심장 초음파 검사법

심장초음파 검사 단계

- 1단계 Window: PLAX,PSAX,A4C,A5c,A2C,A3C View
- 2단계 Chamber dimension M mode & 2D LV, LA, Aorta, IVS, LVPW thickness, Regional wall motion
- 3단계 Diastolic function
  - E (early diastolic),
  - A (atrial stystole), DT, mitral annulus velocity(e', a', s')

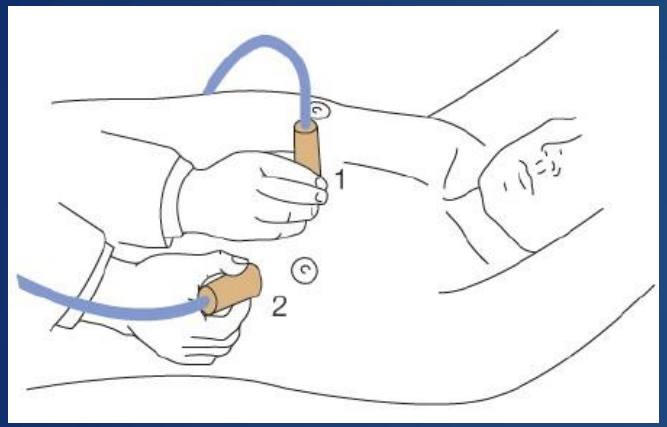
  LV EF & dimension, PA sys pressure Suprasternal notch view, Subcostal view

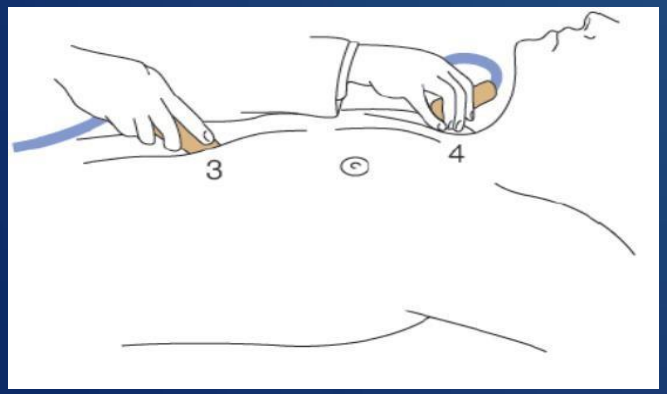
심장초음파 전단계

- 청진
- 과거력, 심전도, 적응증 등의 임상소견 확인
- 탐촉자와 흉벽사이에 공기가 없도록 접촉
- 초음파가 뼈와 공기를 잘 통과할 수 없으므로 초음파가 잘 통과할 수 있는 echo window

경흉부 심초음파

Echo window (transducer position) 순서



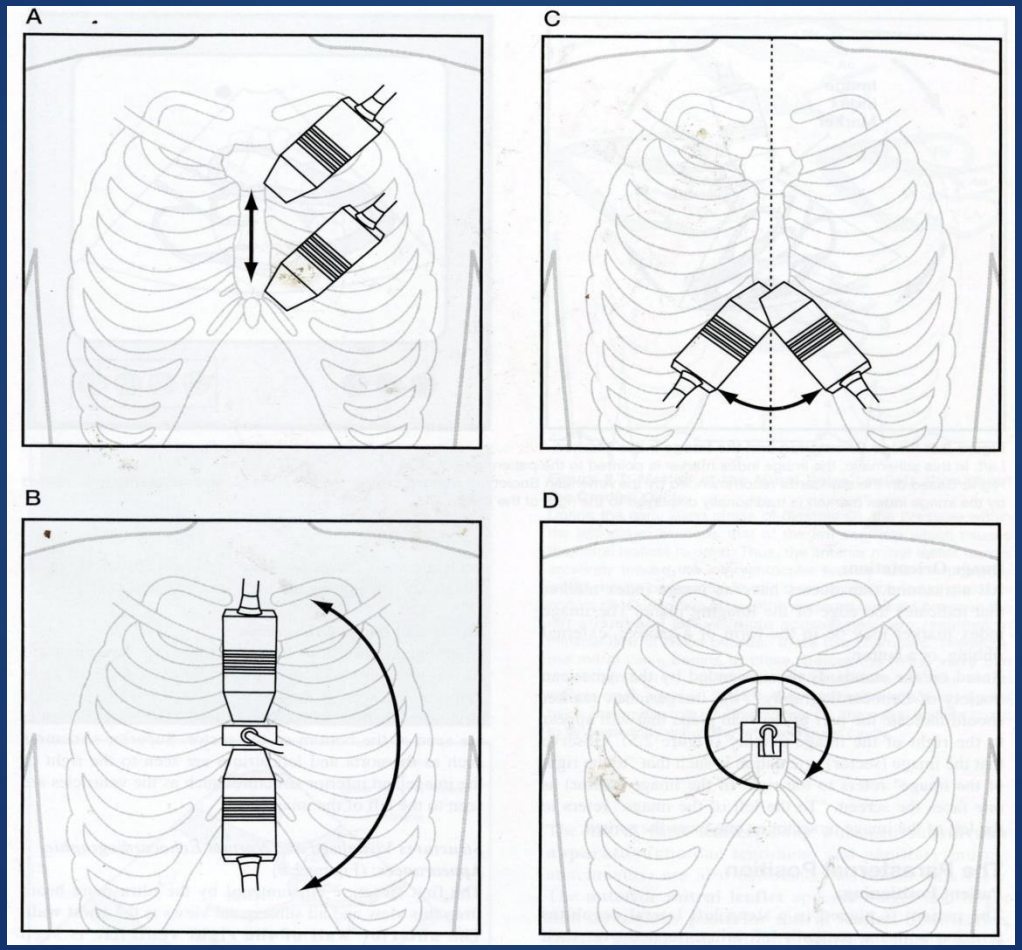


1. Parasternal
2. Apical
3. Subcostal
4. Suprasternal notch

용어

A. 이동 (movement)

B. 기울임 (tilting)



C. 경사 (angulation)

D. 회전 (rotation)

Parasternal long axis view

- lateral decubitus position
- 탐촉자 마크를 환자의 우측 어깨방향
- 좌흉골연의 제3 또는 제4 늑간 위치

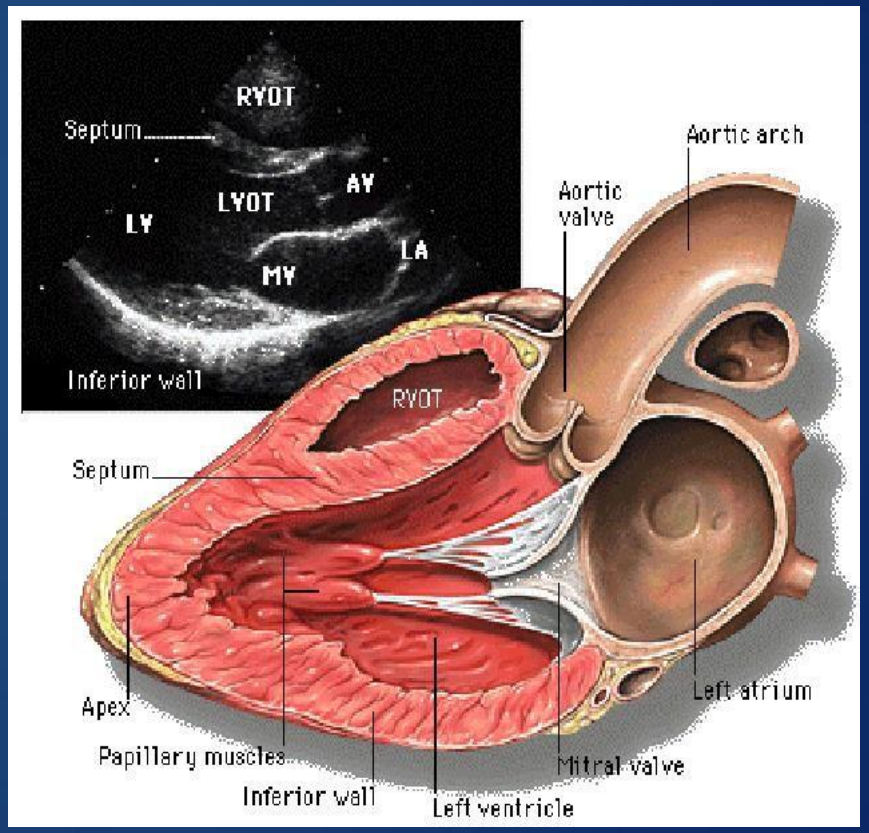




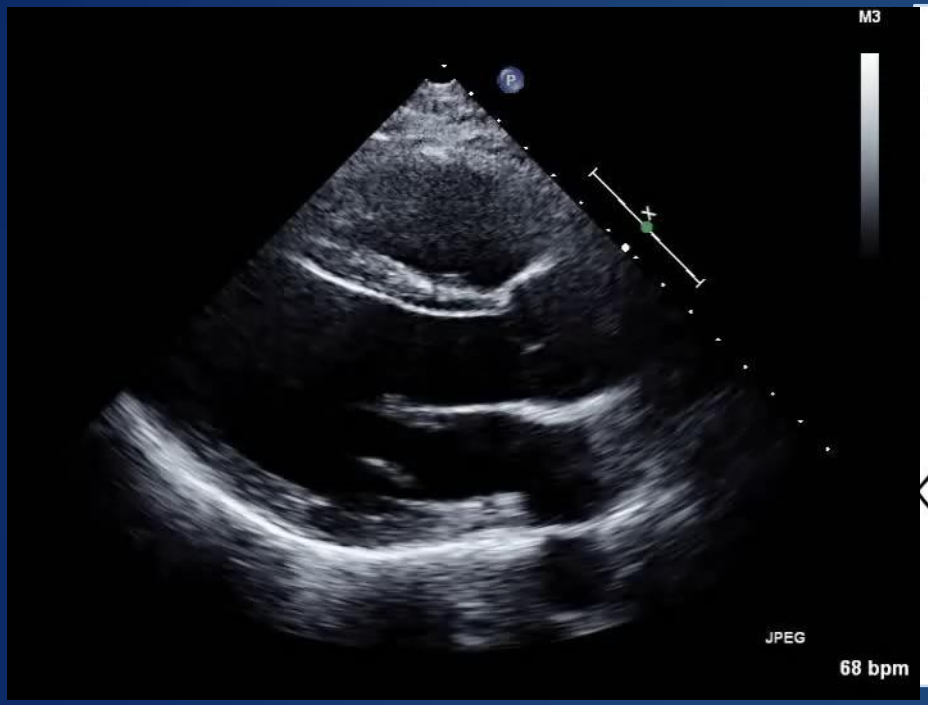


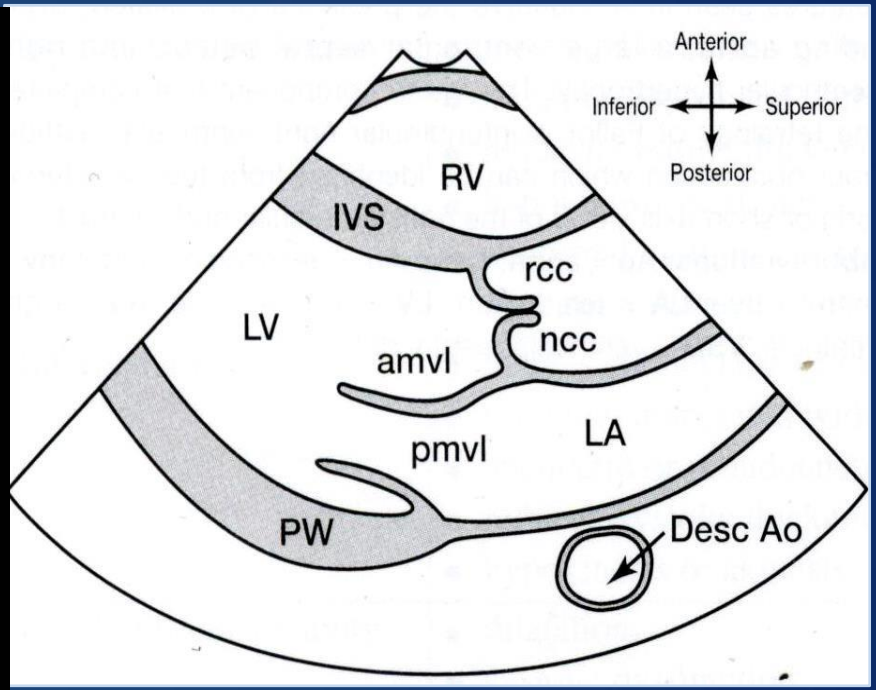
Parasternal long axis view

- LV 크기, 두께 측정
- LV 기능, 벽운동 관찰
- MV 구조, 기능 평가
- AV 구조, 기능 평가
- 대동맥 직경 측정
- LA 직경 측정
- LVOT (outflow tract, 직경 측정)
- 심낭삼출, RV 기능 평가



Parasternal long axis view

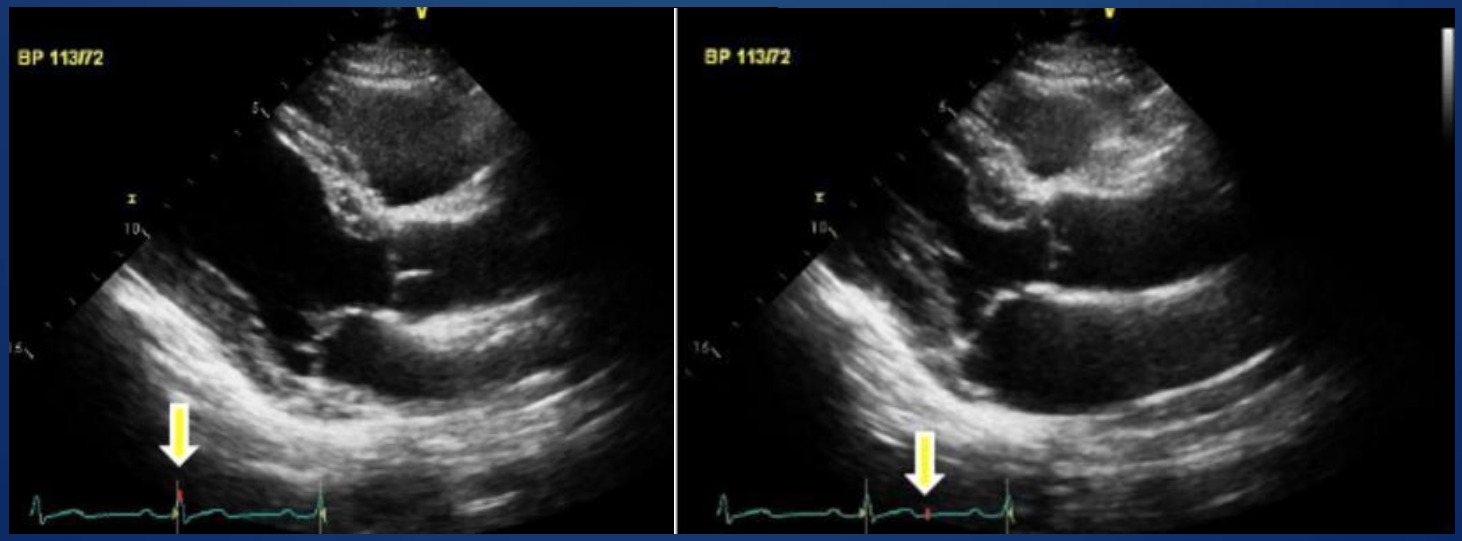




LCC (Left coronary cuspid, 좌반월판), RCC (Right coronary Cuspid, 우반월판)
NCC (Non coronary cuspid, 무반월판)
AML (Anterior mitral leaflet, 승모판막 앞첨판)
PML (Posterior mitral leaflet, 승모판막 뒤첨판)

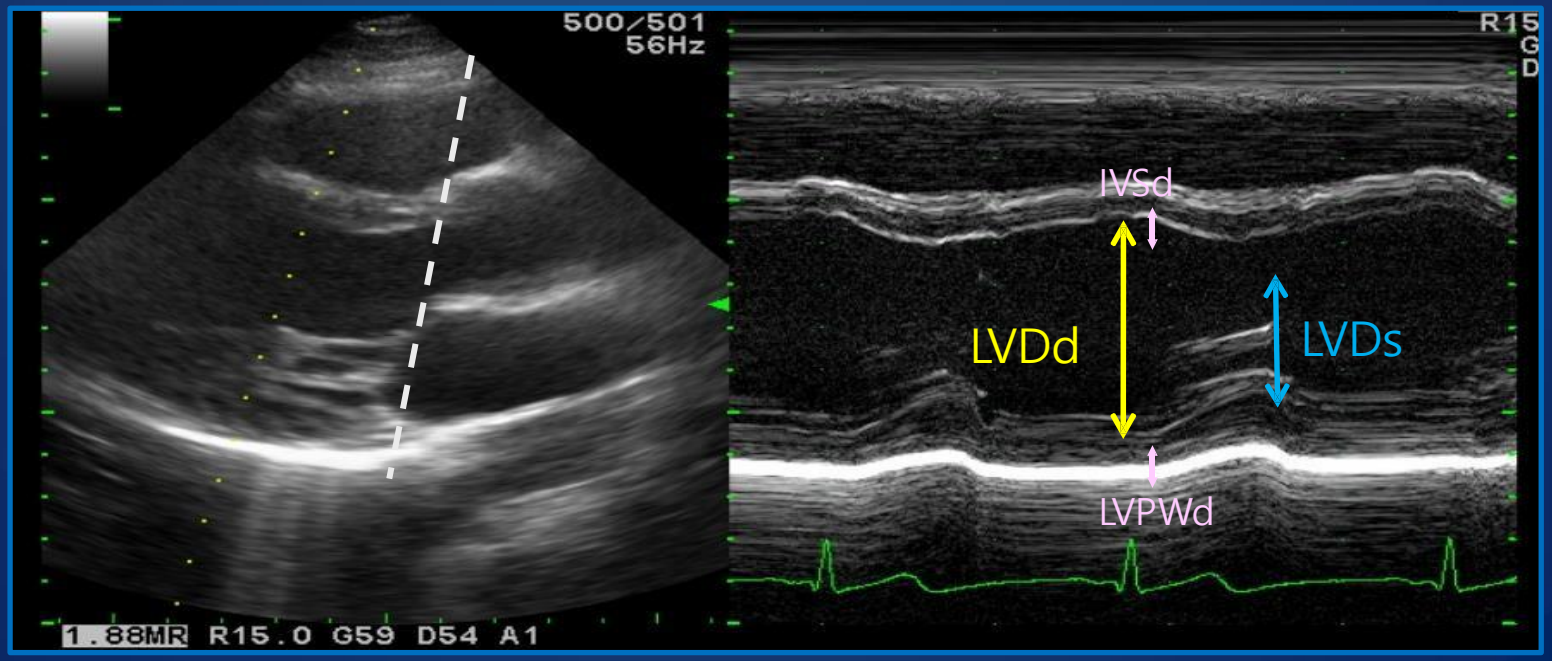
심장 내경 측정의 일반적 원리

- 측정시 고려되어야 할 심주기
  - Sinus rhytm에서 측정
  - 심방세동 시에는 여러 개의 심주기를 측정
  - 심방 및 심실조기 수축을 피한다
- At end-expiration
- End diastole : first frame after mitral valve closure
- End systole : frame after aortic valve closure



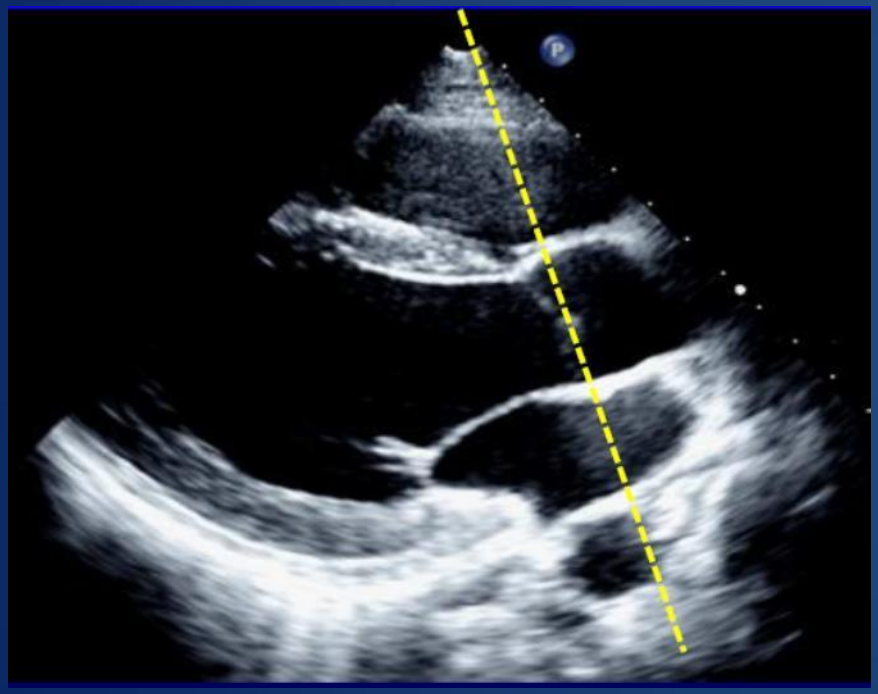
심장 내경 측정의 일반적 원리(LV)

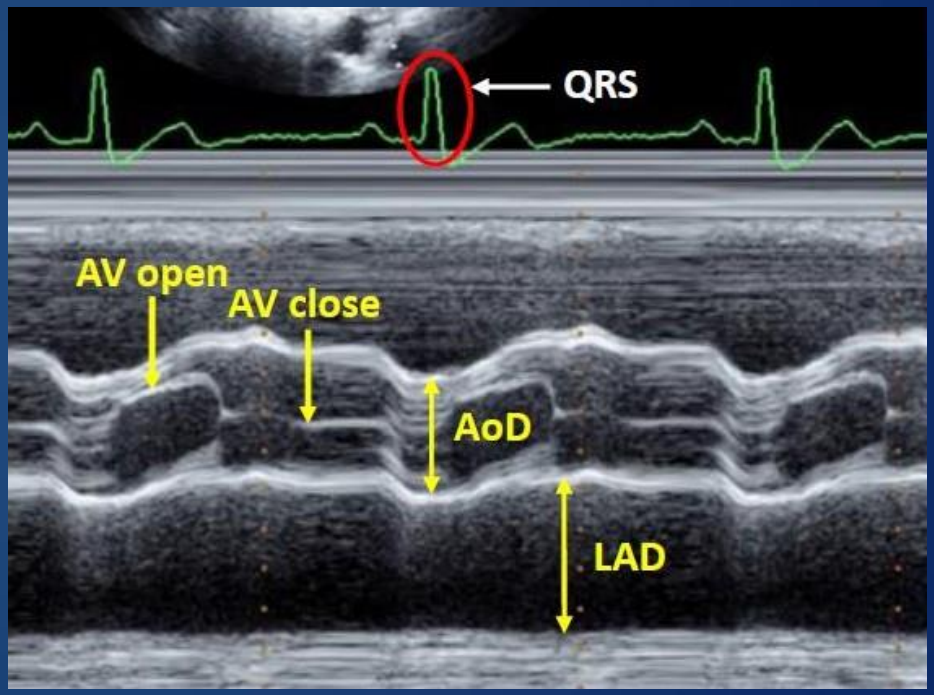
- Perpendicular to the interventricular septum and posterior wall
- 승모판전엽의 끝부분에서 측정
- 확장기말: QRS 파의 시작
- 수축기말: 심실중격이 최대한 좌심실후벽 쪽으로 가까이 왔을 때
- Leading edge to leading edge



심장 내경 측정의 일반적 원리(Ao/LA)

- 대동맥 기시부: 확장기말
- 좌심방: 수축기말





- 대동맥 기시부: 확장기말
- 좌심방: 수축기말

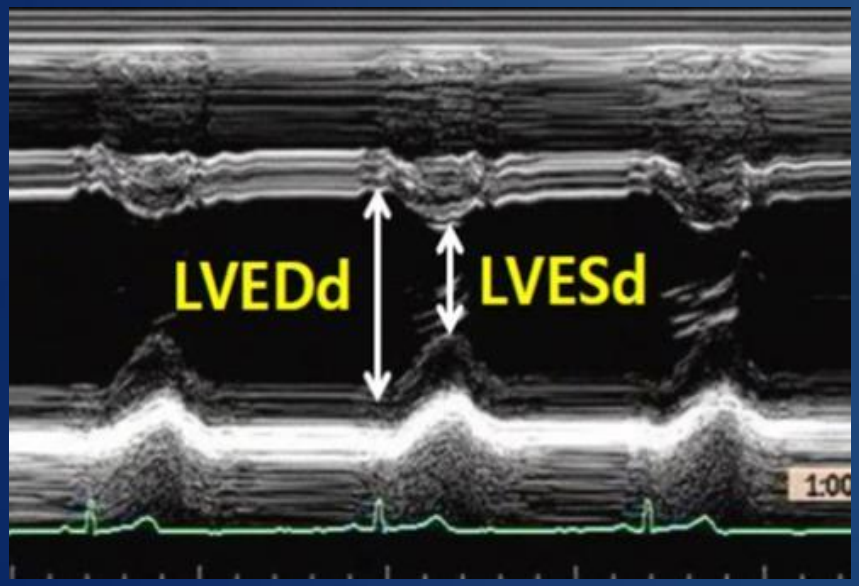
LV EF 측정

- Linear method : M mode, 2D guided
- Volumetric method(biplane Simpson)
- Visual estimation

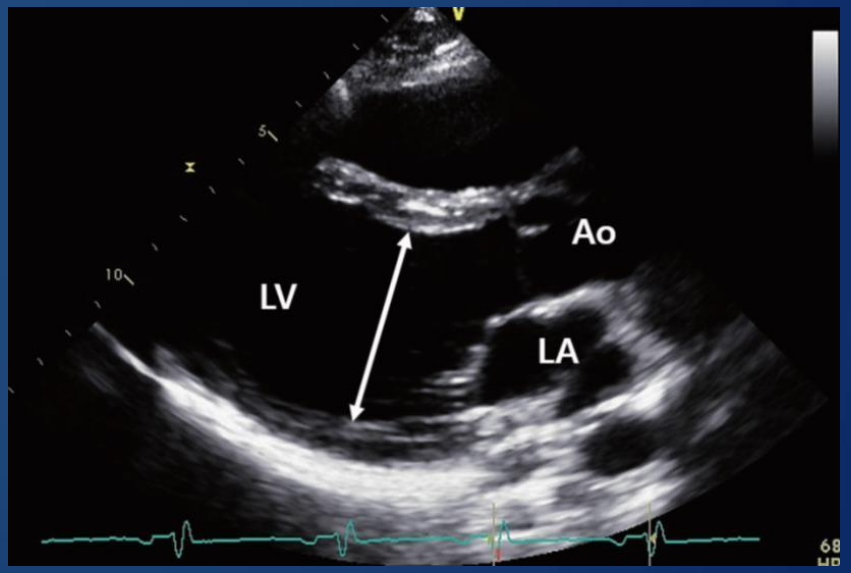
normal	(EF ≥ 55%)
mildly reduced	(EF 45%-54%)
moderately reduced	(EF 30%-44%)
severely reduced	(EF < 30%)

LVEF Linear Measurements

M mode

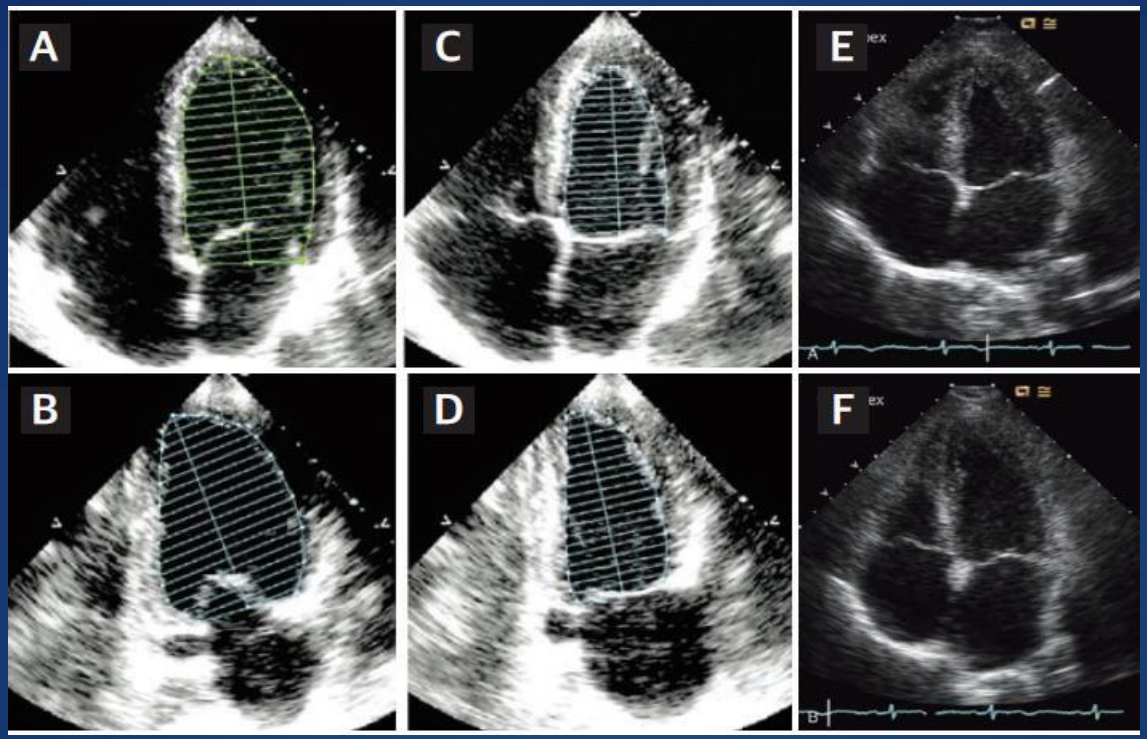


2D guided



EF(%) = (심박출량/이완기말좌심실용적)*100
=[{(LVIDd)^3-(LVIDs)^3}/(LVIDd)^3]*100

Volumetric method(biplane Simpson)

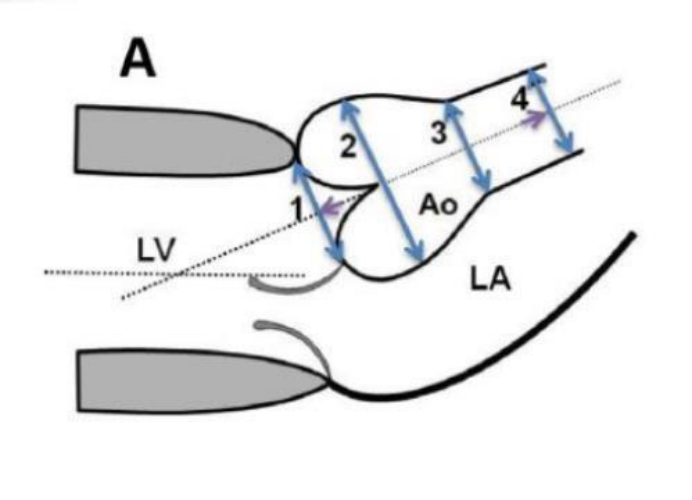


- A4C 와A2C에서 이완기말과 수축기말에 심내막 경계를 추적 산출
- 심내막 경계가 분명한 경우, 국소 벽 운동 장애가 있는 경우 유용

- Foreshortening 시 심실이 구형으로 보이며 LV 용적이 과소평가 심첨부 벽운동 이상을 놓칠 수 있음-> 탐촉자를 한 늑간 밑으로, true apex 쪽을 향해 외측으로 이동

대동맥 근위부 측정

- 대동맥을 중앙에 위치



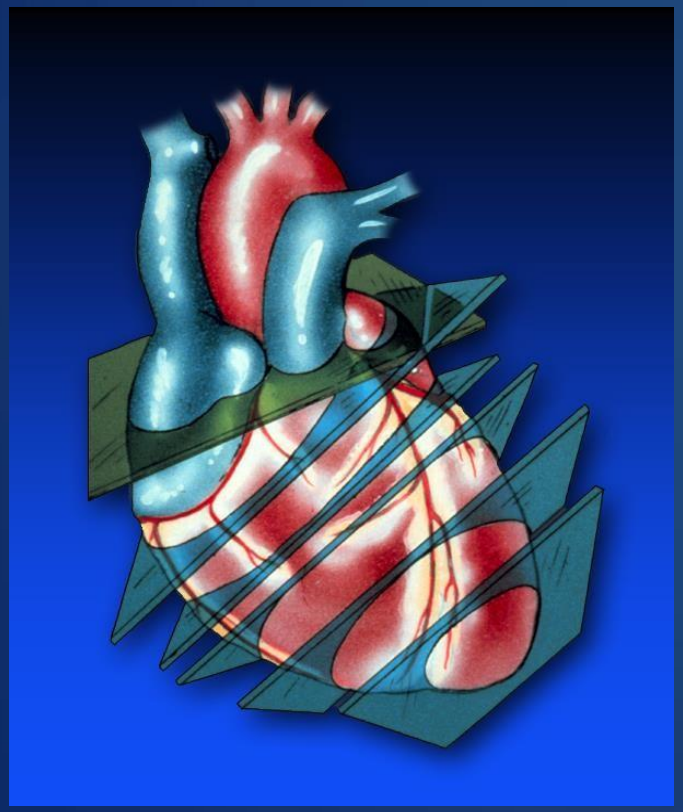


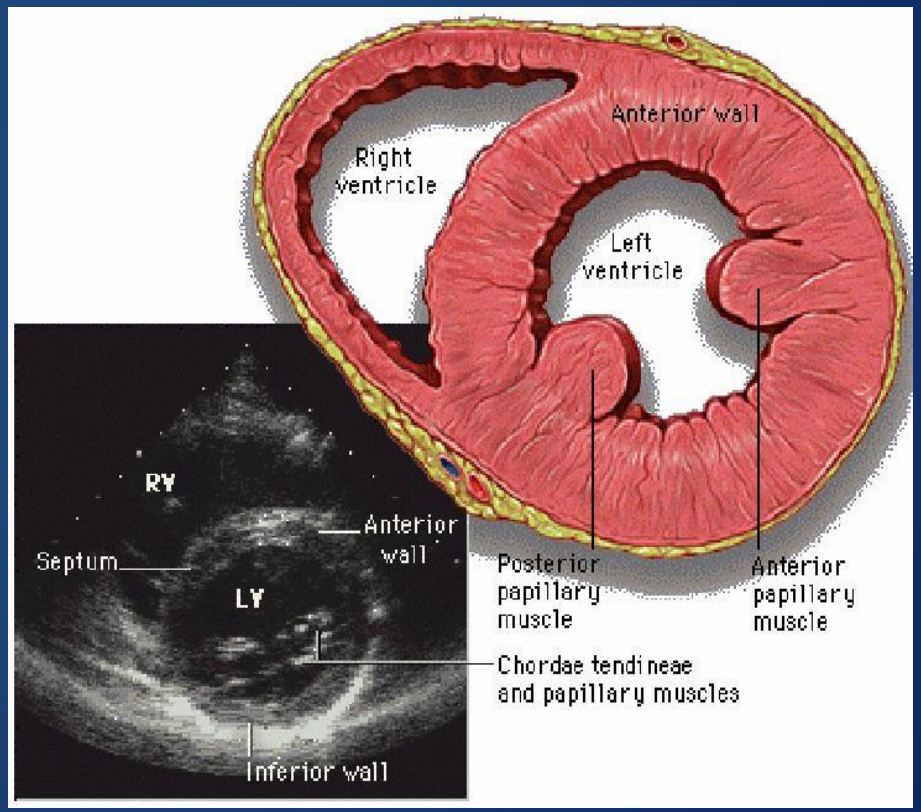
- 1. AV annulus – peak systole
- 2. Sinus of Valsava (maximal diameter)- end diastole
- 3. Sinotubular junction- end diastole
- 4. Proximal ascending aorta- end diastole

Normal Chamber Size

- LV dimension ; systolic < 35 mm,
  diastolic < 55mm
- LV wall thickness (diastolic) < 12 mm
- RV wall thickness < 5 mm
- LA dimension < 40 mm
- Aorta (sinus portion) <35 mm

Parasternal short axis view





Parasternal short axis view

PLAX에서 탐촉자를 시계방향으로 90도 회전



MV level
- LV 기저부 벽운동 관찰
- MV 구조, 기능 평가



Parasternal short axis view





AV level

- AV, PV, TV 구조, 기능 평가
- 심실 크기, 기능 평가
- 심방중격 관찰
- VSD, PDA 유무 확인

Parasternal short axis view





PM level
- 두개의 유두근 확인(3시, 8시 방향)
- LV 크기, 두께 측정
- LV 중간부 벽운동 관찰
- RV 크기, 기능 평가

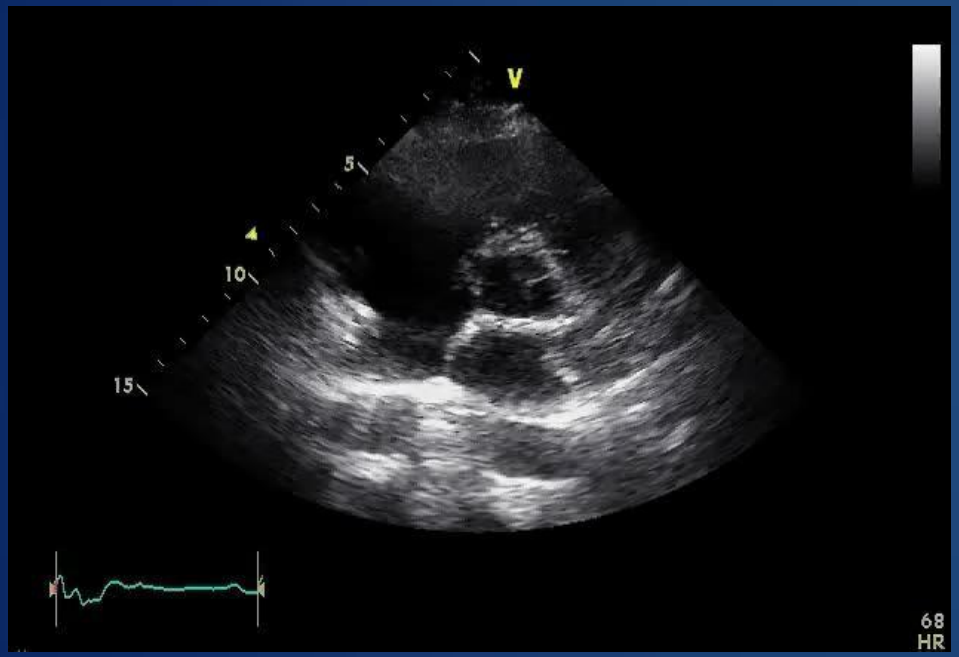


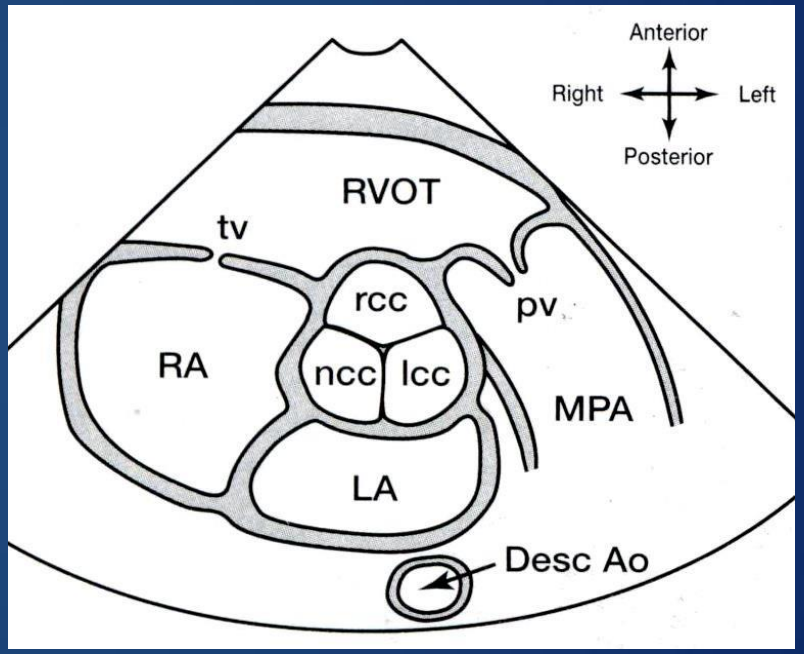
Apical level
- LV 심첨부 벽운동 관찰
- 심첨부 종괴,비후 확인



Parasternal short axis view

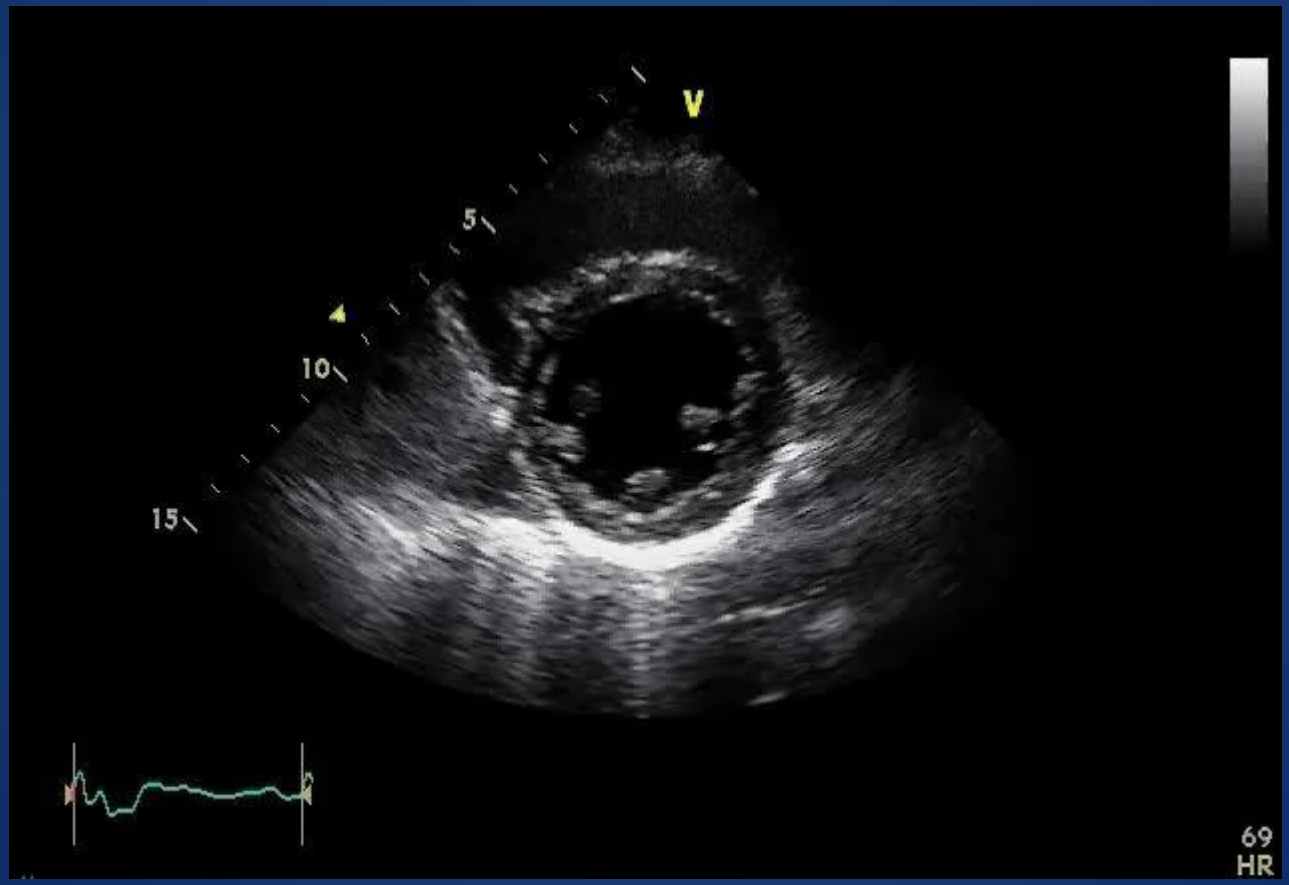
PSAX - AV





Parasternal short axis view

PSAX - MV

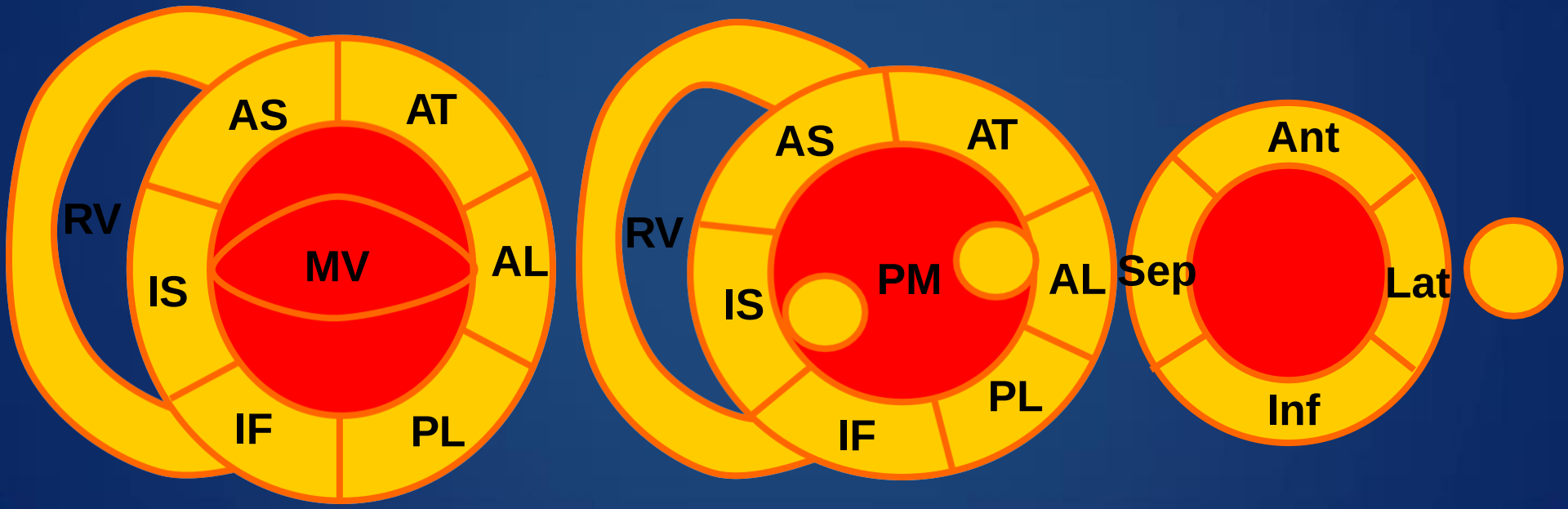


Parasternal short axis view

PSAX - Apex



Regional Function

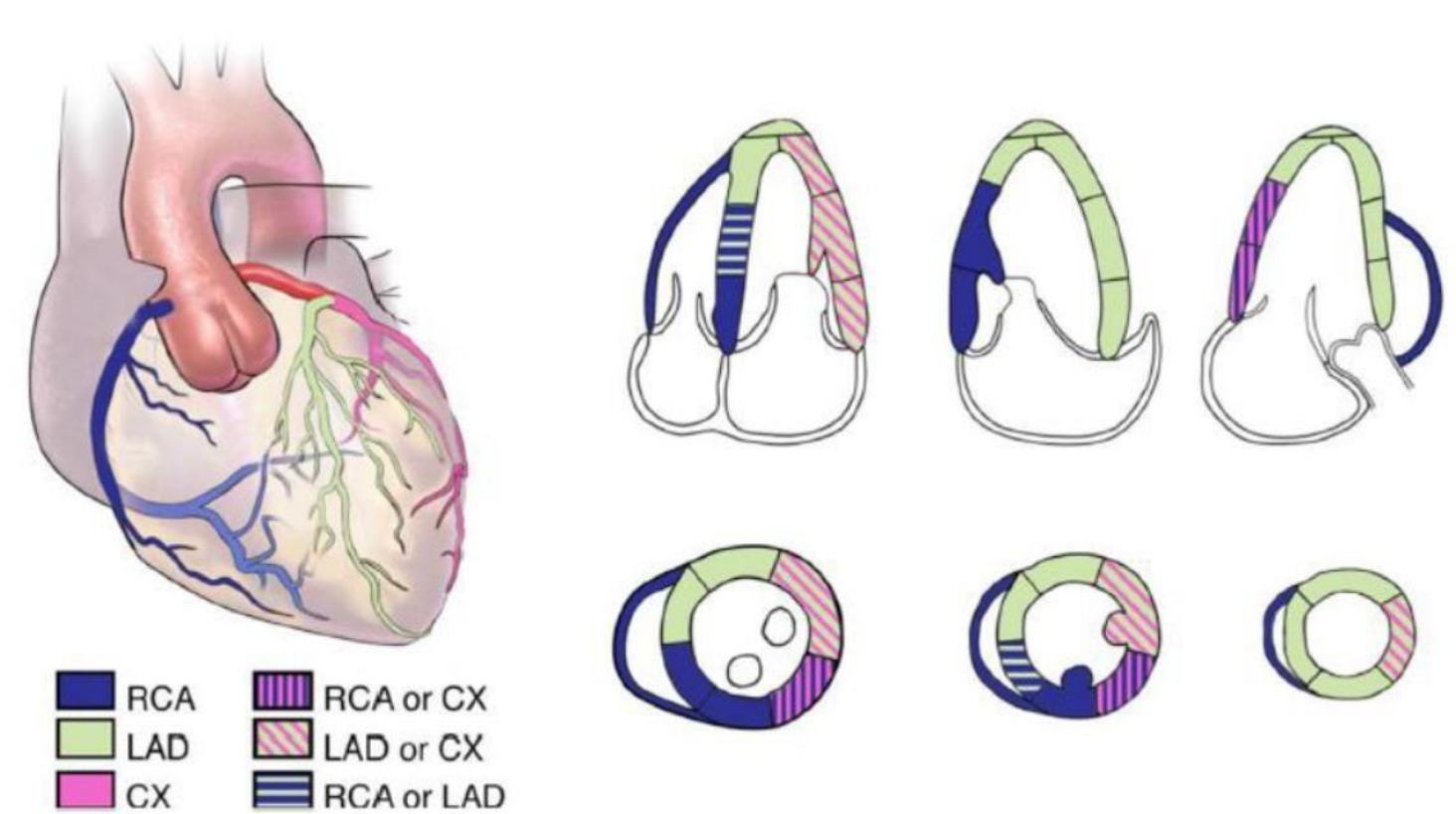


6 6 4 1

Regional Wall motion abnormalities

벽운동	수축기 심근벽 두꺼워짐	수축기 심내막 운동 방향
정상(normal)	정상(>30%)	정상(안쪽)
운동저하 (hypokinesis)	감소(≤30%)	감소
무운동(akinesis)	없음	없음
운동실조 (dyskinesis)	얇아짐	반대(바깥쪽)
심실류(aneurysm)	없거나 얇아짐	수축기와 이완기 모두 반대

Regional Wall motion abnormalities



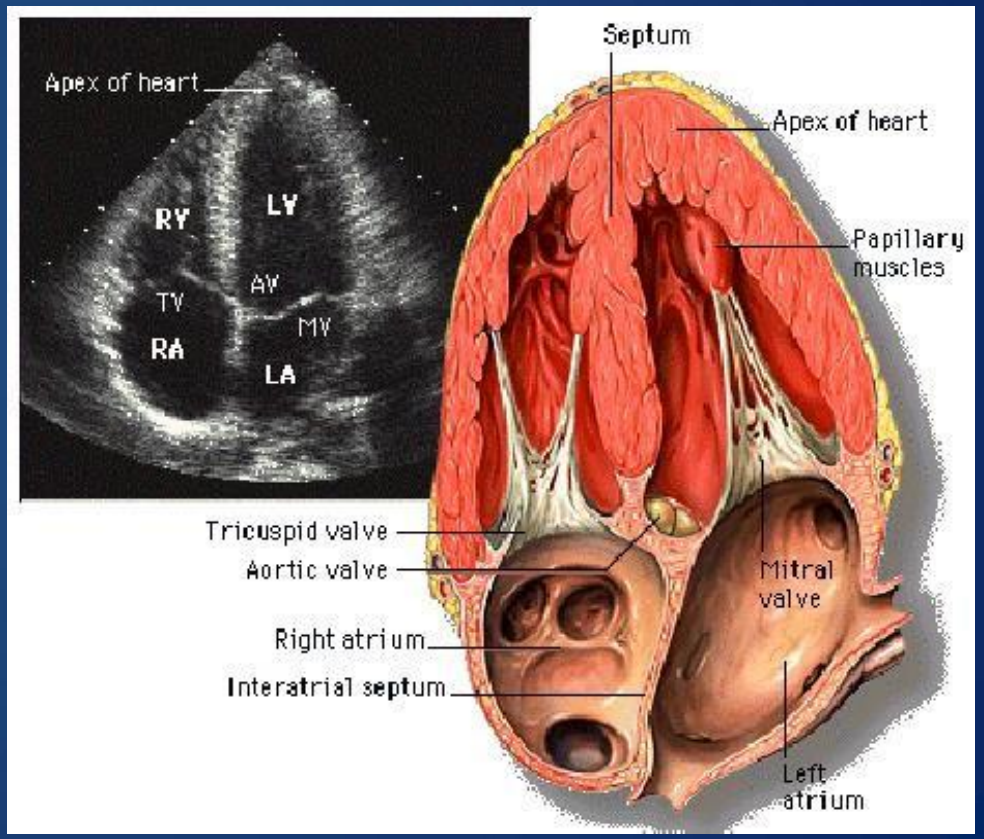
JASE 2015;28:1-39

Apical 4-chamber views

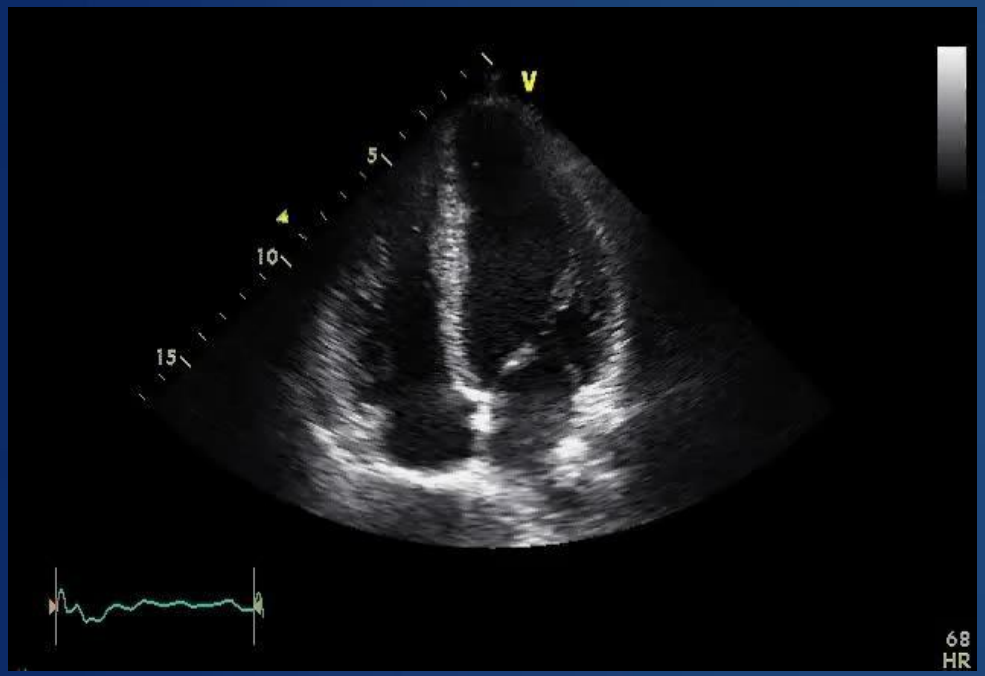
the probe at the apex located at the apical impulse

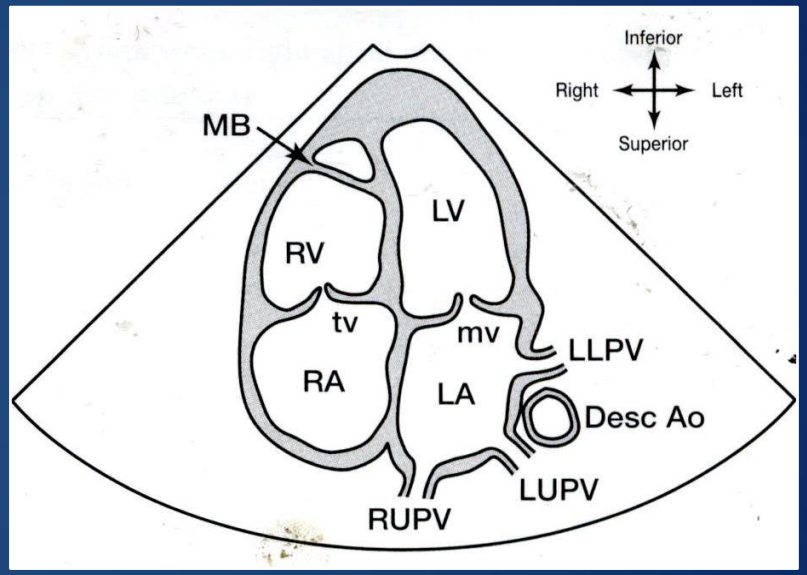


- LV 크기, 두께 평가
- LV 기능(EF), 벽운동 평가
- RV 크기, 두께 평가
- LA, RA 크기 평가
- LV 이완기능 평가 (MV E, A, E/A, DT, e')
- MV구조와 기능 평가
- TV 구조와 기능 평가



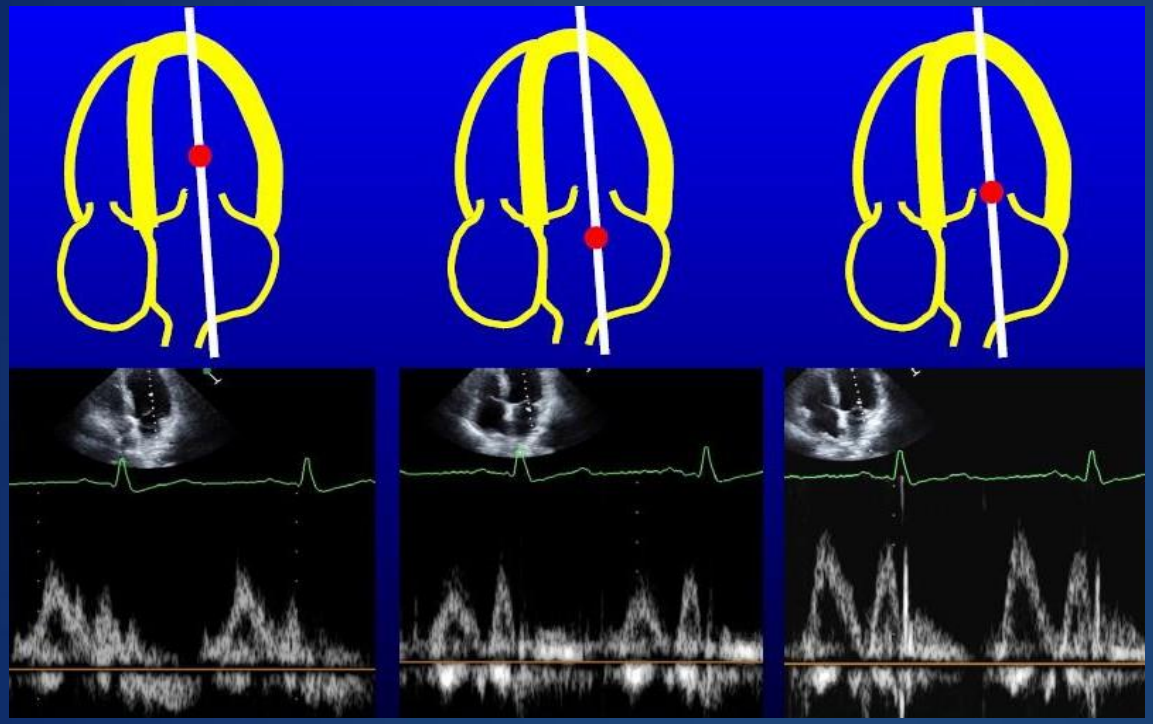
Apical 4-chamber views





- RUPV (right upper pulmonary vein, 오른 위 폐정맥)
- LLPV (left low pulmonary vein, 왼 아래 폐정맥)
- LUPV (left upper pulmonary vein, 왼 위 폐정맥)

Mitral inflow

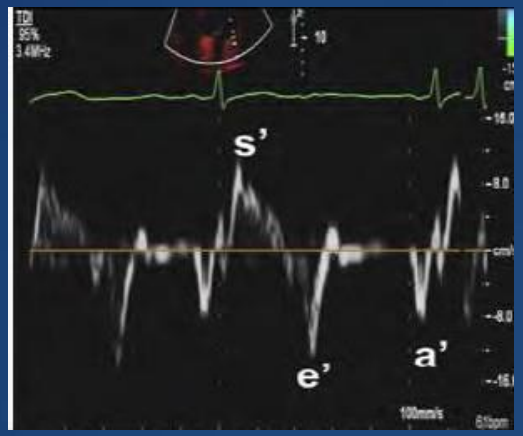


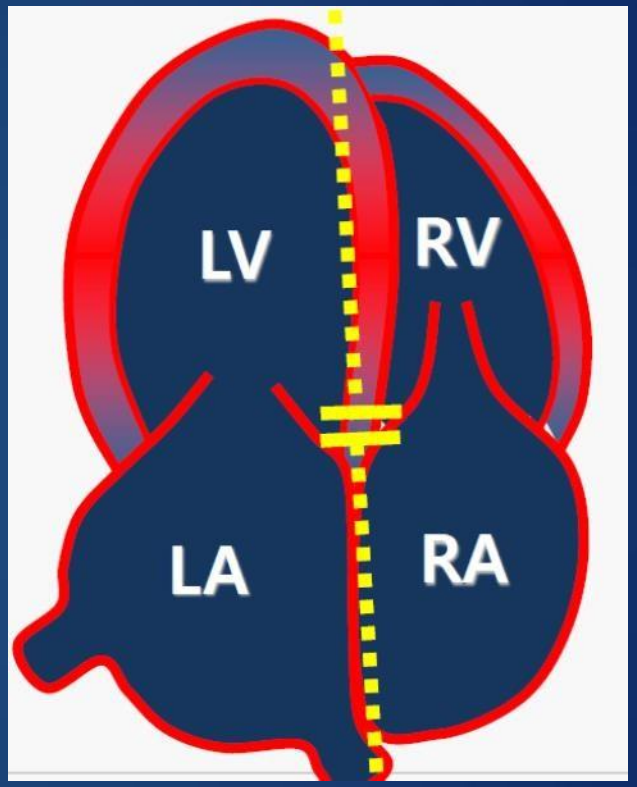
- A4C, PW Doppler
- 표본용적 2-3 mm, MV 끝
- E, A velocity, E/A ratio, DT 측정

Mitral annulus velocity

Tissue Doppler- Medial, lateral

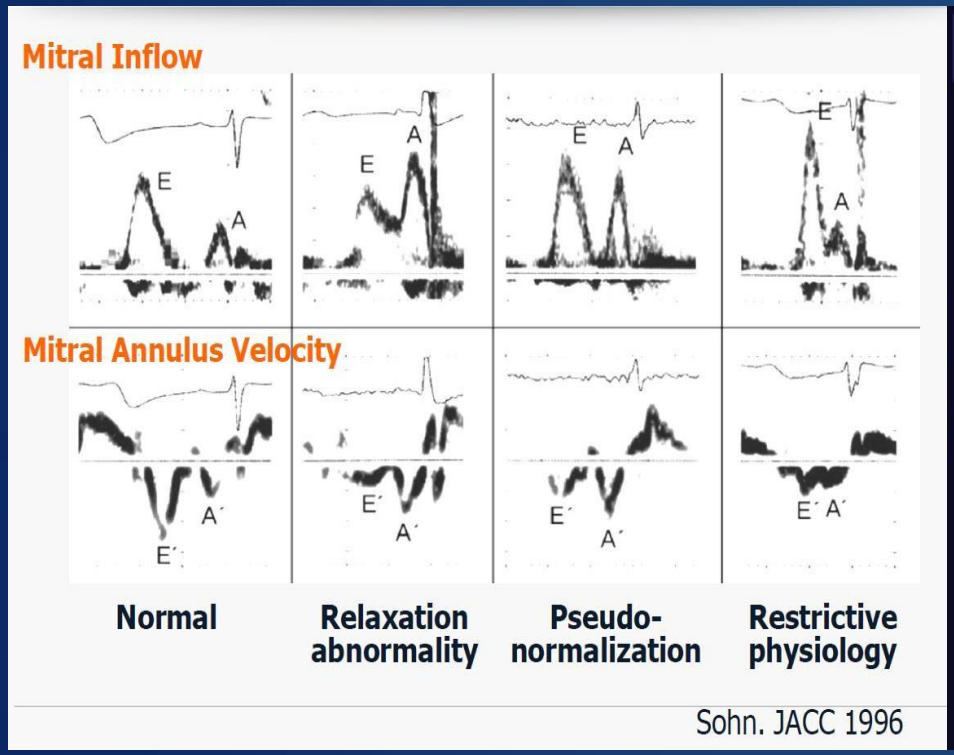
- e’ velocity
- a’ velocity
- e’/a’ ratio
- s’ velocity
- E/e’ ratio

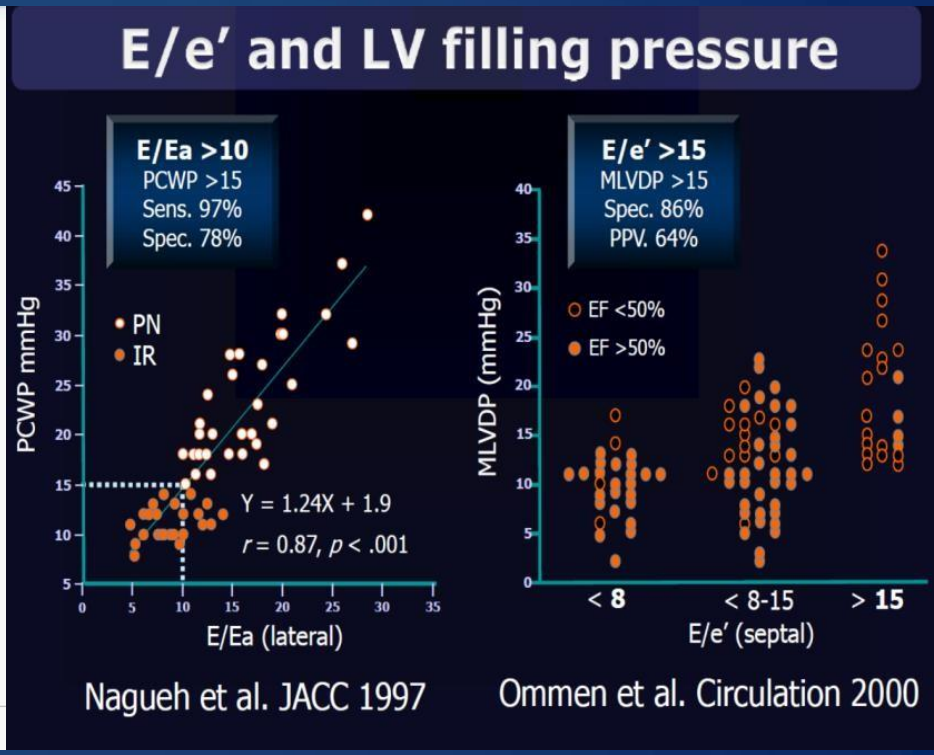




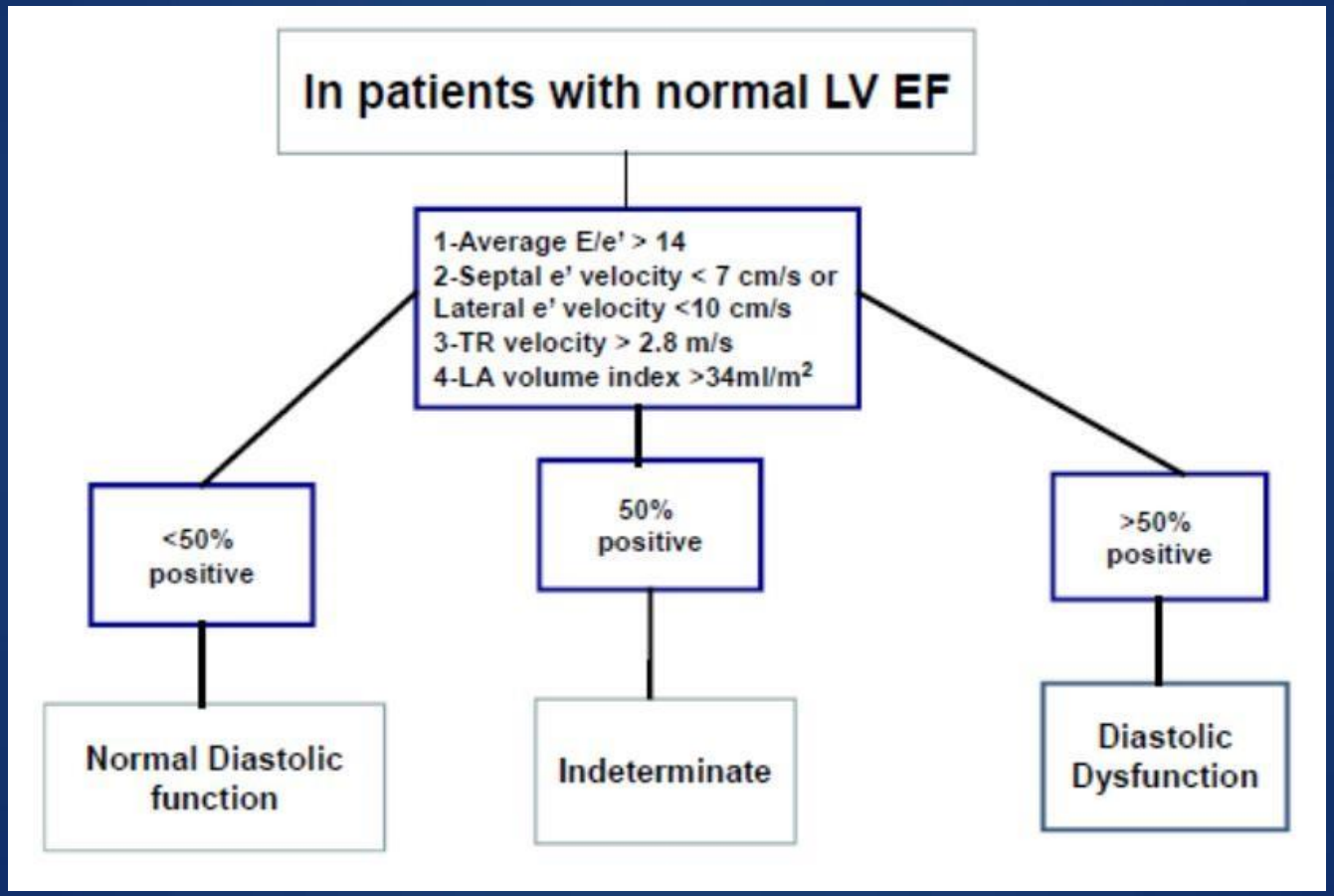
A4C 표본용적(2-3 mm) 승모판륜에서 1 cm 정도 심근 위치

LV diastolic function



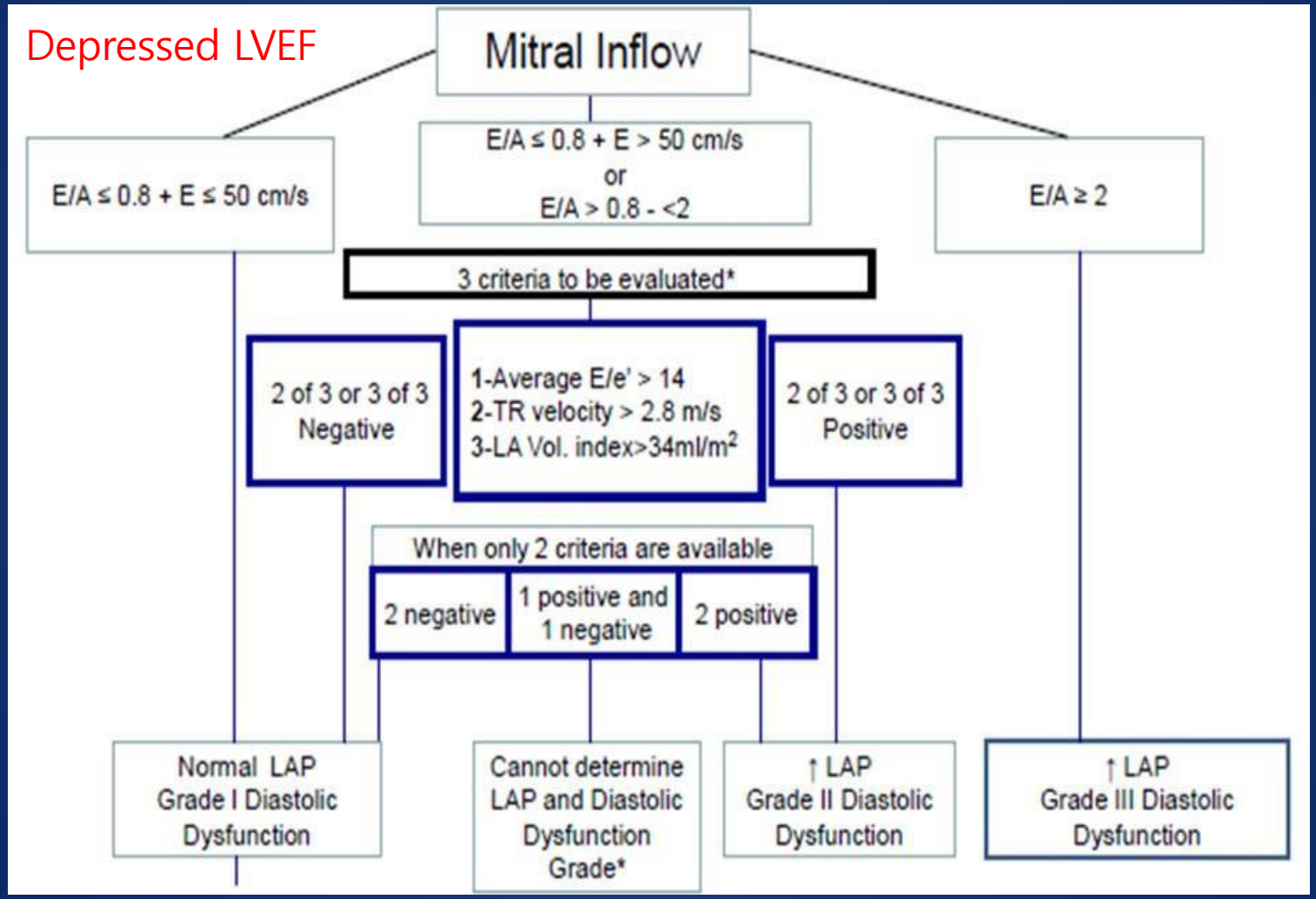


LV diastolic function



(J Am Soc Echocardiogr 2016;29:277-314)

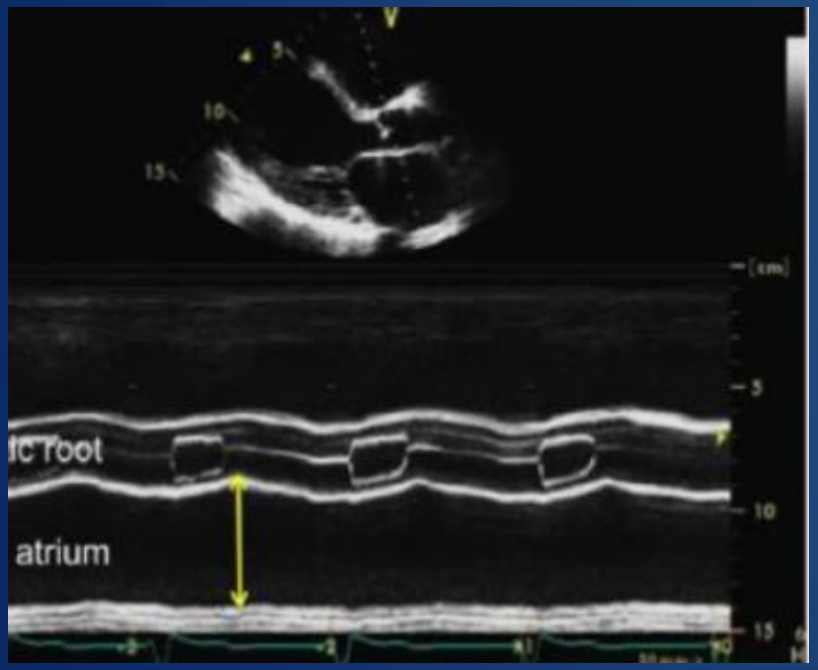
LV diastolic function



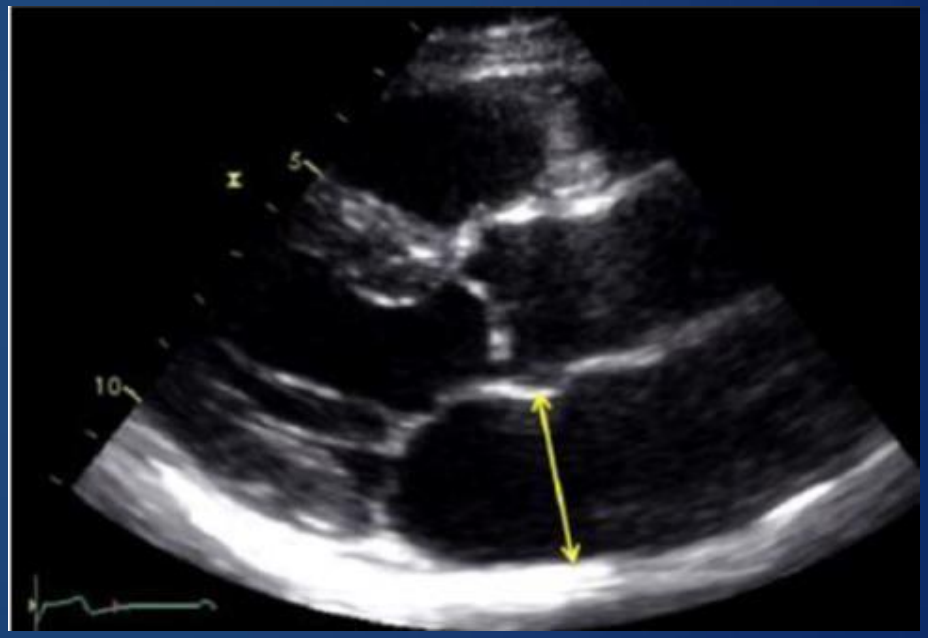
(J Am Soc Echocardiogr 2016;29:277-314)

LA size

M-mode

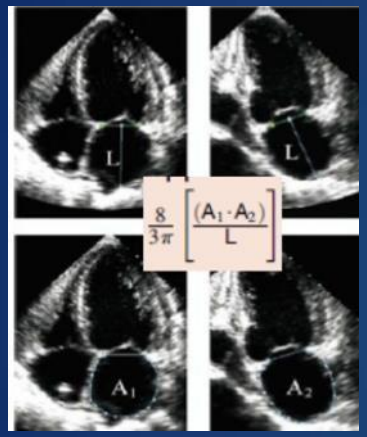


2D-guided linear

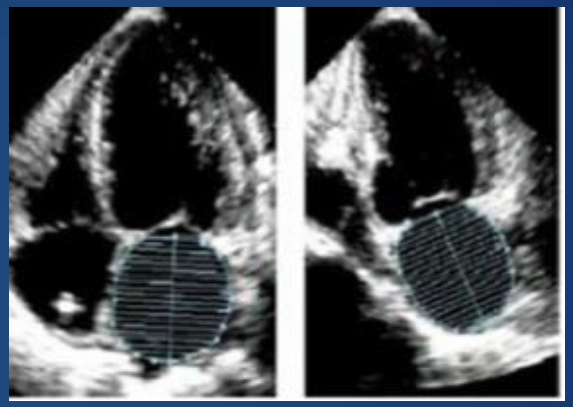


LA size

Area-length technique



Biplane method of disks



	Women	Men
AP dimension (cm)	2.7–3.8	3.0–4.0
AP dimension index (cm/m^2)	1.5–2.3	1.5–2.3
A4C area index (cm^2/m^2)	9.3 ± 1.7	8.9 ± 1.5
A2C area index (cm^2/m^2)	9.6 ± 1.4	9.3 ± 1.6
A4C volume index MOD (mL/m^2)	25.1 ± 7.2	24.5 ± 6.4
A4C volume index AL (mL/m^2)	27.3 ± 7.9	27.0 ± 7.0
A2C volume index MOD (mL/m^2)	26.1 ± 6.7	27.1 ± 7.9
A2C volume index AL (mL/m^2)	28.0 ± 7.3	28.9 ± 8.5

2015 guideline : LA size
by Biplane method < 34 mL/m2

폐동맥 고혈압 평가

- **우심방 우심실간 압력차 = 4 (TR Vmax)^2**

우심실유출로 협착이 없는 경우,

- **폐동맥 수축기압 = 우심실 수축기압**

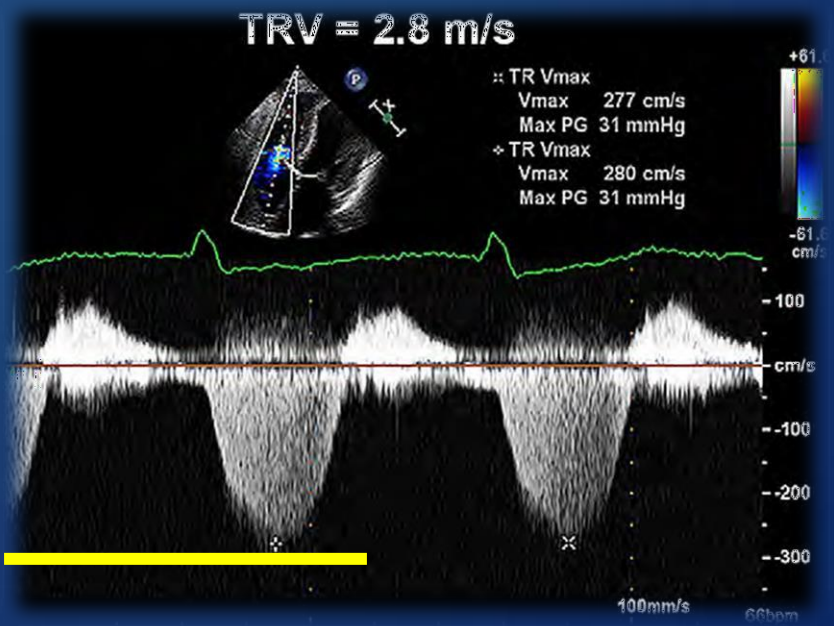
= 4V^2 + (우심방압)

- 정상 우심방압: 2 - 6 mmHg
- 정상 폐동맥 수축기압: 15 -30 mmHg (< 40 mmHg)

Pressure gradient from Doppler measurements

- **Systolic pulmonary arterial pressure**
  = RV systolic pressure
  = 4(TR_{jet})^2 + RA pressure

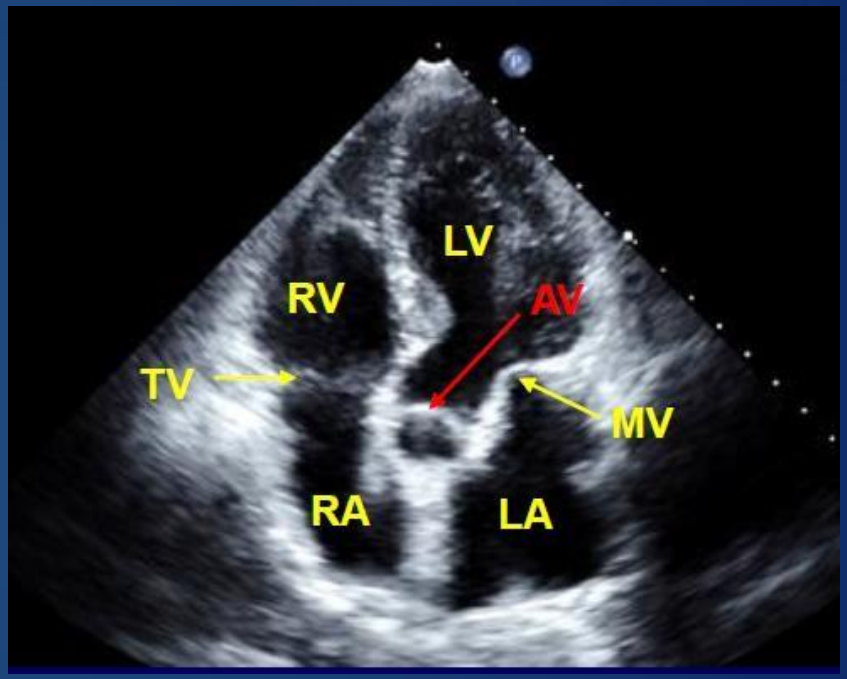
4X2.8X2.8 + 5
= 31+5 mmHg

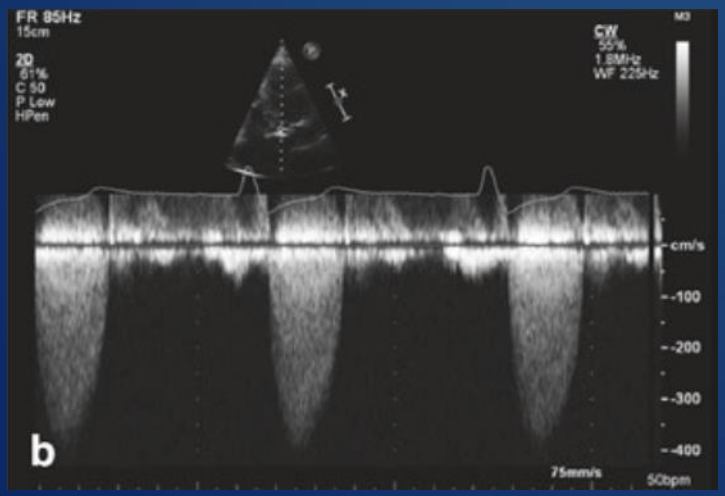


2.8 m/s

Apical 5 chamber view

- A4C view에서 탐촉를 앞쪽으로 tilting 함
- LVOT 관찰
- LVOT TVI 측정
- 대동맥협착, 역류 평가





Apical 2-chamber views

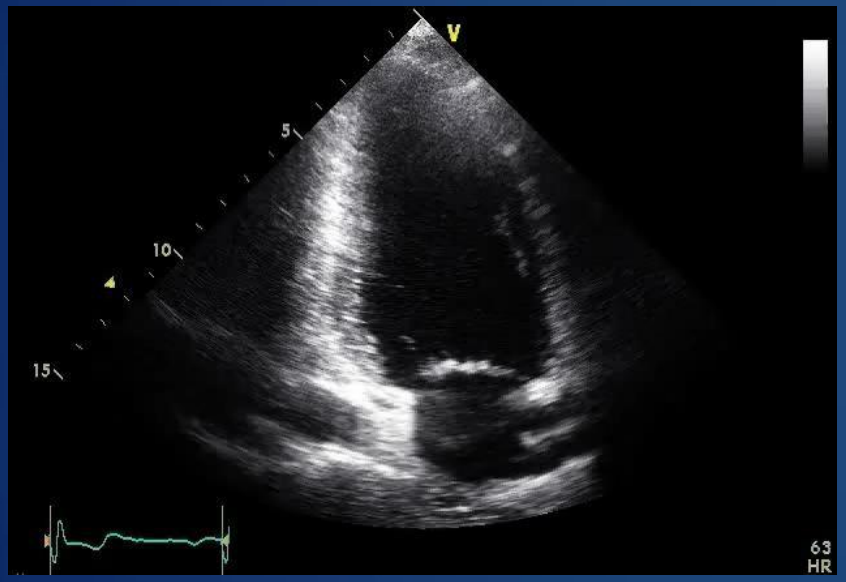


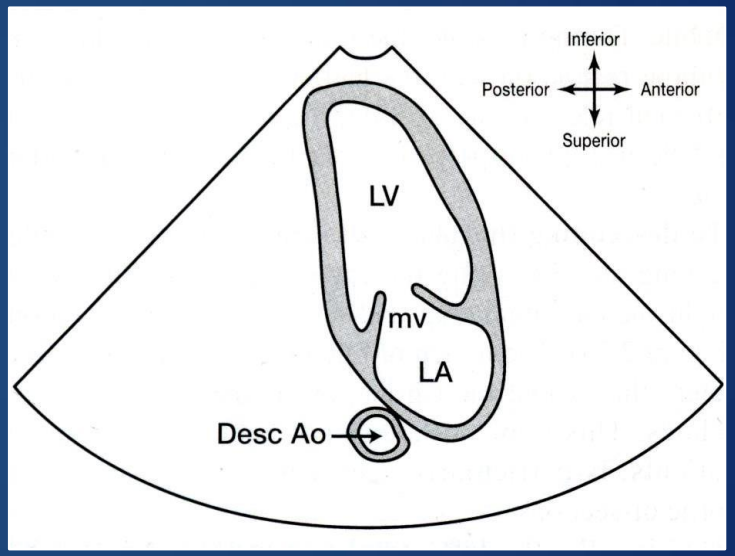
A4C view에서 탐촉자를 반시계 방향으로 60도-90도 회전 (12시 -1시)

- LV 기능, 벽운동 관찰
- LA 직경 측정
- MV 구조와 기능 평가



Apical 2-chamber views





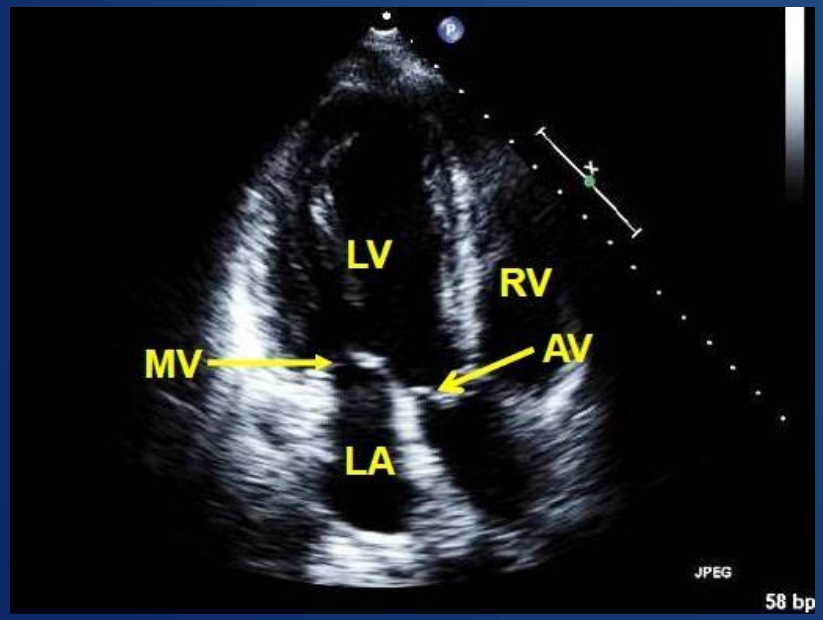
This view is useful to assess the **inferior and anterior walls of the LV.**

It gives you a more precise evaluation of the direction and **severity of mitral reg urgitation**

Apical 3 chamber view

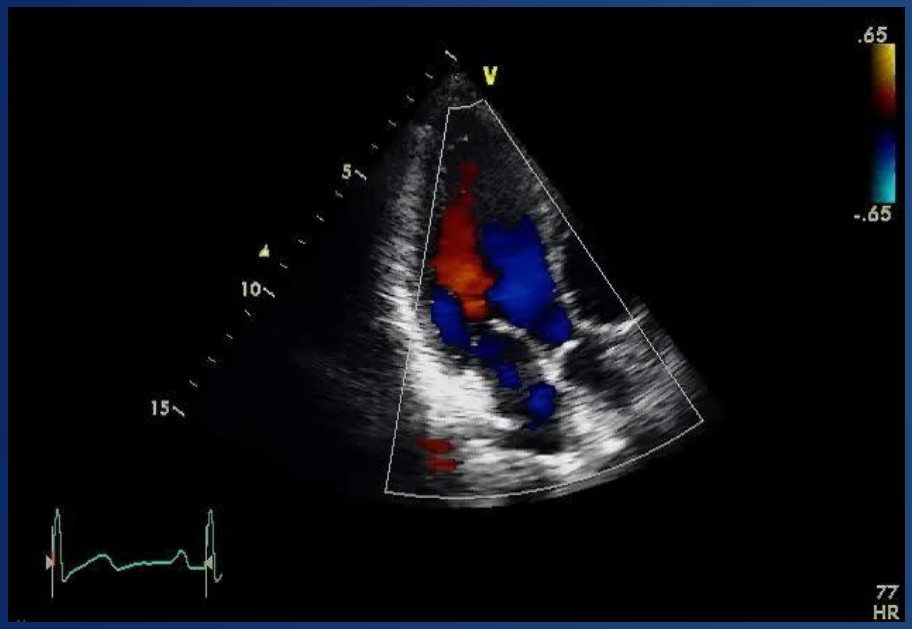


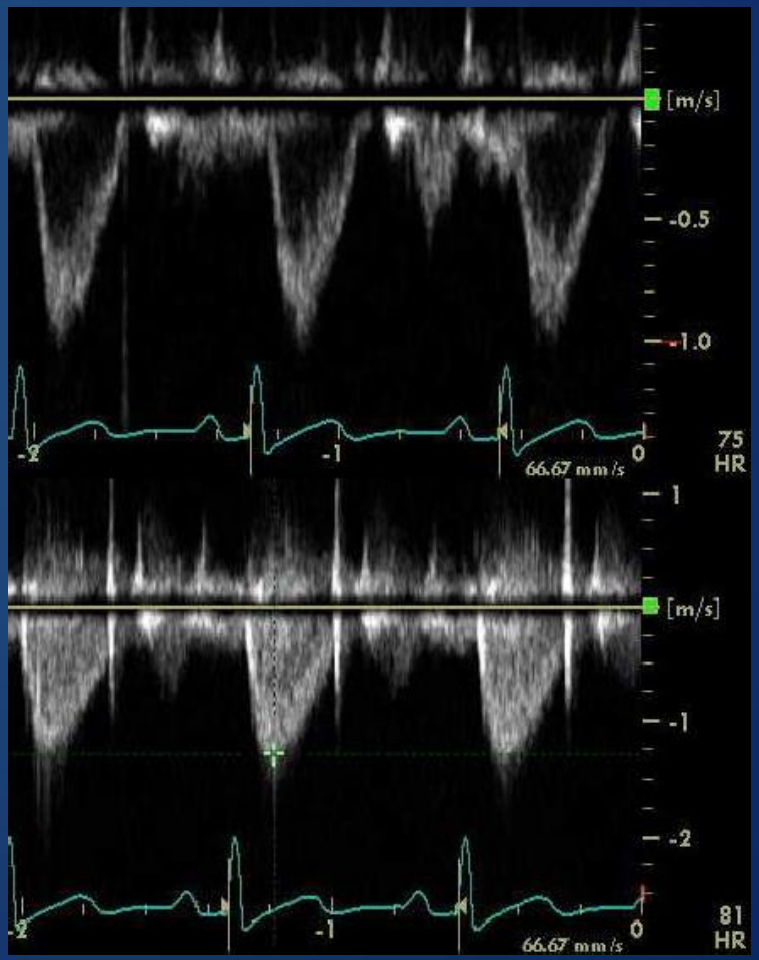
A2C view에서 탐촉자를 반시계방향으로 60도회전 (11시)



- LV 기능과 벽운동 평가
- MV 구조와 기능 평가
- AV 구조와 기능 평가
  LVOT, AS

Apical 3-Chamber View



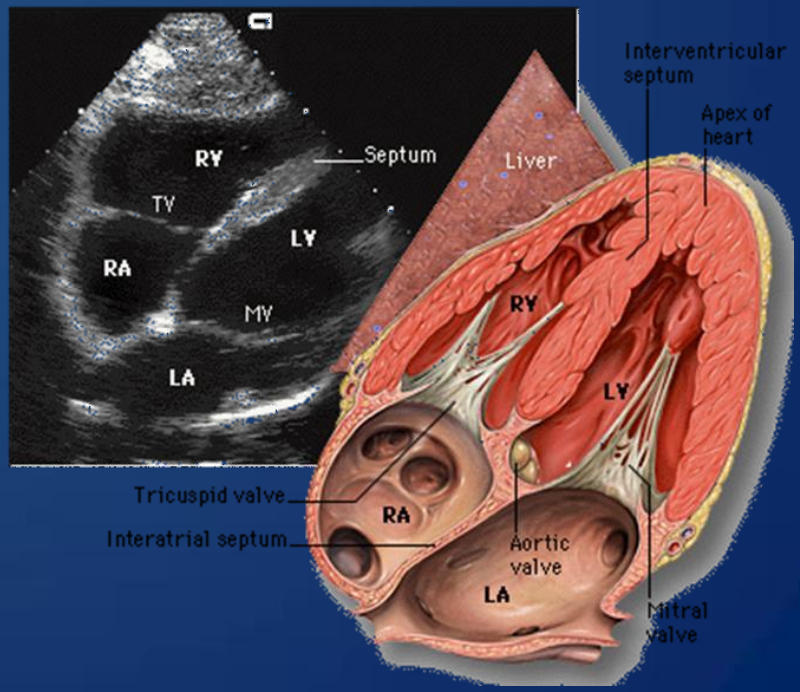


Subcostal 4-chamber view

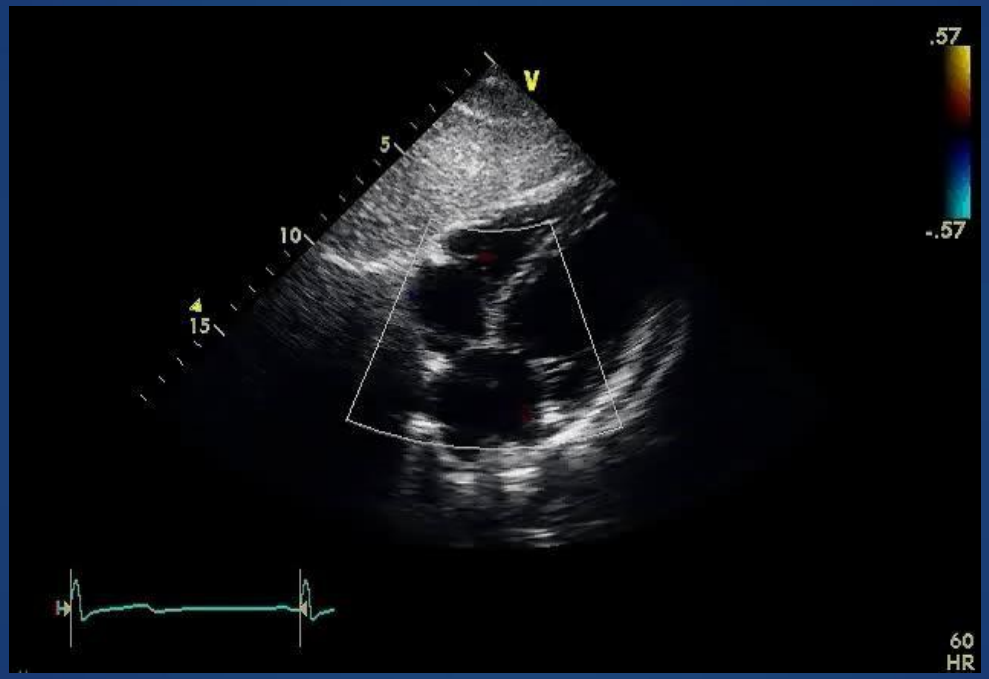
환자를 반듯이 눕히고 무릎을 굽힌 상태에서 탐촉자를 명치부에 두고 마크를 왼쪽 쇄골 방향으로 향하게 함



- ASD 또는 PFO shunt 확인
- RV free wall 두께 측정



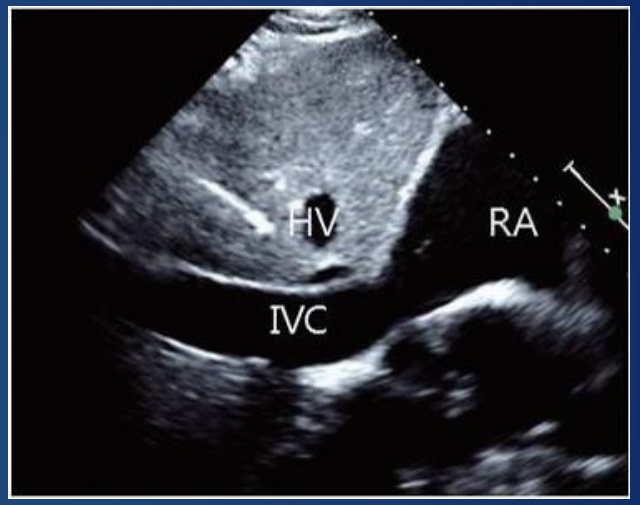
Subcostal views



Subcostal IVC/HV view

Subcostal view 에서 탐 촉 자 를 반시계방향으로 90도

- IVC 크기 관찰
- IVC collapse 정도 평가





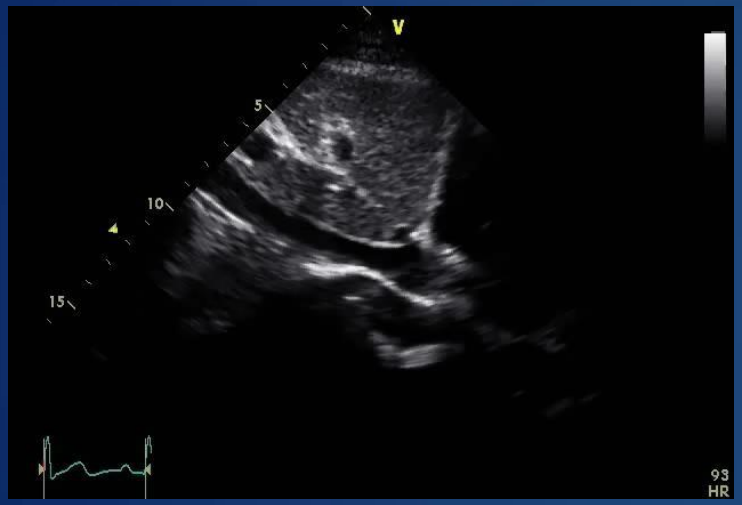
폐동맥 고혈압 평가

- 우심방 압력의 추정

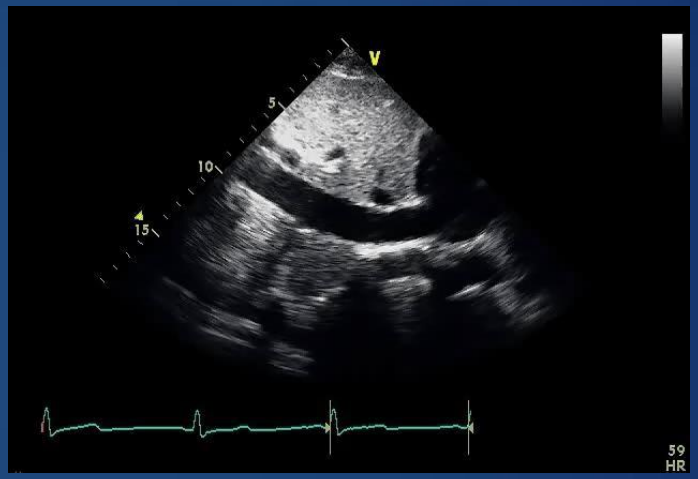
하대 정맥		우심방 압
직경	호흡 시 변화	(mm Hg)
< 2.0 cm	≥ 50 %	5
< 2.0 cm	< 50 %	10
≥ 2.0 cm	< 50 %	15
≥ 2.0 cm	변화 없음	20

Inferior Vena Cava Ultrasound

Normal



Elevated RA pressure



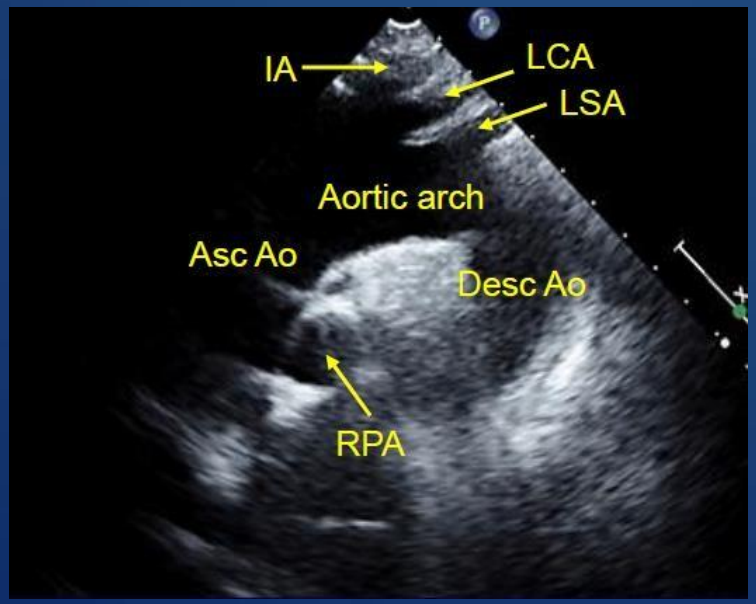
Suprasternal notch view

탐촉자를 흉골 상부에 두고 마크를 좌쇄골 방향(1시)으로 향하게 함

- Aortic arch,
  proximal descending aorta 평가
- Aortic dissection 확인
- Aortic coarctation 확인
- Holodiastolic reversal flow 확인







Suprasternal notch view

