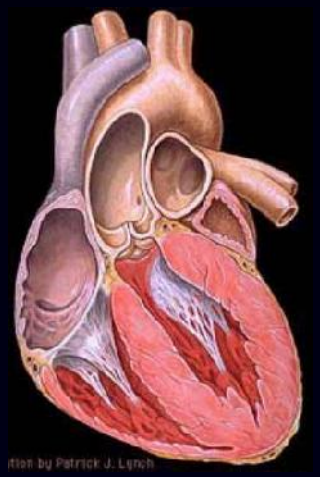
PRINCIPAL TRANS-THORACIC VIEWS



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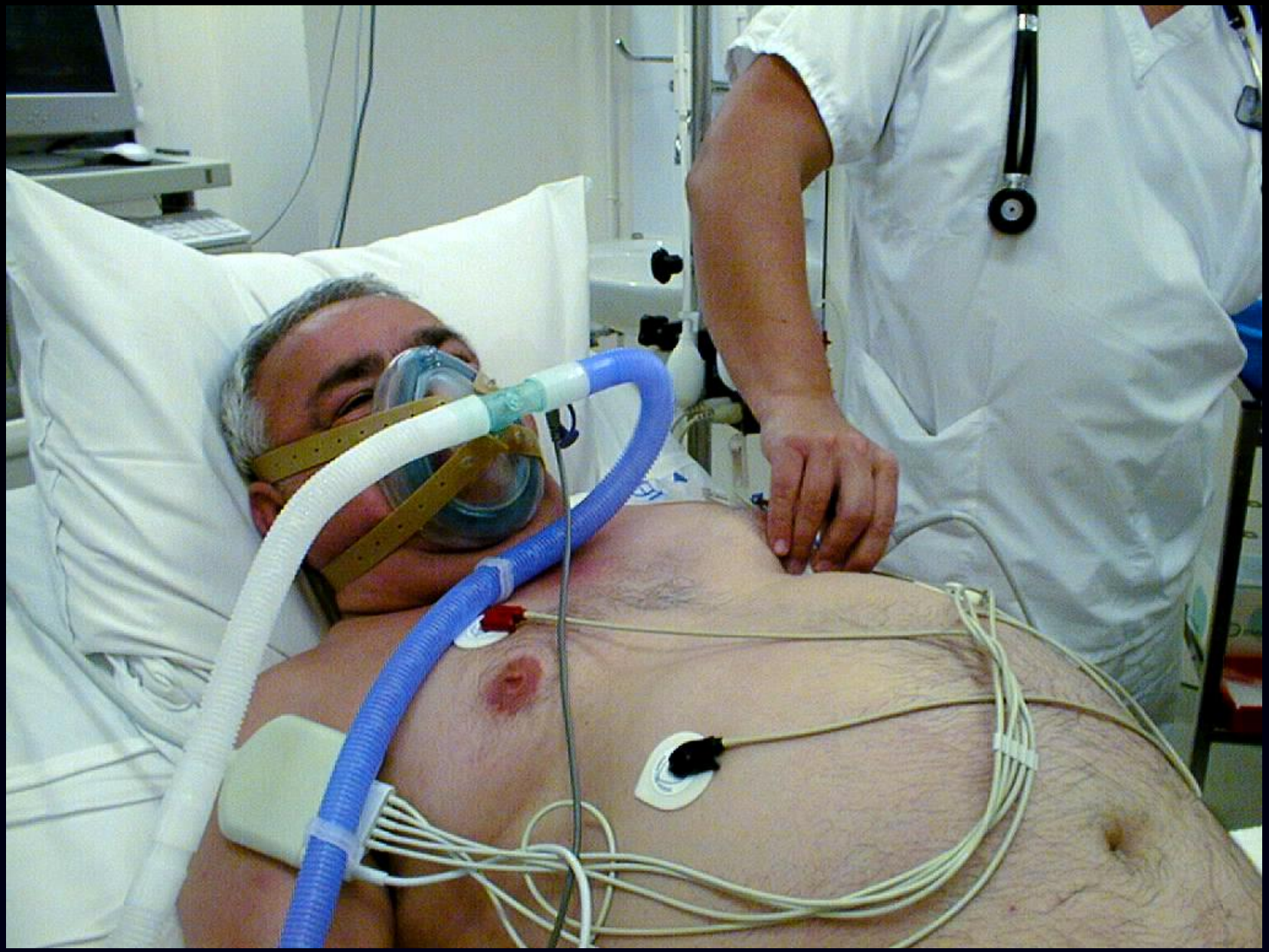
Brussels, Belgium

PRINCIPAL TRANS-THORACIC VIEWS

Trans-thoracic evaluation is the most commonly performed echocardiographic evaluation of the critically ill patient. It is fast to perform and can easily be repeated.

However, trans-thoracic visualization of the heart is usually of average quality in ICU patients, especially when mechanically ventilated. Accordingly, some views cannot always be obtained.

TTE in the ICU: not always easy to perform!



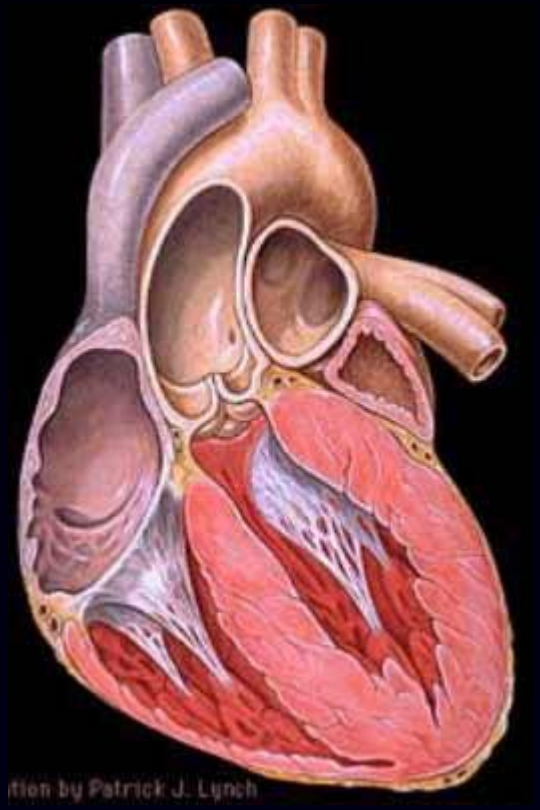
TRANS-THORACIC VIEWS

Due to the specific conditions of the patient, it is not uncommon that the probe needs to be positioned slightly differently.

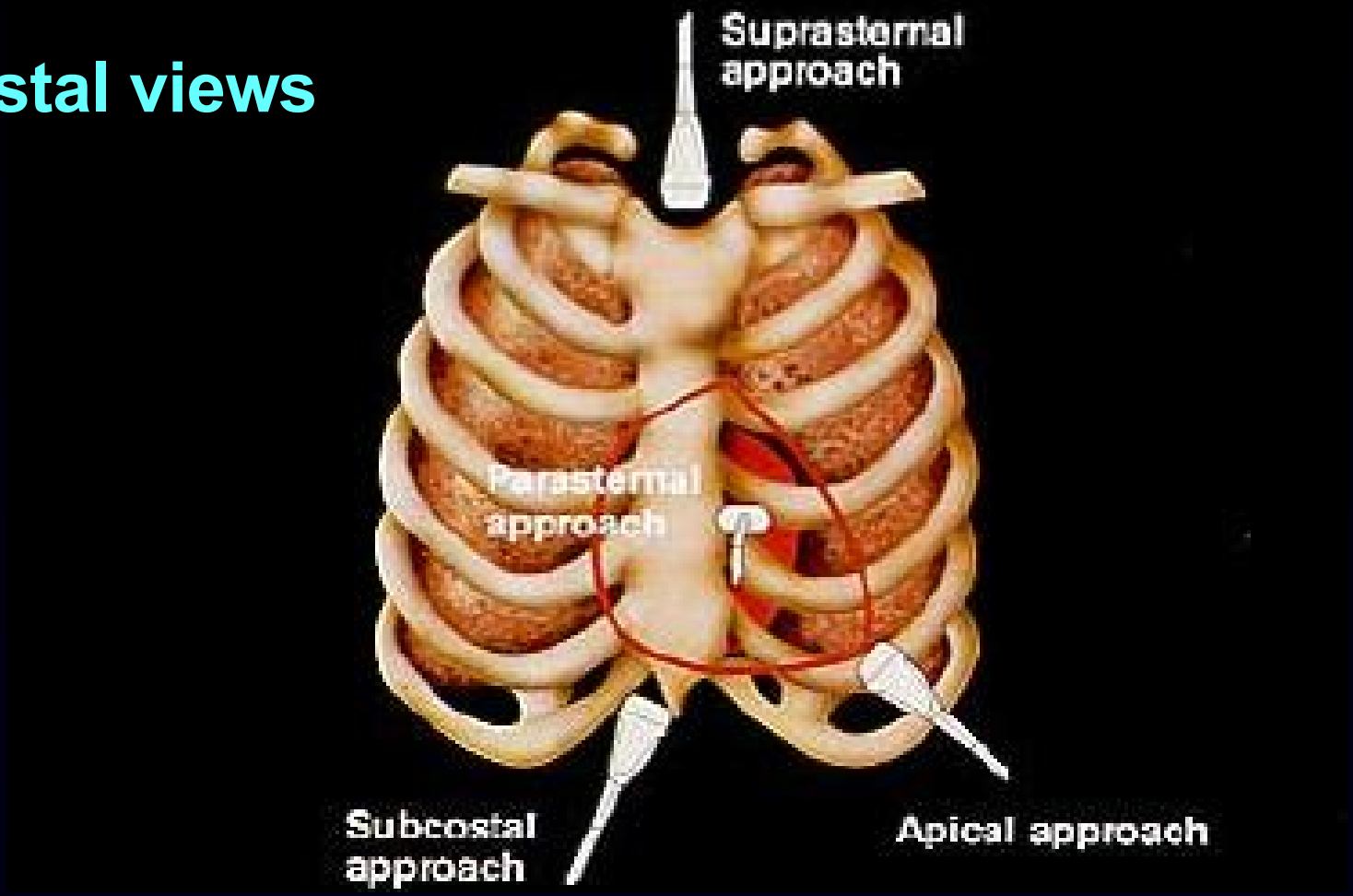
Although most of the morphologic evaluations are still valid, most of the hemodynamic indices will be influenced by the angle of the beam.

Principal views (and probe positions)

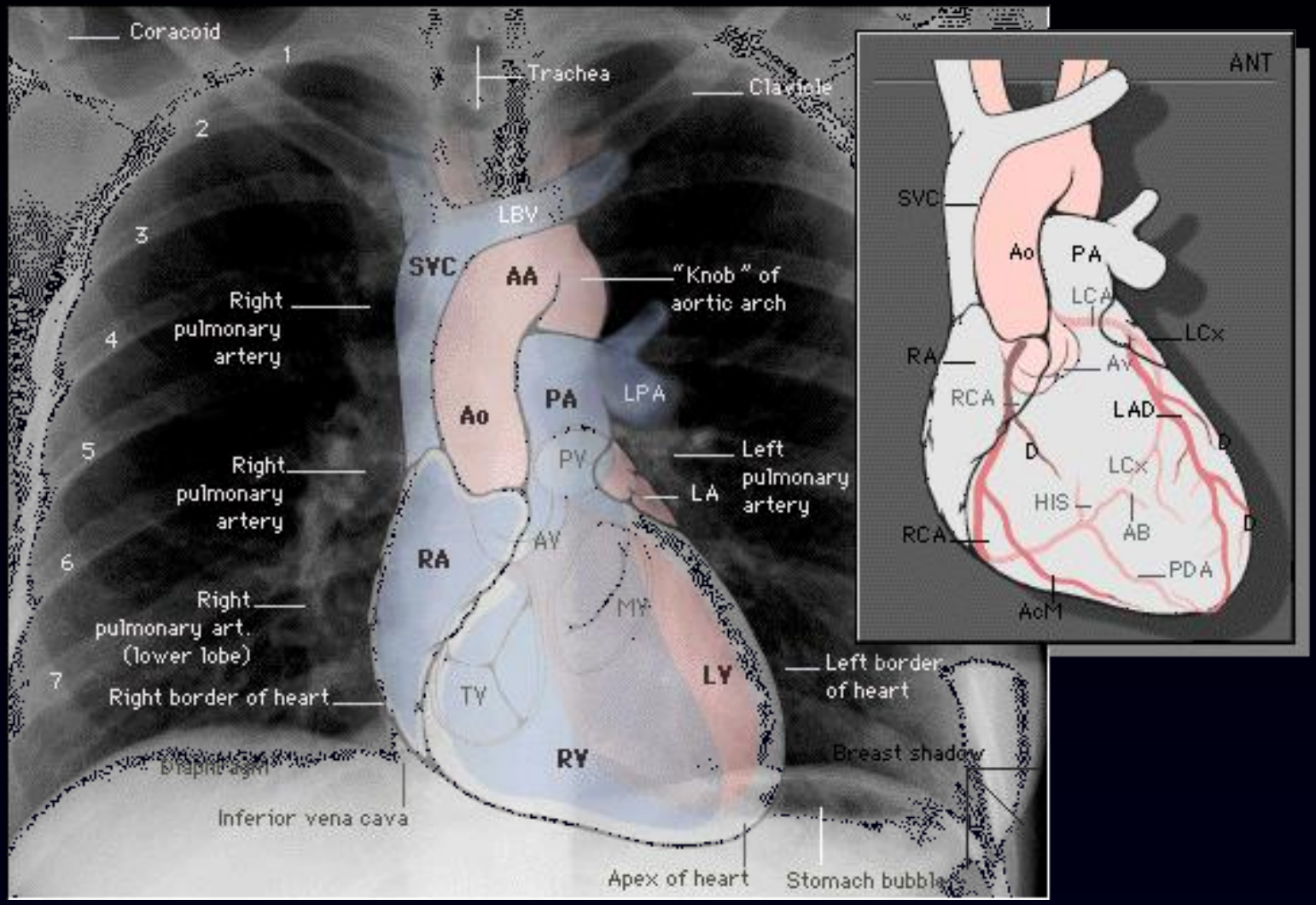
- Parasternal views
- Apical views
- Subcostal views

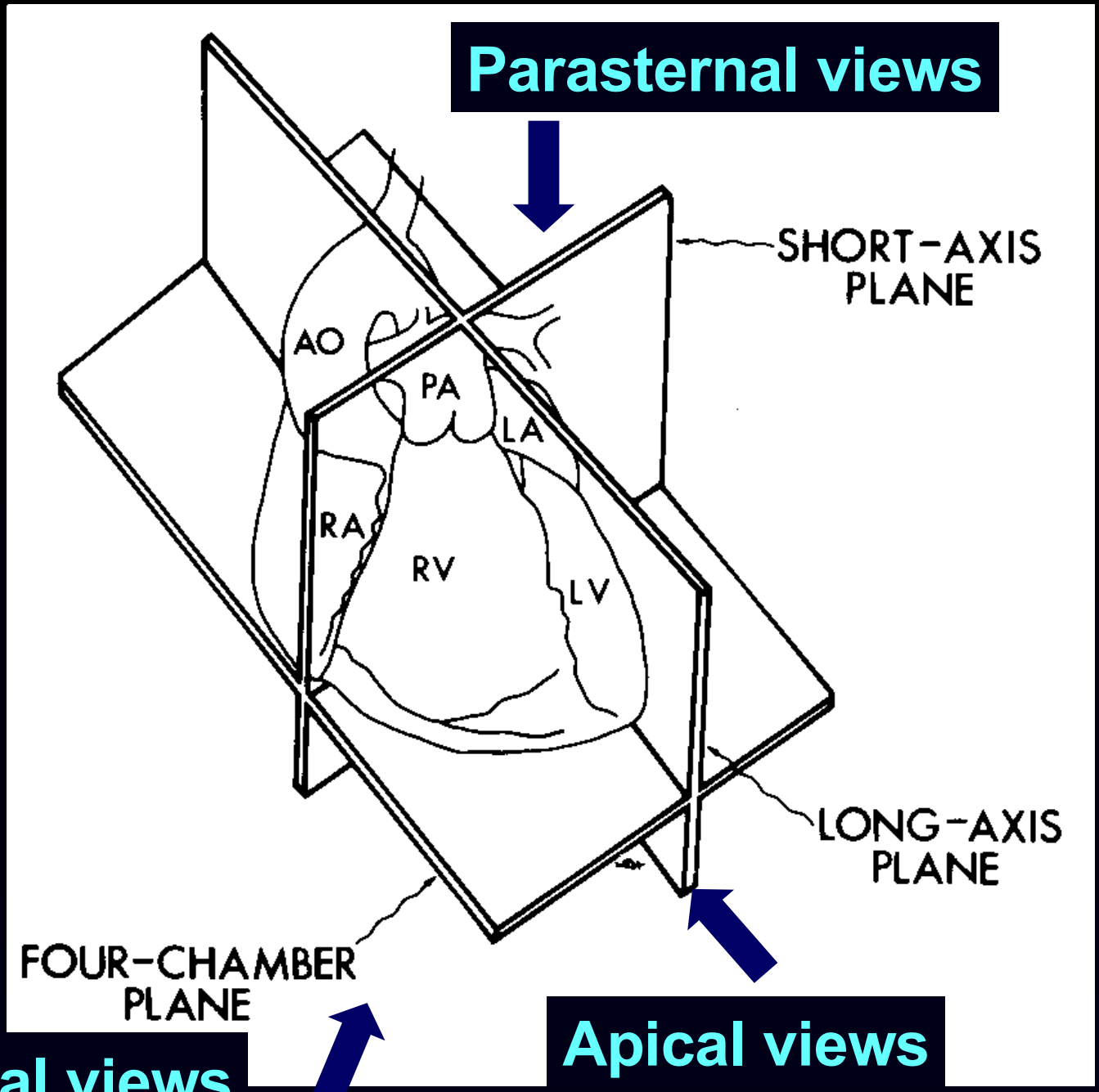


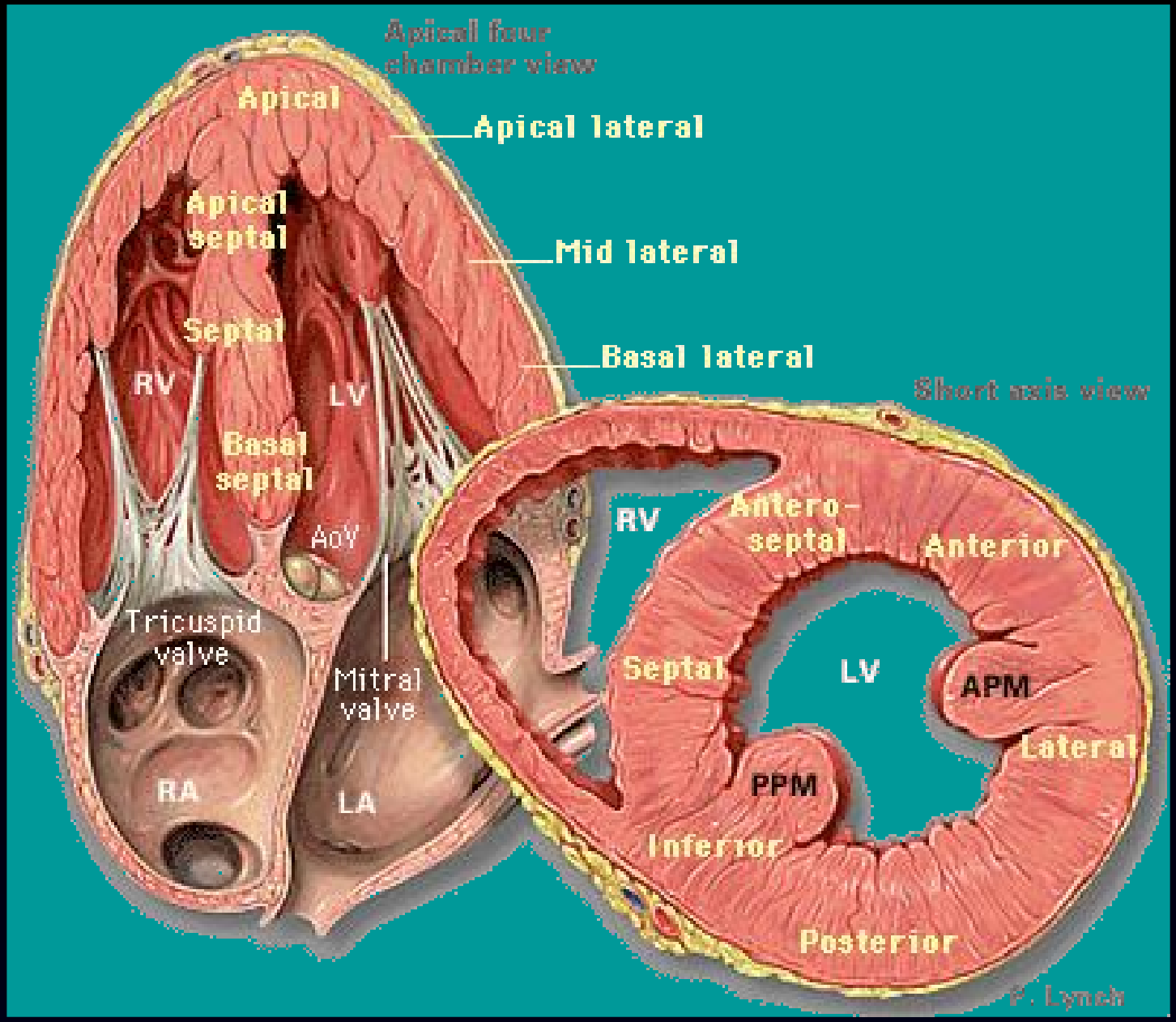
- Parasternal views
- Apical views
- Subcostal views

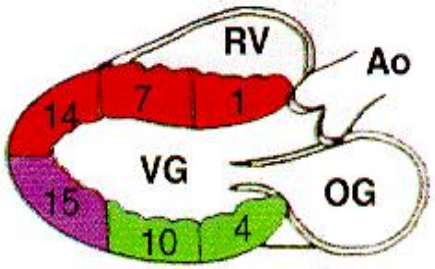


- Parasternal views
- Apical views
- Subcostal views

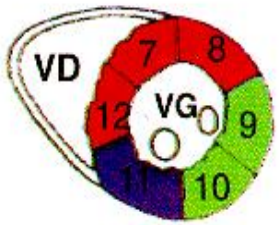



Parasternal views
SHORT-AXIS PLANE
AO
PA
LA
RA
RV
LV
LONG-AXIS PLANE
FOUR-CHAMBER PLANE
Subcostal views
Apical views

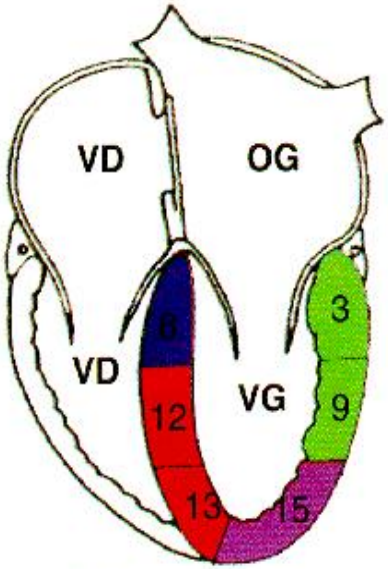

Apical four chamber view
Apical
Apical lateral
Apical septal
Mid lateral
Septal
Basal lateral
RV
LV
Basal septal
AoV
Tricuspid valve
Mitral valve
RA
LA
Short axis view
RV
Antero-septal
Anterior
Septal
LV
APM
Lateral
PPM
Inferior
Posterior
F. Lynch



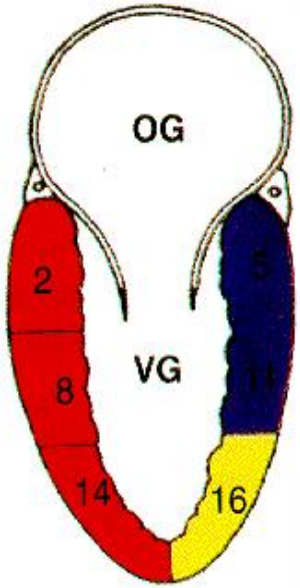
Parasternale grand axe



Parasternale petit axe



Apicale 4 cavités



Apicale 2 cavités

Distribution artères coronaires

	ANT SEPT	ANT	LAT	POST	INF	SEPT
BASE	1	2	3	4	5	6
MOY	7	8	9	10	11	12
	APICAL SEPT	APICAL ANT	APICAL LAT	APICAL INF		
	13	14	15	16		

IVA

CX

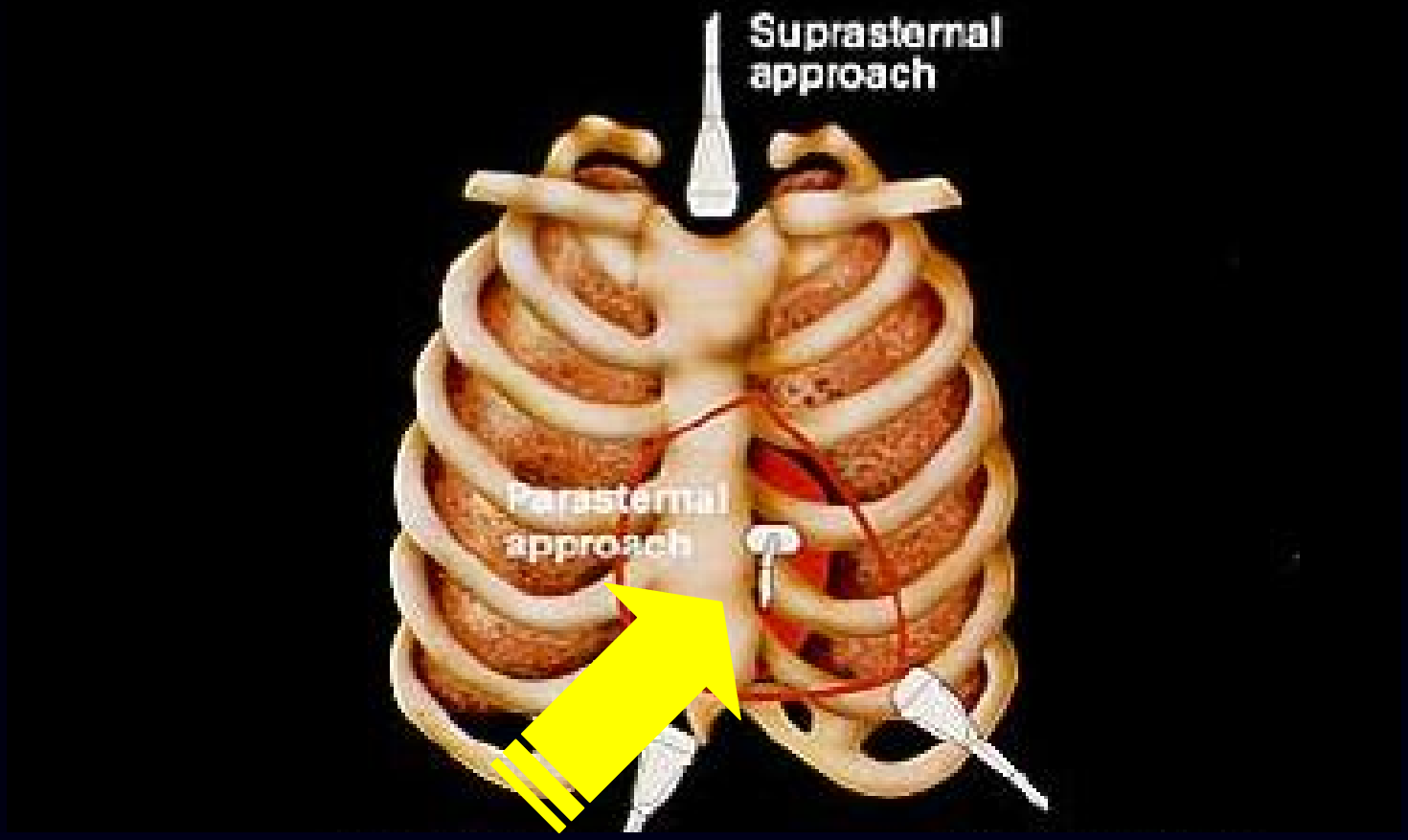
CD

ambiguïté IVA/CX

ambiguïté IVA/CD

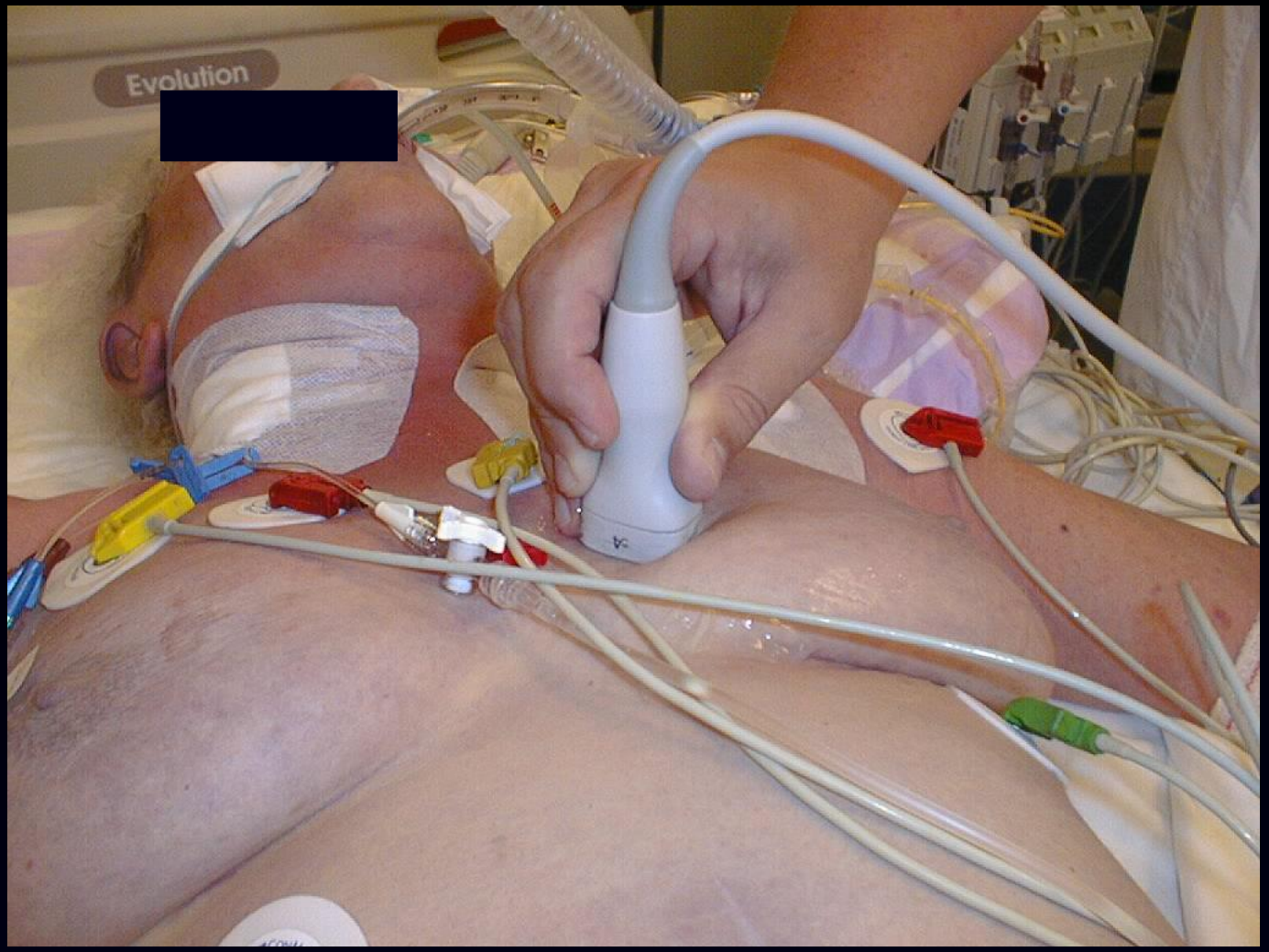
PARASTERNAL VIEWS

- **Parastenal views:**
  - **Parasternal long axis**
  - **Parasternal short axis**



Probe: IVth intercostal / 2 cm laterally to sternum

PARASTERNAL (long and short axis)

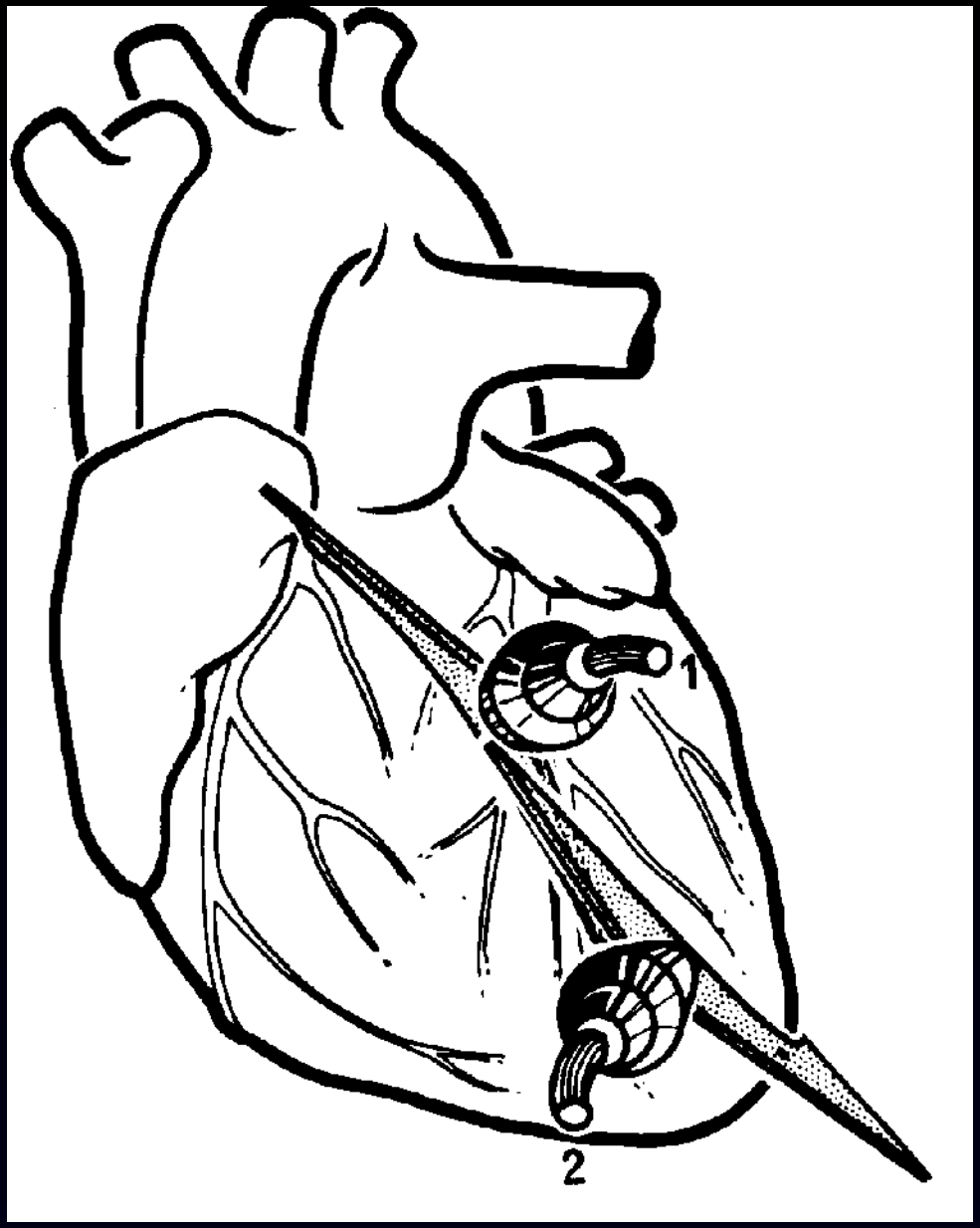


PLA (PSA = probe rotation by 90°)

PARASTERNAL VIEWS

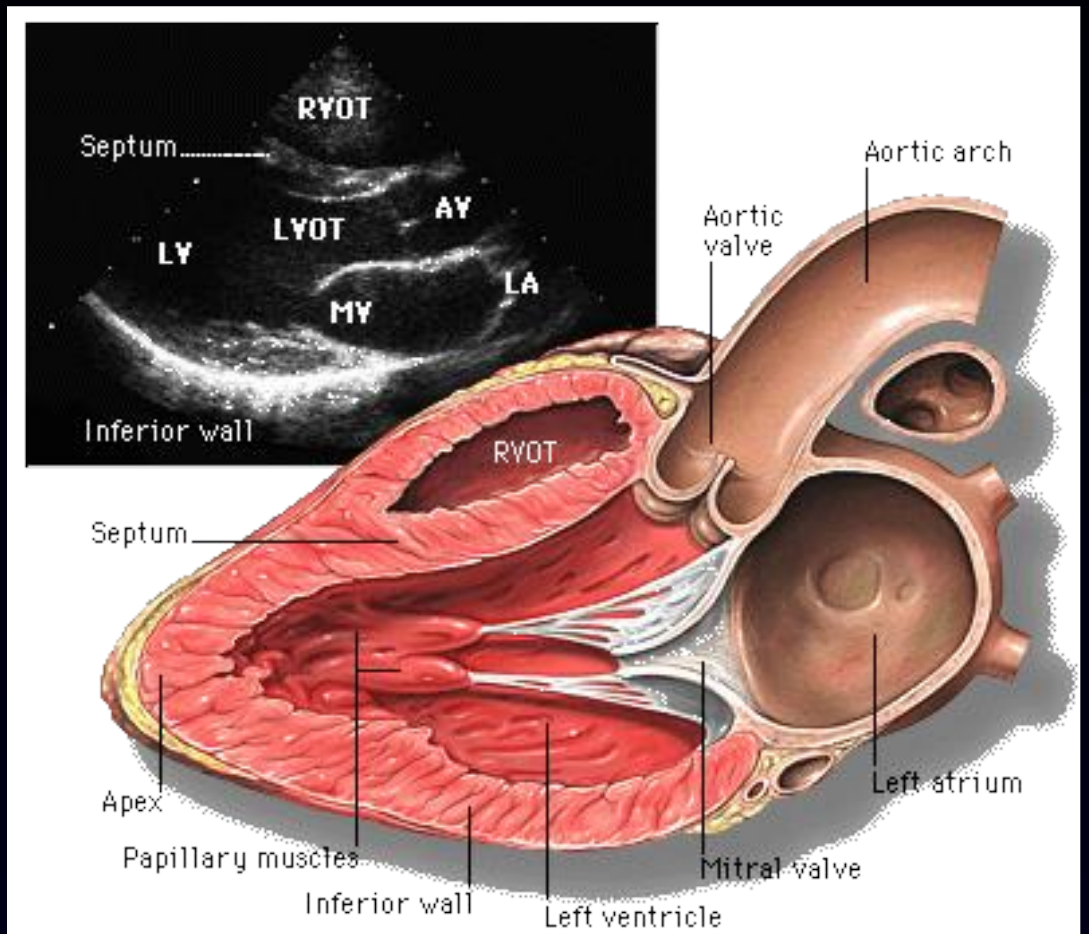
- Parasternal long axis

Parasternal long axis view (TTE)

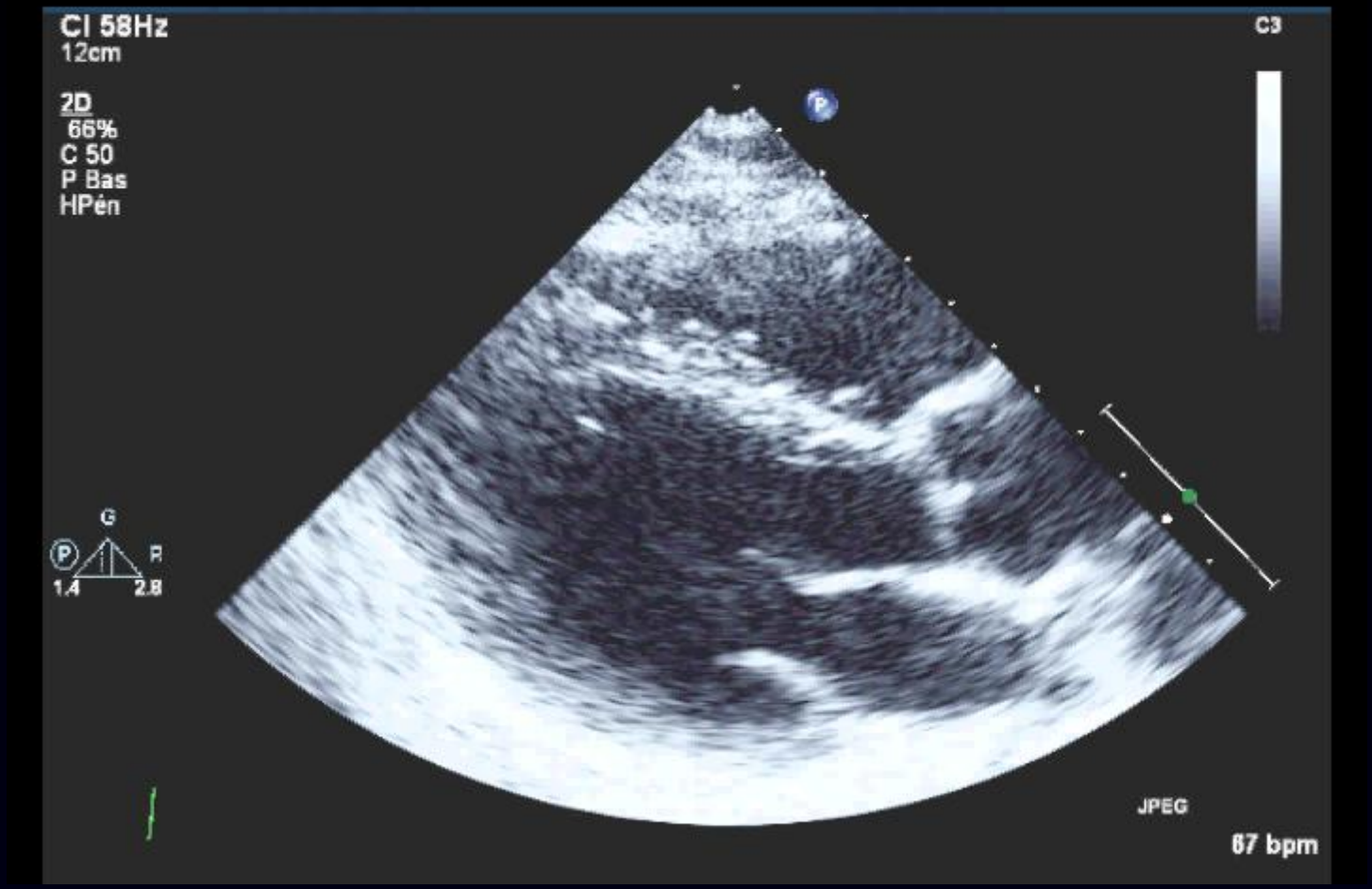


Parasternal long axis (TTE)

- Visualizes:
  - IV Septum
  - RV ant wall
  - LV postero lat wall
  - LVOT
  - Ao root



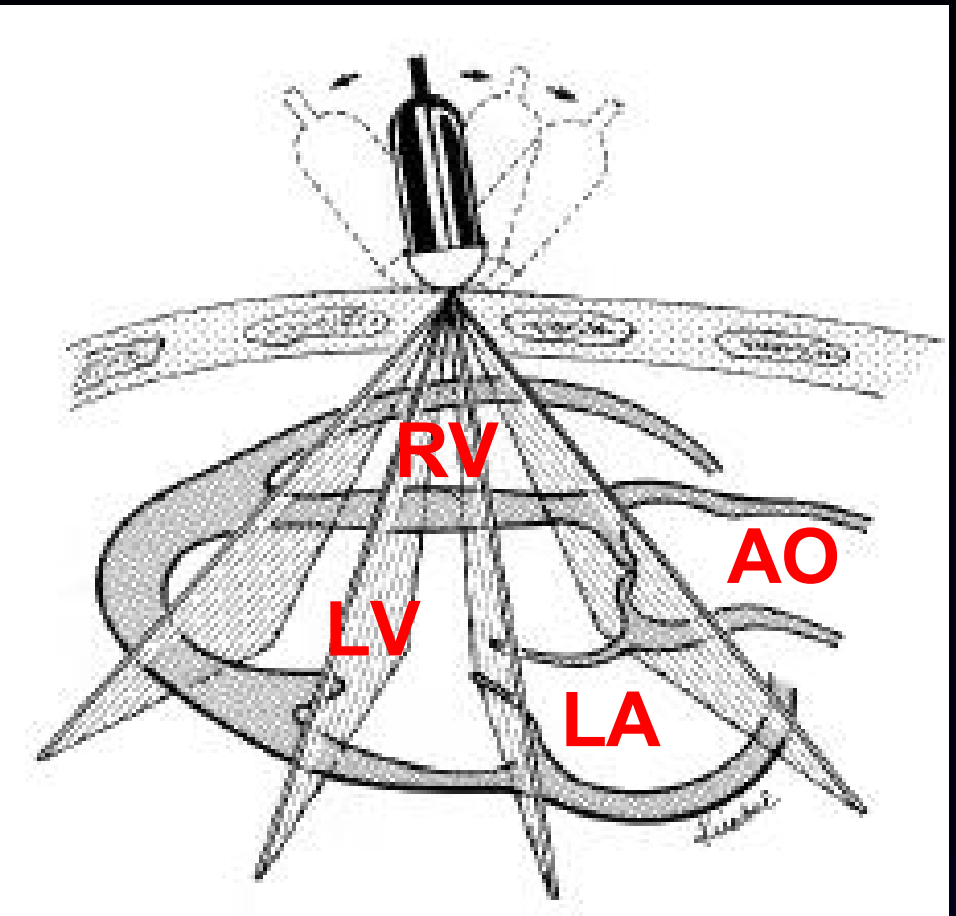
Parasternal long axis (TTE)



Parasternal long axis (TTE)

Measurements:

- Dimensions LV/RV
- Shortening fraction (TM)
- LVOT diameter

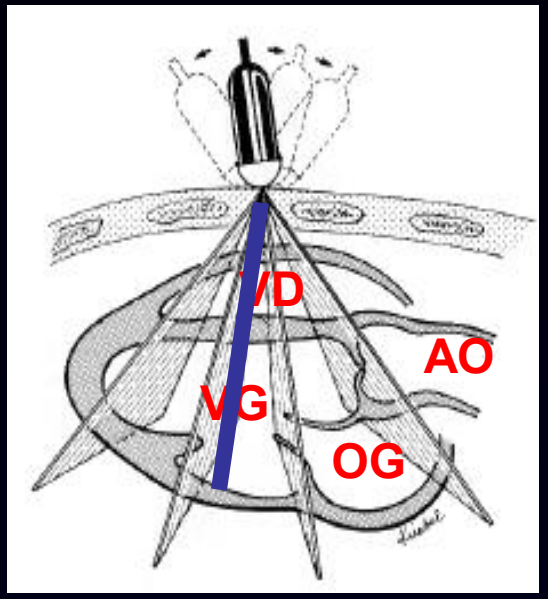


Parasternal long axis (TTE)

Mesurements of LV/RV dimensions and calculation of shortening fraction (TM)

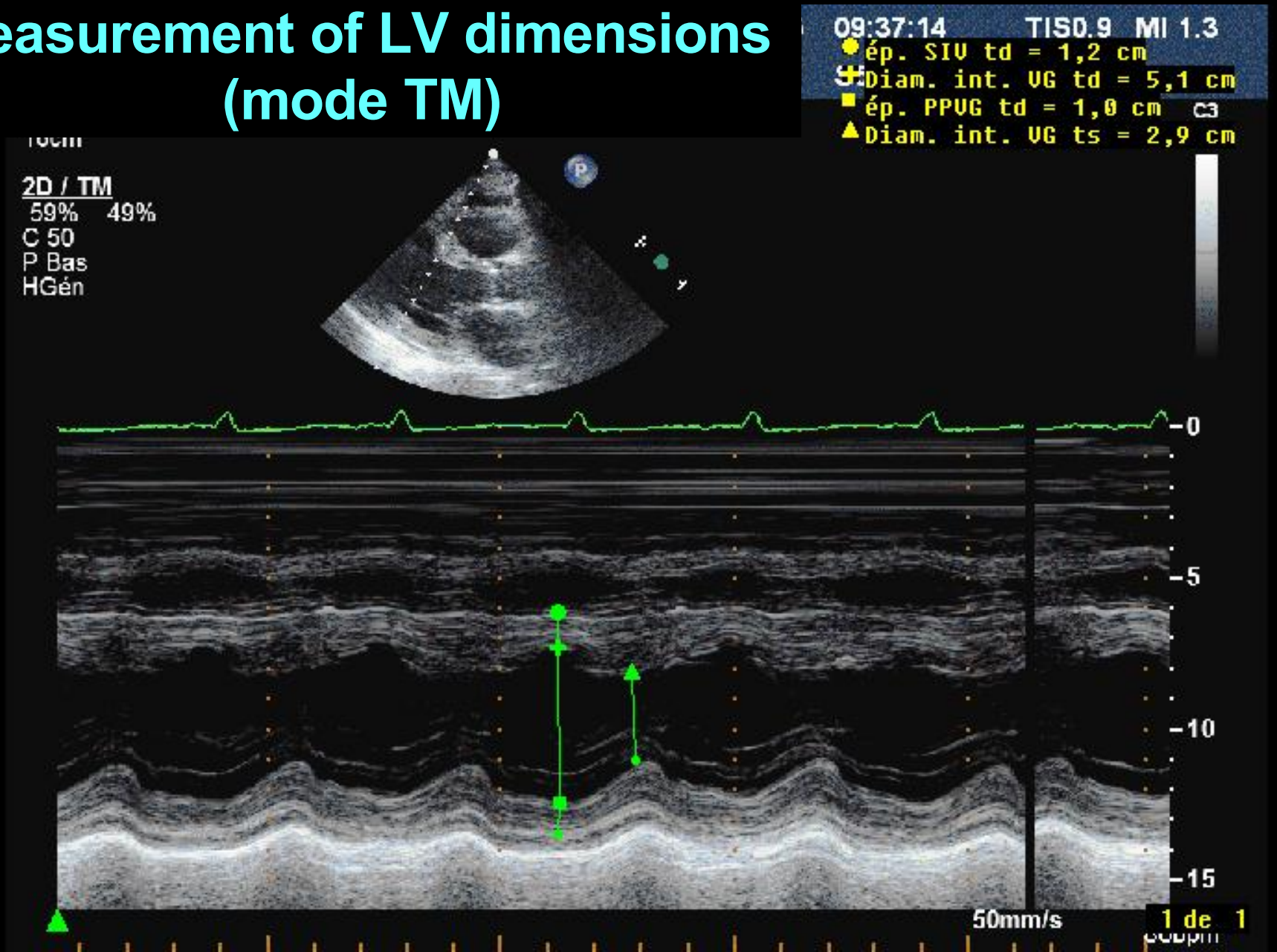
The use of time-movement (TM) mode allows to measure telesystolic and telediastolic LV dimensions and to calculate shortening fraction.

Ideally, this view should encounter the mitral valve papillary muscle, in the median part of LV.



Parasternal long axis (TTE)

Measurement of LV dimensions (mode TM)



Parasternal long axis (TTE)

Calculations:

SF (diam) = (TDLVD – TSLVD) / TDLVD

Calculation of LV volumes

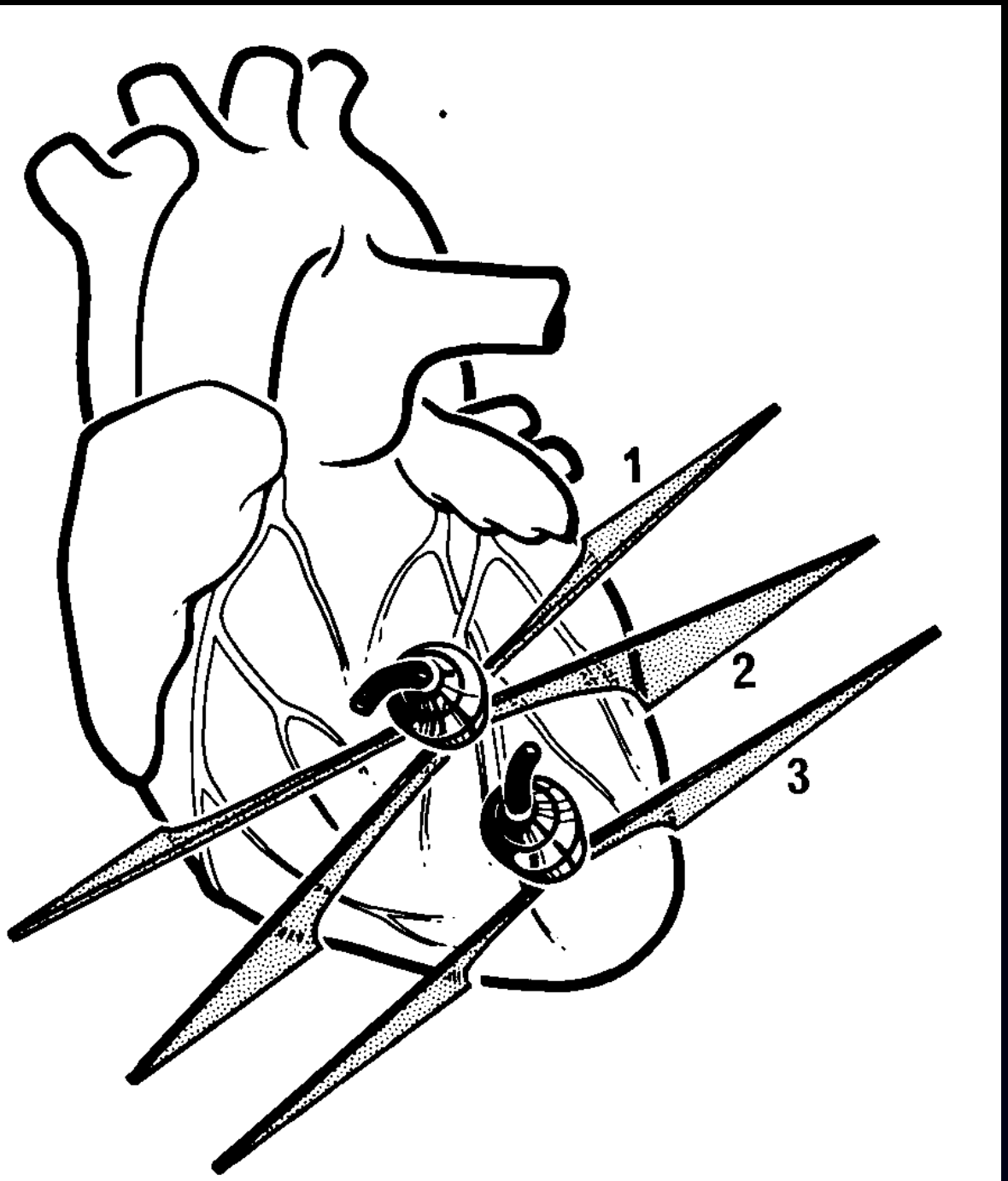
- **Cube formula ($V = D^3$)**
- **Teicholz formula [$V = 7D^3/(2.4 + D)$]**

Other interest of this view:

Allows visualization of paradoxal septal movement (and its localization in cardiac cycle with time-movement mode).

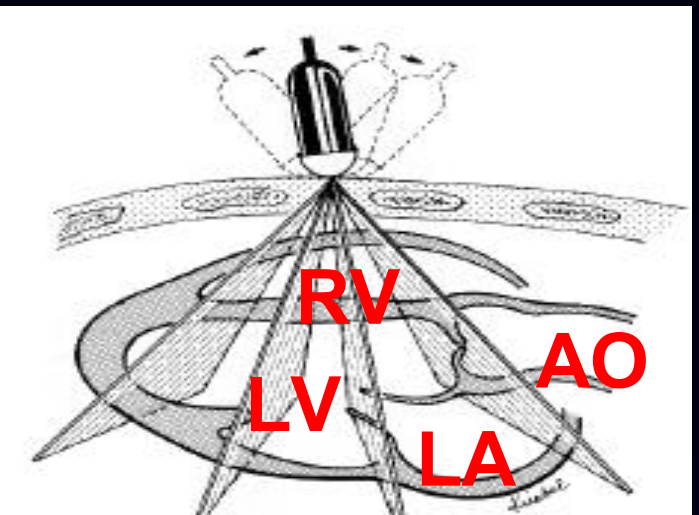
LATERO STERNAL VIEW

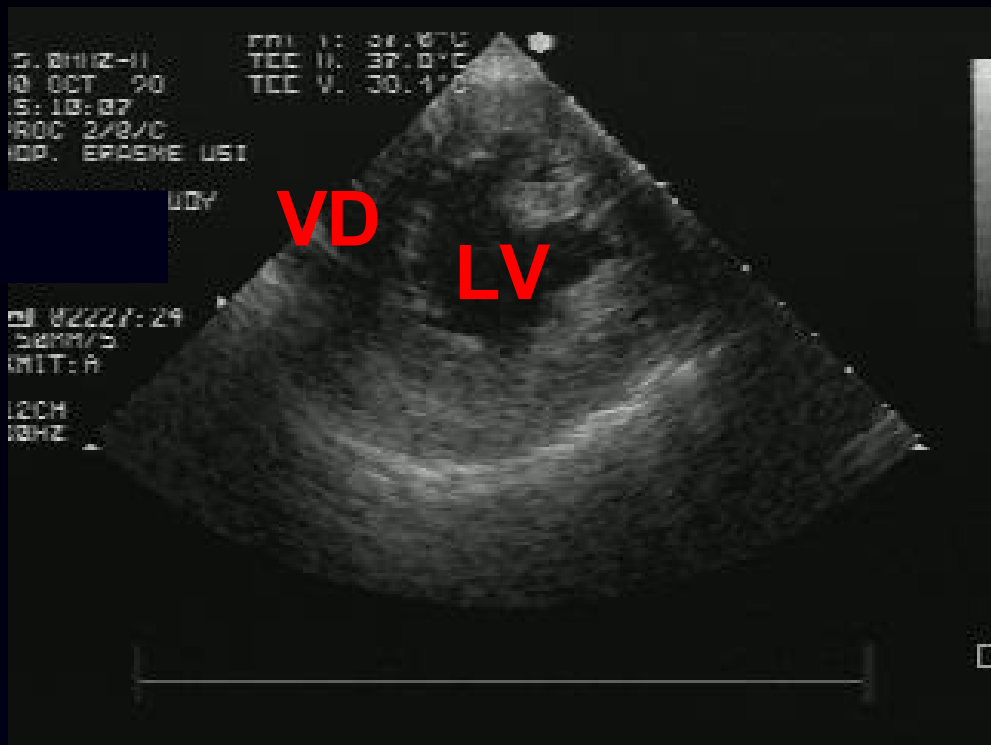
- Parasternal long axis
- Parasternal short axis

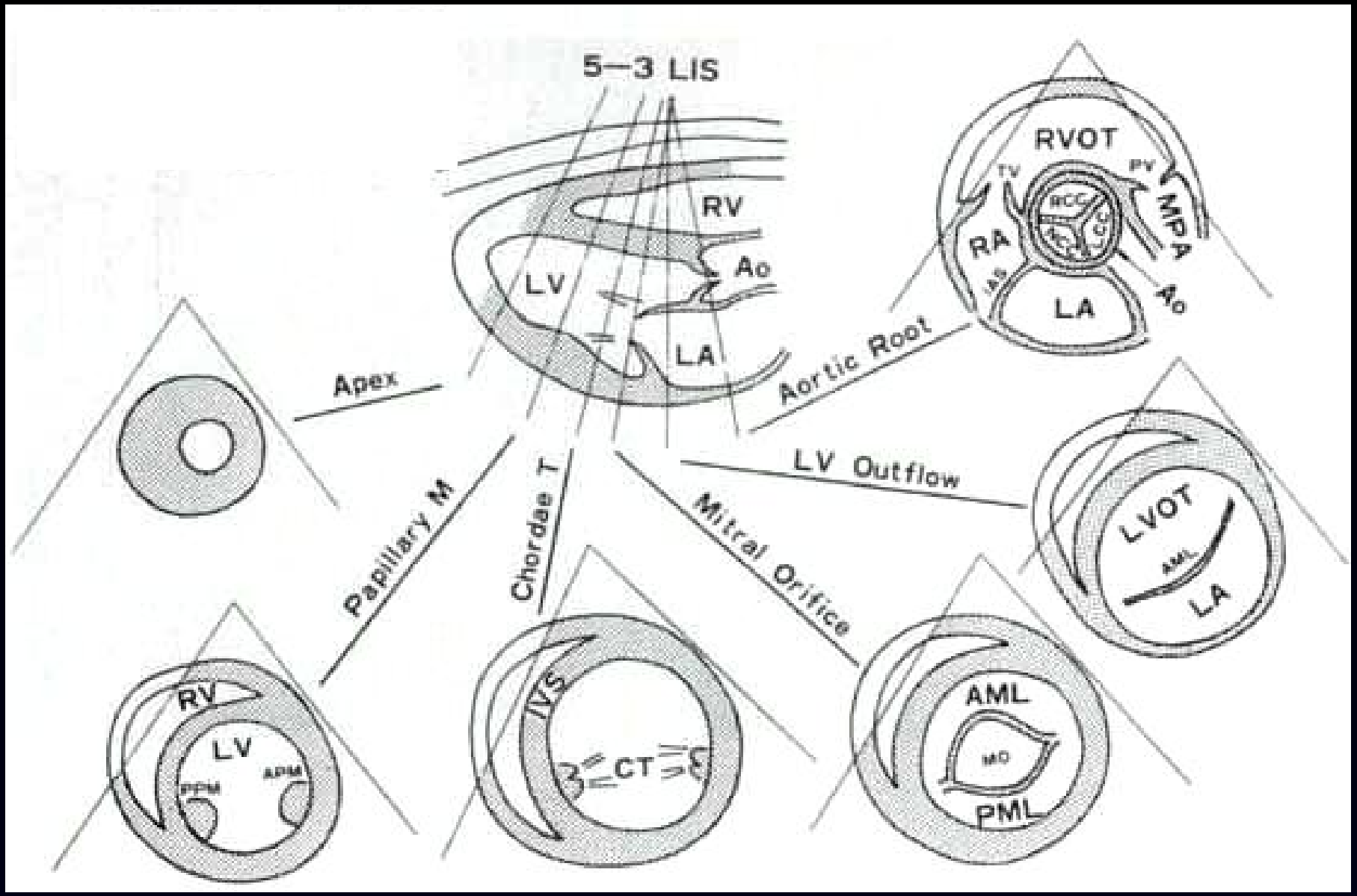

1
2
3

ETT parasternal short axis

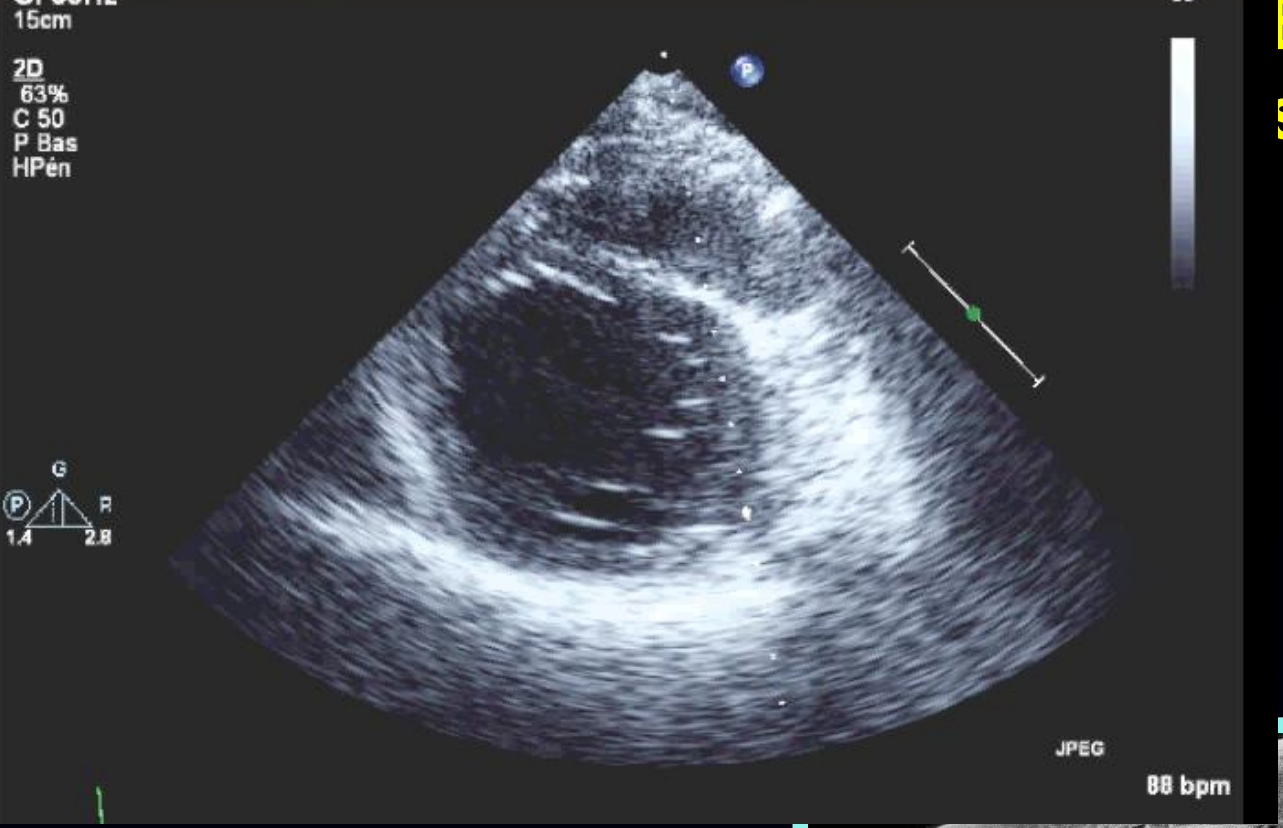
The median portion (mitral valve papillary muscle) is the most commonly used. Up and down angulation of the probe allows visualization of basal regions (up) or apical regions (down).

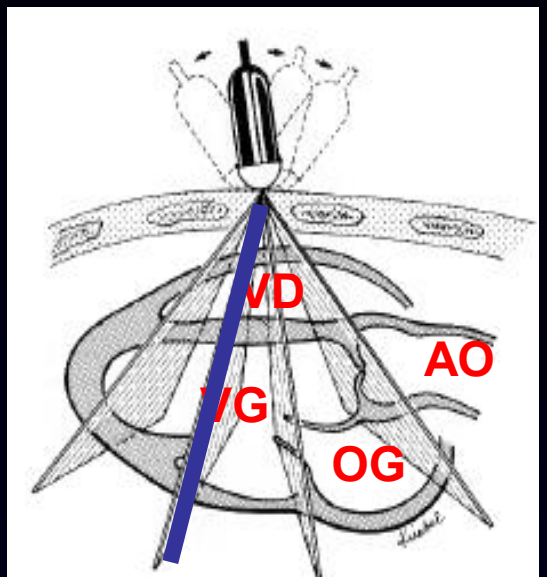


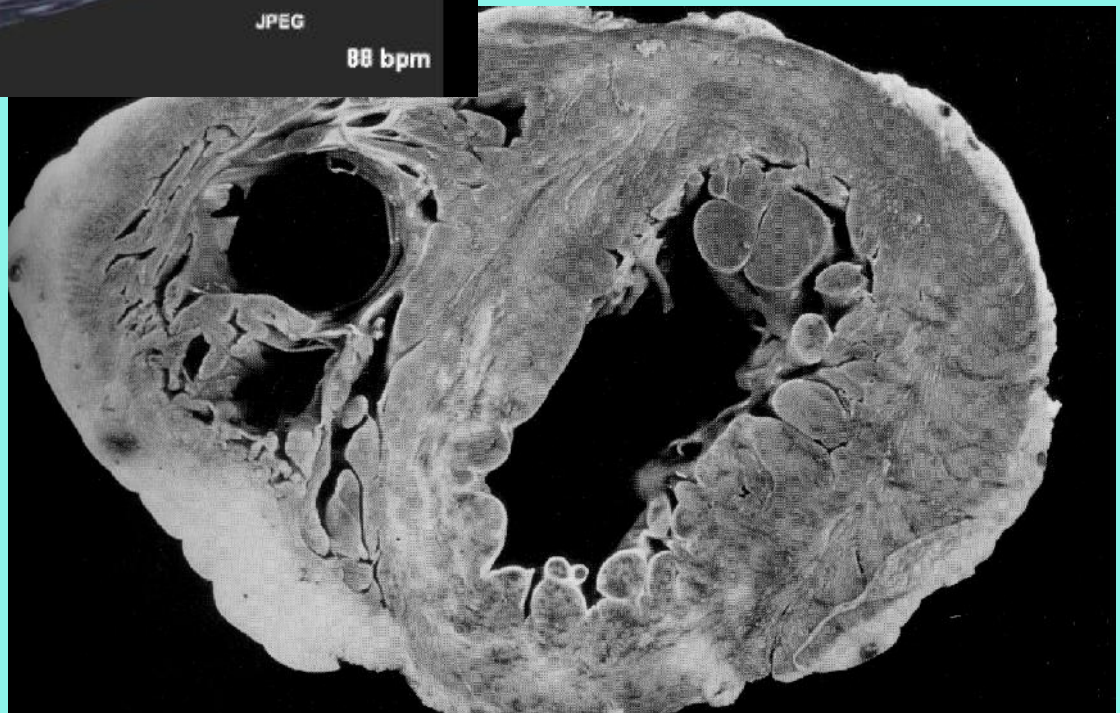



5–3 LIS
RV
Ao
LV
LA
RVOT
TV
PV
MPA
RA
RCC
LCC
AS
Ao
LA
Apex
Aortic Root
LV Outflow
Papillary M
Chordae T
Mitral Orifice
LVOT
AML
LA
RV
LV
PPM
APM
IVS
CT
AML
MD
PML

ETT parasternal short axis



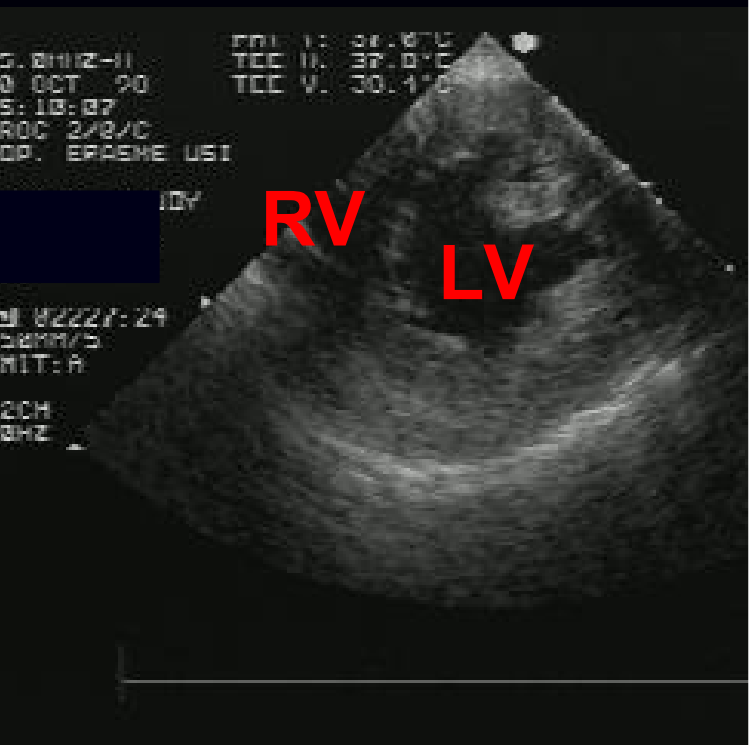


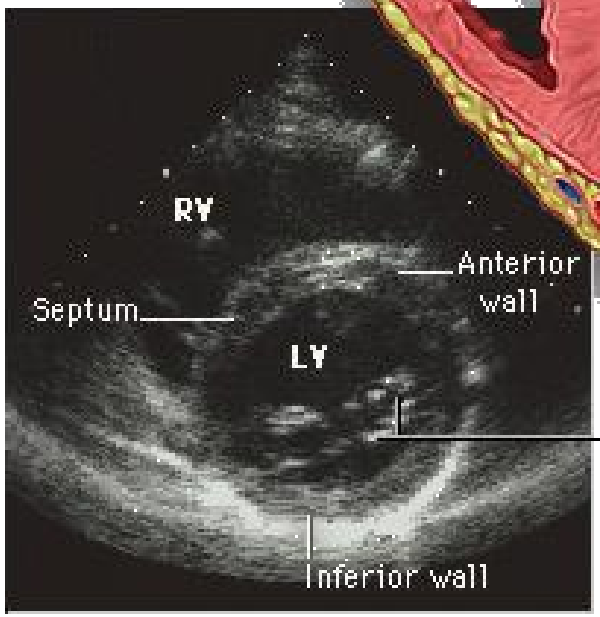


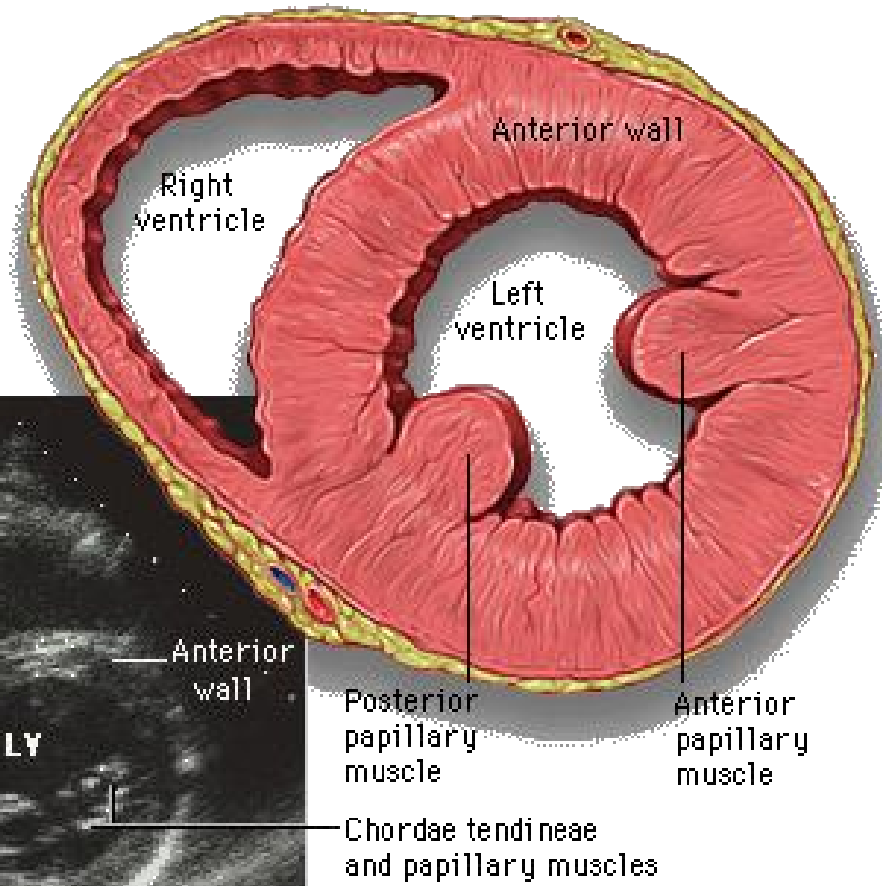
ETT parasternal short axis

Visualizsation:

- IV Septum
- Anterior, postero lateral and inferior wall of LV
- Anterior wall RV

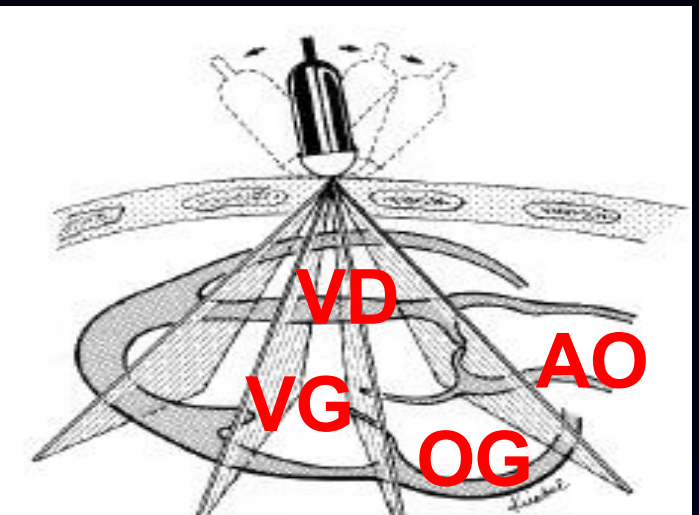


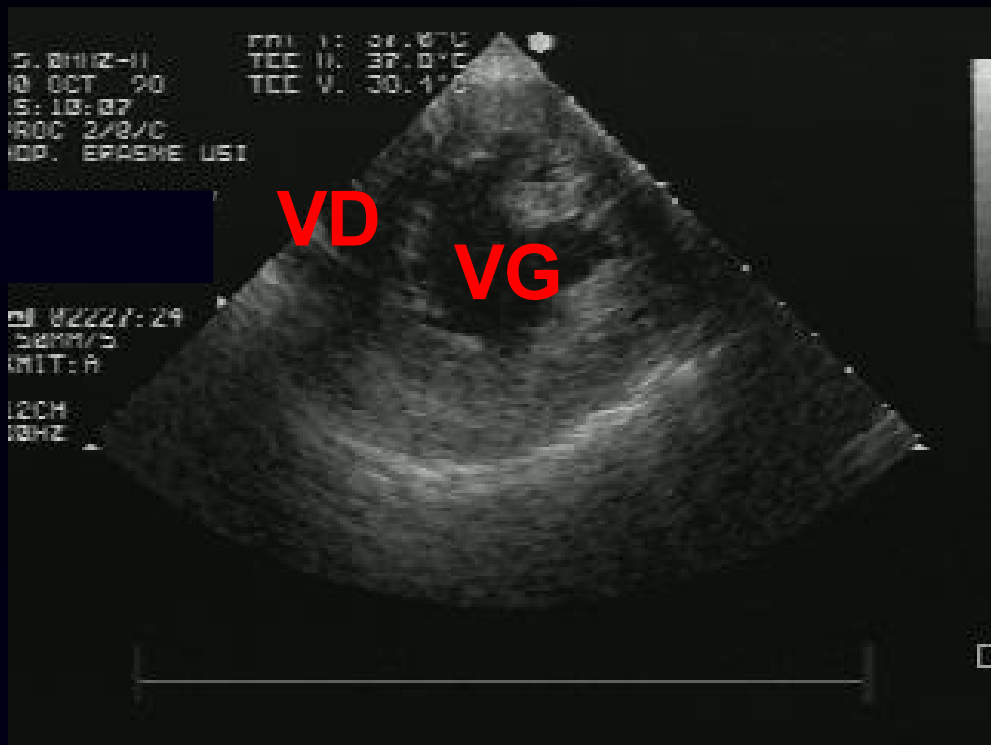




ETT parasternal short axis

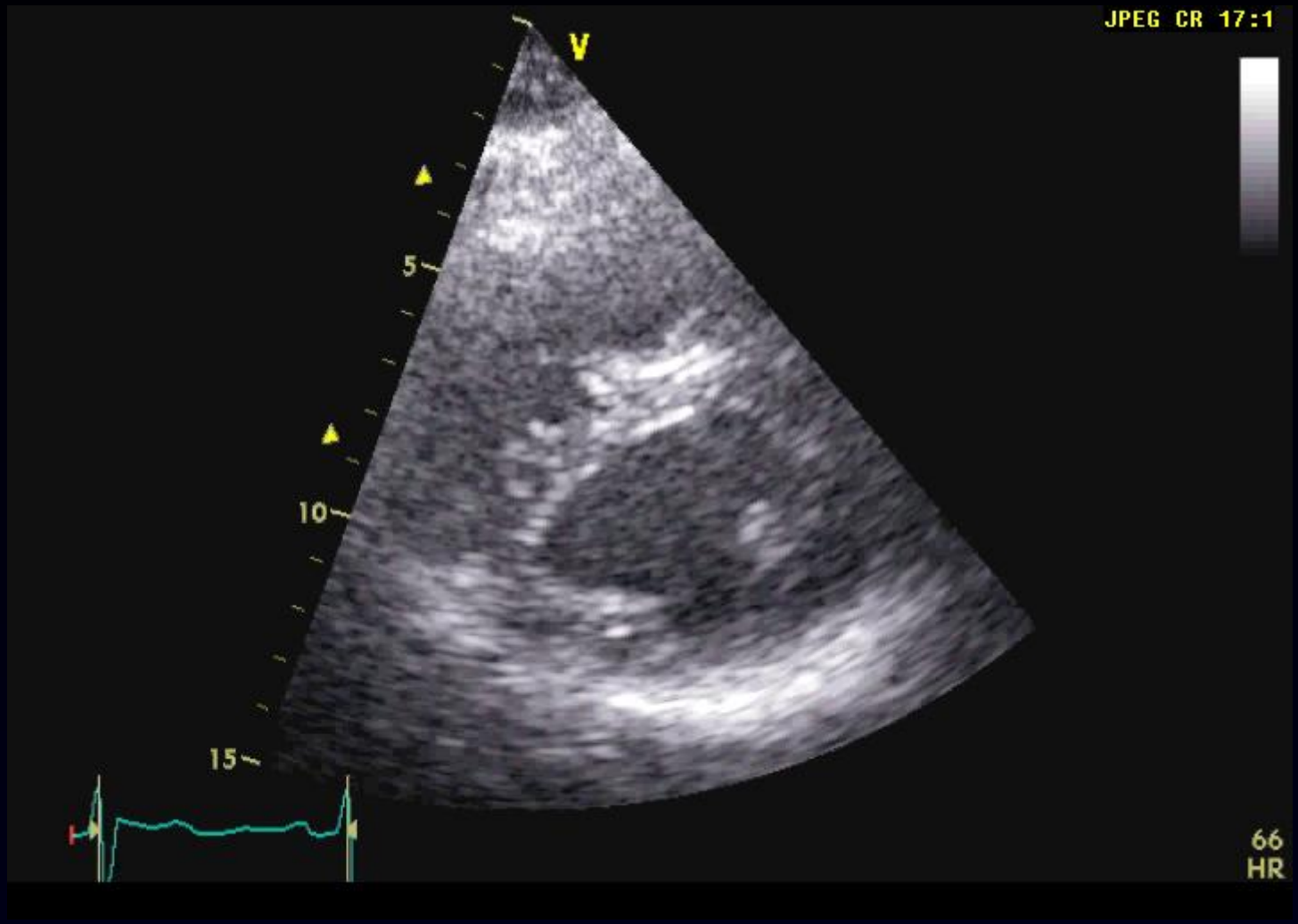
Ideal for detecting paradoxal septal movement.





ETT parasternal short axis

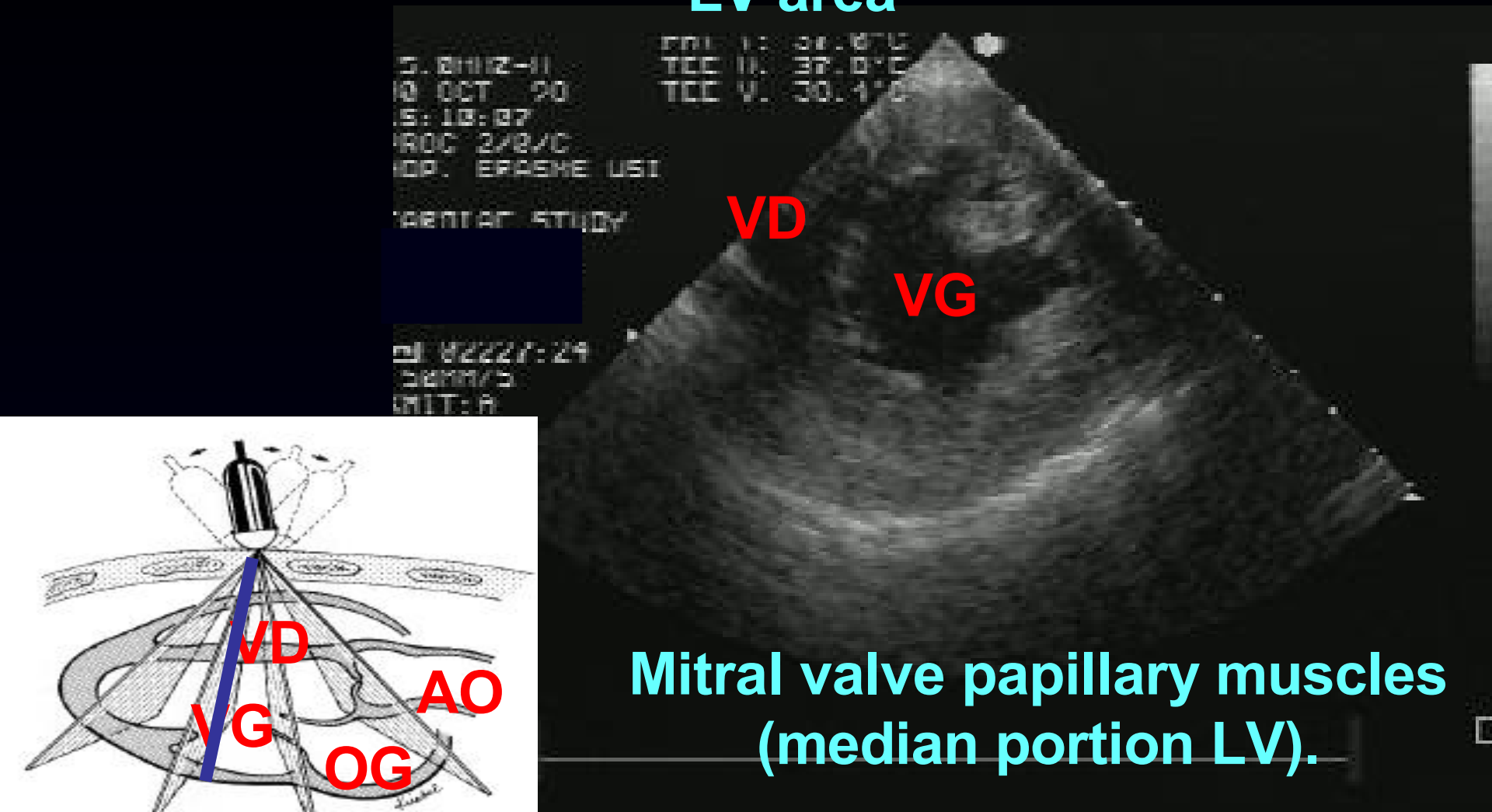
Ideal for detecting paradoxal septal movement.



ETT parasternal short axis

Principal mesurements:

- RV/LV dimensions
- LV area

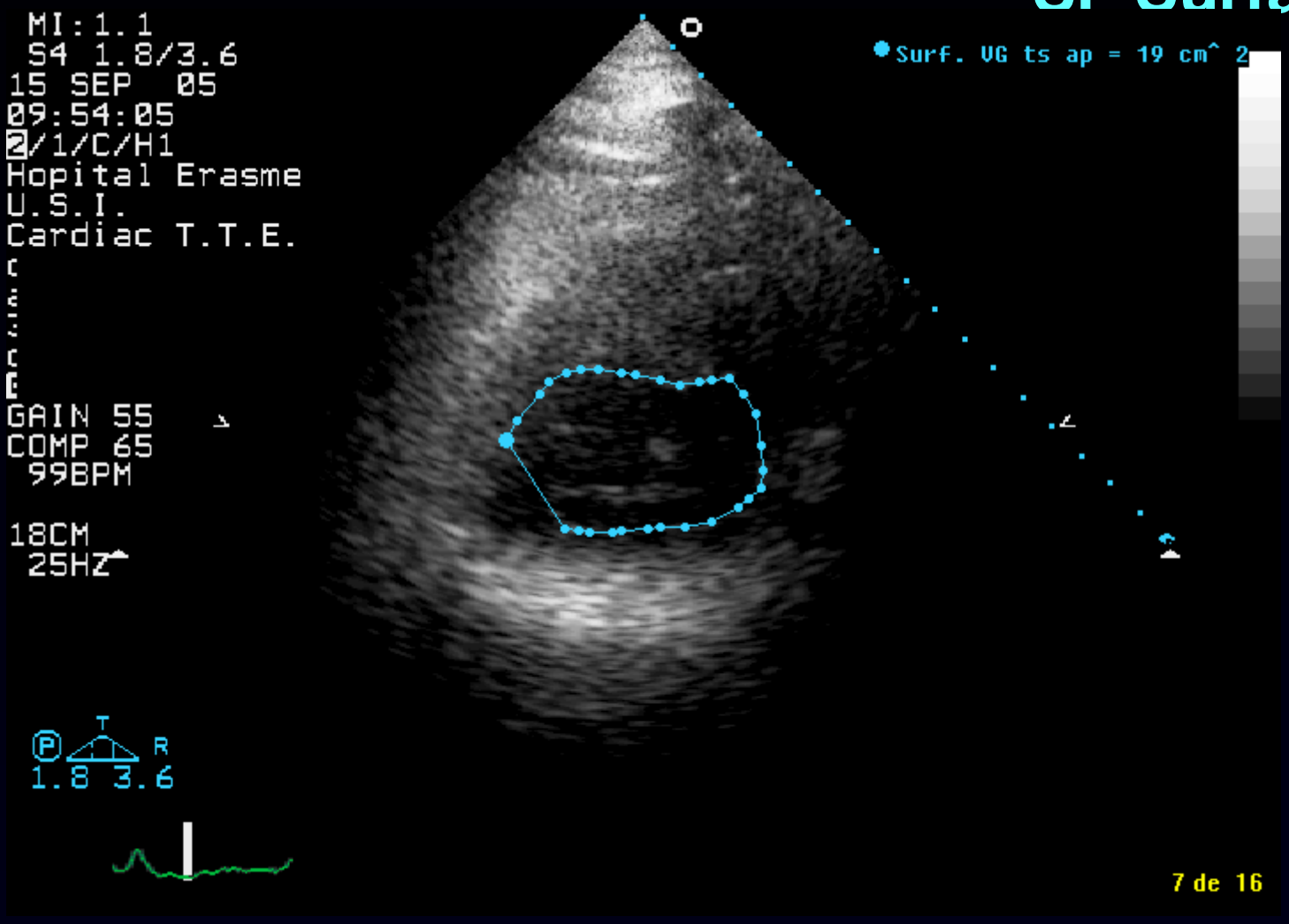


Mitral valve papillary muscles (median portion LV).

ETT parasternal short axis

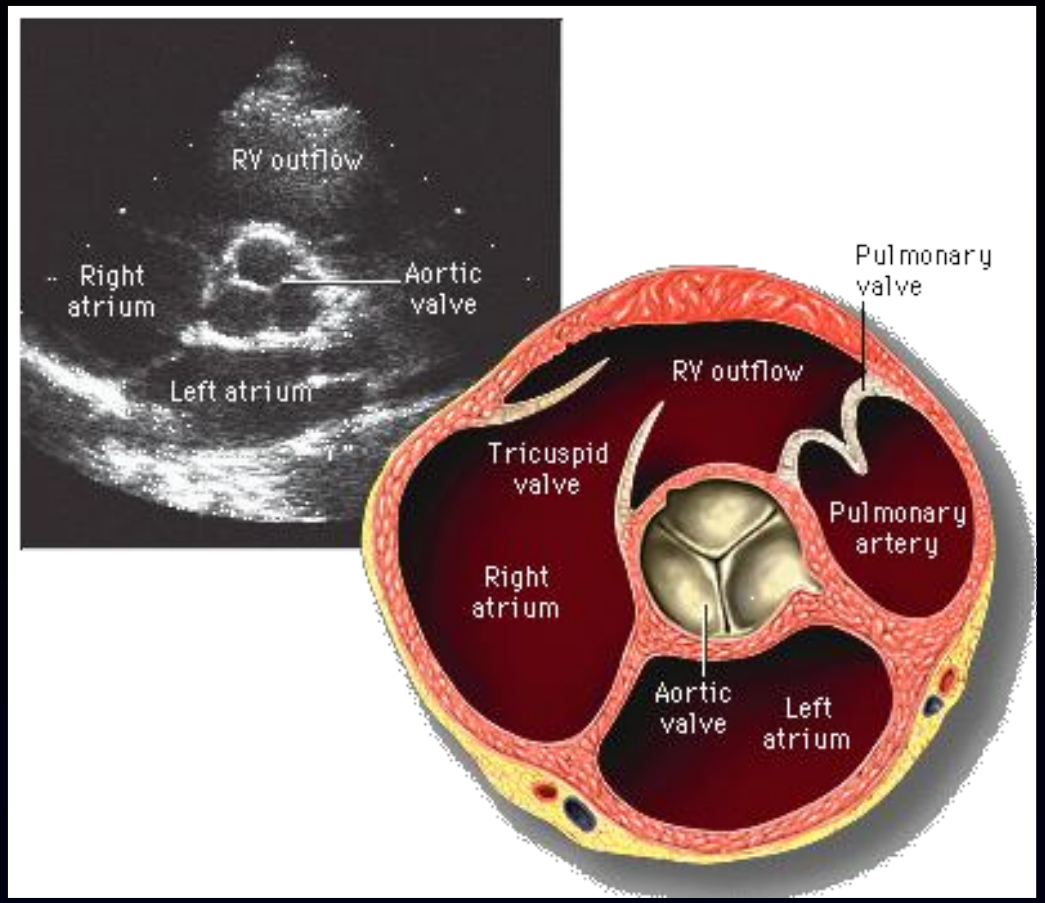
Principal measurements:

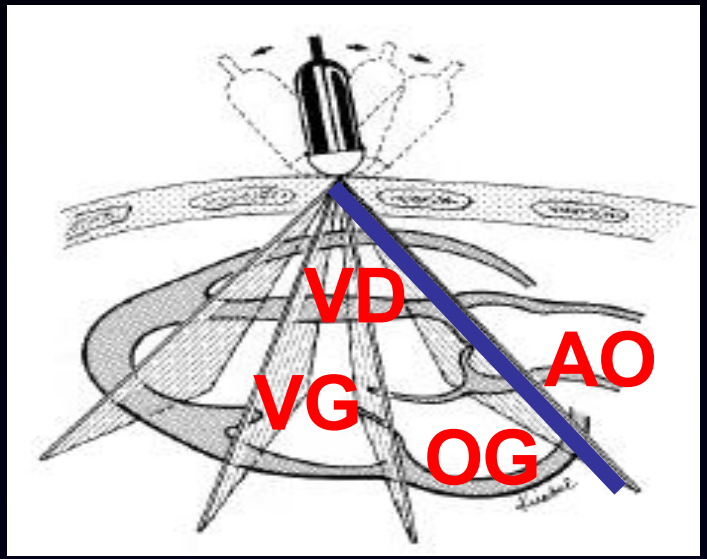
- LV/RV dimensions
- SF Surfaces



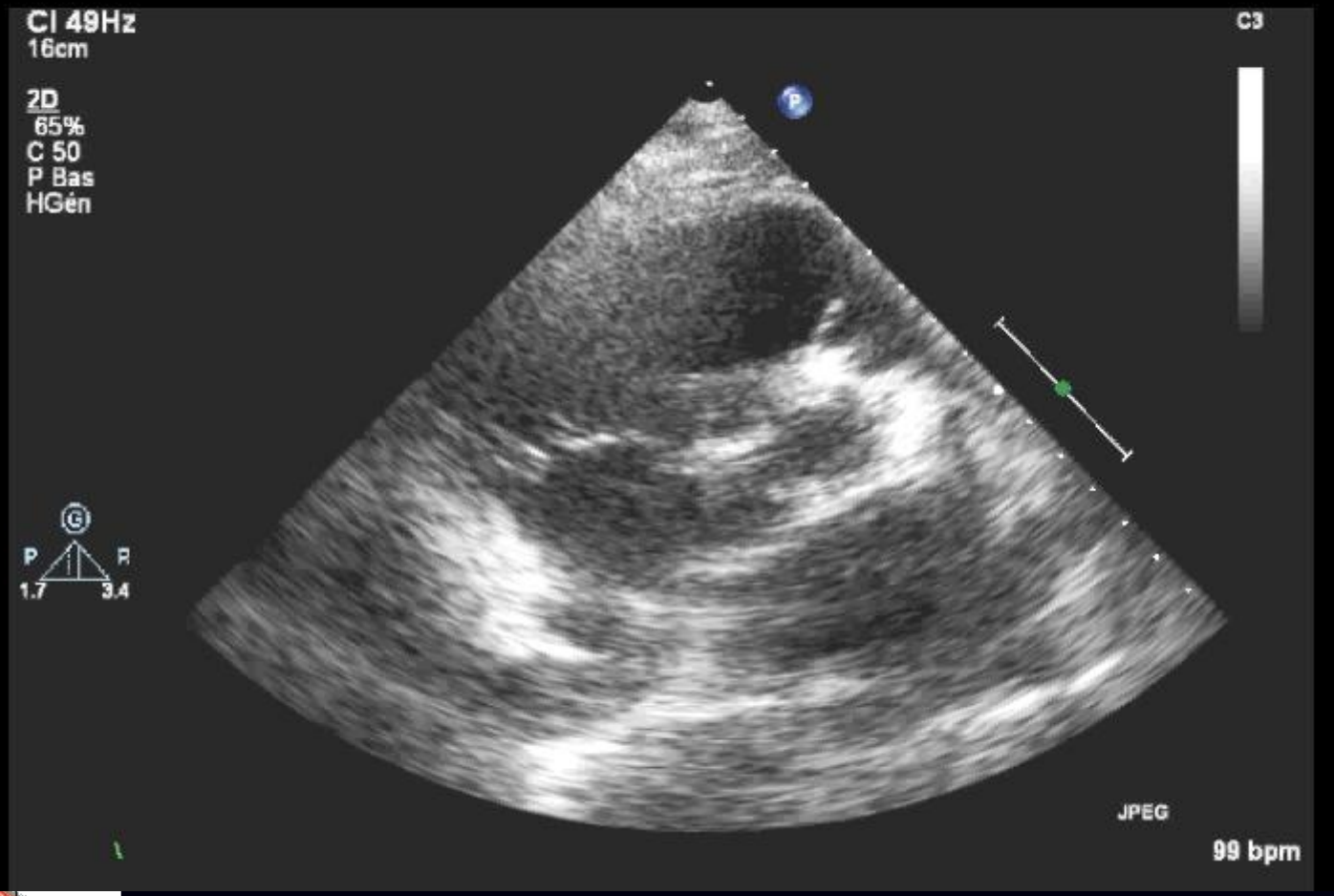
ETT parasternal short axis (BASAL)

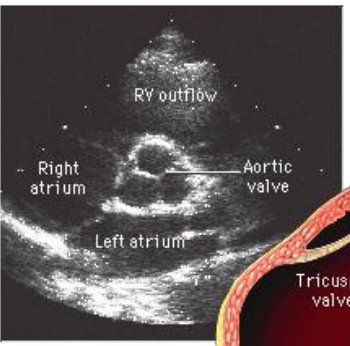
Upper angulation of the probe

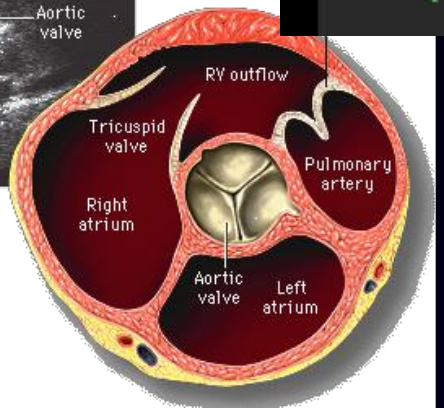




ETT parasternal short axis (BASAL)



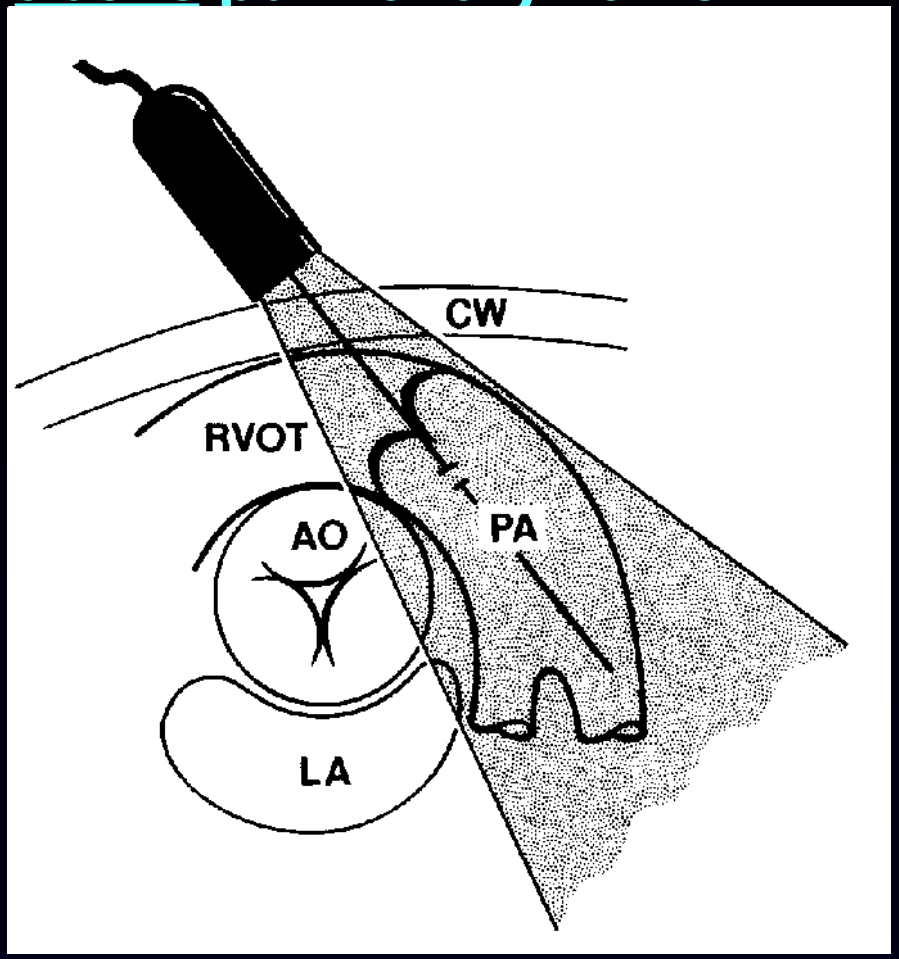




ETT parasternal short axis (BASAL)

Upper angulation of the probe

⇒ RV ejection flow, just above pulmonary valve.



ETT parasternal short axis (BASAL)

Upper angulation of the probe

⇒ RV ejection flow, just above pulmonary valve.

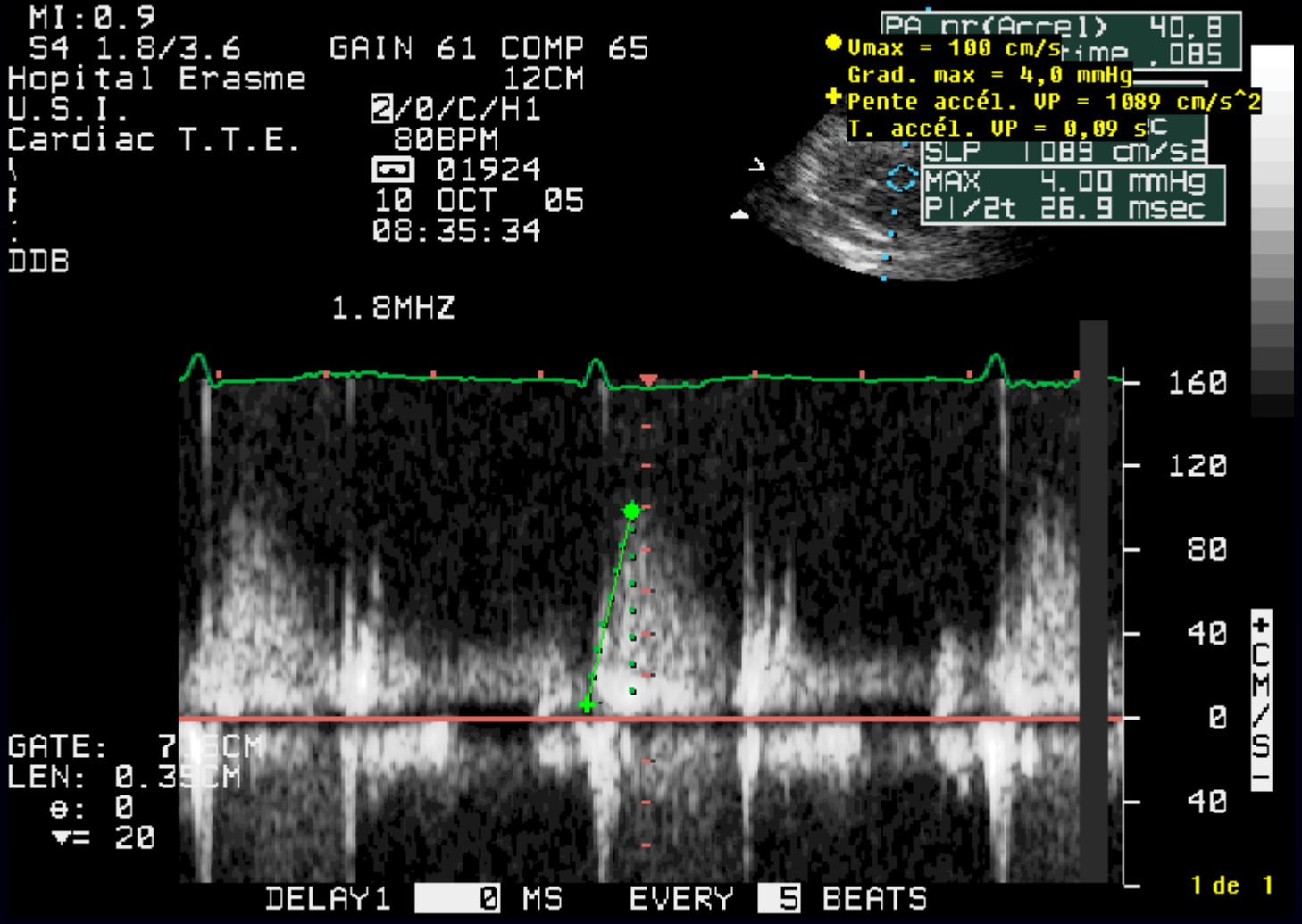
⇒ Measurement of CO with velocity time integral (VTI) and pulmonary artery diameter (EV = VTI x π D^2 / 4).

⇒ Signs of pulmonary hypertension :

(2) A short acceleration time (onset to peak <100 ms) evokes PAH

(2) Flow morphology: A biphasic flow evokes massive pulmonary embolism

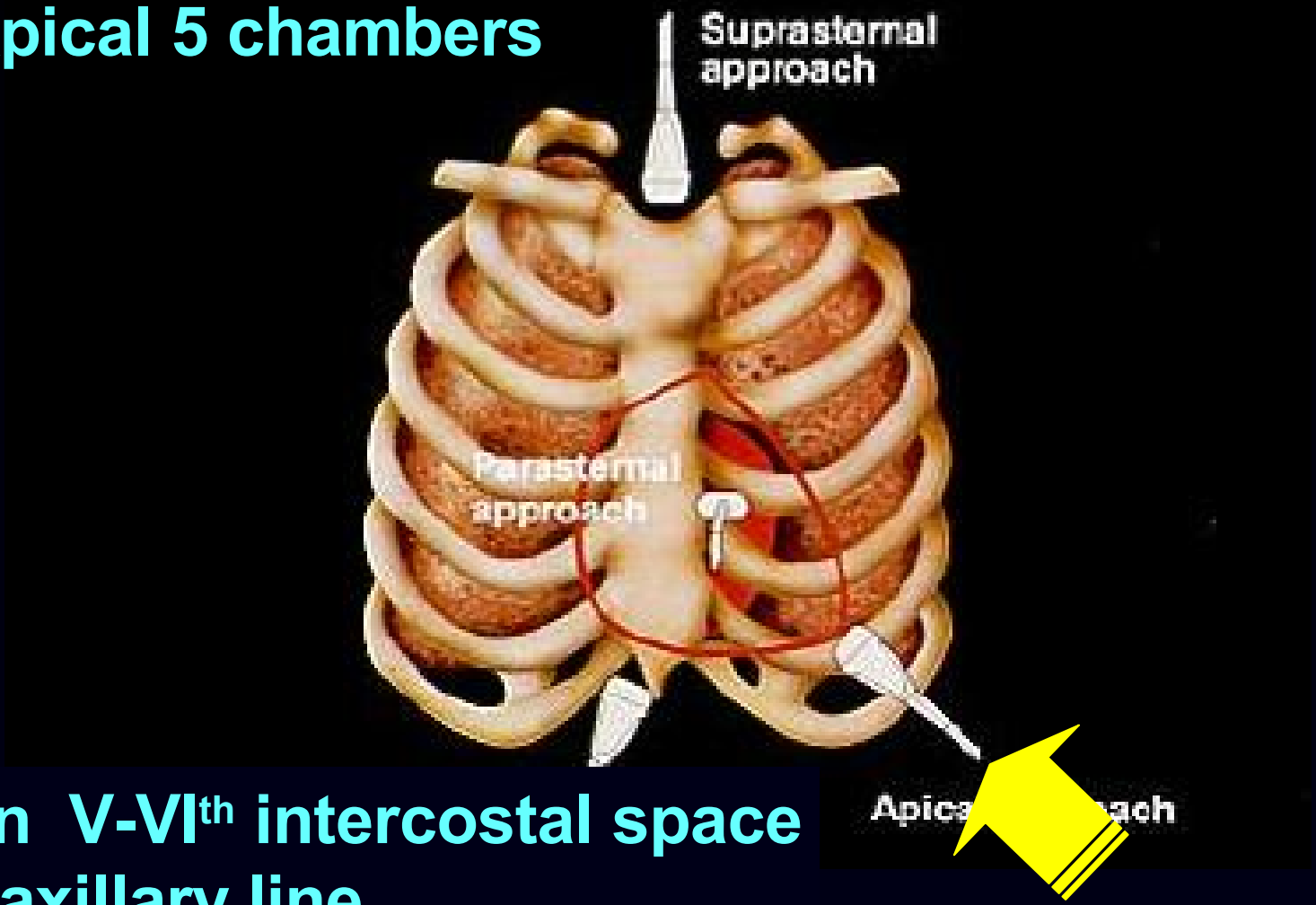
Pulmonary flow acceleration time



PAPm 35 mmHg

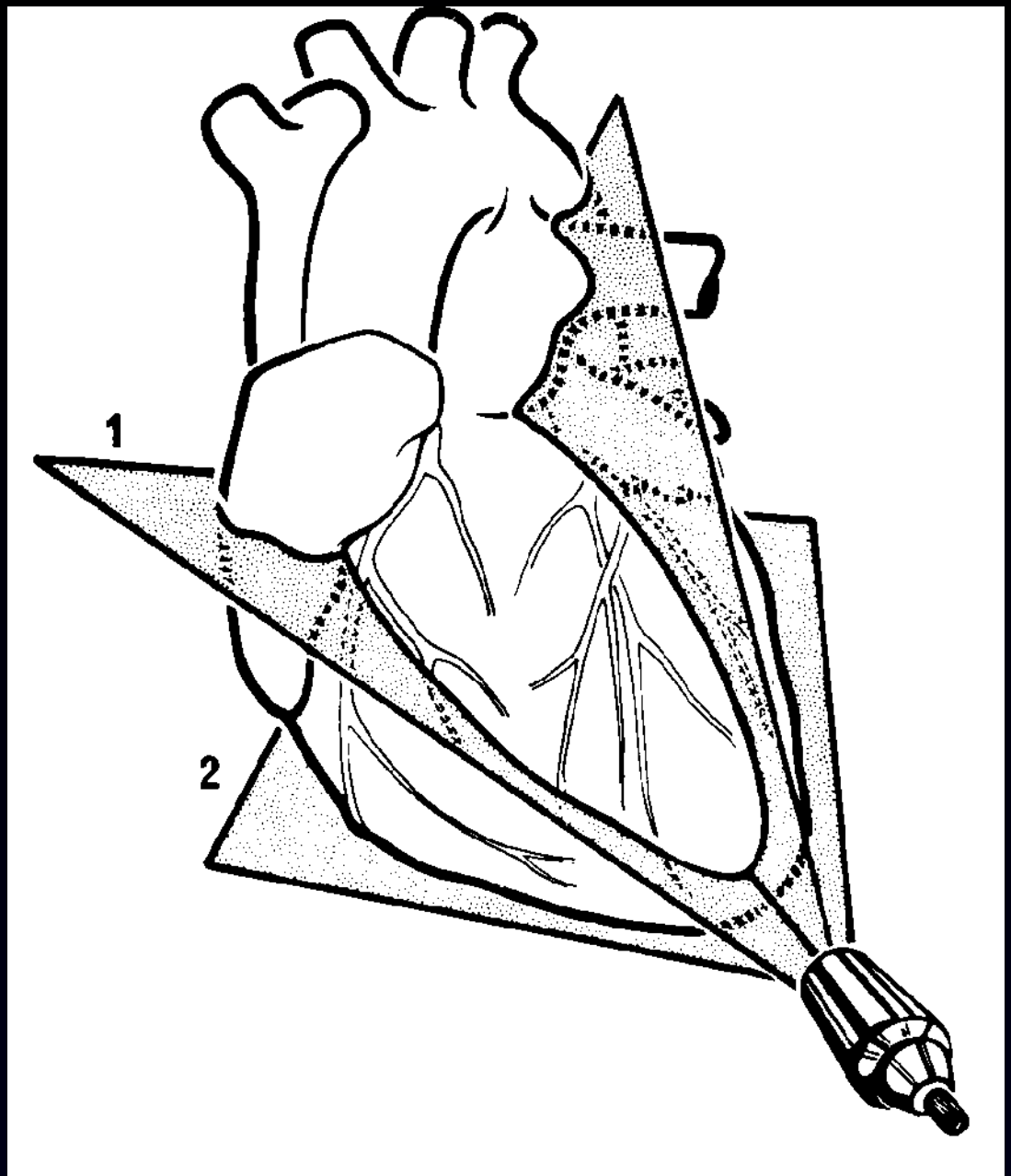
APICALS VIEWS

- **Apicals views:**
  - **Apical 2 chambers**
  - **Apical 4 chambers**
  - **Apical 5 chambers**

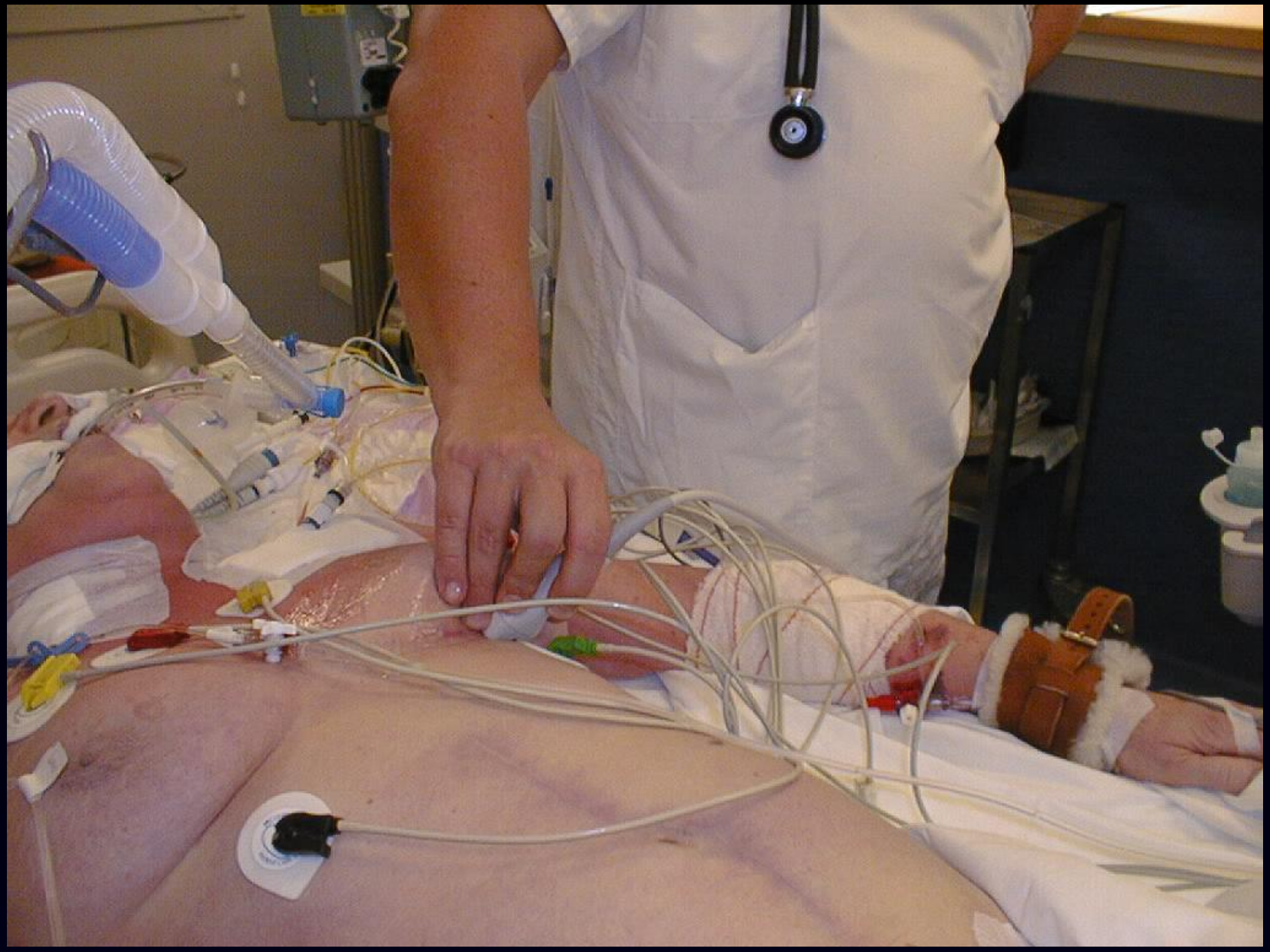


Probe in V-VIth intercostal space / medioaxillary line

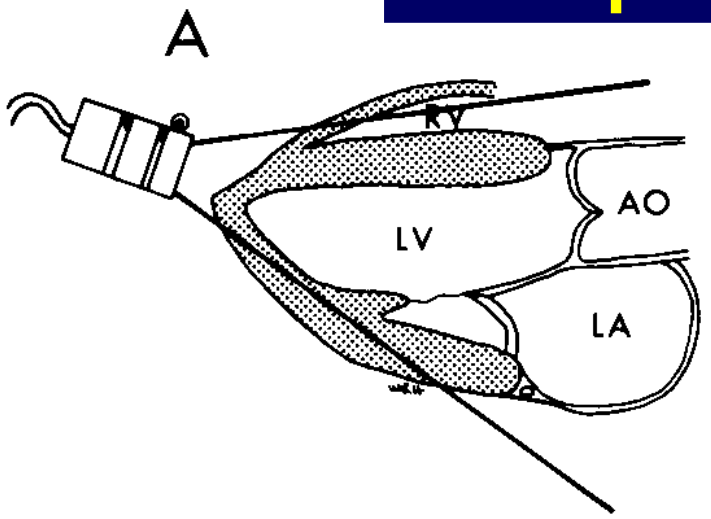
ETT apical view



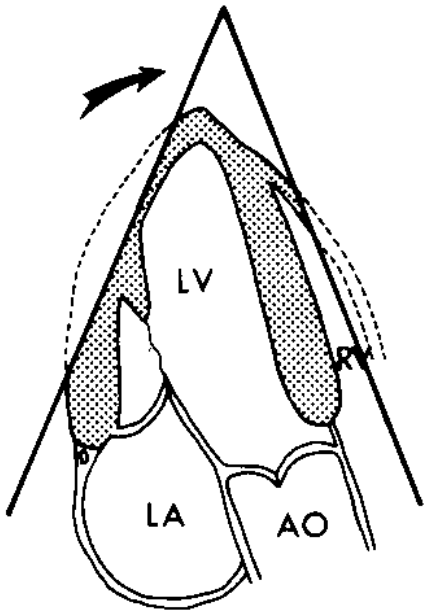
ETT apical view



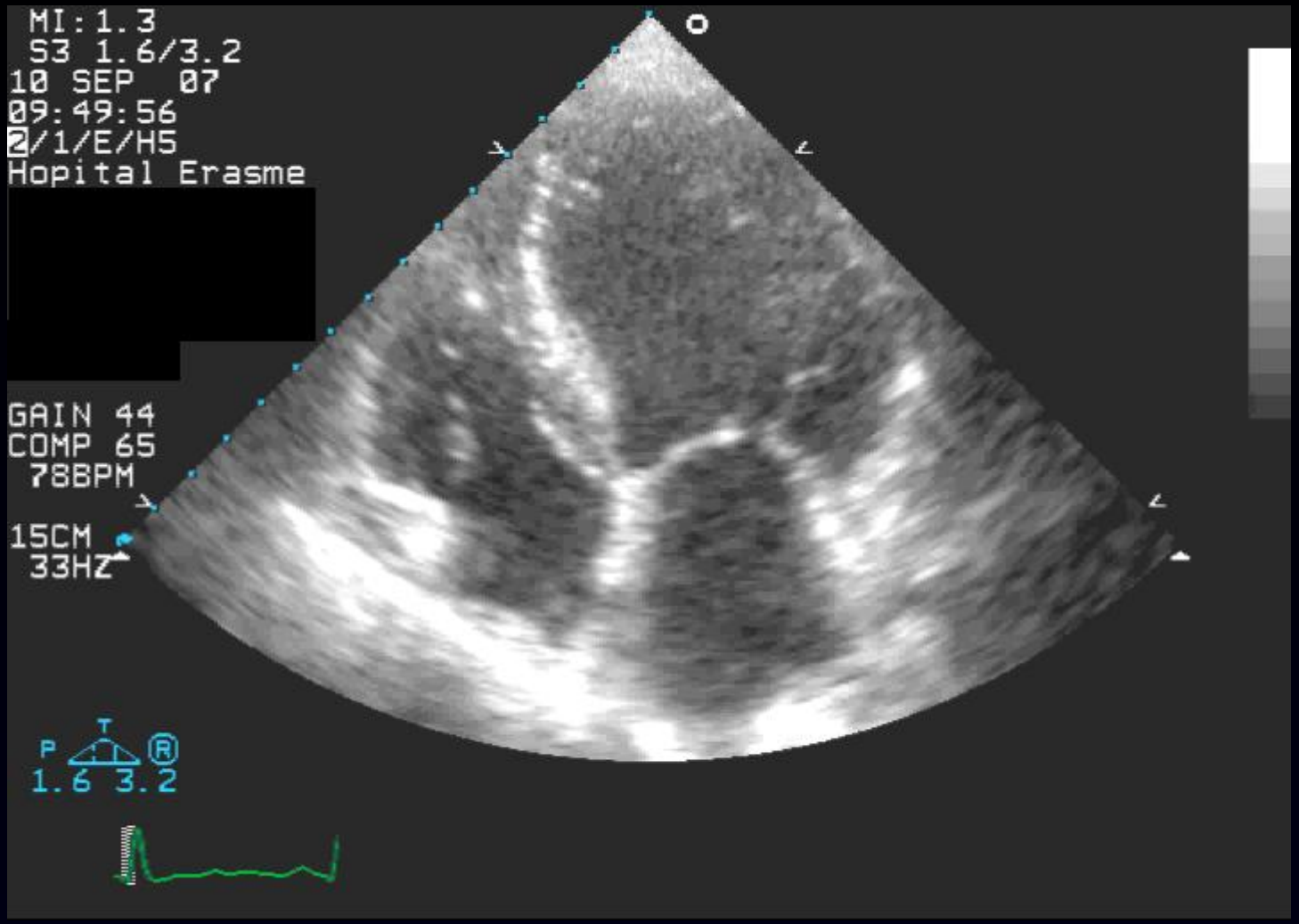
ETT apical view 4 chambers



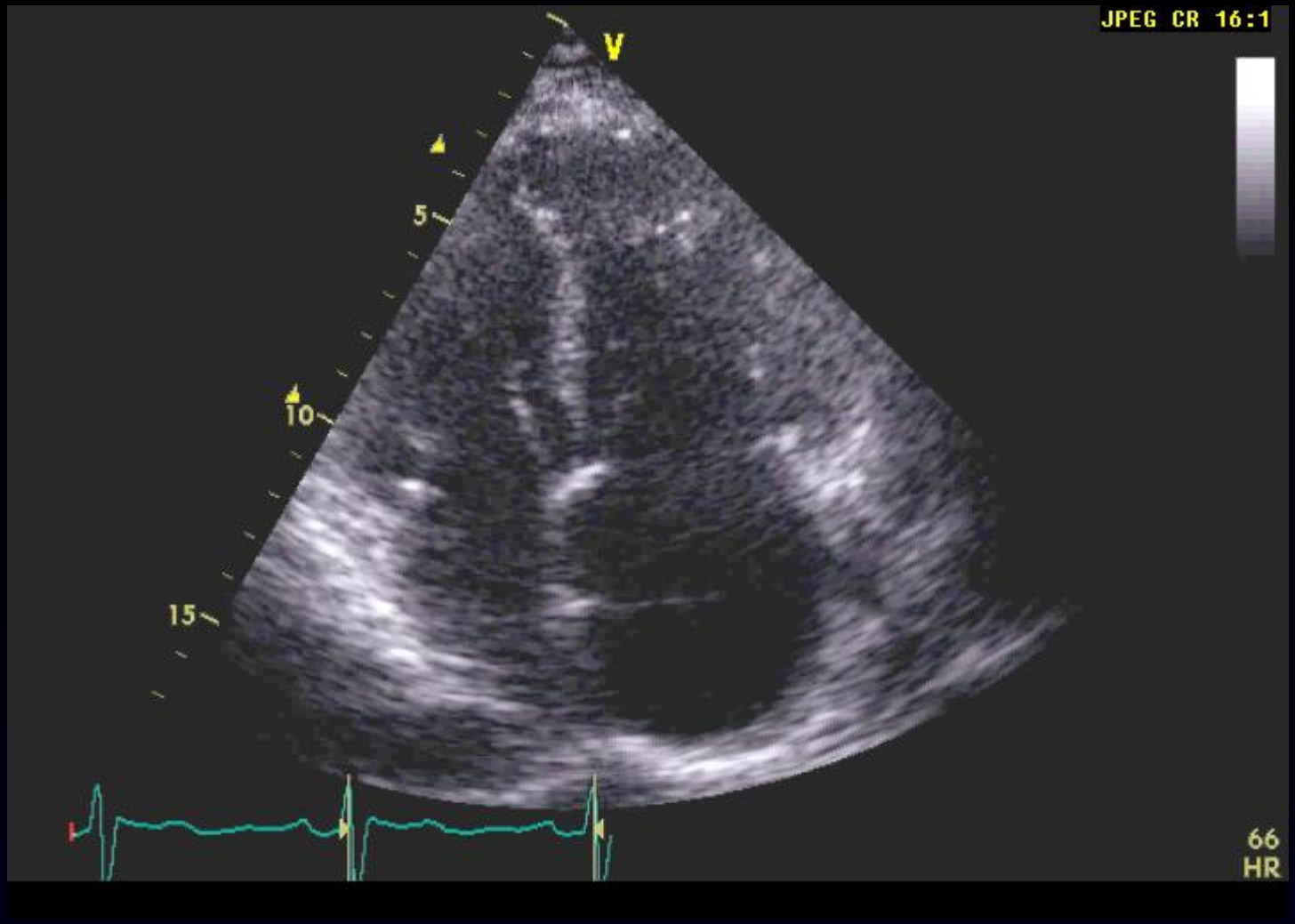
APICAL LONG-AXIS



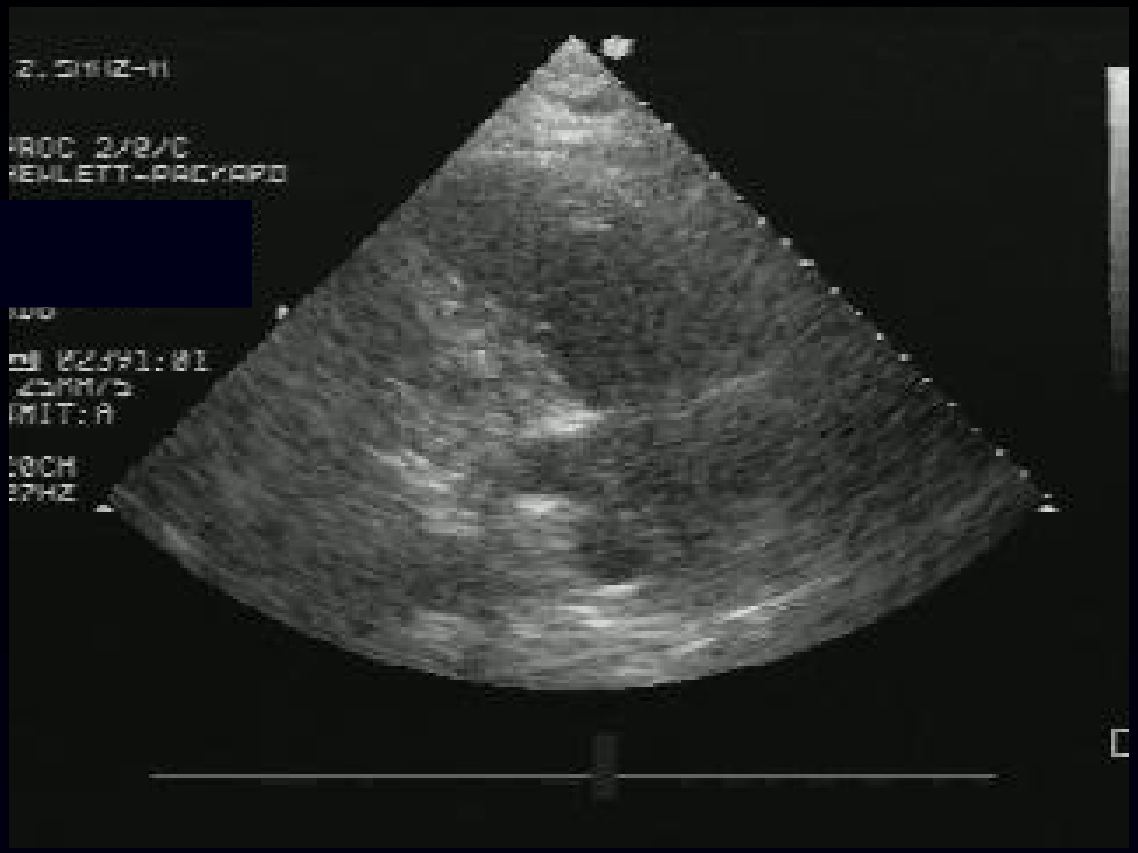
ETT apical view: 4 chambers



ETT apical view: 4 chambers



ETT apical view: 4chambers

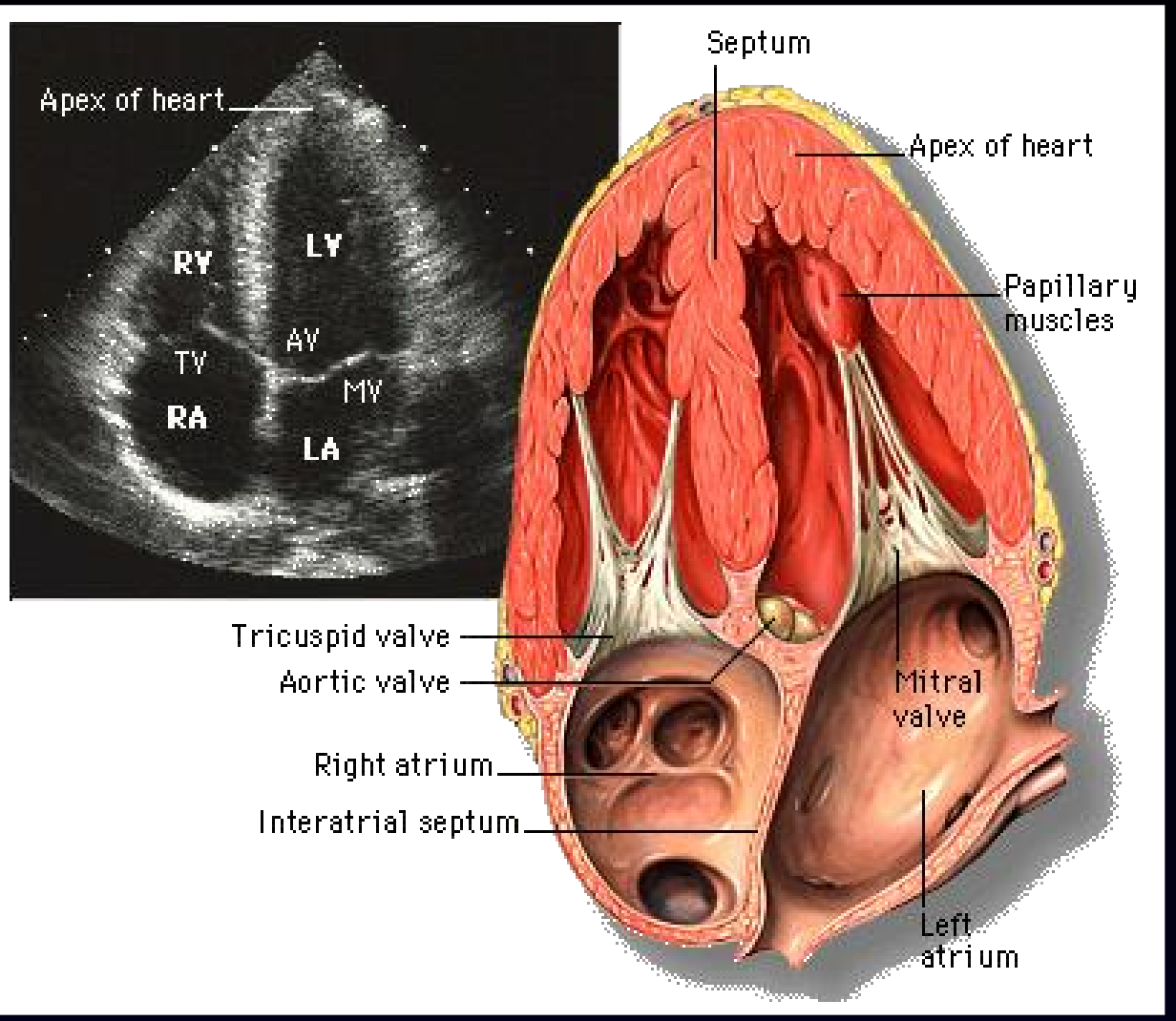


! L/R Orientation of the probe !

ETT apical view (4 chambers)

Visualization:

- RV (free wall)
- IV Septum
- LV (apical, lat wall, *LVOT*)
- LA
- RA
- IA Septum



ETT apical view: 4 chambers

Measurements:

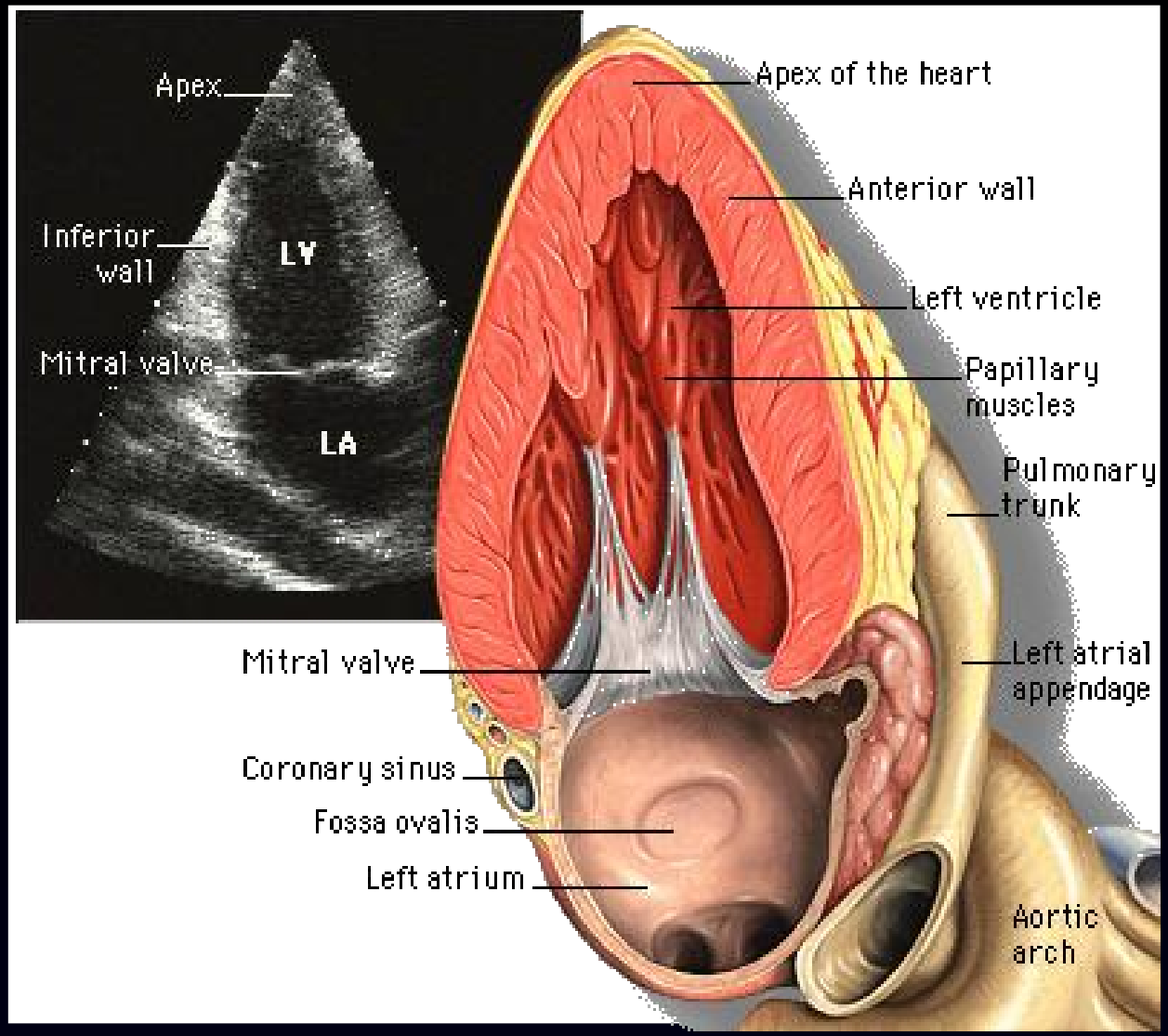
- Diameters long and short axis RV and LV
- Surfaces LV (RV)
- LA
- RA

Calculations:

- RV Dilatation (surfaces): TDSRV/TDSLV (nl<0.6)
- Volumes: TDVLV and TSVLV => EF

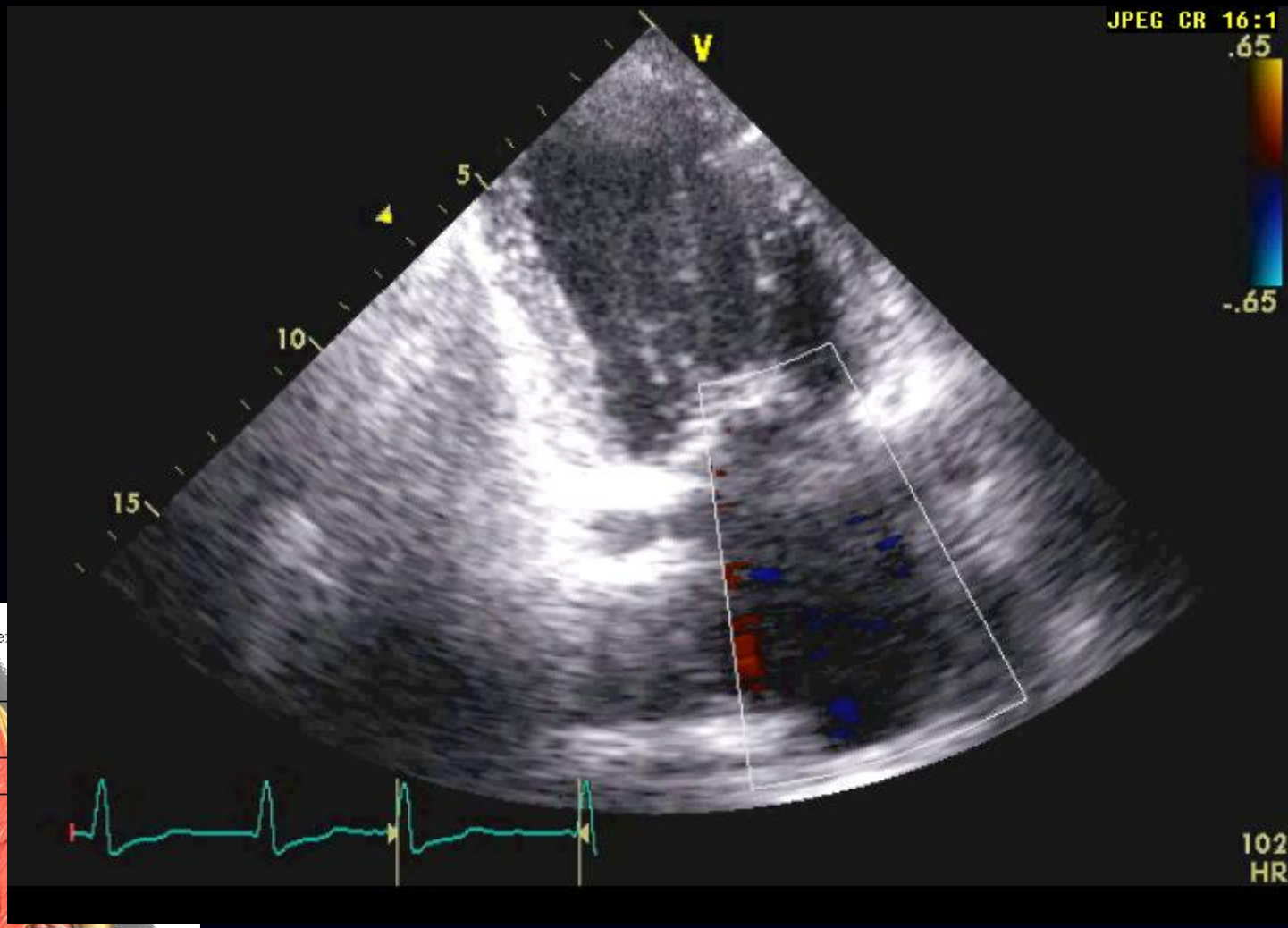
(surface / length estimation, now replaced by Simpson method)

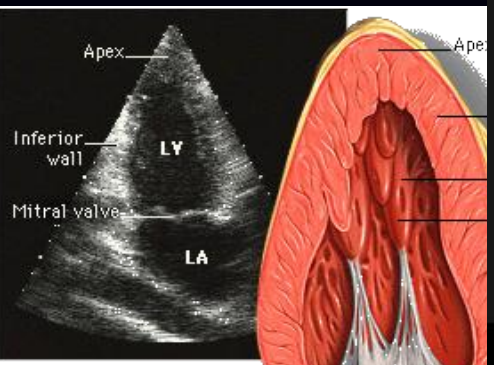
ETT apical view: 2 chambers



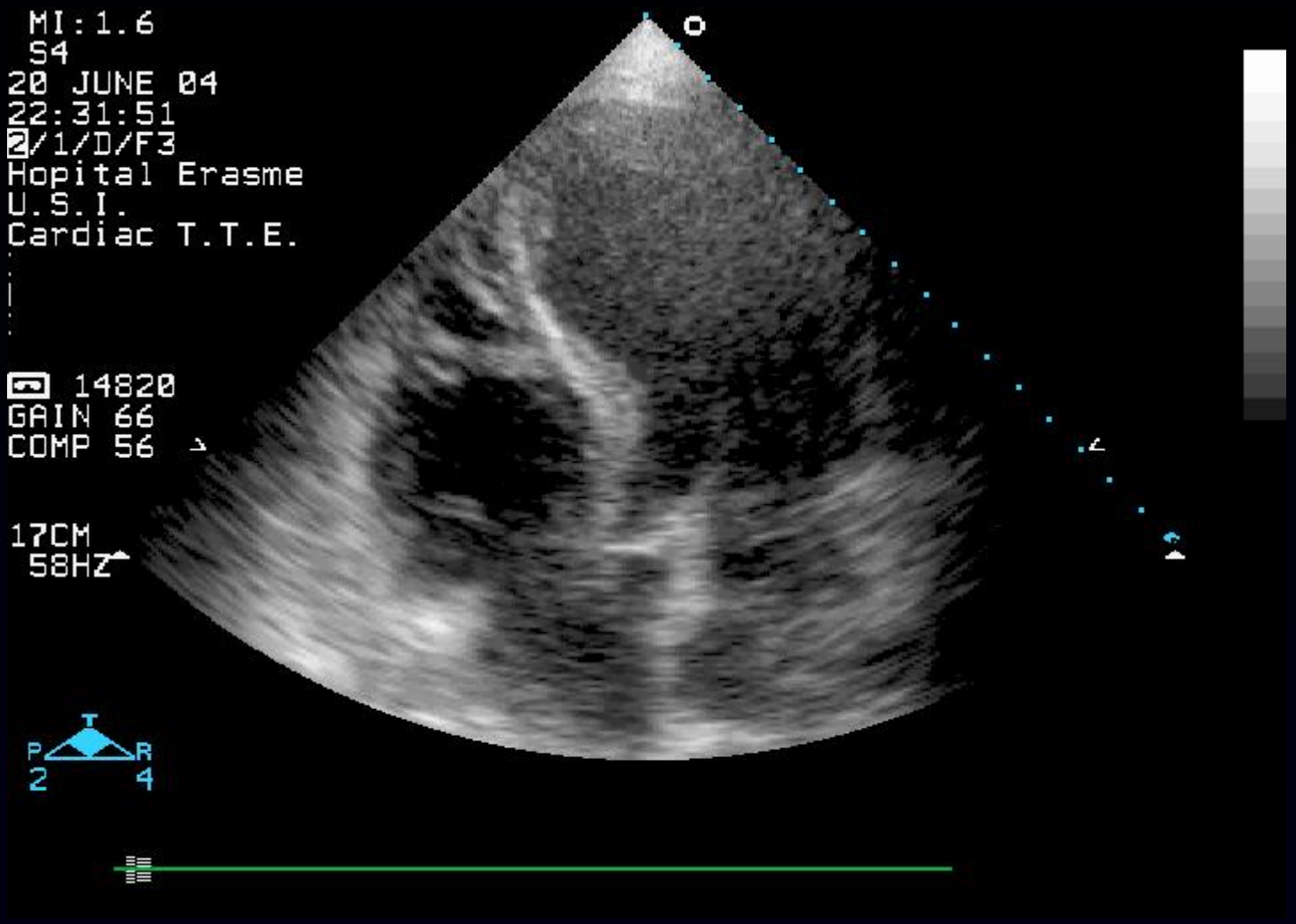
http://info.med.yale.edu/intmed/cardio/echo_atlas/views

ETT apical view: 2 chambers





ETT apical view: 5 chambers

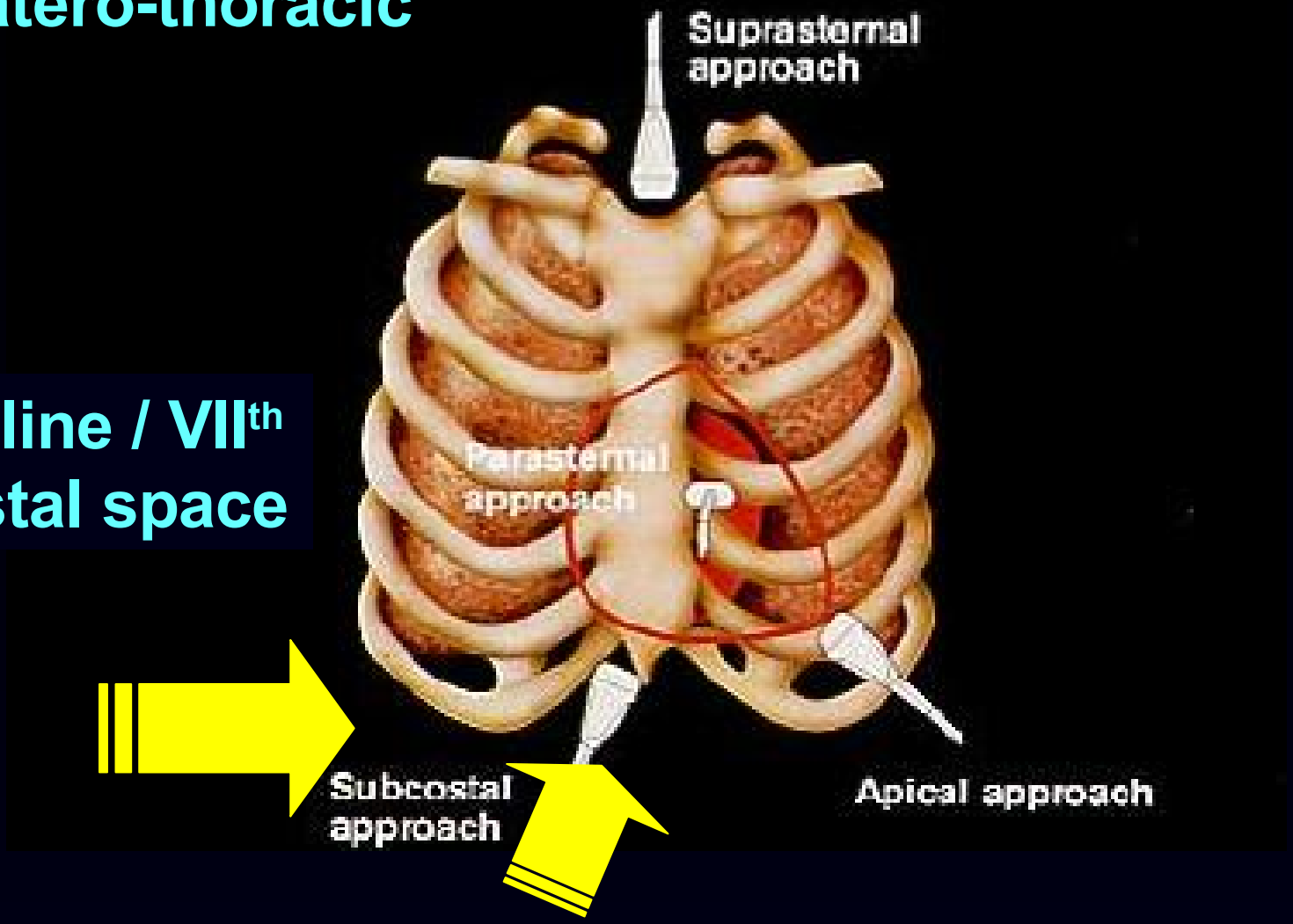


Aortic flow (CO measurement / gradient)

SUBCOSTAL VIEWS

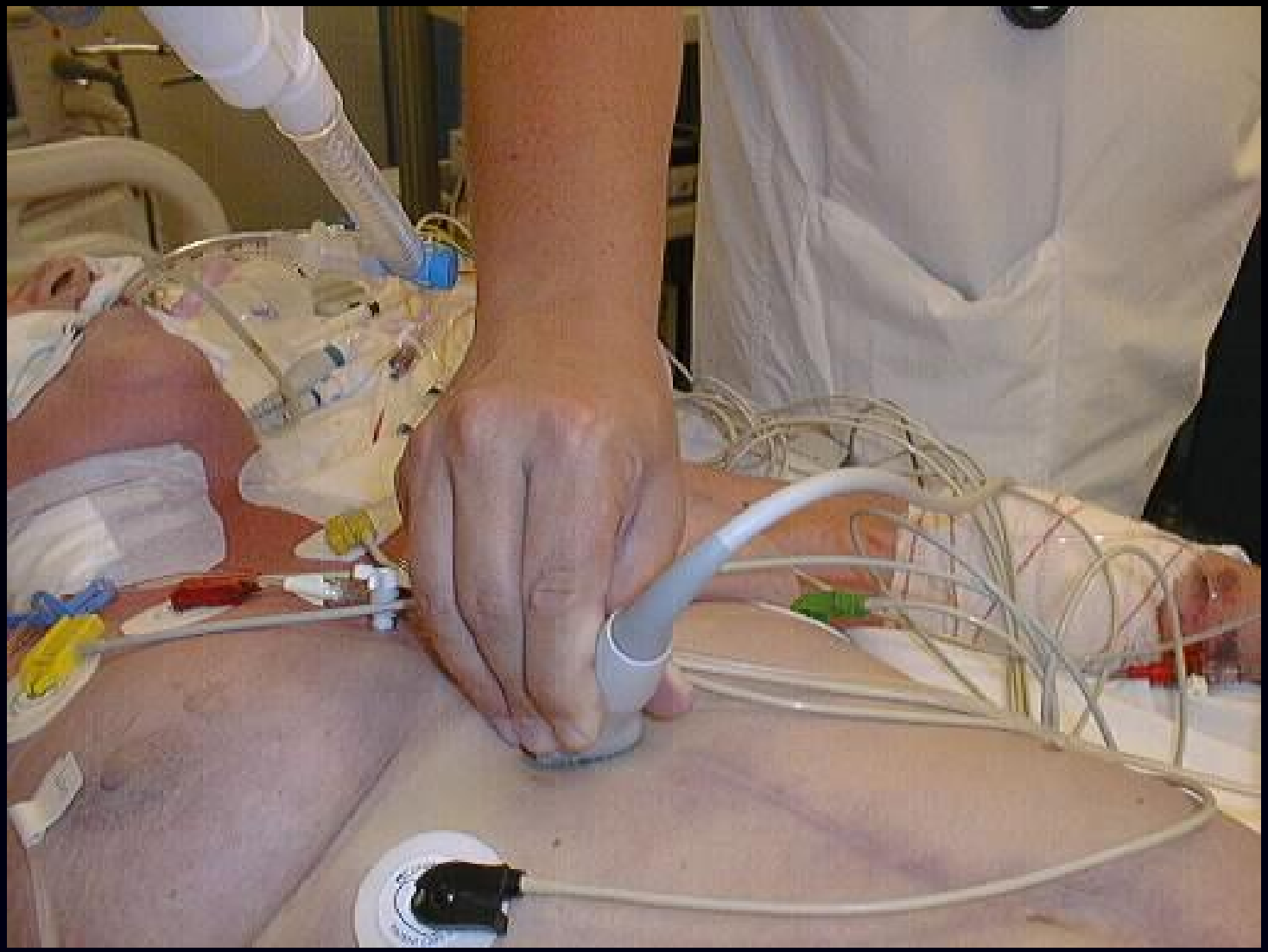
- **Subcostal views:**
  - **Sub xyphoidal**
  - **Latero-thoracic**

Median line / VIIth intercostal space

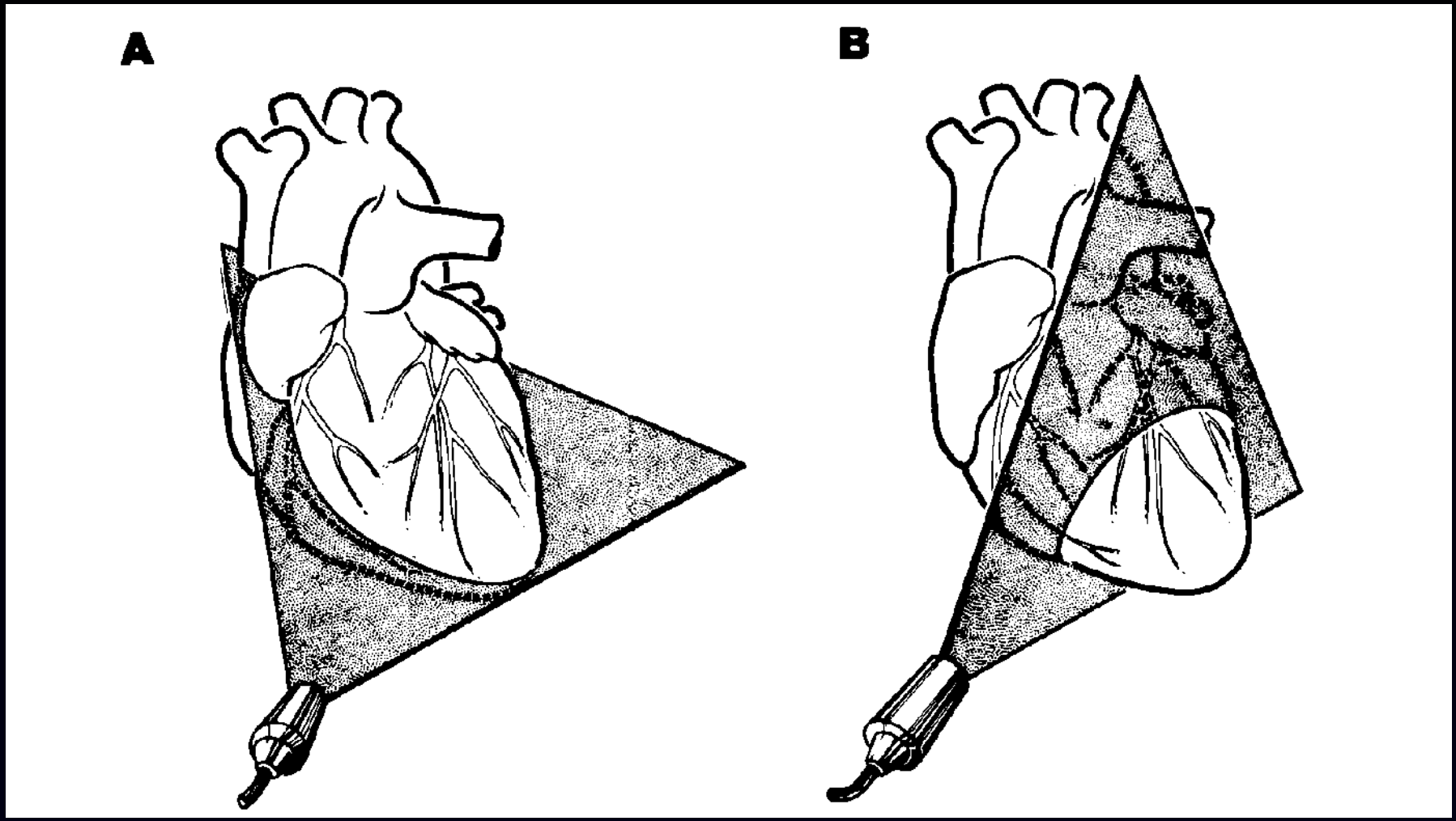


Sub xyphoidal: probe directed to left scapula

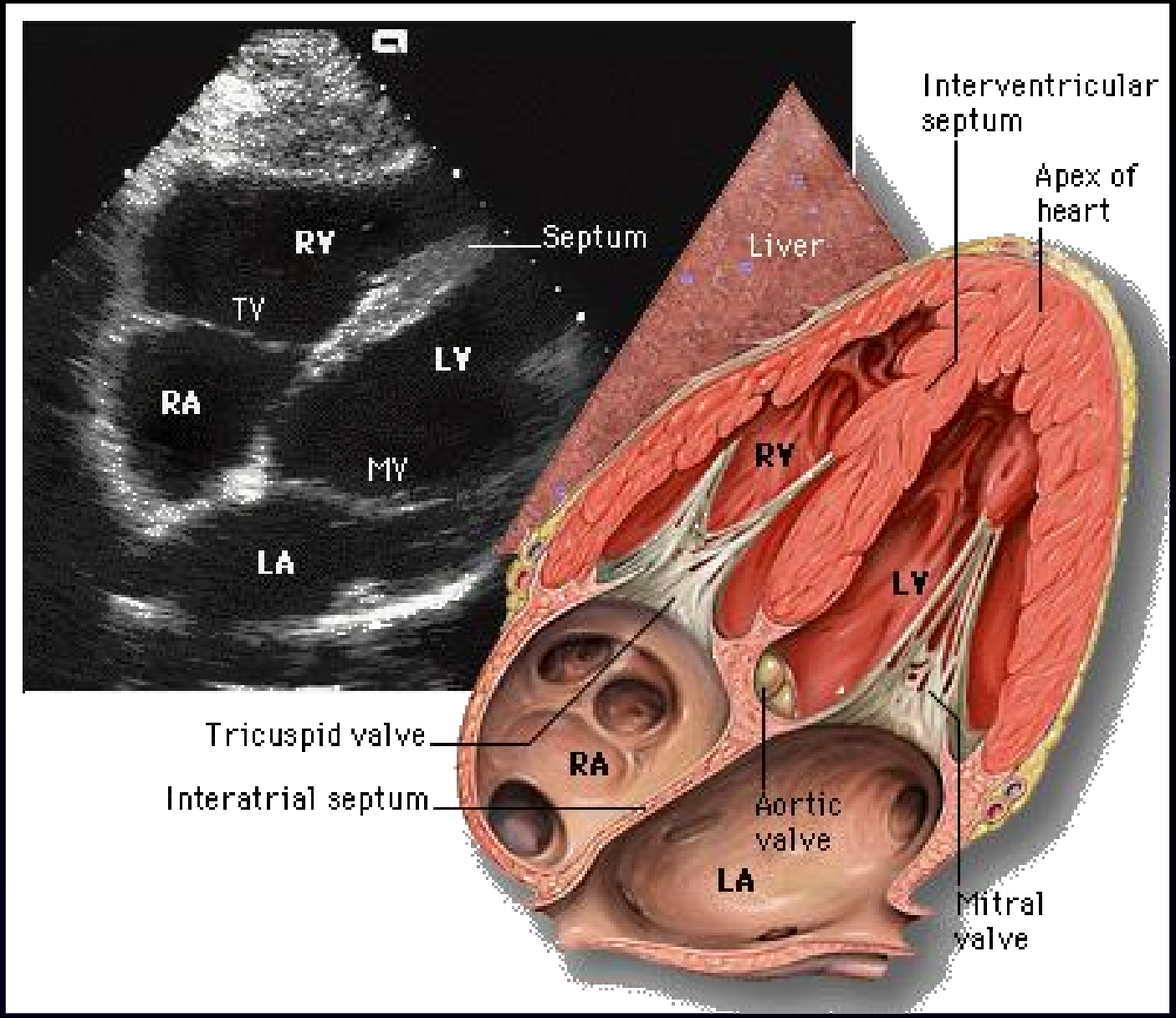
SUB COSTAL VIEWS



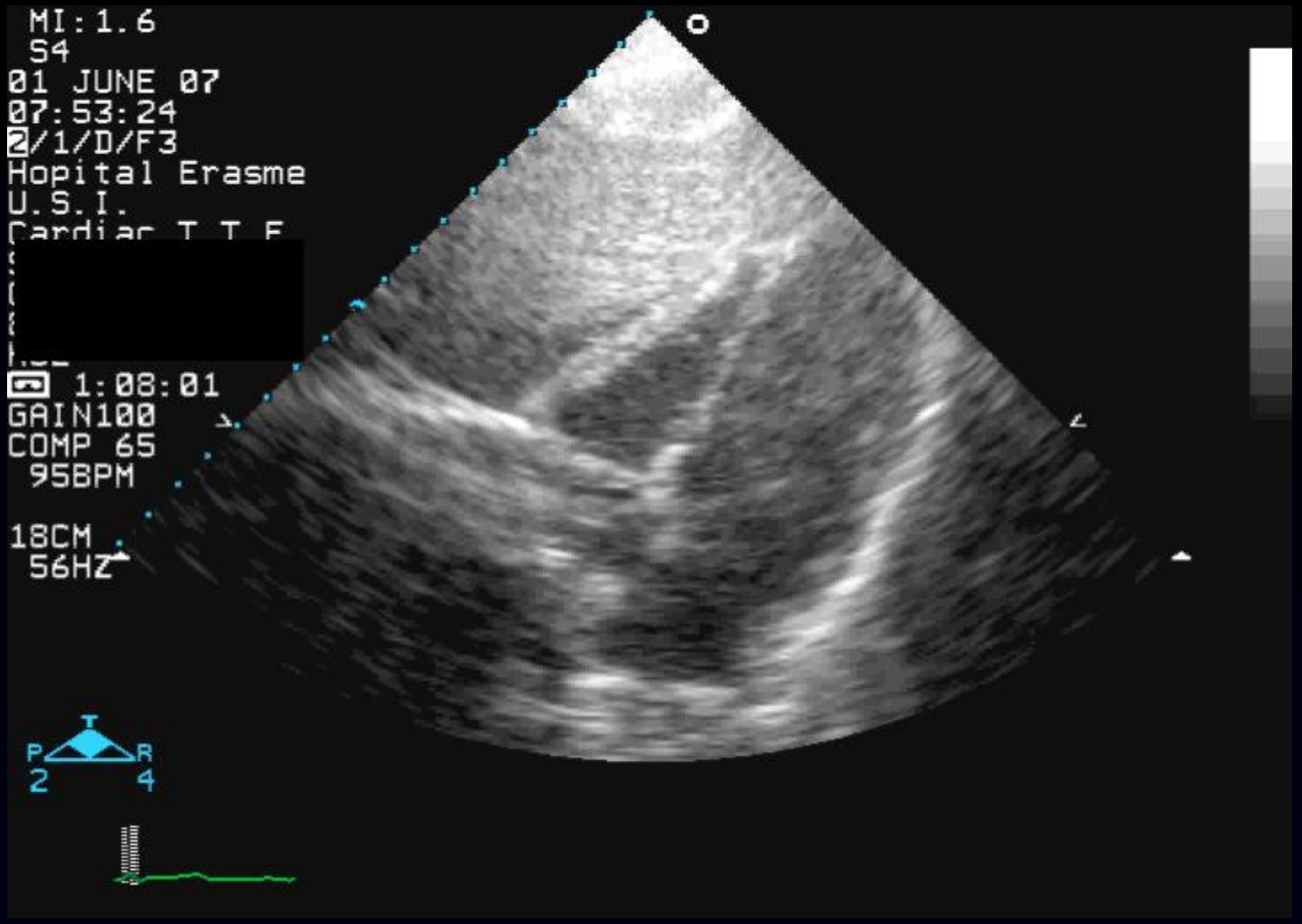
SUB XYPHOIDAL VIEW



SUB XYPHOIDAL VIEW ~ A4C



ETT Sub costal view (sub xyphoidal)

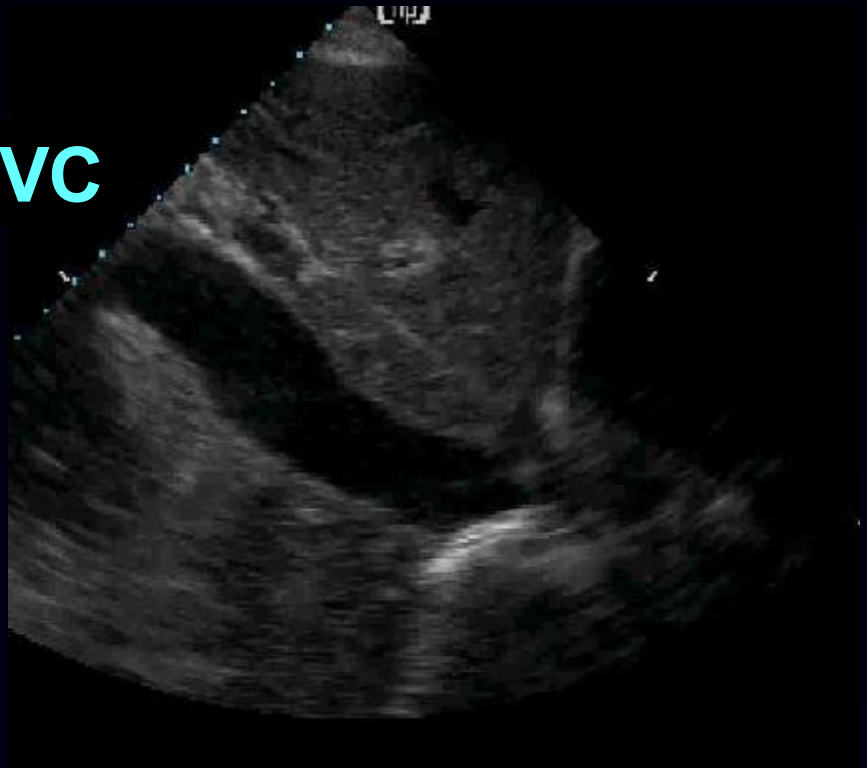


SUB COSTAL VIEWS

Visualization:

- **Inferior vena cava**
- **Hepatic veins**
- **“ 4 chamber view”(but measurements may be erroneous due to angle of the beam)**

IVC

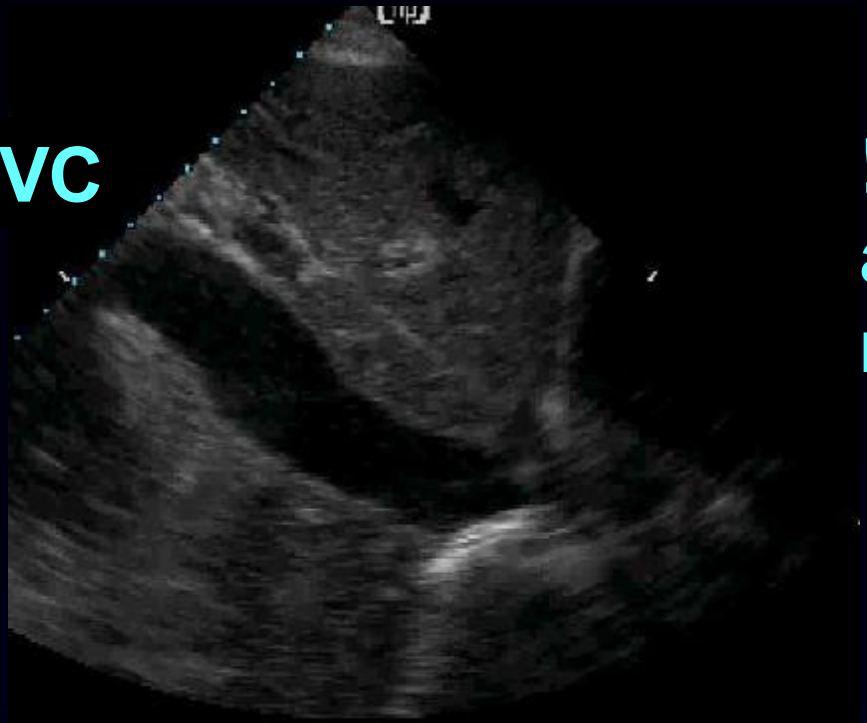


SUB COSTAL VIEWS

Mesurements:

- **Inferior vena cava (estimation of CVP)**
- **Respiratory variations**

IVC



! IVC diameter varies according to the site of measurement !

=> Respiratory variations are more useful than absolute value

Estimation of CVP ?

Based on relationship between size and pressure

Biased:

- vascular compliance
- pleural pressure (intra- vs extra- thoracic)
- semi-quantitative assessment

Jue et al
JAmSocEcho 5:613;1992

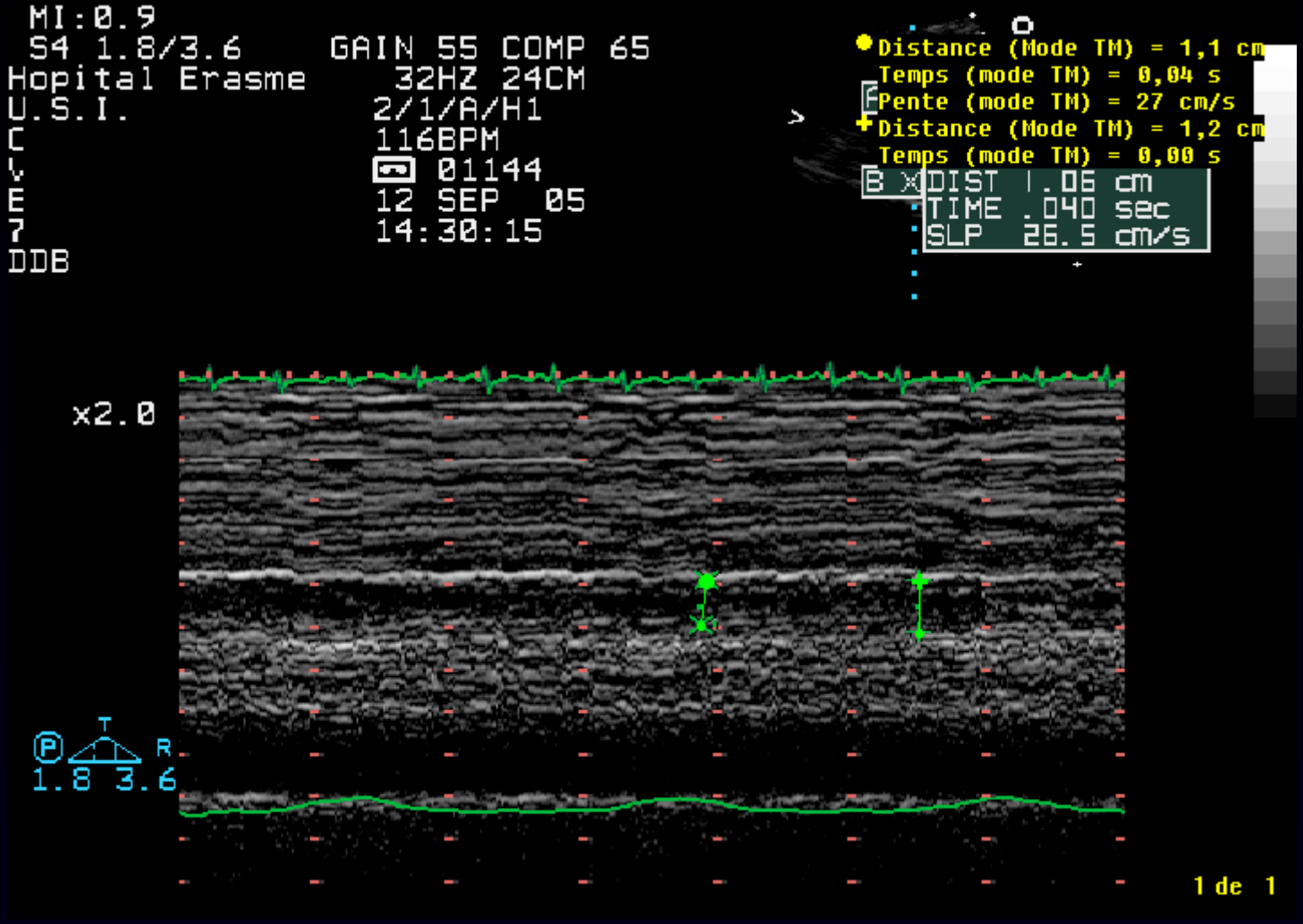
Measurements of CVP by IVC diameter (mechanical ventilation)

Poor correlation (r=0.13) but:

- Diameter < 12 mm had a 100% specificity (but a 25% sensitivity) to diagnose a CVP<10 mmHg
- Diameter > 12 mm had no predictive value

SUB COSTAL VIEWS

Respiratory fluctuations IVC (TM mode)

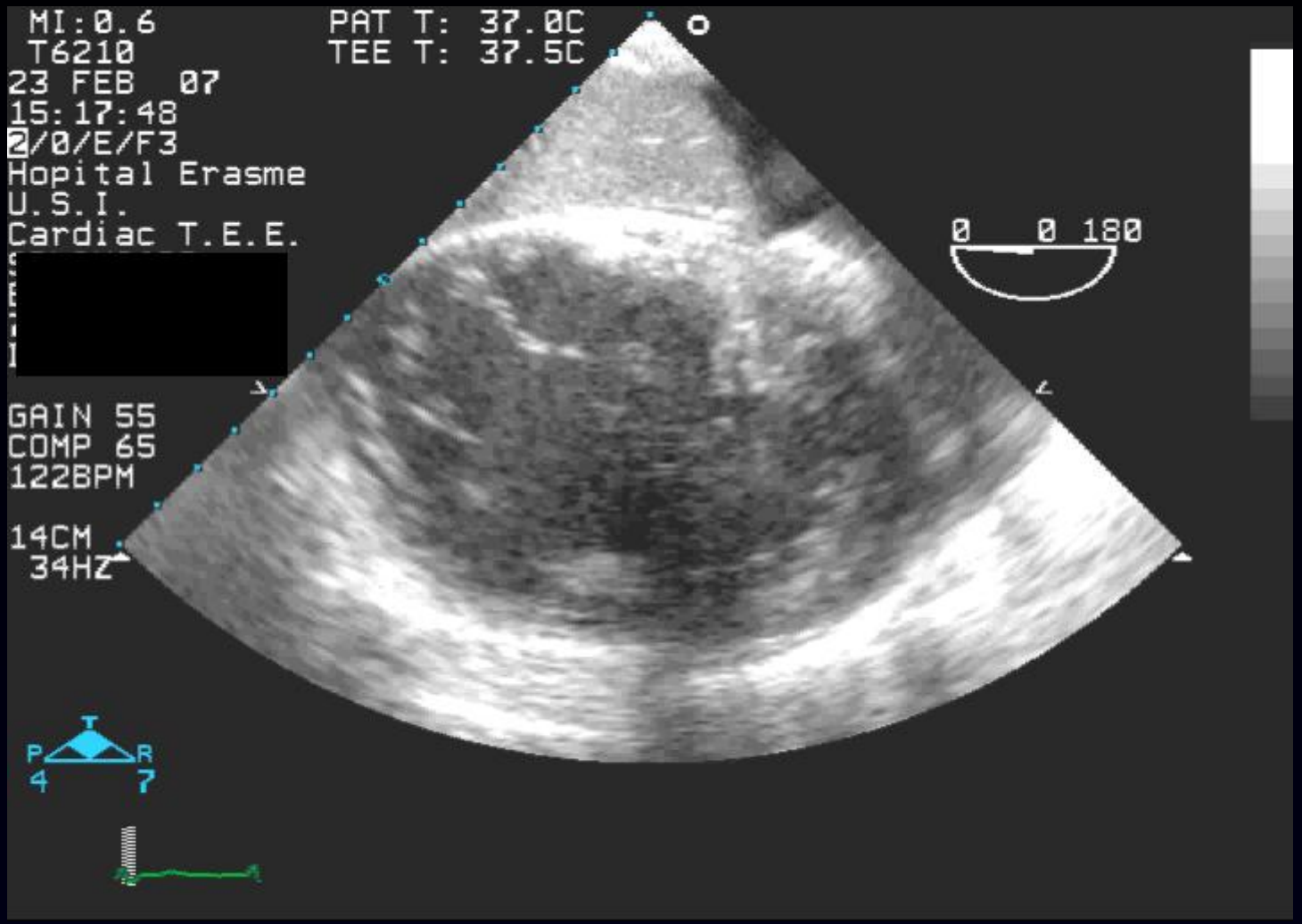


What do you need for hemodynamic evaluation ?

A4C	=>	RV/LV surfaces / PA pressure
A5C	=>	Aortic flow
PLA	=>	LV diameter (FS) / LVOT diam
PSA	=>	contractility / LVDarea
Subcostal	=>	inferior vena cava

Good quality Doppler signals can often be obtained even when the quality of 2D echo is poor!

Do not hesitate to perform a TEE examination when TTE does not give the answer…



TT ECHO: PRINCIPAL VIEWS

Conclusions

The hemodynamic evaluation with trans thoracic echocardiography requires at least the visualization of parasternal views (LA and SA) and an apical 4 chambers view.

The echographist should adapt himself to the patient. When hybrid views are used, absolute values of measurements may be erroneous, but changes are still valid.

It is mandatory to always use the same views to estimate the impact of interventions.