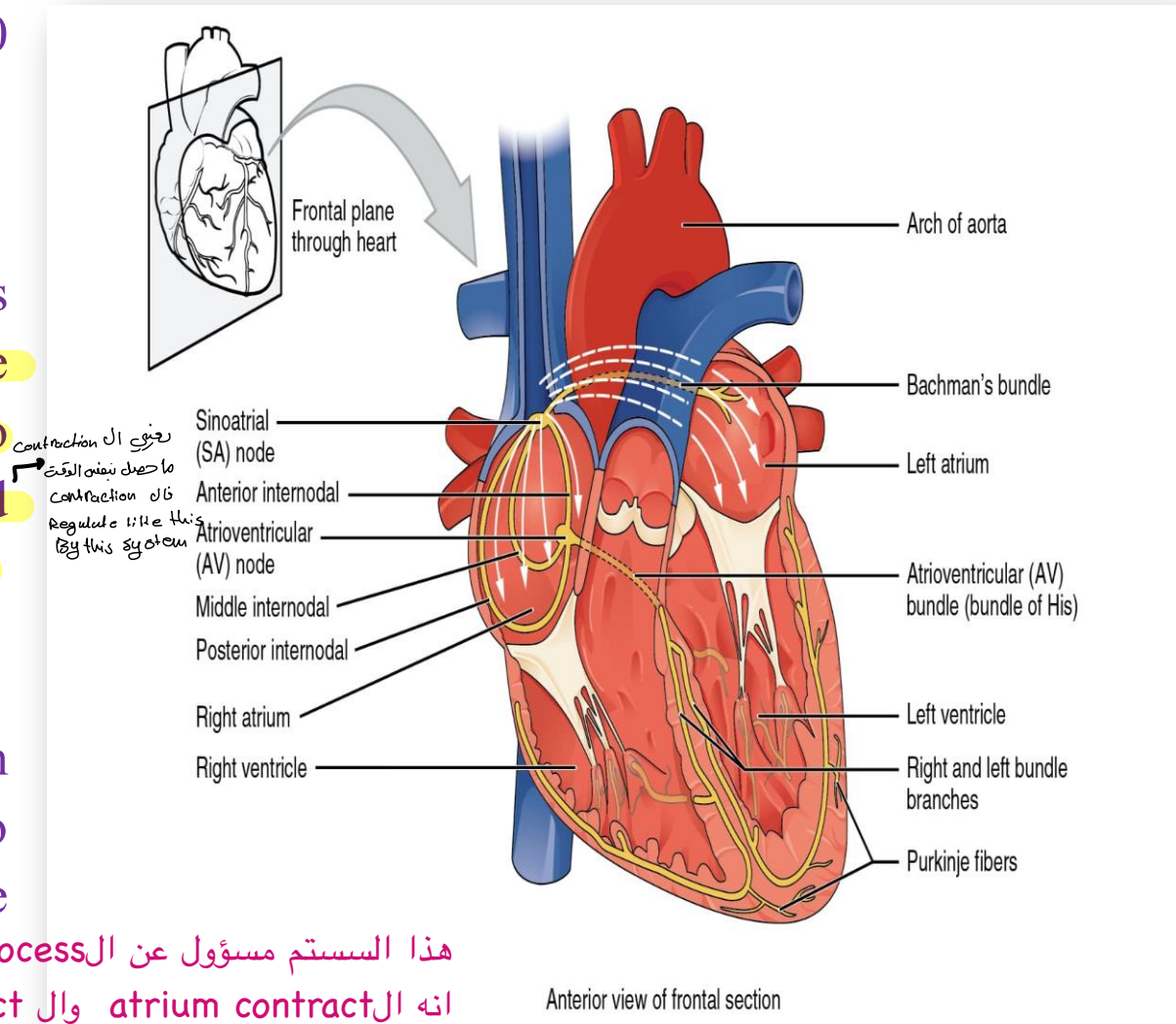
بالصوت مدسوم عند 5<sup>th</sup> →  
 بس انتة تبكون ماخذ العنقه زي ما هو مكتوب



From Drake R et al. Gray's atlas of anatomy. 2nd ed. Philadelphia, PA: Churchill Livingstone/Elsevier; 2015.

# Conductive System of the Heart

- The normal heart contracts rhythmically at about 70 to 90 beats/ minute in the resting adult.
- The **rhythmic contractile process** originates spontaneously in the conducting system and the impulse travels to different regions of the heart, so the atria contract first and together, to be followed later by the contractions of both ventricles together.
- The slight delay in the passage of the impulse from the atria to the ventricles allows time for the atria to empty their blood into the ventricles before the ventricles contract.



هذا السستم مسؤول عن ال rhythmic contractile process يعني ايه ؟ يعني انه ال atrium contract وال ventricle contract وال الإثنين ال contractions تبعمهم مش بيحصل في نفس اللحظة ، يعني بيحصل ال contraction of atrium

The specialized **cardiac muscle fibers** that form the **conductive system of the heart**, represented in:

- **Sinuatrial node (SAN)**
- **Atrioventricular node (AVN)**
- **Atrioventricular bundle** and its right and left terminal branches.
- **Subendocardial plexus of Purkinje fibers.**

وال SA node تعتبر ال peac maker يعني ايه ؟

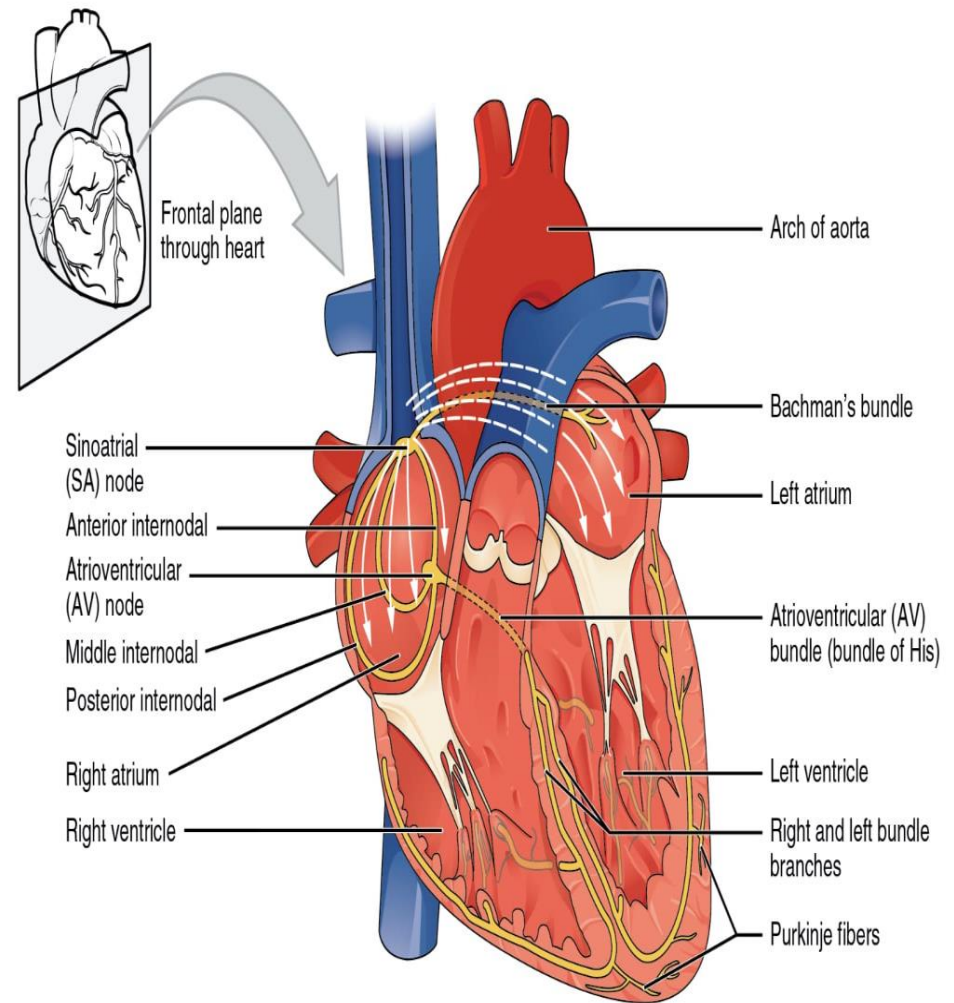
يعني الجزء من ال conductive system الي initiate spontaneously electrical impulses يعني ال الجزء من ال conductive system الي initiate spontaneously electrical impulses بعدها تنتشر لل

impulses يعني الي تبدأ بشكل تلقائي تفعل ال electrical impulses بعدها تنتشر لل left and right atrium ويحصل contraction لل R and L atrium بعدها

ال electrical impulses تنتقل لل AVN ، هل تعتبر ال AVN peace maker ؟ لا ما تعتبر لان ال SA node هي ال peace maker ، يحصل في ال AVN stimulation بسبب

الإشارات الي بسبب ال atrium ، ويخرج من ال AVN ال Atrioventricular bundle لو تقتكروا ال AVN bundle هي التي تتجاوز ال Fibrous skeleton طيب كيف اخترقتها ؟

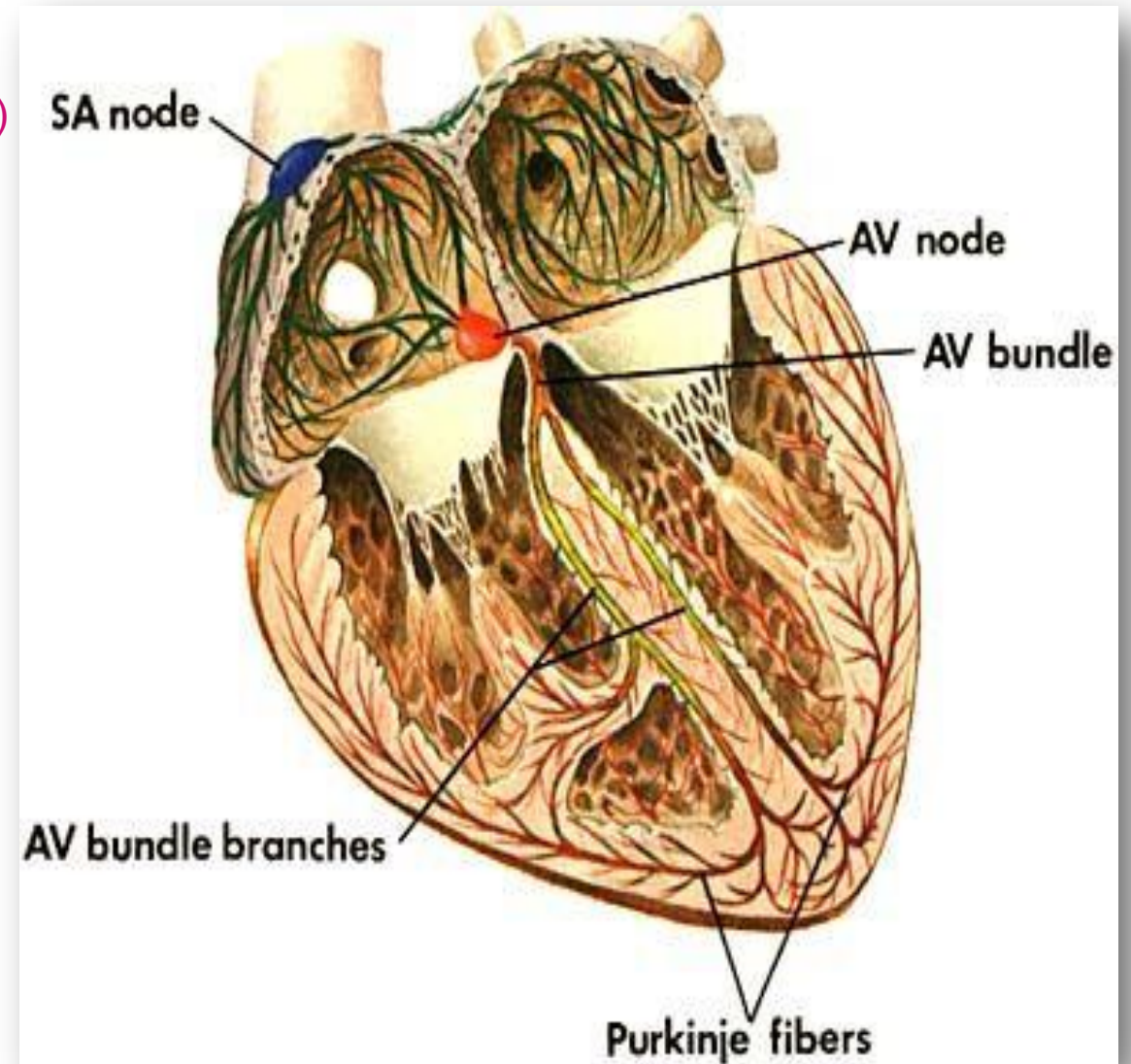
هذا الي راح نعرفه المحاضرة الجاي



Anterior view of frontal section

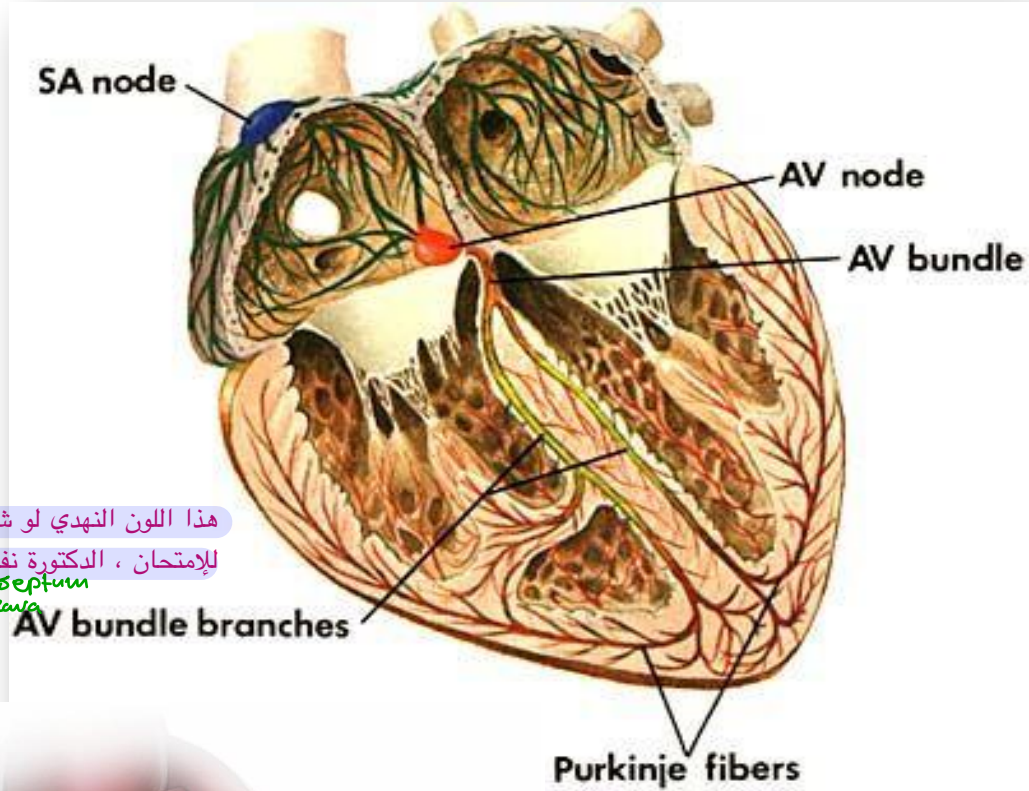
# Sinoatrial node (SAN)

- It is the **pacemaker of the heart**, initiates the impulse of contraction. (يعني هي المسؤولة عن توليد الimpulse)
- The sinoatrial node is an **elliptical structure, 10–20 mm long.**
- **Site:** is located in the wall of the right atrium in the upper part of the sulcus terminalis, subepicardially. just to the right of the opening of the superior vena cava
- The node **spontaneously gives origin** to rhythmic electrical impulses that spread in all directions through the cardiac muscle of the atria and cause the muscles to contract.

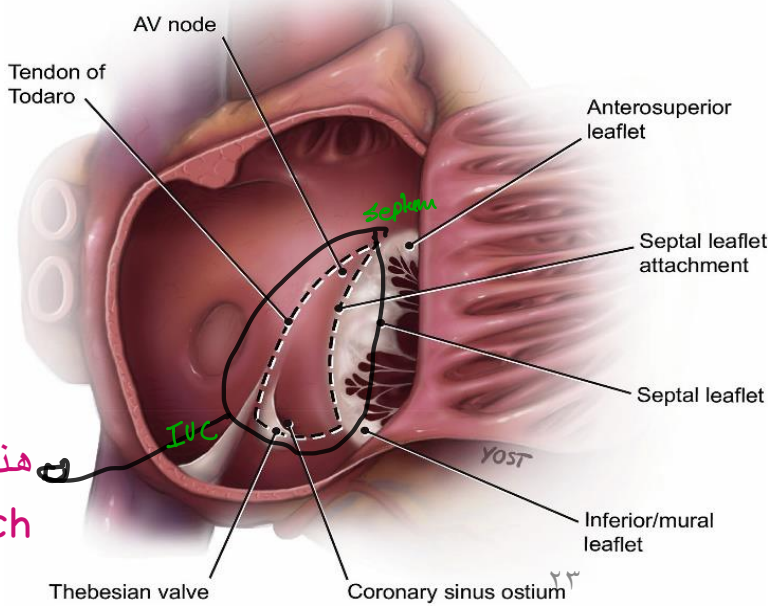


# Atrioventricular Node (AVN)

- **Site:** It is located within the **triangle of Koch** (at its apex)- above the attachment of the septal cusp of the tricuspid valve.
- Triangle of Koch is a region located at the right atrium defined by the following landmarks: the coronary sinus ostium, tendon of Todaro (tT), and the septal leaflet of the tricuspid valve (TV).
- The atrioventricular node is **stimulated** by the excitation waves as it pass through the atrial **myocardium**.
- **From it** the cardiac impulse is conducted to the ventricles by the **atrioventricular bundle**.



هذا اللون النهدي لو شففته بأي سلايد للفهم وليس للإمتحان ، الدكتور نفسه قالت مش راح تسألك فيه  
 → collagenous band connect between inter Atrial septum and inferior vena cava



هذا المثلث اسمه ال triangle of koch

فبروس سكليون Fibrous skeleton  
 له الكي ممكننا عنهما انها الوصلة اللي تقدي ( بالعاصرة الثلاثة )

opening

collagenous band connect between inter Atrial septum and inferior vena cava

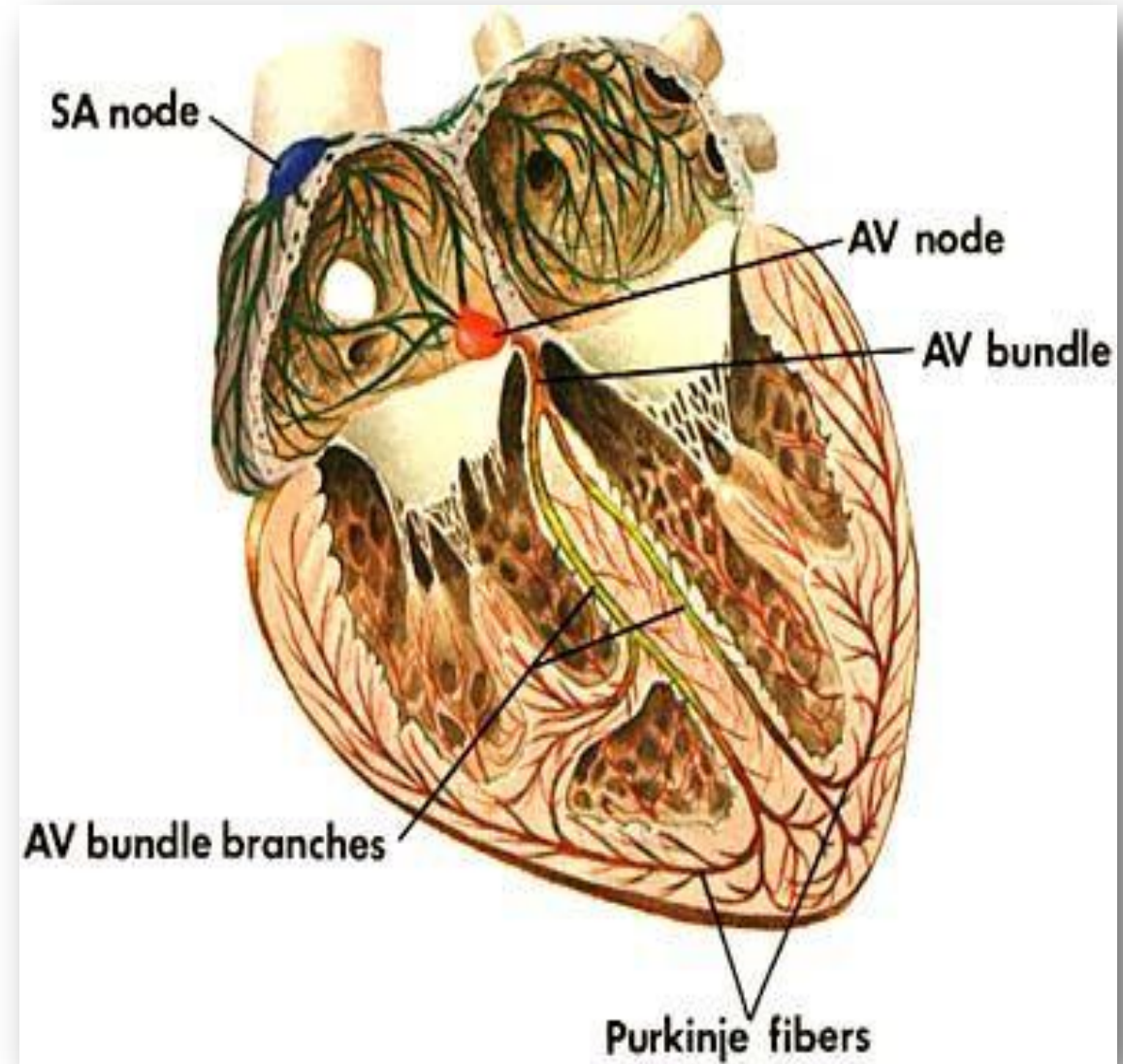
YOST

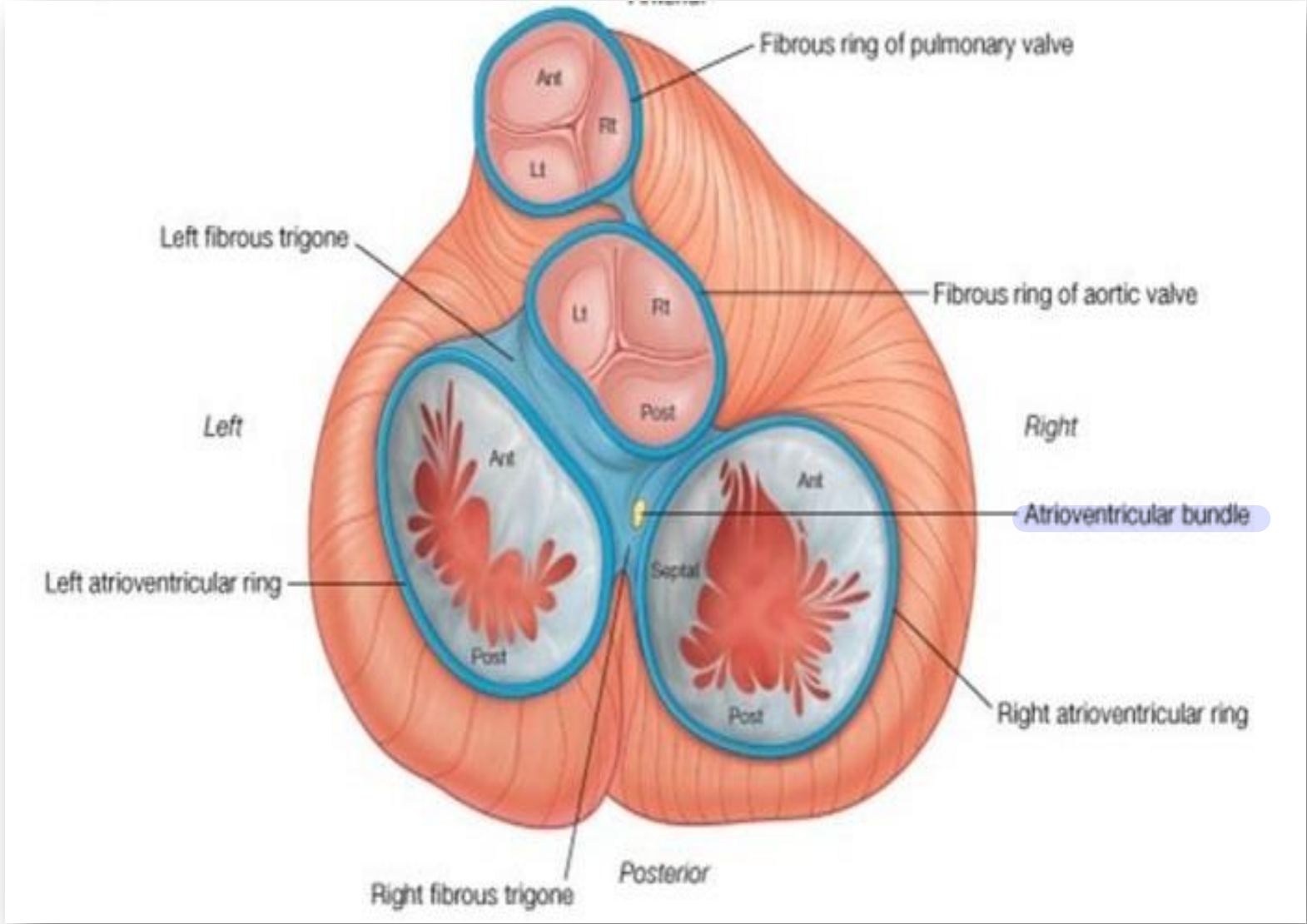
٢٣



**Atrioventricular Bundle:** *originate from AV node.*

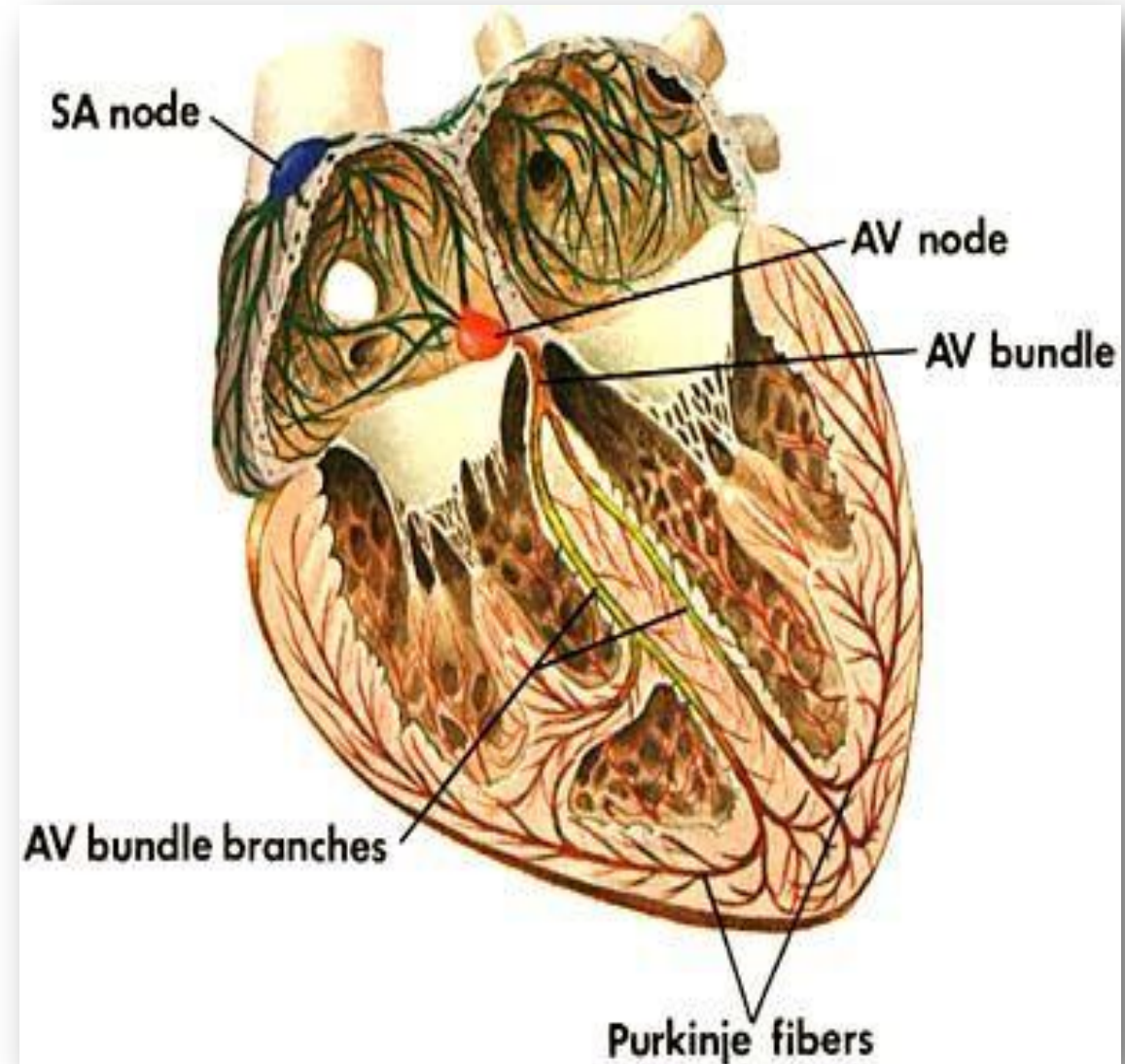
- The atrioventricular bundle (**bundle of His**) it is the only bundle of cardiac muscle that **connects** the myocardium of the atria and the myocardium of the ventricles.
- So it is thus the **only route** along which the cardiac impulse can travel from the atria to the ventricles.
- **Course:** The bundle **descends** through the fibrous skeleton of the heart, **then descends** behind the septal cusp of the tricuspid valve to reach the membranous part of the ventricular septum.
- **End:** *( At the junction between membranous and muscular ).* At the upper border of the muscular part of the ventricular septum **it divides into** two branches, one for each ventricle, **Right & left bundle branches.**





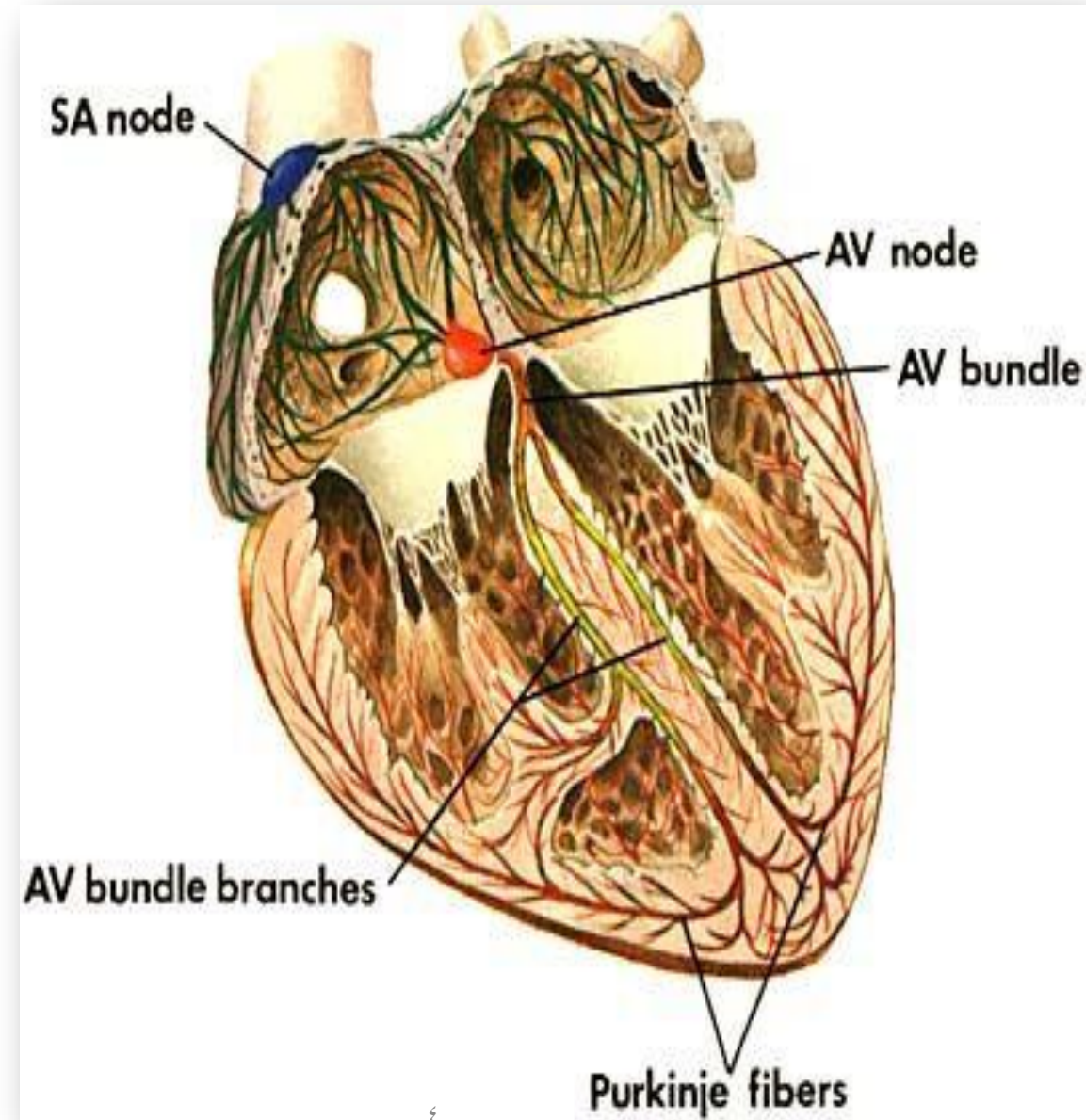
### The right bundle branch (RBB):

- It **passes down** on the right side of the interventricular septum beneath the endocardium.
- It **enters the moderator band**, to reach the anterior papillary muscle of the right ventricle.
- Then it divides profusely into fine sub-endocardial branches that surround the papillary muscles and distributed to the remaining ventricular walls. Here it **becomes continuous with** the fibers of the **Purkinje plexus of the right ventricle**.



## The left bundle branch (LBB):

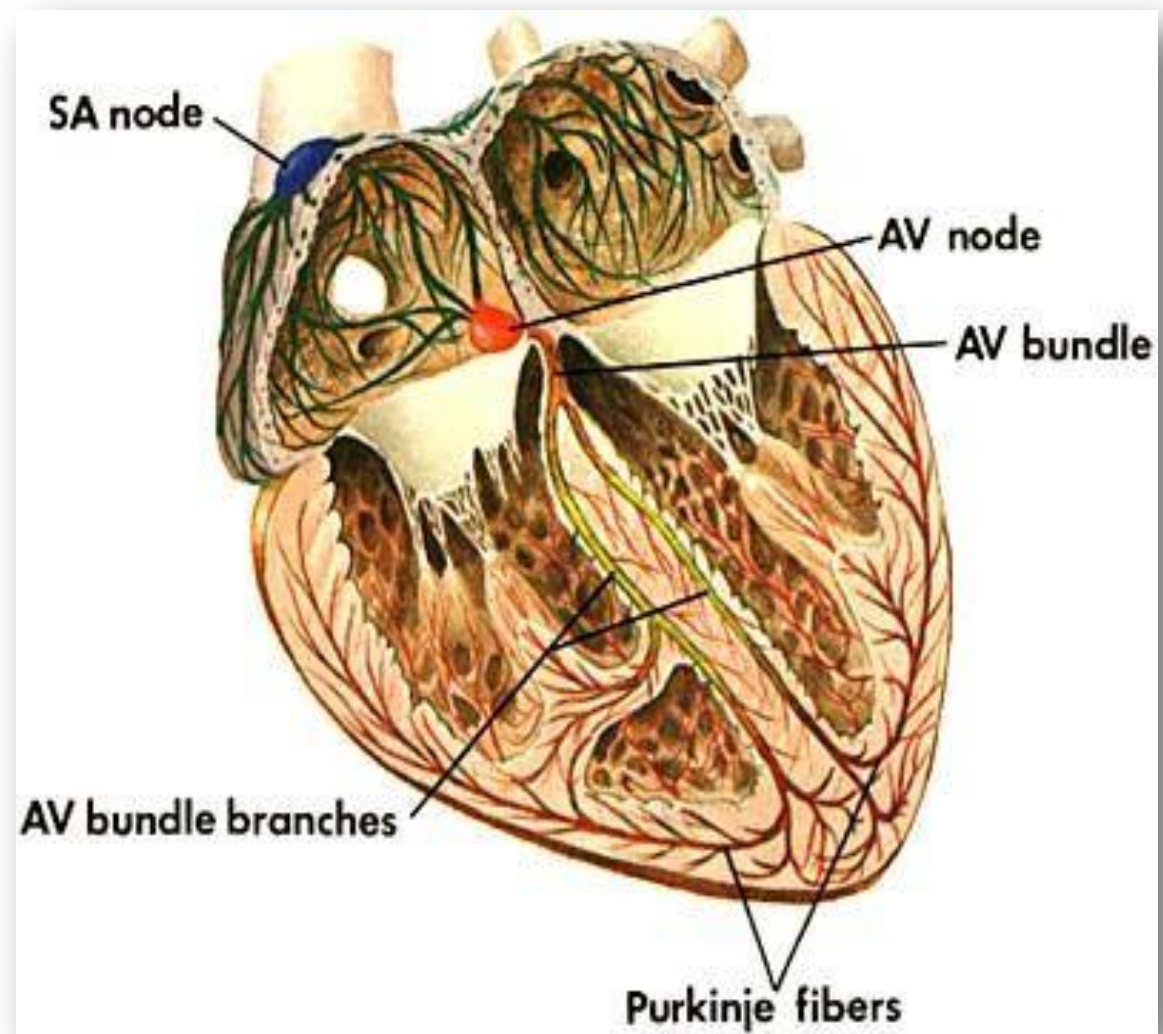
- It **passes down on left side** of the interventricular septum beneath the endocardium.
- It divides profusely into fine sub-endocardial branches, which first surround the papillary muscles and distributed to all parts of the ventricle, which become continuous with the fibers of the Purkinje plexus of the left ventricle.



Contraction of papillary muscle just electrical impulse - **ملاحظة**  
site impulses valves closures during contraction of the wall of ventricle **الخلاصة**

**Purkinje fibers:** → Atria. **ما الكلاصة بال**

- Are **located in** ventricular walls of the heart, just beneath the endocardium.
- The Purkinje fibers are specialized conducting fibers composed of electrically excitable cells.
- Purkinje fibers **allow** the heart's conductive system to create synchronized contractions of its ventricles.



# Quiz

A 57-year-old patient has a heart murmur resulting from the inability to maintain constant tension on the cusps of the atrioventricular (AV) valve. Which of the following structures is most likely damaged?

- (A) Crista terminalis
- (B) Moderator band.
- ~~(C) Chordae tendineae~~
- (D) Pectinate muscle.

سufficient closure ل cusps

Which of the following sequences correctly represents the conduction of an impulse through the heart?

- ~~A) SA node, AV node, AV bundle, bundle branches~~
- B) SA node, AV bundle, AV node, bundle branches
- C) AV node, SA node, AV bundle, bundle branches
- D) SA node, bundle branches, AV node, AV bundle
- E) AV node, AV bundle, SA node, bundle branches

لأهمية مادة الأناطومي في هذا السيستم رح نفصل كل محاضرة و جميعها الفيديوهات المطلوبة من المصادر يلي رح نشوقها أحسن اشي ان شاء الله

المحاضرة	الفيديوهات المطلوبة 1	الفيديوهات المطلوبة 2	الفيديوهات المطلوبة 3
Lecture 1	External features & relations	Pericardial and Sinuses Pericardium من اول الفيديو الى الدقيقة 13:16	ملاحظة: اخر المحاضرة في سلايدين شرحهم مع فيديوهات محاضرة 2
Lecture 2	Internal features & Valves	conducting system من الدقيقة 32:30 الى نهاية الفيديو	-
Lecture 3	conducting system cont.	Blood Supply and Nerve Supply of the Heart	-
-	-	Histology of Blood Vessels 1.Histology of general structure of blood vessels and large	Cardiovascular Revision Questions on Histology Questions on Histology of the blood vessels

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