Echocardiographic findings of Valvular Heart Disease

심장내과 조 정 선

가톨릭대학교 대전성모병원
THE CATHOLIC UNIV. OF KOREA DAEJEON ST. MARY'S HOSPITAL

Echocardiography (심초음파)

- **A mature technology that is an essential and fully integrated component of the practice of cardiology**

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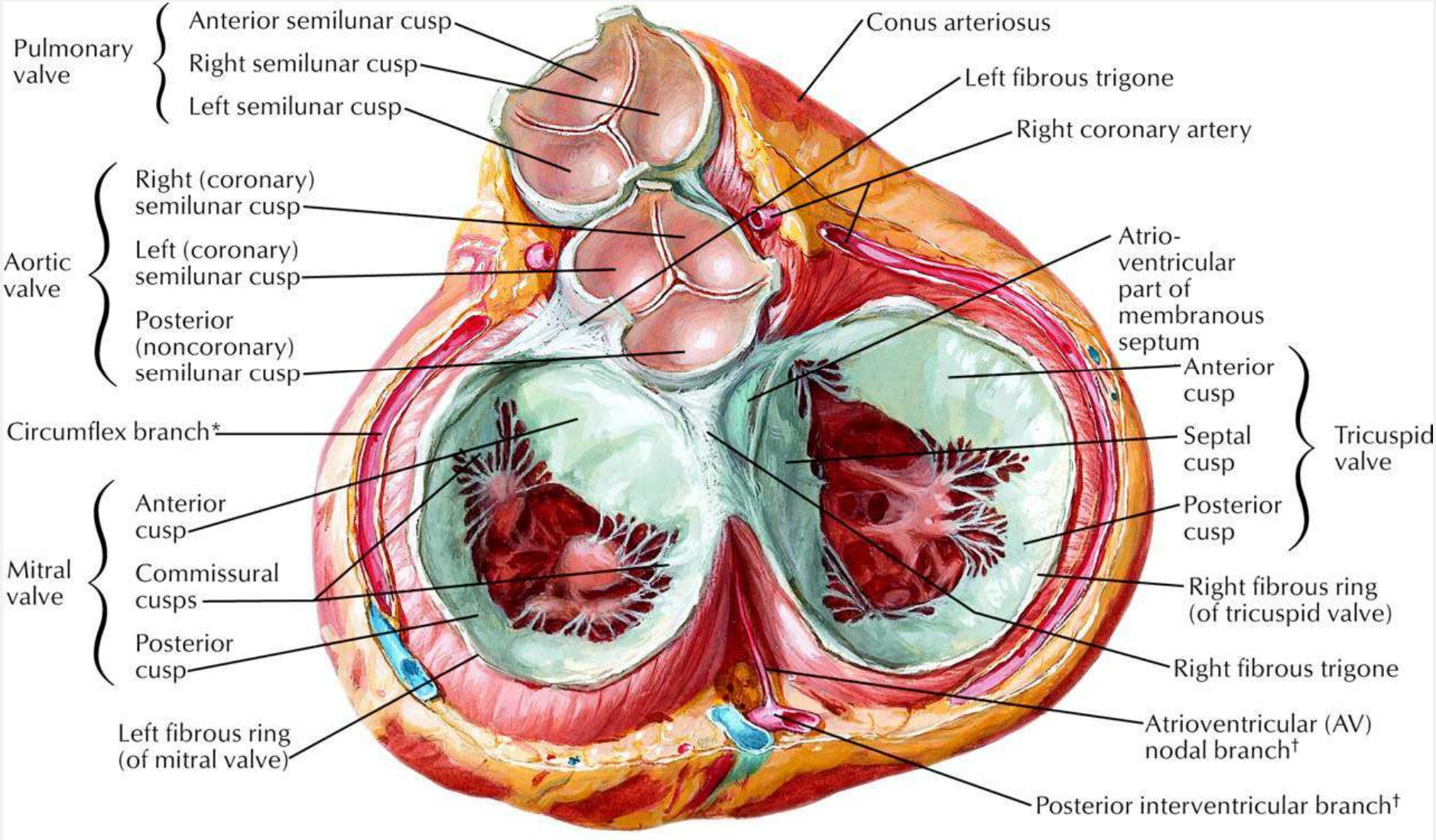
A Mature Tree with Numerous Branches

Cardiac Anatomy



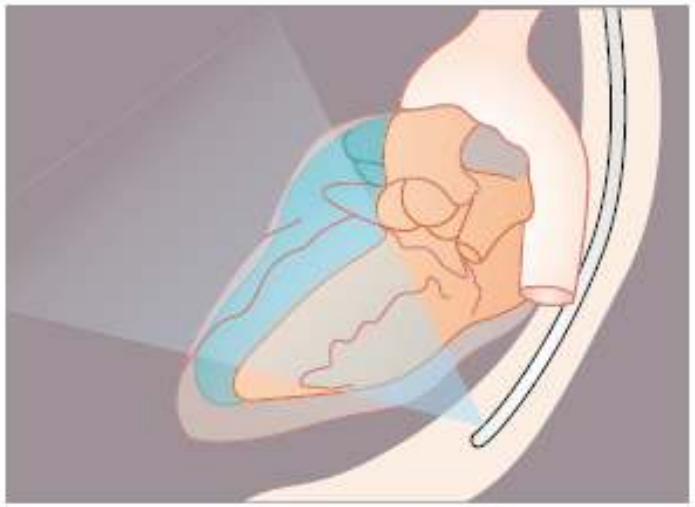
Echocardiographic findings of Valvular Heart Disease

- 경흉부 심초음파의 기본 소견
- 각 판막의 질환에 따른 경흉부 및 경식도 이차원 심초음파 소견
- 수술 전 환자 별 판막 질환의 이해를 돕는 삼차원 심초음파 의 이용
- 수술 중 경식도 심초음파 소견
- 판막 수술 이후 경흉부 심초음파 소견

경흉부 심초음파

【 심장초음파 검사 】

경식도 심초음파



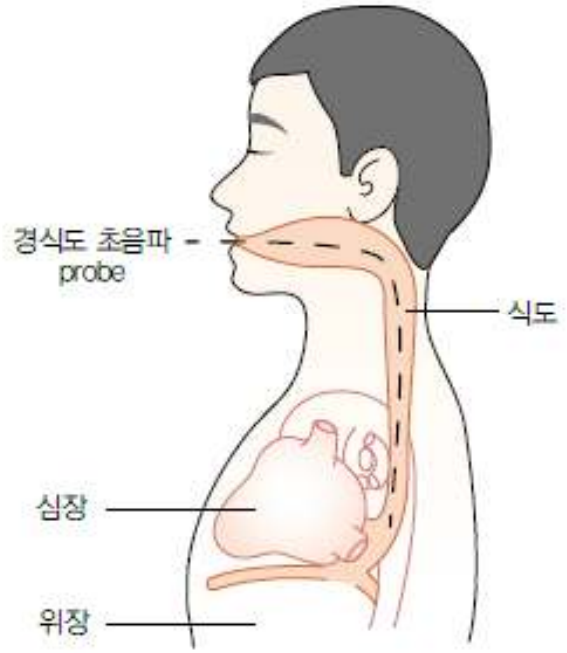
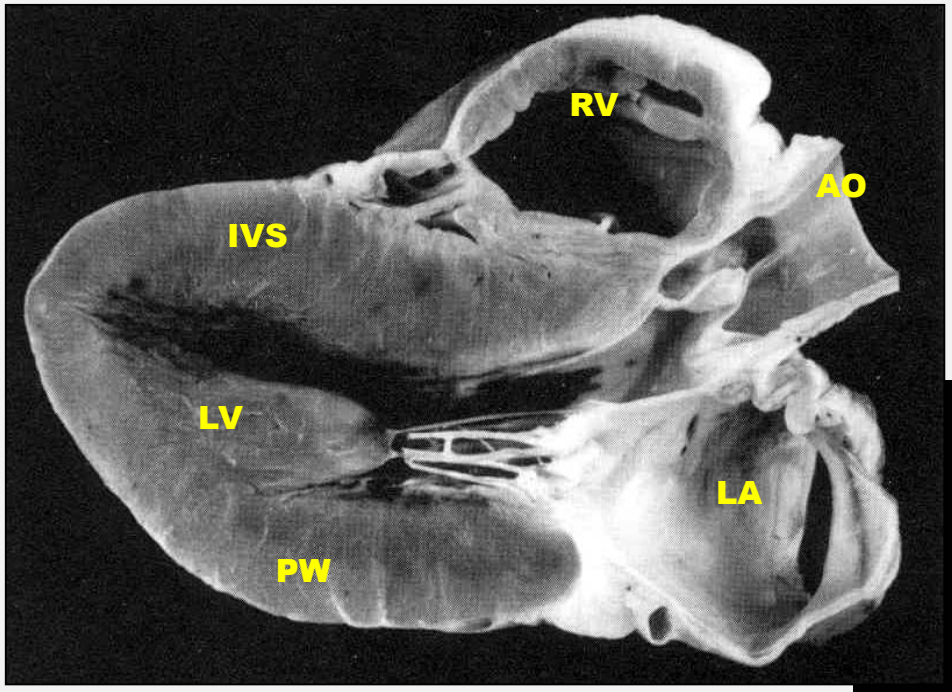
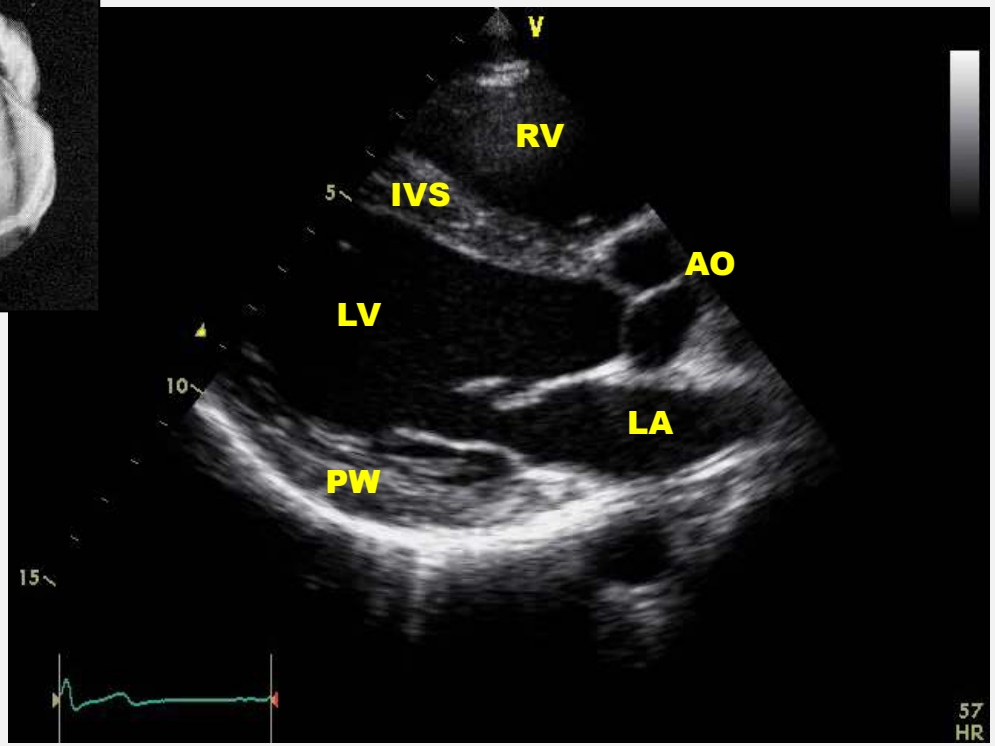


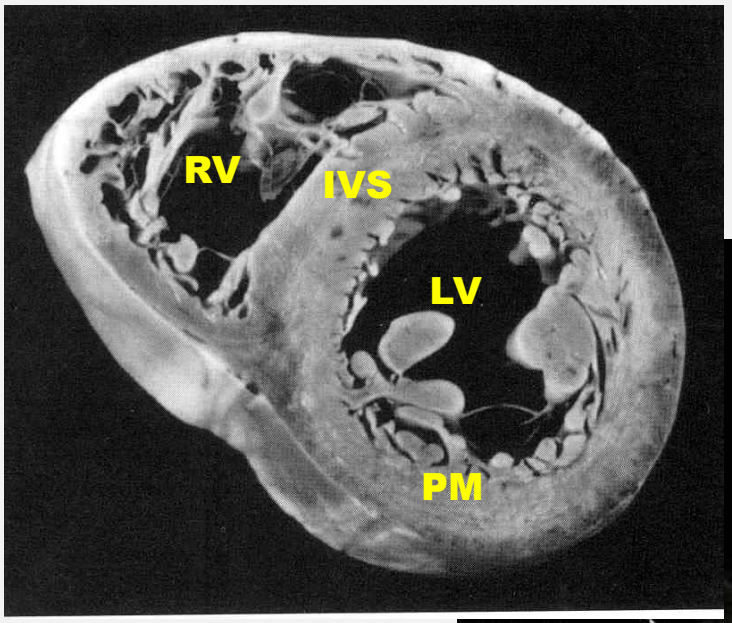
그림 15 ● 경식도 초음파 검사

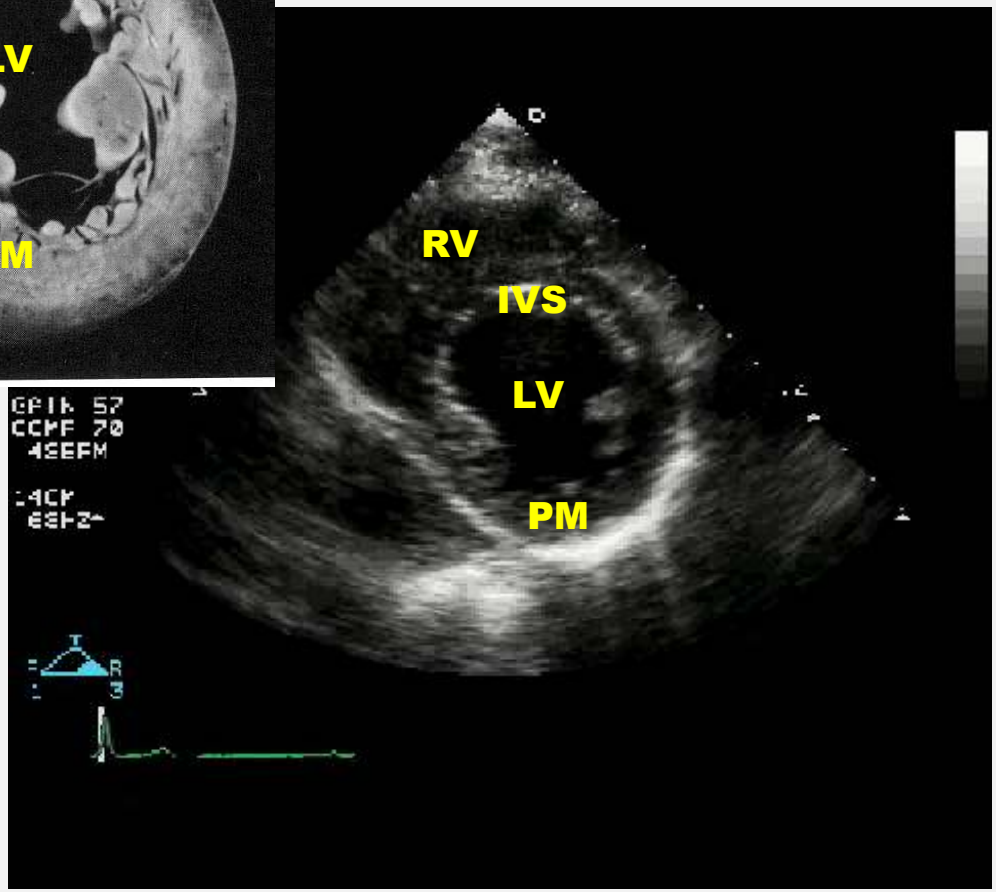
Parasternal Long Axis view



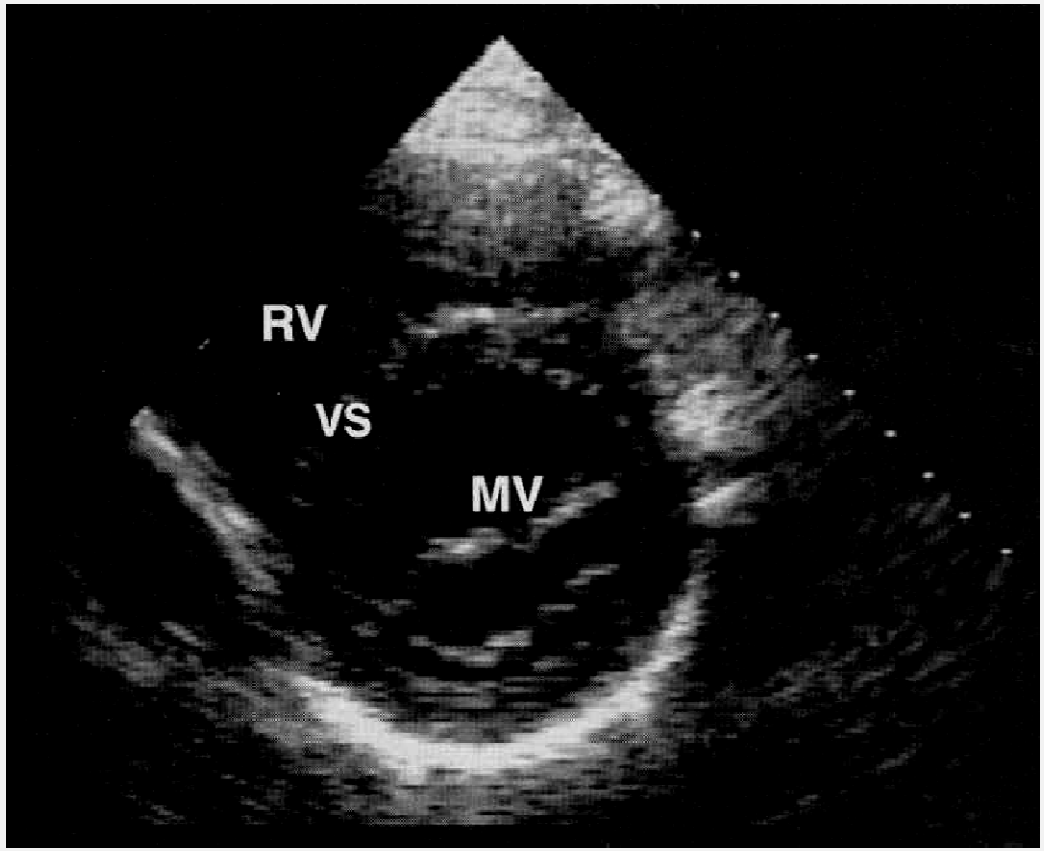


Parasternal Short Axis view ; PM level



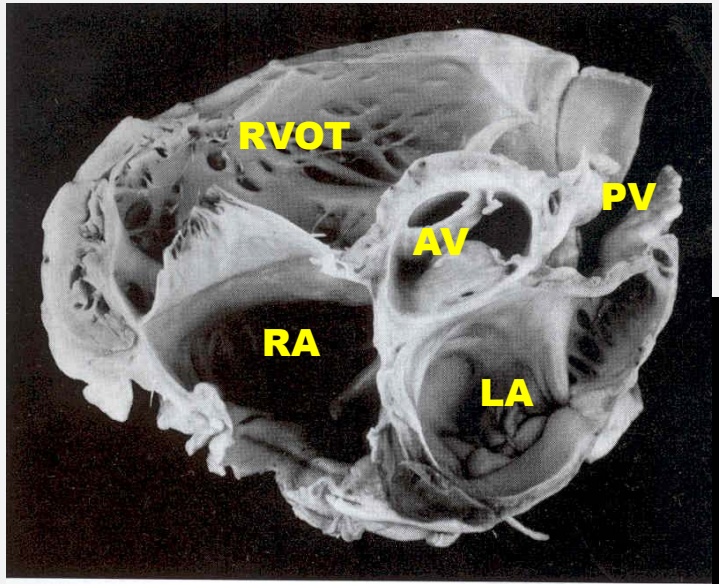


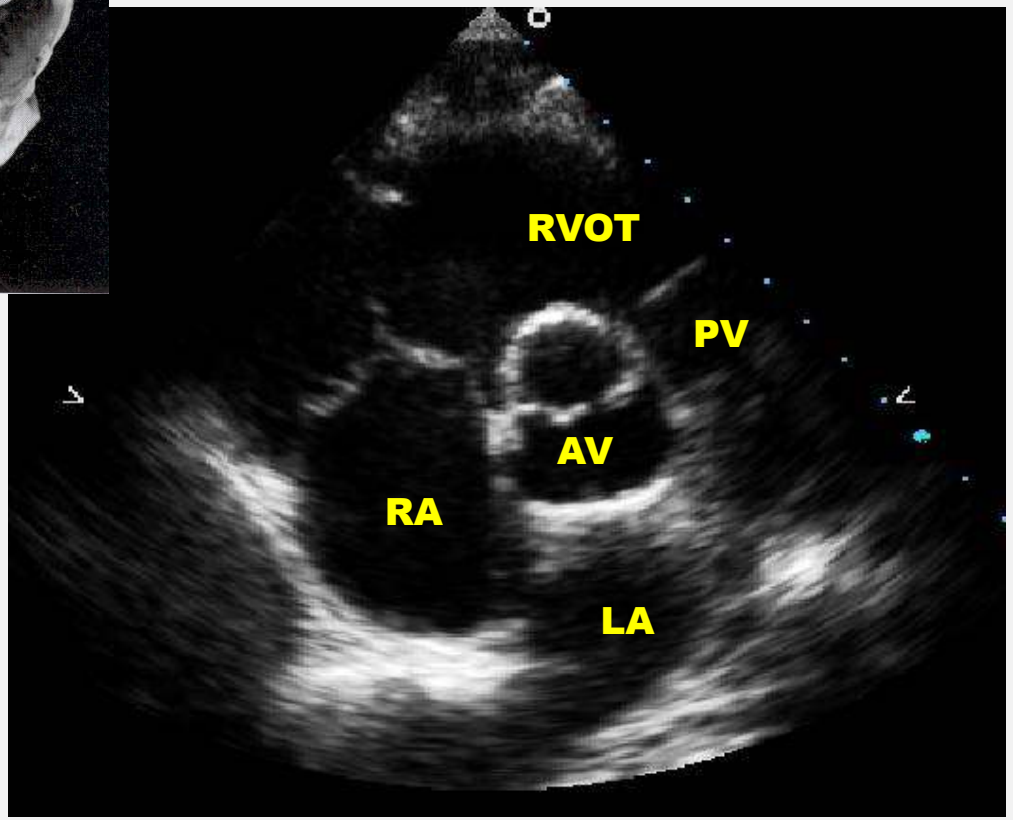
Parasternal Short Axis view ; MV level



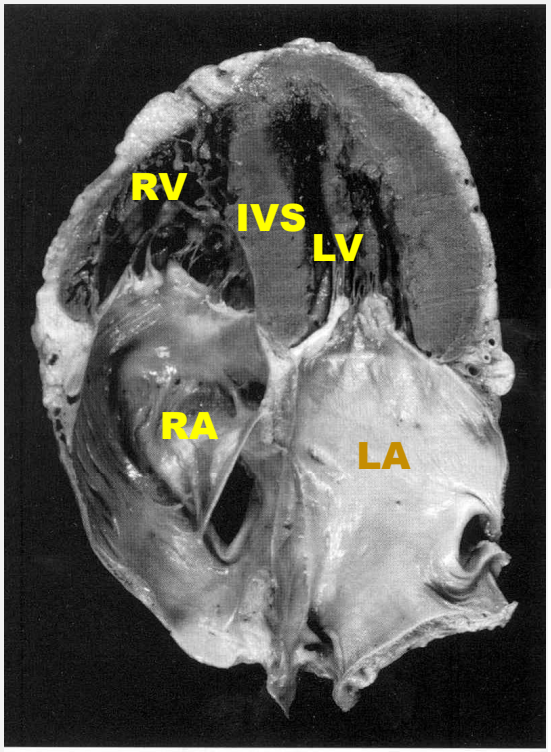
RV; right ventricle, **MV**: mitral valve, **VS**: interventricular septum

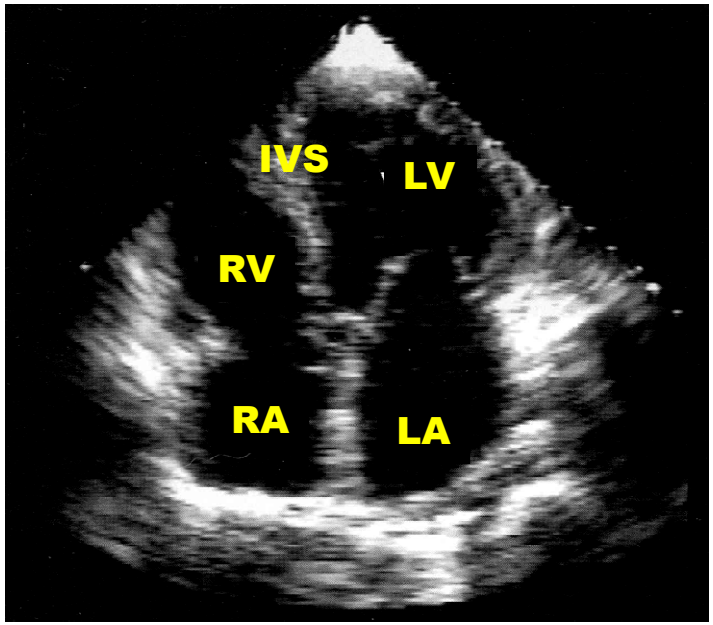
Parasternal Short Axis view ; AV level



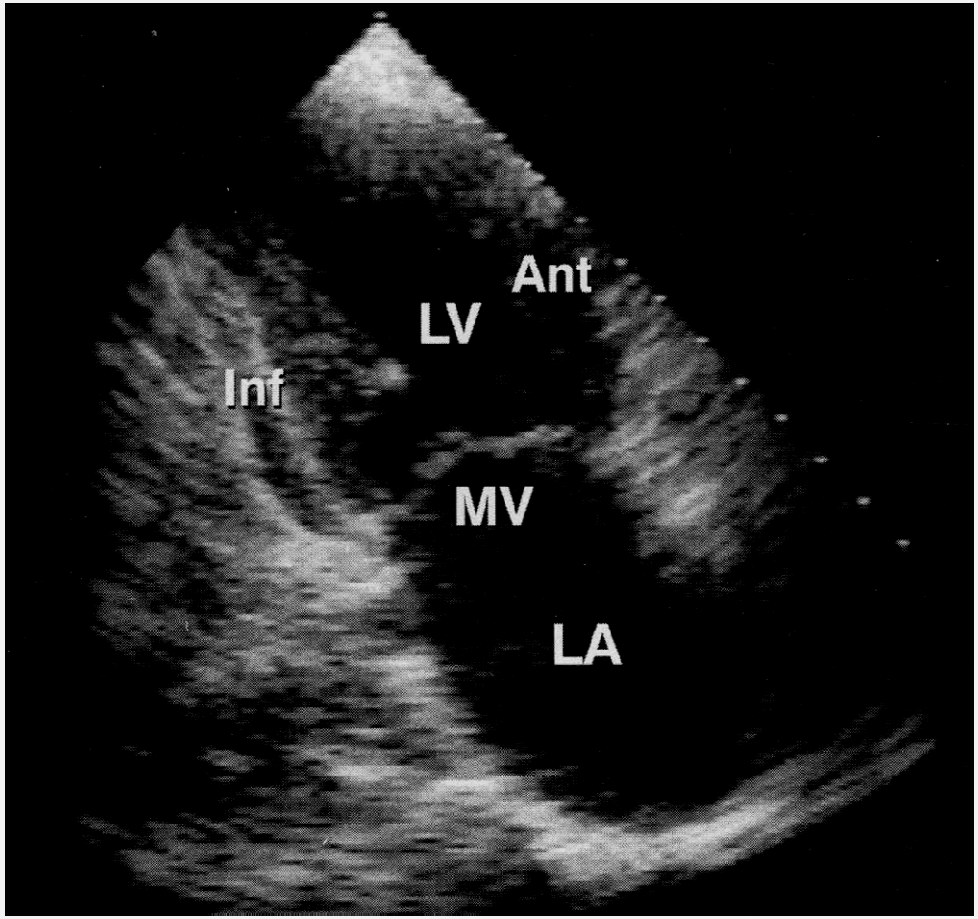


Apical Four Chamber View



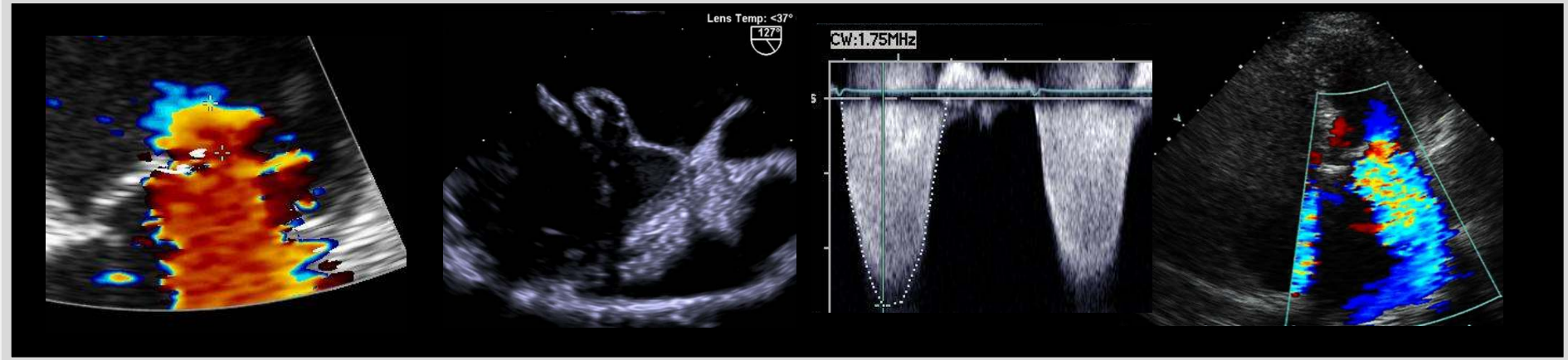


Apical Two Chamber View

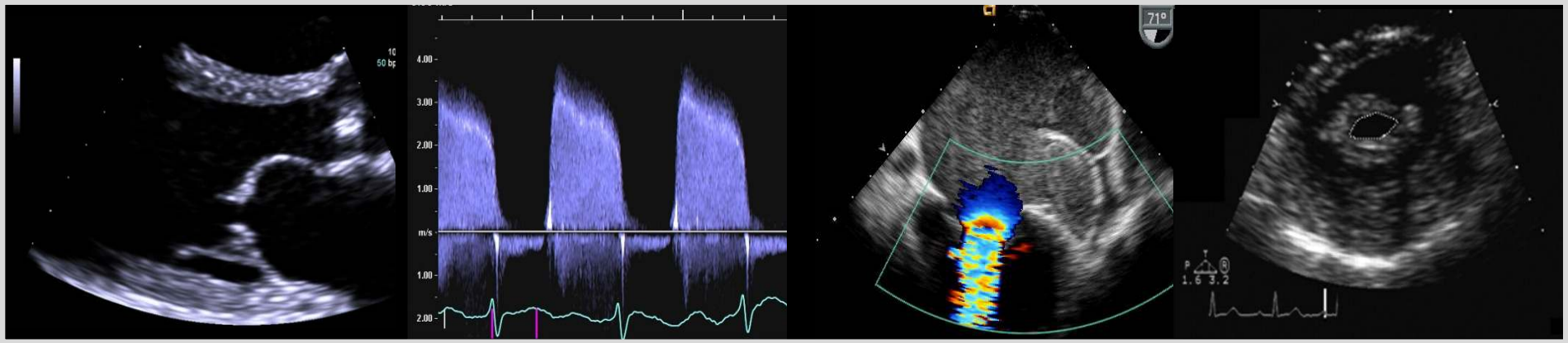


MV; mitral valve, **Ant**: anterior wall of LV, **Inf**: Inferior wall of LV, **LV**: left ventricle

LA: left atrium



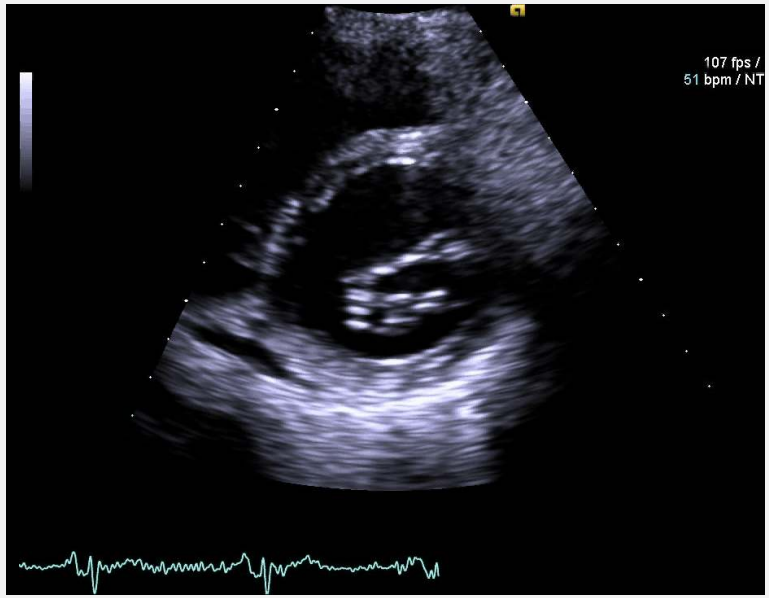
Mitral Valvular disease

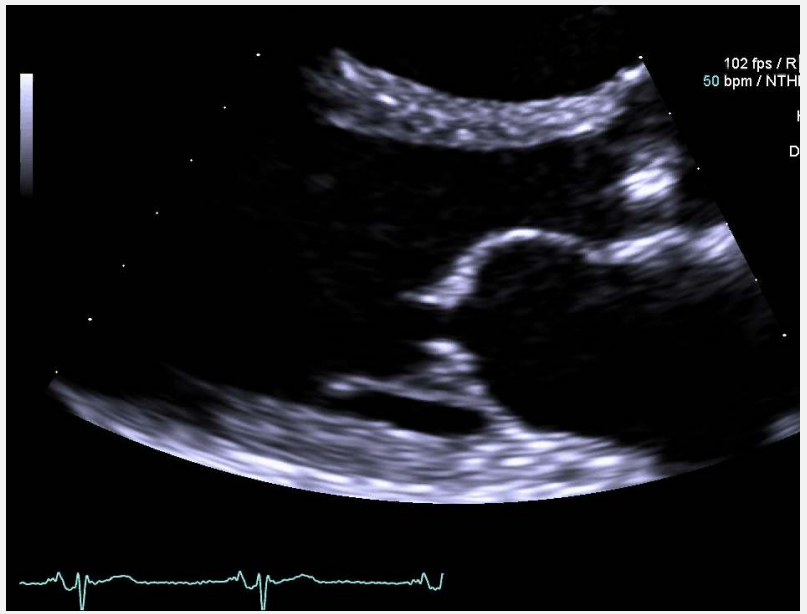


Mitral valve stenosis

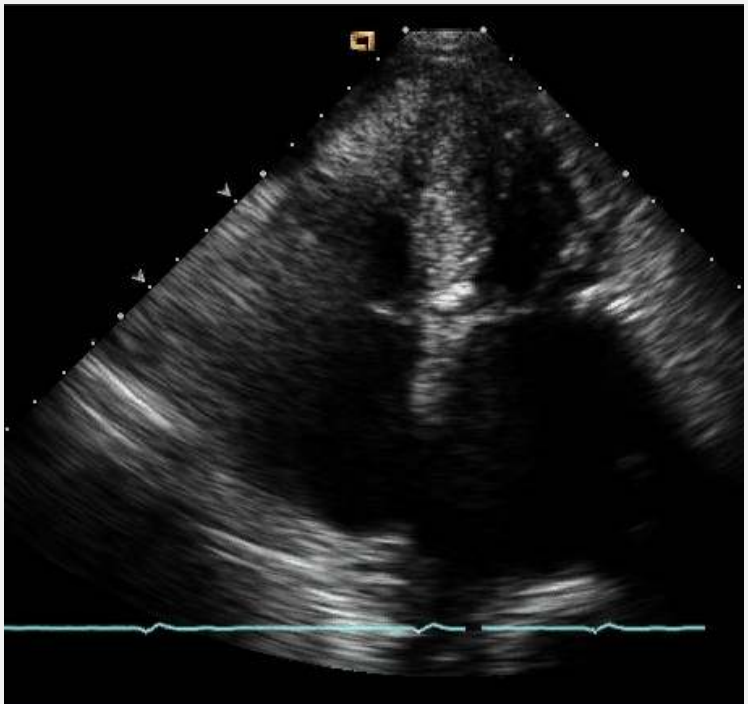
- **Rheumatic**
- **Degenerative calcification**
- **A complication of mitral valve surgery, …**

Rheumatic mitral valvular stenosis





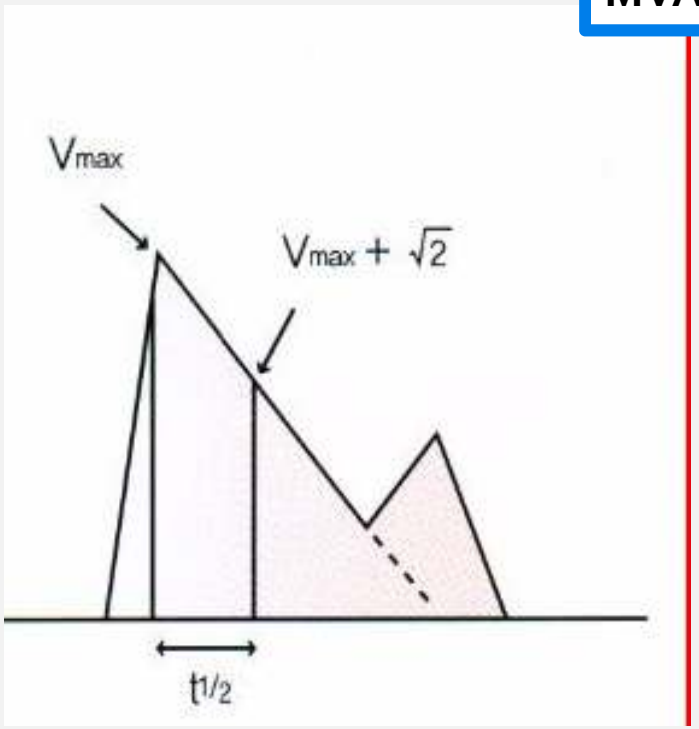
Mitral annular calcification



Pressure half time (압력반감 시간)

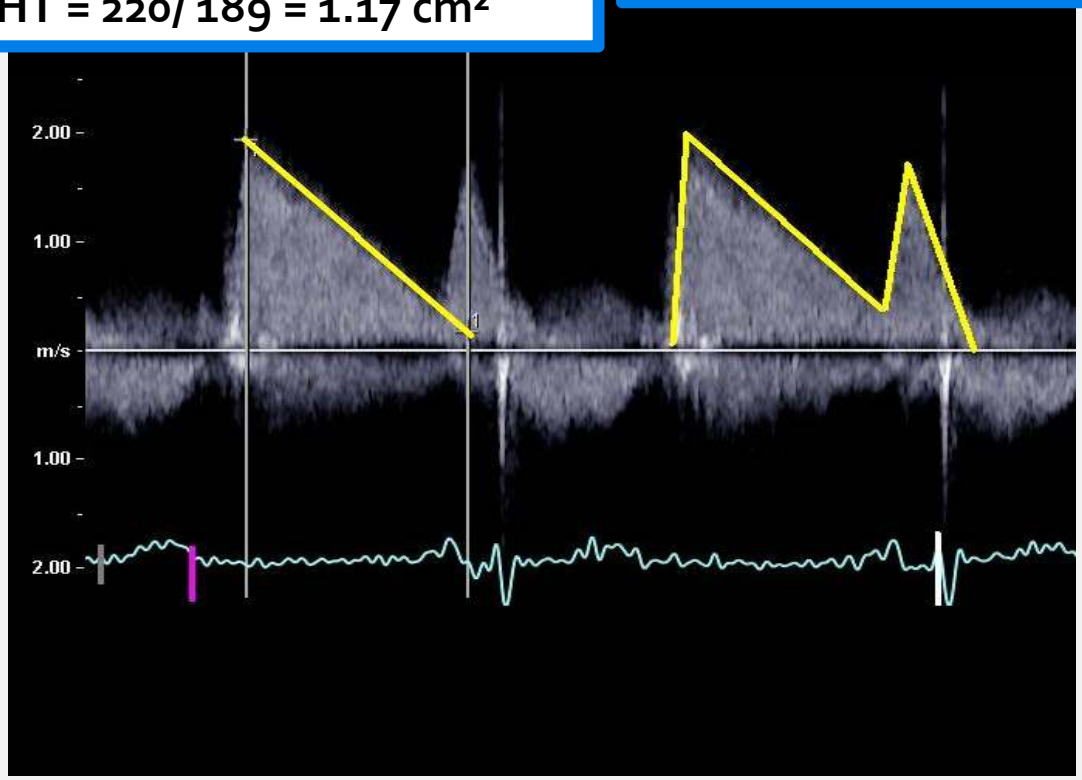
$$PHT = DT \times 0.29$$

$$MVA = 220 / PHT \quad (\textit{220 empirical constant})$$

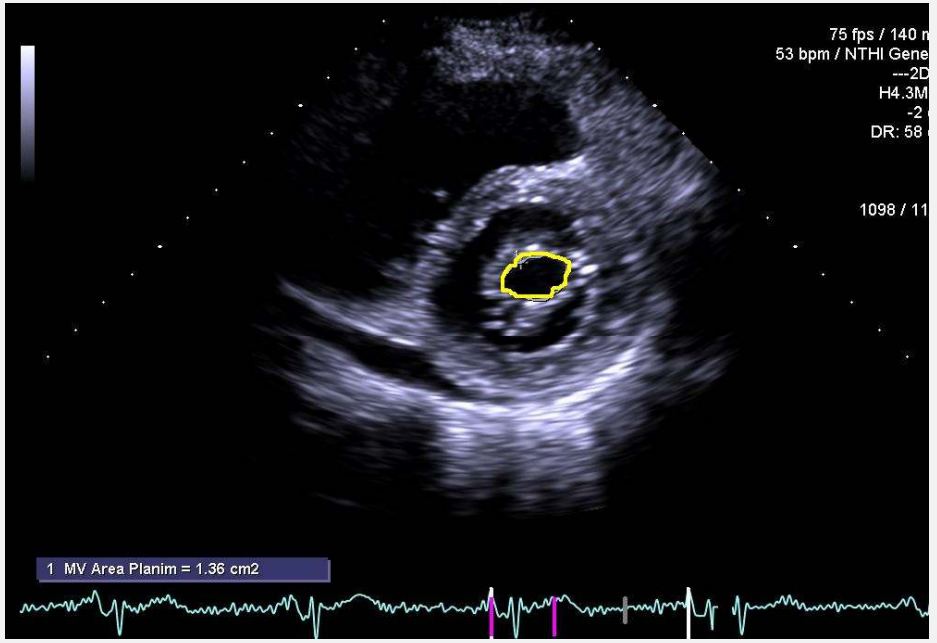


MV DT 650 msec
MV PHT = 189 msec
MVA PHT = 220/ 189 = 1.17 cm²

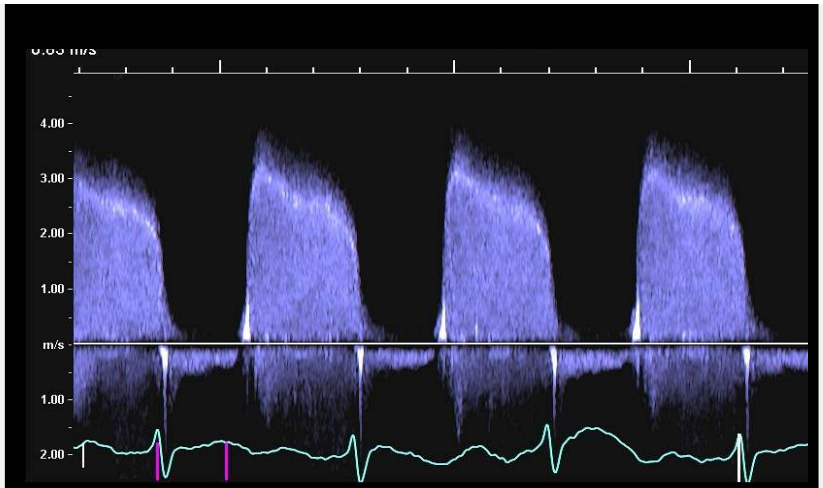
MV Mean PG= 6.0 mmHg

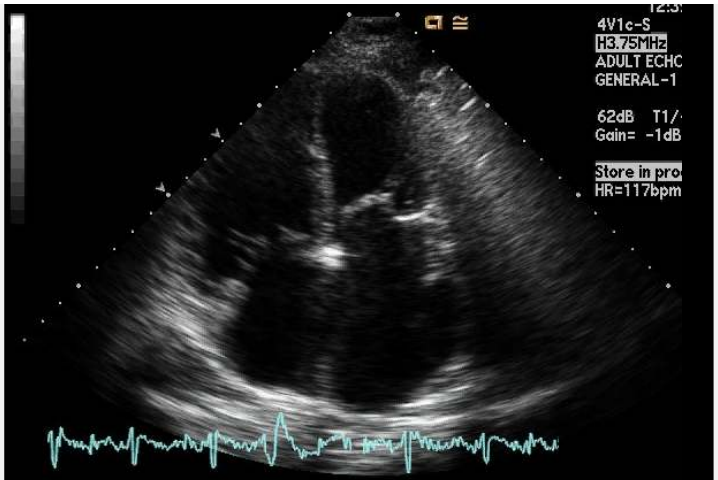


Planimetry evaluation of mitral stenosis

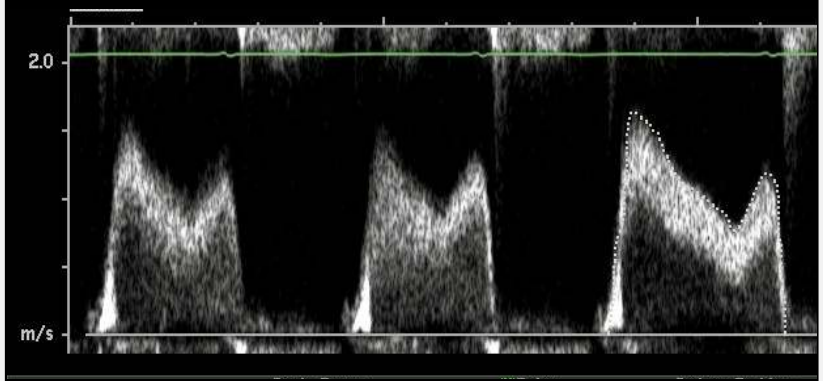


Severe

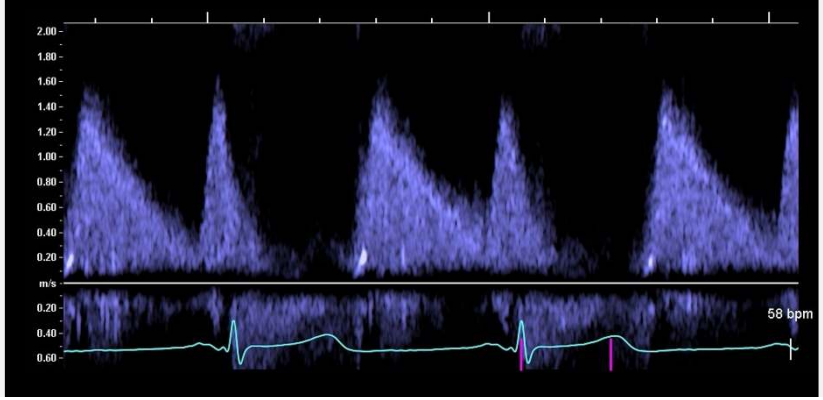




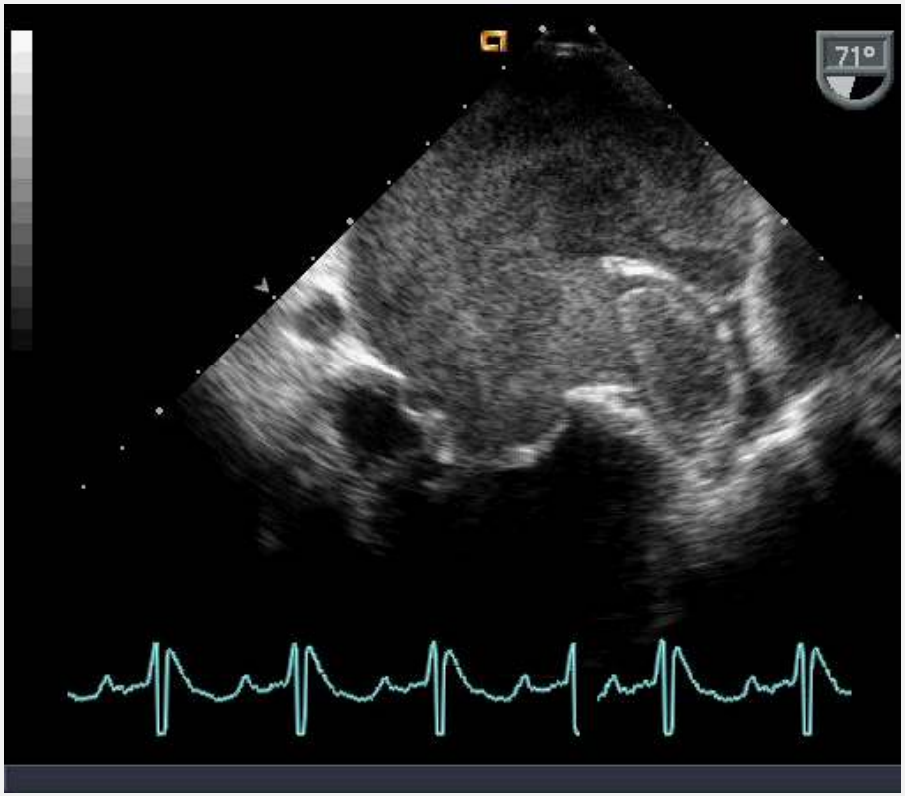
Moderate

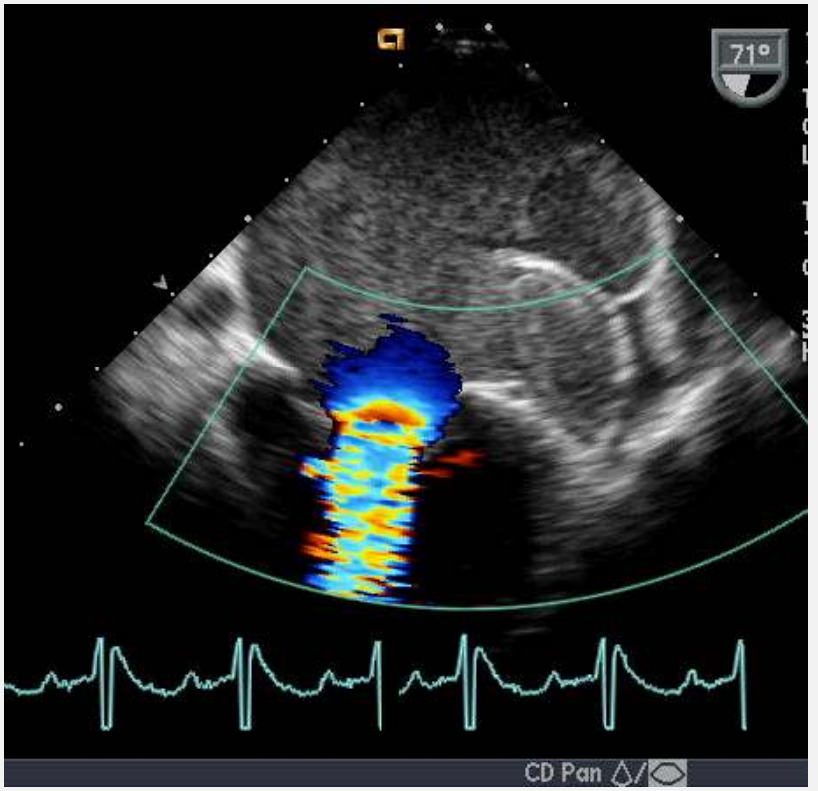


Mild

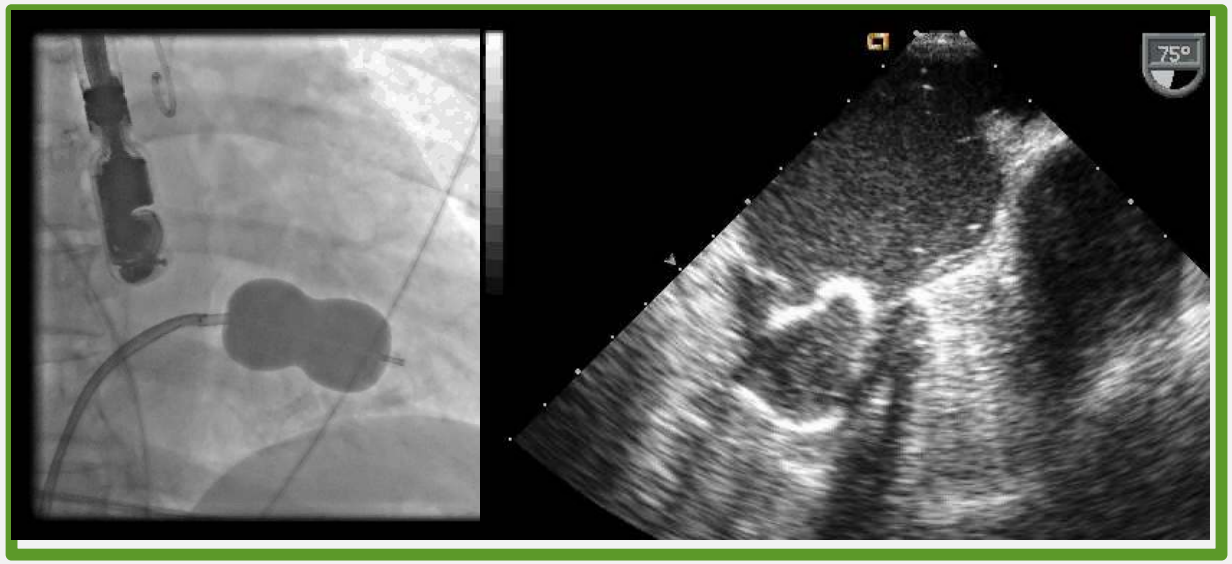


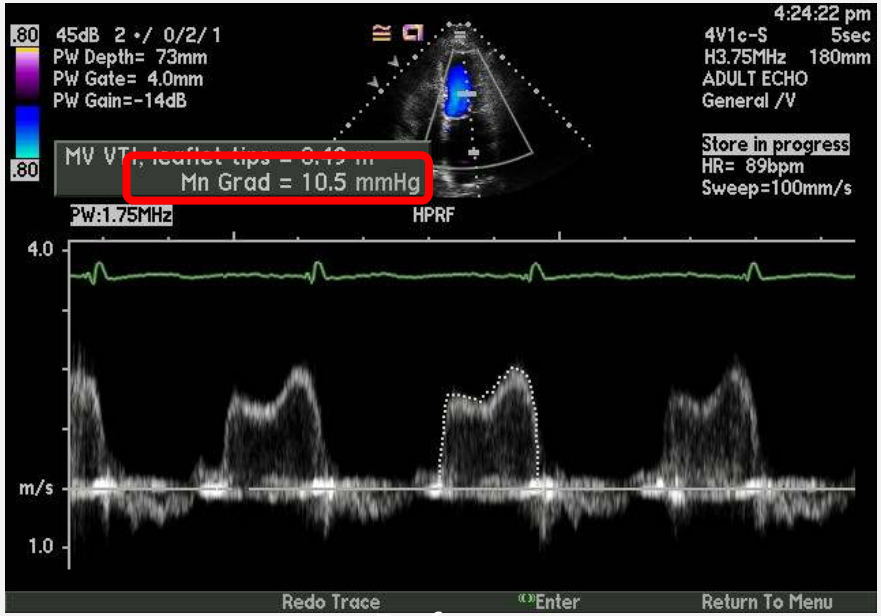
Transesophageal echocardiography of Severe Rheumatic Mitral stenosis



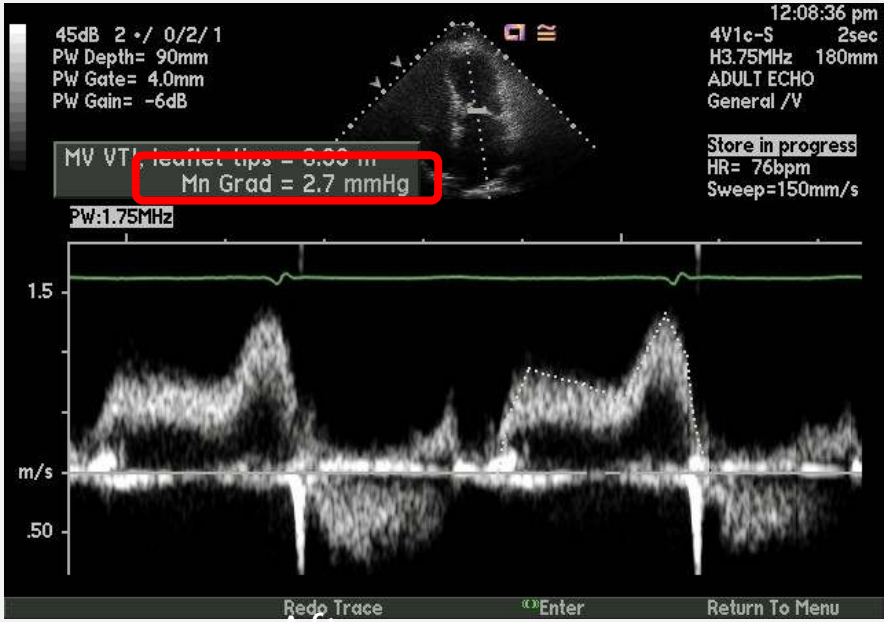


Percutaneous mitral balloon valvotomy





Before

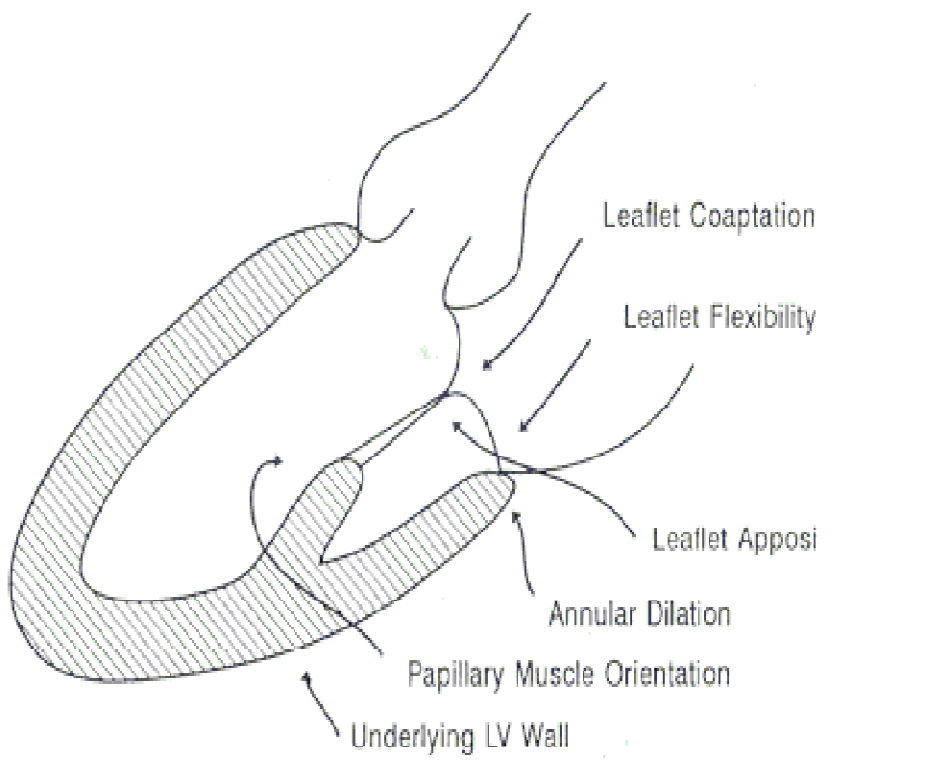


After

Etiology of Mitral valve Regurgitation

- Valvular
  - Myxomatous CT Disease
  - Rheumatic
  - Endocarditis
- Chordae
- Annulus
  - Calcification
- Papillary Muscles
  - CAD (Ischemia, Infarction)
  - Infiltrative disorders
- LV Dilatation & Functional Prolapse

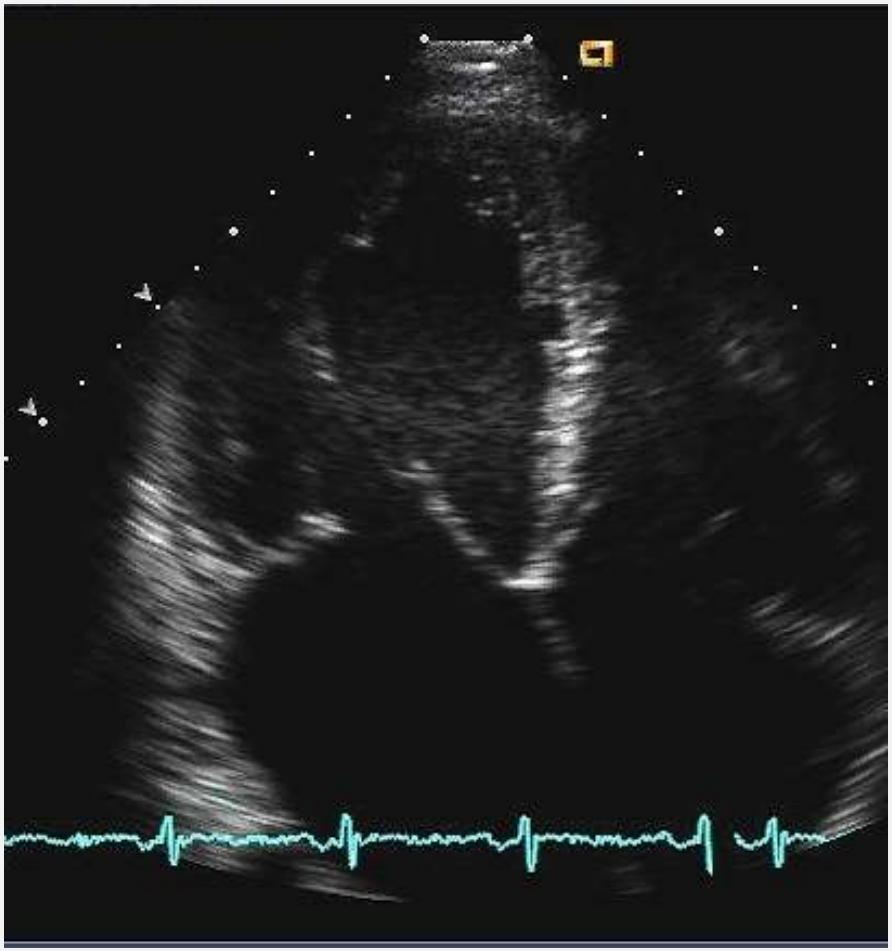
Mechanisms of MR

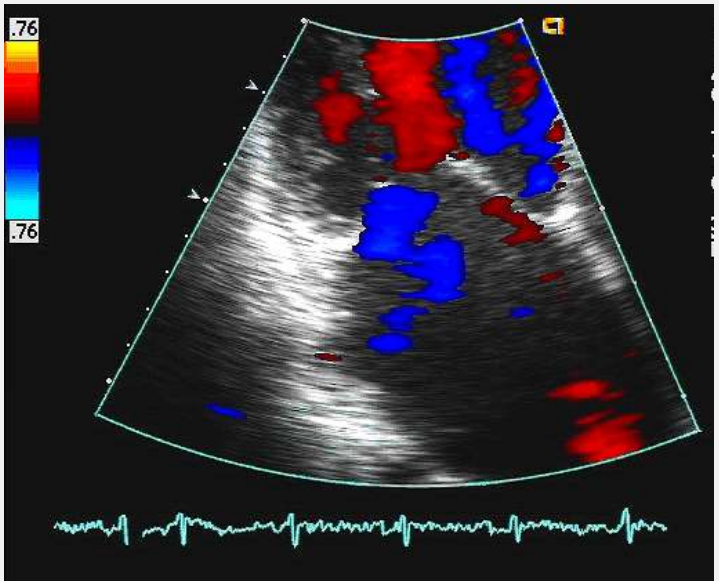


Components of MV apparatus

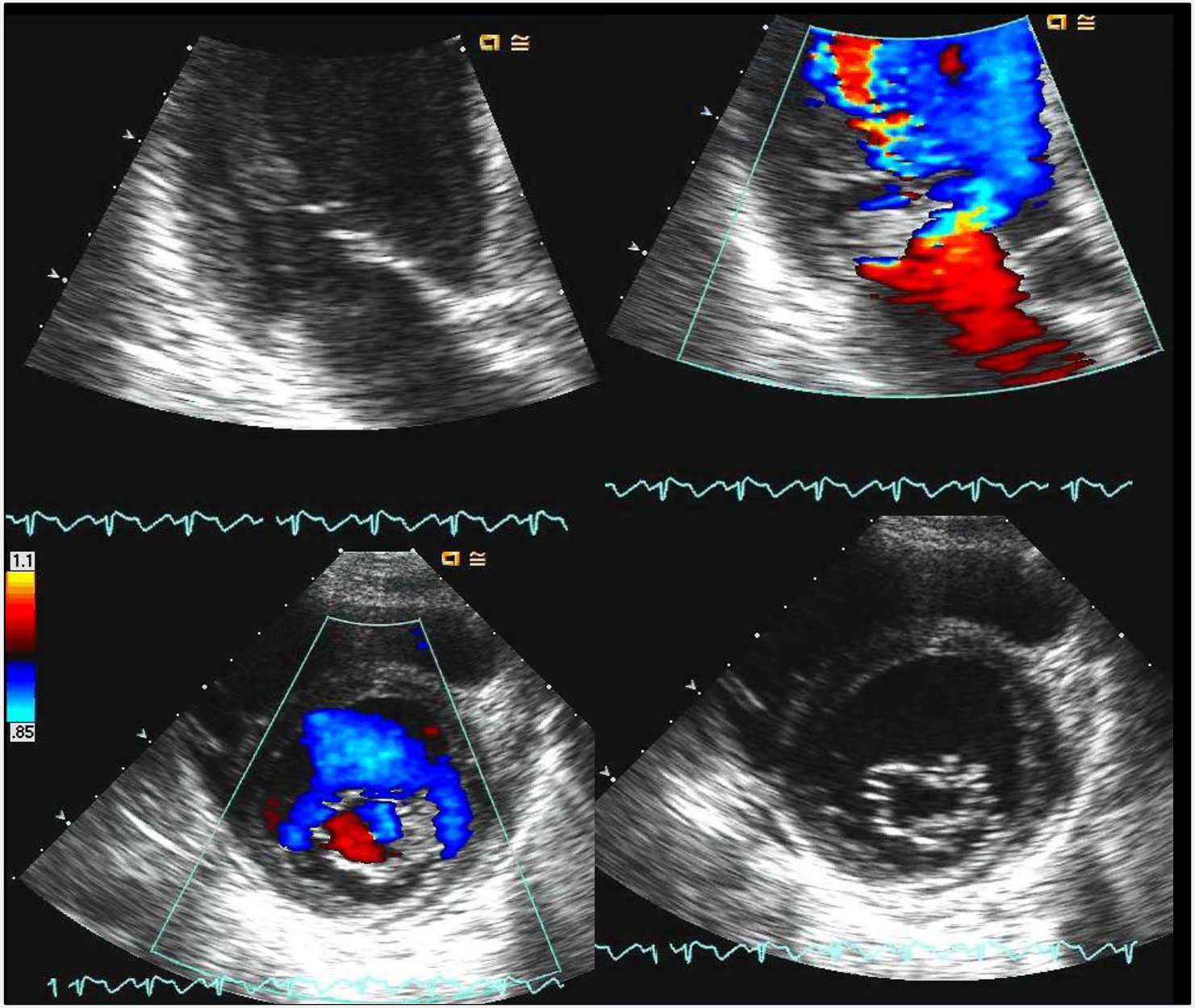
- **Left atrial wall**
- **Mitral annulus**
- **Anterior & posterior leaflets**
- **Chordae**
- **Papillary muscles**
- **Left ventricular myocardium**

Severe MR with MVP and Chordae rupture

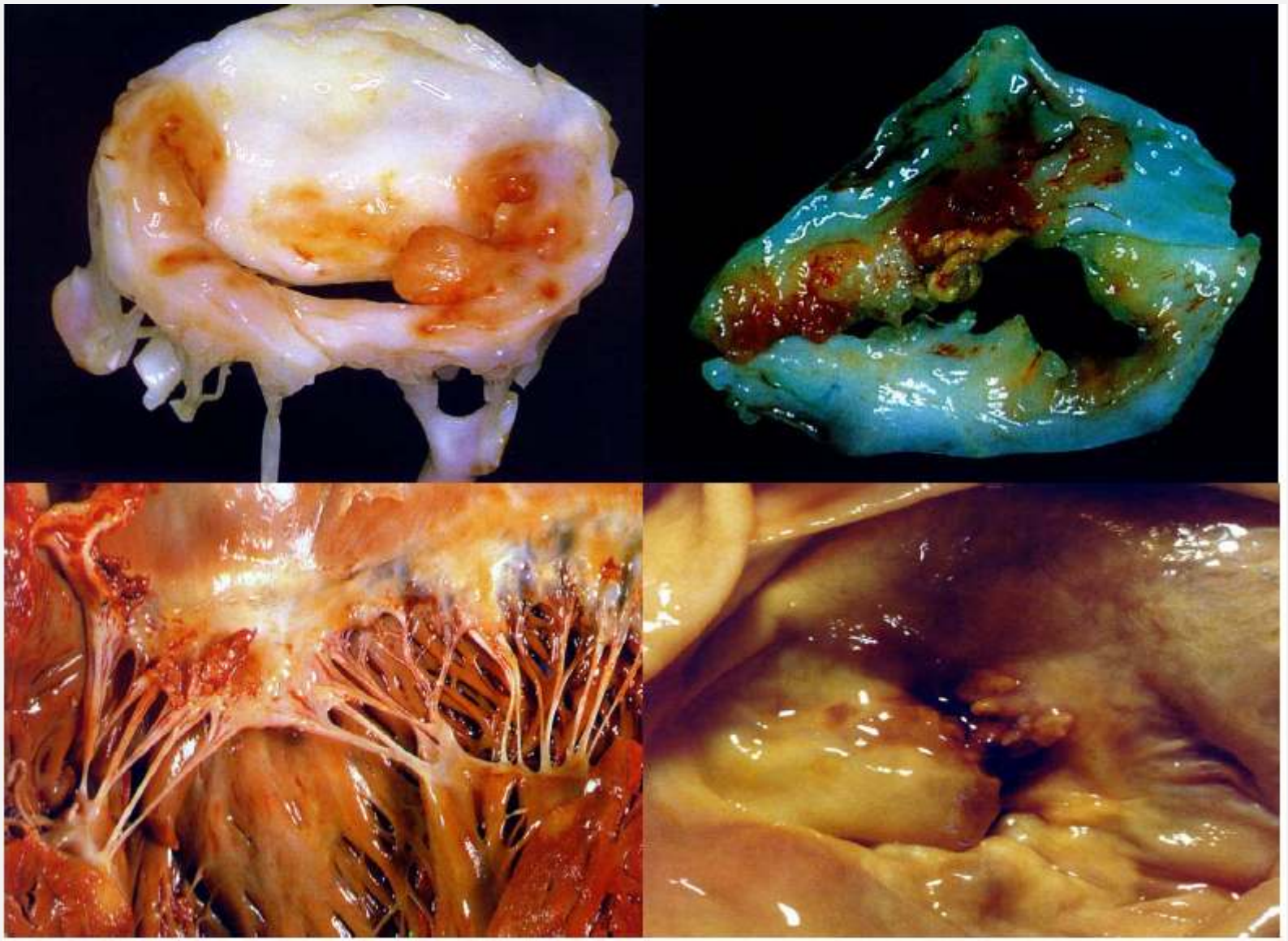




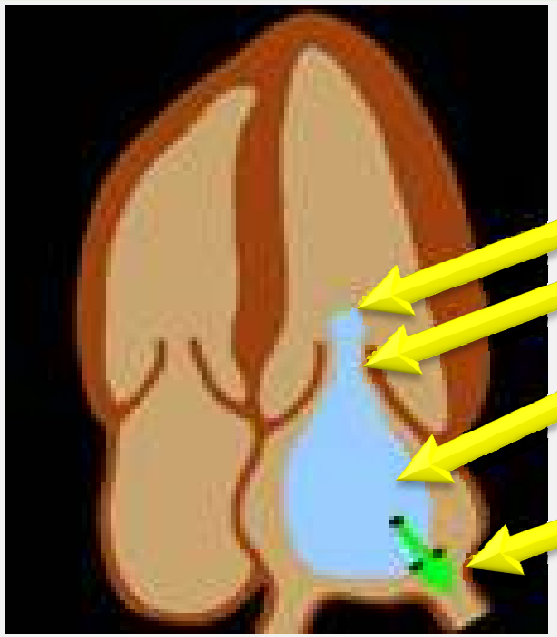
Severe MR with infective endocarditis



Endocarditis



Color Doppler Flow Mapping

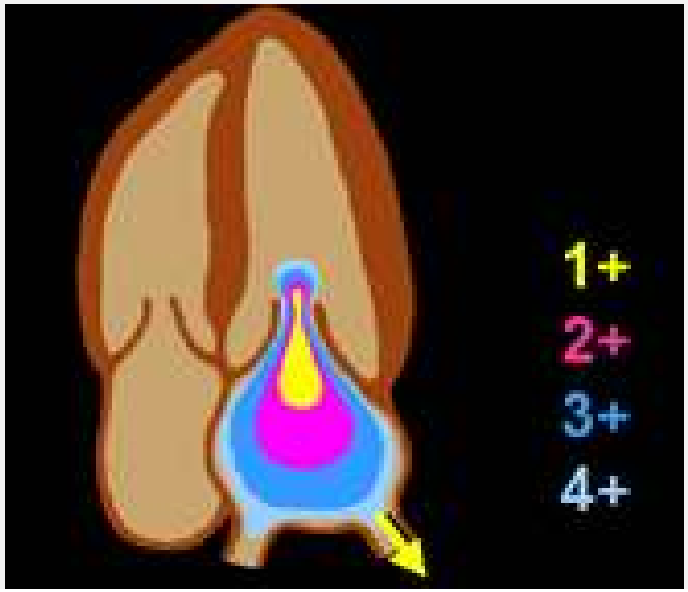


PISA

Vena contracta

Flow disturbance (jet size)

PV flow reversal

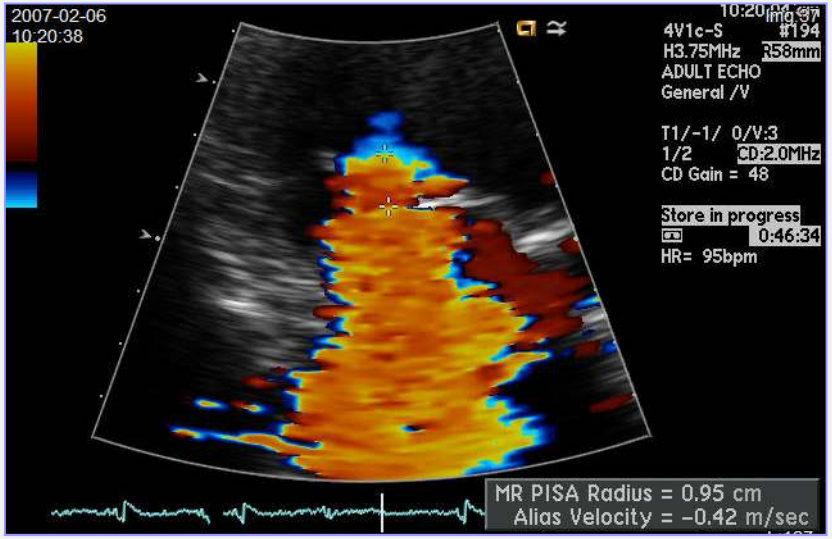


Mild

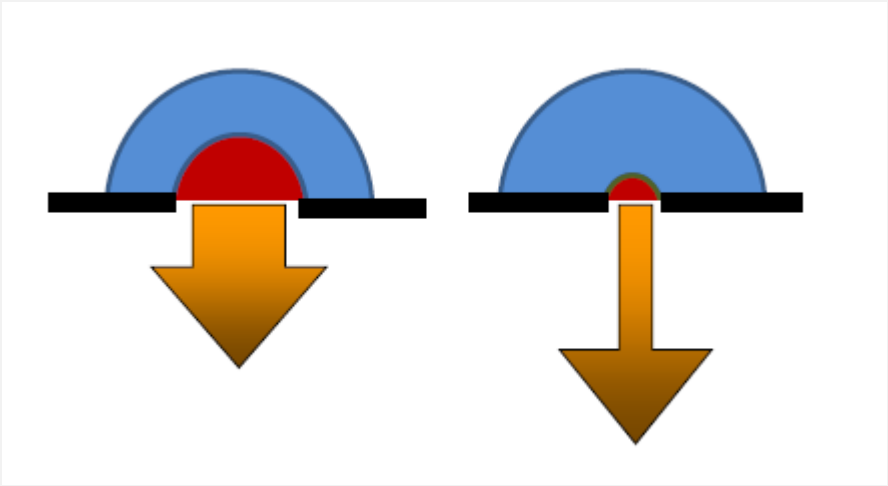
Moderate

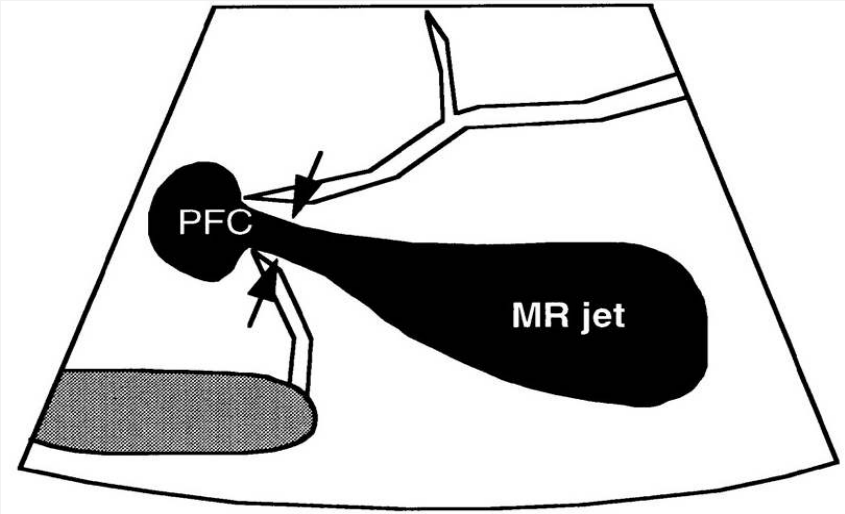
Severe

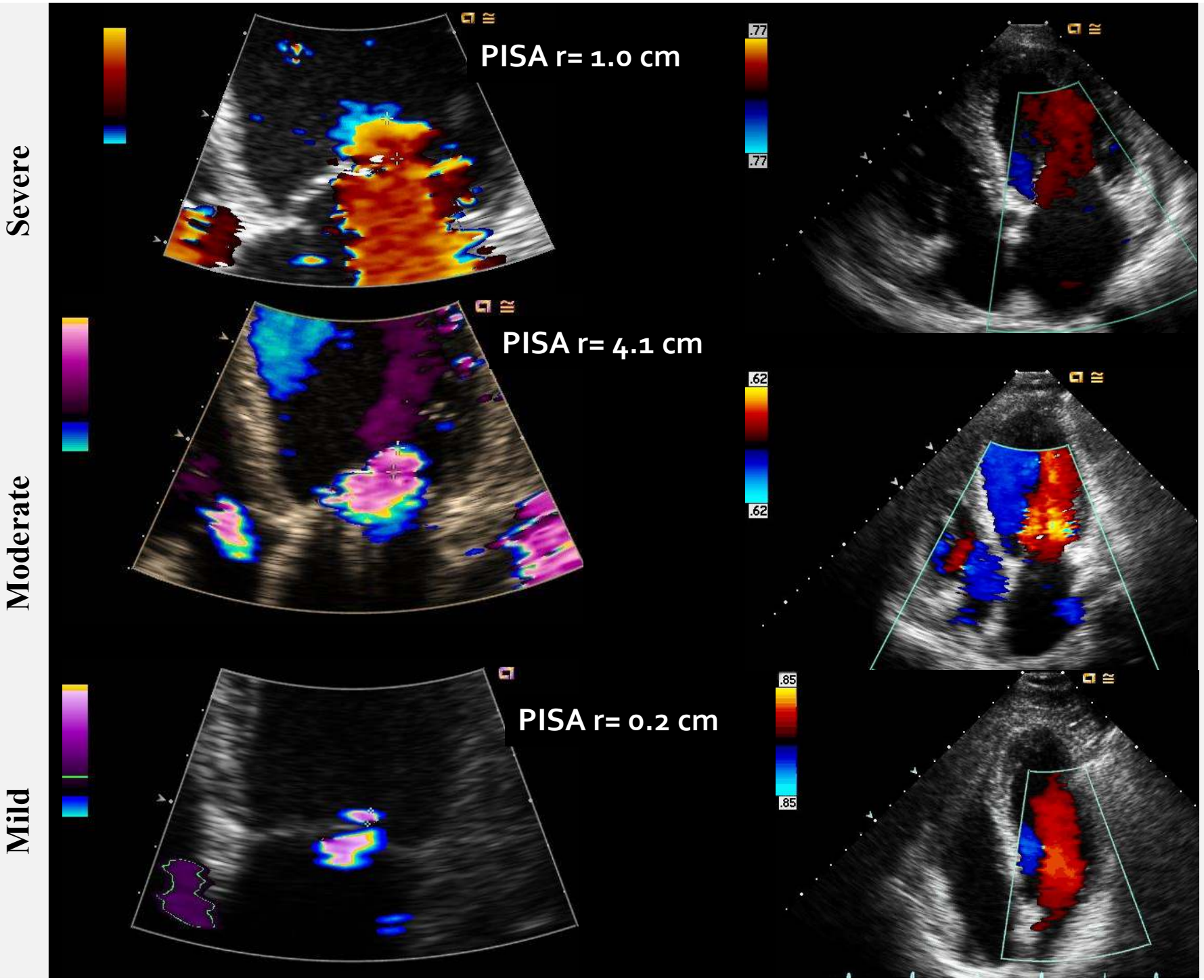
Regurgitation volume measurement with PISA

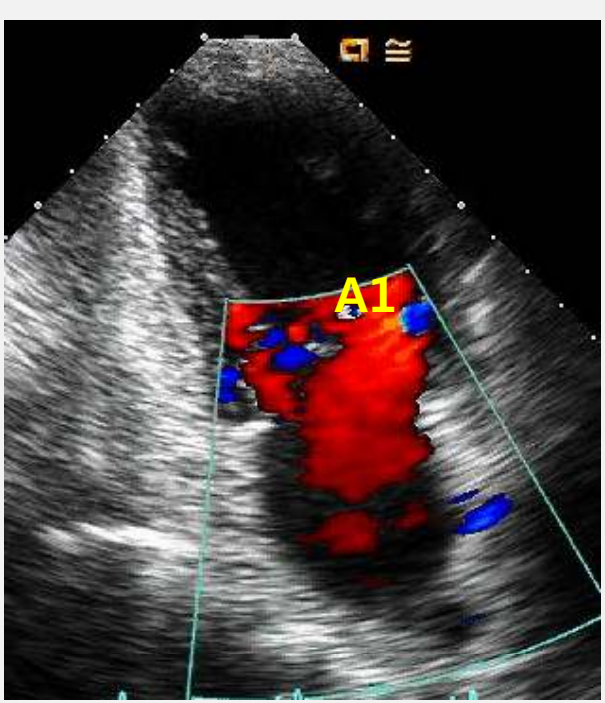


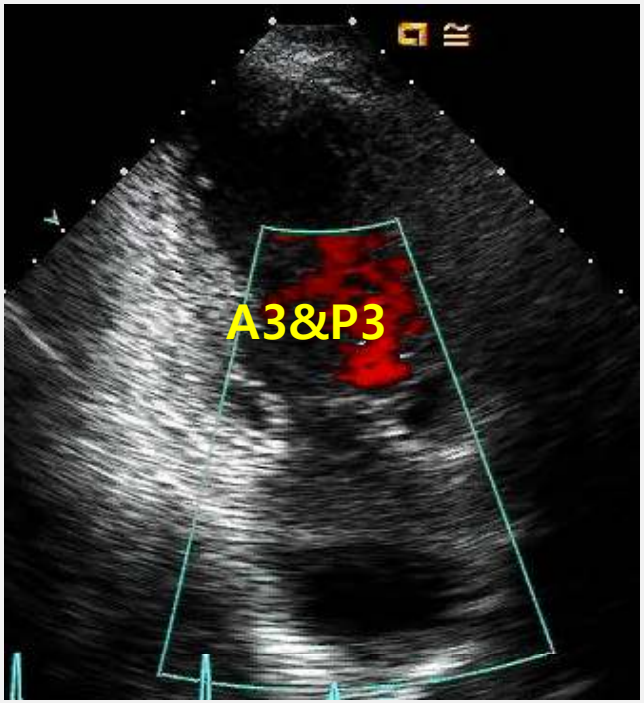
- ERO $= 6.28 \times (0.95)^2 \times 42 / 513 = 0.46\ cm^2$
- RegV $= 0.46 \times 174 = 80$ cc

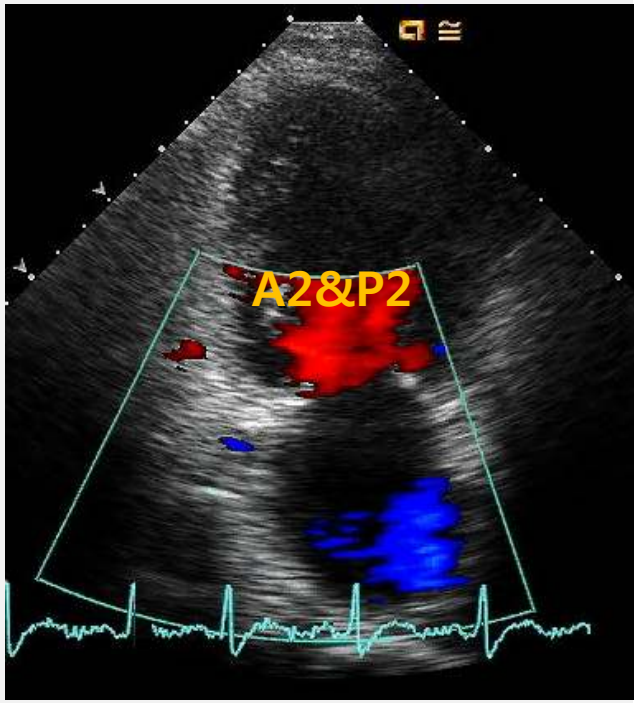


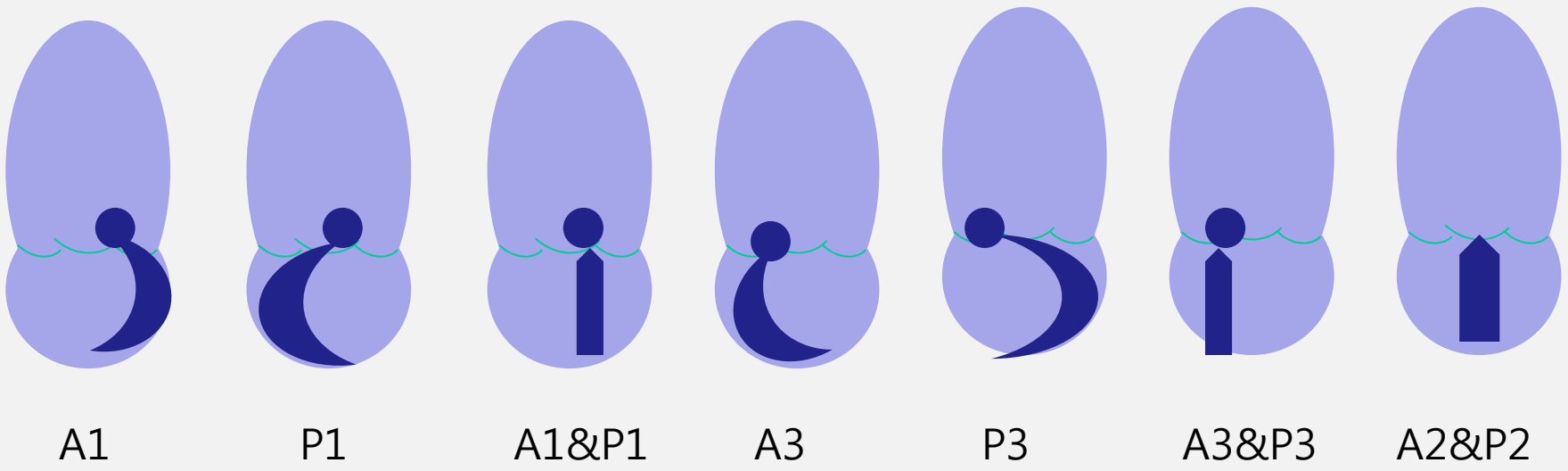


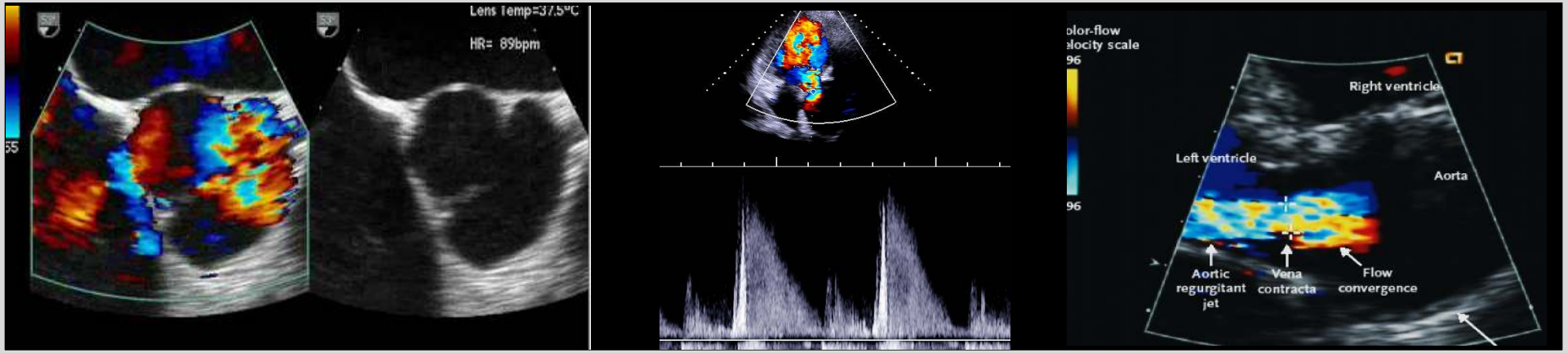

Severe
Moderate
Mild
PISA r= 1.0 cm
PISA r= 4.1 cm
PISA r= 0.2 cm
.77
.77
.62
.62
.85
.85


A1

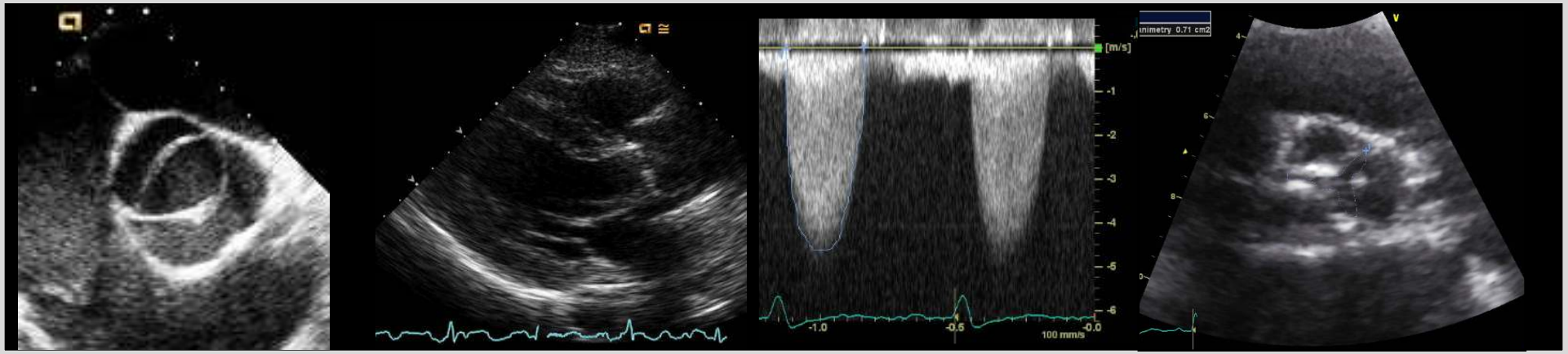

A3&P3


A2&P2


A1
P1
A1&P1
A3
P3
A3&P3
A2&P2



Aortic valvular disease



Aortic valvular disease

- **Rheumatic fever**
- **Calcific AS**
- **Infective endocarditis**
- **Myxomatous proliferation of the aortic valve**
- **Congenital bicuspid valve ….**

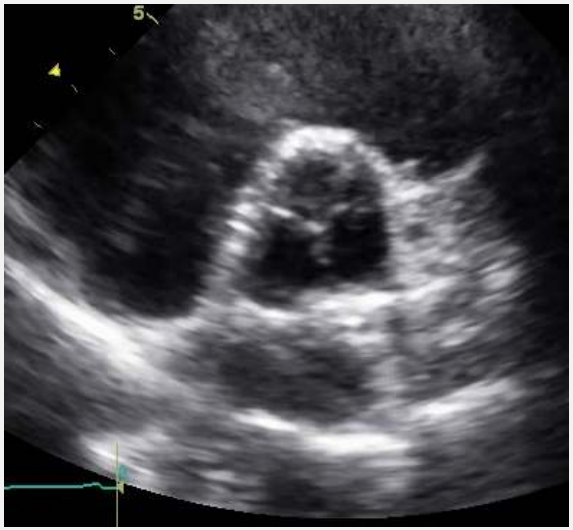
Aortic root disease

- Marfan's syndrome
- Degenerative
- Aortic dissection
- Syphilitic aortitis
- Bechet's syndrome …

Aortic Valve Stenosis

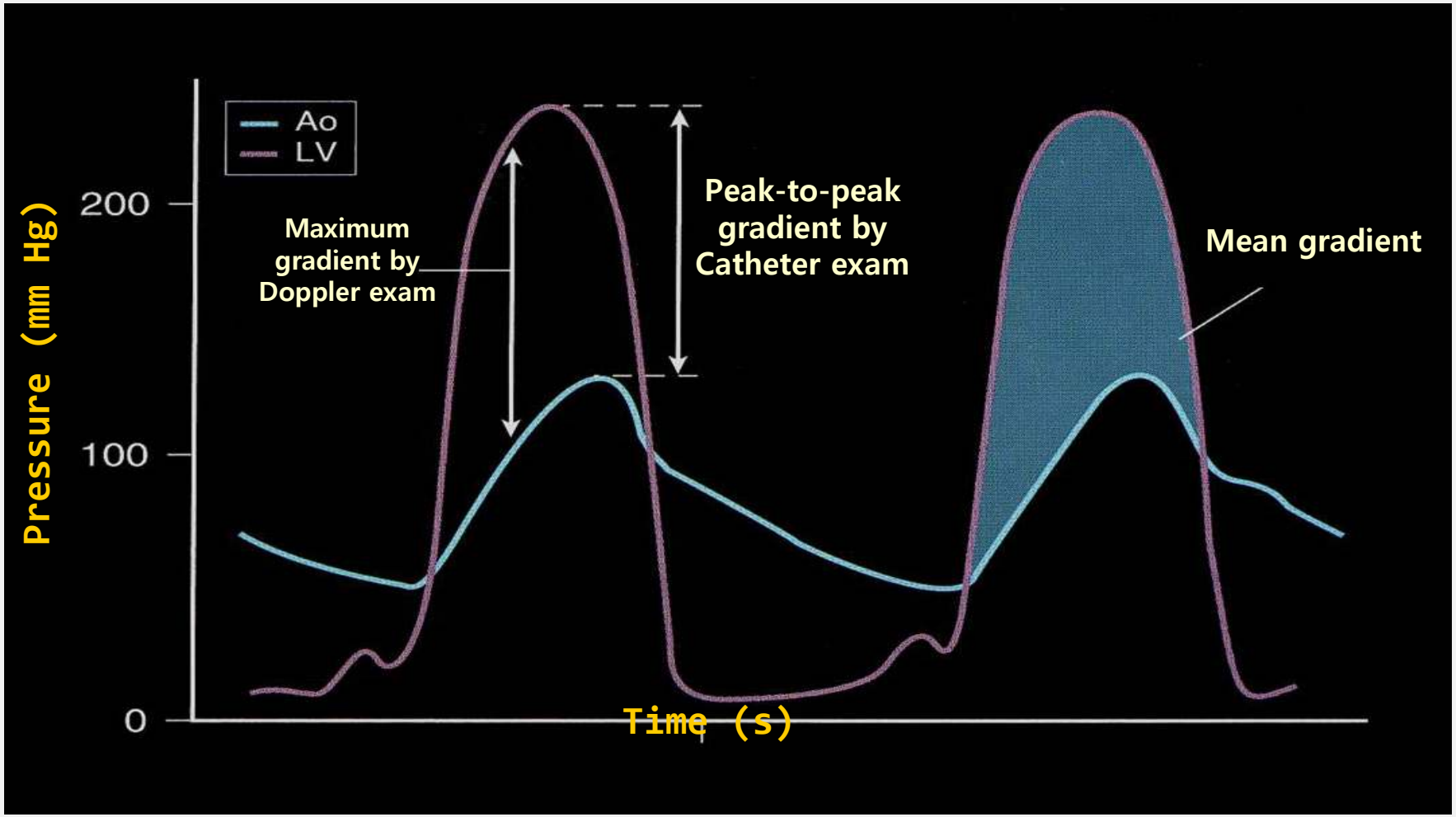
Normal	Degenerative	Rheumatic
		
		

Aortic Valve Stenosis

Normal	Bicuspid Aortic Valve
	
	

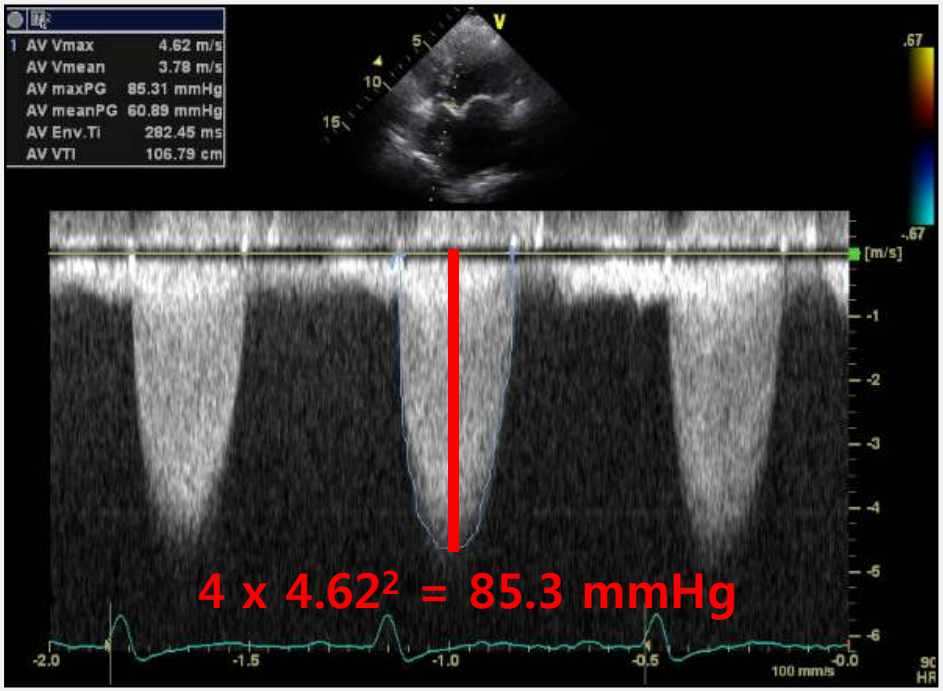
Doppler Examination

LV and Aortic Pressures measured with catheter in a patient with severe AS



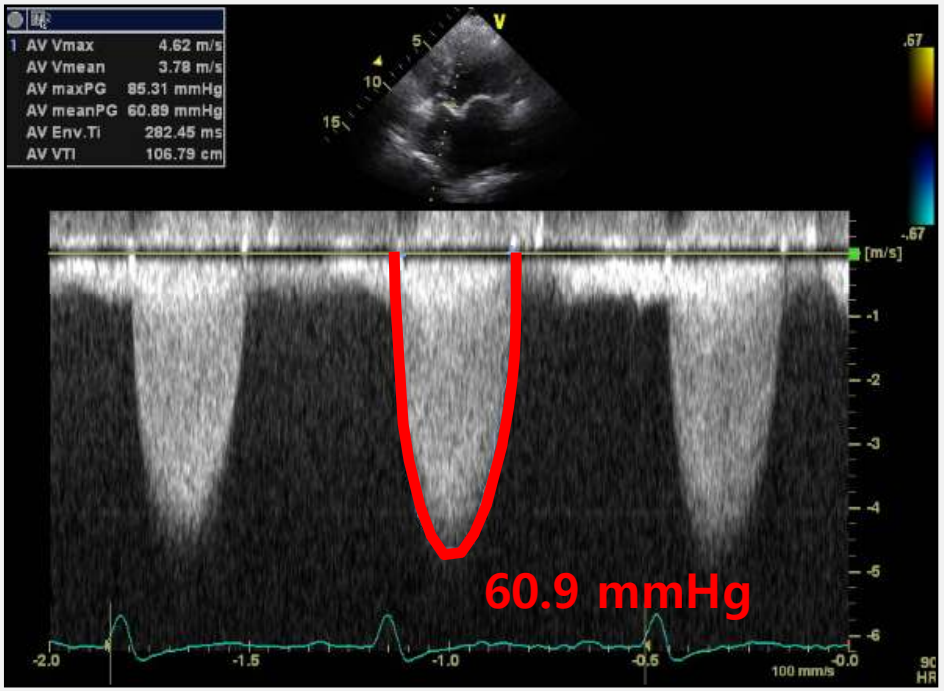
Doppler Examination

Peak pressure gradient



Modified Bernoulli Equation
Pressure Gradient = 4 x Vmax²

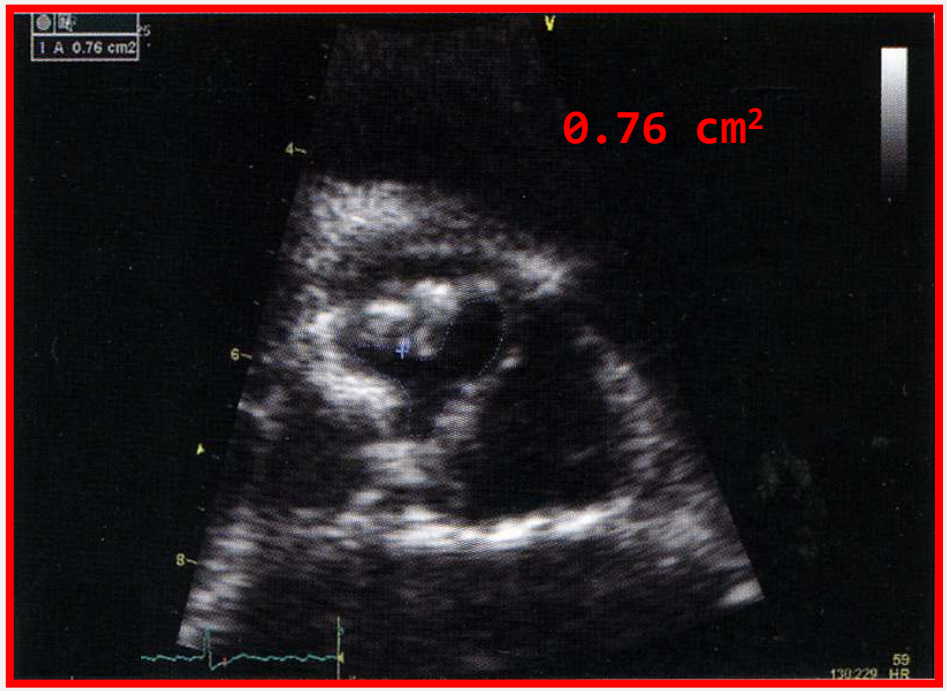
Mean pressure gradient

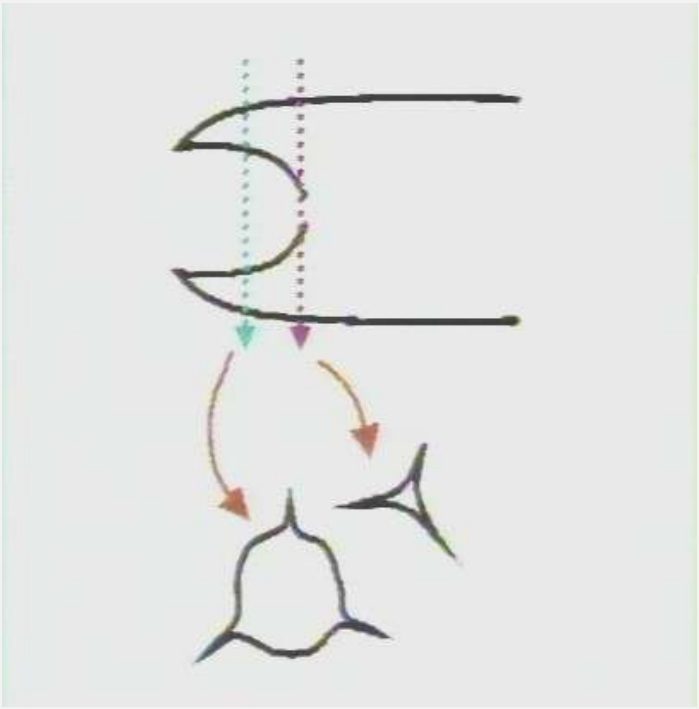


Tracing of Velocity Curve
Mean Pressure Gradient

2D Planimetry

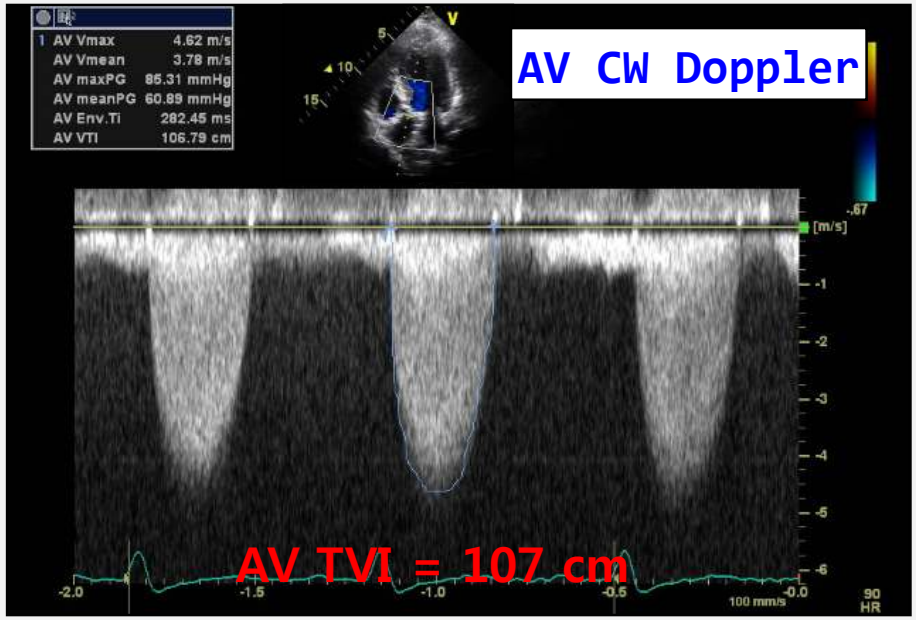
Orifice Tip

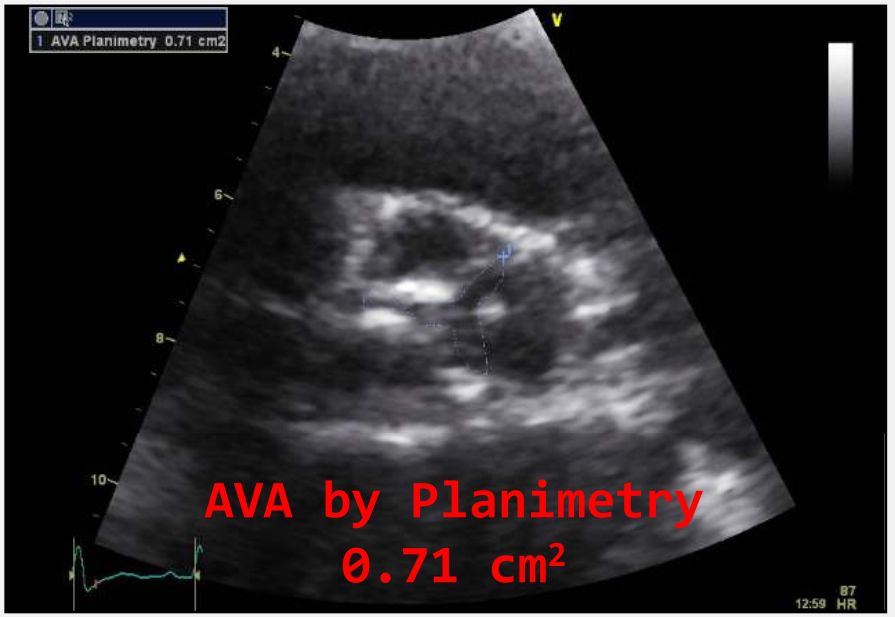




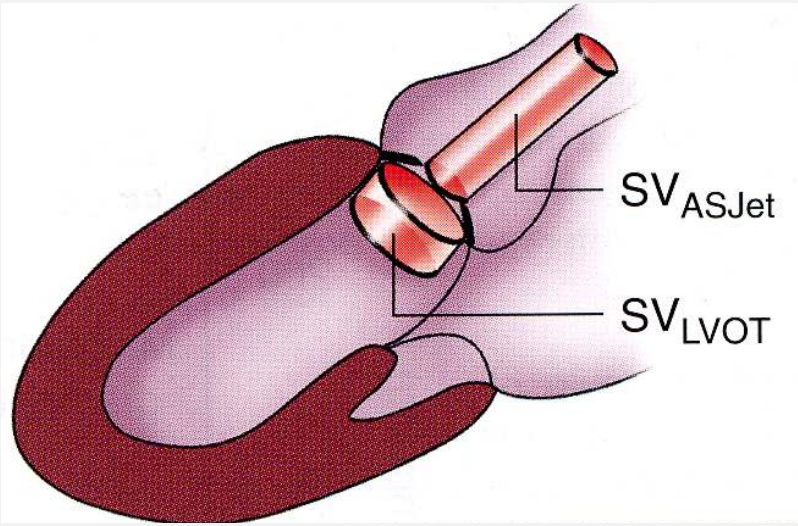
판막의 첨단 (oritice tip)에서 측정하여야 한다.

Continuity Equation

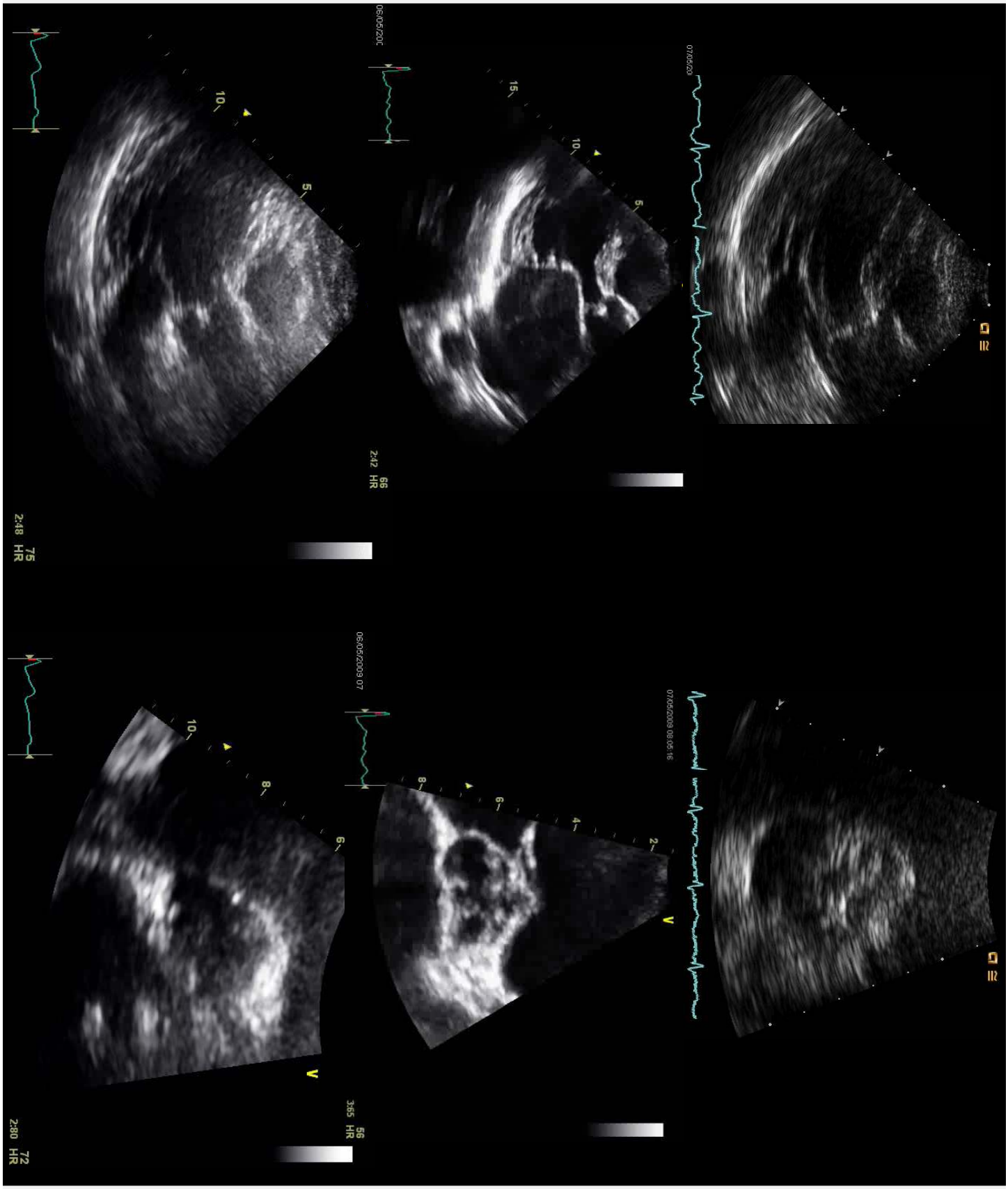




Aortic Valve Area
(LVOT Flow / AV TVI)
= 79.2 mL / 107 cm
= 0.74 cm²

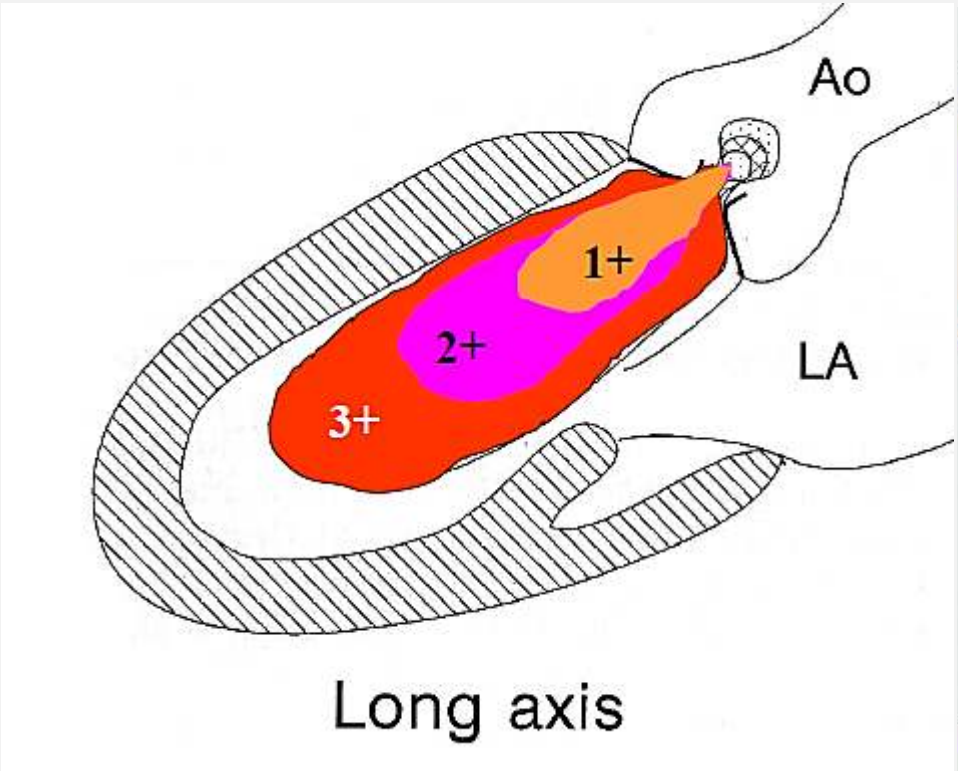


Mild **Moderate** **Severe**

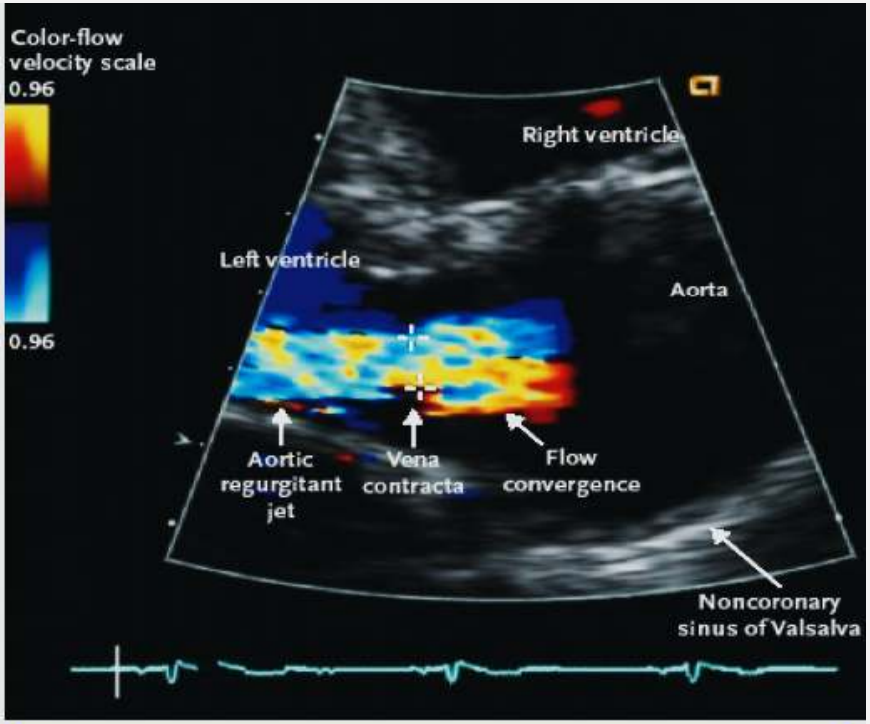


Assessment of severity of Aortic Valve regurgitation

Penetration of Color Jet



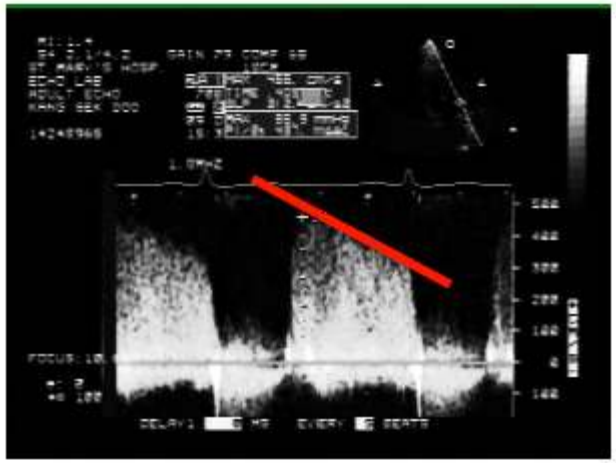
Vena Contracta Width



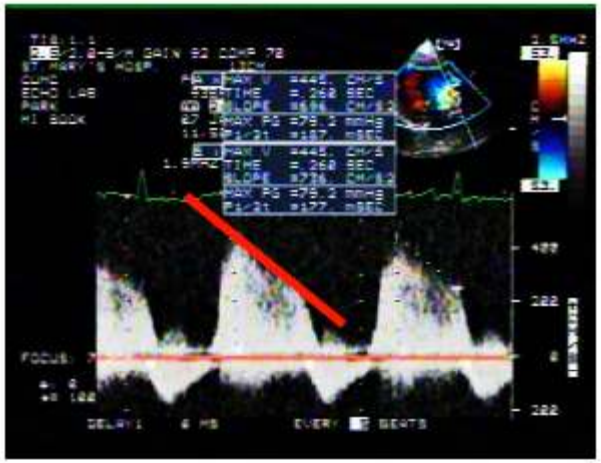
The smallest area (neck portion) of regurgitant flow

Assessment of severity of Aortic Valve regurgitation

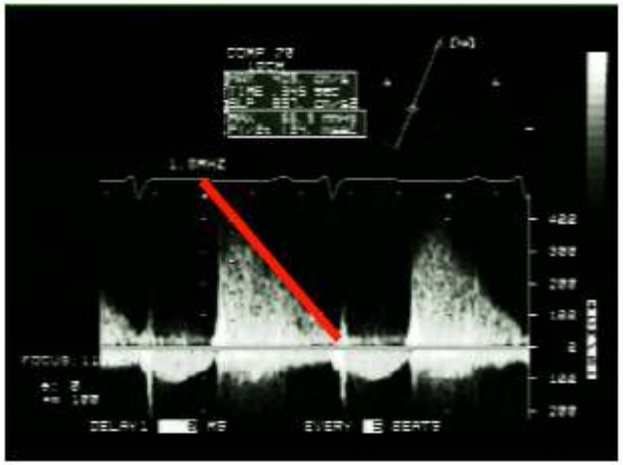
Pressure Half Time



PHT=437 msec



PHT=177 msec

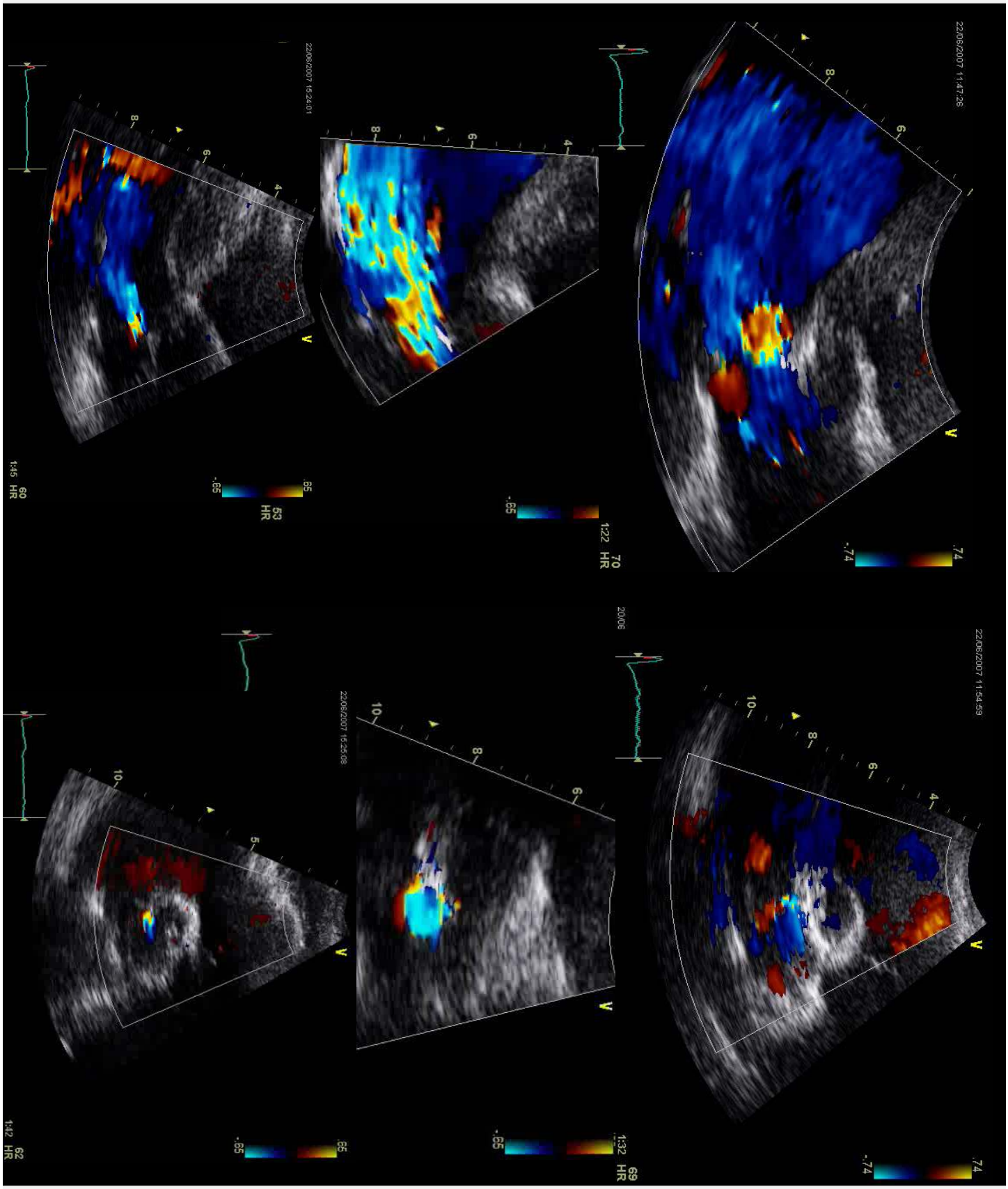


PHT=134 msec

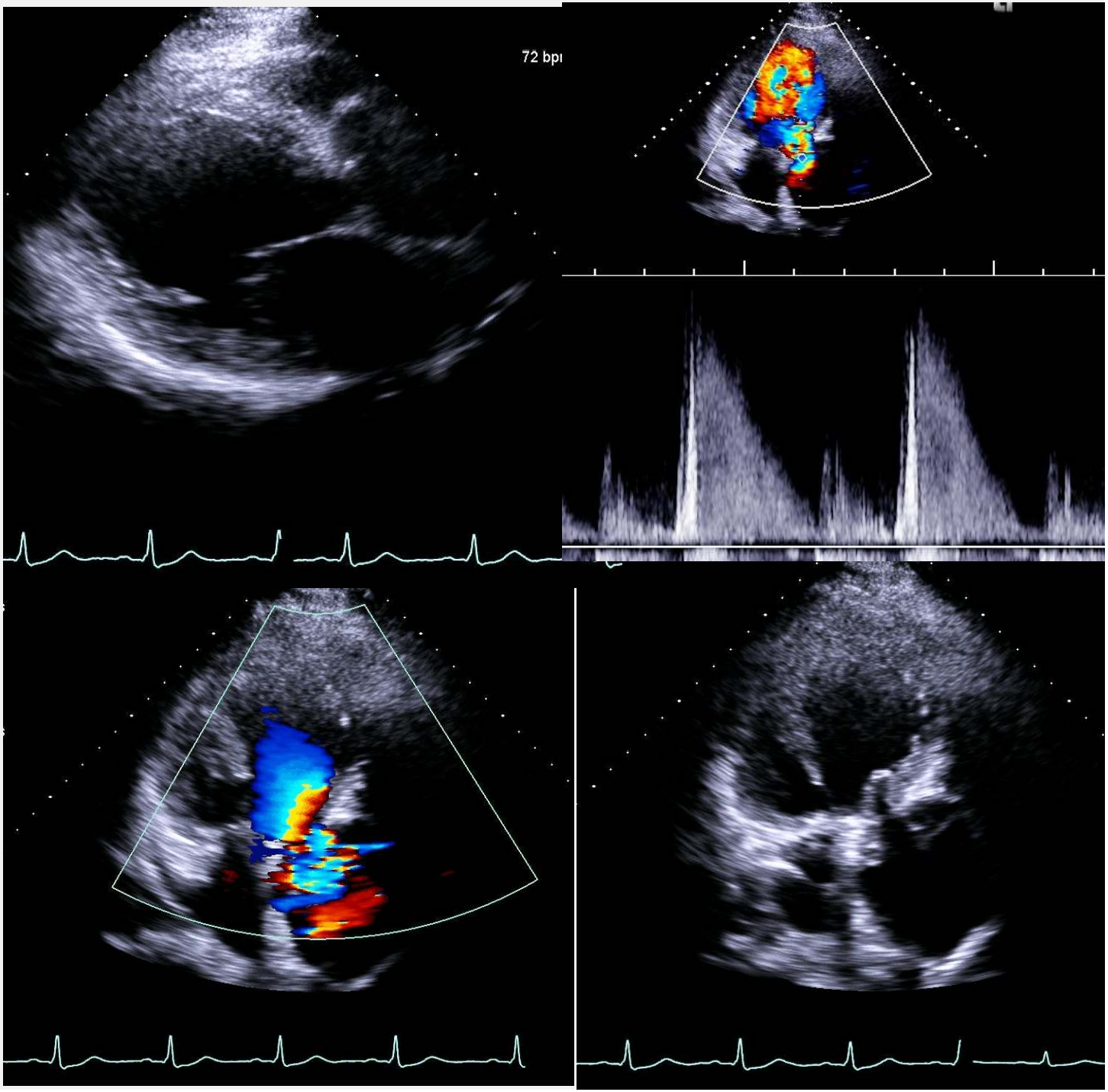
Mild vs **Severe**

PHT	
Mild	≥ 500 msec
Moderate	350-500 msec
Mod-Severe	200-350 msec
Severe	≤200-250 msec

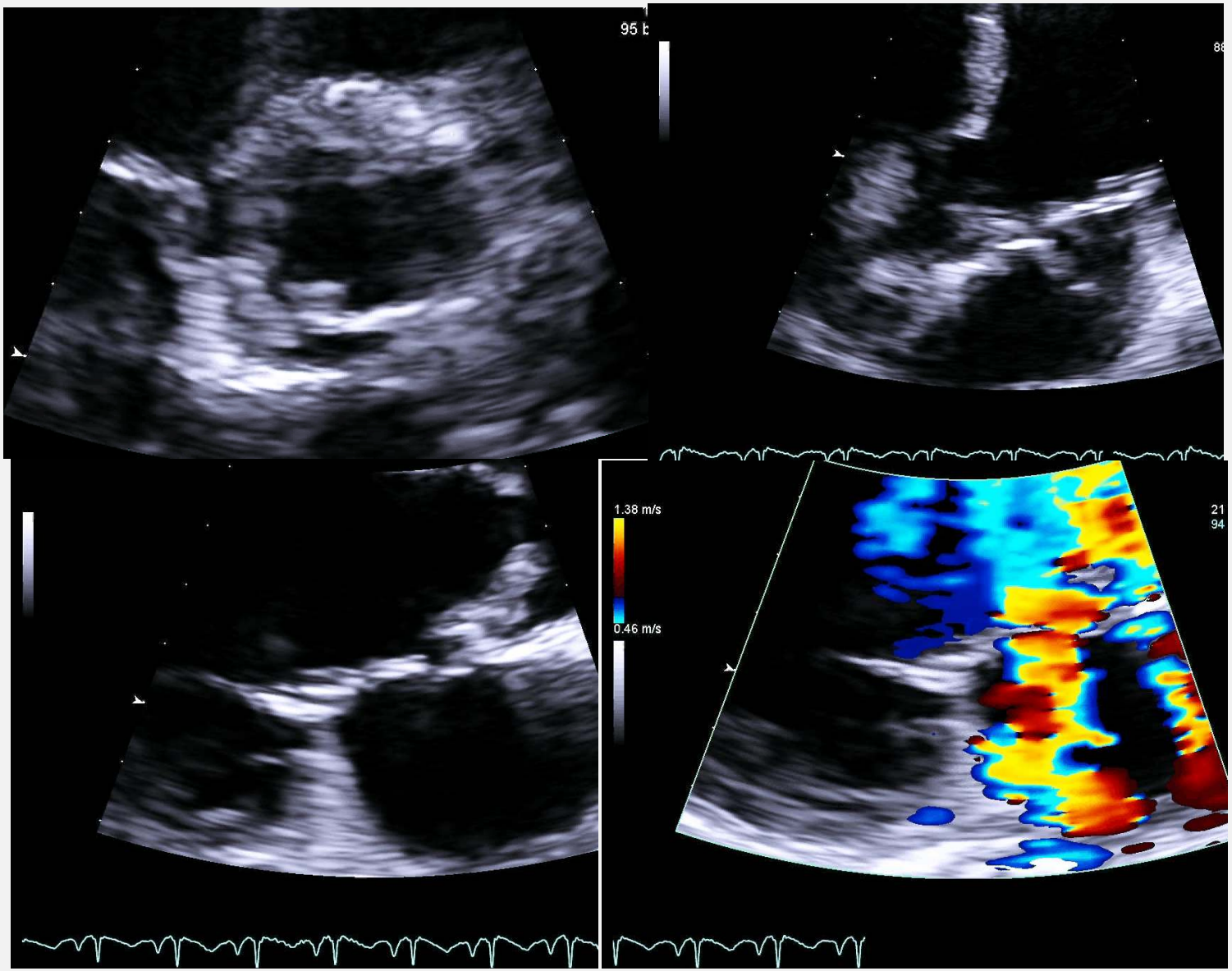
Mild **Moderate** **Severe**



Severe Acute Aortic valve Regurgitation d/t Aortic dissection

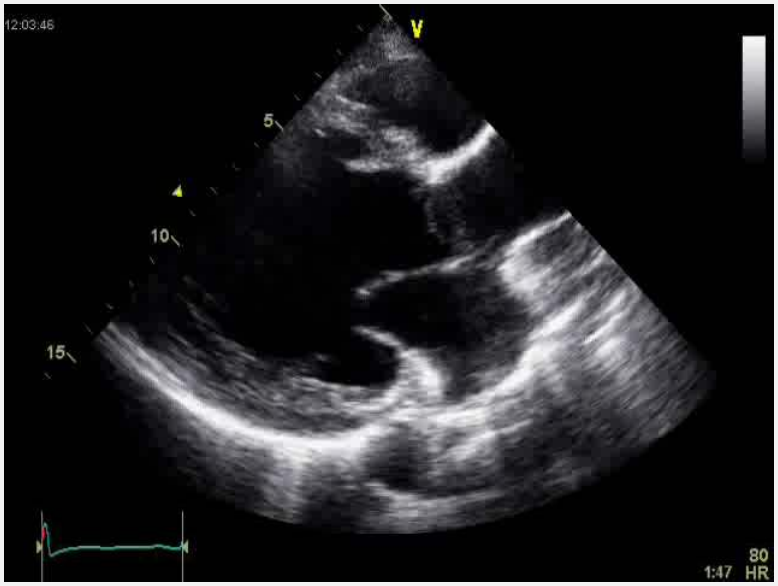


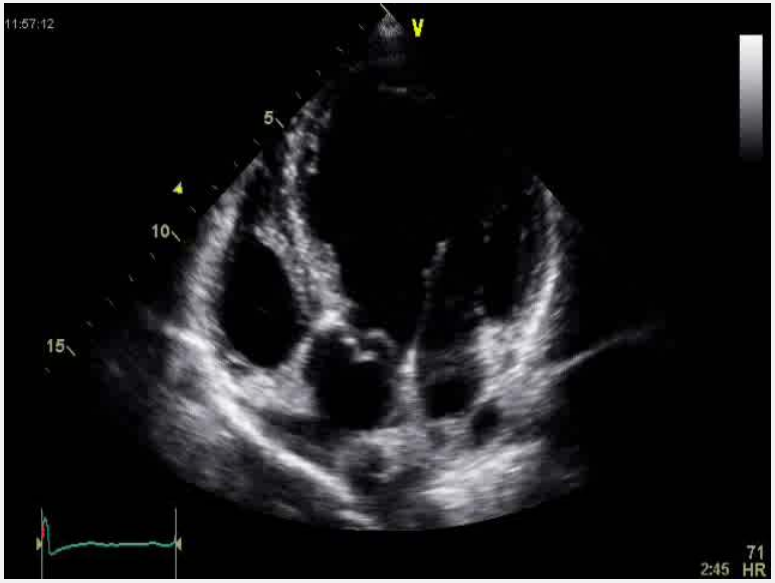
Infective endocarditis of bicuspid Aortic valve and mitral valve perforation

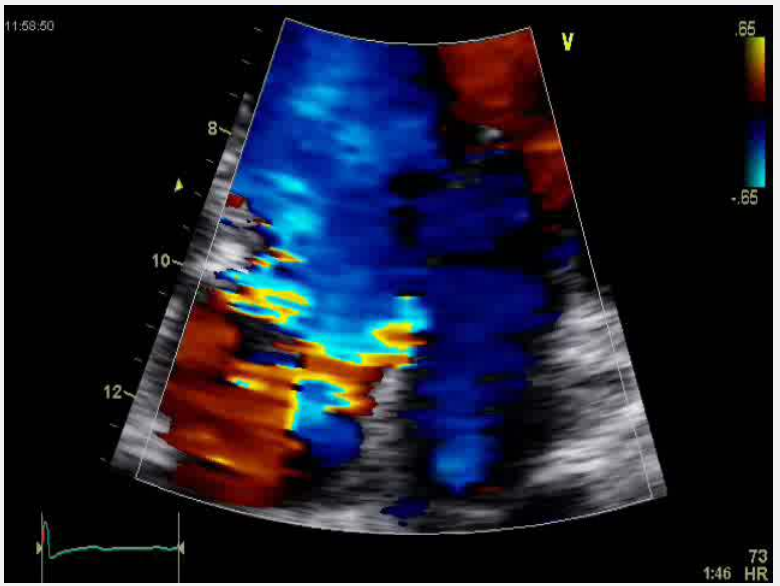


Transthoracic Echocardiography (TTE)

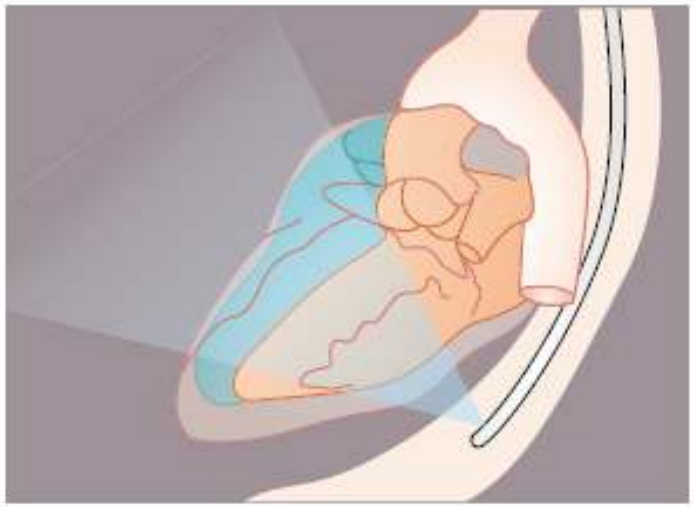
Aortic valve prolapse with severe aortic regurgitation







경식도 심초음파



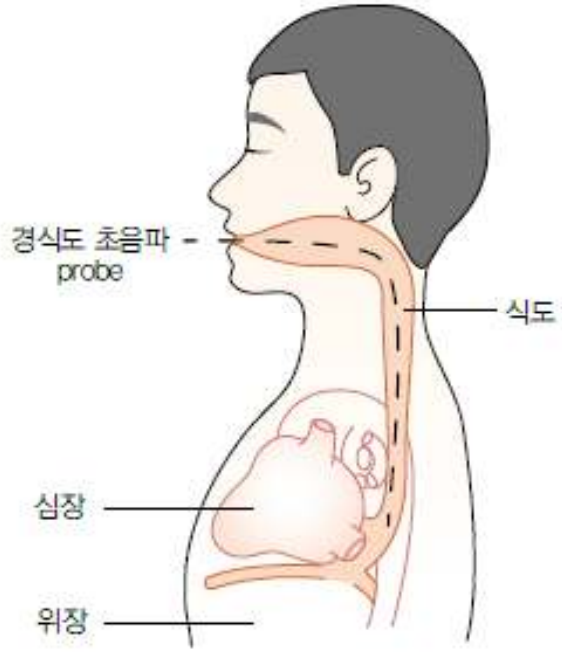
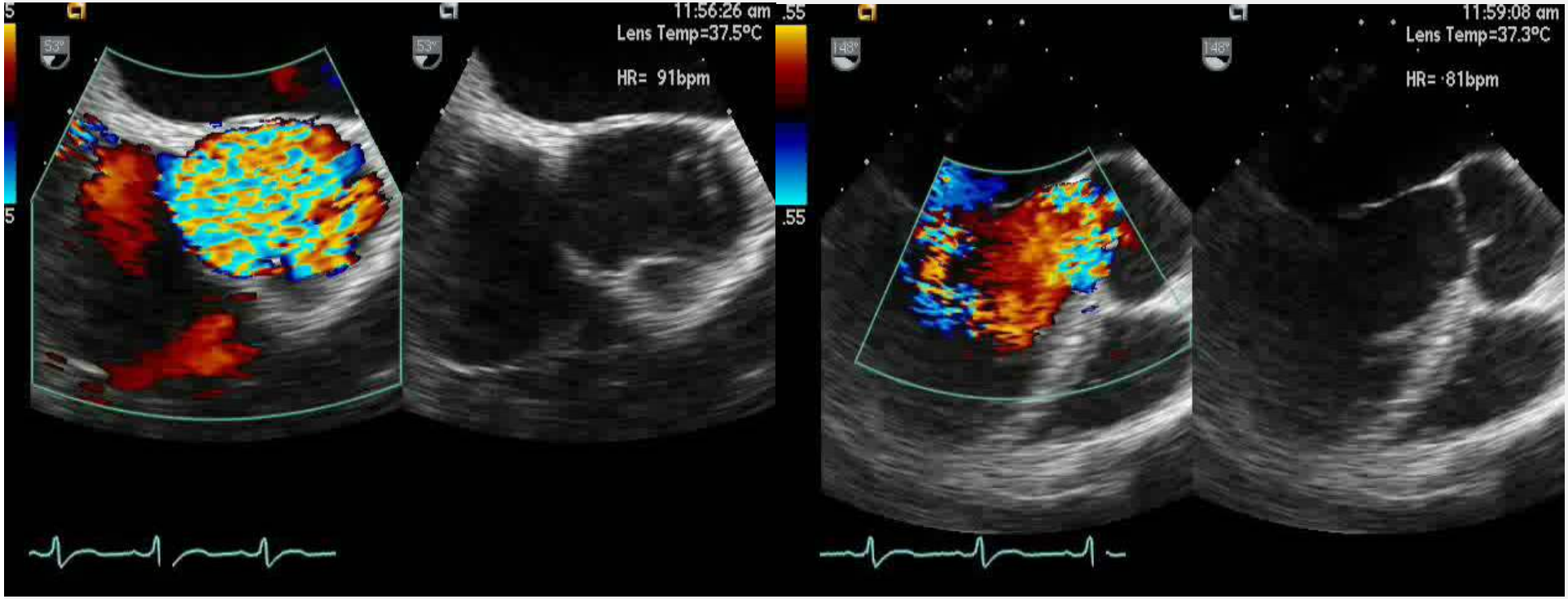
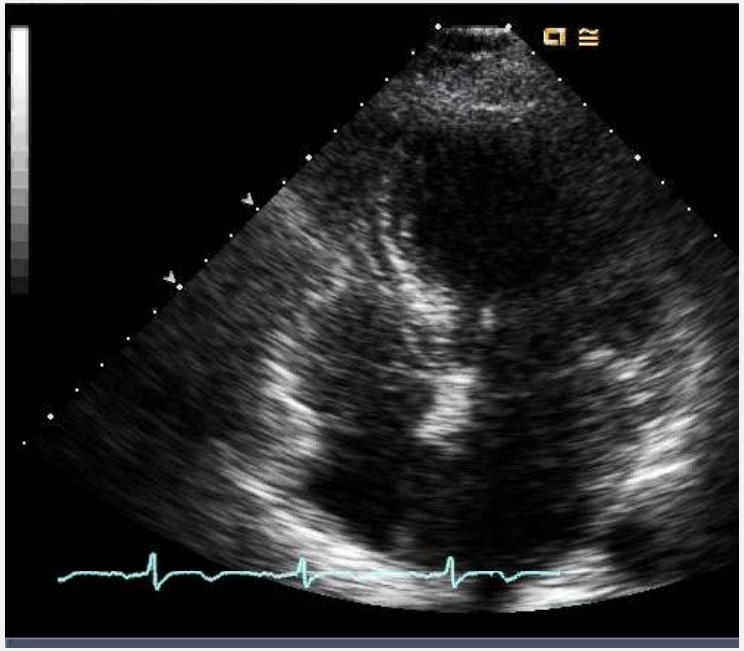


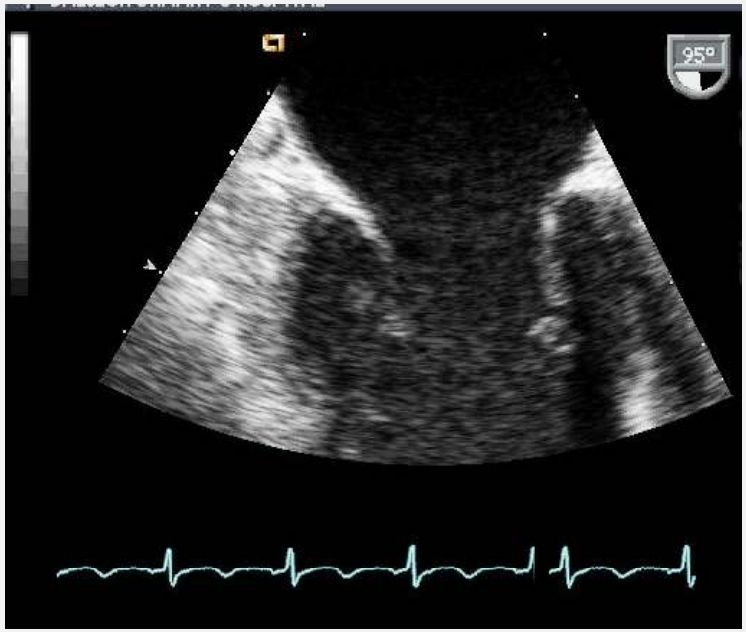
그림 15 ● 경식도 초음파 검사

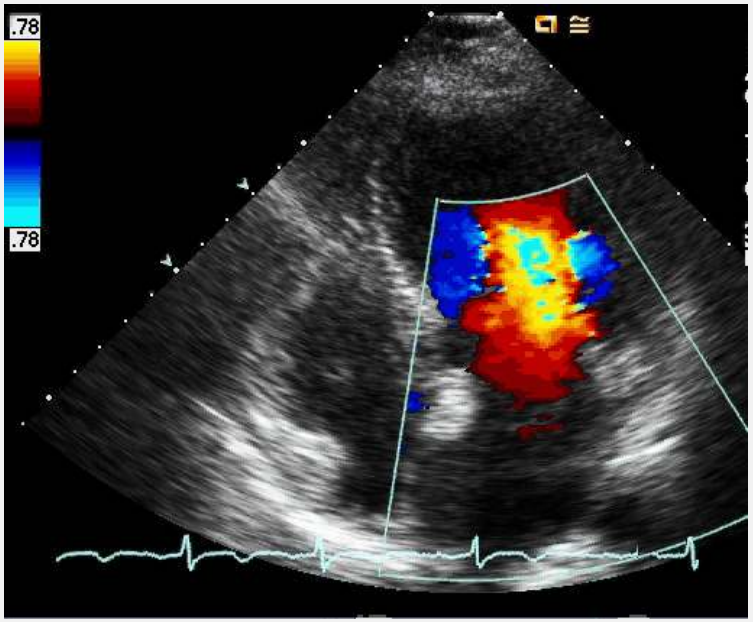
Transesophageal Echocardiography (TEE)
Aortic valve prolapse with severe aortic regurgitation

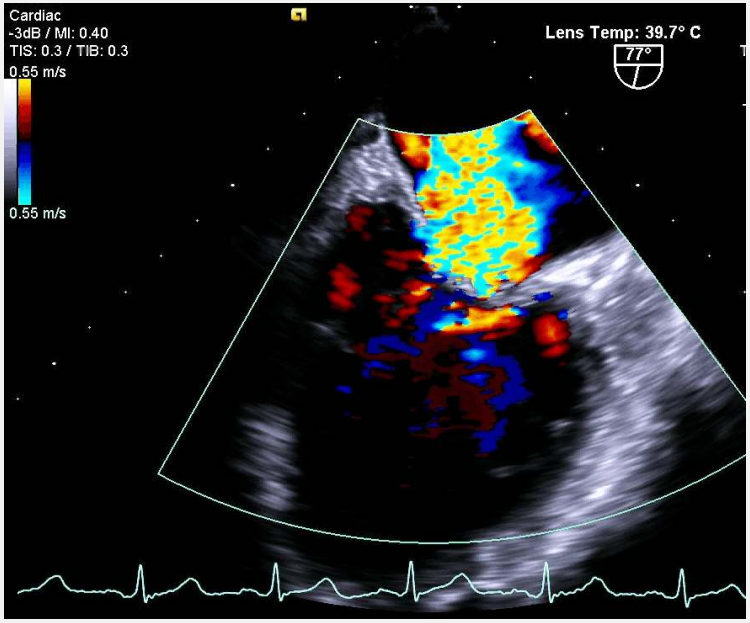


Preoperative TTE and TEE



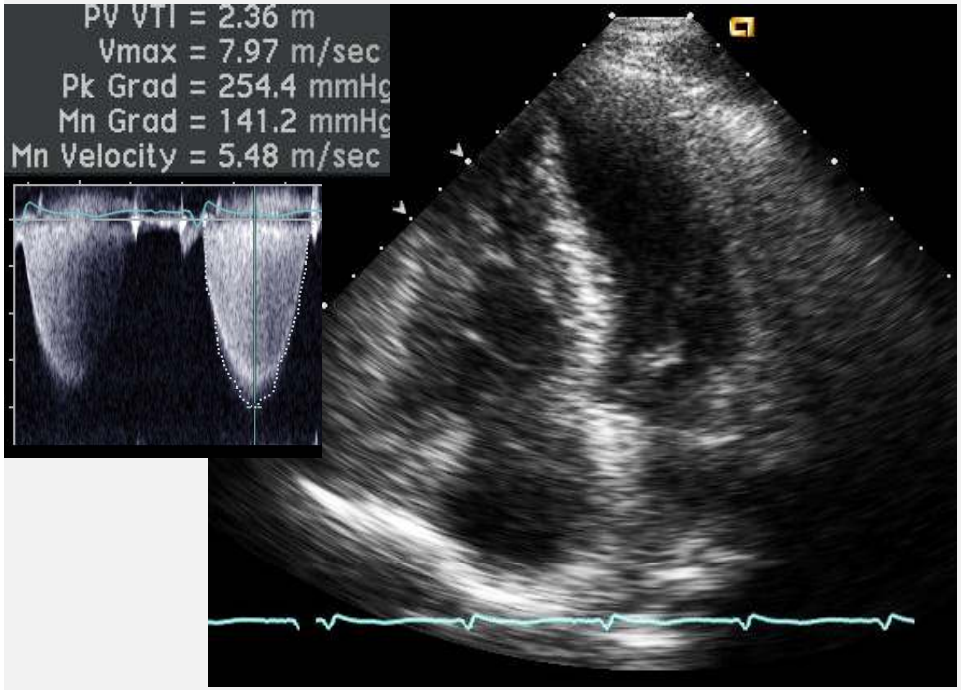


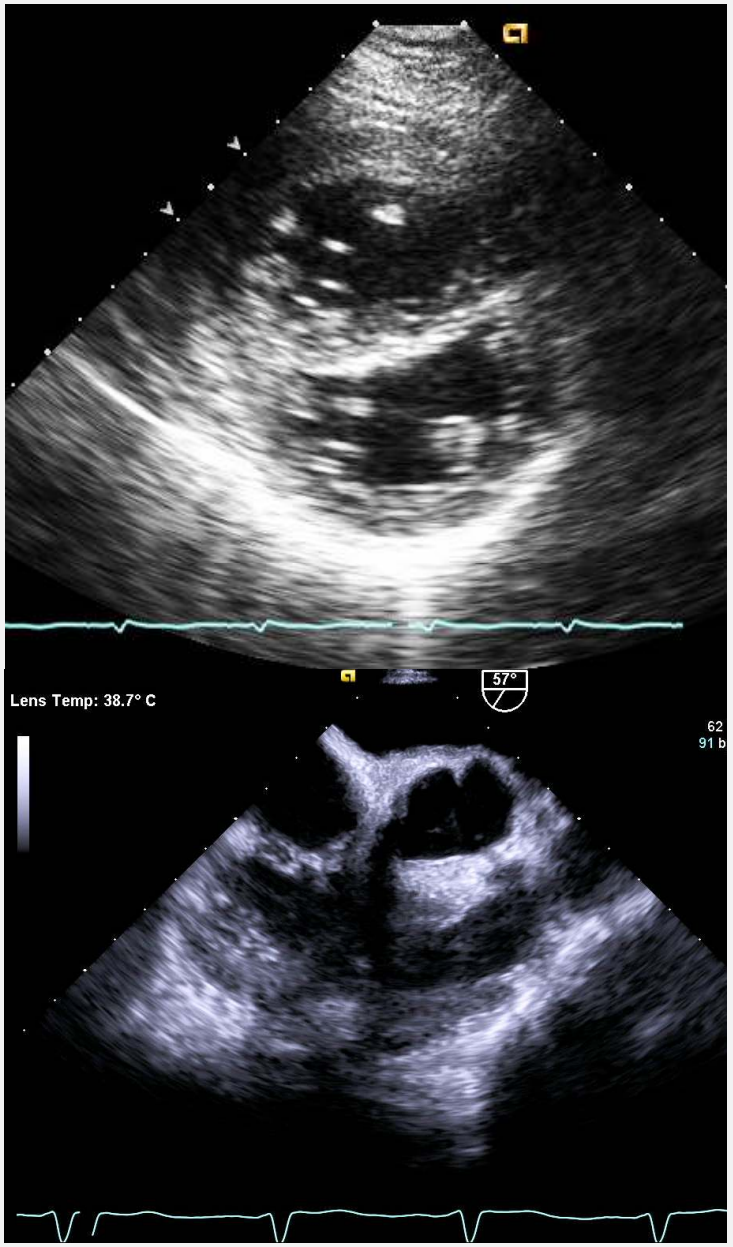


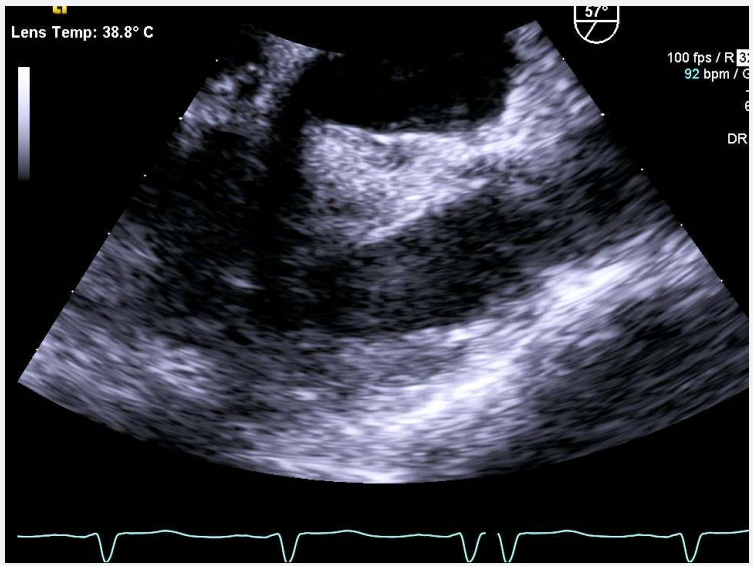


Pulmonary & Tricuspid Valvular disease

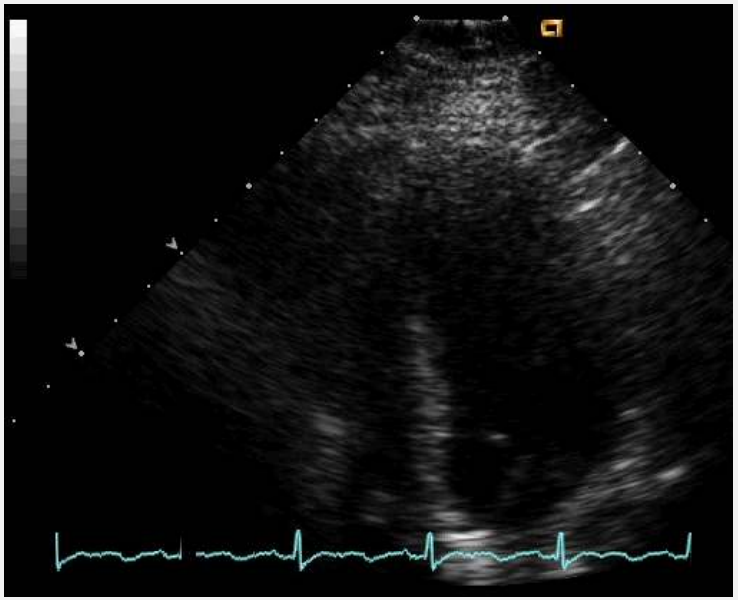
Severe Pulmonary valve stenosis

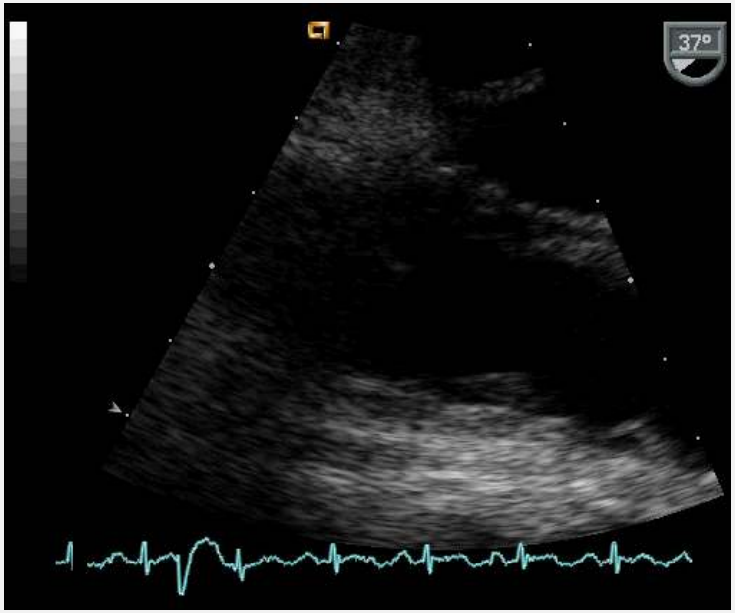


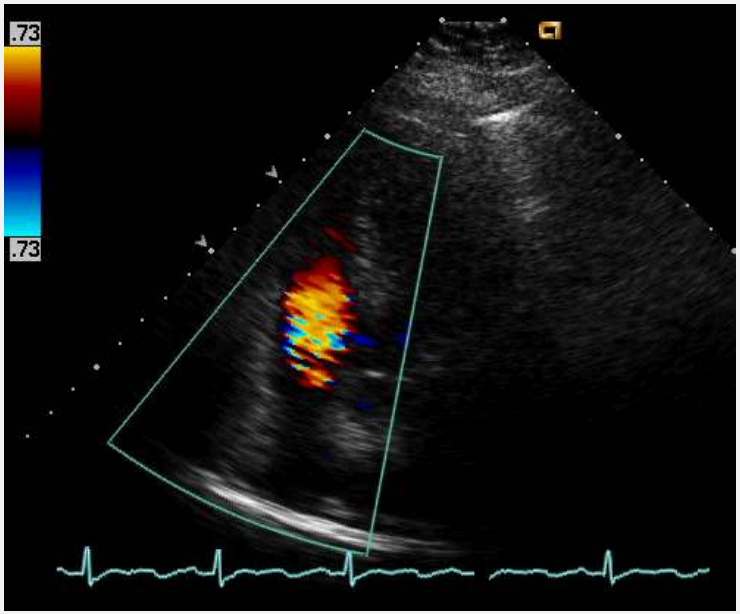


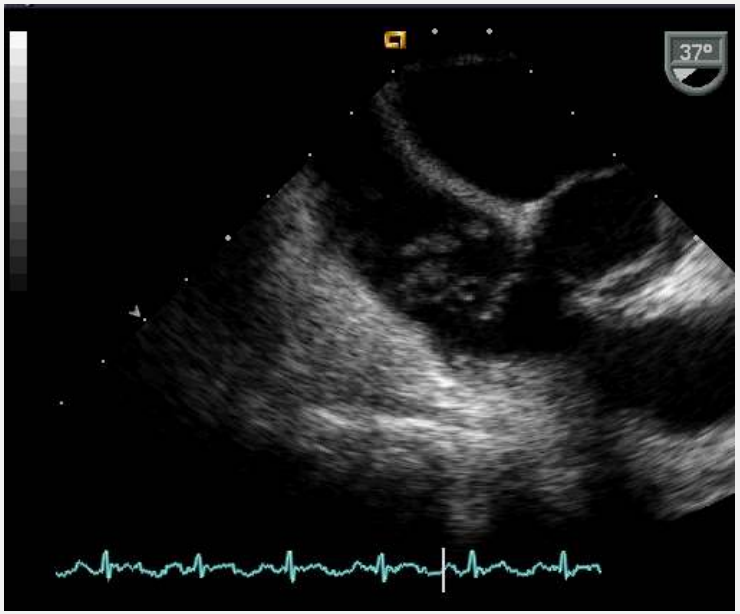


Infective endocarditis of Tricuspid Valve

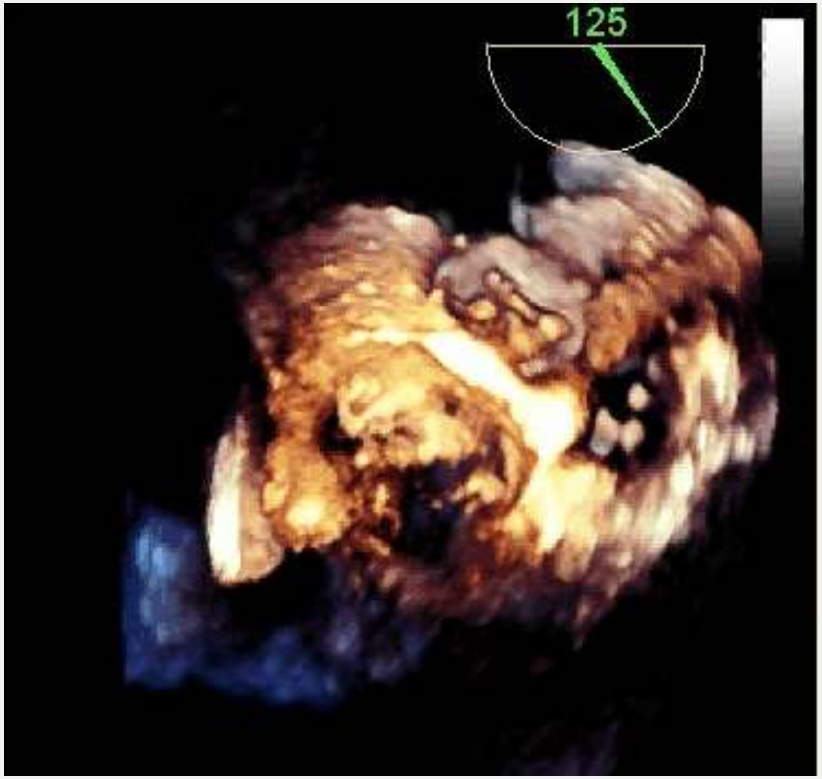




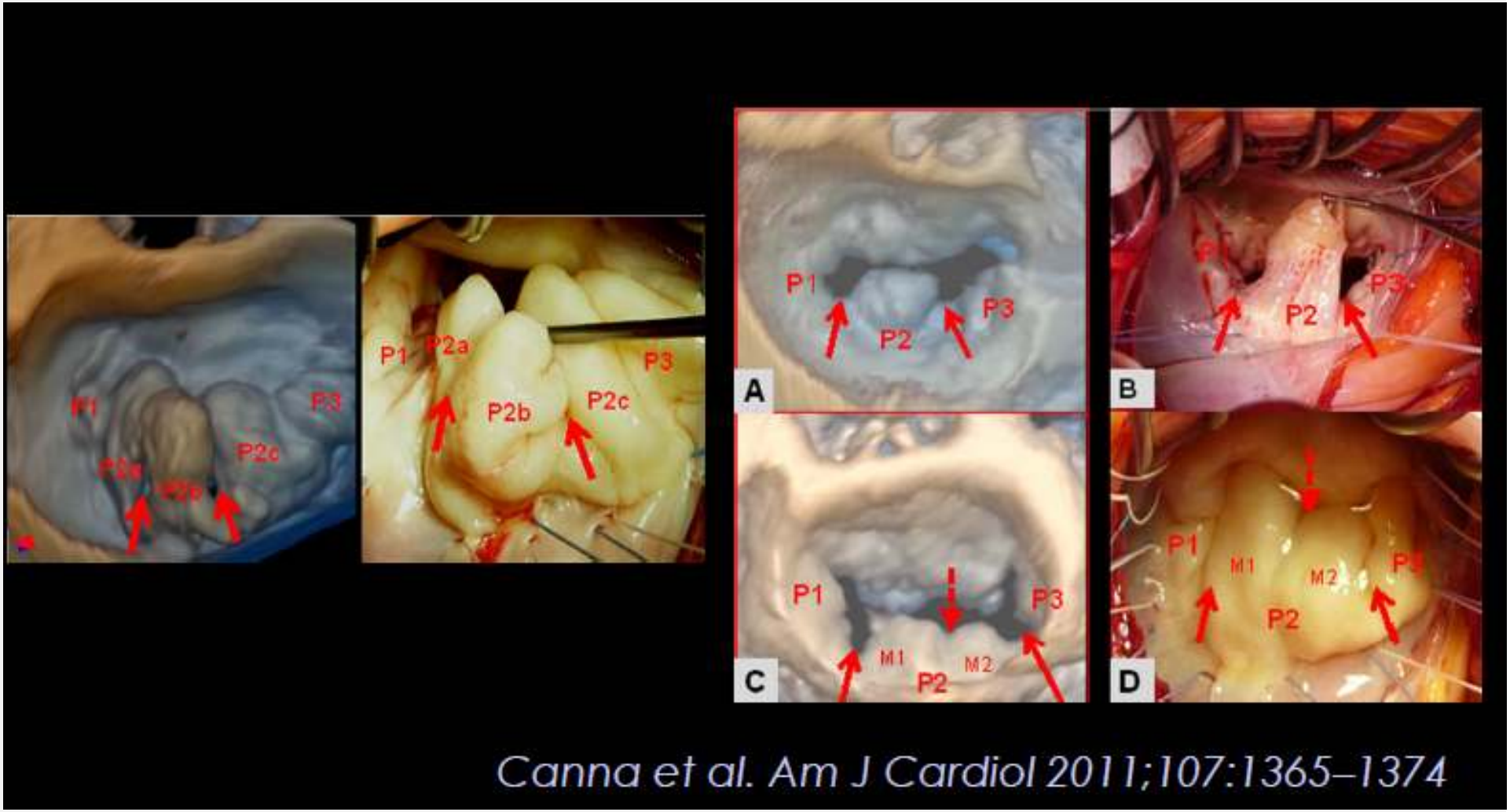




Surgeon's View of 3D Echocardiography

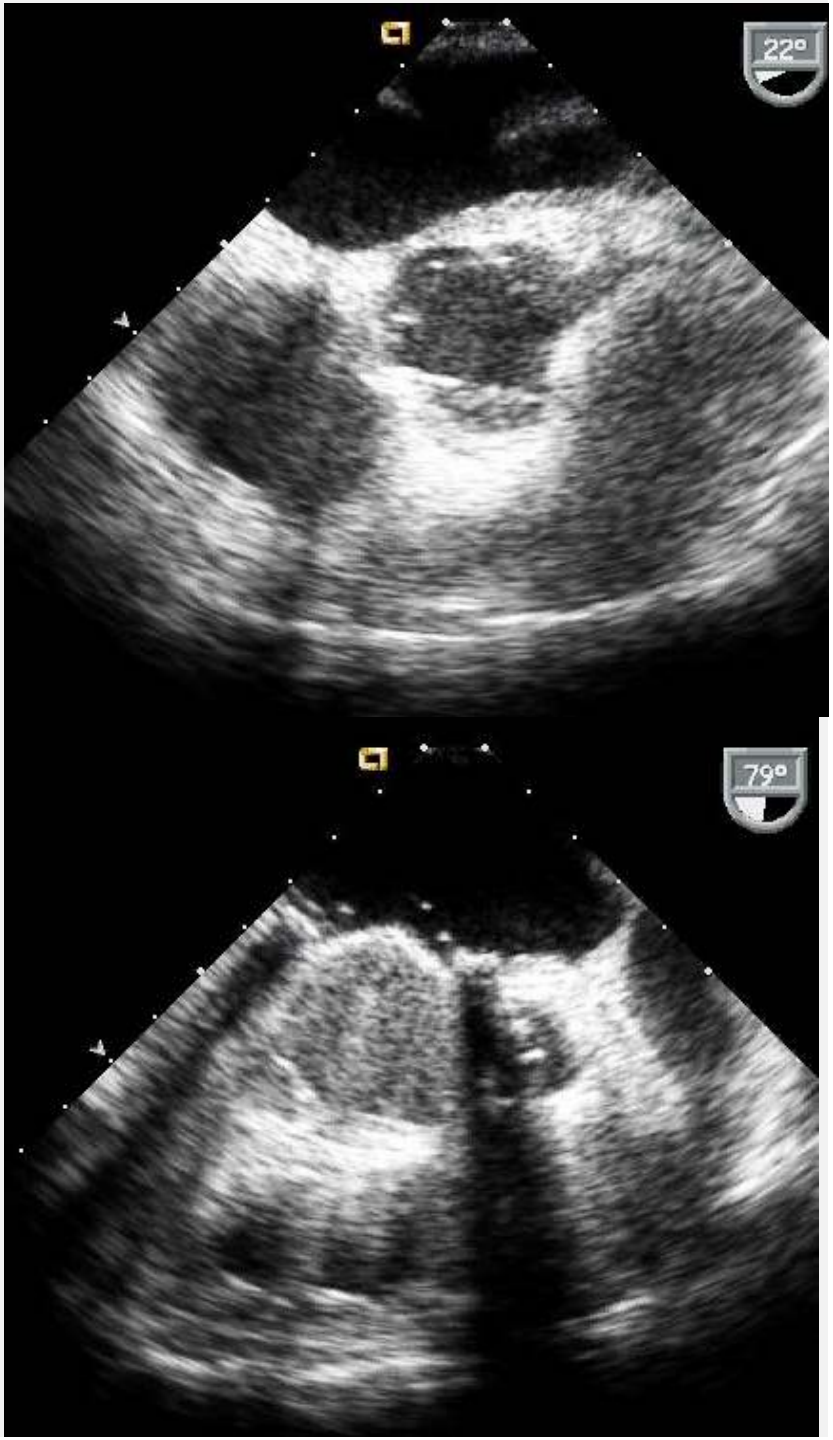


Surgeon's View of 3D Echocardiography
Mitral Valve Prolapse



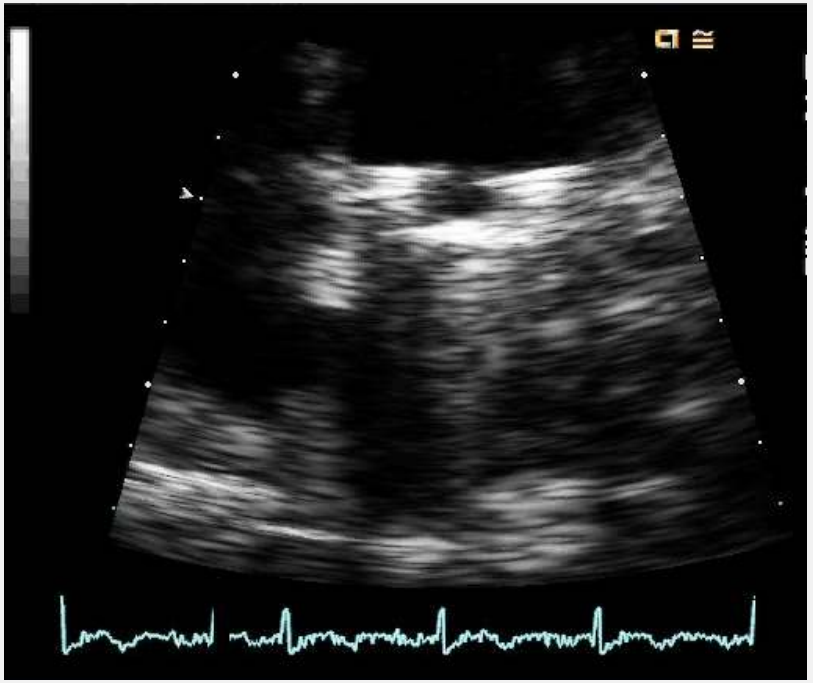
Canna et al. Am J Cardiol 2011;107:1365–1374

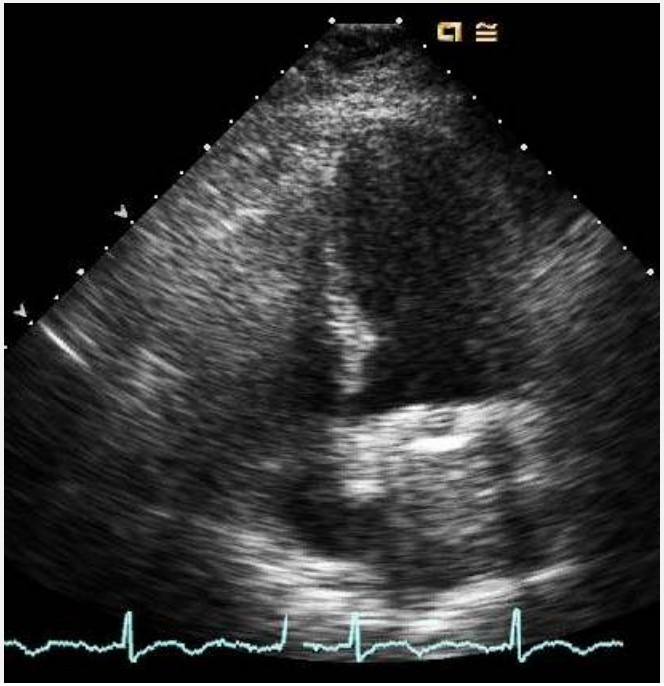
Intraoperative TEE

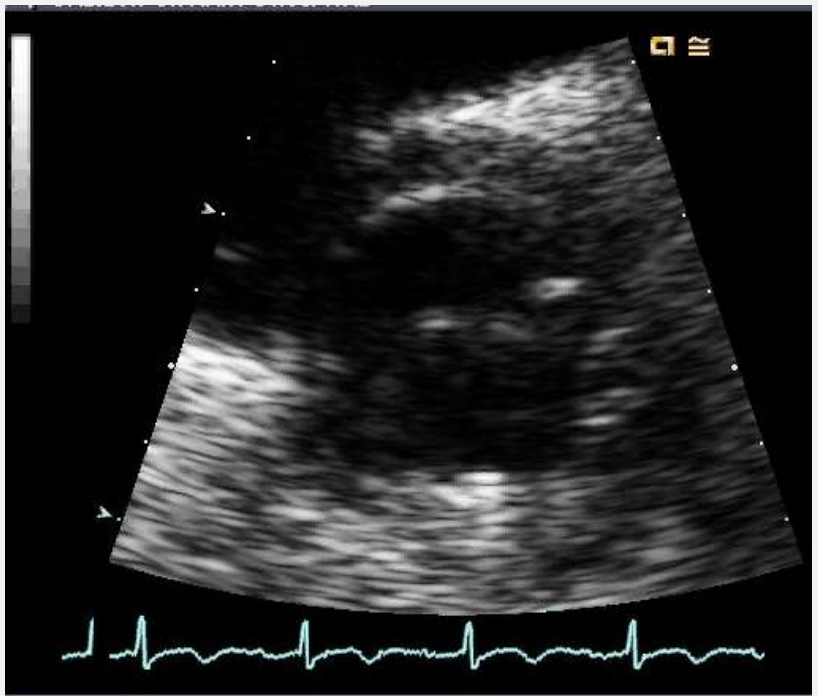


Postoperative Transthoracic Echocardiography

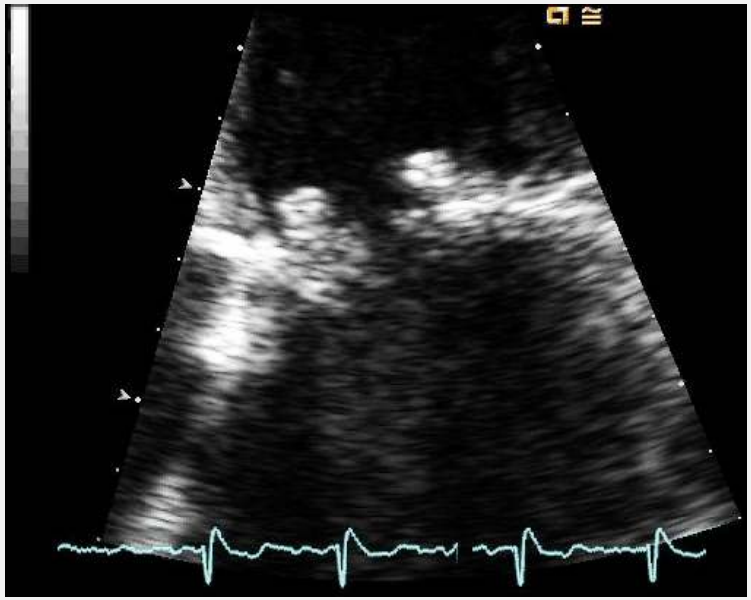
Postoperative TTE - Mechanical valve

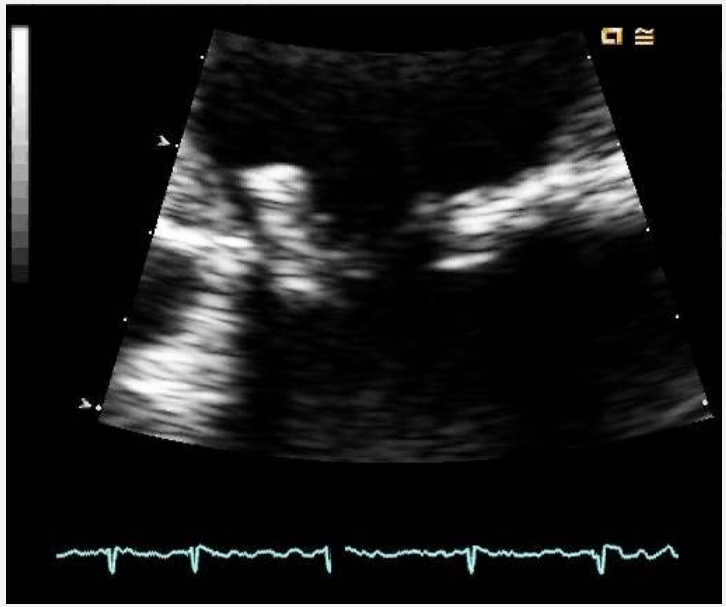


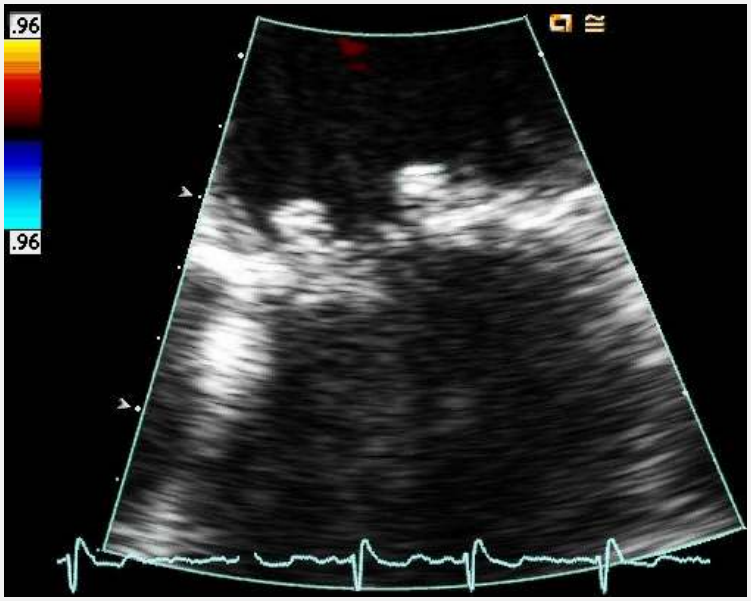


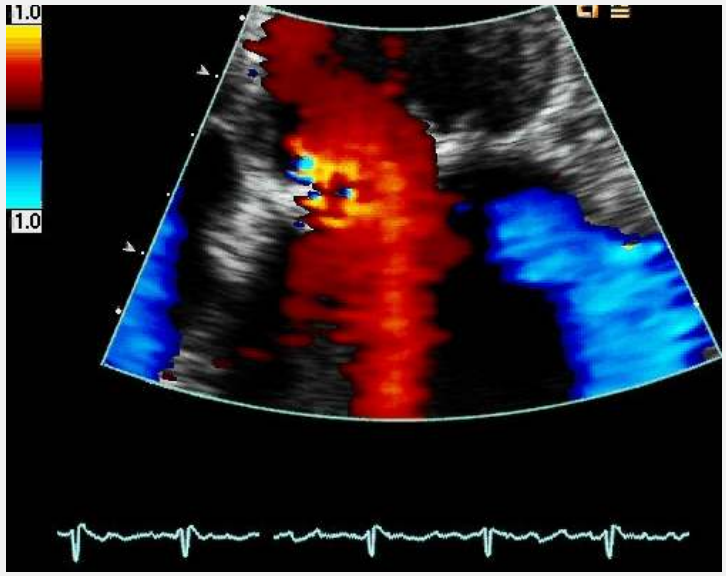


Postoperative TTE - Tissue valve









Take home message

- 심장 초음파는 판막 질환에 있어 흉부외과선생님들의 눈과 같은 역할을 할 수 있으므로 심초음파 영상의 기본 소견을 알고 직접 영상을 확인한다.
- 수술 전, 수술 중, 수술후의 환자의 판막 및 심장 상태를 어느 검사방법보다 비침습적으로 비교적 저렴하게 확인 할 수 있다.
- 심초음파 전문의와 의견 교환이 환자의 치료과정에 도움을 줄 것입니다.