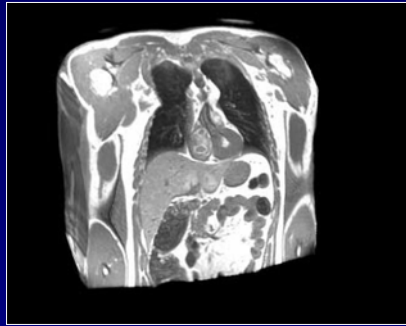


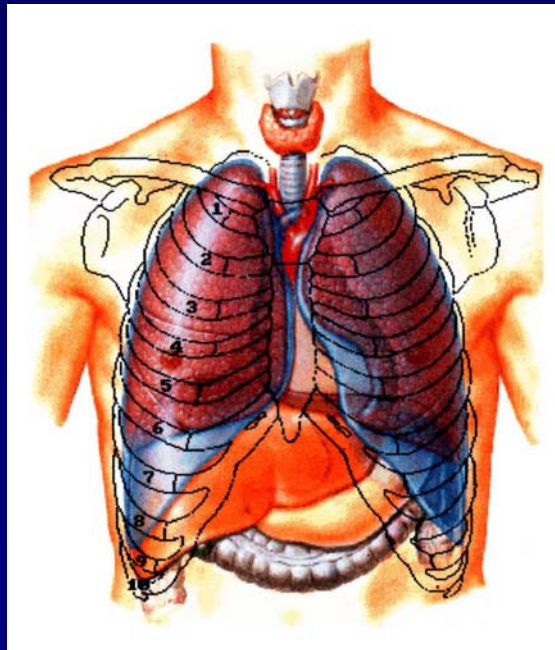
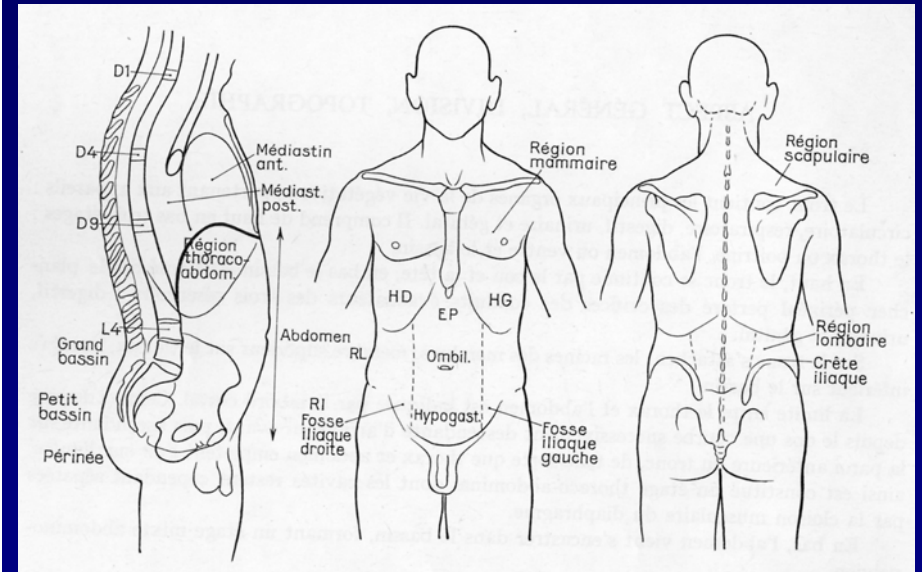
Anatomical and Physiological Basis for cardiac robotic surgery



Nicolas Bonnet

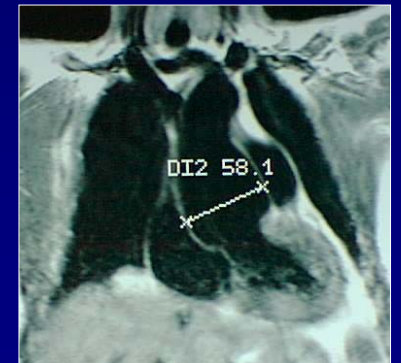
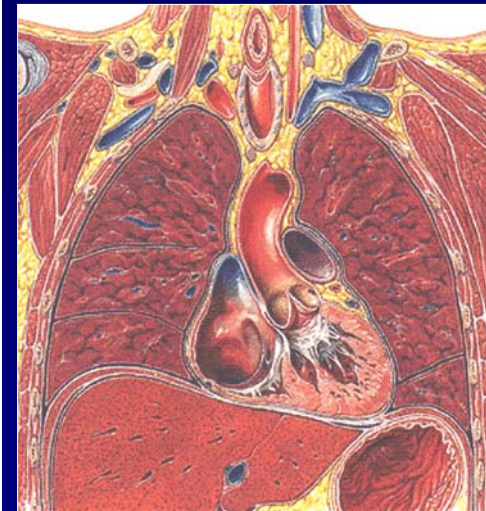
La Pitié-Salpêtrière, Paris, France

The thorax is the upper part of the trunk

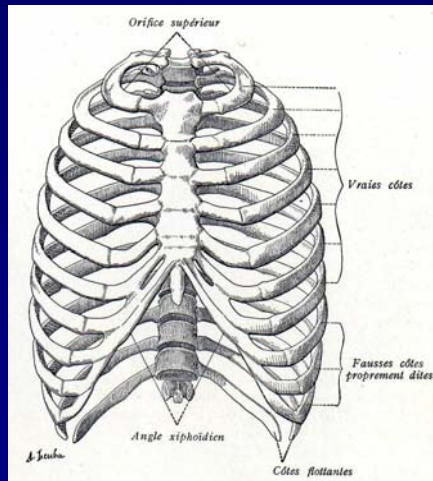
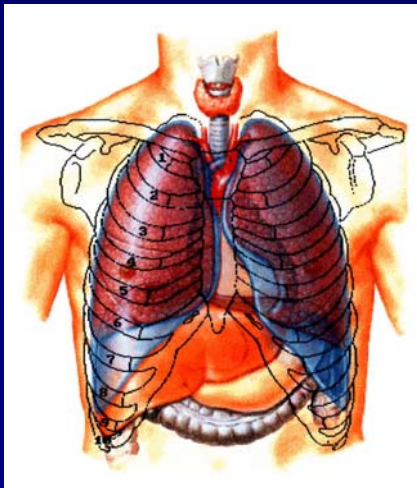


Thorax

The Thorax...



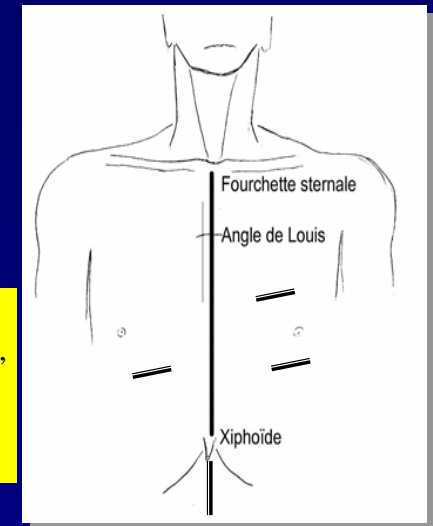
The heart is in a jail, the thoracic skeleton



How to work on the heart

- Go inside
- Reach the target(s)
- Do the cardiac procedure

The procedure is a choice of the best approach regarding the cardiac target, the tools available designed for the procedure and the predictable and unpredictable difficulties.



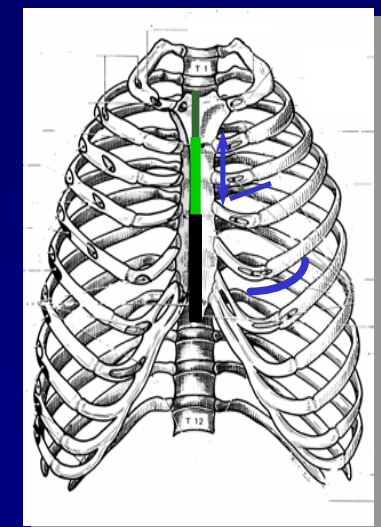
Sternotomy

- Full access in direct vision
- Redo surgery
- Combined surgery



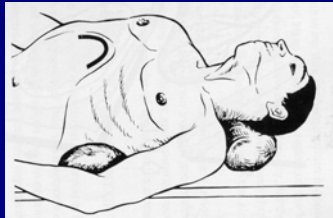
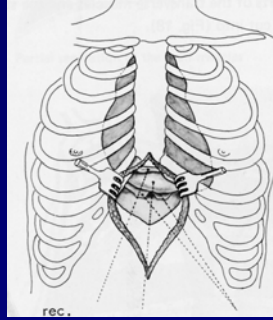
Ministernotomies are sternotomies

- General anesthesia, surgeon, saw...
- Direct but limited vision to some parts of the heart



Classical subxyphoid –Marfan-

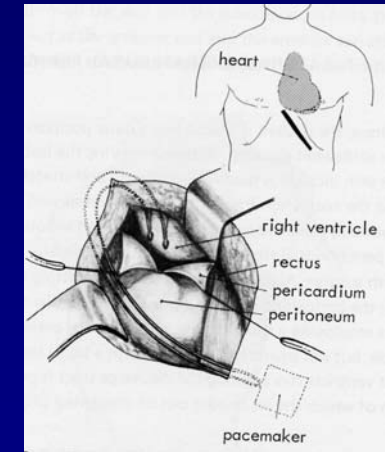
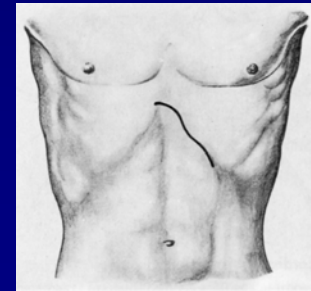
- Easy
- Fast
- Direct vision
 - Pericardium
 - RV
- Improvement of vision with video
- Difficult in obese or redo patients



Old incisions

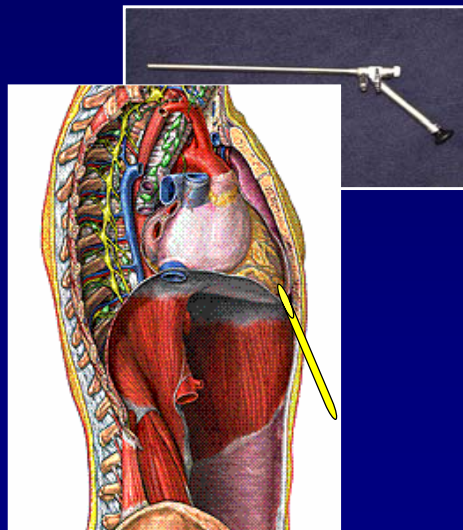
– Larrey Rehn-,– Parsonnet-

- Real surgery
- Best vision on the RV
- Difficult to close

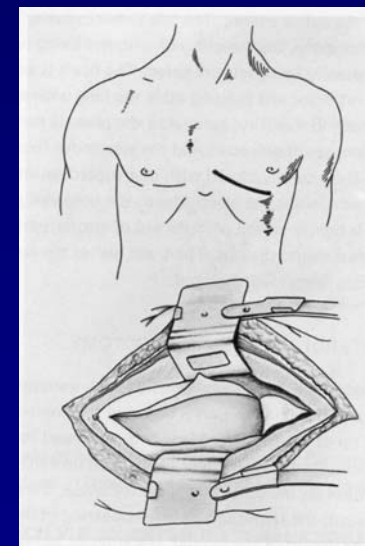


New subxyphoid approach

- Blind technic:
Percutaneous
- Safe technic:
Videoscopic approach with a translucent self-cutting trocar
-Ethicon™-



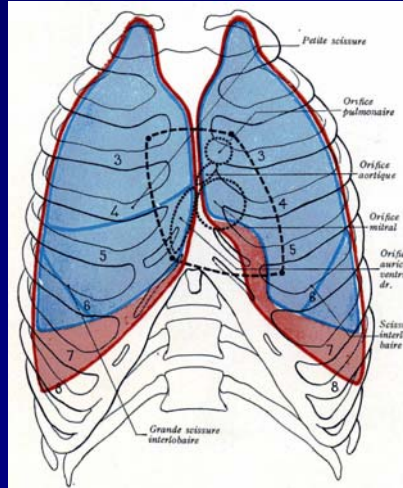
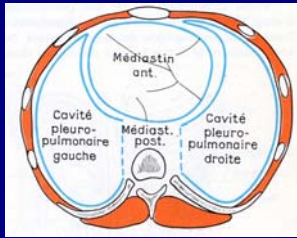
Left minithoracotomy



- Easy and Fast
- Direct vision
 - Pericardium
 - LV ± LA
- Improvement of vision with video

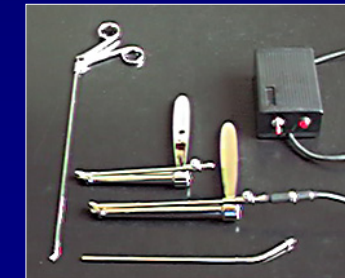
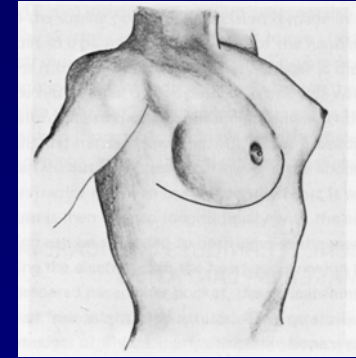
Anterior minithoracotomy, pericardium, pleura and lung

- Pericardium is « under skin »
- Lung is away –no selective intubation-
- Pleura can be avoided
- Take care to the ITA

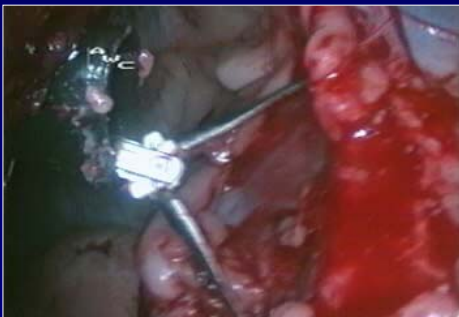


Right minithoracotomy

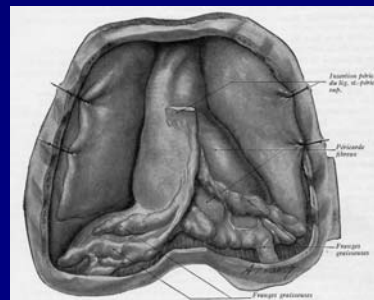
- Easy and Fast
- Direct vision
 - Pericardium
 - RA ± LA
- Improvement +++ of vision with video
- Rescue for endocardial access through RA or LA



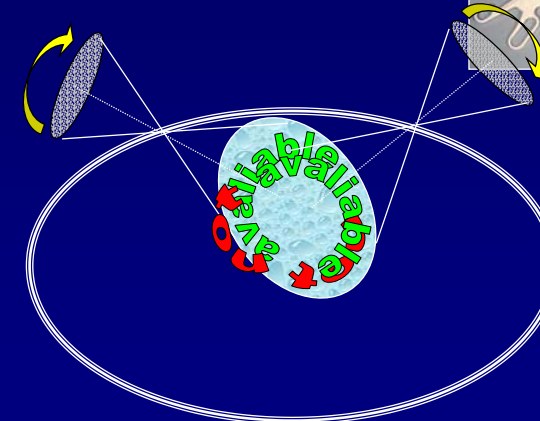
Thoracoscopy



Click on image to start video
Courtesy of Dr. Omar Lattouf



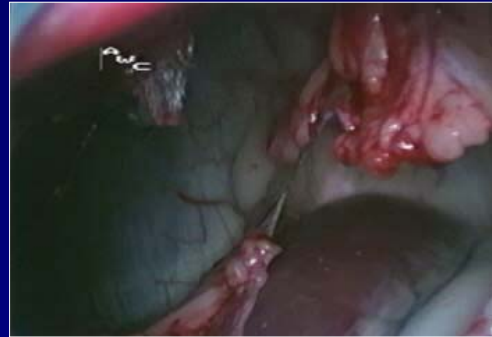
Target and entry point, a geometrical problem



If the tools are rigid, the pericardial approach depends on the target

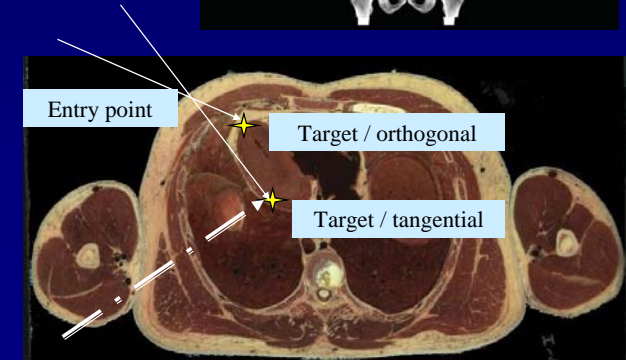
More degree of freedom (dof)

new tools and robotic surgery

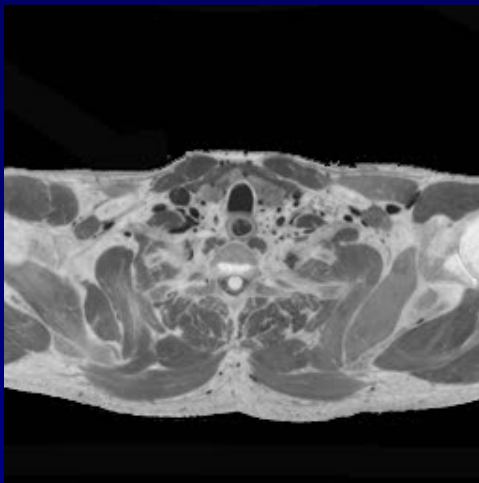


Click on image to start video
Courtesy of Dr. Omar Lattouf

Surgical approach, a geometrical problem.
Inside - Outside



Planification, Virtual Reality



- Preoperative data
- Simulation
- Multimodal vision
- But what about:
 - Motions (heart, ventilation...)
 - Deformations (patient on the right side...)
- To directions
 - Real time reconstructions
 - modelisations

How to see the target(s) and the danger(s)

- Direct vision
- Videoscopy
 - Rigid
 - Flexible
- X-ray
- Echo
- EP, magnetic navigation
- NMR...

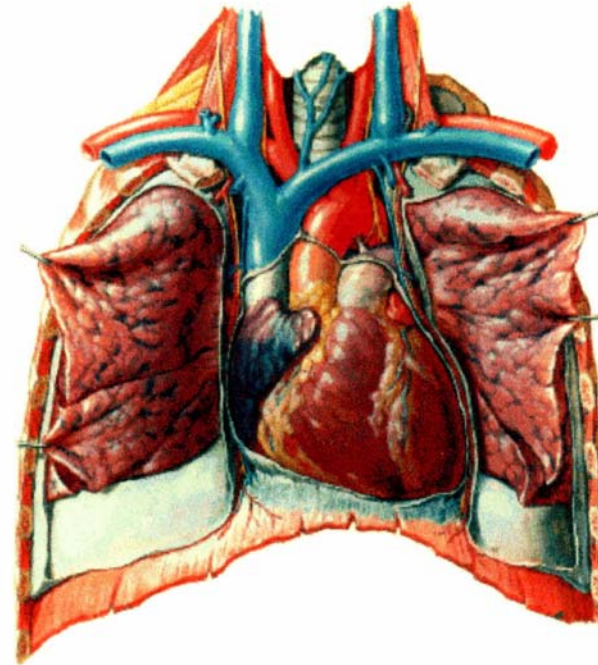


- In the futur
 - Multimodal vision
 - Enhancement of the reality (recalage)

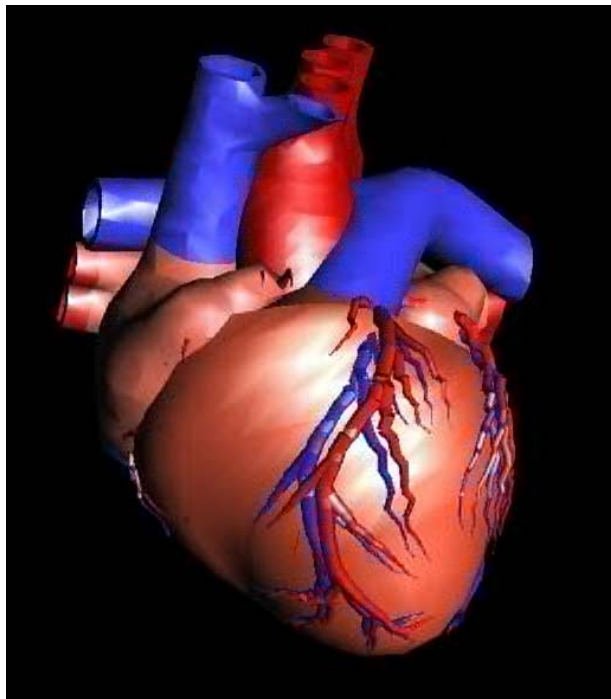
Multimodal operating room and team

Wath is surgery, wath is not?

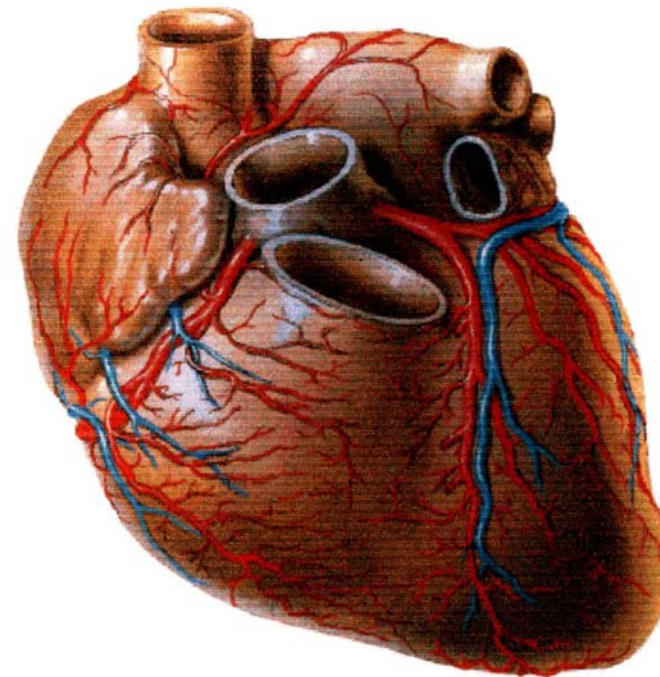
- Surgery
 - General anesthesia
 - Surgeon
 - Operative room
 - Incision
 - Direct vision of the target and the danger
- No surgery
 - Local anesthesia
 - Cardiologist
 - EP lab
 - Percutaneous
 - X-Ray, Ultrasound... no direct vision of the target
- The future
 - Anesthesiologist choice
 - Trained physician
 - Multimodal room
 - The best approach
 - Safe
 - Fast..
 - Multimodal vision



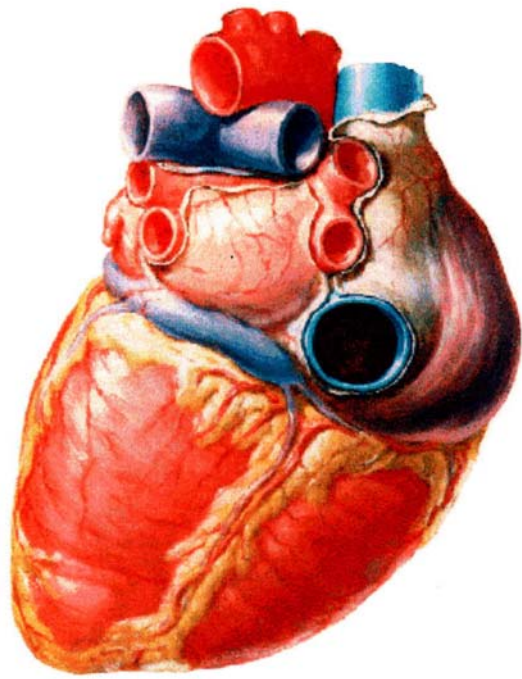
Heart-Lung



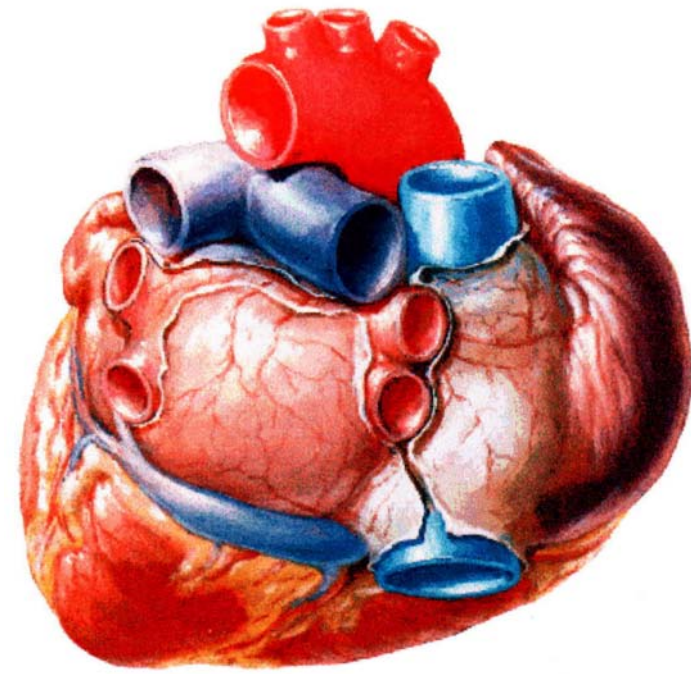
Heart



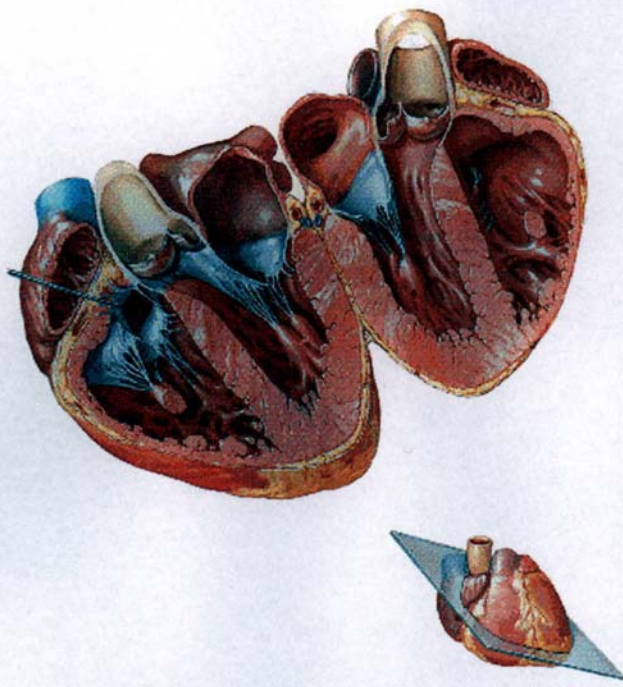
Heart



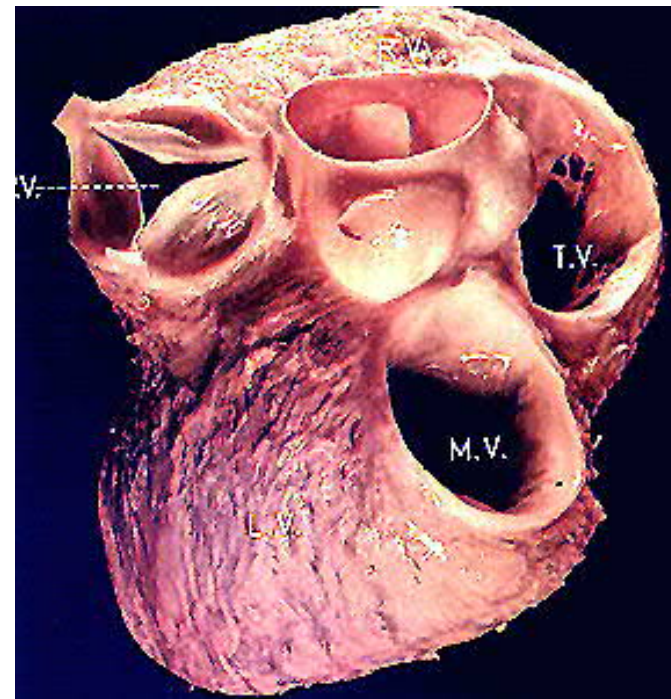
Heart



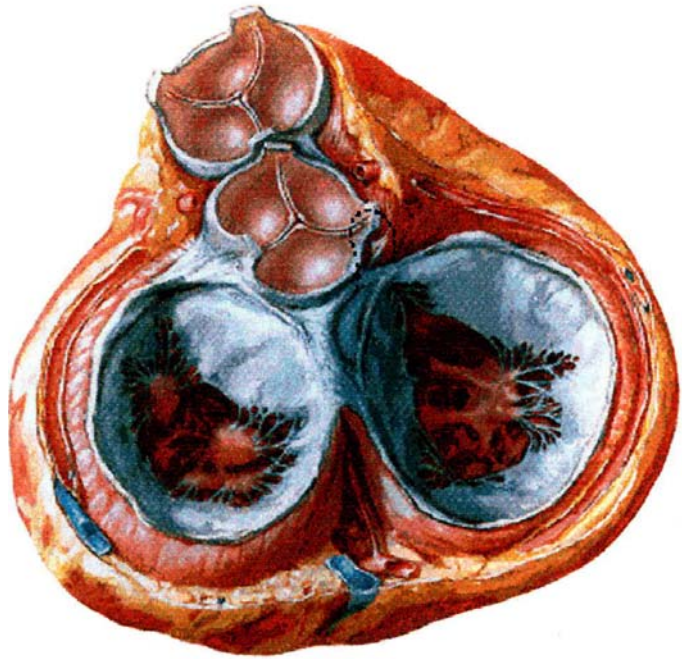
Heart



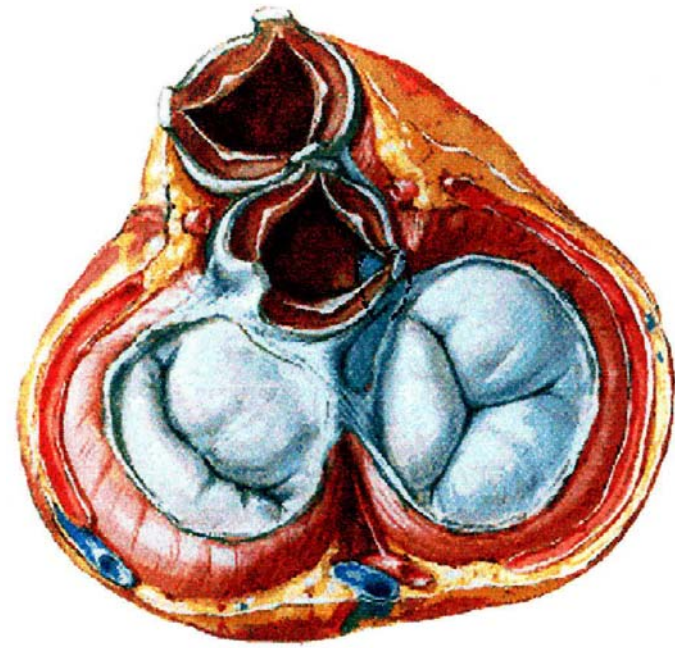
**4
Chambers**



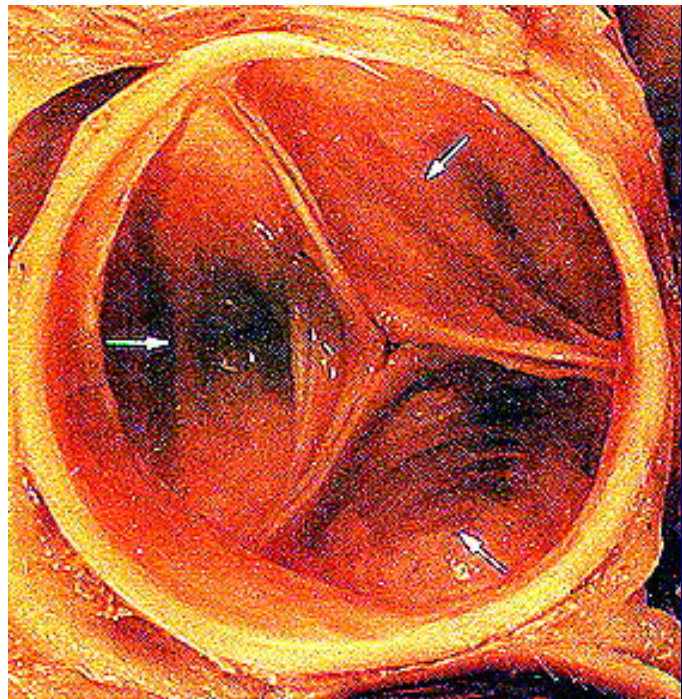
4 valves



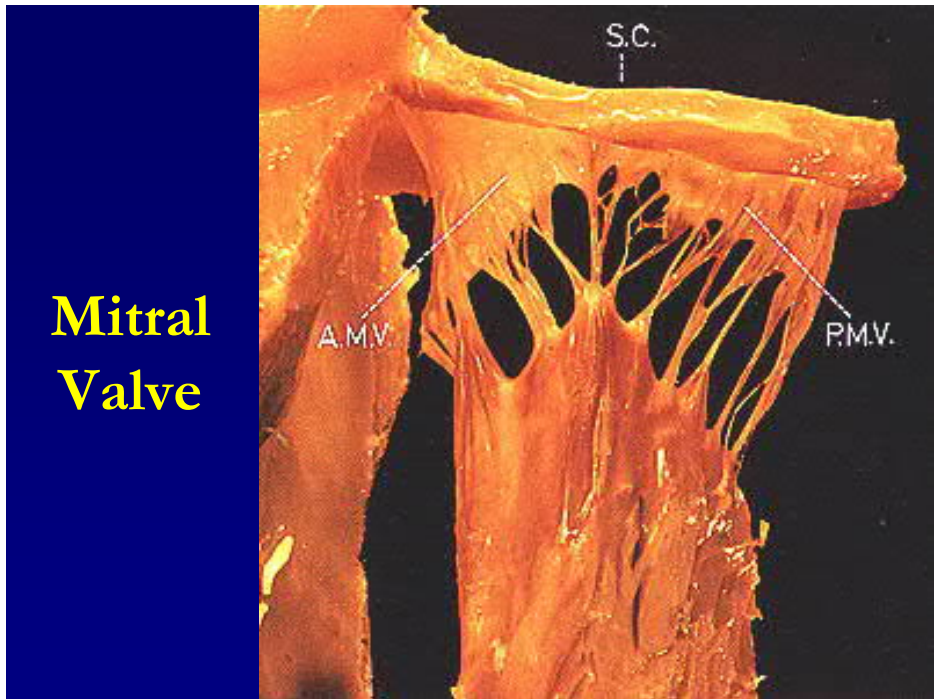
Diastole



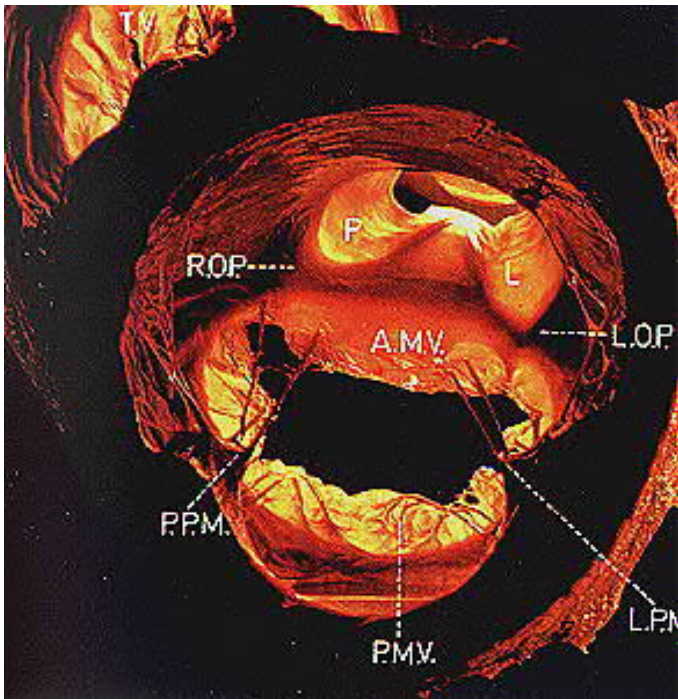
Systole



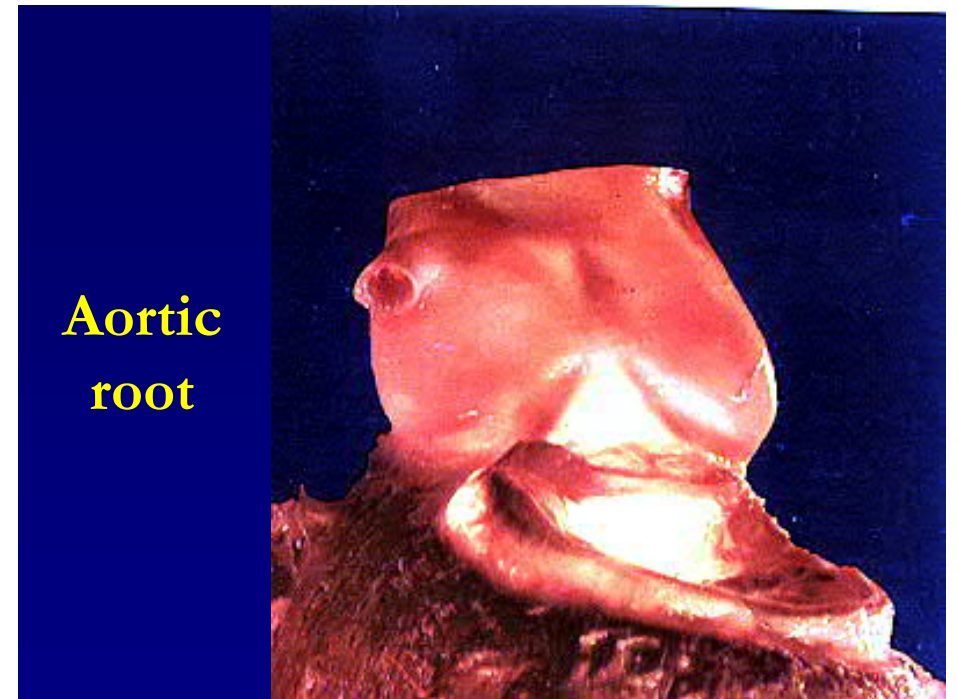
Aortic Valve



Mitral Valve



Mitral Valve

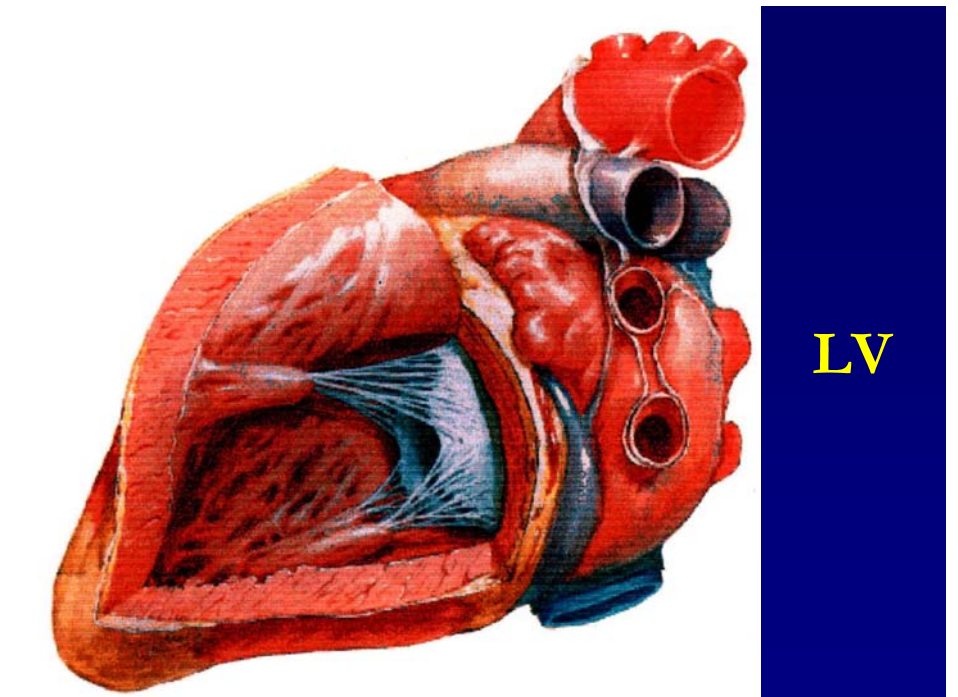


Aortic root

Valvulopathy

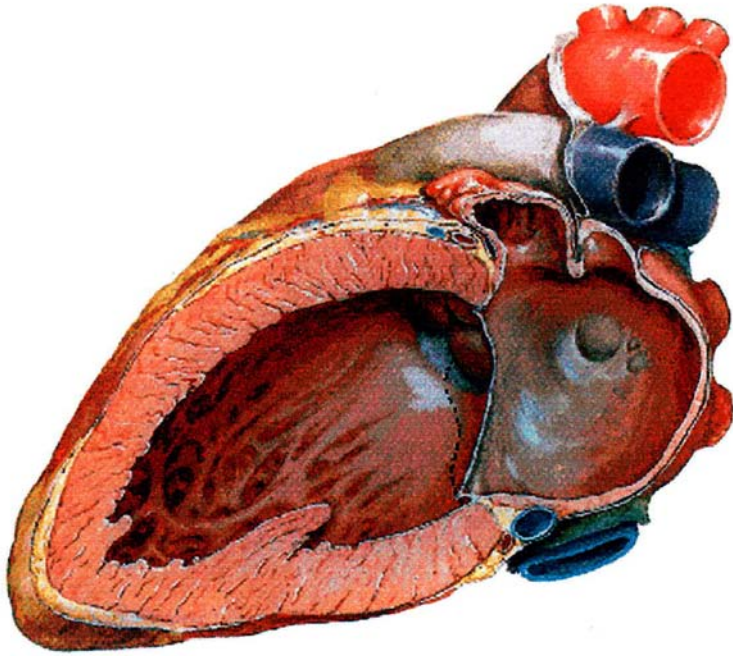


- Stenosis
- Insufficiency
- Valvuloplasty
- Valve Replacement

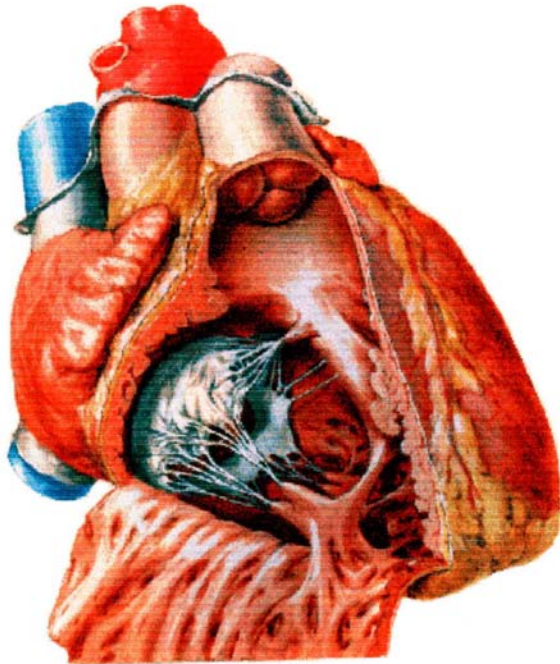
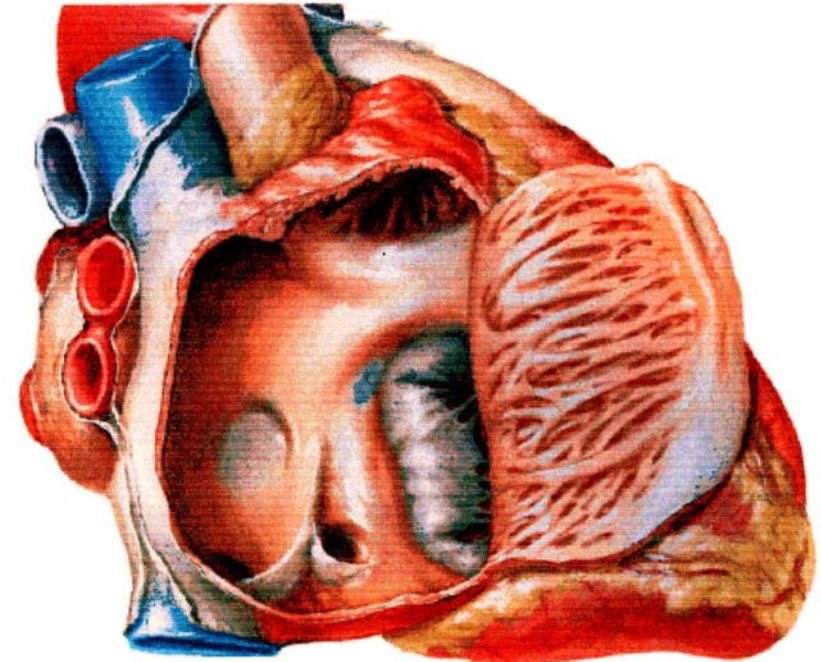


LV

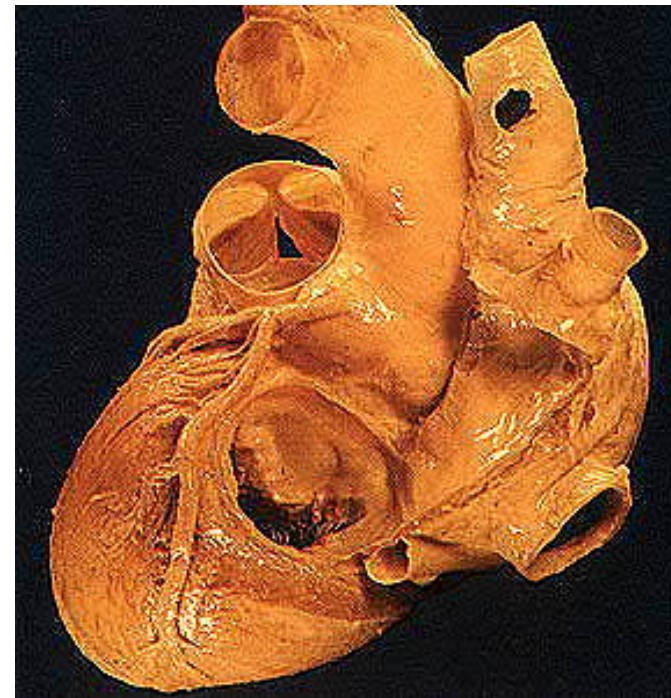
LV



**R
A**

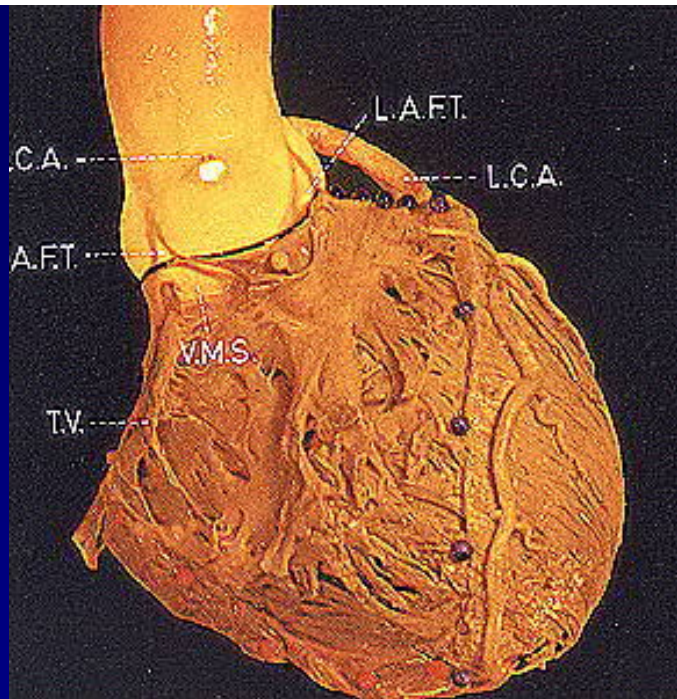


**RV
Tricuspid
Valve**

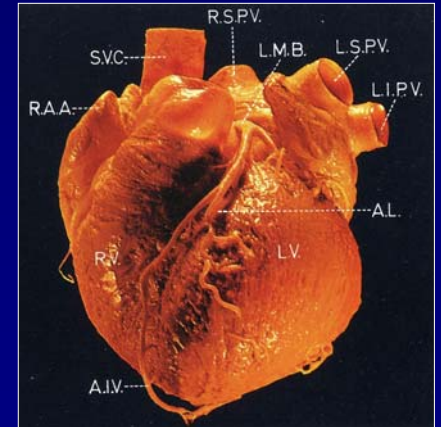
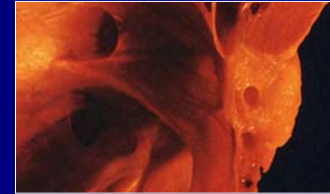
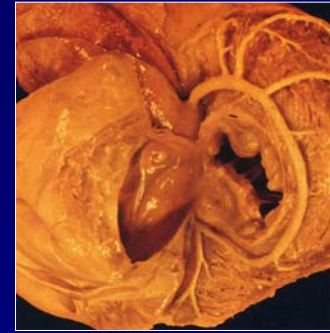


**Left
main
coronary
artery**

Left Anterior Descending Artery

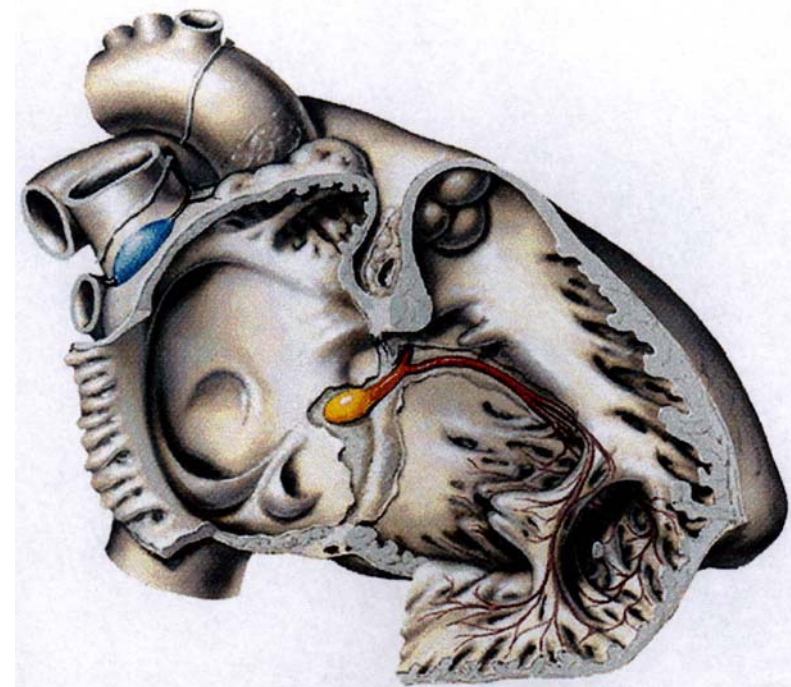


Fat, grooves and coronary arteries



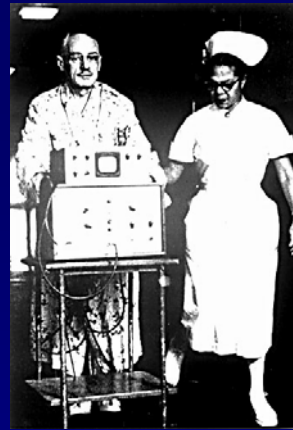
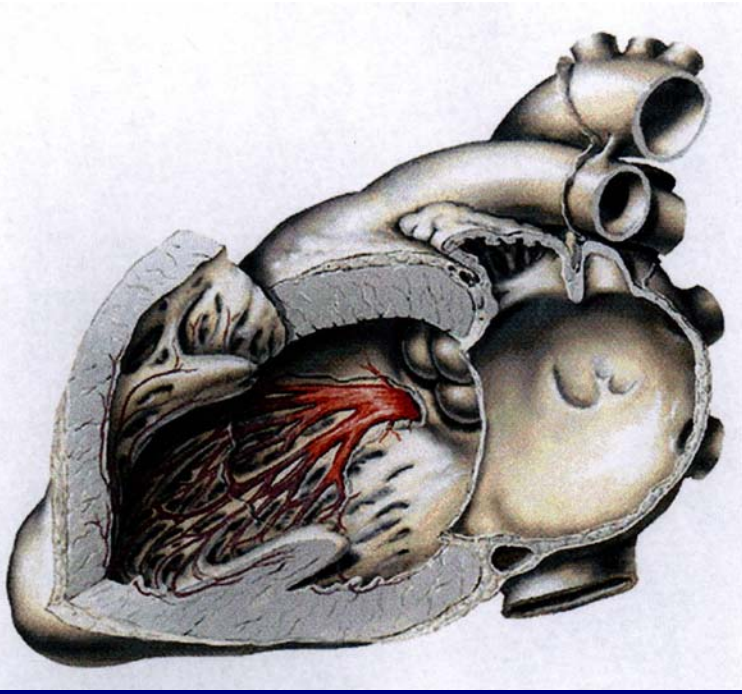
Coronaropathy

- Etiology: atherosclerosis
- Symptoms:
 - Angina pectoris
 - Myocardial Infarction
 - Heart Failure
- Revascularization
 - Percutaneous angioplasty
 - Coronary artery bypass grafting (CABG)

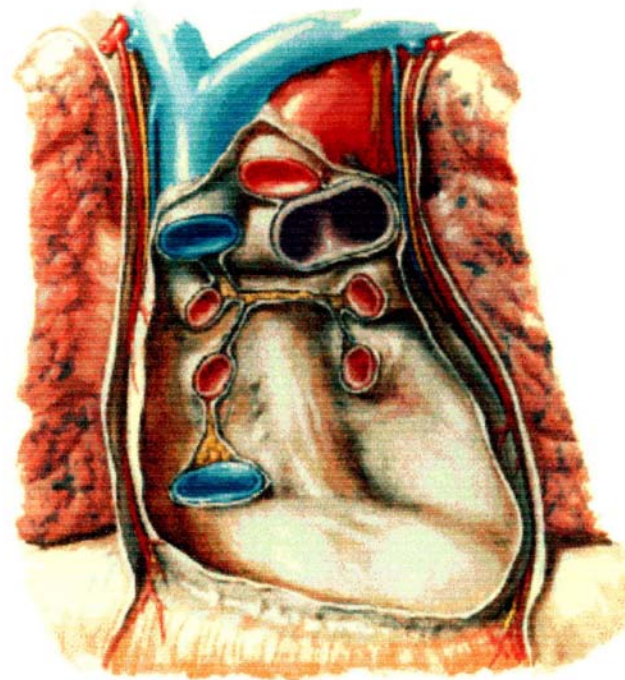
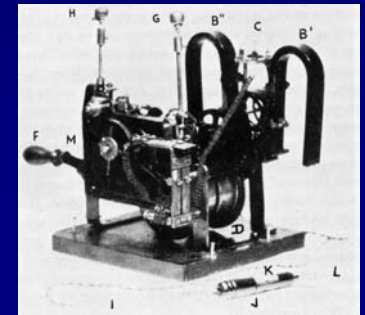
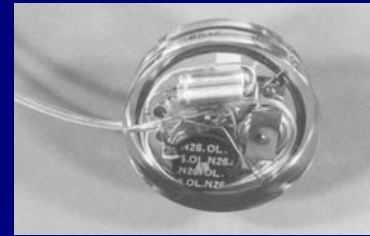
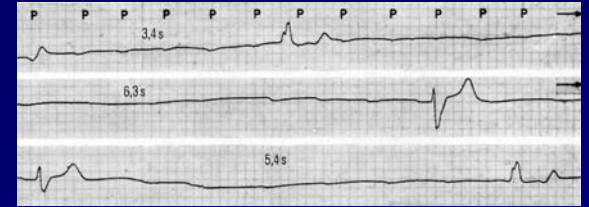


His Bundle

**Left
Bundle
Branch
of the
His**

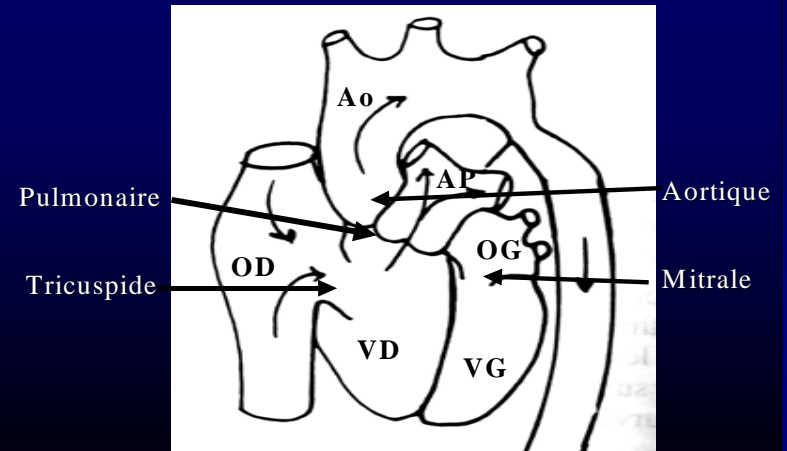


**Atrio-Ventricular
Block, Cardiac pacing**



Pericardium

Physiology – W Harvey



**Bloc
CP**

