

# Surgical Anatomy and Exposure for Valve Surgery

**Hyung Gon Je. MD**

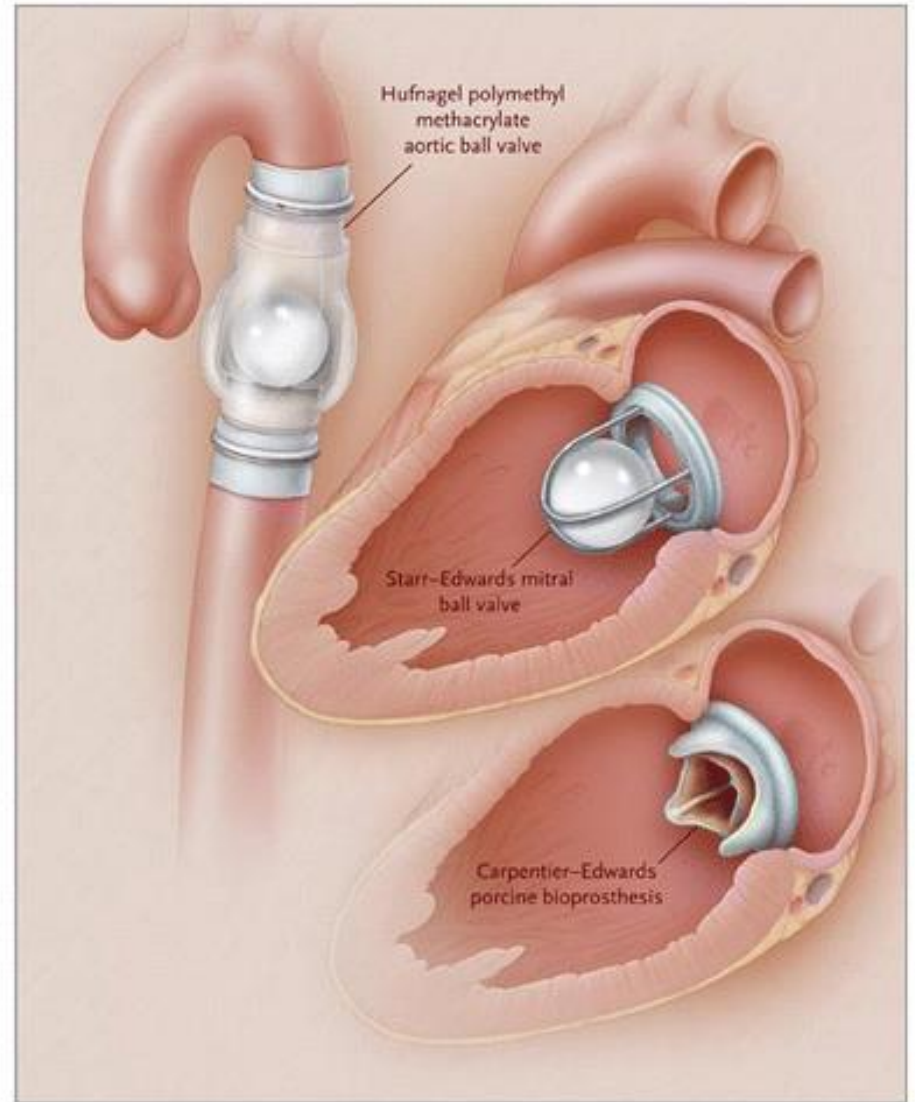
Dept. of Thoracic and Cardiovascular surgery

Pusan National University Yangsan Hospital

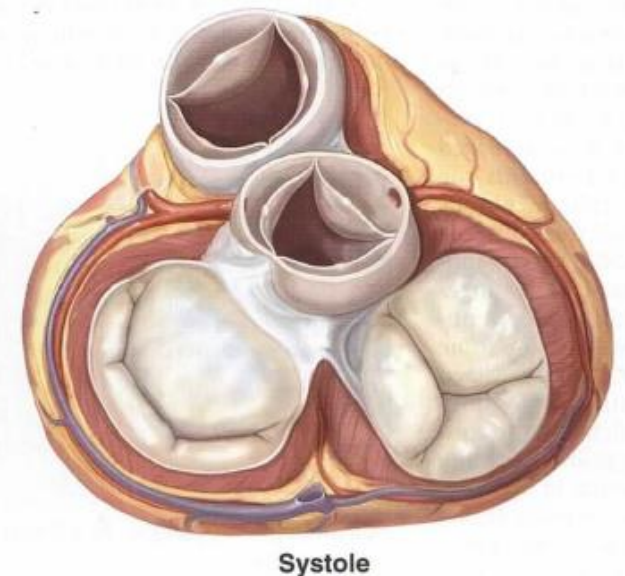
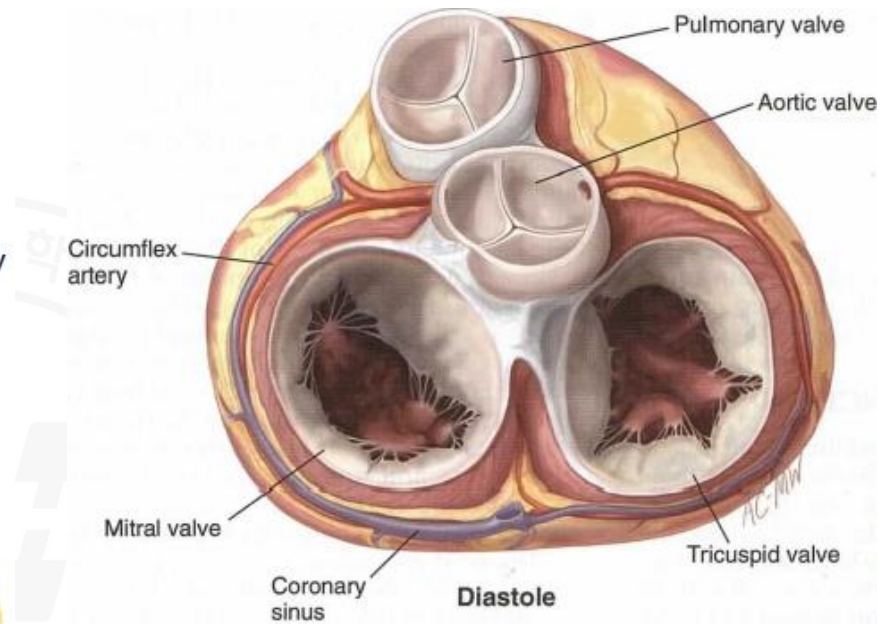
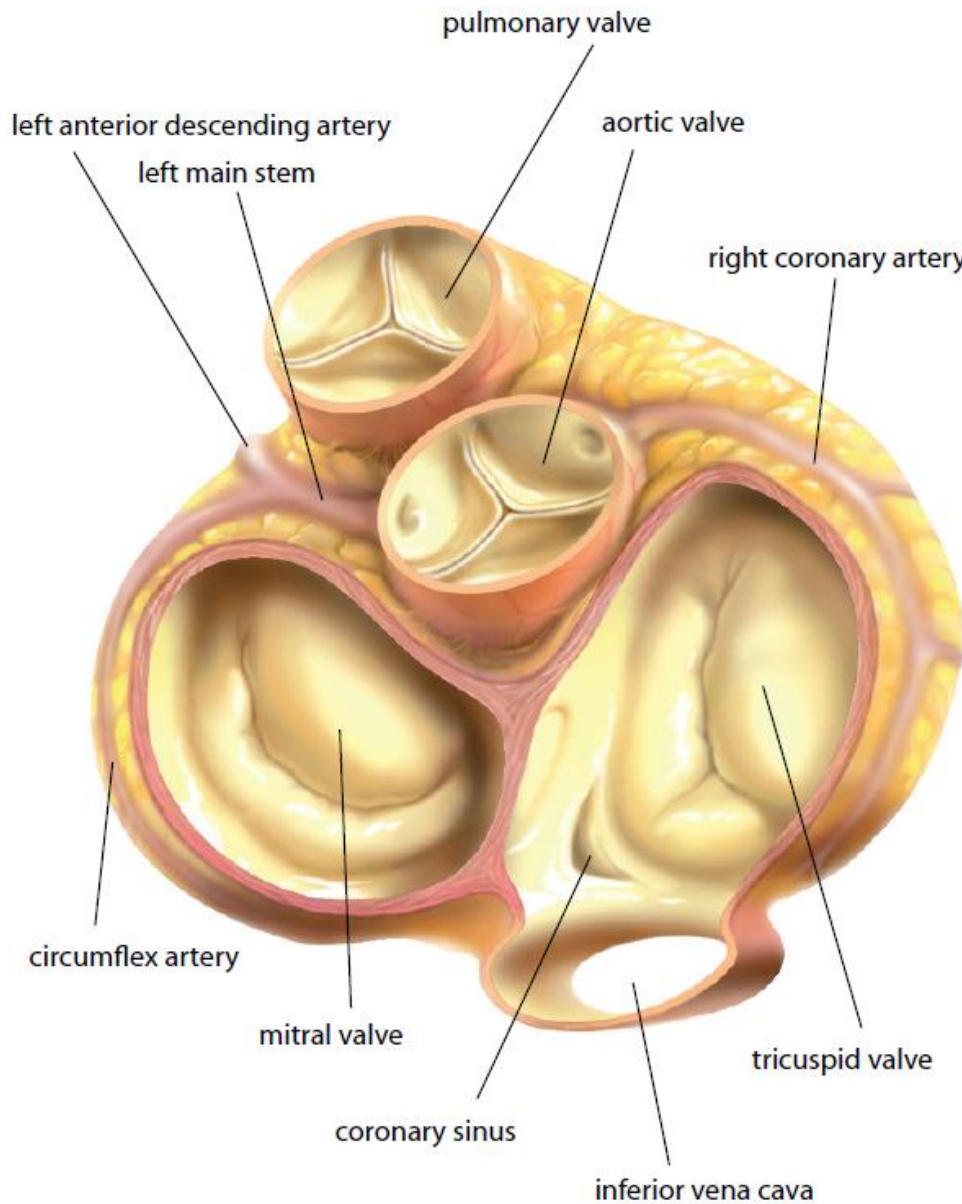
Yangsan, Korea

# Contents

- Anatomy
- Valve Exposure
- Surgical Approach



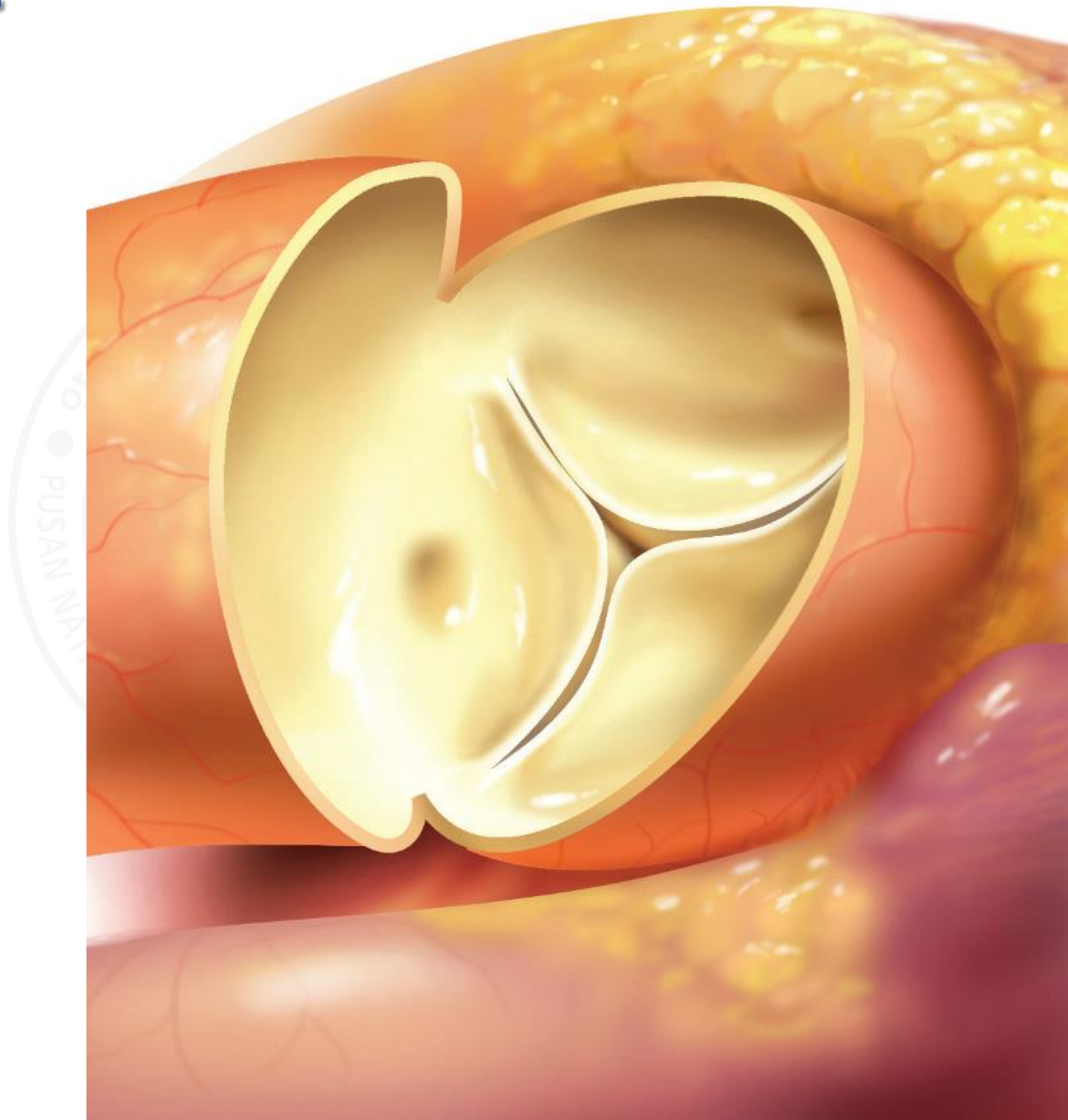
# ANATOMY OF VALVES



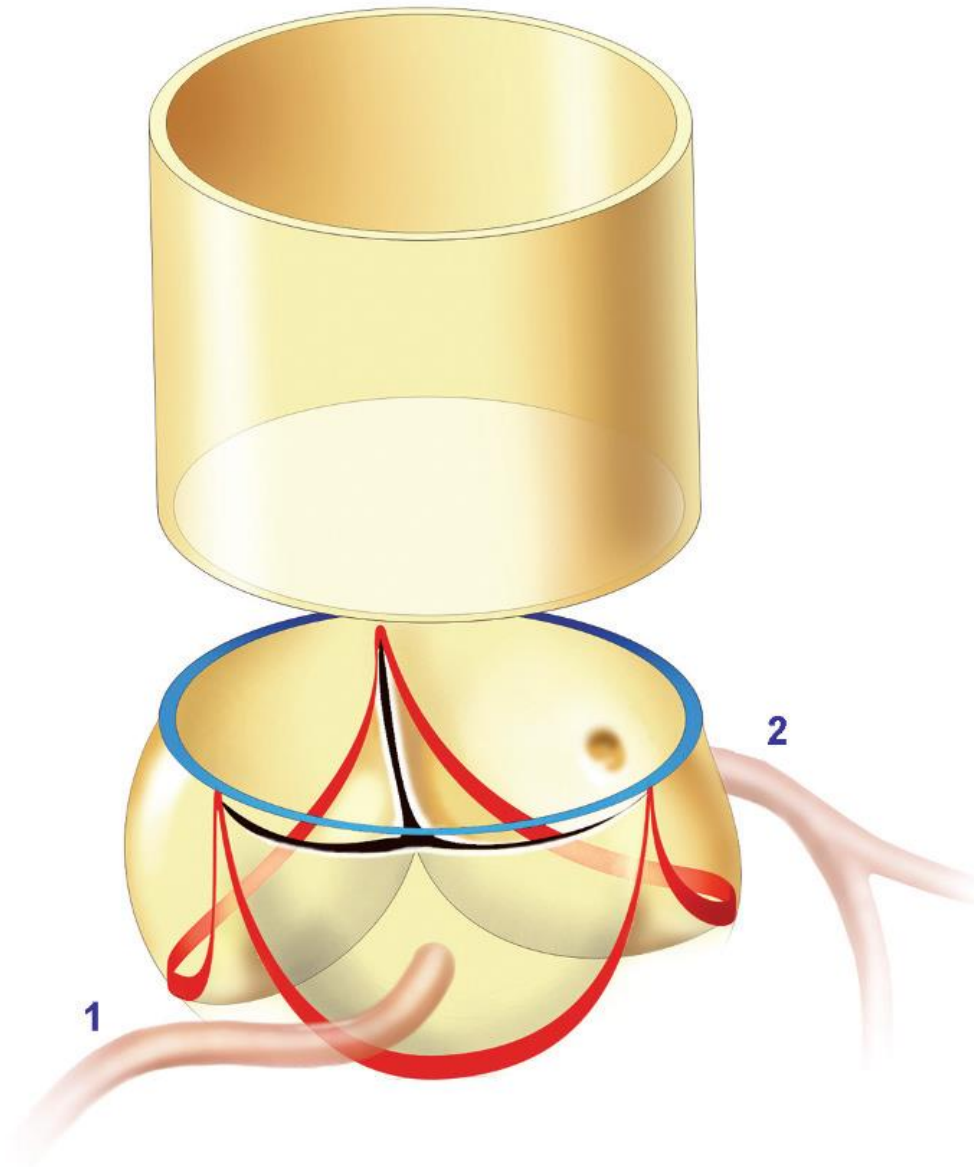
# ANATOMY OF VALVES



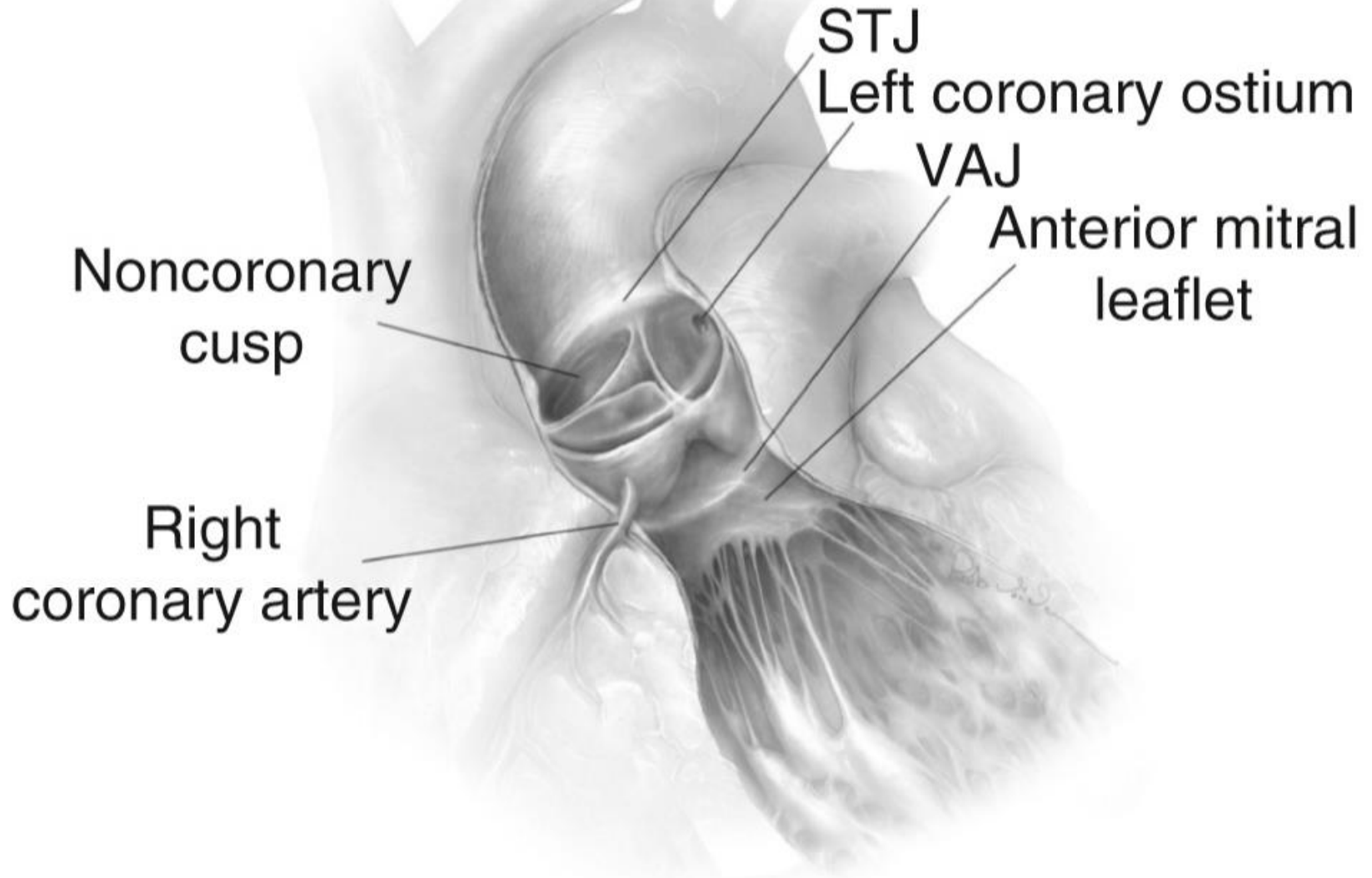
# Aortic Valve



# Aortic Valve

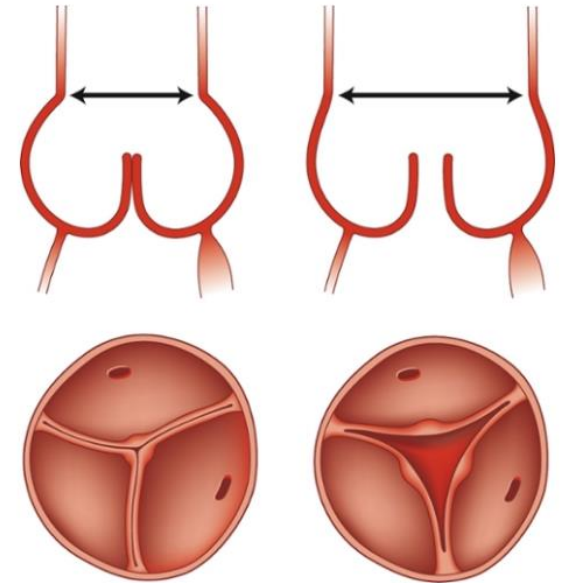


# Aortic Valve



# Aortic Valve

- Normal STJ: 15% less than AA
- Base of leaflet: 15% larger than free margin

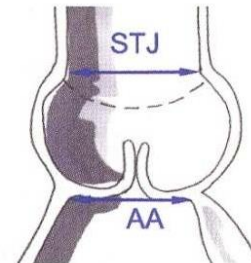


## Geometric Relationships



Base of semi-lunar leaflet insertion (B)

$$B = 1.5 > FM$$



$$AA = 15-20\% > STJ$$

Sinotubular junction (STJ)

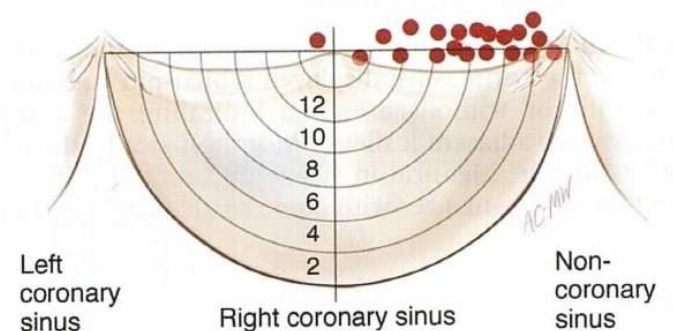
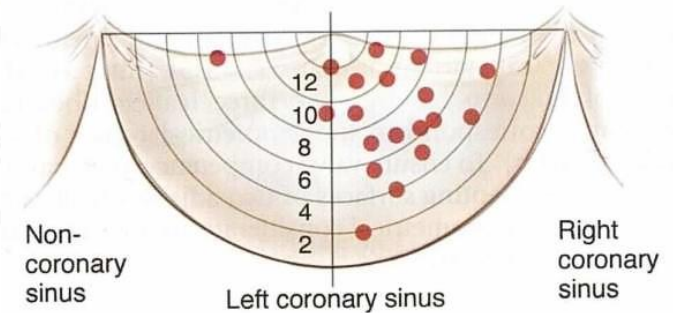
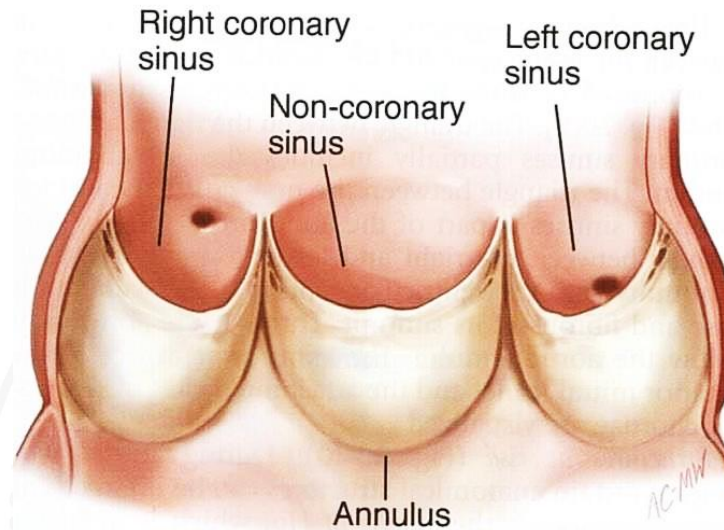


Aortic annulus (AA)

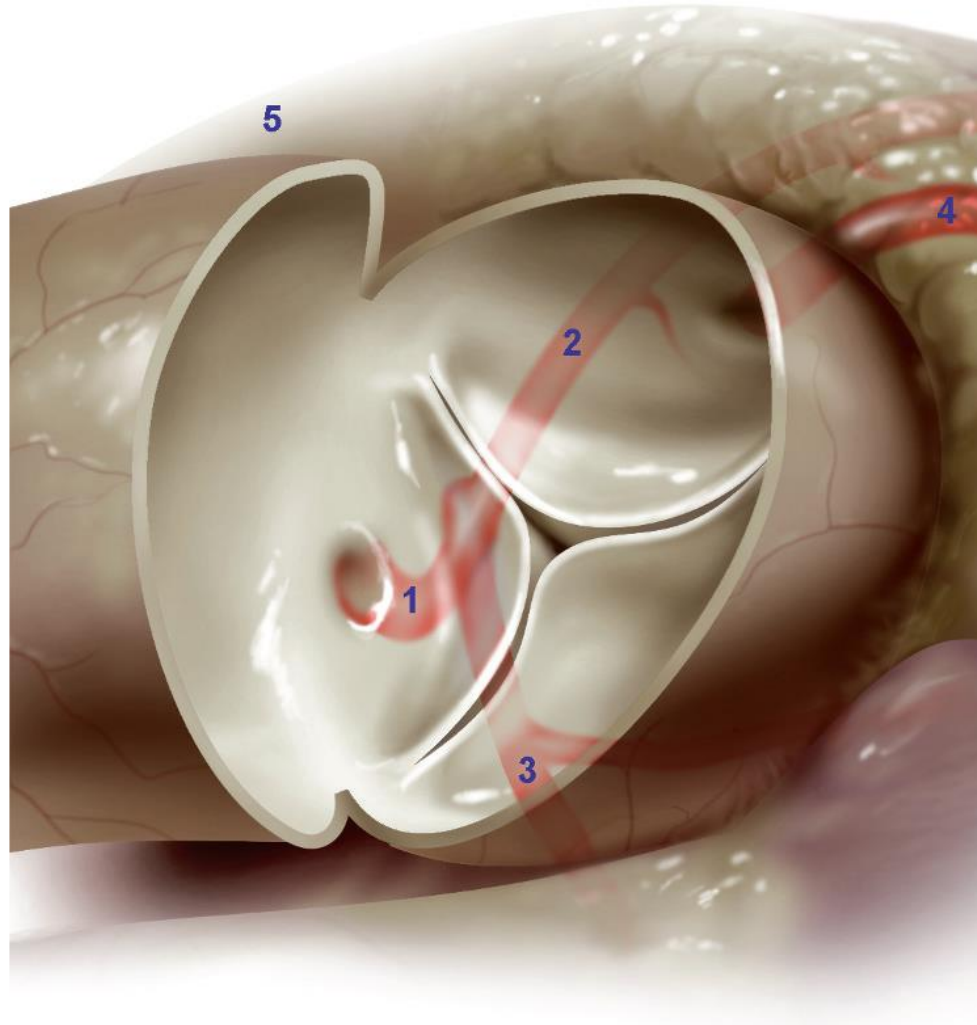


# Aortic Valve

- **Root**
  - Annulus
  - ST junction
  - Sinus of Valsalva
  - Aortic cusps
  - Subcommissural triangles
- **Three sinuses: not symmetrical**
- **Coronary ostium: different level**



# AV & Coronary ostia

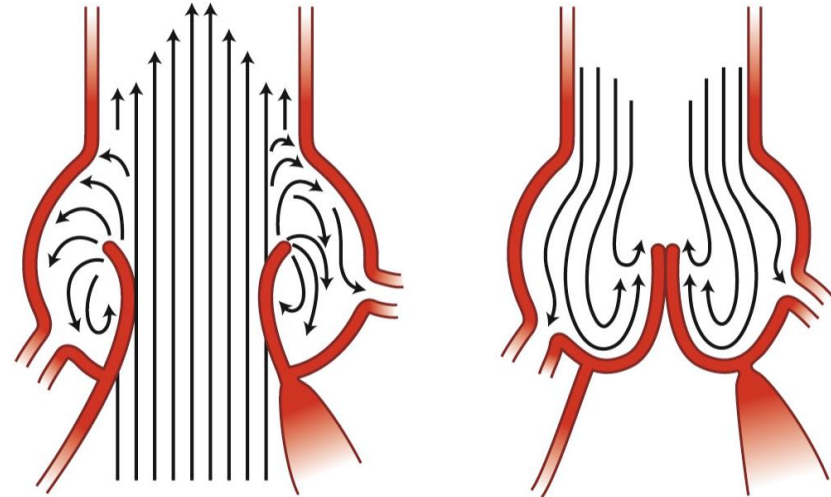


- **Aortic sinus**

- **Facilitate valve closure**

- **Prevent occlusion of the**

- coronary os during systole**

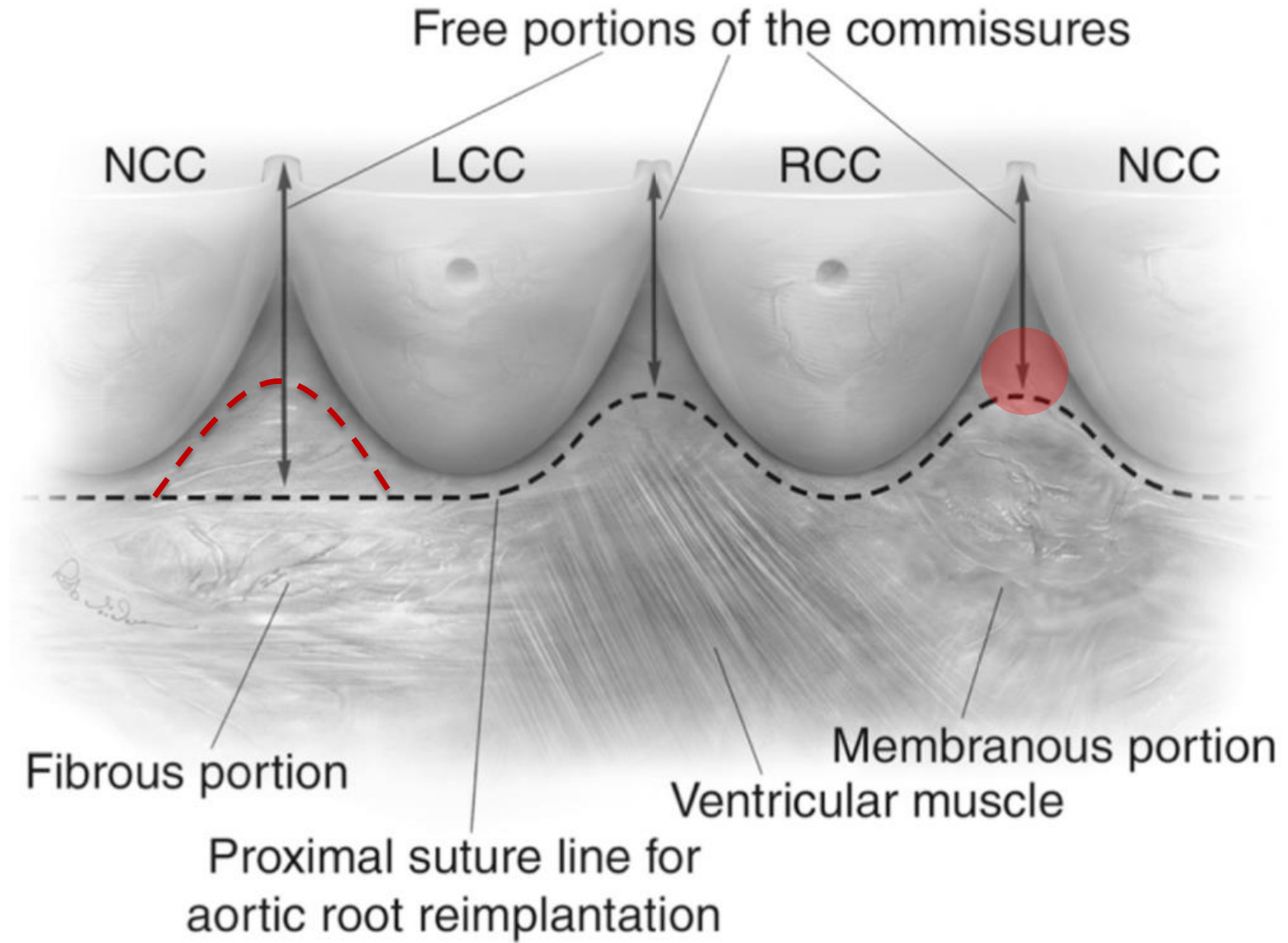


**Eddies and currents in  
aortic sinus**

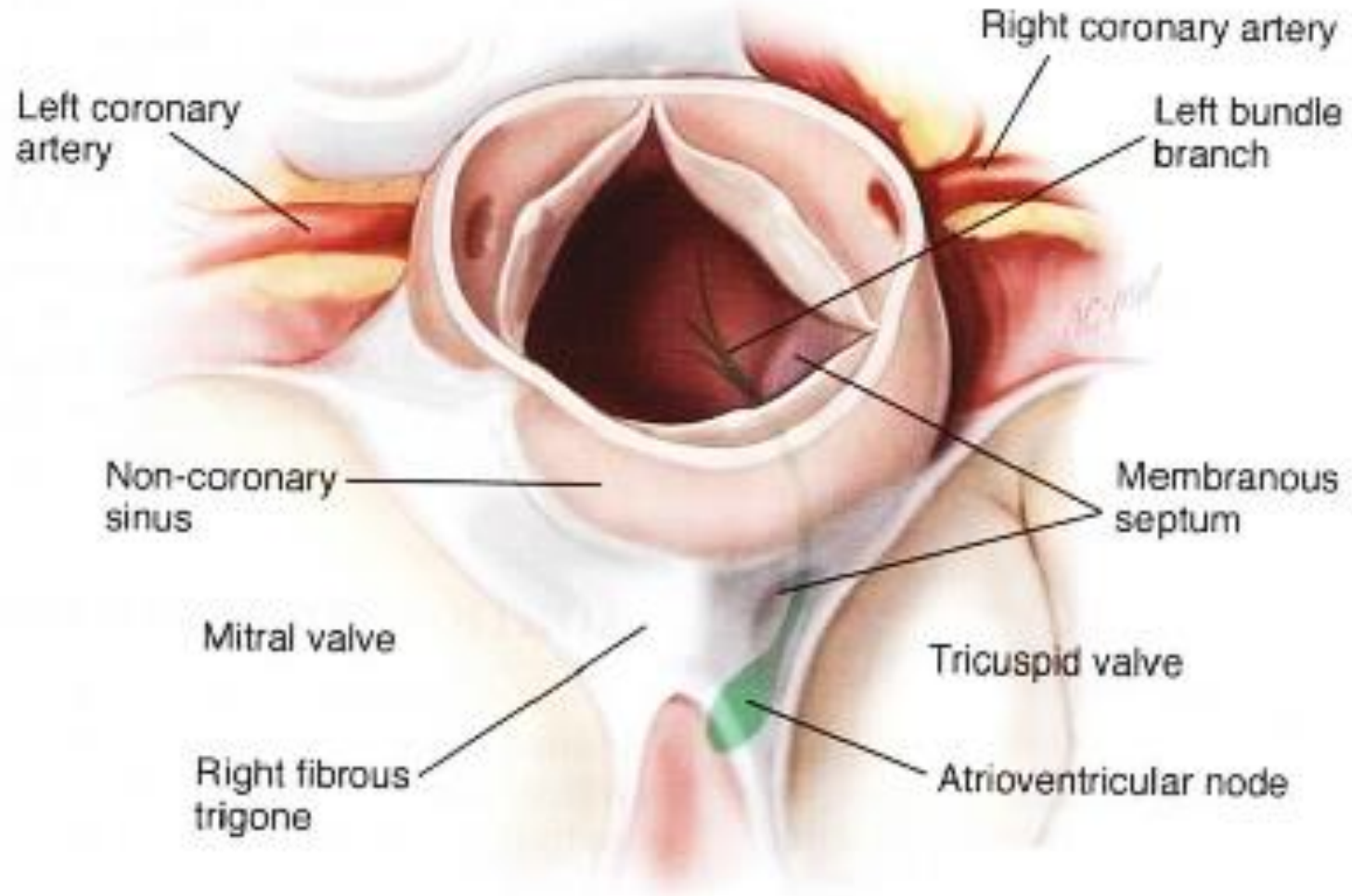
# Aortic Valve



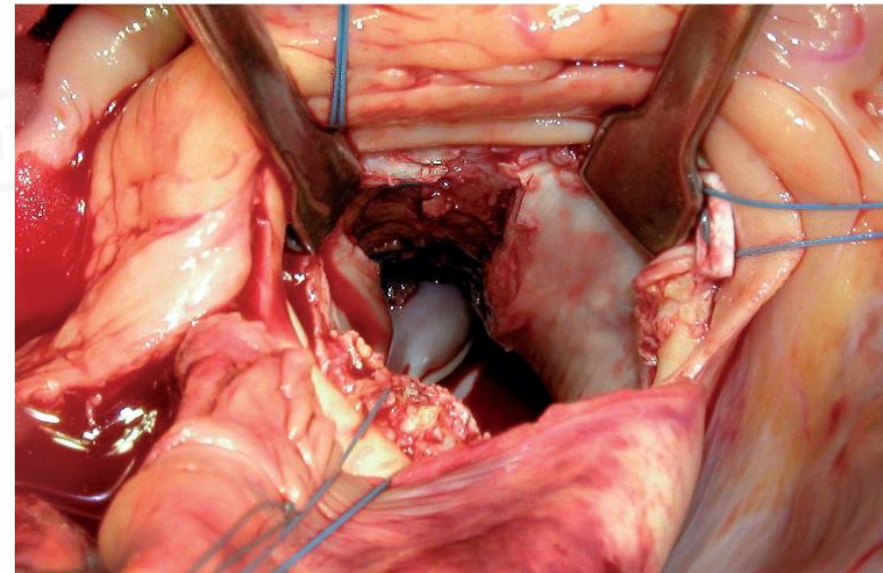
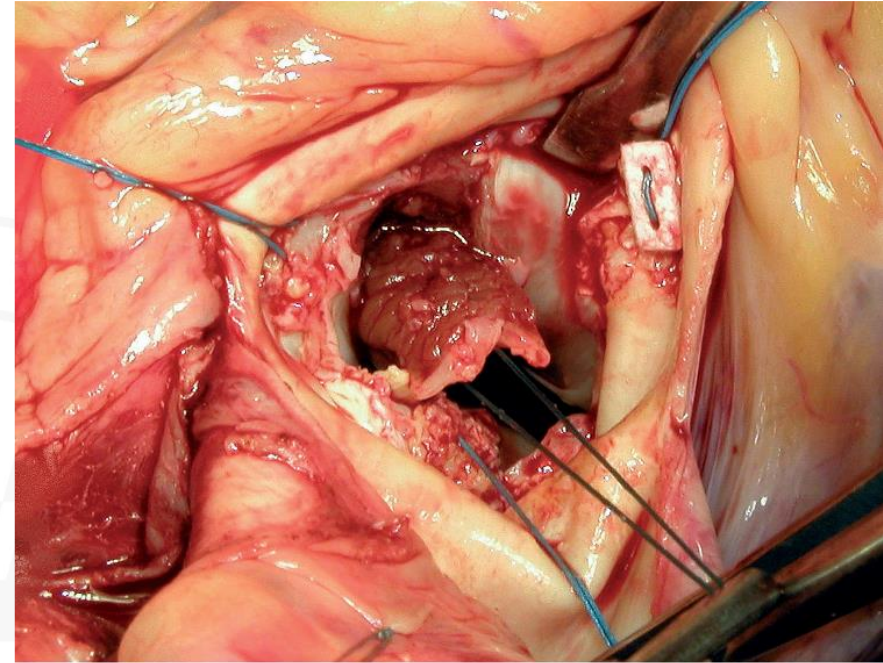
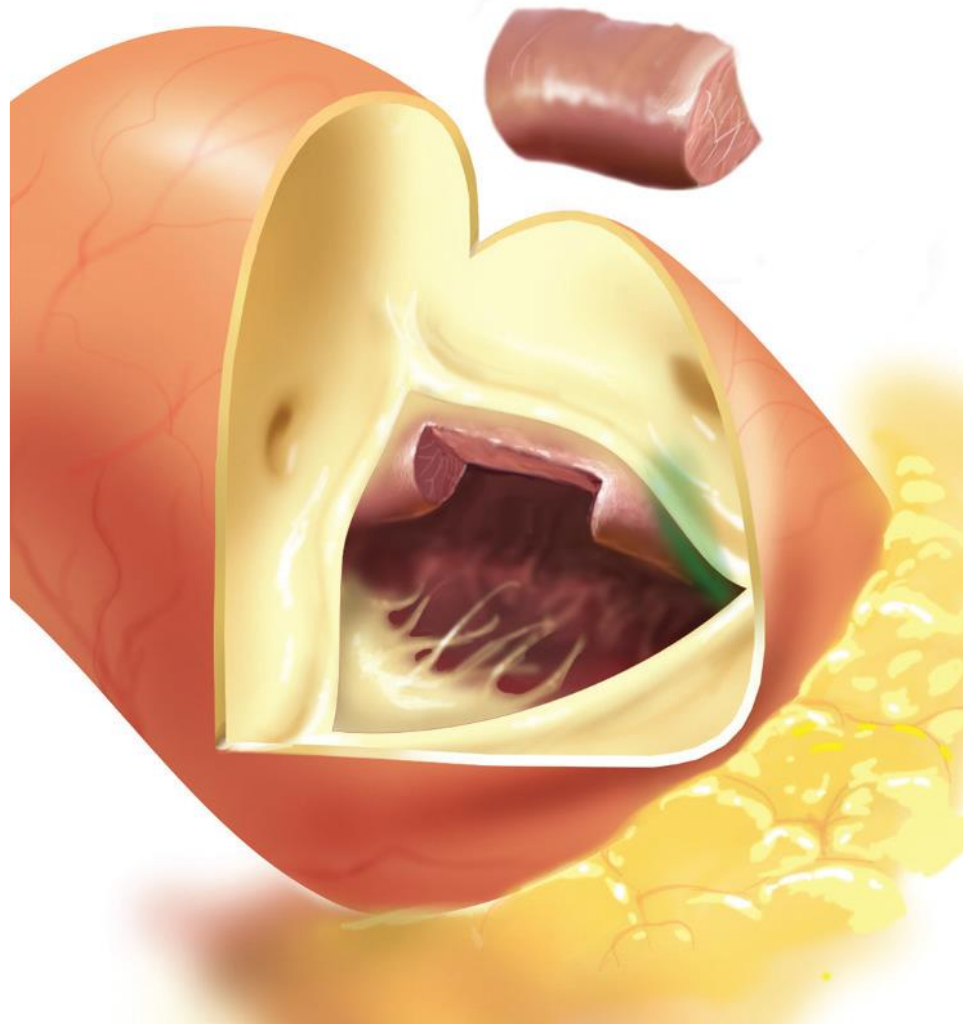
# Aortic Valve



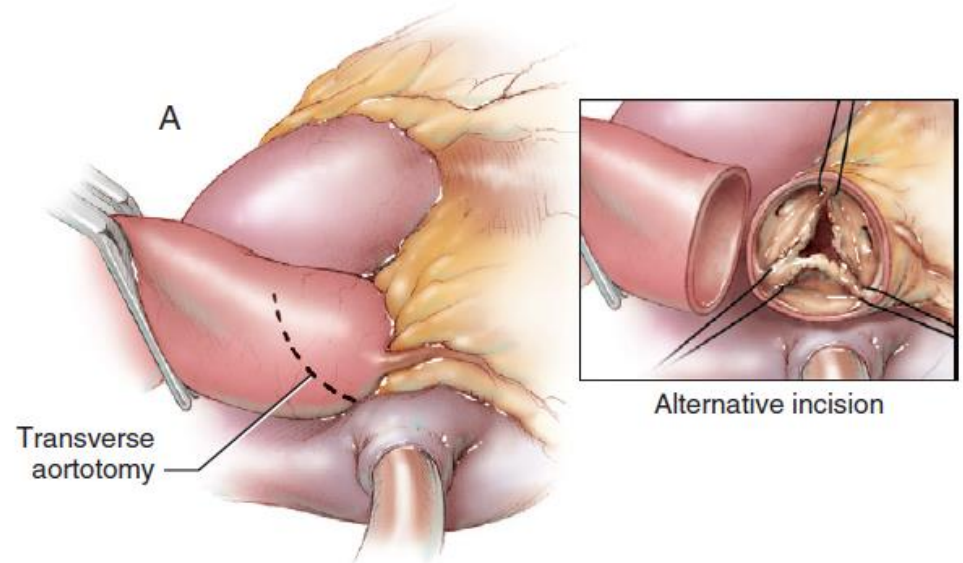
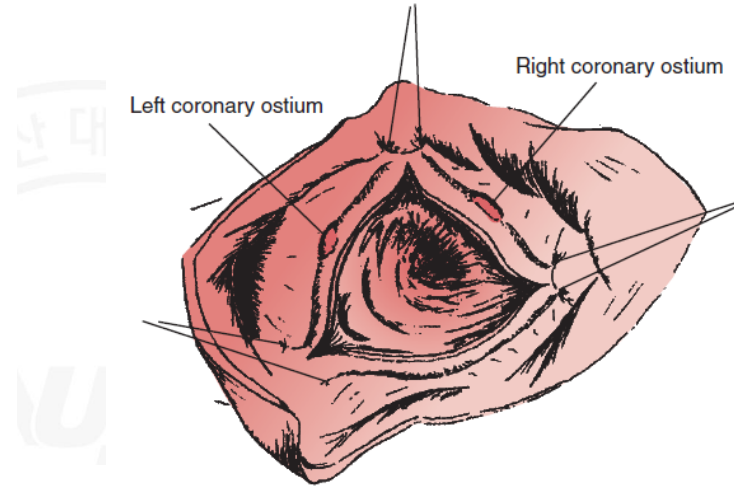
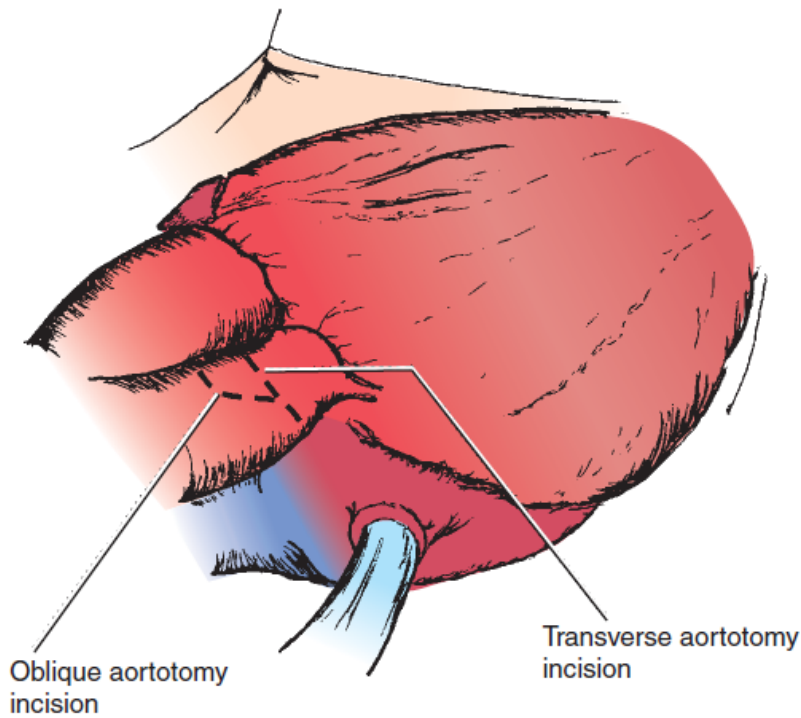
# AV: Adjacent Structures



# Septal myectomy



# Surgical Exposure for AV

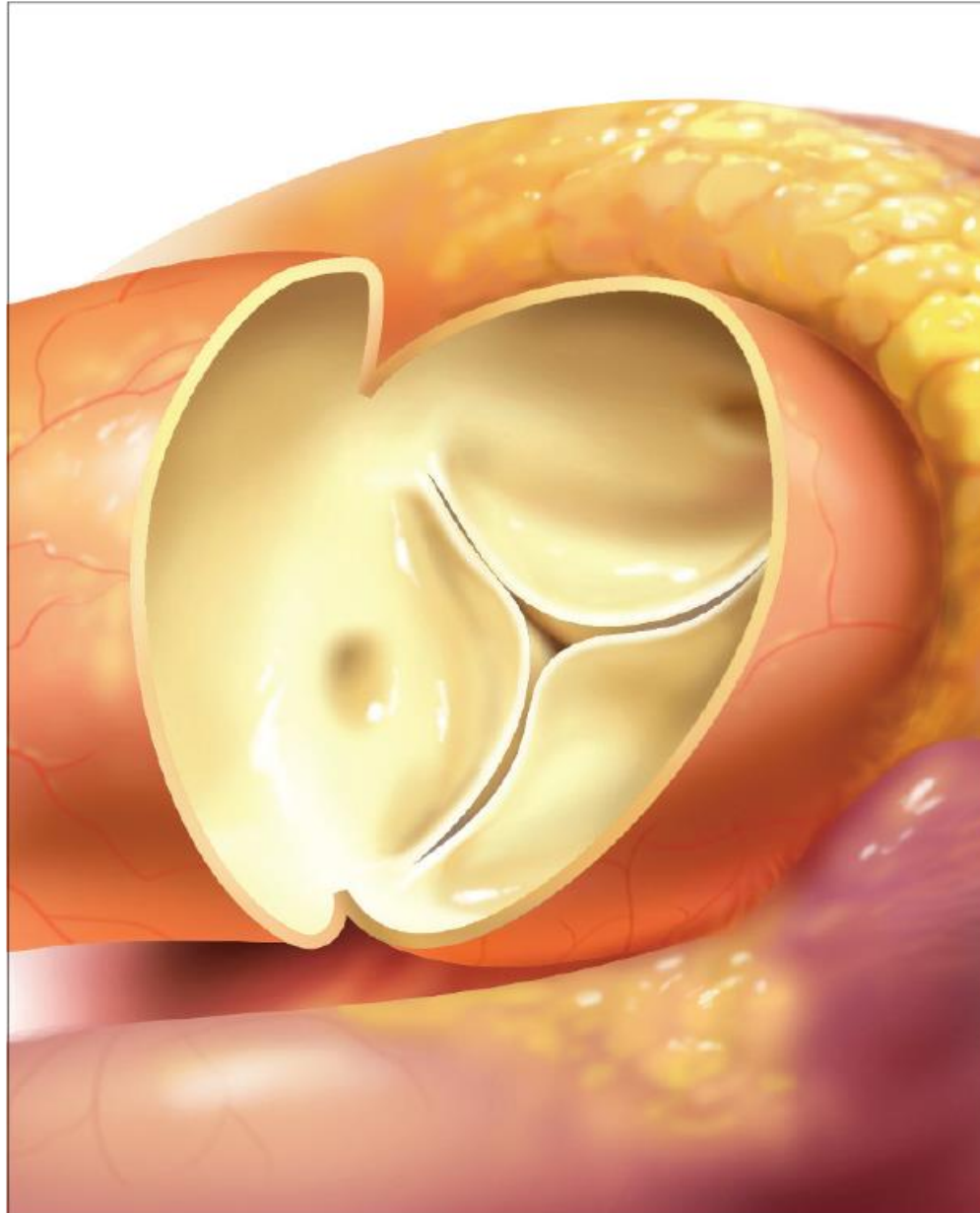




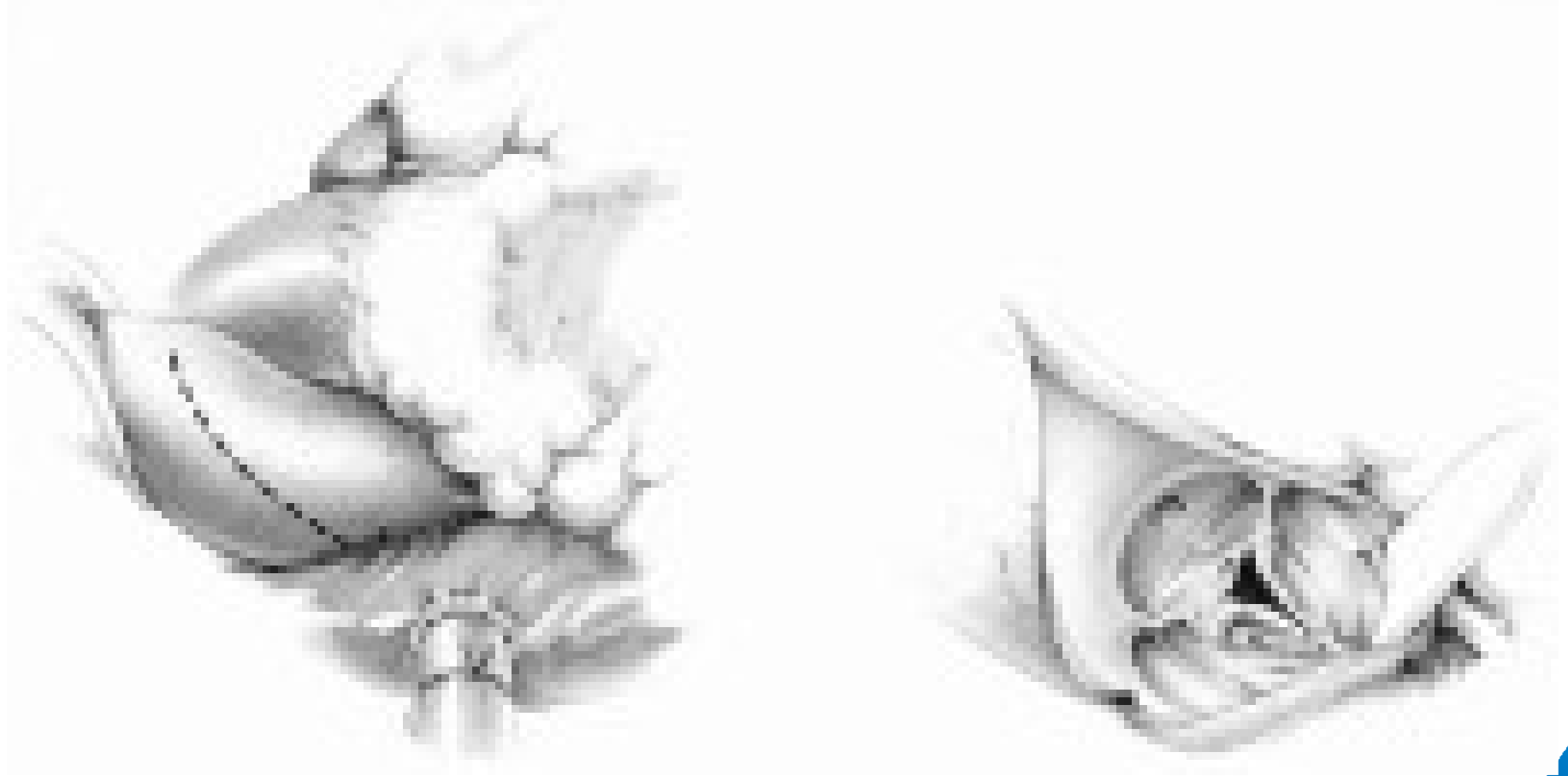
# AV: Transverse aortotomy



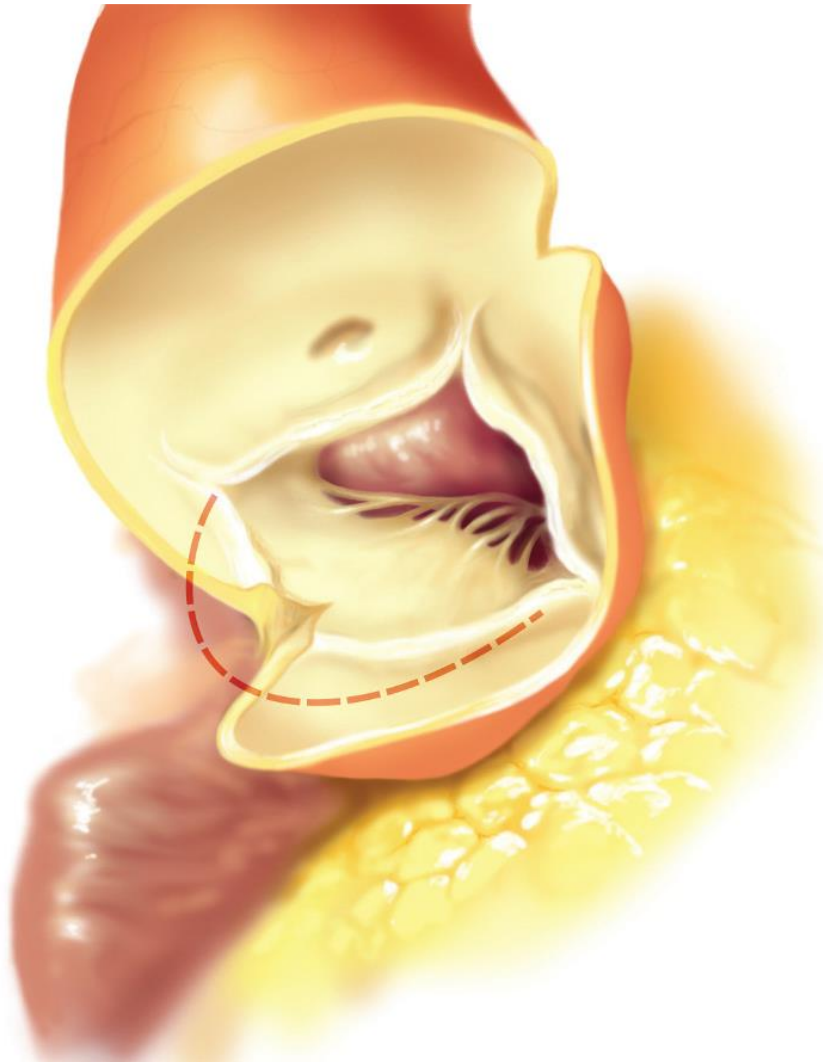
양산부산대학교병원  
Pusan National University Yangsan Hospital



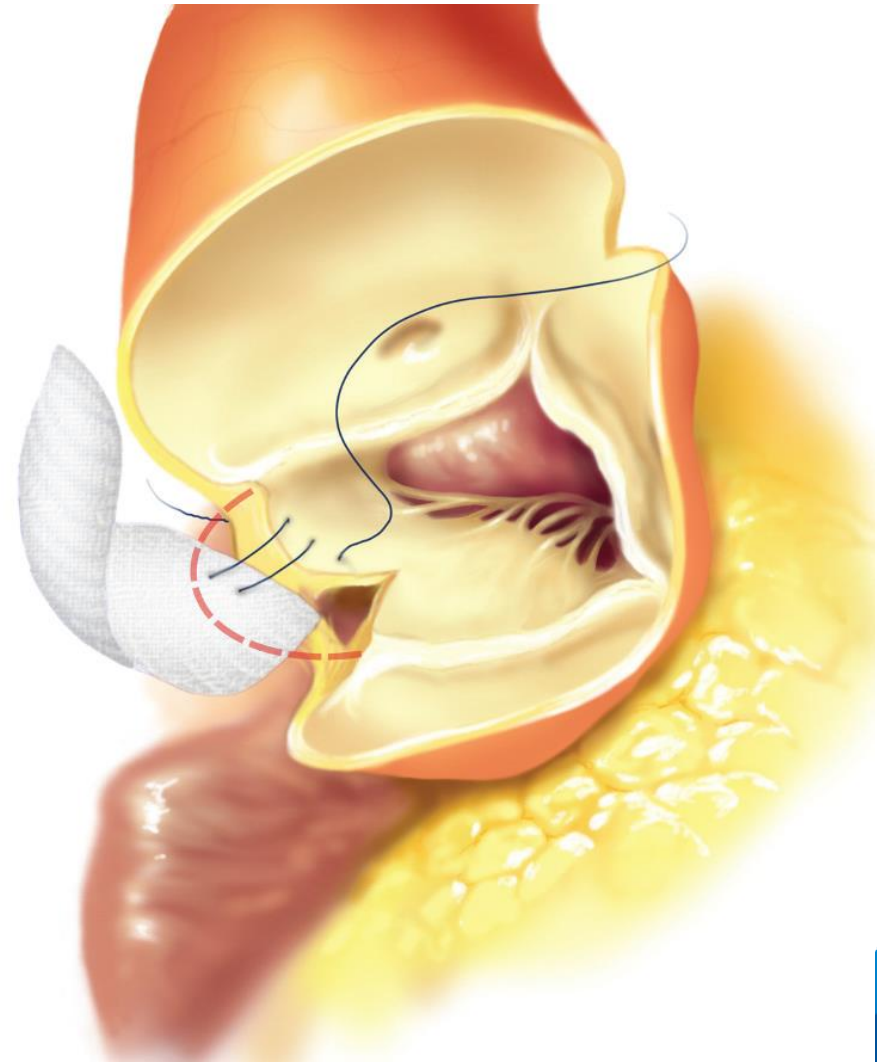
# AV: Oblique aortotomy



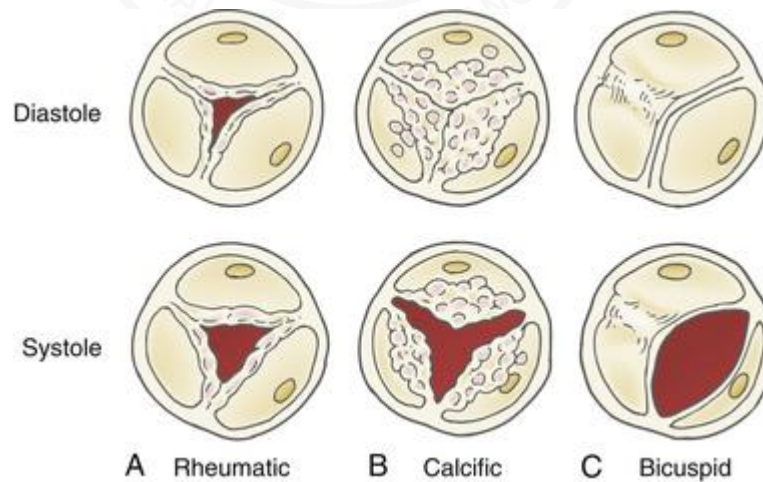
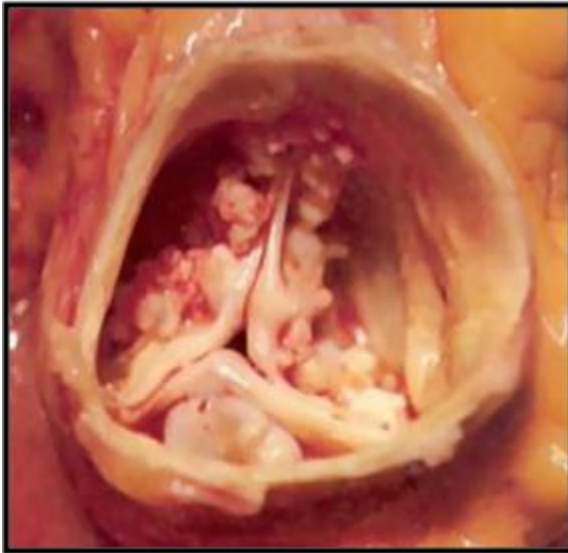
# Nicks & Manouguian



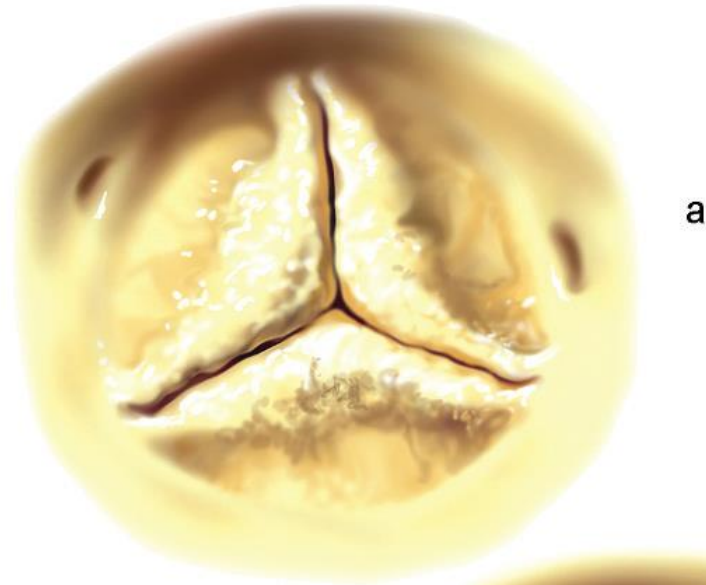
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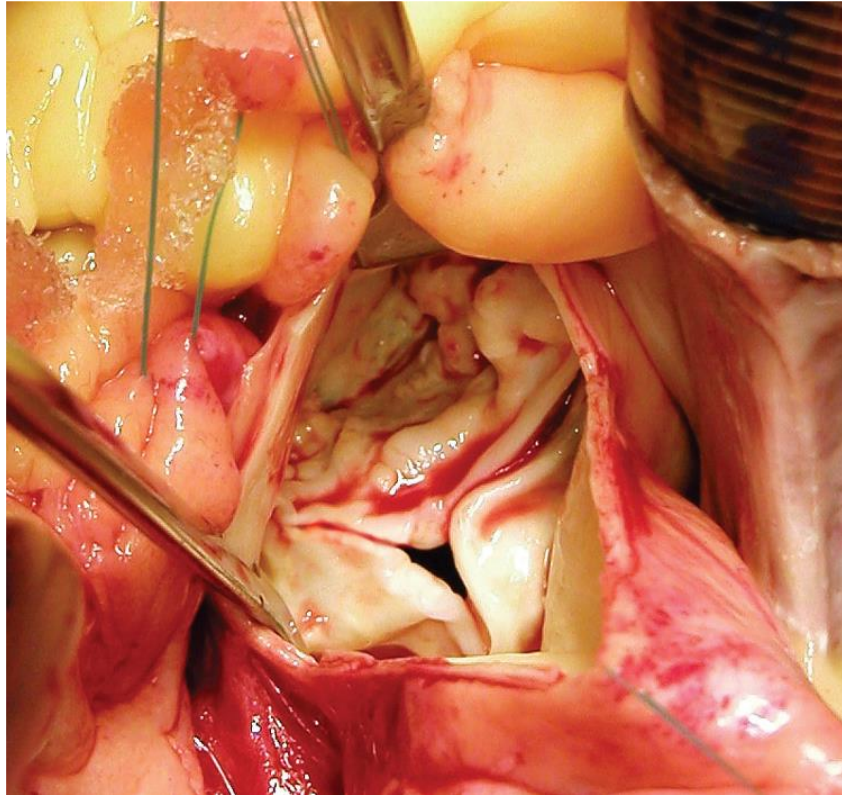
# Aortic Valve disease



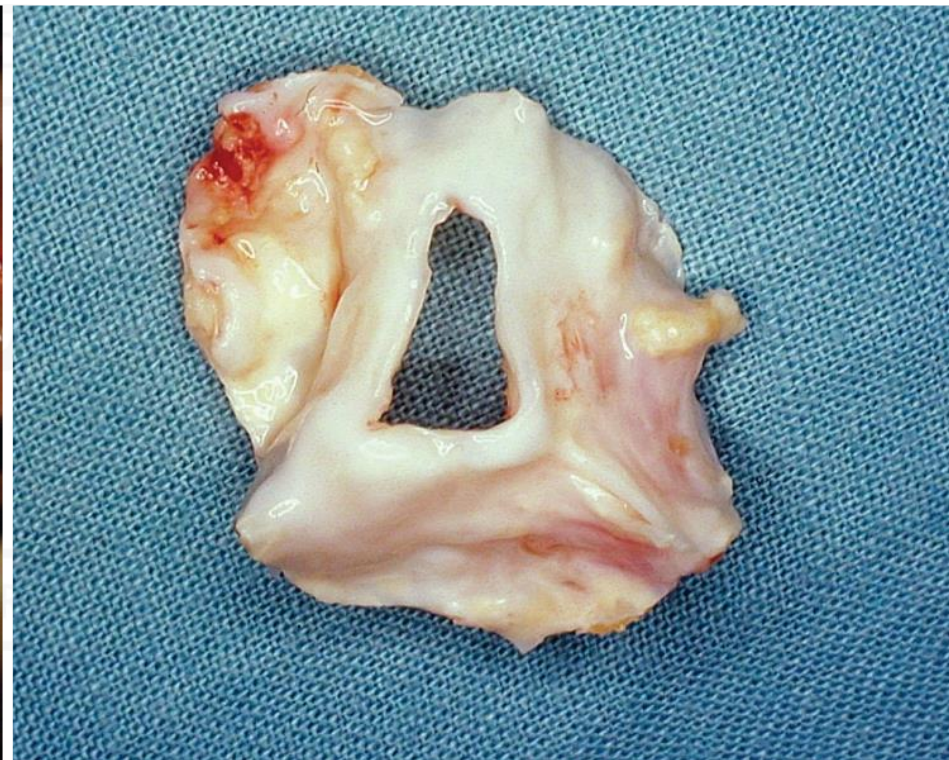
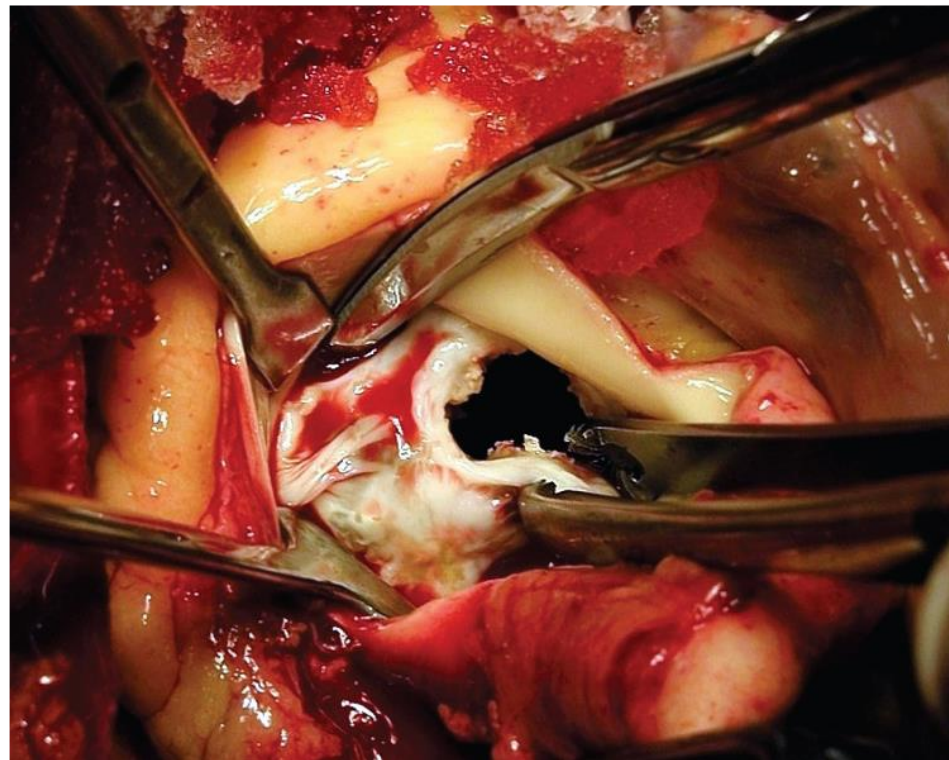
# AV: Degenerative vs. Rheumatic



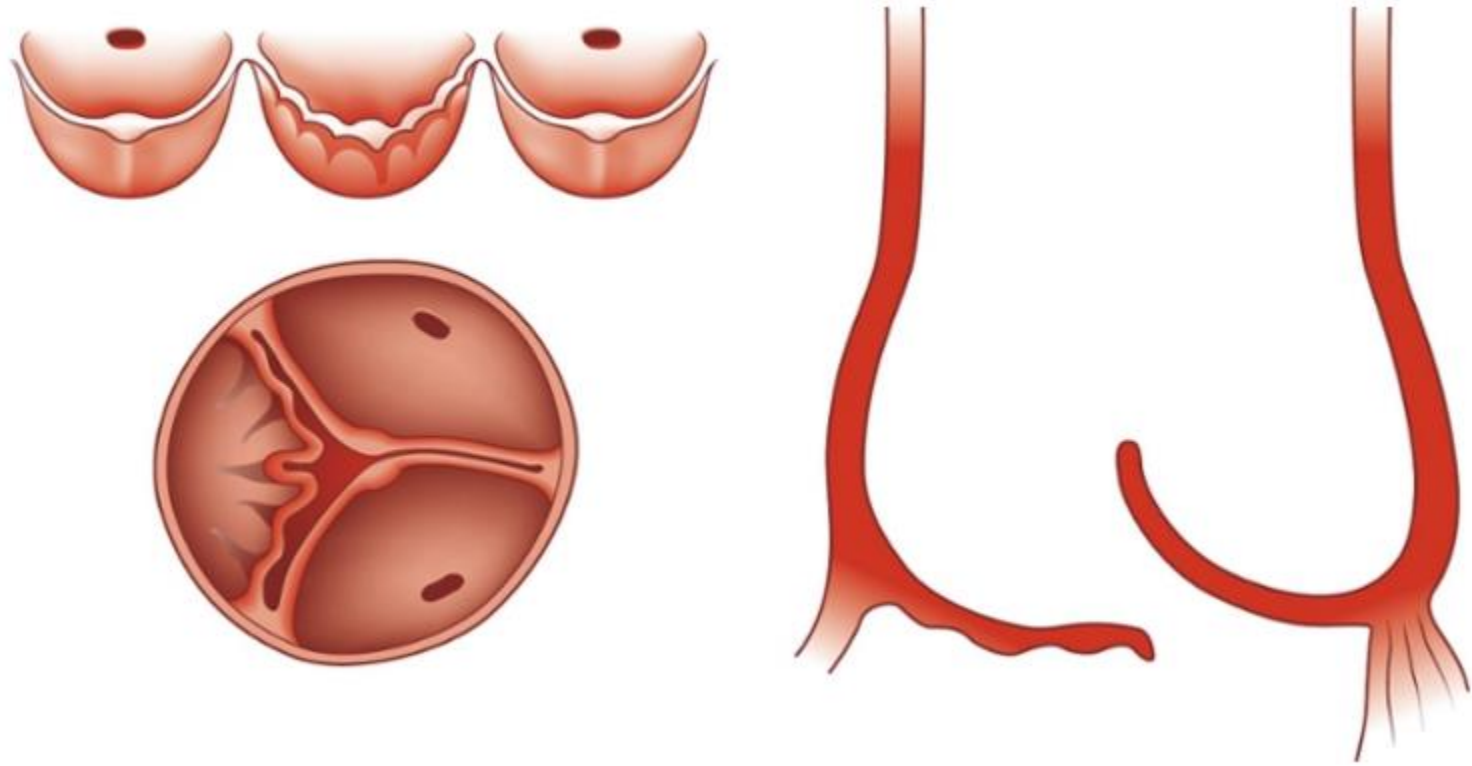
# AV ds, Etiology ?



# AV ds. Etiology ?



# Aortic Valve: Prolapse

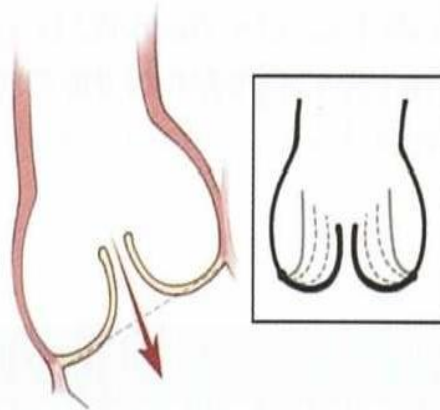


Elongation of the free margin

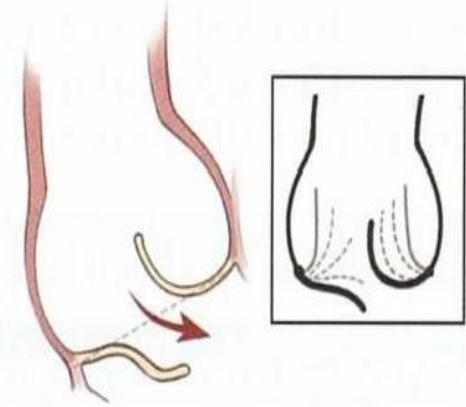


# Functional Classification

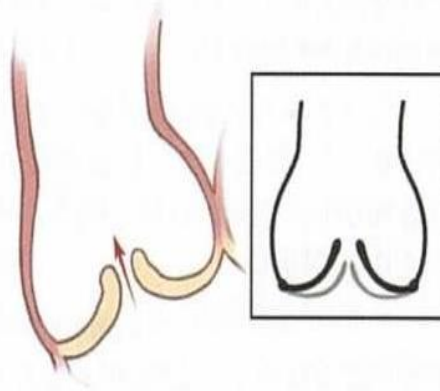
**Type I -**  
Valve dysfunction with  
normal leaflet motion



**Type II -**  
Leaflet prolapse



**Type IIIa -**  
Restricted leaflet  
opening

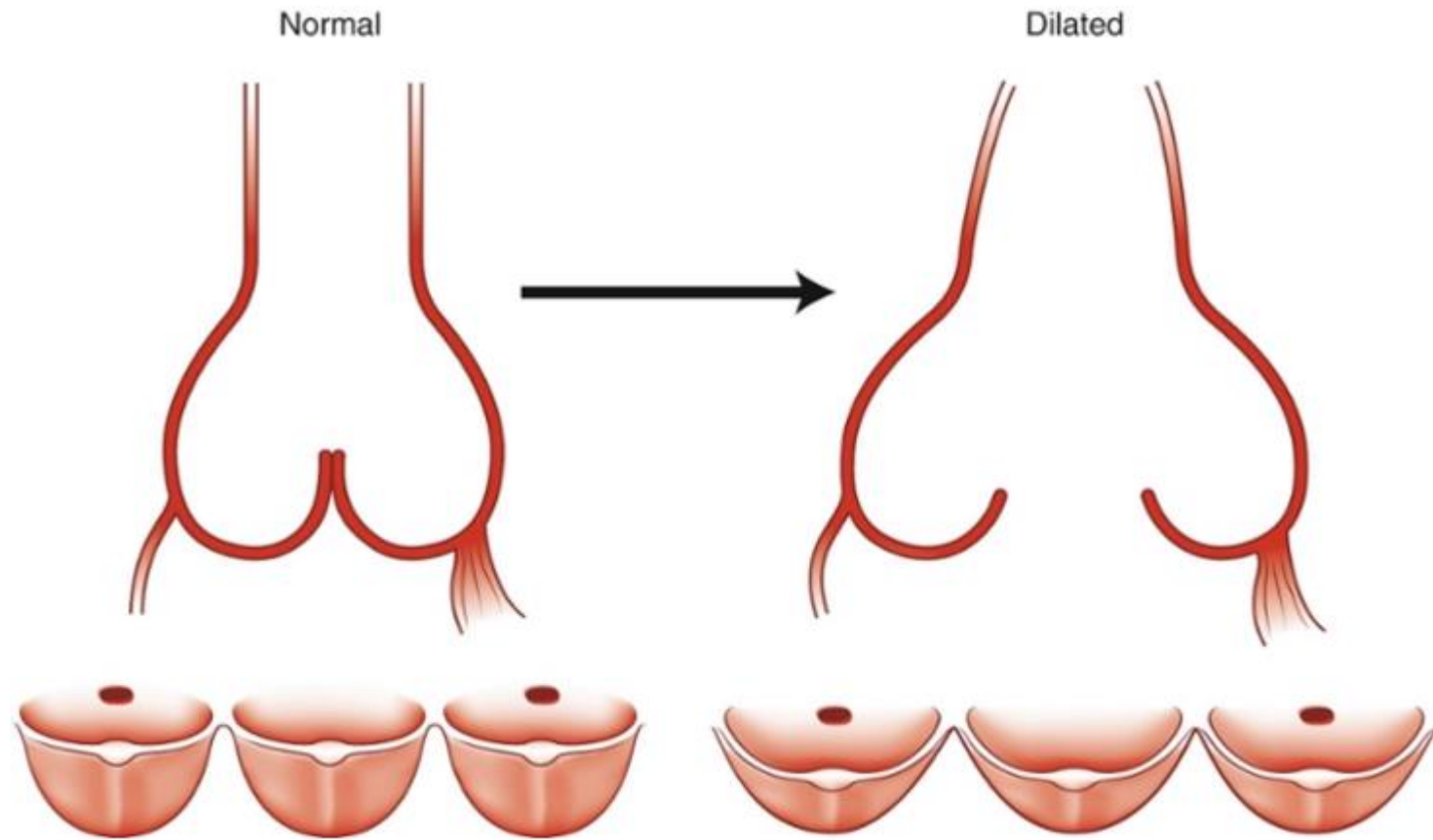


**Type IIIb -**  
Restricted leaflet  
closure



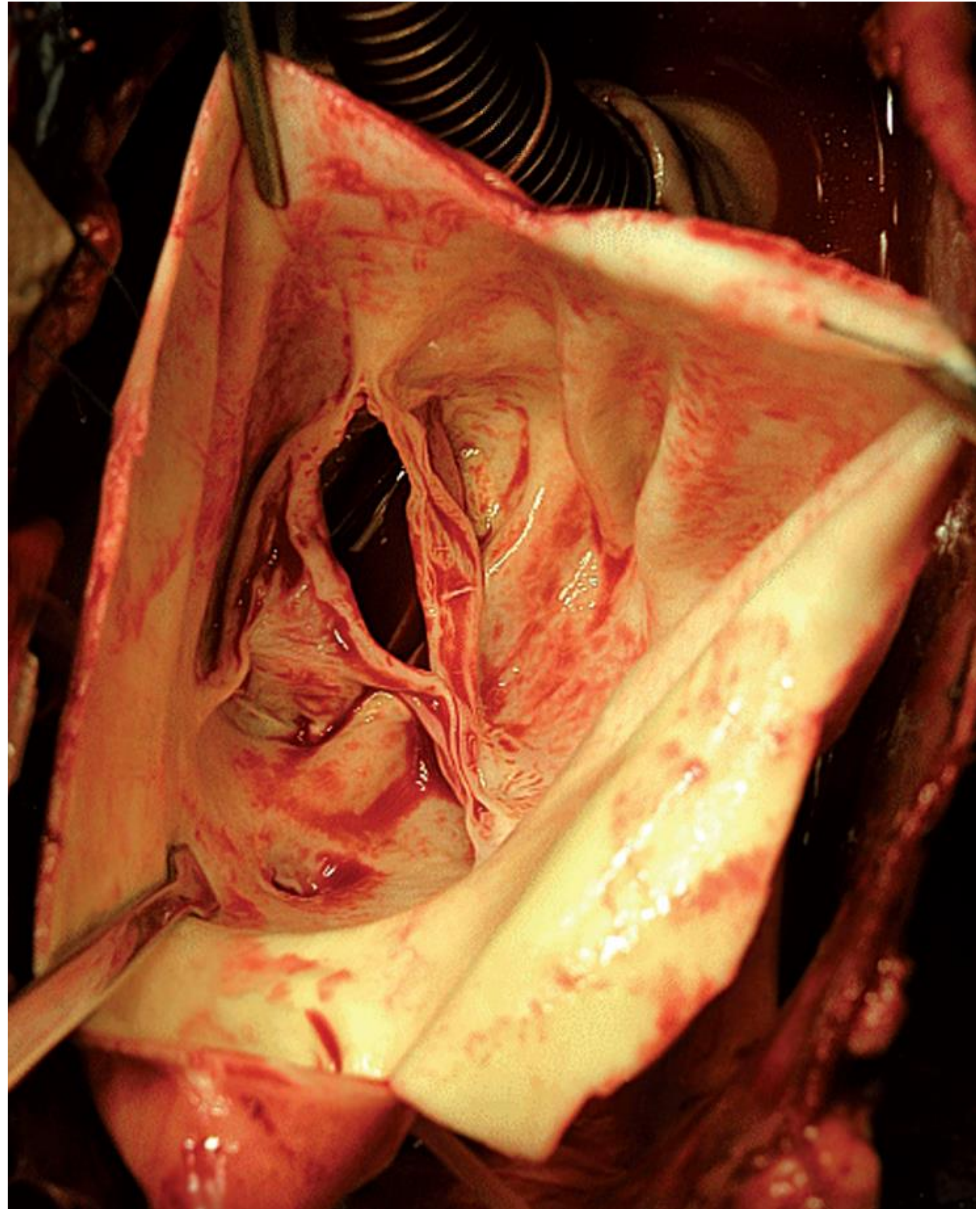
AC-MW

# IIIb: annular enlargement



Dilation of the aortic annulus

# BAV with AAE

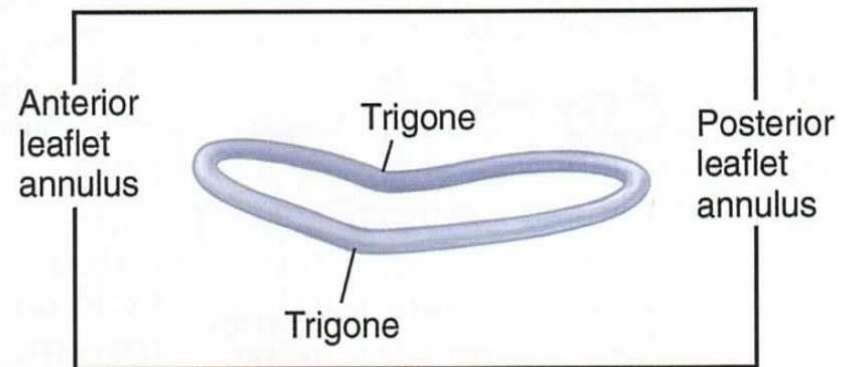
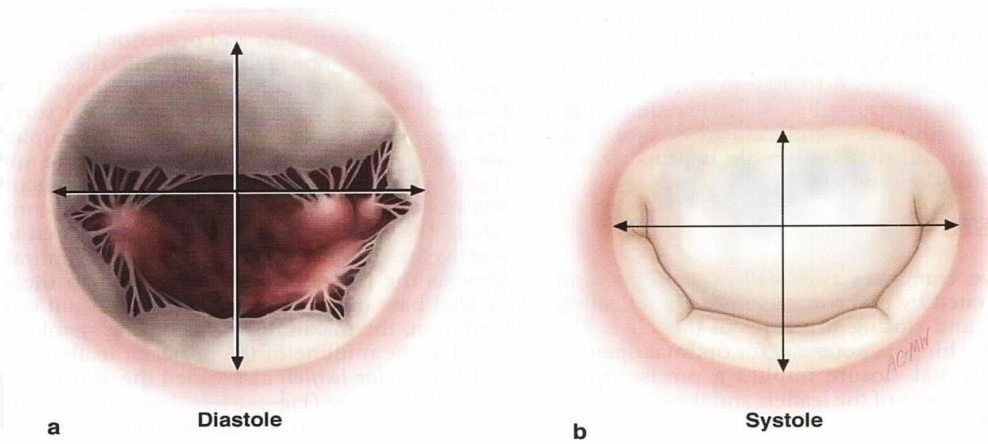


# Mitral Valve



# MV: Annulus

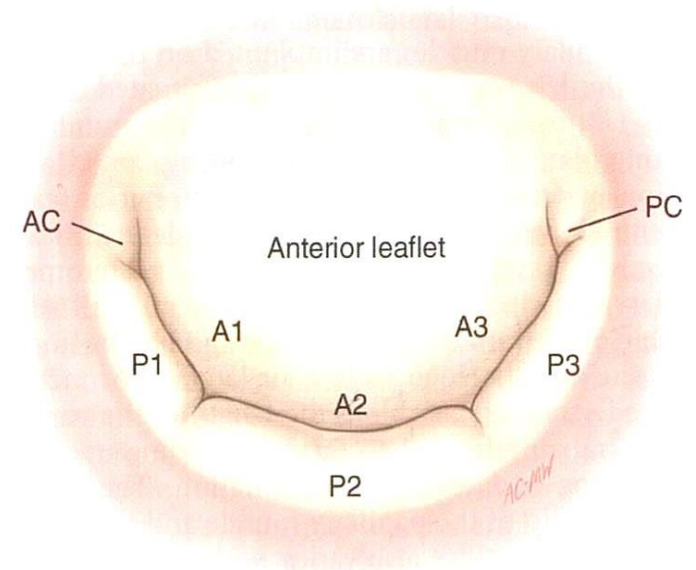
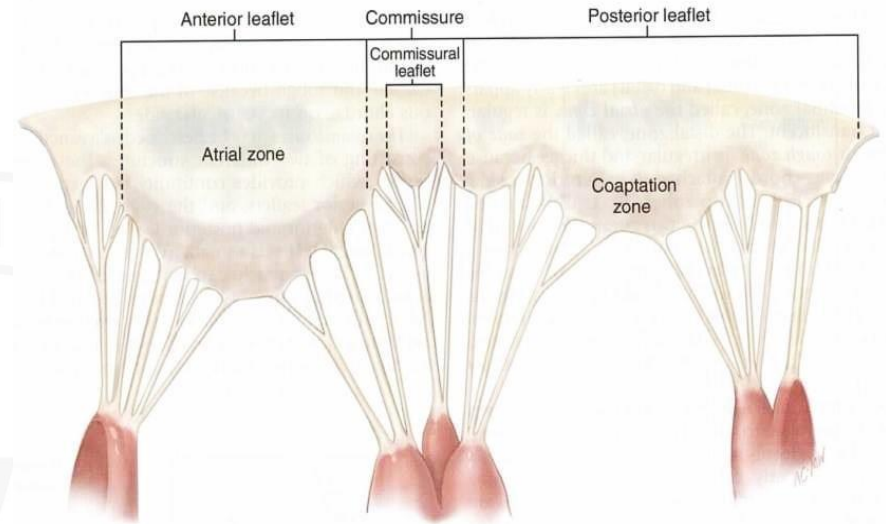
- Nonexistent structure: virtual transition space
- Orifice area:  $6.5\text{cm}^2 \sim 8.0\text{cm}^2$
- Circumference: 9 ~ 10cm
- Size change in cardiac cycle: 23 ~ 40%
- Kidney shape during systole
- Circular during diastole
- Saddle shape



Schematic configuration of mitral annulus

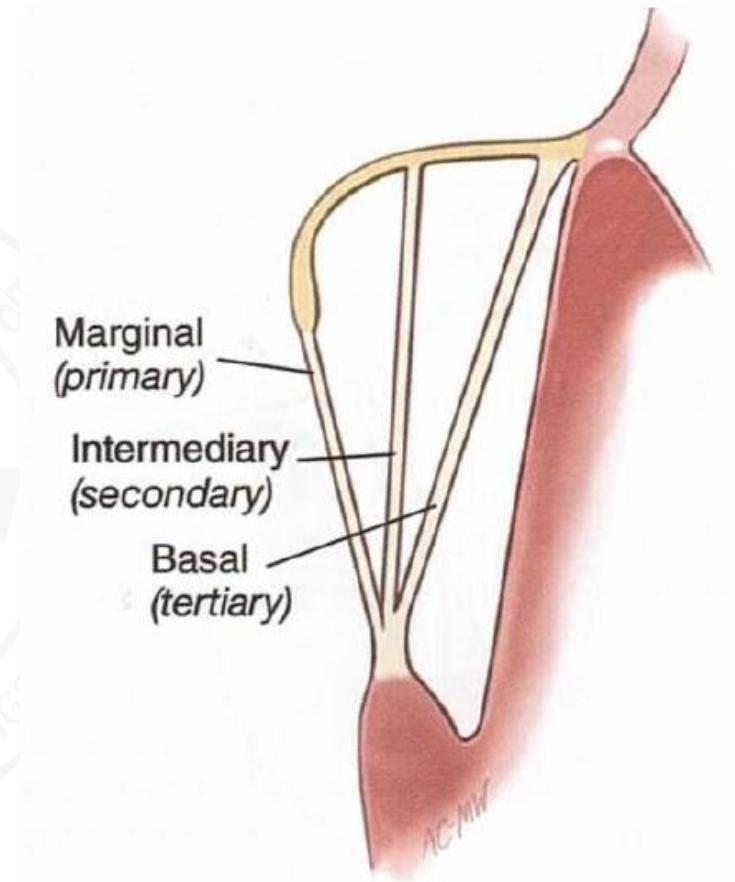
# MV: Leaflets

- 3 layers
- Anterior: triangular, smooth
- Posterior: rectangular, indentation
- Rough zone & Smooth zone
- Carpentier classification
  - Anterior leaflet: A1, A2, A3
  - Posterior leaflet; P1, P2, P3
  - AL commissure
  - PM commissure



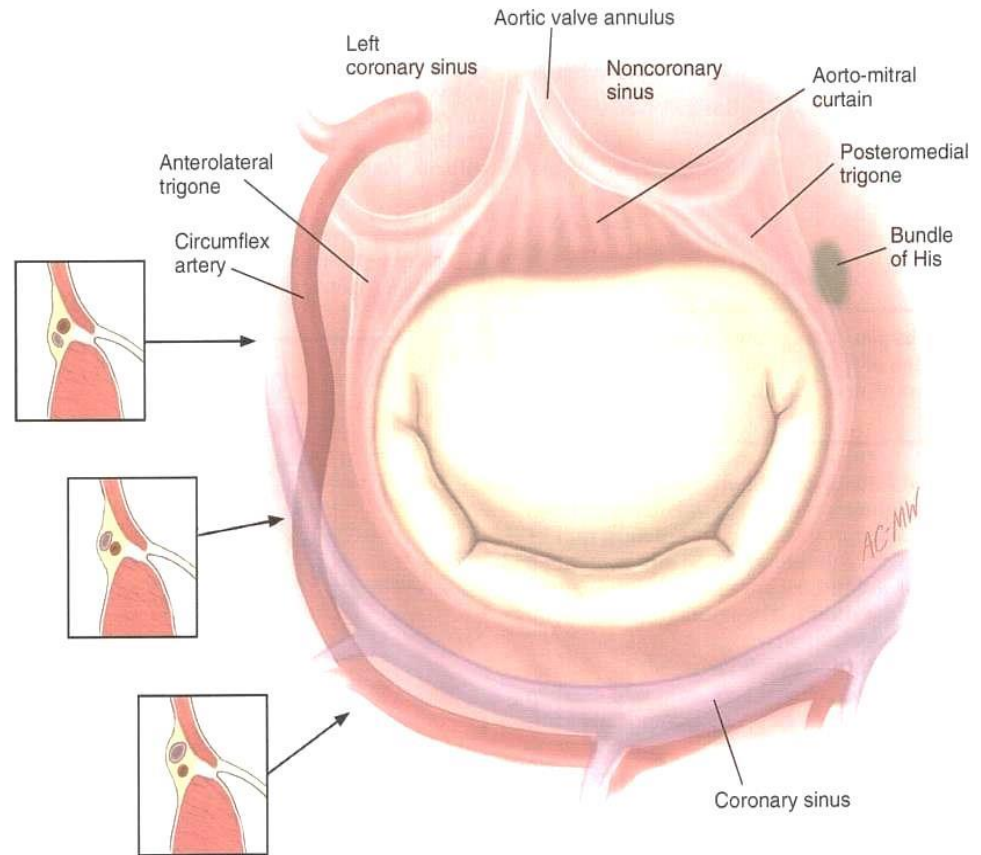
# MV: Chordae Tendineae

- **Primary (marginal)**
  - Leaflet free margin
  - Prevent leaflet prolapse
- **Secondary (intermediary)**
  - Ventricular surface of the leaflets
  - Reduce excess tension of leaflets
  - Maintain LV geometry
- **Tertiary (Basal)**
  - Limited to the posterior leaflet
  - Connect the leaflet base to the mitral annulus and surrounding myocardium



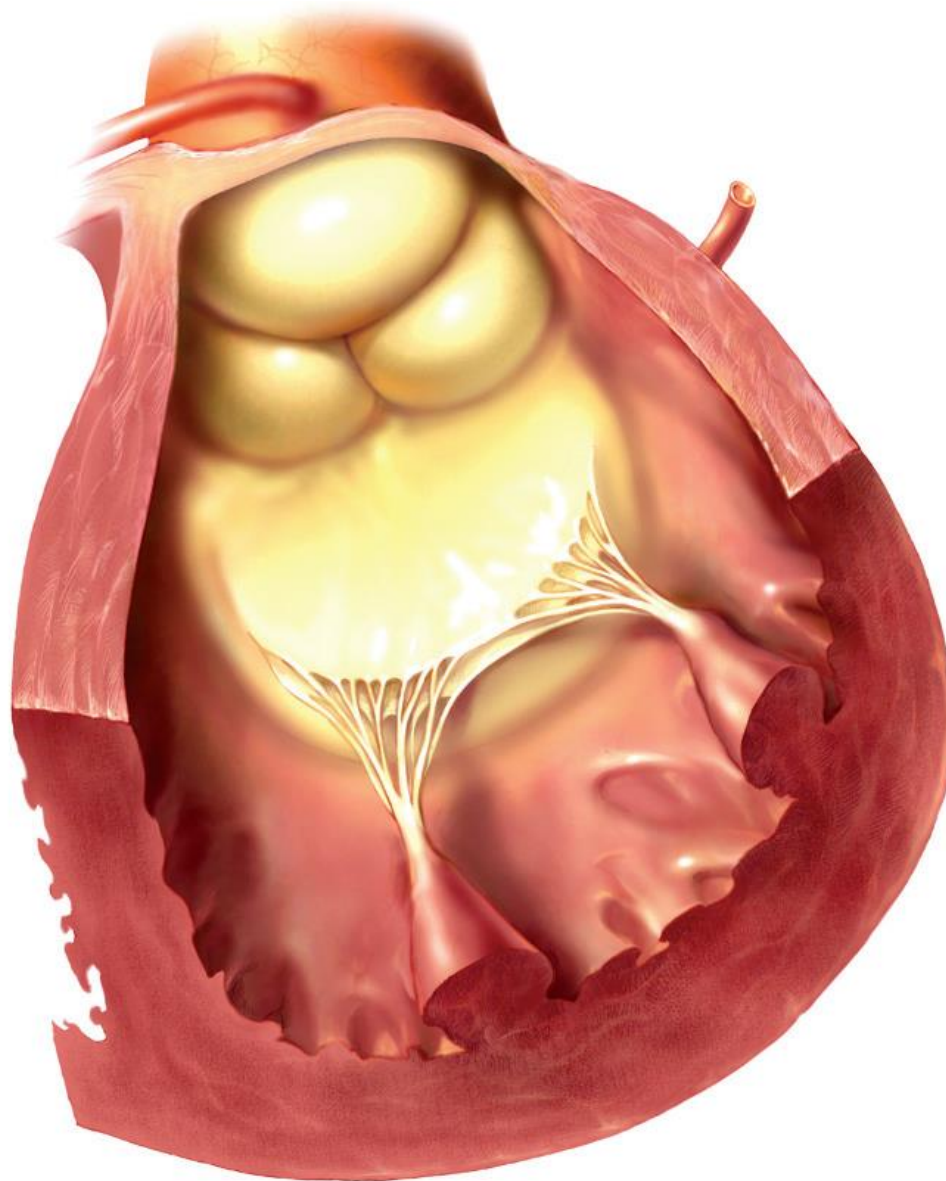
# MV: Adjacent Structures

- Aortic valve
- Aortomitral memb.
- Trigons
- LCx
- His bundle

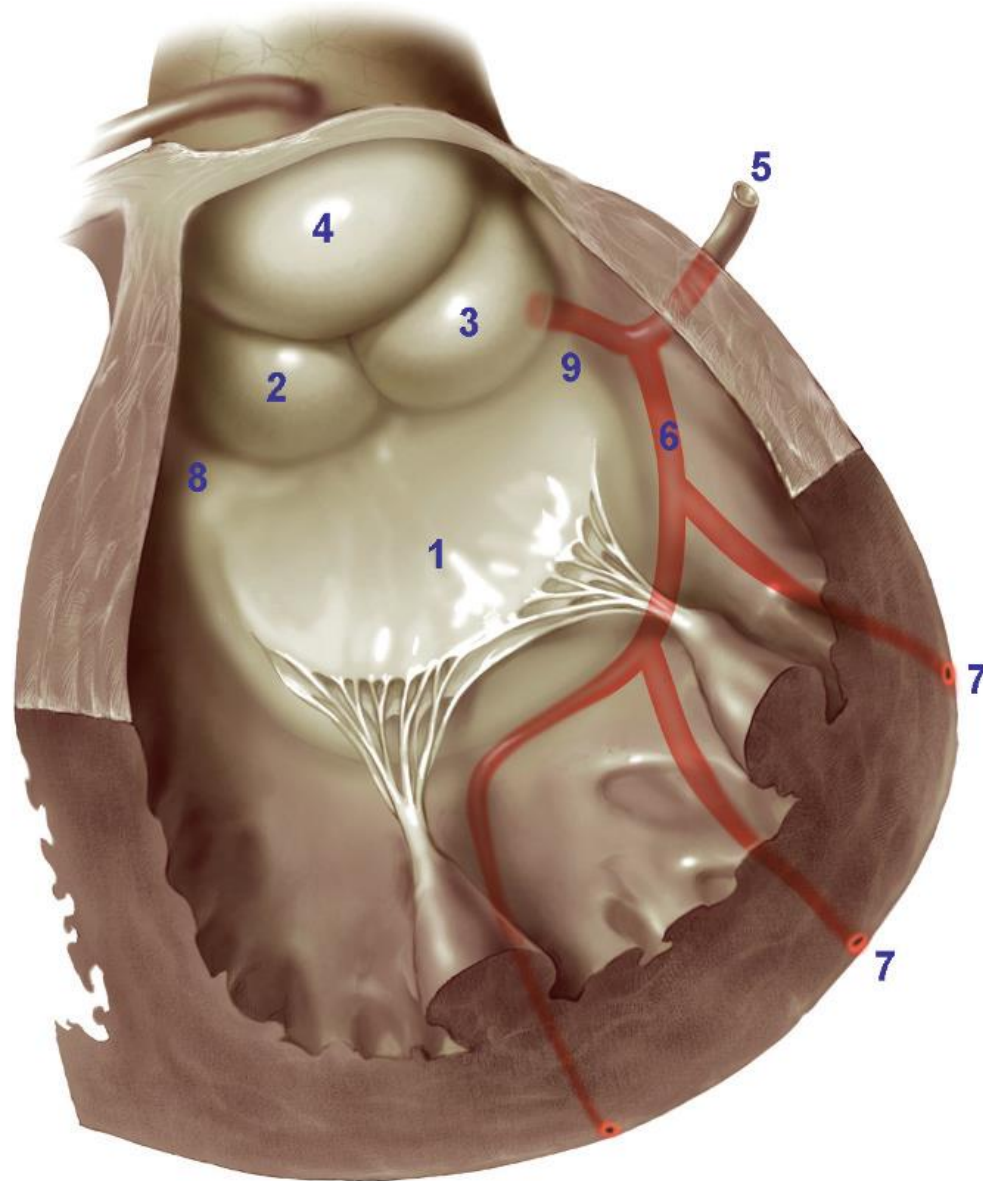




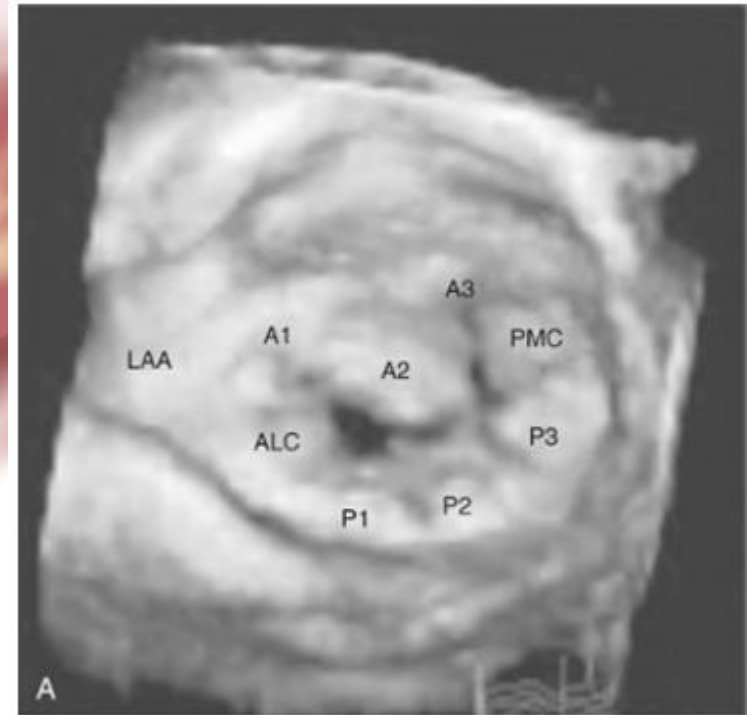
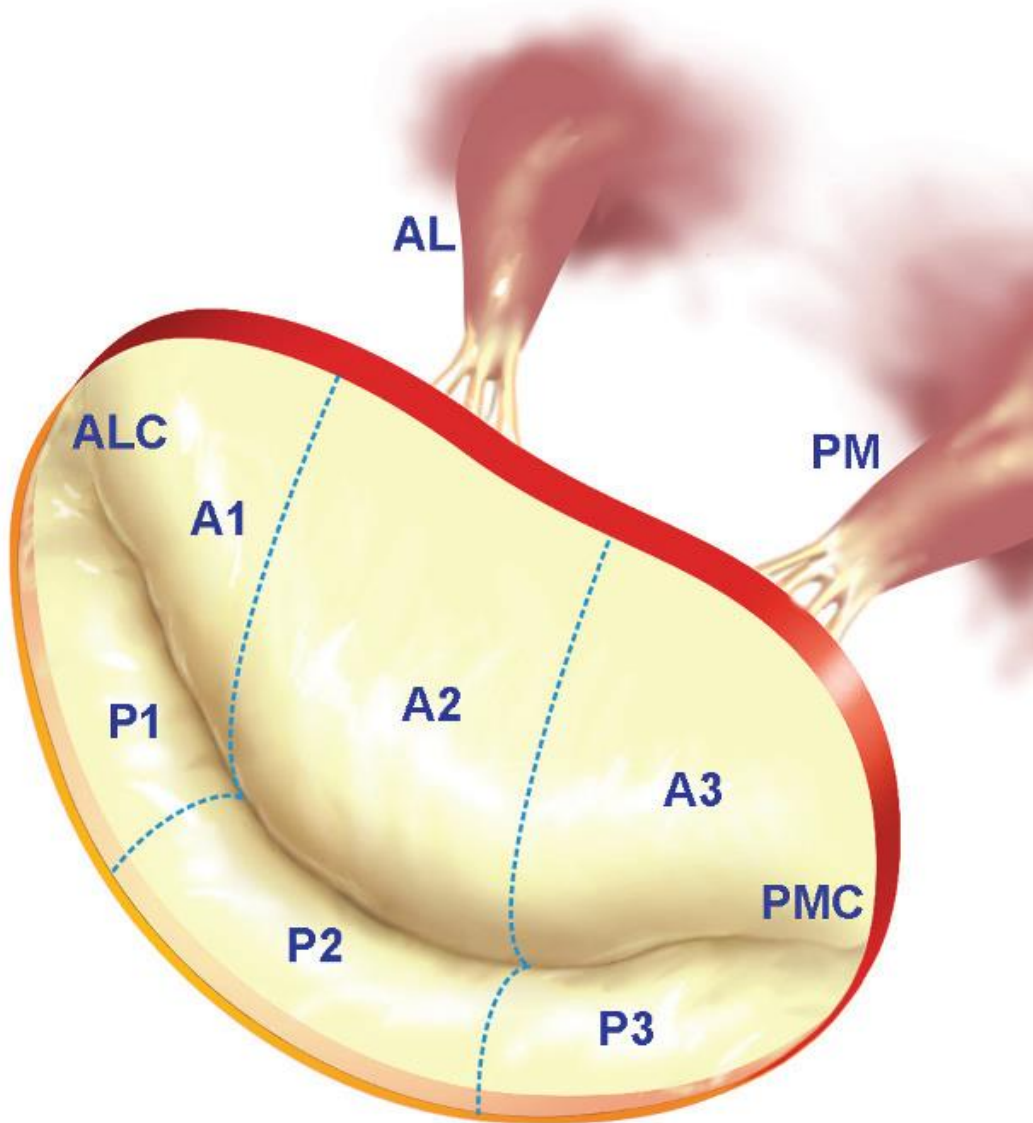
# Aortic & Mitral Valve



# Aortic & Mitral Valve

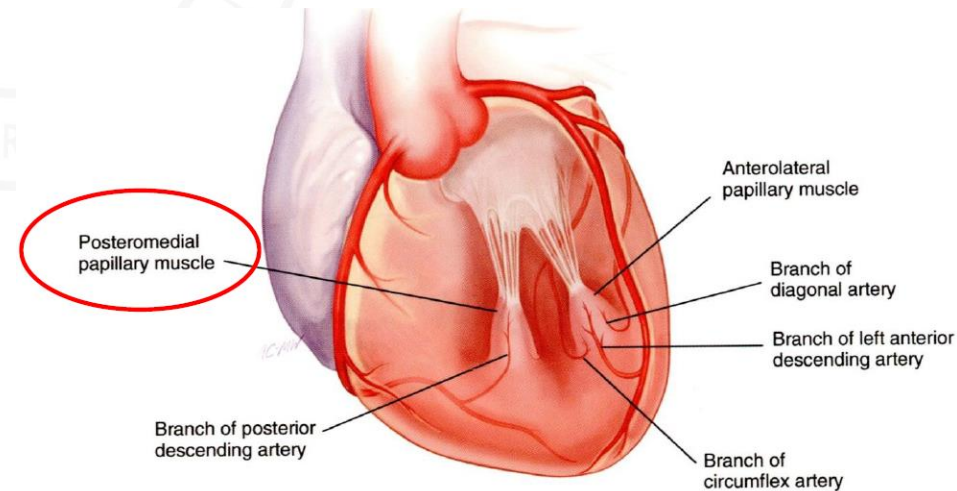
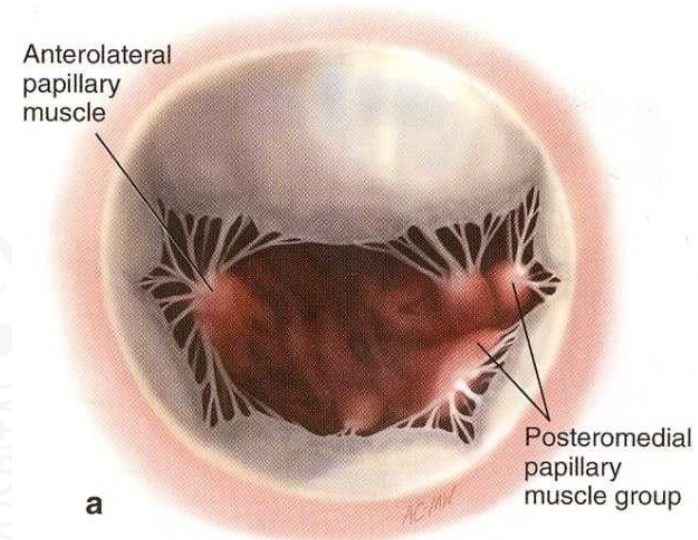


# MV: Papillary Muscles



# MV: Papillary Muscles

- Function: contract before LV wall contraction  
→ keeping the chords under tension
- Anterolateral PM:
  - Large, usually single
  - Dual blood supply: LCx & Diagonal
- Posteromedial PM:
  - U shaped, two or three columns
  - Single blood supply: RCA or LCx,



# Functional Classification

**Type I - Normal Leaflet Motion**

Annular distension      Leaflet perforation

Vegetations      Leaflet tear

**Type II - Leaflet Prolapse**

Chordae rupture      Chordae elongation

Papillary muscle rupture      Papillary muscle elongation

**Type III Restricted Leaflet Motion**

**Type IIIa - Diastolic**

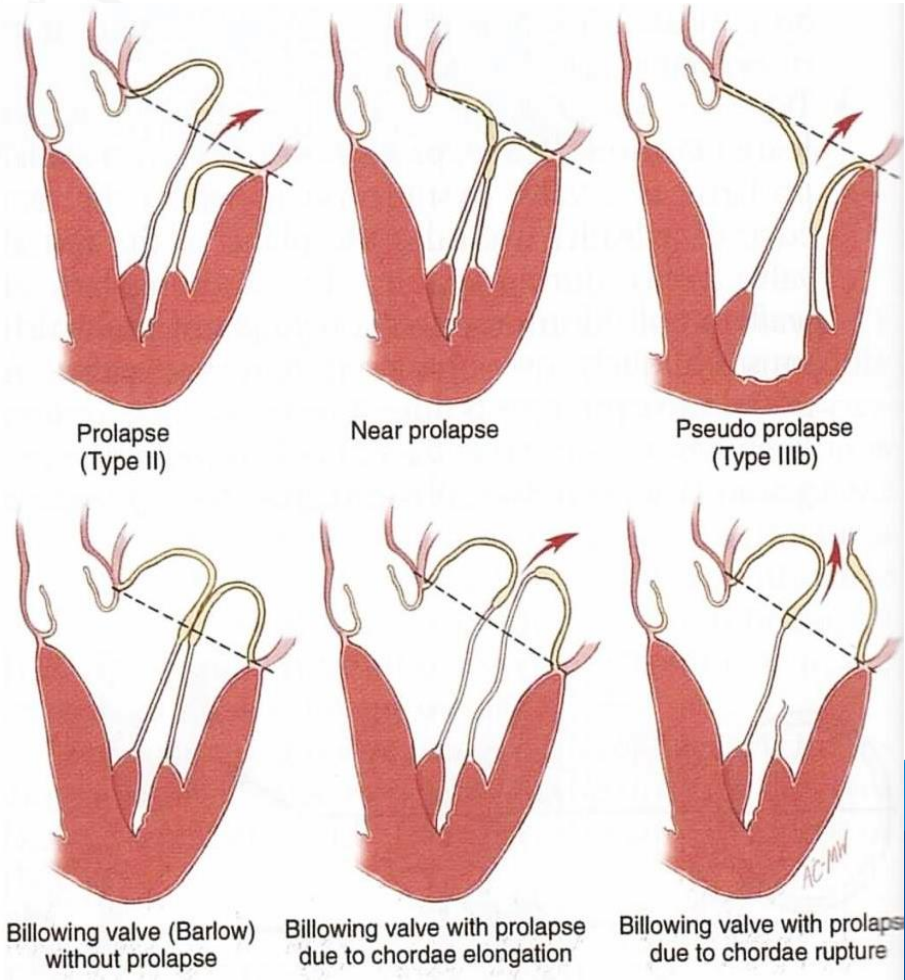
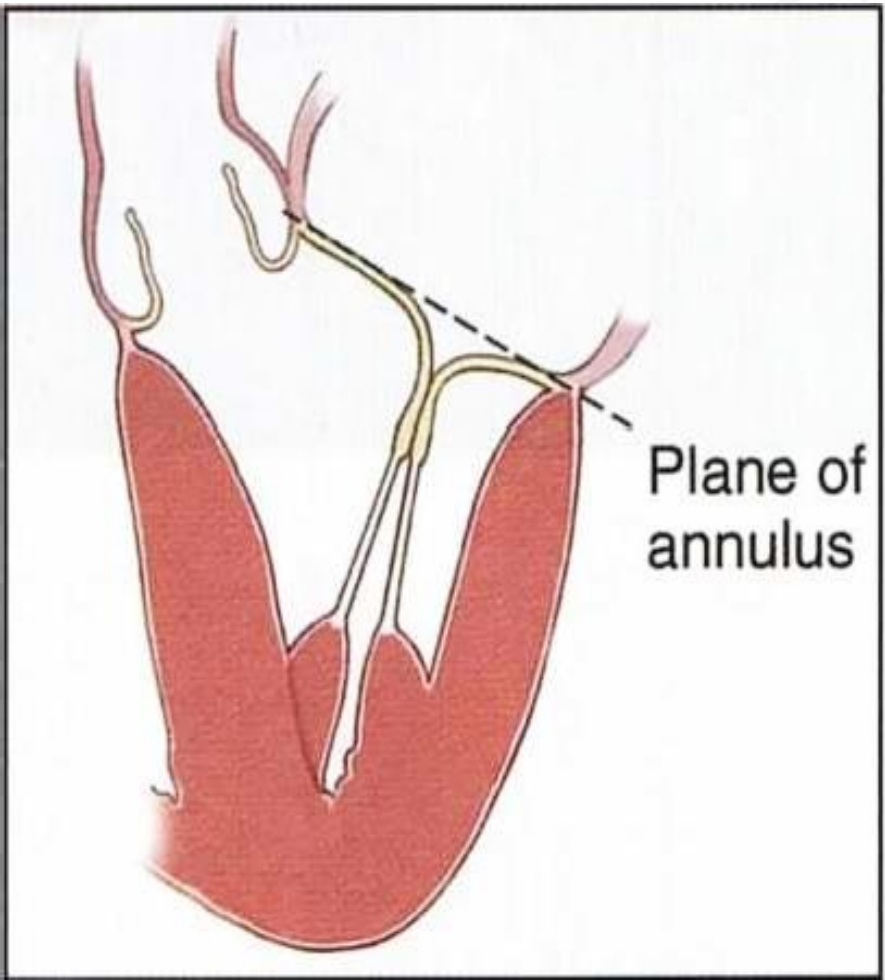
Commissure fusion/leaflet thickening      Chordae thickening/fusion

**Type IIIb - Systolic**

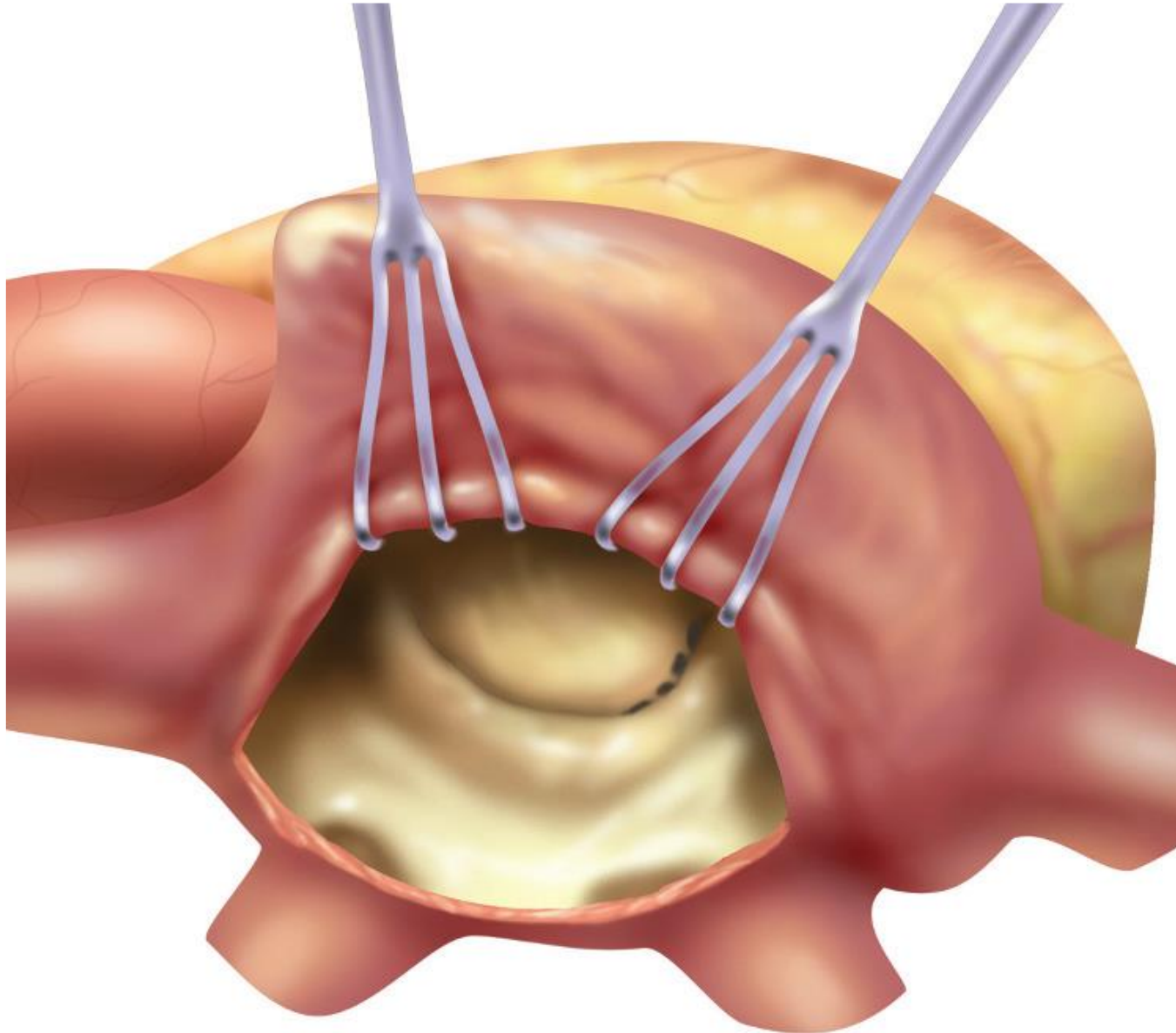
Myocardial infarction      Ventricular dilatation

# Billowing vs. Prolapse ?

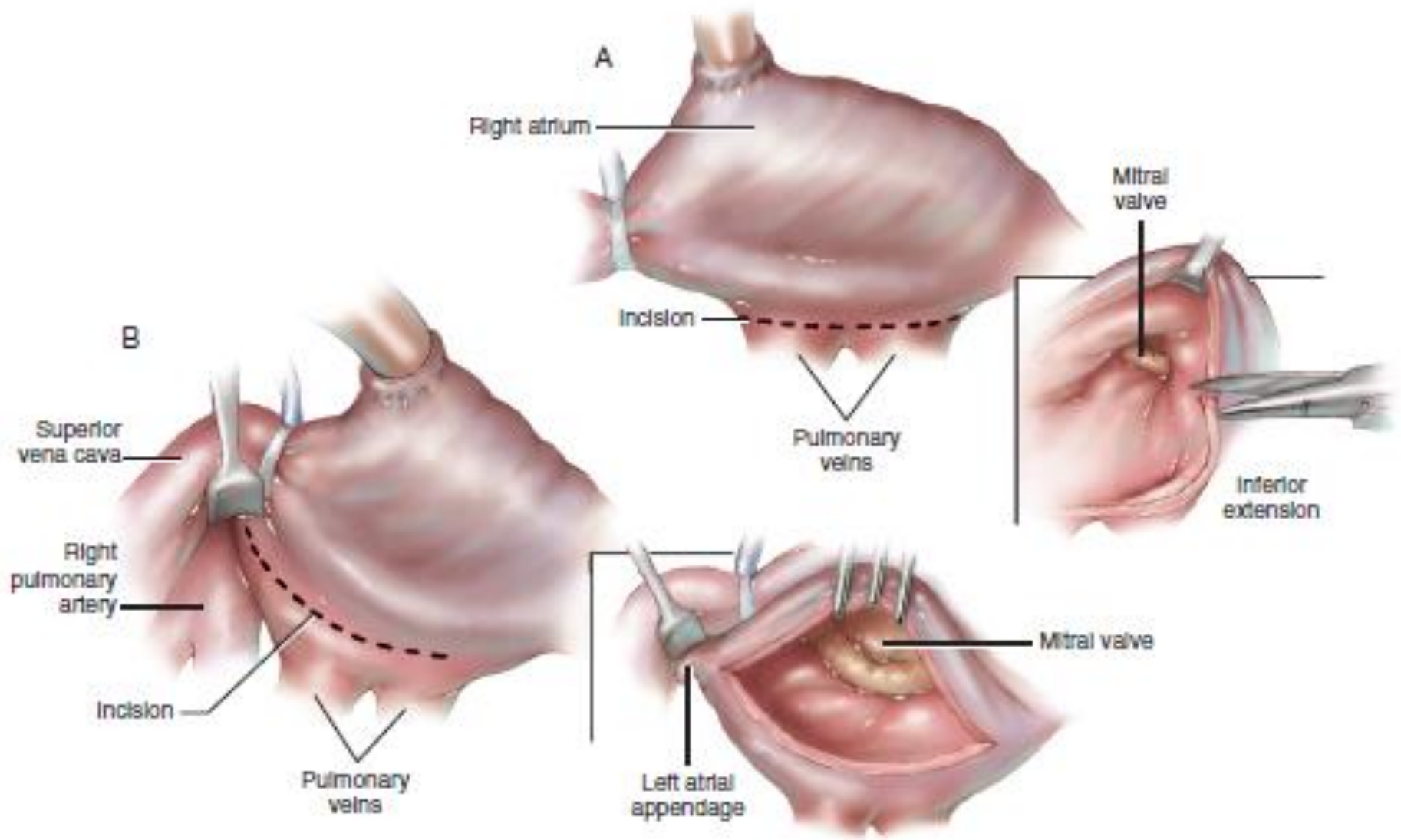
- Plane of annulus
  - coaptation below the plane of orifice



# MV Exposure: Interatrial groove

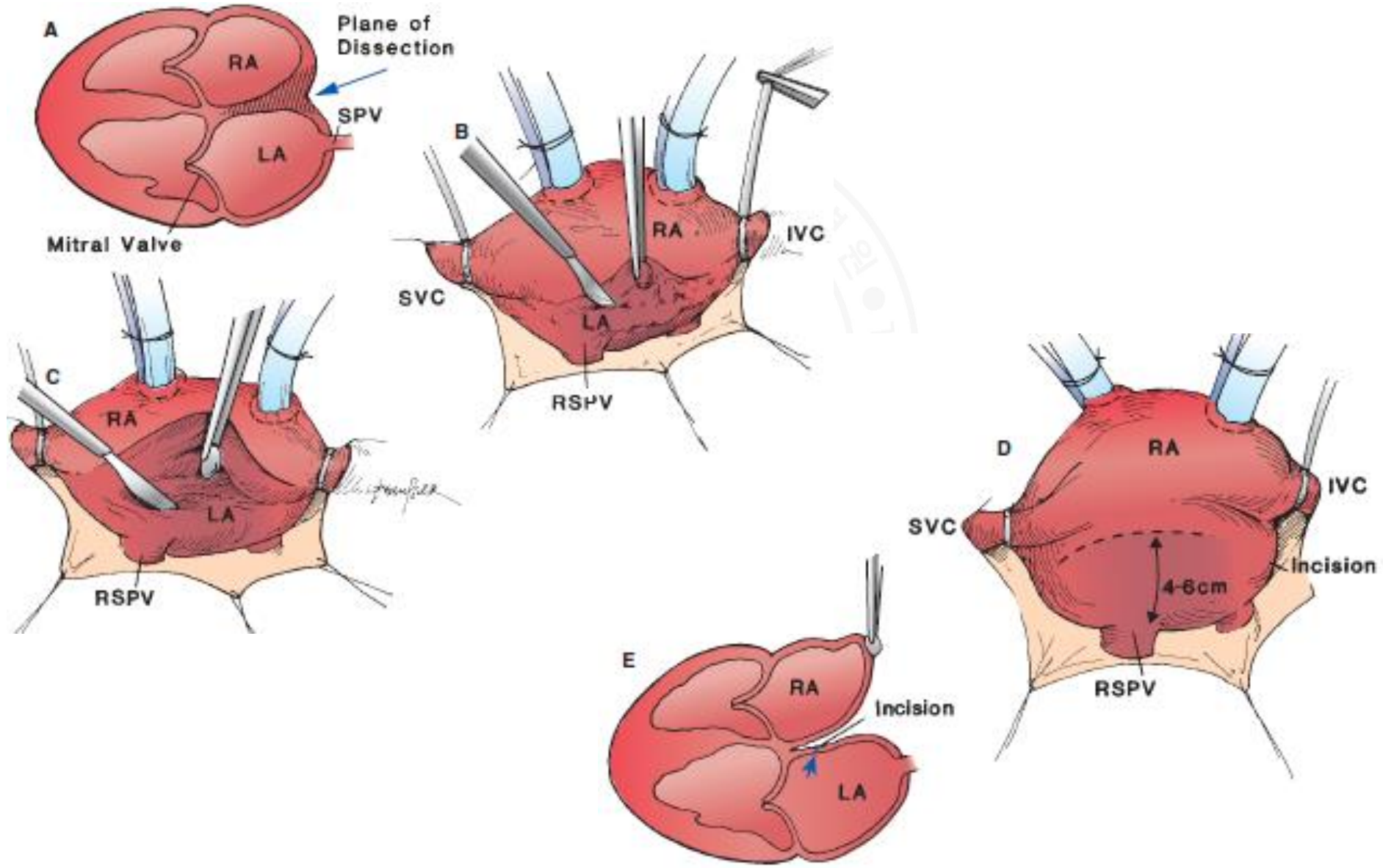


# MV Exposure: Interatrial groove

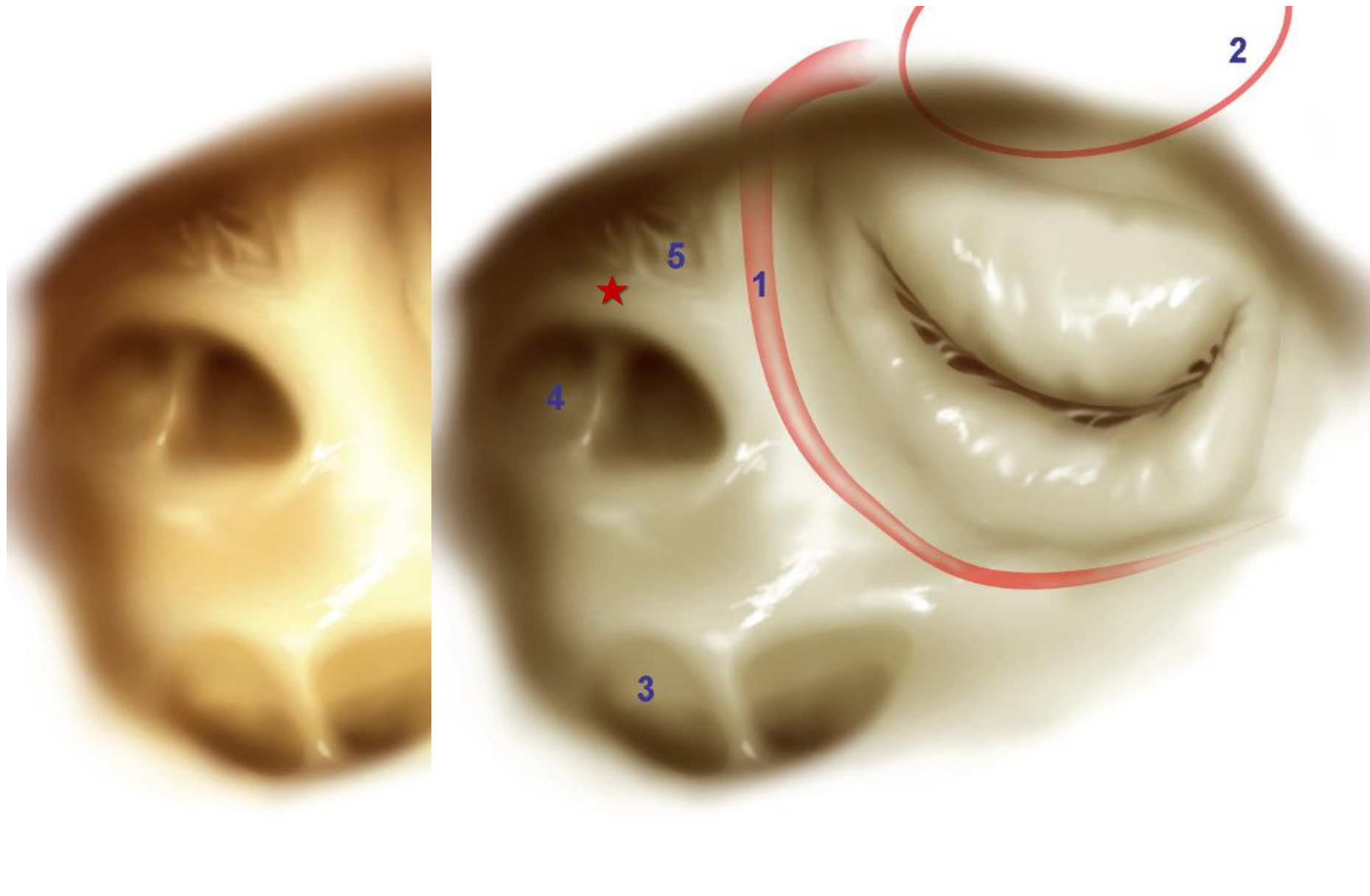




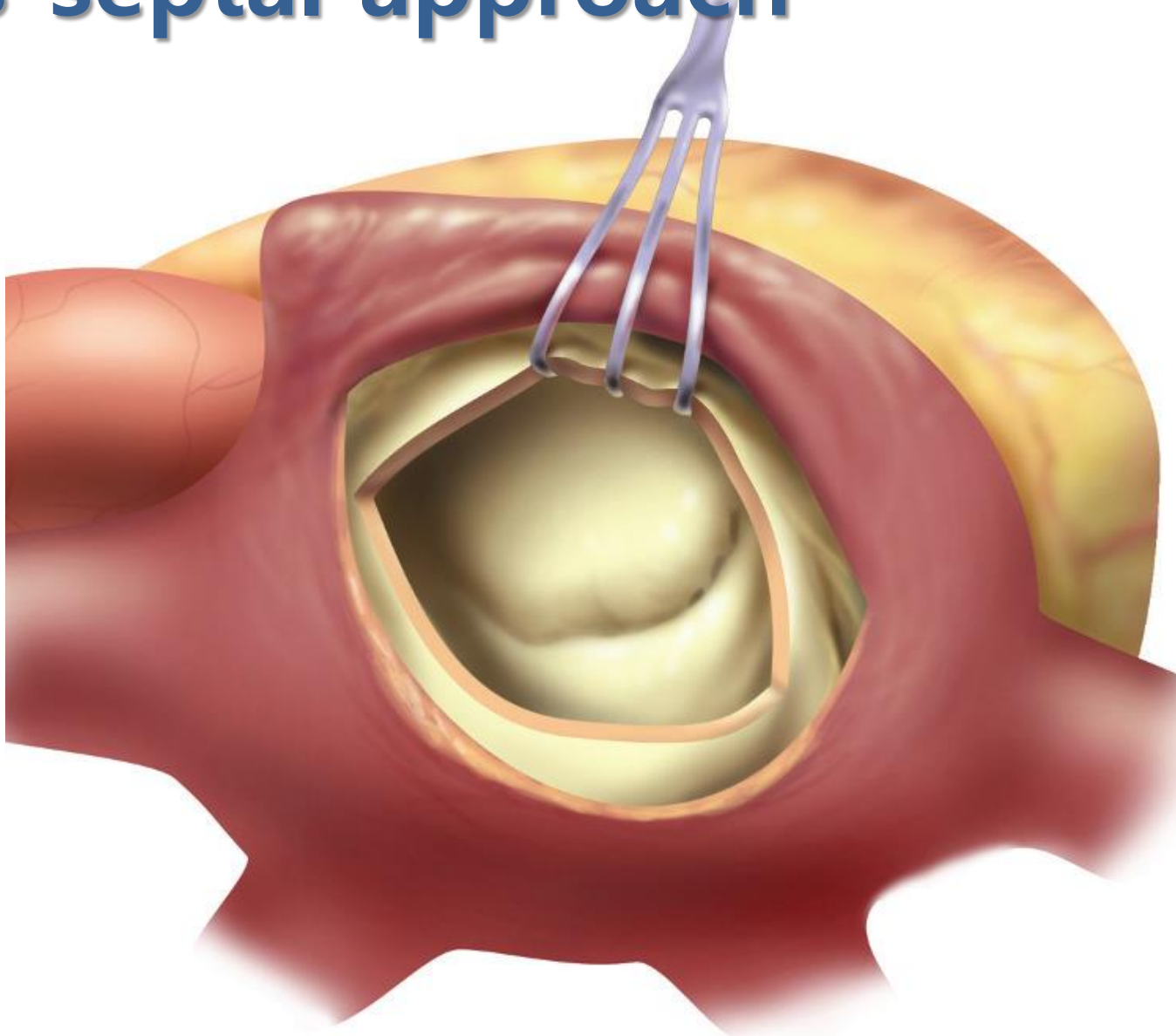
# MV Exposure: Interatrial groove



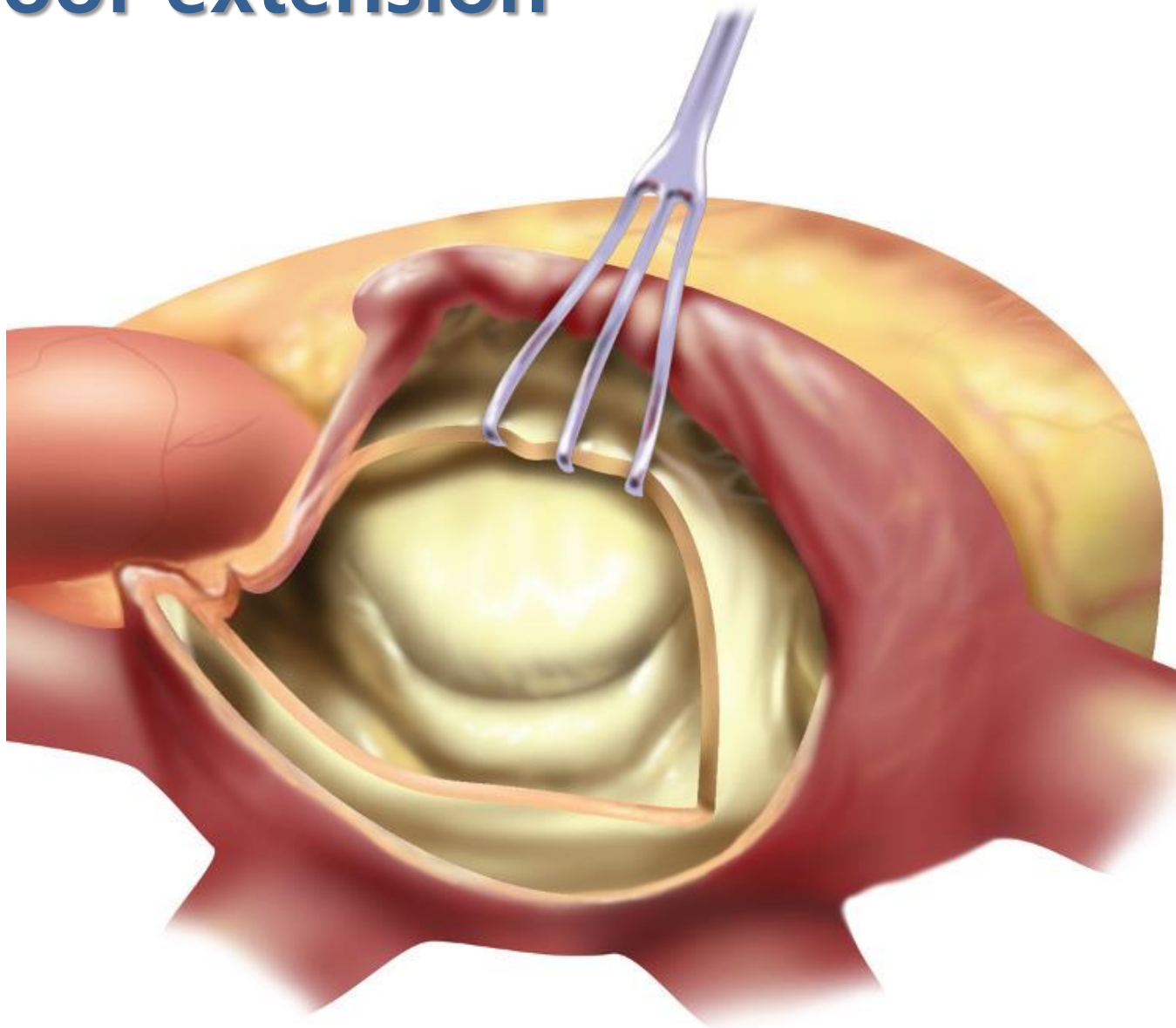
# Mitral Valve: via LA tomy



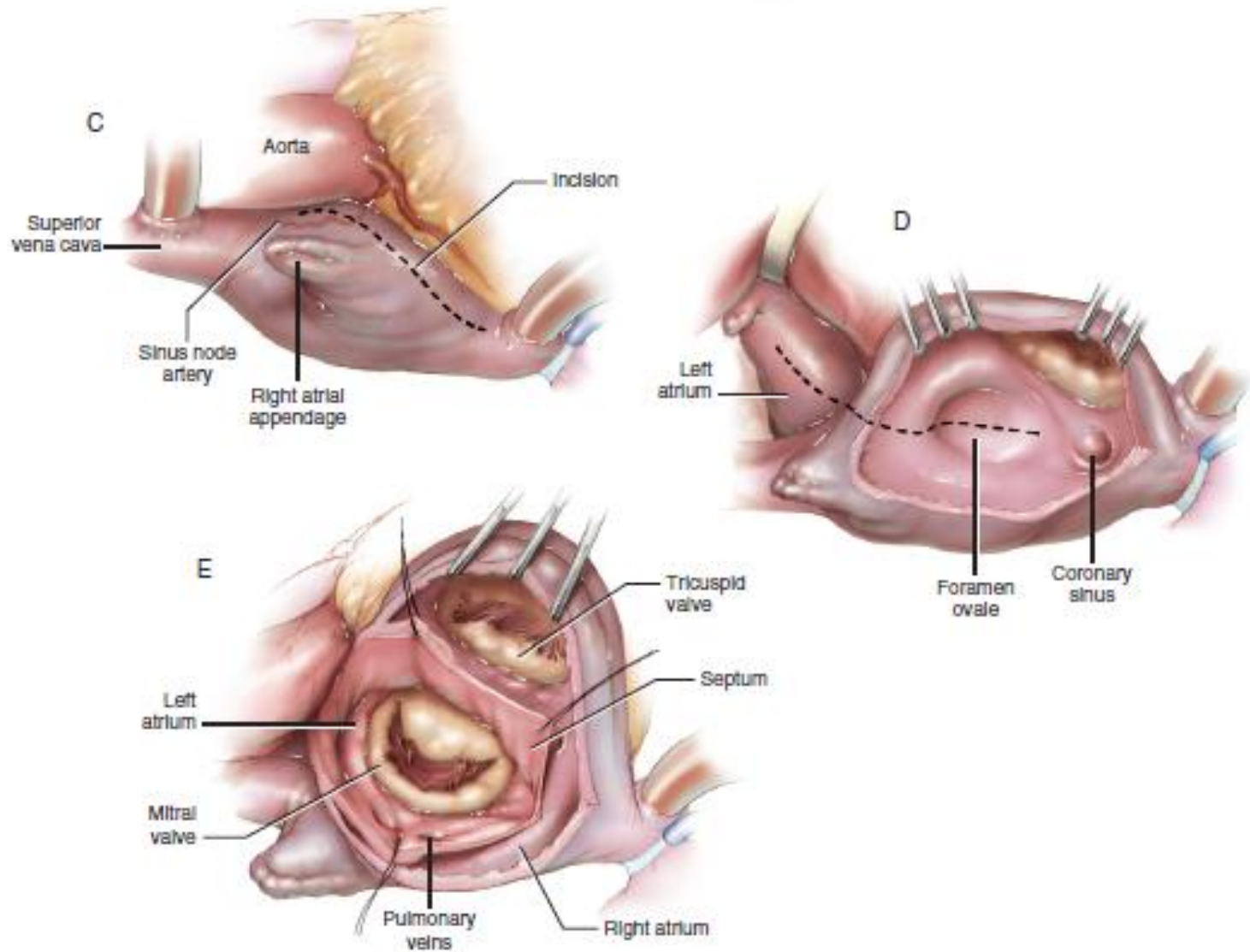
# MV Exposure: RA, Trans-septal approach



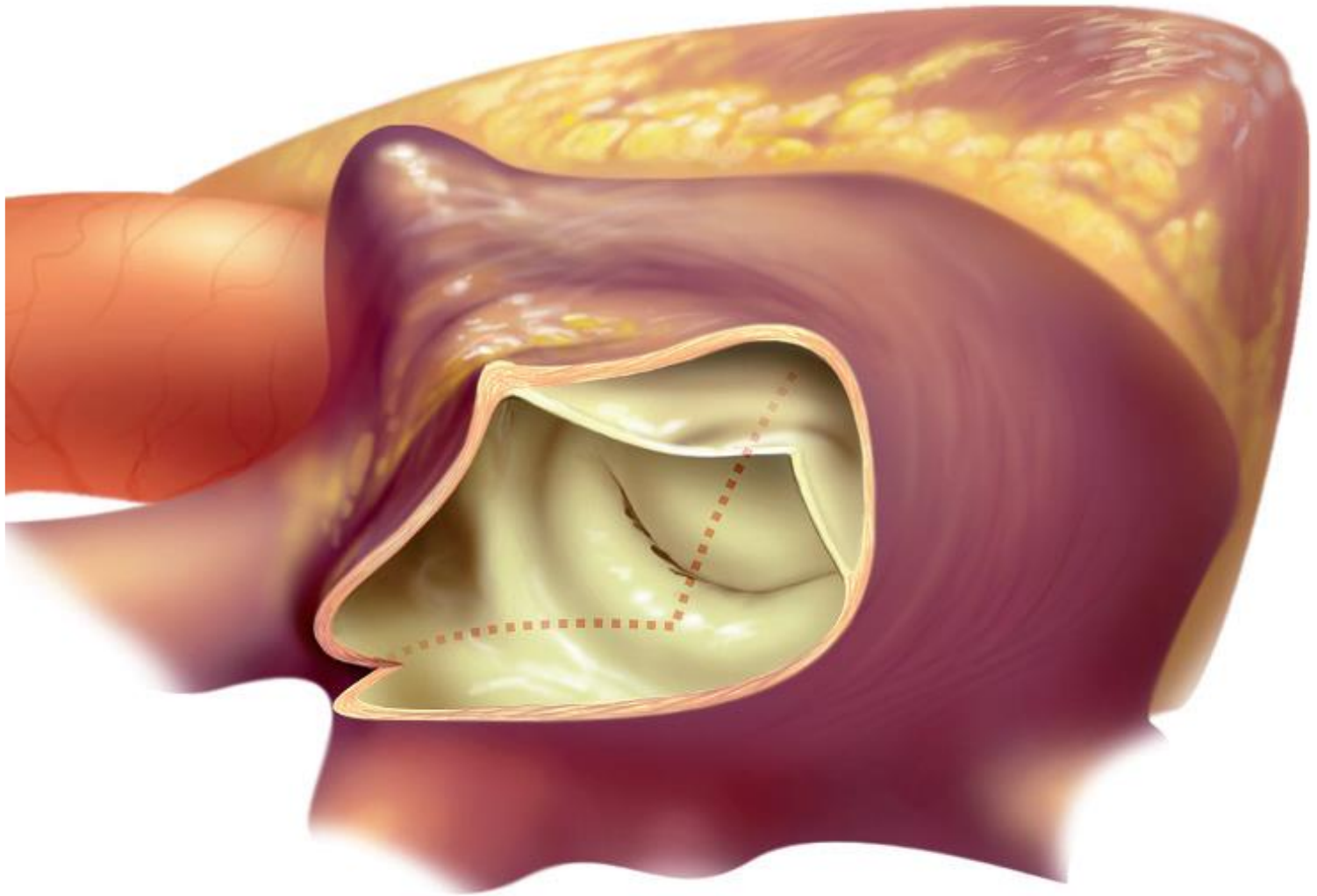
# MV Exposure: Trans-septal & LA roof extension



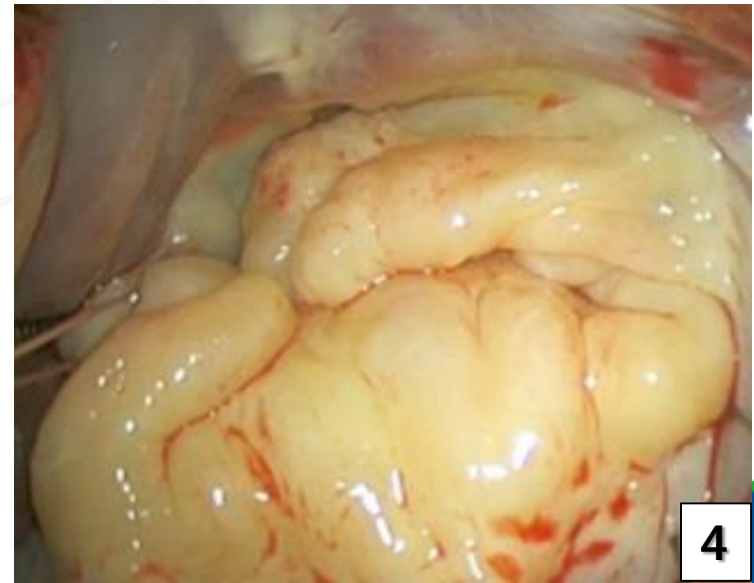
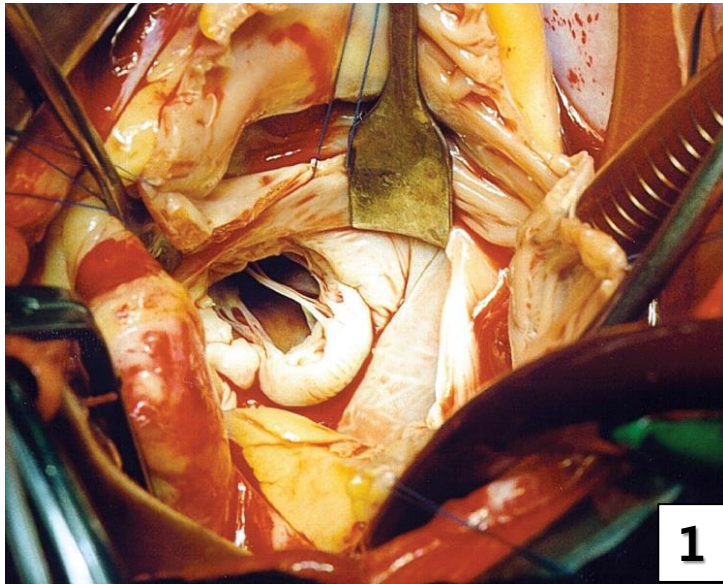
# MV Exposure: RA, Trans-septal approach



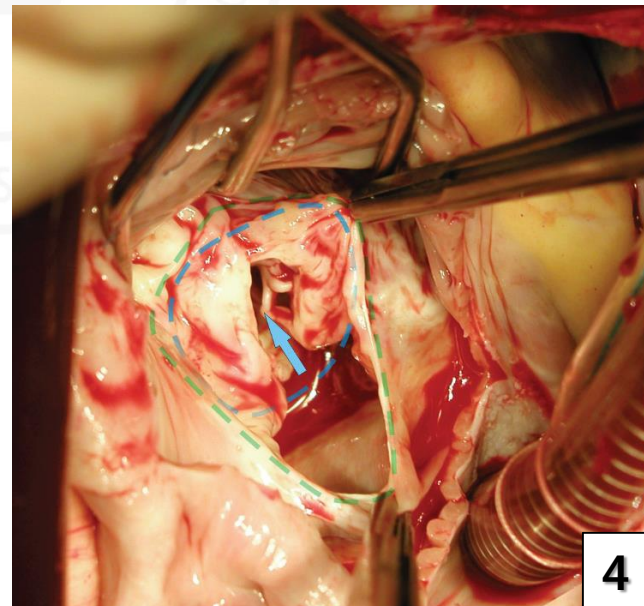
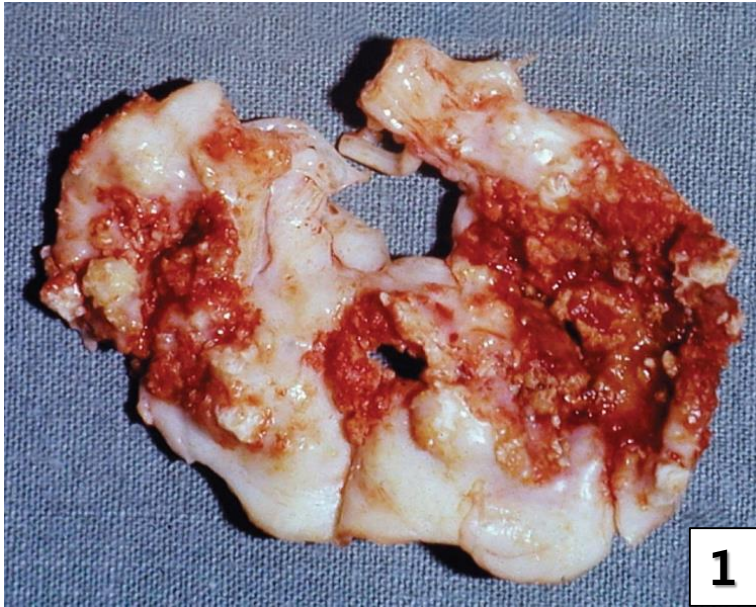
# MV Exposure: Hockey-stick biatrial approach



# MV ds.; Etiology ?

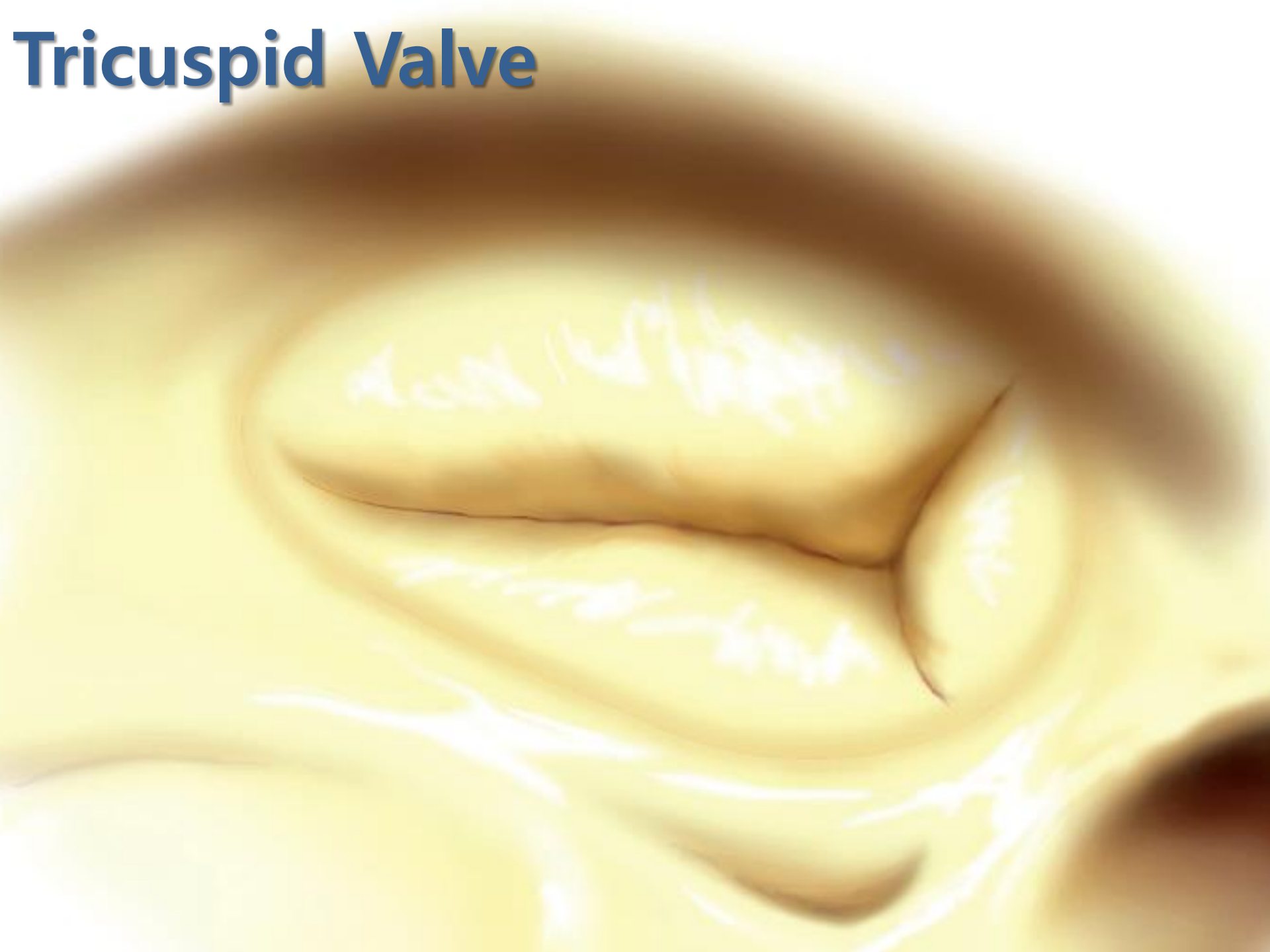


# MV ds.; Etiology ?



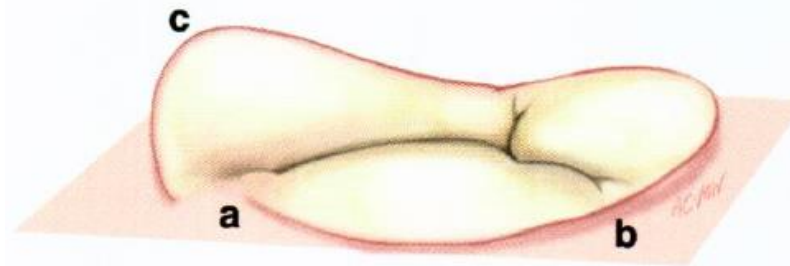
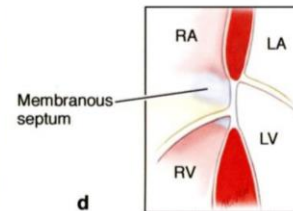
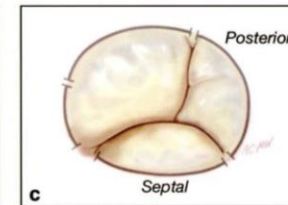
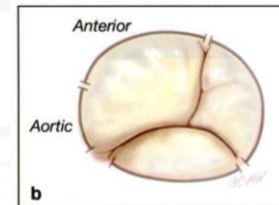
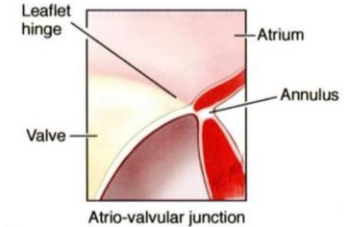
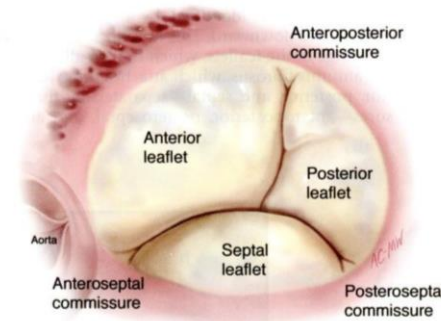


# Tricuspid Valve



# Tricuspid Valve Annulus

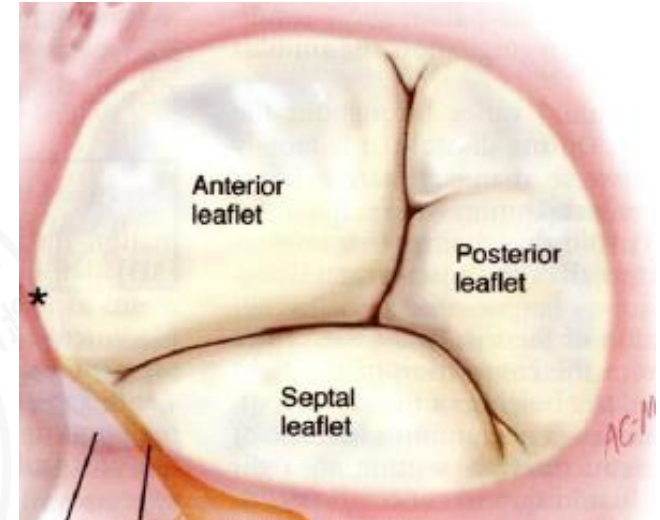
- Ant./post. leaflets → free wall of RV
- Septal leaflet → IVS
- No encircling fibrotic structure
- Changes during cardiac cycle
- Saddle shape



# Tricuspid Valve

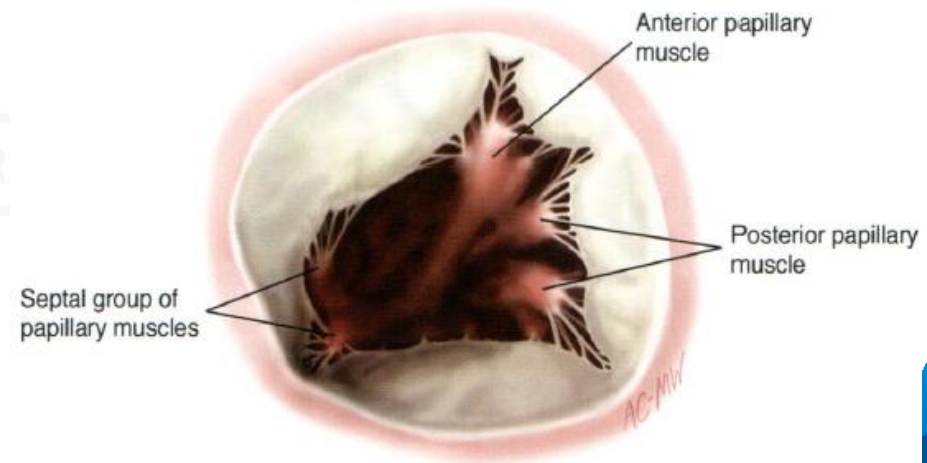
## ■ Leaflets

- Three leaflets (ant. > septal > post.)
- Three commissures (anteroseptal, anteromedial, and posteroseptal)

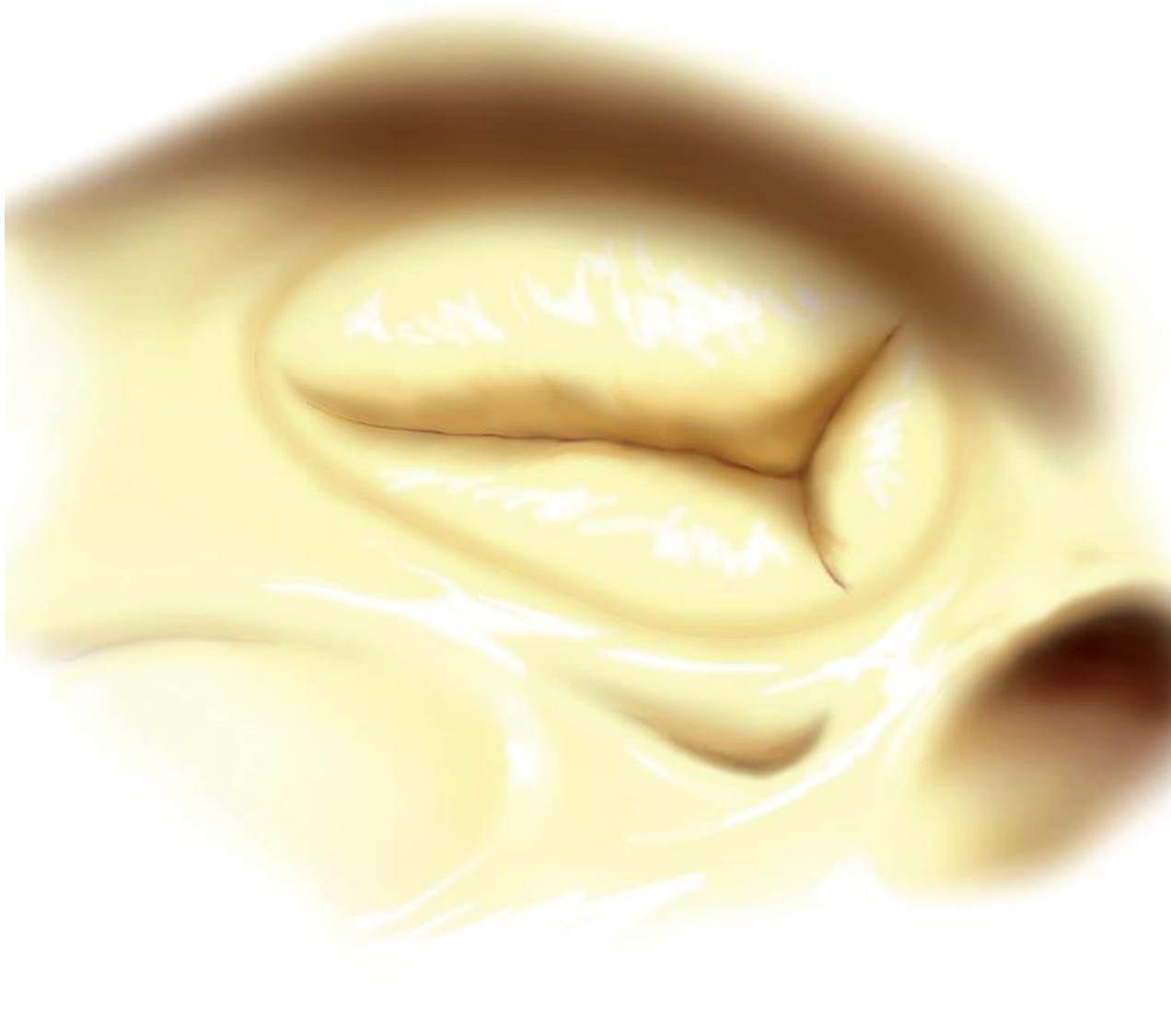


## ■ Chordae Tendineae & PMs

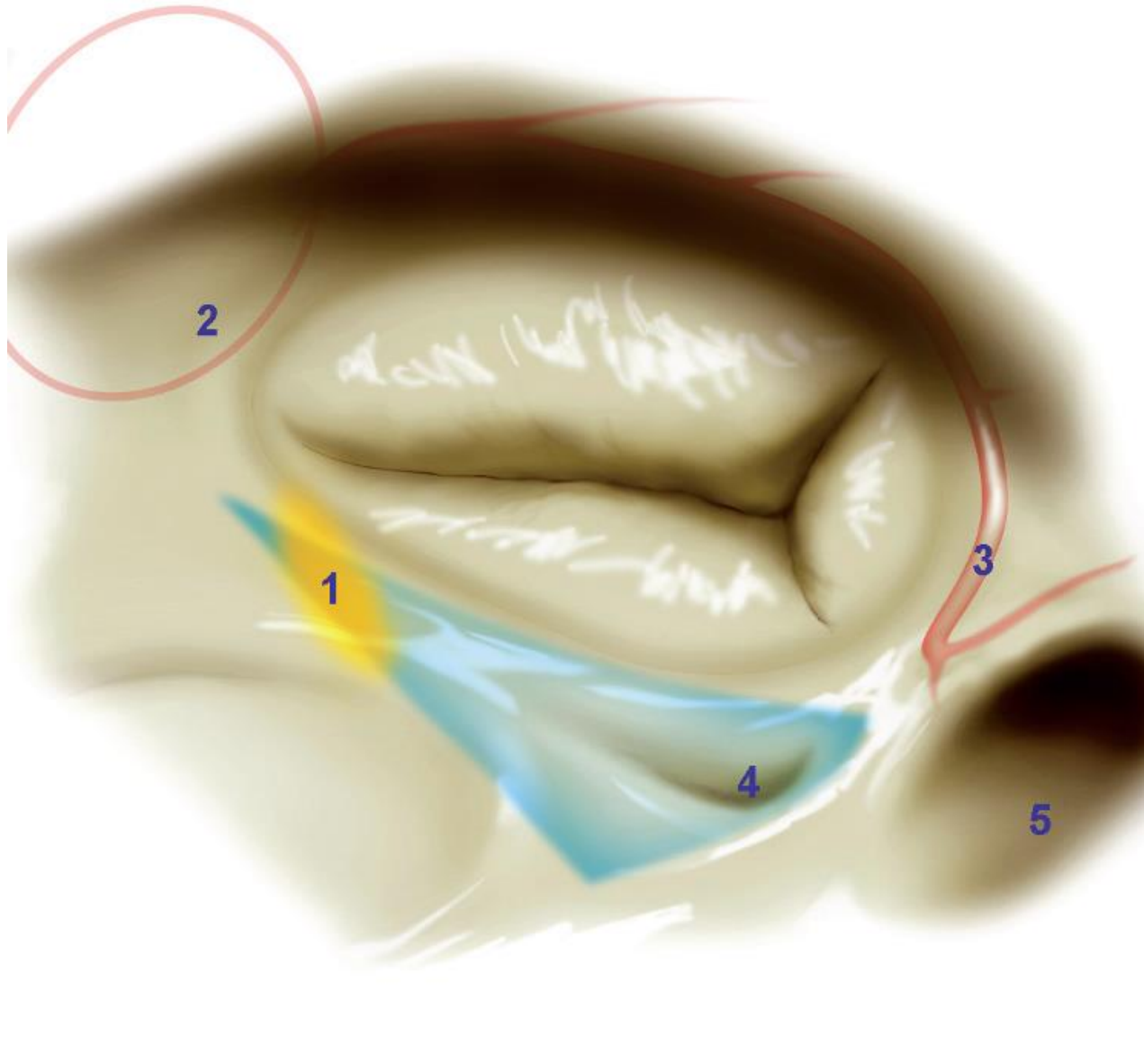
- 3 groups (ant., post., & septal)
- Marginal and basal chords



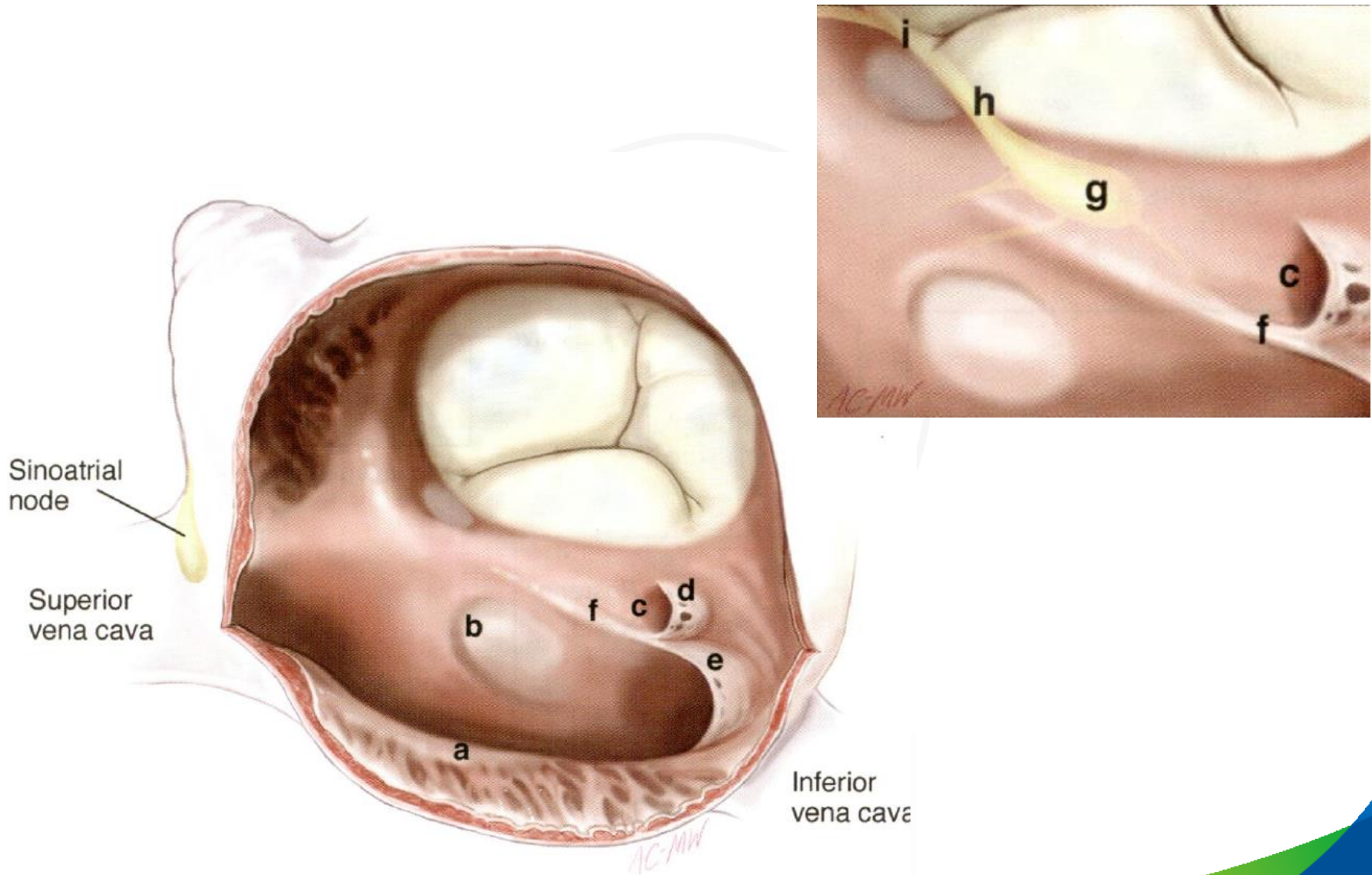
# Tricuspid Valve via RA

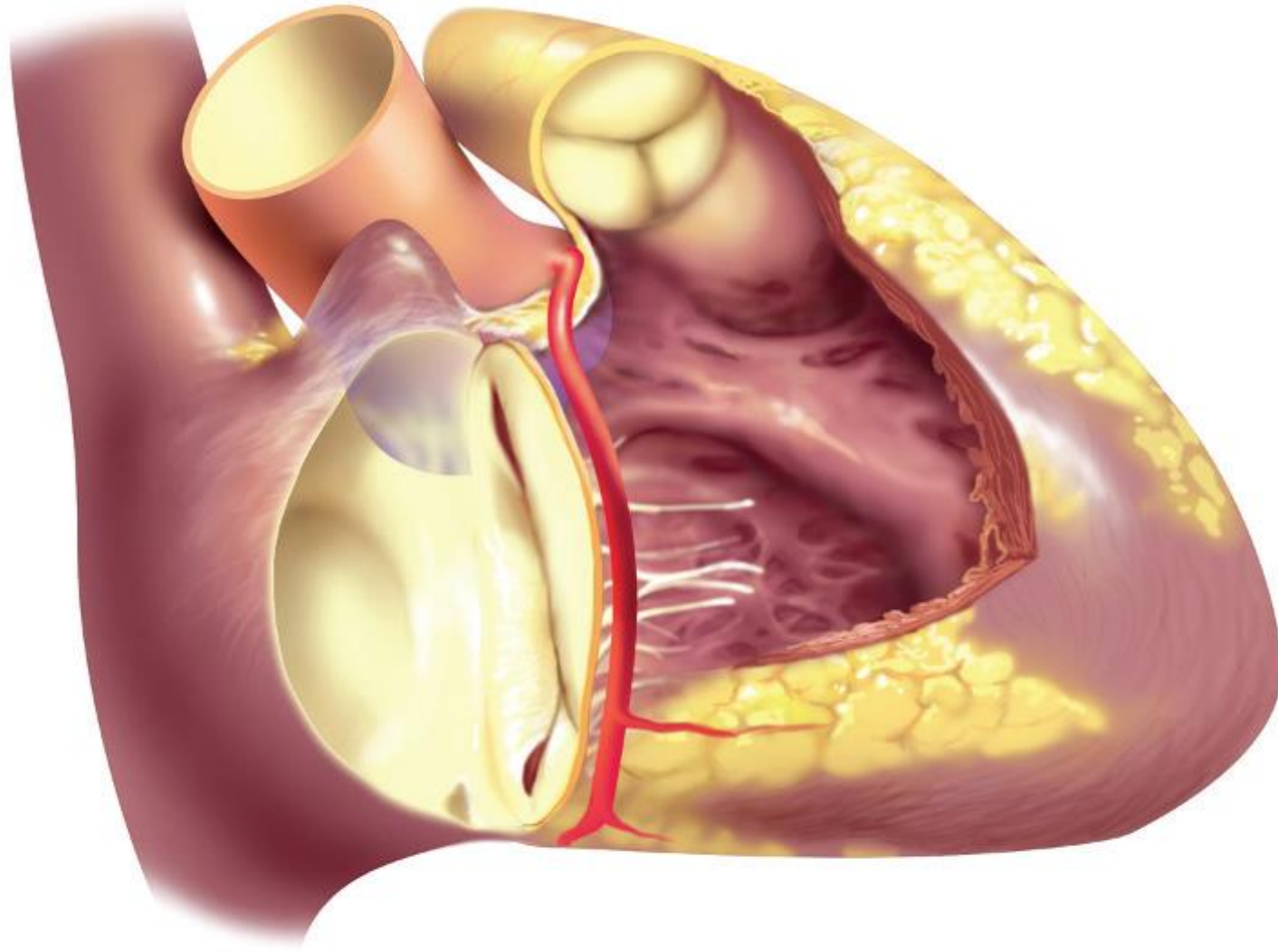


# TV: Adjacent Structures

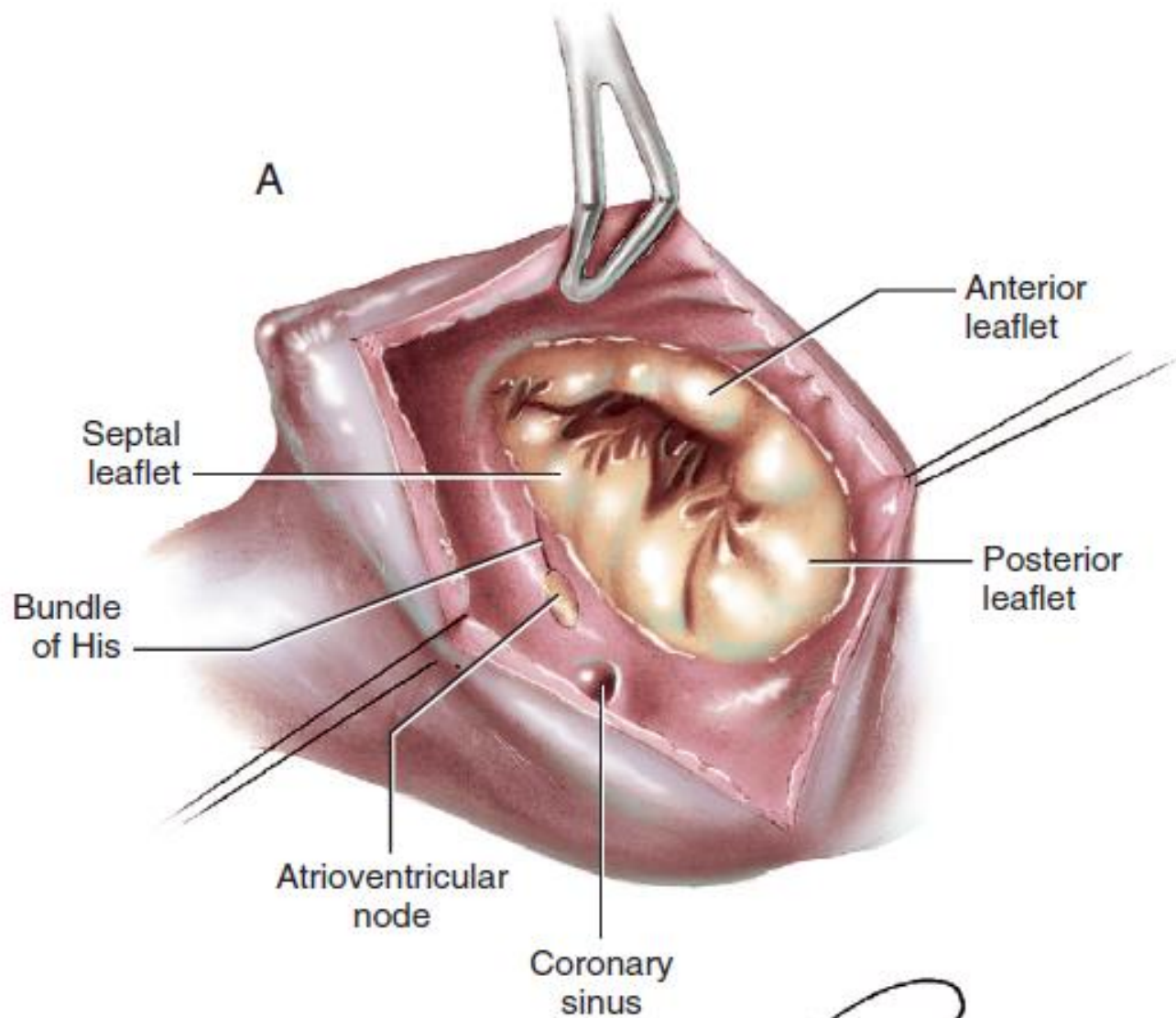


# TV: Adjacent Structures



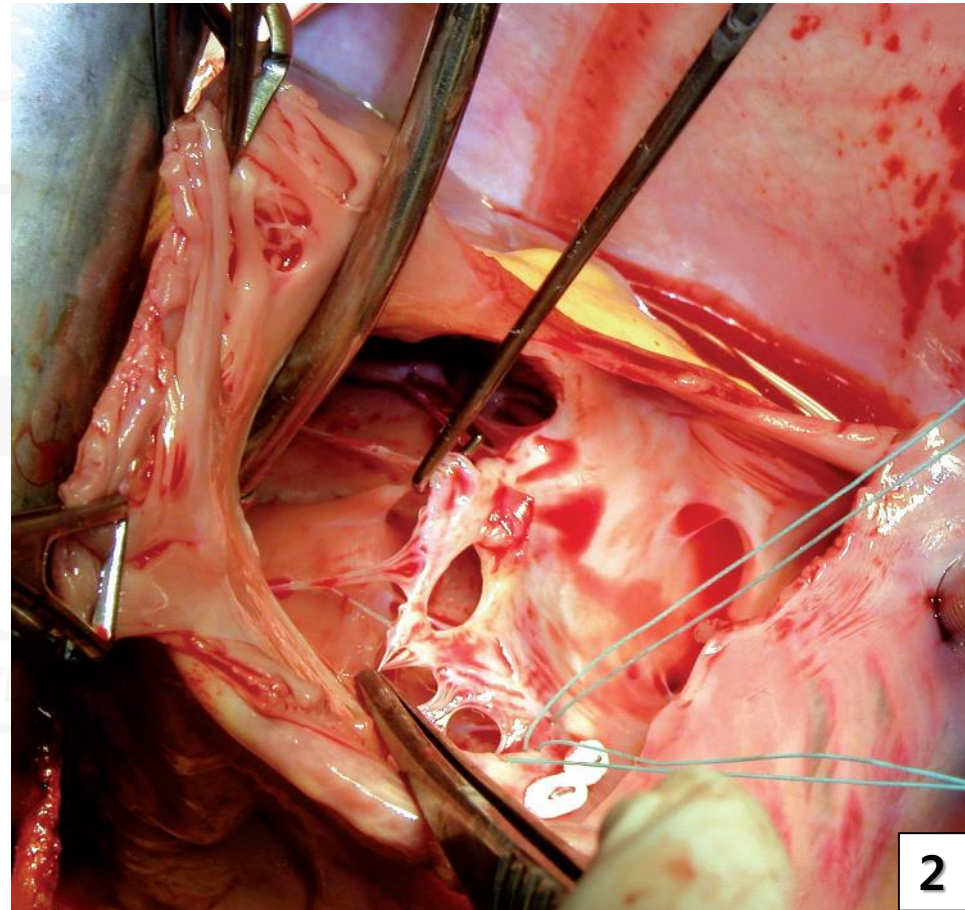
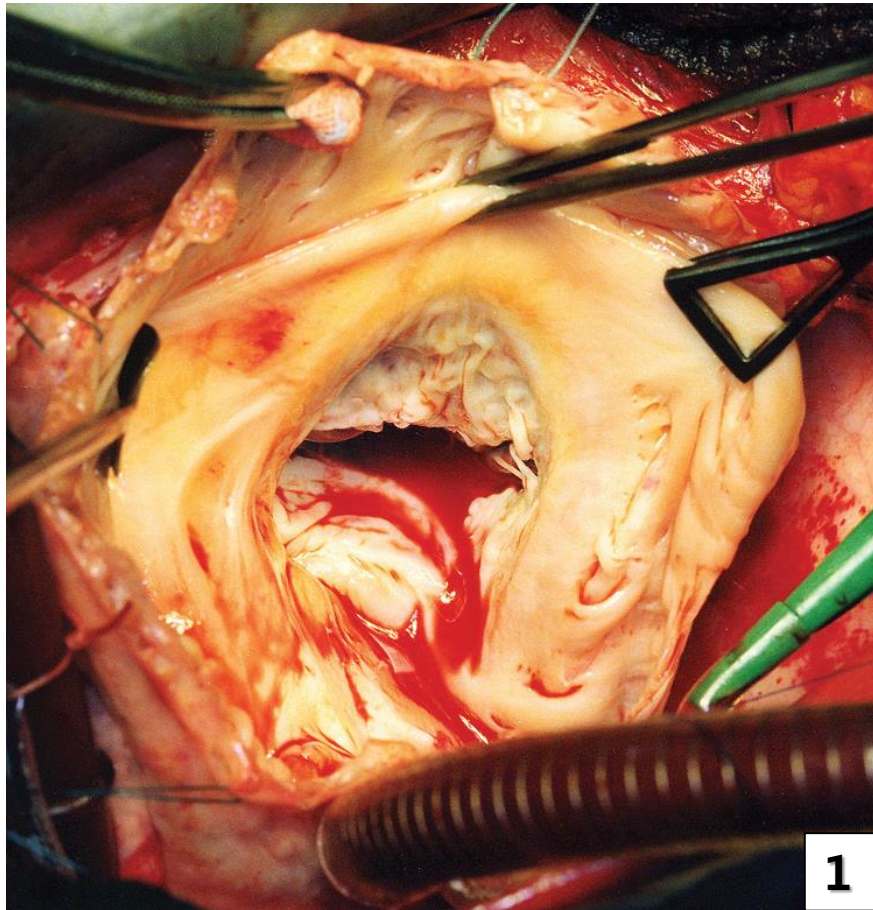


# Oblique RA-tomy for TV



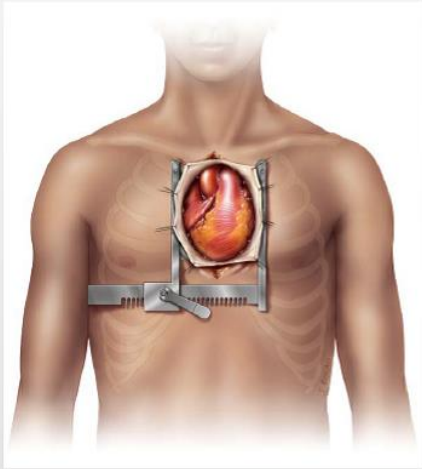


# TR; Etiology ?



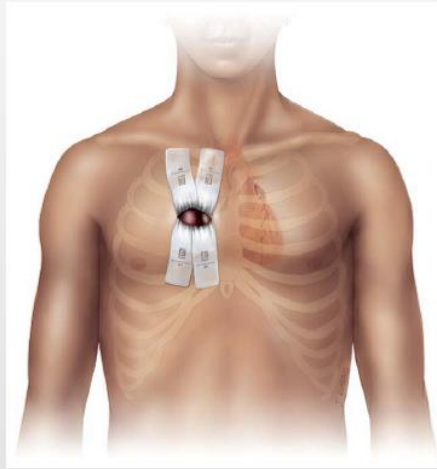
# Surgical Approaches

## Conventional

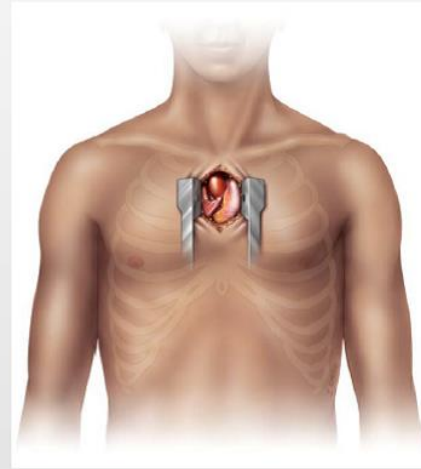


Open-chest or Sternotomy

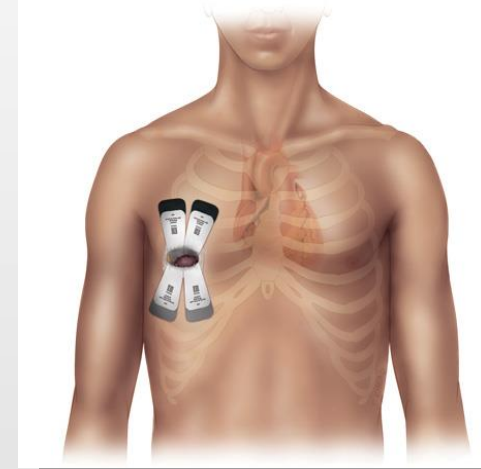
## Minimal Incision



Right Anterior  
Thoracotomy 2<sup>nd</sup> ICS

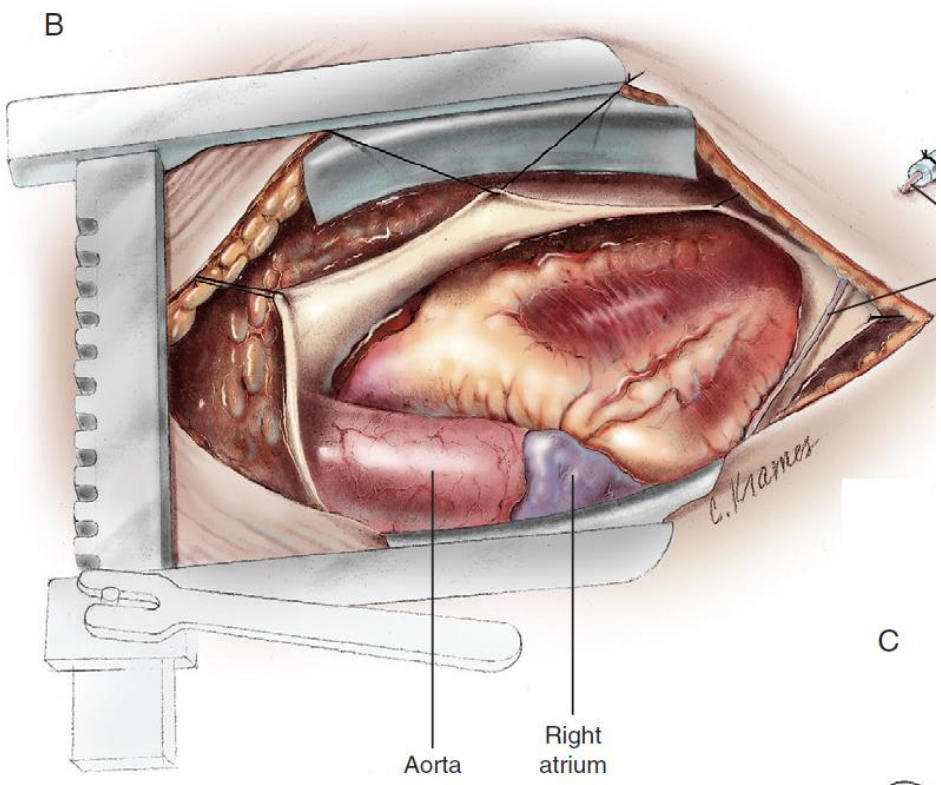
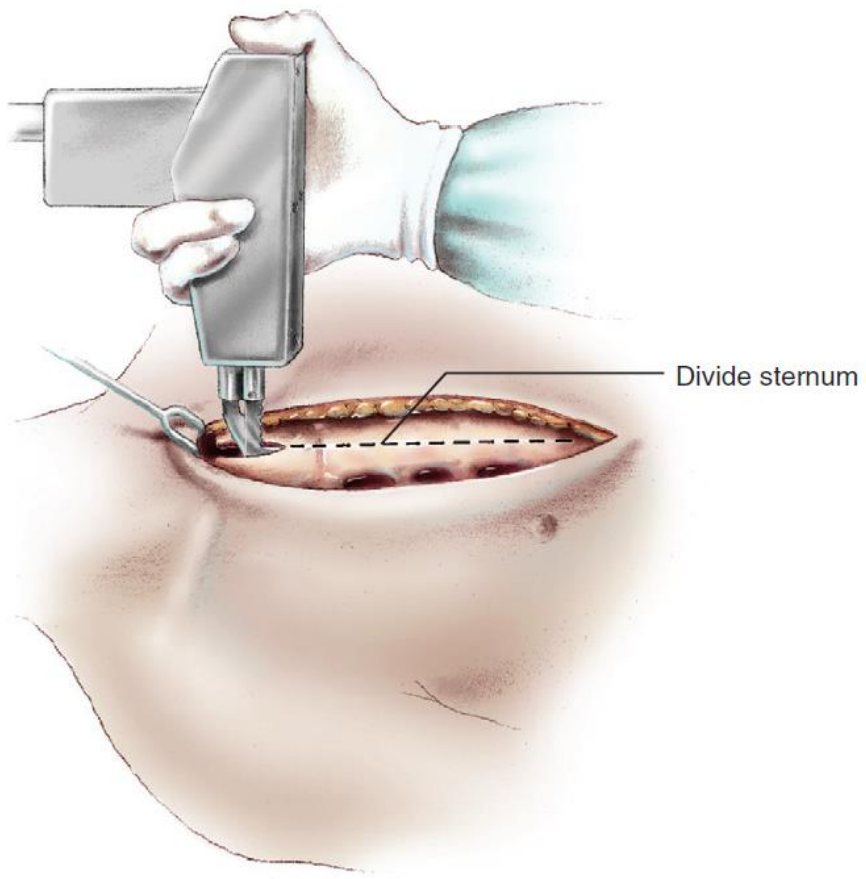


Mini-sternotomy



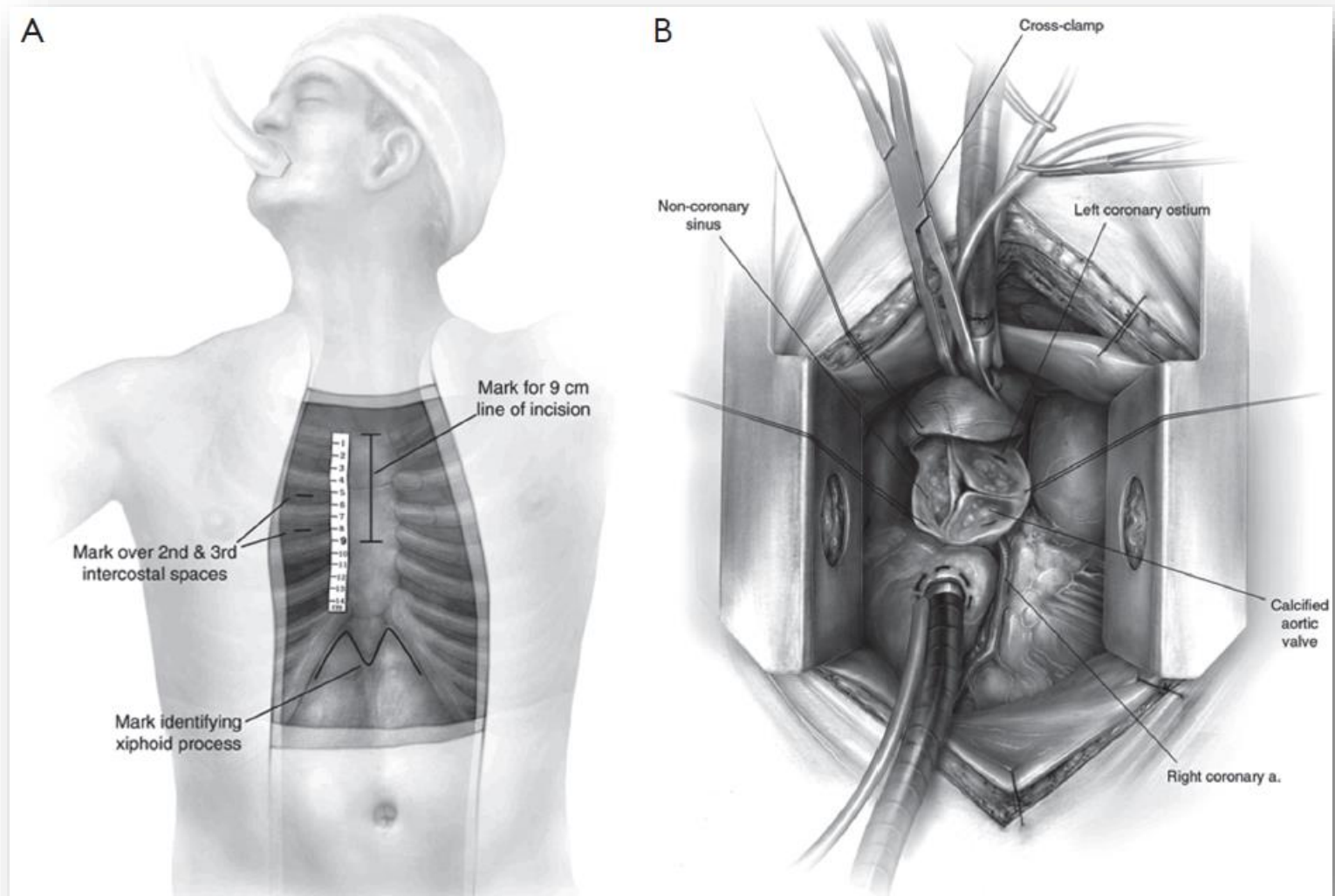
Right Anterior  
Thoracotomy 4<sup>th</sup> ICS

# Median sternotomy



C

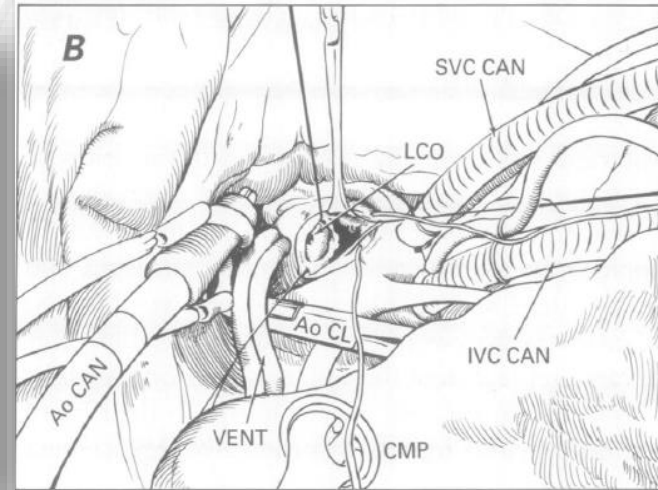
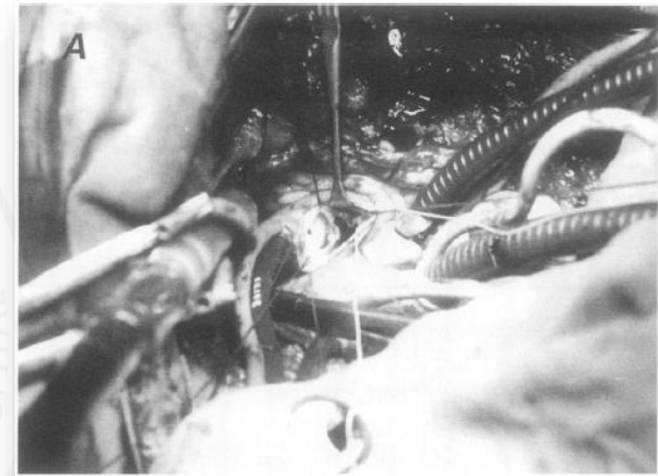
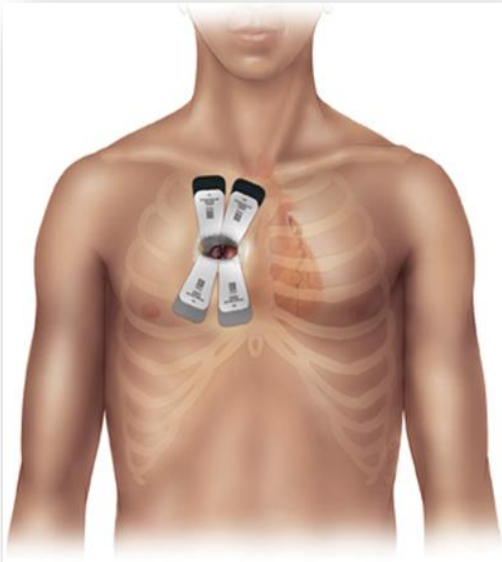
# MI AVR: Mini-sternotomy



*Cohn et. al. ATS 1997.*

**Minimally invasive cardiac valve surgery improves patients satisfaction while reducing costs of cardiac valve replacement and repair**

# Mini-AVR: Thoracotomy



Brief  
Communication

## Aortic Valve Replacement through Right Thoracotomy

Pantula N. Rao, MS  
A. Sampath Kumar, MCh

*There has never, to our knowledge, been a report of aortic valve replacement via a right thoracotomy. However, we recently used this approach in 2 young women with severe aortic stenosis. Exposure of the aortic valve was excellent, and we encountered neither technical difficulties nor sequelae related to the right thoracotomy. We believe that right thoracotomy provides adequate access for safe aortic valve replacement and yields cosmetically more appealing results than does median sternotomy. (Texas Heart Institute Journal 1993;20:307-8)*

# AVR: Mini-Thoracotomy

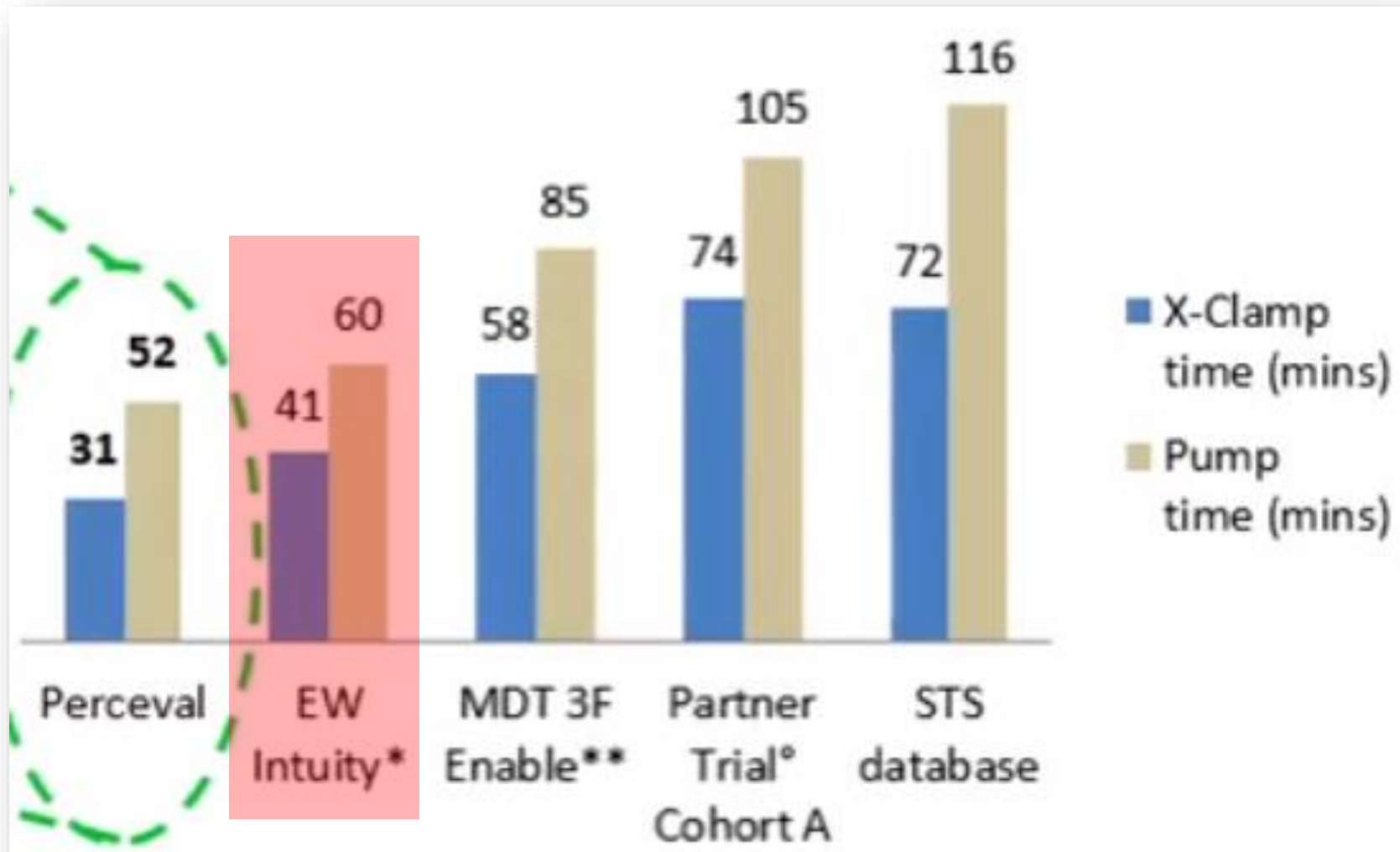


# Rapid Deployment AVR

# SUtureless AVR



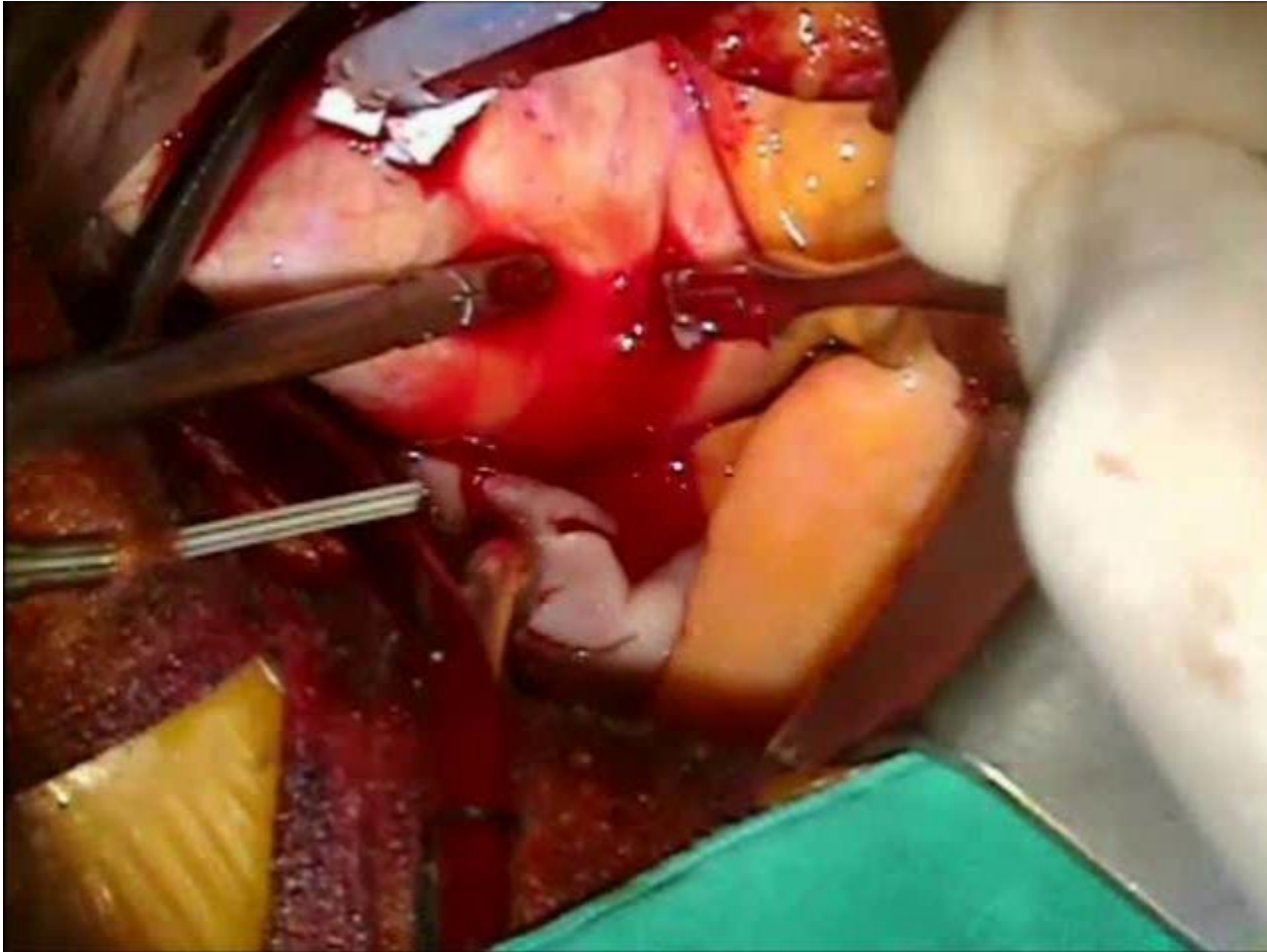
# AVR: CPB and ACC time



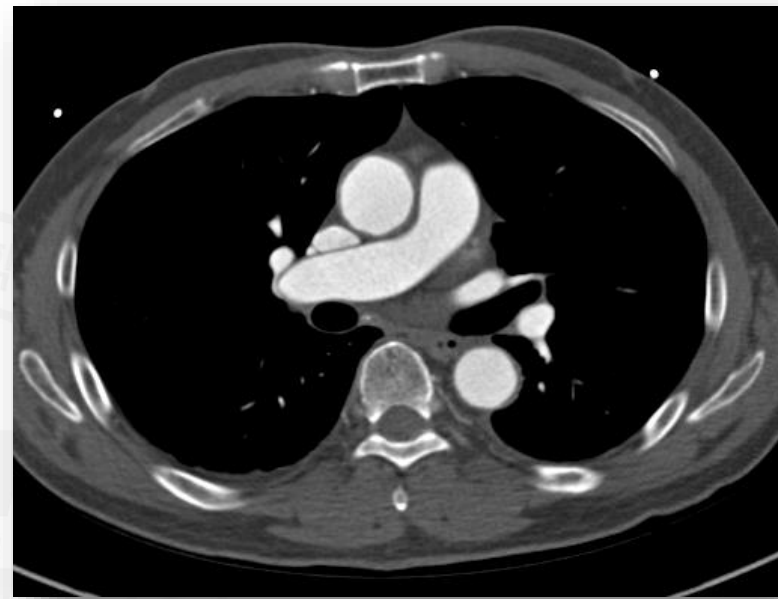


# RD-AVR, Thoracotomy

- CPB/ACC time : 84/55 min

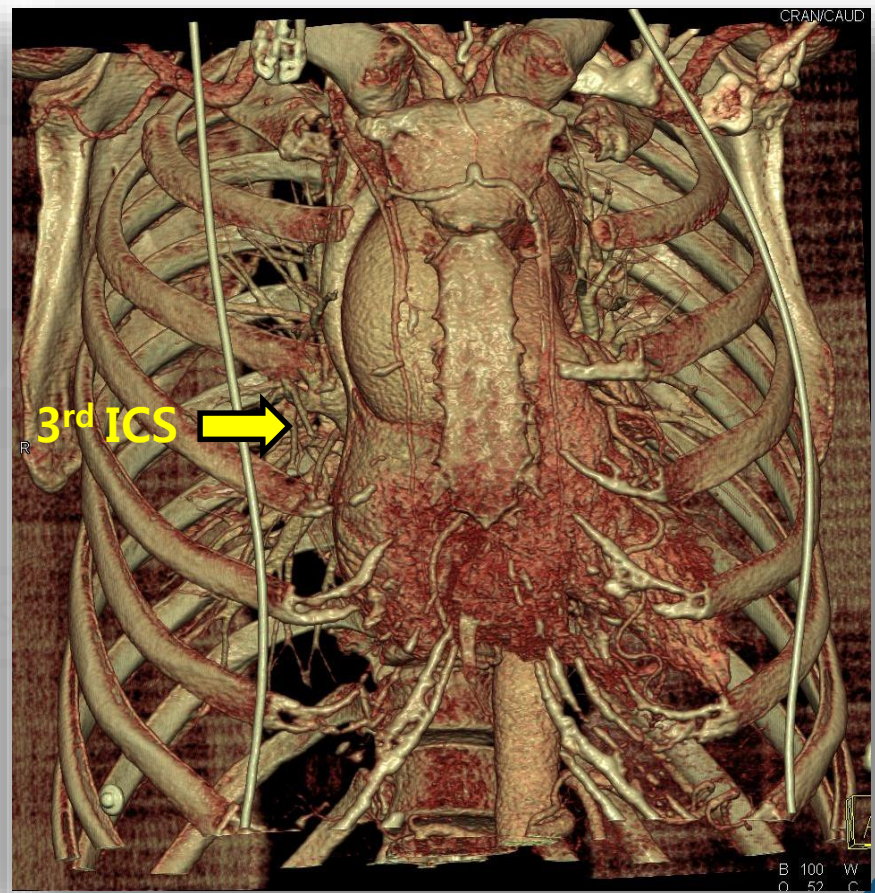
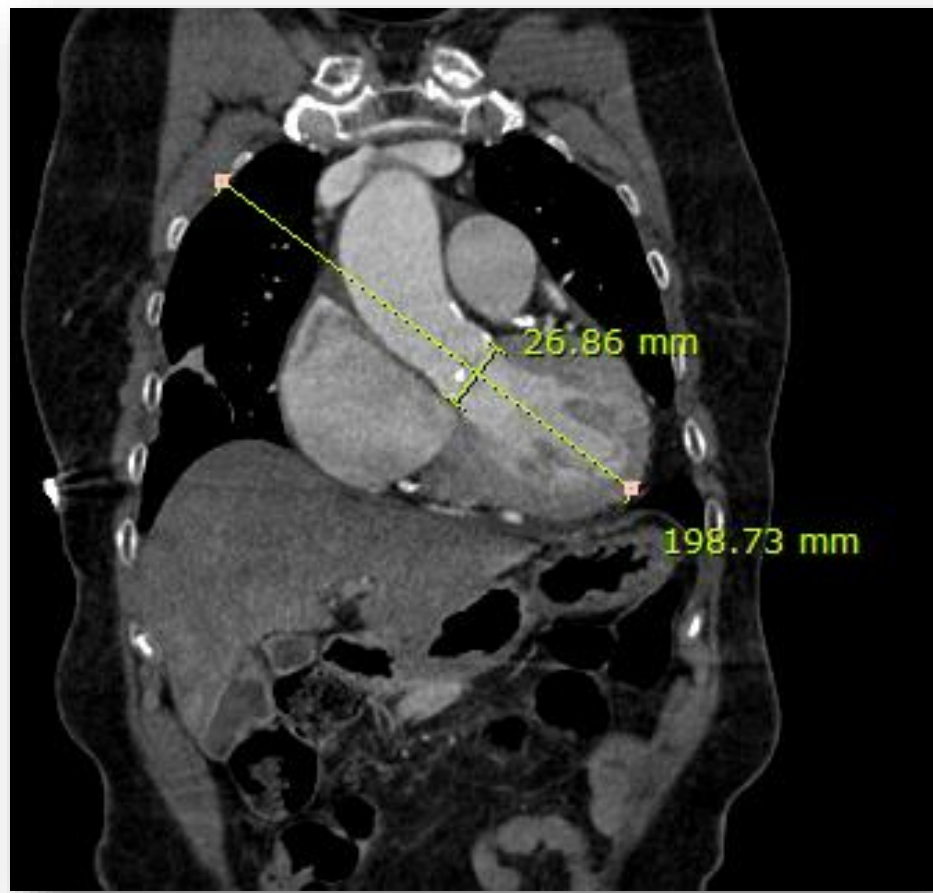


# MI AVR: Preop. CTA



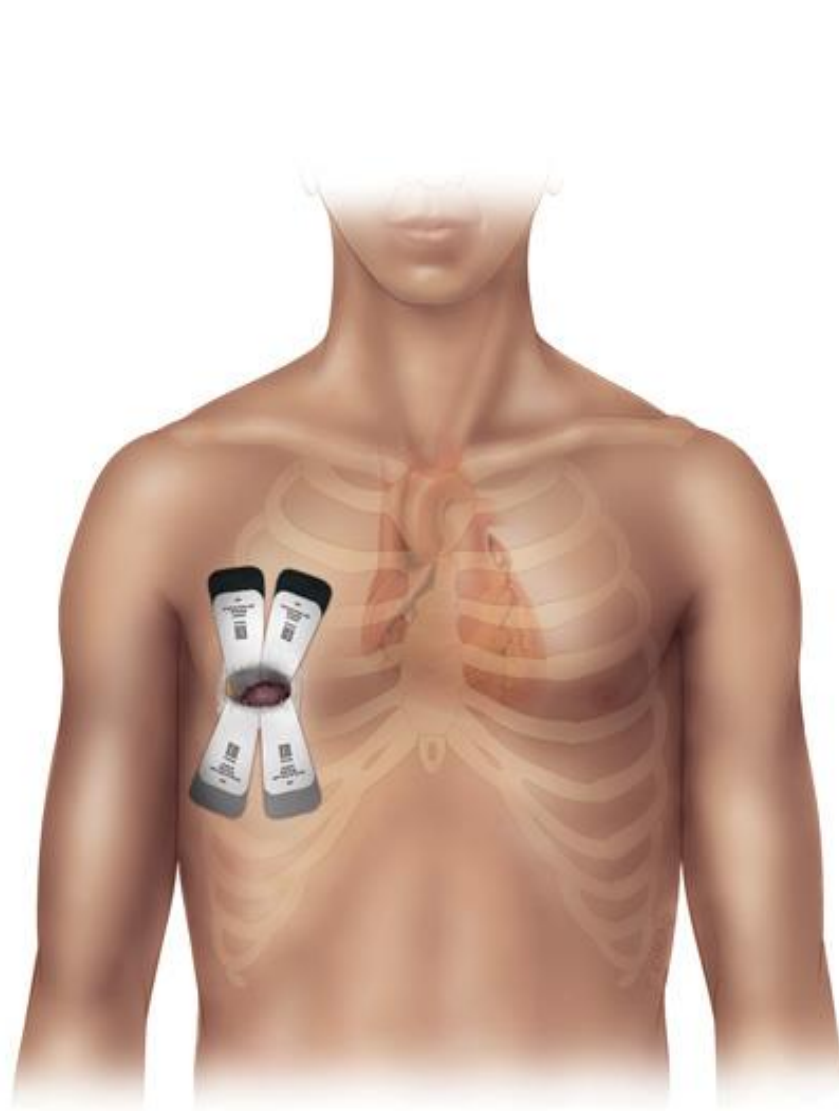
# Mini-AVR: Thoracotomy

- 2<sup>nd</sup> ICS vs. 3<sup>rd</sup> ICS

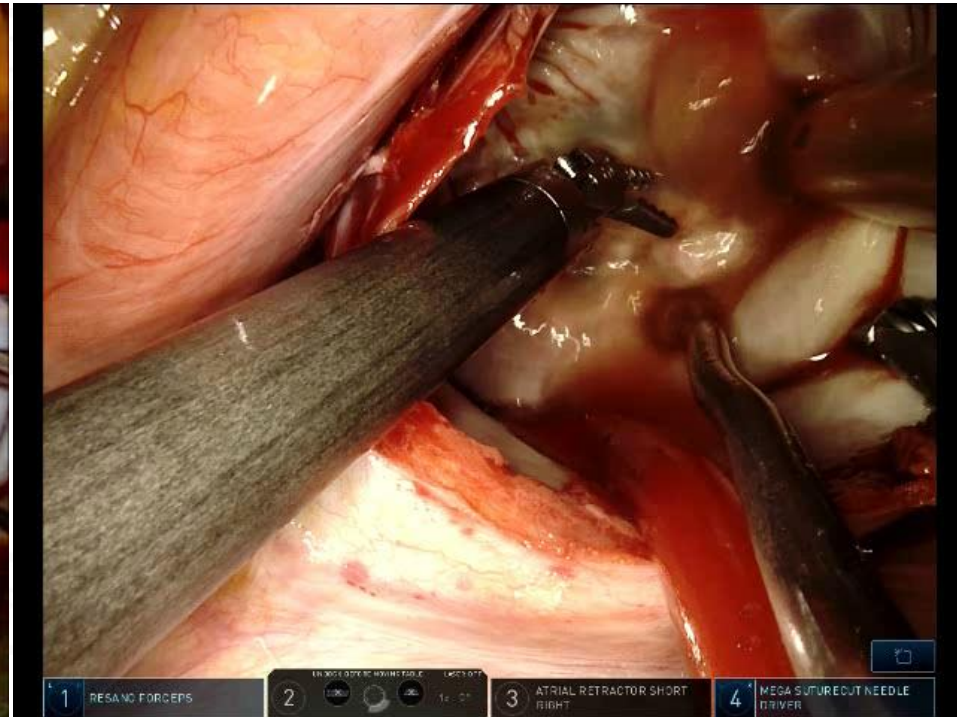




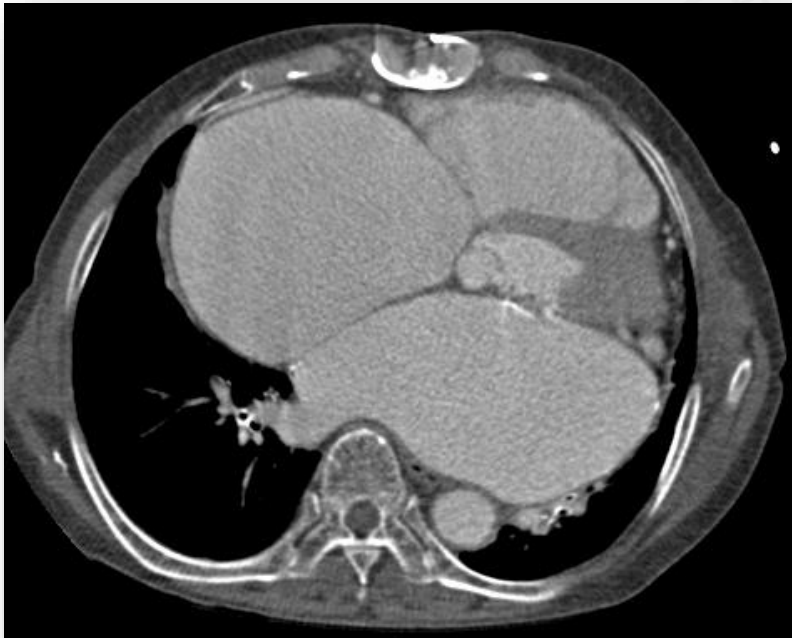
# MICS: MV, TV, Maze, Myxoma, ASD, pAVSD, pmVSD



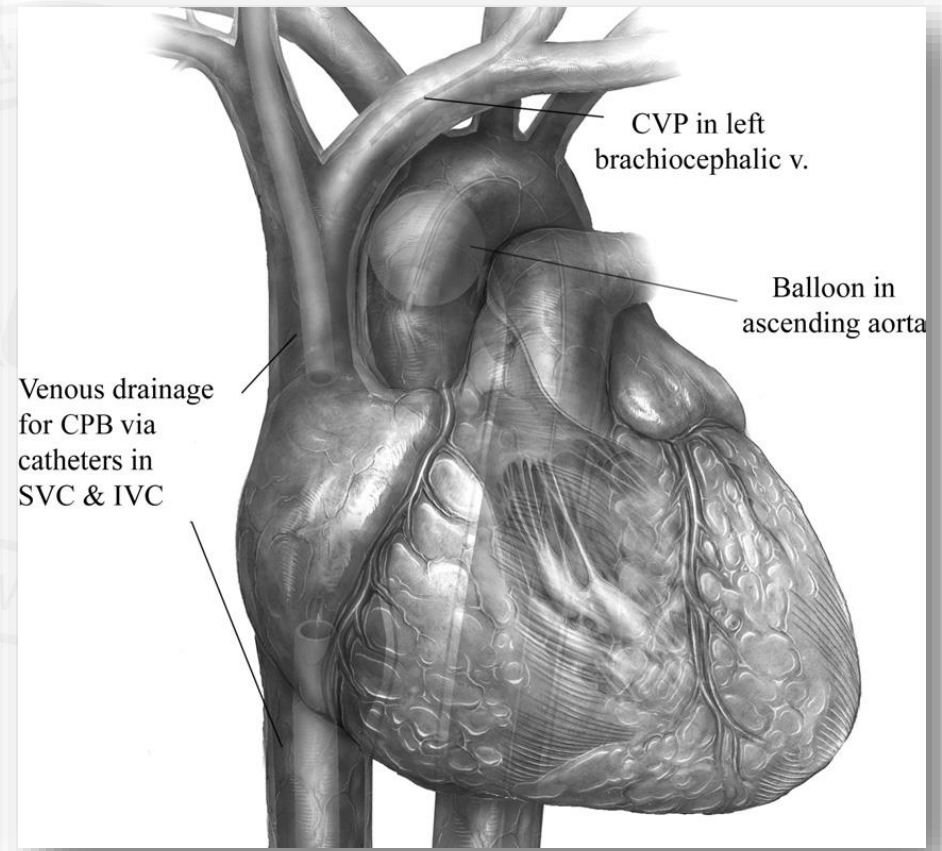
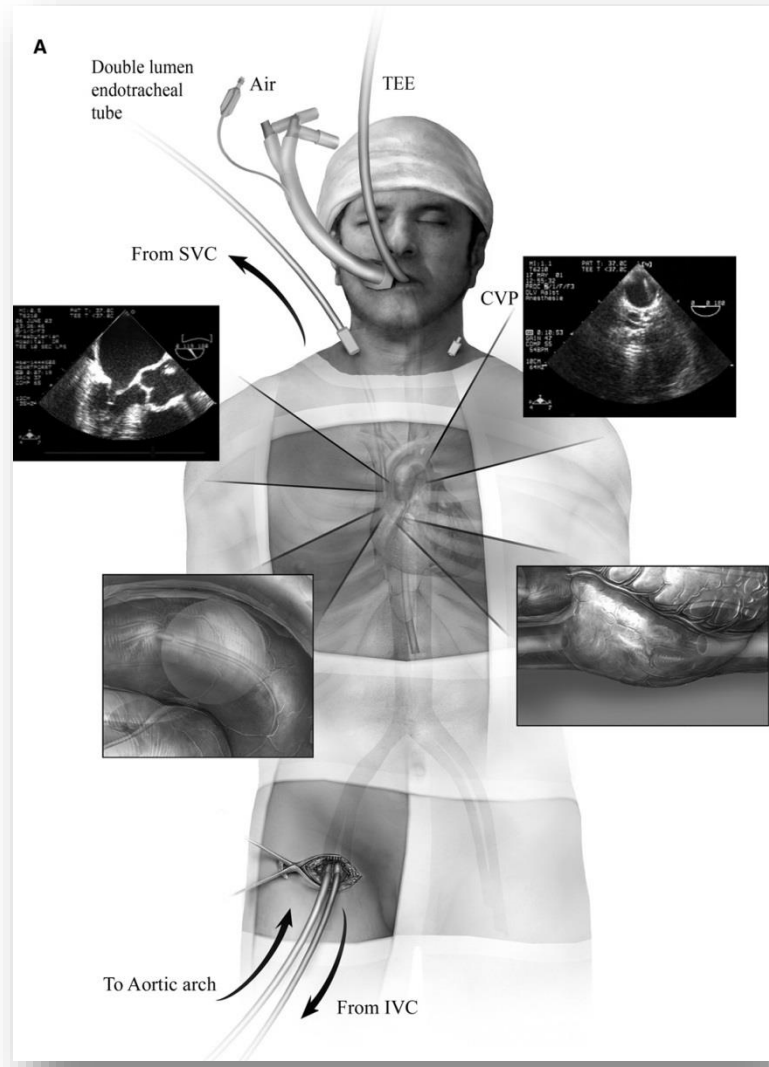
# MVP: thoracotomy vs. da Vinci



# Surgeon: Hesitant to do



# MICS Redo TVR





# MICS Beating Heart TVR



# MICS MV, TV op. wound

