A NEET SS (SURGERY) PREPARATION COURSE BY MARROW, WITH A TEAM OF SELECTED SUPER-SPECIALITY FACULTY

SURGERY NEET SS

CTVS

PREPARATION COURSE BY MARROW, WITH A TEAM OF SELECTED SUPER-SPECIALITY FACULTY

NEET SS
SURGERY

CTVS

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CONTENT

BASICS

ANATOMY OF THE HEART

General Anatomy

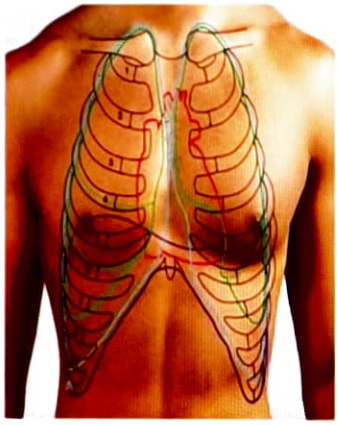
00:00:50

Surface marking :

Extends from 2nd to 5th intercostal spaces.

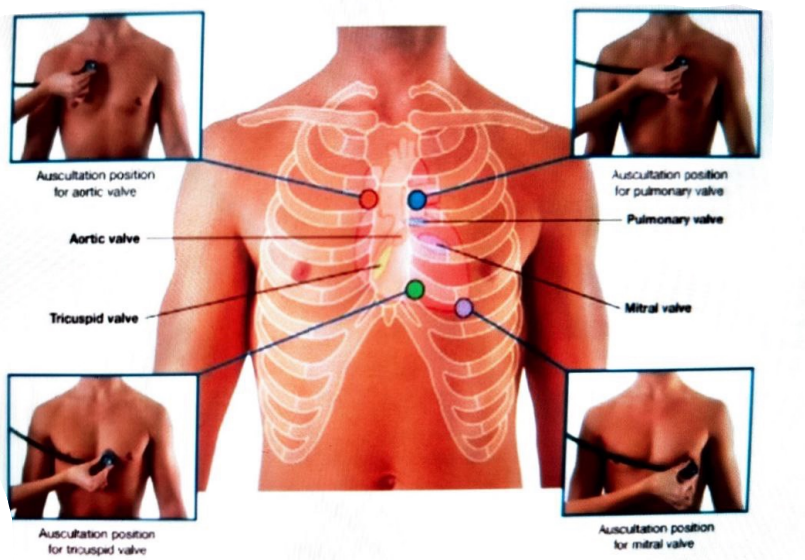
Right heart border corresponds to the right sternal border.

Left heart border corresponds to the apex, located in left 5th intercostal space in the midclavicular line.



Surface marking

Cardiac valves, positions and areas :



Auscultation

Aortic valve : Right 2nd intercostal space.

Pulmonary valve : Left 2nd intercostal space.

Tricuspid valve : Left lower sternal border.

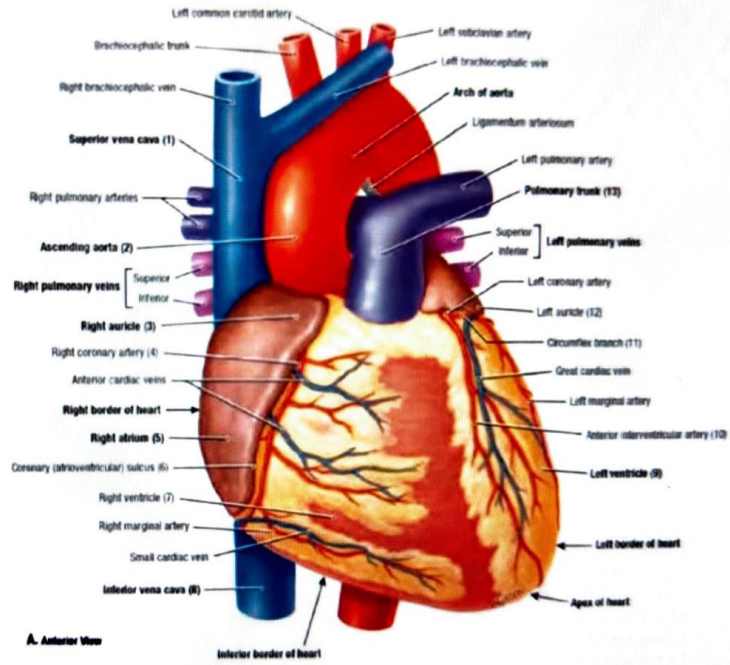
Mitral valve : Left 5th intercostal space (apex).

Gross view of surfaces and structures :

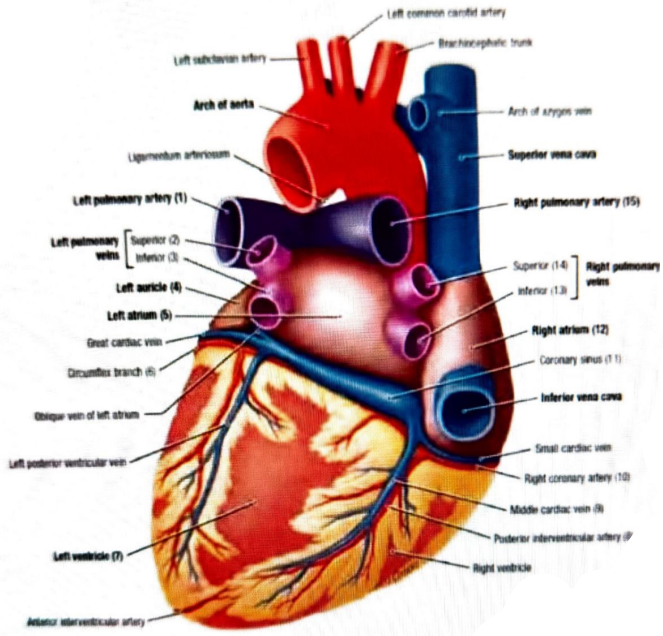
RA, LA and pulmonary artery : Anterior structures.

Rv, LV and aorta : Posterior structures.

Pulmonary artery → Left & anterior, aorta → Right & posterior.



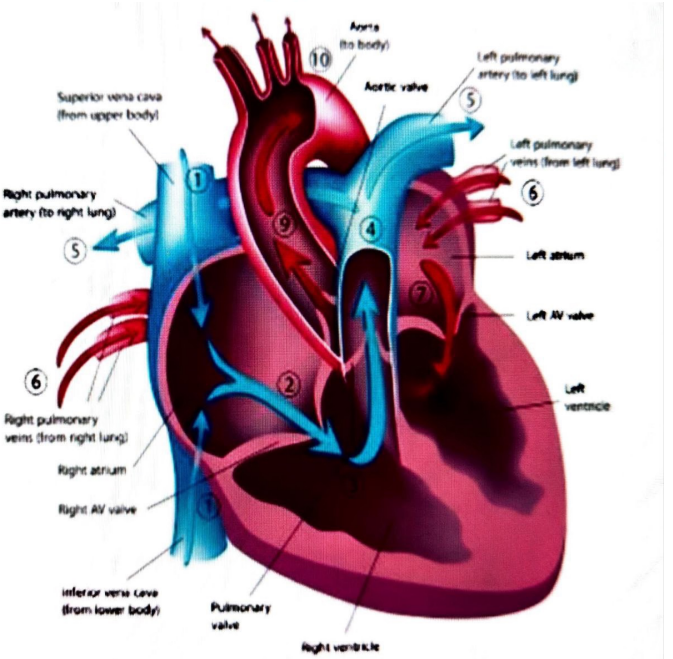
Heart : Anterior surface



Heart : Posterior surface

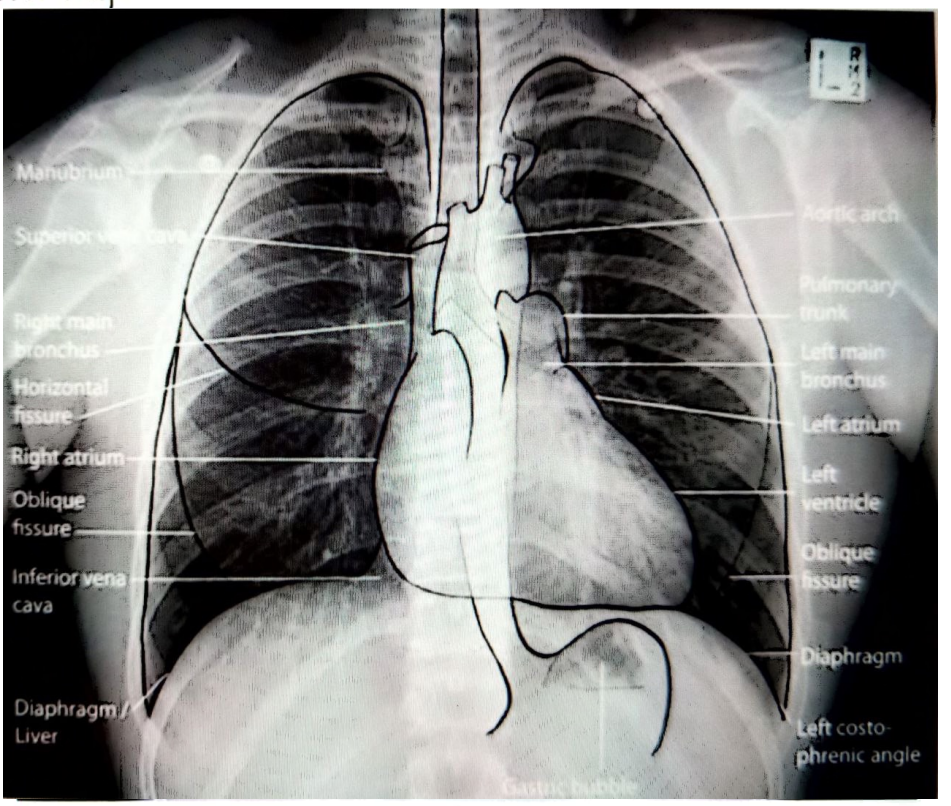
Pathway of blood flow through the heart :

Blood from SVC & IVC → Right atrium → Right ventricle → Right & left pulmonary artery (deoxygenated blood) → Right & left lungs → Right & left pulmonary veins (oxygenated blood) → Left atrium → Left ventricle → Aorta → Supplied to all systems.



Heart : Blood flow pathway

Chest X-ray :



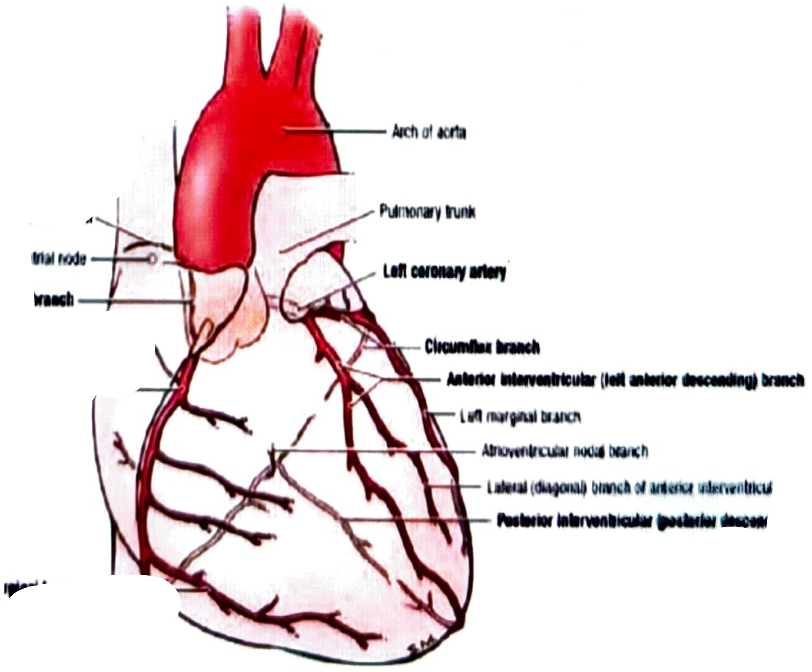
Chest X-ray

Borders and surfaces of heart :

Border	Formed by
Posterior	• Left atrium
Inferior	• Right ventricle • Left ventricle
Right	• Right atrium
Left	• Pulmonary trunk, • Left atrial appendange • Left ventricle
Surface	**Formed by**
Anterior/sternocostal	• Right ventricle
Inferior/diaphragmmatic	• Right ventricle • Left ventricle
Superior	• Aorta • Pulmonary artery
Right pulmonary	• Right atrium
Left pulmonary	• Left atrium • Left ventricle

Blood supply of heart

Arterial supply :



Coronary arteries : Anterior view

Left coronary artery :

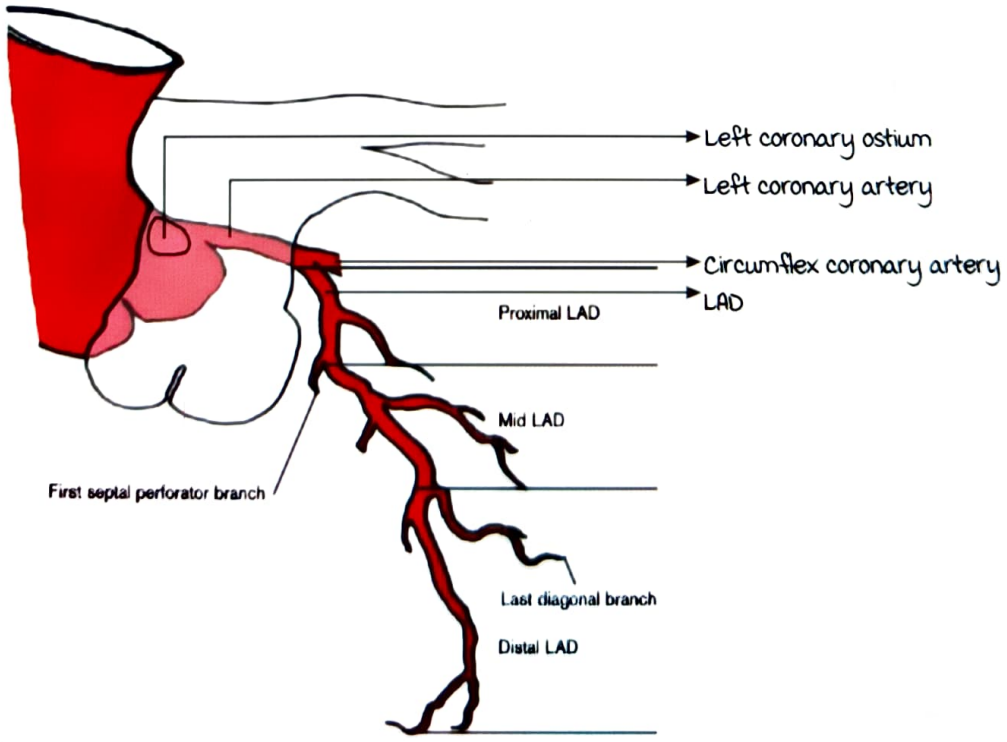
Has a variable length : 2-20 mm.

Divides into :

- Left anterior descending artery.
- Left circumflex coronary artery.

Left anterior descending artery (LAD) :

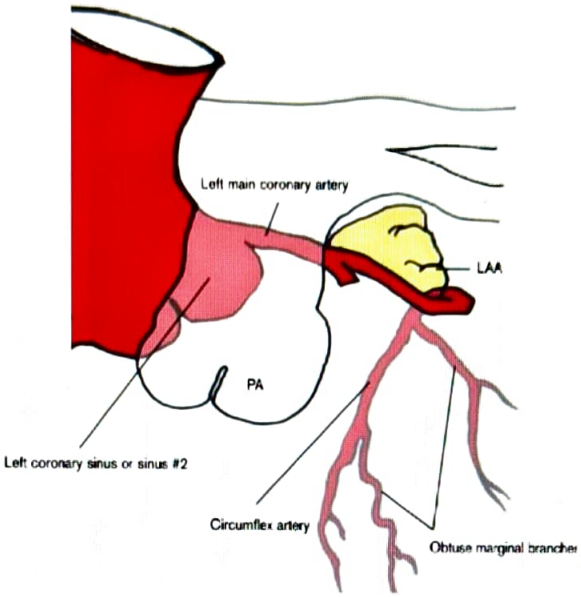
- LAD descends into the anterior interventricular groove.
- During descent, it gives various branches :
  a. Septal perforator branches (Perpendicular to the LAD).
  b. Diagonal arteries (Surface branches).
- Supplies 55% of the myocardium.
- 1st septal perforator lies in very close relation with the sub pulmonary infundibulum → Great surgical significance : During harvesting of pulmonary root, there is chance of injury to this branch.
- LAD is divided into :
  a. Proximal : From the origin to LAD to the 1st septal perforator.
  b. Mid : From the 1st septal perforator to the last main diagonal branch.
  c. Distal : After the last diagonal branch till the termination of LAD.



Left coronary artery & LAD

Left circumflex coronary artery :

- It goes between the pulmonary trunk and left atrial appendange and posteriorly into the atrioventricular groove.
- Branches : Obtuse marginal arteries, given to the lateral and posterior surface of the heart.



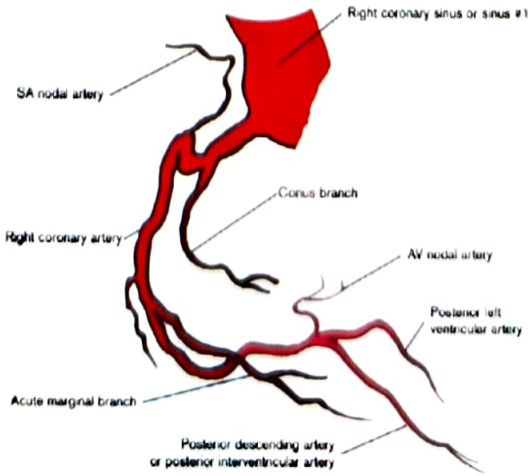
Circumflex coronary artery

Right coronary artery :

- Arises from right coronary sinus.
- Comes down in the right atrioventricular groove.
- Gives acute marginal branches and SA nodal artery.
- At inferior surface of heart, can give a branch to AV node and terminates into 2 branches :

  a. Posterior left ventricular artery.

  b. Posterior descending artery : Travels into posterior interventricular groove.



Right coronary artery

Note :

1. SA nodal artery :

   Arises from :

   - Right coronary artery in 55-65% of persons.
   - Circumflex coronary artery in 35-45% of persons.

2. AV nodal artery : Arises from RCA in 85-90% of persons.
3. Accessory AV nodal artery (Kugels artery) arises from :
   - Right coronary artery or circumflex coronary artery in 40% of persons.
   - Circumflex coronary artery in 10-15% of patients.

Summary of branches of coronary arteries :

Artery	Branches
Left coronary	• LAD • Left circumflex coronary artery • Ramus intermedius
Left anterior descending	• Diagonals • Septal perforators
Left circumflex coronary	• Obtuse marginals • Left posterolateral branch
Right coronary	• Acute marginal artery • Posterior descending artery • Right posterolateral artery • SA nodal artery • AV nodal artery • Conal artery
Conal artery : Can have communication with LAD, in cases of thrombotic occlusion, the LAD can get flow distally from this branch → Loop of Veiussens	

Coronary veins :

Great cardiac vein :

- Accompanies LAD and left circumflex arteries.
- Communicates with middle cardiac vein.
- Joined by oblique vein of left atrium & forms coronary sinus, opens into the right atrium.
- At opening of coronary sinus : Thebesian valve.

Small cardiac vein :

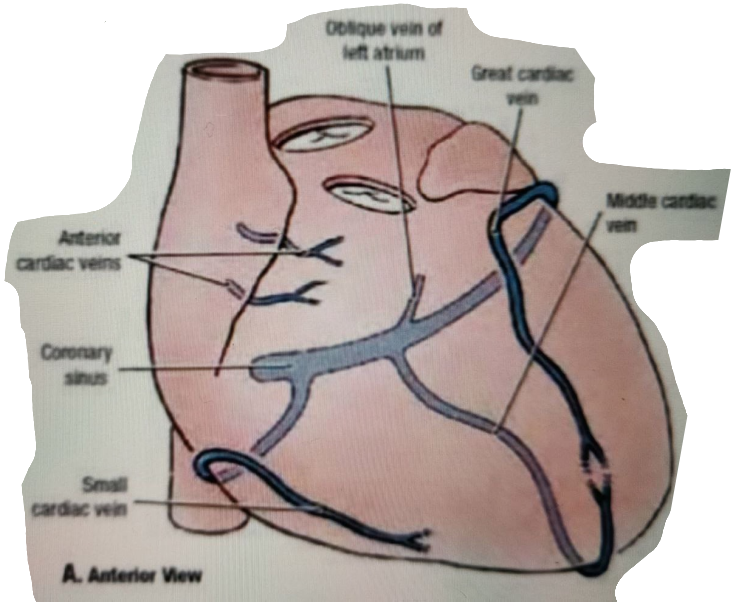
It runs in the right AV groove, accompanies right coronary artery and acute marginal artery.

Multiple small veins :

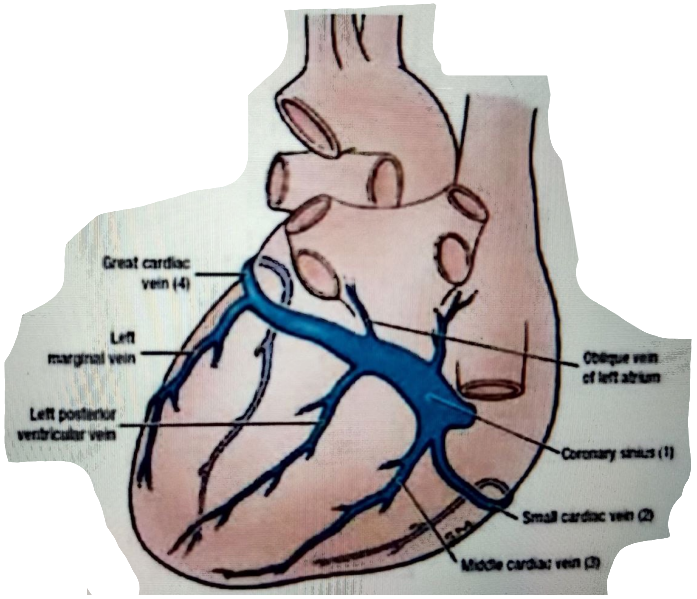
Anterior cardiac veins, Thebesian veins open directly into the right atrium.

Venous drainage :

Coronary vein	Anatomical location	Accompanied by
Coronary sinus	Left atrioventricular groove	• Circumflex artery
Great cardiac vein	Anterior interventricular groove into left atrioventricular groove	• LAD • Circumflex artery
Middle cardiac vein	Posterior interventricular groove	• Posterior descending artery
Small cardiac vein	Right atrioventricular groove	• Right coronary artery • Acute marginal artery



Coronary veins on anterior surface



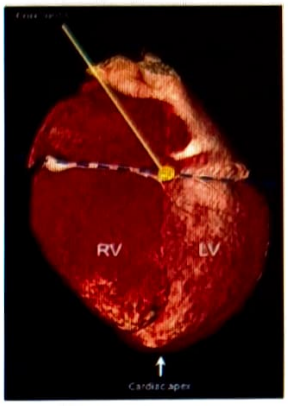
Coronary veins on posterior surface

Dominance :

Right dominance : 90%

Left dominance : 10%

Co-dominance can be present in some cases.



Codominence

Right atrium

00:27:25

Smooth and rough portions.

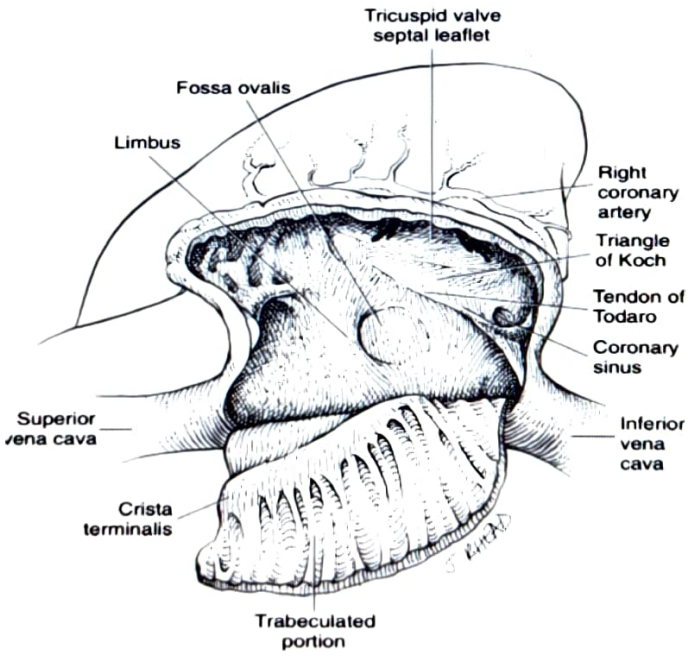
Crista terminalis : Border between smooth and rough surfaces.

Right atrial appendage : Broad and triangular

Sulcus terminalis : Corresponding portion of crista terminalis on the outside.

IVC valve : Eustachian valve.

Tendon of Todaro : Fibrous extension of Eustachian valve.



Interior of right atrium

Note :

Left atrial appendage : Tube like or finger like, only trabeculated portion of LA.

No crista terminalis in left atrium.

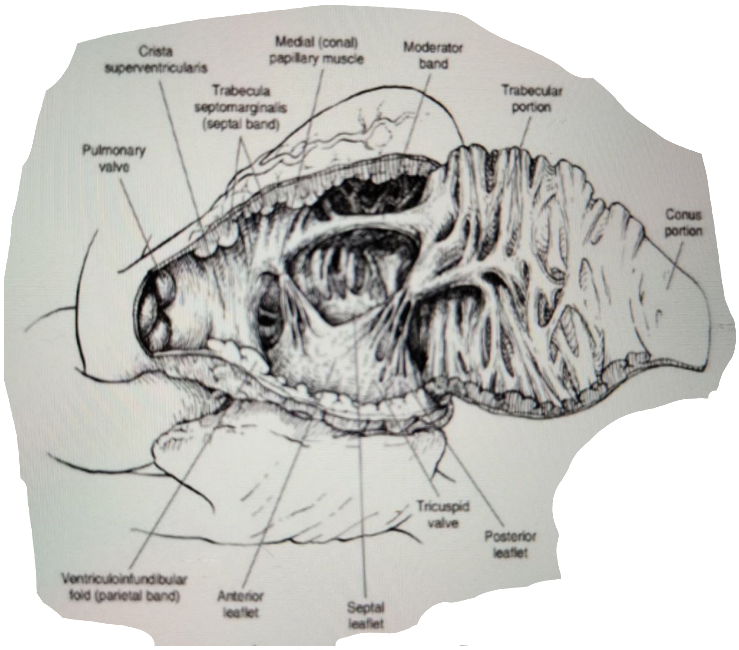
Right ventricle

Thinner than LV, cut section cresenteric in shape.
Trabeculations : Coarse and big in RV.
Papillary muscles : Septal, anterior, posterior
Tricuspid valve : 3 leaflets.
3 papillary muscles :

- Anterior (Largest).
- Septal (medial) → muscle of Lancisi/Lushka.
- Posterior (Smallest).

Thick muscular band in RV : moderator band

- Gives insertion to anterior papillary muscle.
- Contains right bundle branch.

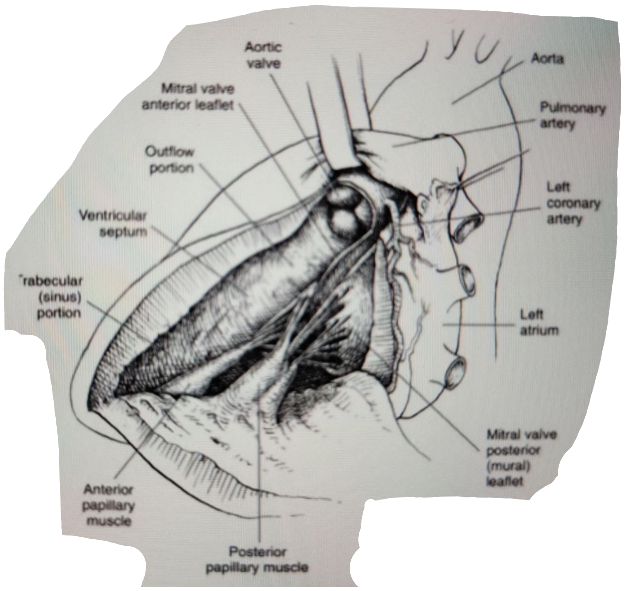


Interior of right ventricle

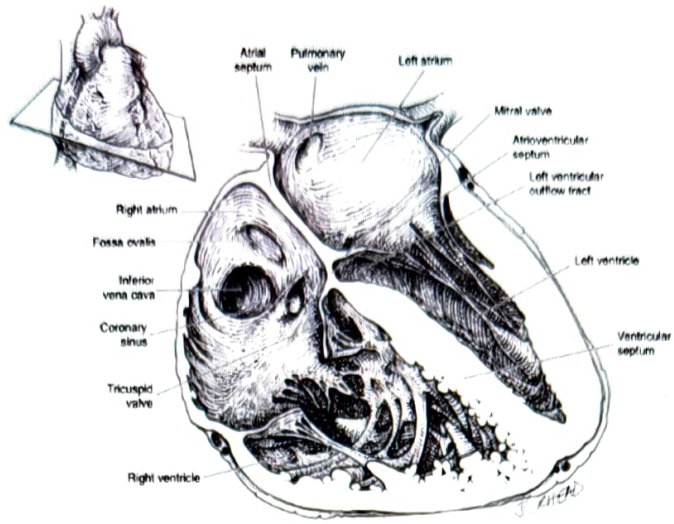
Left Ventricle

00:37:10

Cut section circular in shape.
2 papillary muscles.
Trabeculations small and fine in LV.



Interior of left ventricle



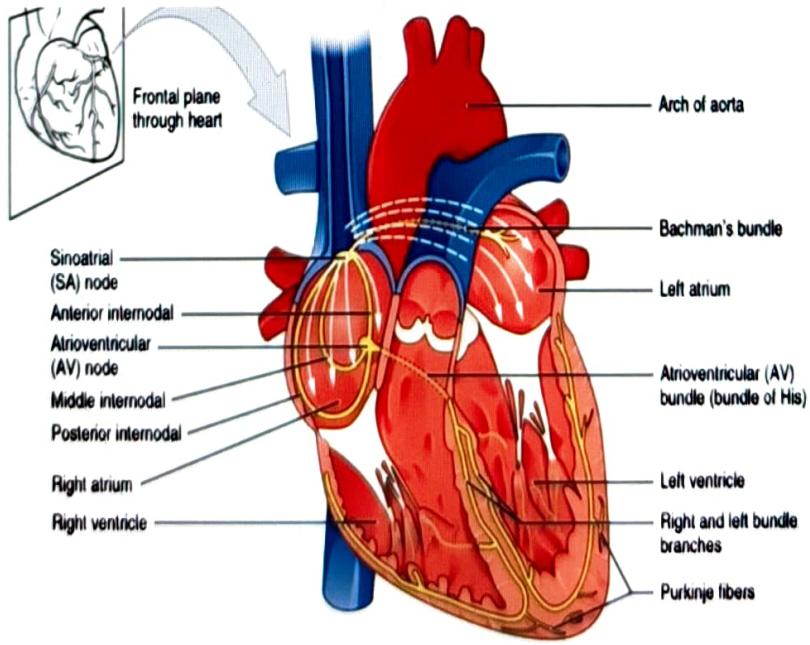
4 chamber view of the heart

Conduction bundle

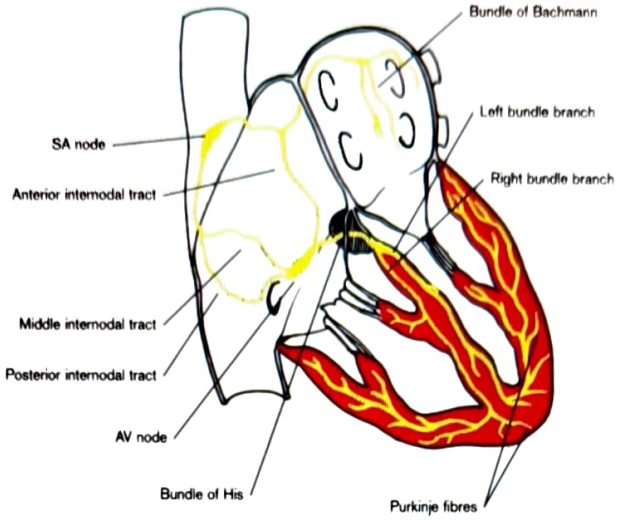
00:39:53

SA node	AV node
• Natural pacemaker of the heart • Lateral to junction of SVC with right atrium • Subepicardial location	• Located between junction of RA and RV, in triangle of Koch • Subendocardial in location

From RA to LA : Interatrial tract → Bachman's bundle.



Conduction bundle



Conduction bundle

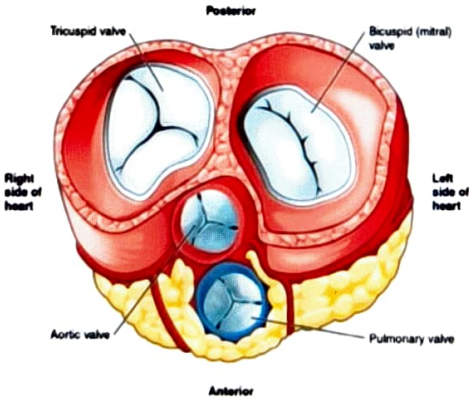
Valves

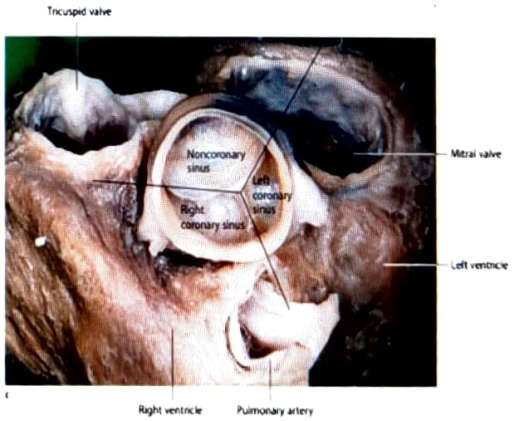
00:43:50

Aortic valve :

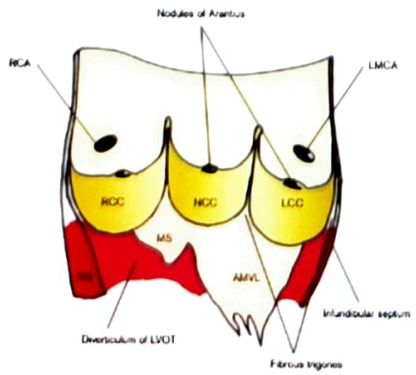
Central portion of heart.

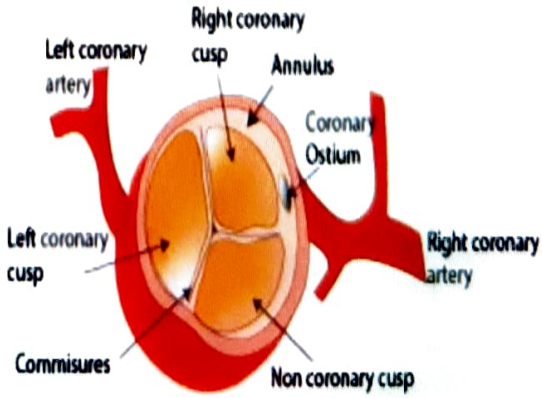
Related with all valves.



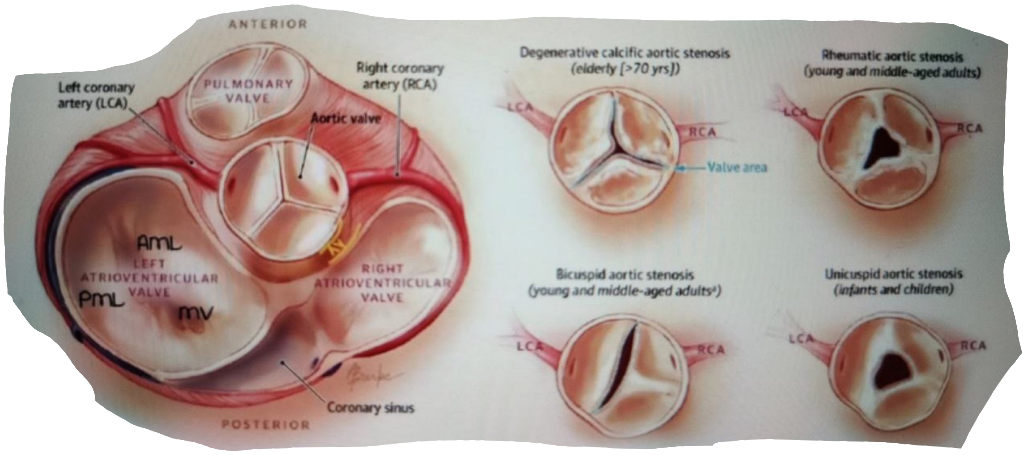


Conduction bundle



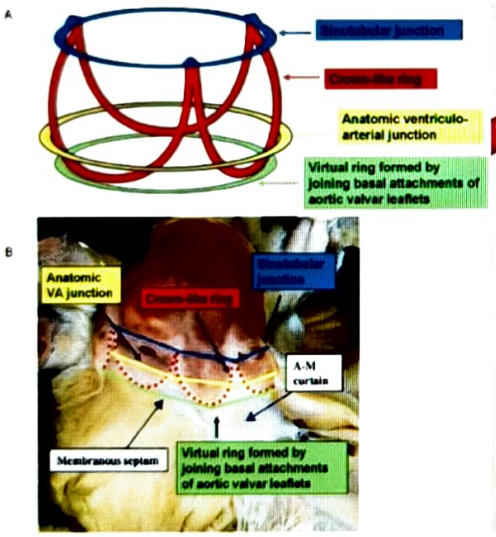


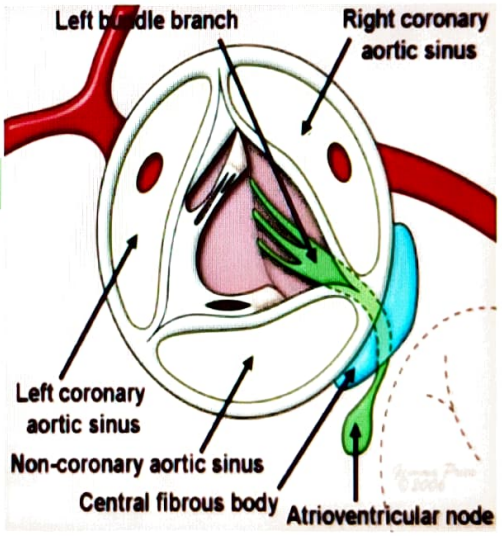
Aortic valve : Cusps and commisures



Aortic valve : Relation with vessels and involvement in various diseases

Left coronary and non coronary cusp : Aorto-mitral curtain.





Mitral valve :

2 leaflets :

- Anterior/aortic/septal leaflet : 1/3rd of anulus
- Posterior/mural/ventricular leaflet : 2/3rd of anulus.

Limits of aortomitral curtain → Two trigones.

Chordae → 3 orders :

First : At the leaflet tip.

Second : A few mm away.

Third : At base (Only PML).

2 commissures : Posteromedial (Bundle of His) and anterolateral.

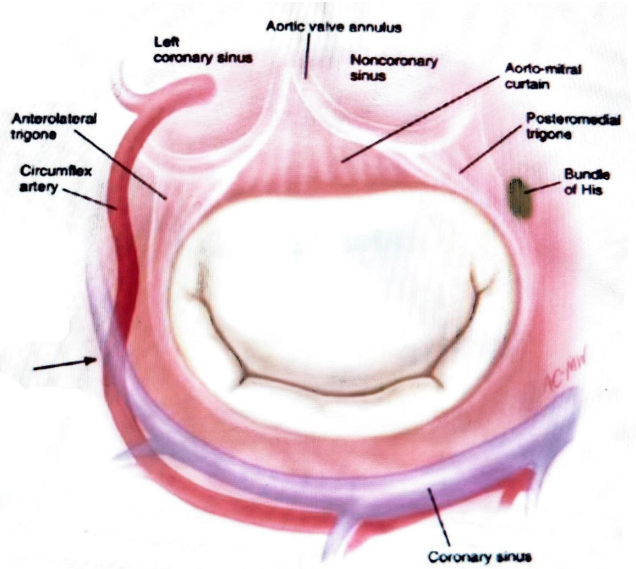
Relations :

Coronary sinus : In relation with posterior mitral leaflet.

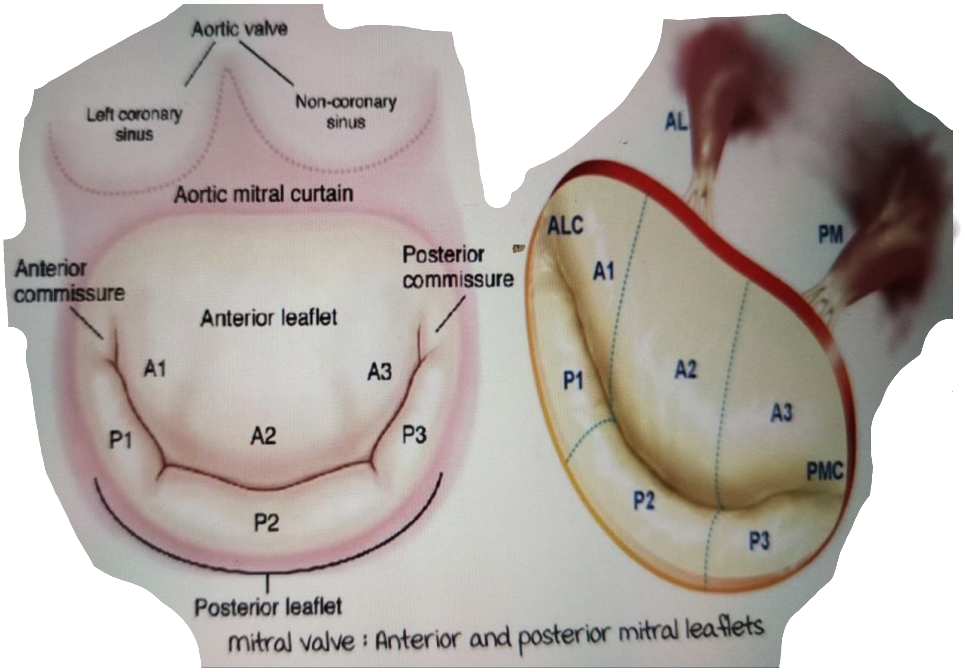
Left circumflex artery : In relation with anterolateral commissure.

Aorto-mitral curtain : Between left and non coronary sinuses.

Bundle of His : Between right and non coronary sinuses.



Mitral valve



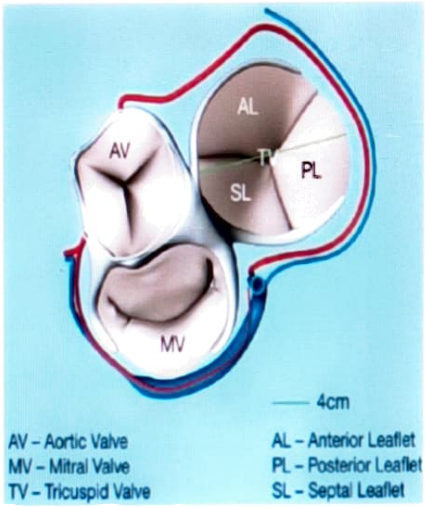
Mitral valve : Anterior and posterior mitral leaflets

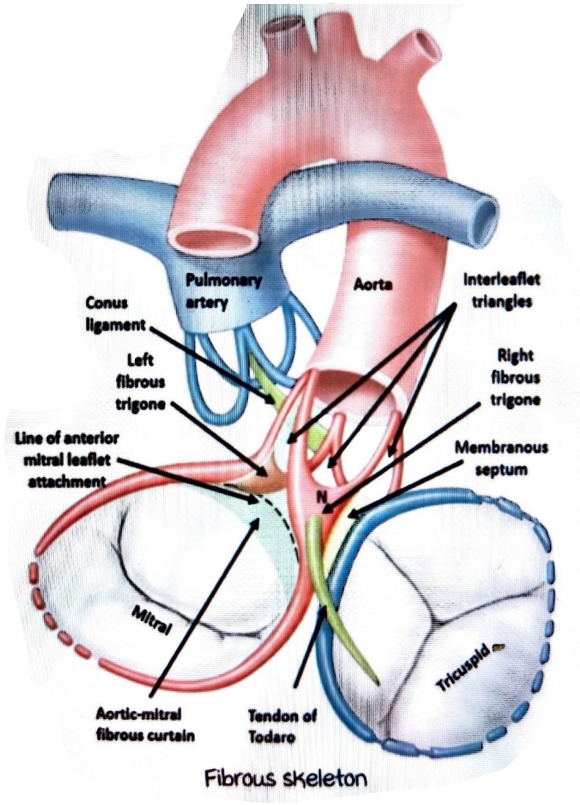
Fibrous skeleton :

Part of left coronary and non coronary of aortic valve.

Anterior mitral leaflet of mitral valve.

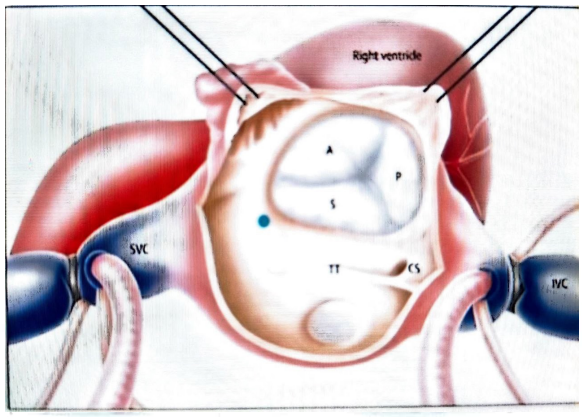
Septal leaflet of tricuspid valve.





Fibrous skeleton

Tricuspid valve :



Tricuspid valve

Triangle of Koch :

It is bounded by :

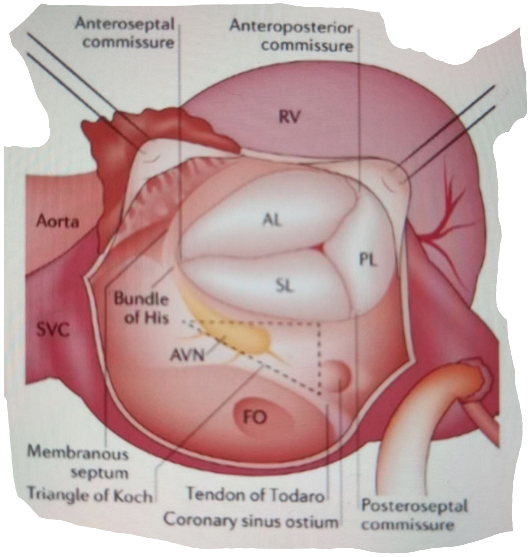
Coronary sinus.

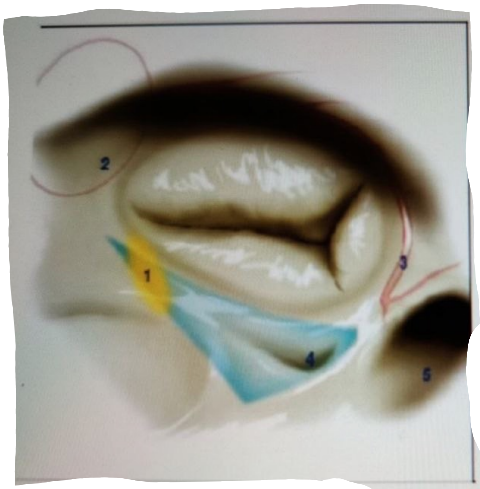
Tendon of Todaro.

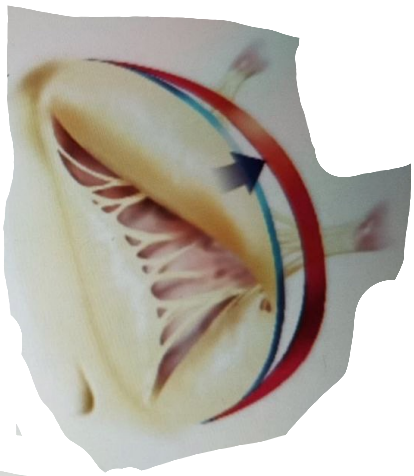
Septal cusp of tricuspid valve.

Content :

AV node and nerve bundle at the apex.

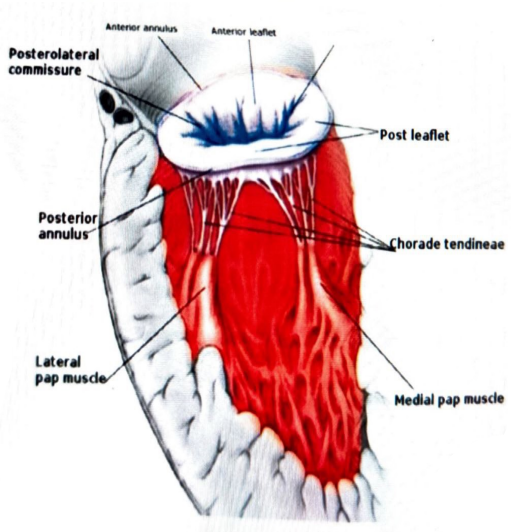






Tricuspid valve

Papillary muscles :

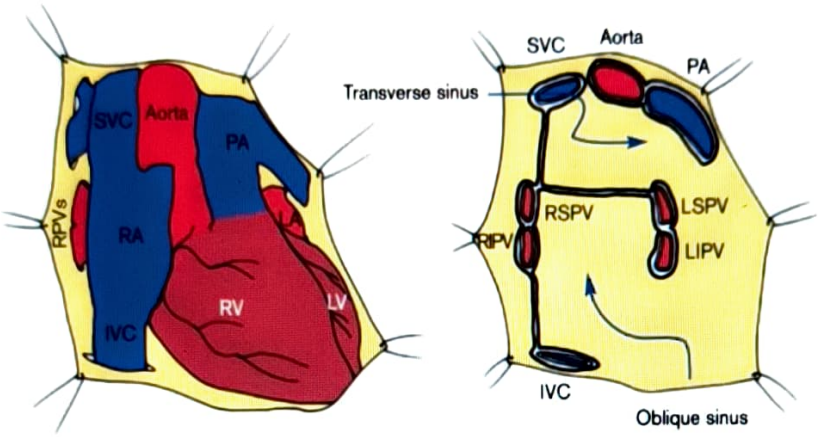


Cardiac sinuses

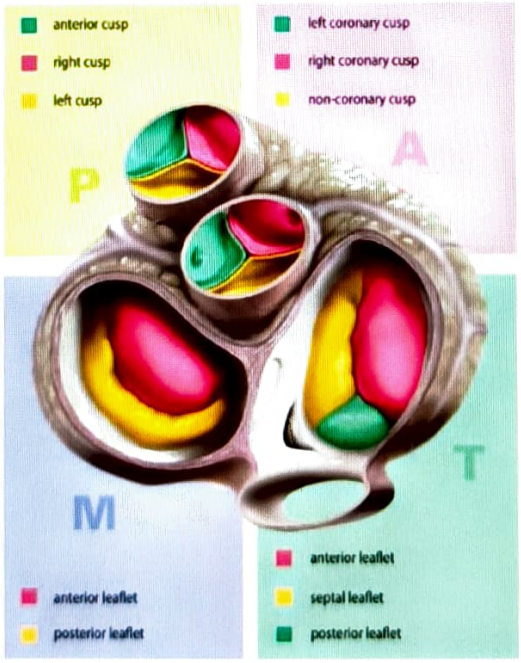
01:02:50

Transverse sinus.

Oblique sinus.



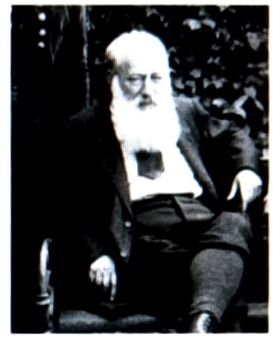
Cardiac sinuses

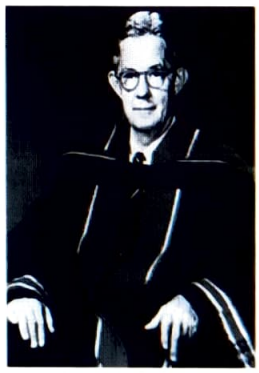


Cardiac valves : Summary

HISTORY OF CARDIAC SURGERY

Cardiopulmonary bypass & related history 00:00:28

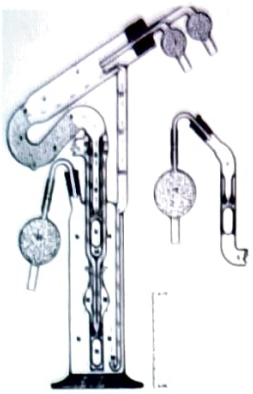
Scientist	Image
Stephen Paget : Surgery of the heart has probably reached the limits set by Nature to all surgery. No method, no new discovery, can overcome the natural difficulties that attend a wound of the heart.	
Alexis Carrell : 1st vascular surgeon to get the Noble prize in 1912. "It may even be regarded as extremely doubtful whether open heart surgery may ever be applicable to human surgery".	
Werner Forssmann, 1929 : 1st person to perform cardiac catheterization.	
Charles A. Lindberg : 1st person to have an idea of mechanical heart. Appointed in Rockerfeller Institute of medical Research. Developed Carell-Lindbergh Heart Pump in 1936. Glass device : Regulated compressed air to vary pressure and perfusion rates.	

Scientist	Image
Maude Abbot : Abbot's artery, in relation to coarctation of aorta. She published over 100 papers & books and delivered many lectures. Her Atlas of Congenital Cardiac Disease (1936) confirmed her status at the top of her field.	
Robert E. Gross : Performed the first cardiac surgery on August 8, 1938. With John P. Hubbard, in Boston. Procedure : Succesful surgical ligation of PDA. Also developed atrial well technique for closure of ASD.	
November 29, 1944 : The 1st blue bird operation Palliative procedure for baby with Tetralogy of Fallot. Blalock-Taussig shunt : Subclavian artery to pulmonary artery. Helen Taussig : Pediatric cardiac surgeon.   Hellen B. Taussig	 Alfred Blalock

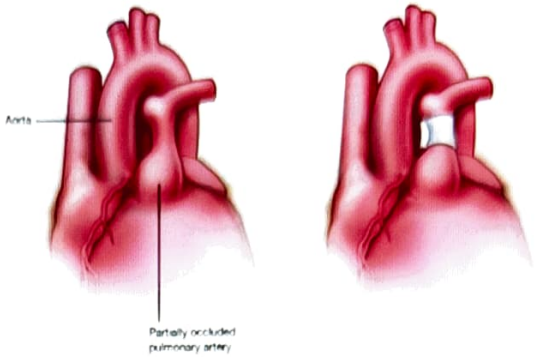
Blue bird operation

Gross atrial well technique

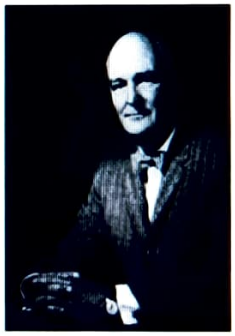
Cardiac catheterization



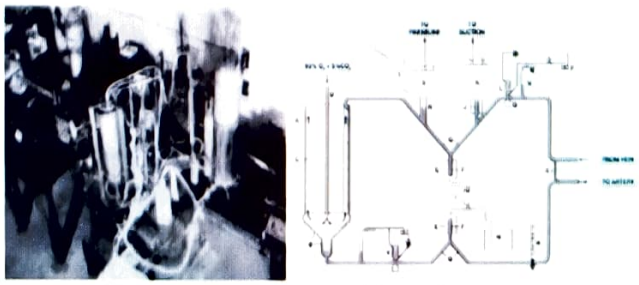
Carrel Lindberg pump



Pulmonary artery banding : Muller, Damman (1952)

Scientist	Image
Brock : Pulmonary valvotome to relieve cyanosis.	
John Heshyam Gibbon Jr : • 1st mechanical heart apparatus built Boston, 1934–35. • Built 1st apparatus (Primitive cardiopulmonary bypass machine) with his wife Mary Gibbon. • 1st to consider how to work on heart with circulation supported by machine. Issues with Gibbon's machine : • Imperfect CPB machine : made of glass & rubber → hemolysis. • Priming caused anemia. • Excessive bleeding due to heparin. • Lengthy & complex procedure. • Poor anaesthetic technique.	 1st person to perform successful open heart surgery in 1953

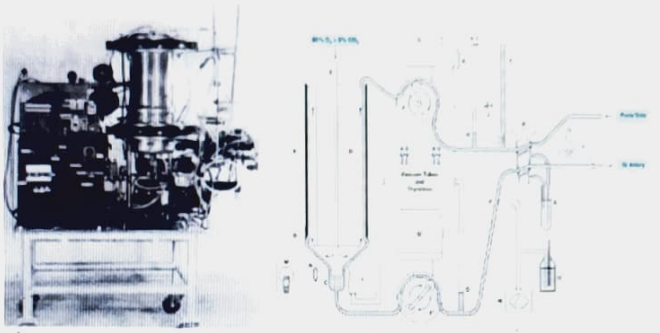
John Gibbon Jr and his wife Mary Gibbon



1st oxygenation machine built by John Gibbon Jr

1916 : Mc Lean discovered heparin.

1930 : De bakey introduced roller pumps.



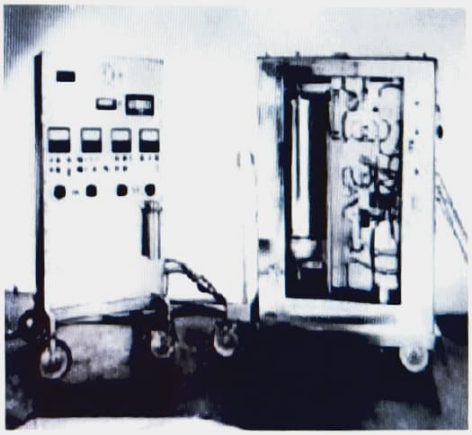
2nd oxygenator with larger capacity, 1938, built by John Gibbon Jr.

Stainless steel canulas to reduce hemolysis.
Donor blood for priming.

Issues :
Improper oxygenation : Death due to anoxia & organ damage.
Bleeding due to heparin.

After world war II,
Gibbon met IBM chairman for engineering assistance.
model I oxygenator developed by IBM 1949, used in dogs.

IBM chairman



Oxygenation machine built by IBM and John Gibbon Jr

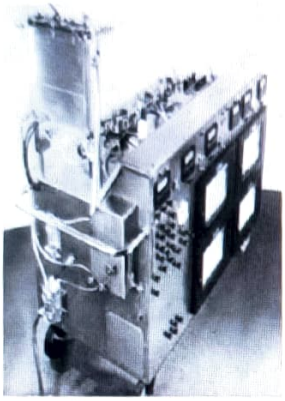
Modifications in IBM and John Gibbon Jr machine :

- Modified hardware.
- Metal canula, roller pump, venous level monitors.
- Glass and rubber parts coated with silicone.
- Priming restricted to 550 ml.
- Introduced arterial filter (metal mesh).
- Protamine was used for 1st time.

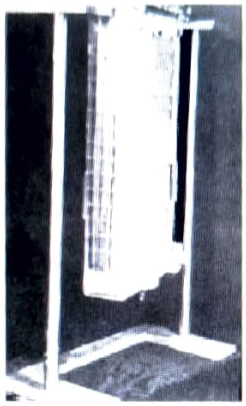
Issues :

- Need for increased oxygenating capacity to be used in humans
- ↑ turbulence, ↑ surface area.

Model II : Screen oxygenator → IBM 1951.



model II oxygenation machine built by John Gibbon Jr



Parallel screens : Lung for model II

Mary Gibbon : The 1st perfusionist

Clinical experience of Dr Gibbon with IBM II model :

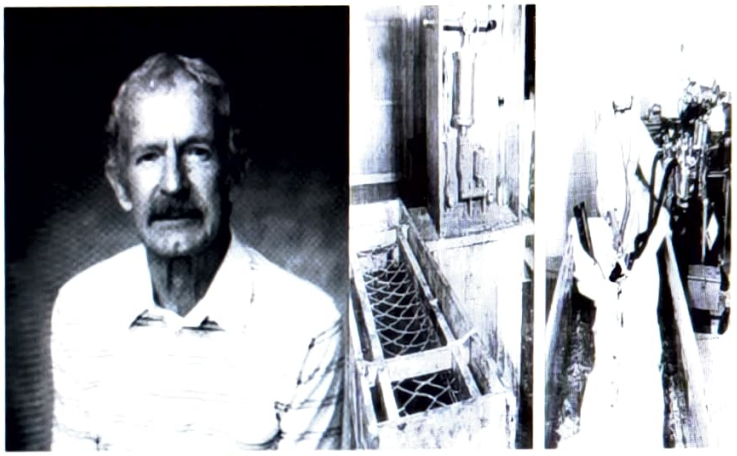
S.No	Date	Age	Pre-op diagnosis	Outcome
1	Feb 1952	15 months	ASD	Died in OR (PDA)
2	May 6, 1953	18 years	ASD	Lived long term
3	July 1953	5.5 years	ASD	Died in OR
4	July 1953	5.5 years	ASD	Died in OR (VSD, PDA)
5	NA	NA	NA	Died
6	NA	NA	NA	Died

The "Sick Human Heart" :

Surgeon	Year	Outcome
C Dennis	1952	2/2 died
J Gibbon	1953	5/6 died
J Helmsworth	1953	1/1 died
D Dodrill	1953	2/2 died
G Clowes	1953	2/2 died
W Mustard	1953/54	5/5 died
17/18 died, mortality : 94.5%		

Lewis/Tauffic/Varco in 1952 :

- ASD closure, 1st open cardiac surgery without using cardiopulmonary bypass.
- 5 yr child with OS ASD, placed in cold water bath → 2 hrs 41 min → cooled to 28°C.
- Opened the chest and occluded all inflows → pulmonary artery/aorta clamped to prevent air embolism.
- 5.5 min → Direct ASD closure.
- Declamped, massage → Heart recovered.
- 33 ASD corrected with 12 % mortality.

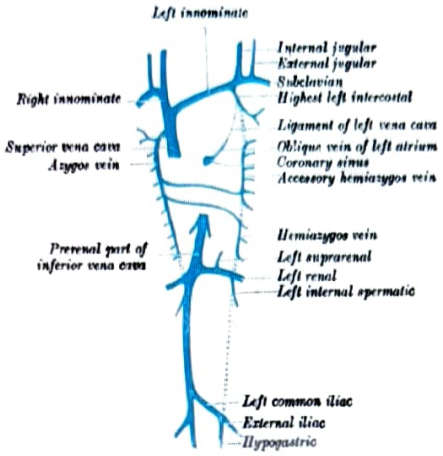


1st cardiac surgery without bypass with hypothermia induction

Bigelow : Proposed hypothermia in 1950

Azygous flow principle :

- Proposed in 1952 by Anthony Andreasen & Frank Watson.
- Principle : Animals can survive prolonged venacaval occlusion without sequelae if blood from the azygos vein alone is permitted to reach the heart.
- Patients are reperfused during CPB at flows much less than the normal cardiac output.
- Dogs survived for 40 minutes without brain damage.
- 10% of blood flow needed to maintain life.



Azygous vein

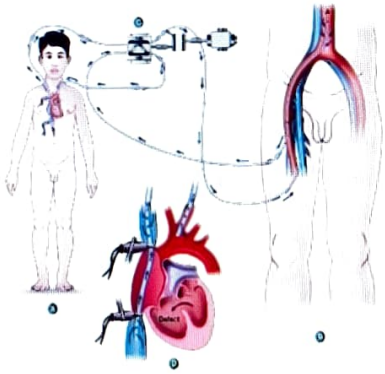
Clarence Walton Lillehei :

Father of open heart surgery.

Controlled cross circulation :

- Controlled pumps precisely control the balance of volume of blood flowing into and out of patient and donor.
- Cannulation in child : Long IJV cannula, arterial cannula in left common carotid.
- Cannulation in donor : Right femoral artery & right GSV.

Clarence Walton Lillehei



Controlled cross circulation

Results of procedures with controlled cross circulation :

Diagnosis	Number	Mortality	<2 yrs	Mortality
VSD	28	8 (28%)	16	6 (37%)
PDA (PAH)	1	0	-	-
TOF	10	4 (36%)	5	3 (60%)
ASVD	5	3 (75%)	3	2 (67%)
IPS	1	0	-	-
PAPVC, PS	1	0	-	-
15/45 patients survived : 33% survival rate.				