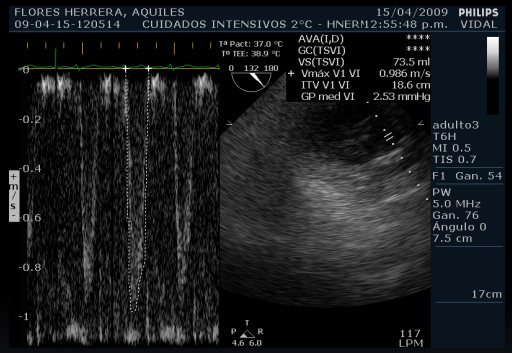
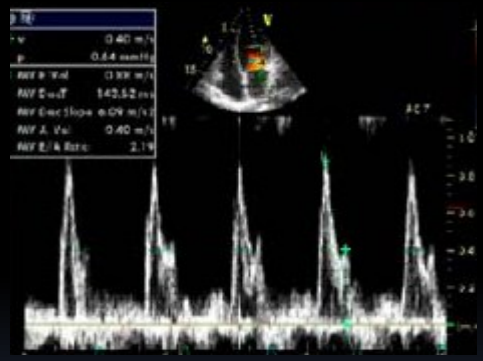
EVALUACION ECOCARDIOGRAFICA

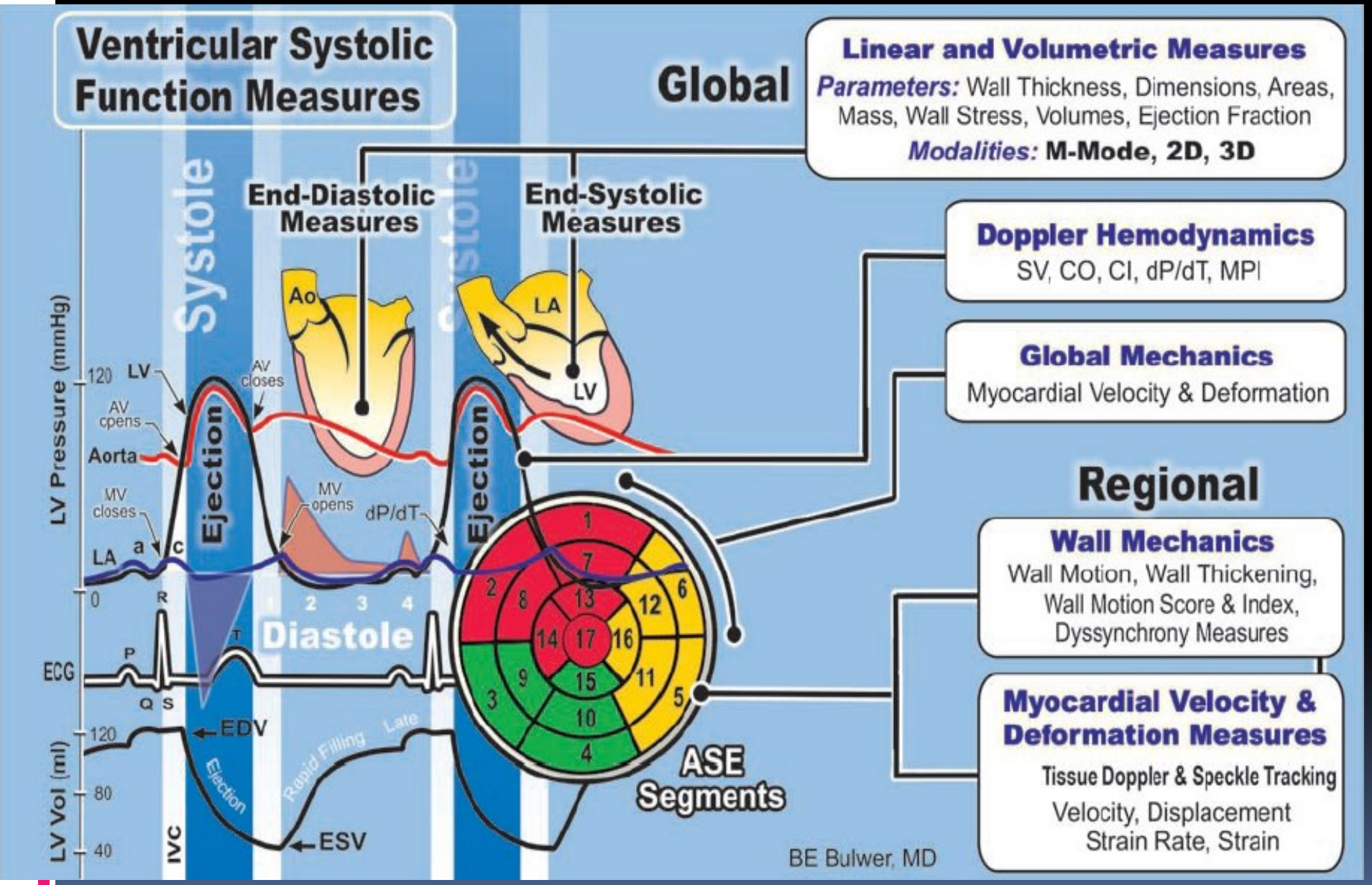
FUNCIÓN SISTÓLICA

HOSPITAL NACIONAL EDGARDO REBAGLITI MARTINS - LIMA-PERU
CUIDADOS INTENSIVOS GENERALES - UCI-I- UNIDAD ULTRASONIDO CRITICO





MOISES VIDAL LOSTAUNAU
MEDICO INTENSIVISTA
MEDICO ASISTENTE UNIDAD POSTOPERADOS CARDIOVASCULAR Y TRANSPLANTADOS
CMP 32818 - RNE 15535


Ventricular Systolic Function Measures
Global
Linear and Volumetric Measures
Parameters: Wall Thickness, Dimensions, Areas, Mass, Wall Stress, Volumes, Ejection Fraction
Modalities: M-Mode, 2D, 3D
End-Diastolic Measures
End-Systolic Measures
Systole
Ao
LA
LV
Doppler Hemodynamics
SV, CO, CI, dP/dT, MPI
Global Mechanics
Myocardial Velocity & Deformation
LV Pressure (mmHg)
120
LV
AV closes
AV opens
Aorta
MV closes
MV opens
dP/dT
LA
a
c
Ejection
0
R
1 2 3 4
Diastole
P
T
ECG
Q S
Regional
Wall Mechanics
Wall Motion, Wall Thickening, Wall Motion Score & Index, Dyssynchrony Measures
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
ASE Segments
Myocardial Velocity & Deformation Measures
Tissue Doppler & Speckle Tracking
Velocity, Displacement
Strain Rate, Strain
120
EDV
Ejection
Rapid Filling
Late
80
40
LV Vol (ml)
IVC
ESV
BE Bulwer, MD

QUE ES IMPORTANTE ?

- MORFOLOGIA VI.
- FE, VOLUMENES, GEOMETRIA.
- REGURGITACION MITRAL.
- ISQUEMIA INDUCIBLE Y VIABILIDAD.

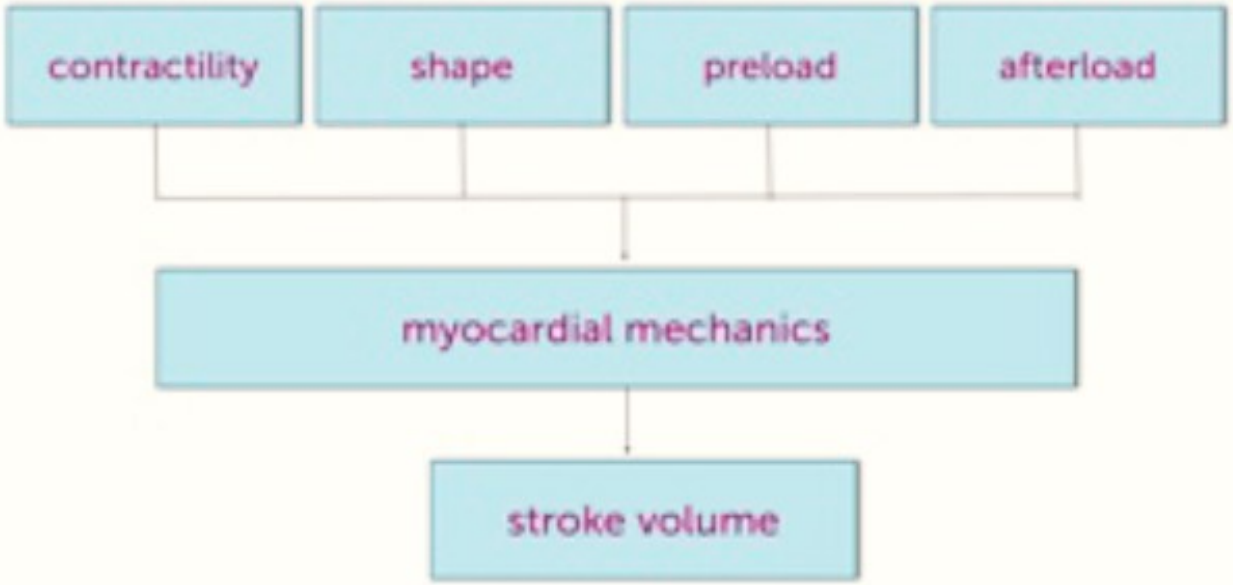
QUE PUEDO MEDIR POR ECO?

- DDVI, DSVI y FRACCION ACORTAMIENTO.
- VDVI, VSVI y FE (QUE METODO?)
- MASA VI (QUE METODO?)
- GASTO CARDIACO POR TVI DEL TSVI.
- dP/dt DERIVADO DE LA REGURGITACION MITRAL.

Medidas de función ventricular

- Fracción de acortamiento sistólico (modo M)
  - Inapropiado en VI remodelado o con asimetrías segmentarias
- Fracción de eyección (recomendado el método biplano)
- Volúmenes ventriculares
- Índice de masa ventricular

Principles of LV Function:



Factors which influence ejection fraction / stroke volume

Parameters of LV Function

Fractional shortening	Cardiac output
"Eyeballing" of LVF	Cardiac Index
Ejection fraction (EF) - Simpson method	Contractility (dp/dt)
Stroke volume	Tei index

Medidas de función ventricular

- Fracción de acortamiento sistólico (modo M)
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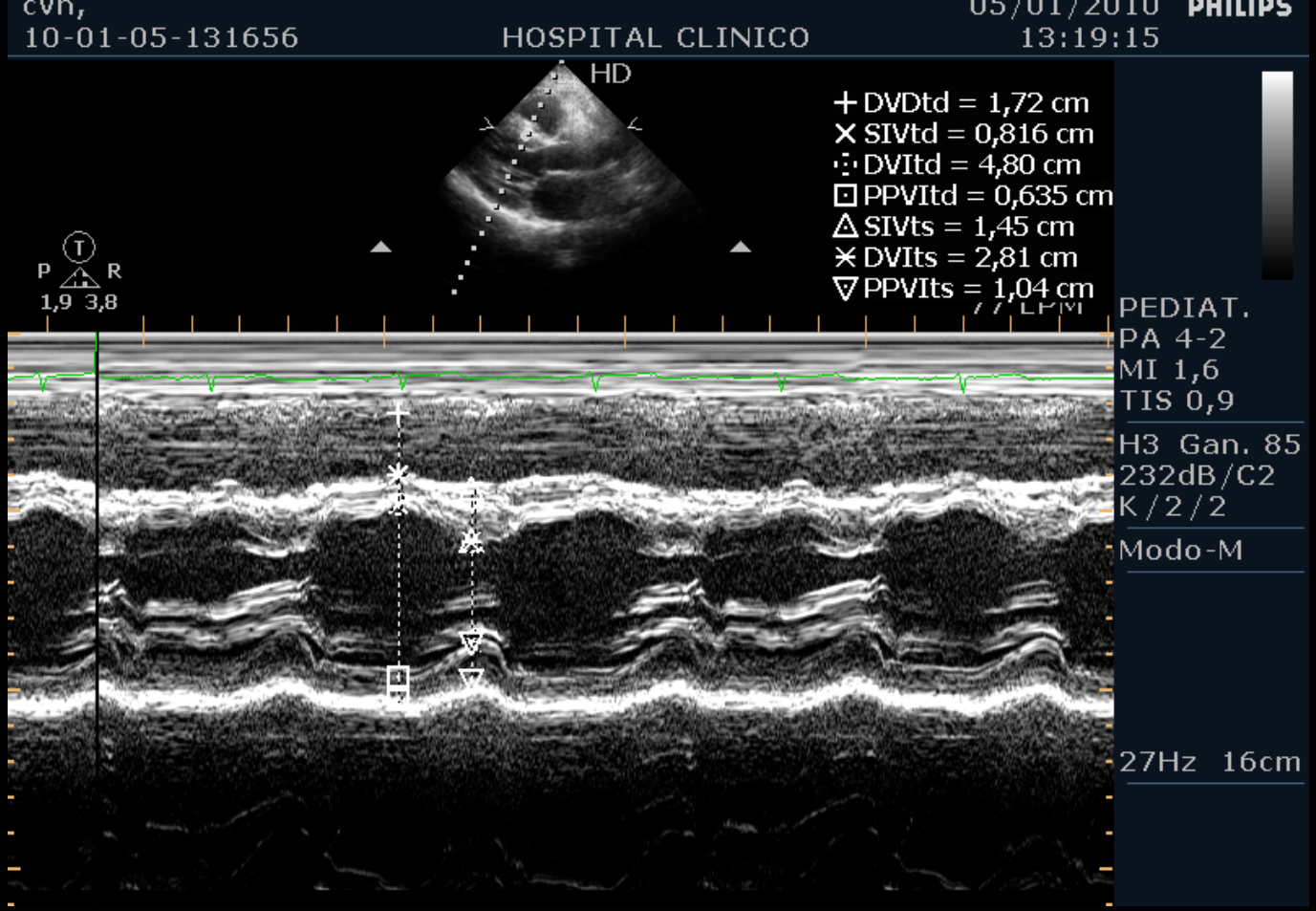
- Índice de masa ventricular



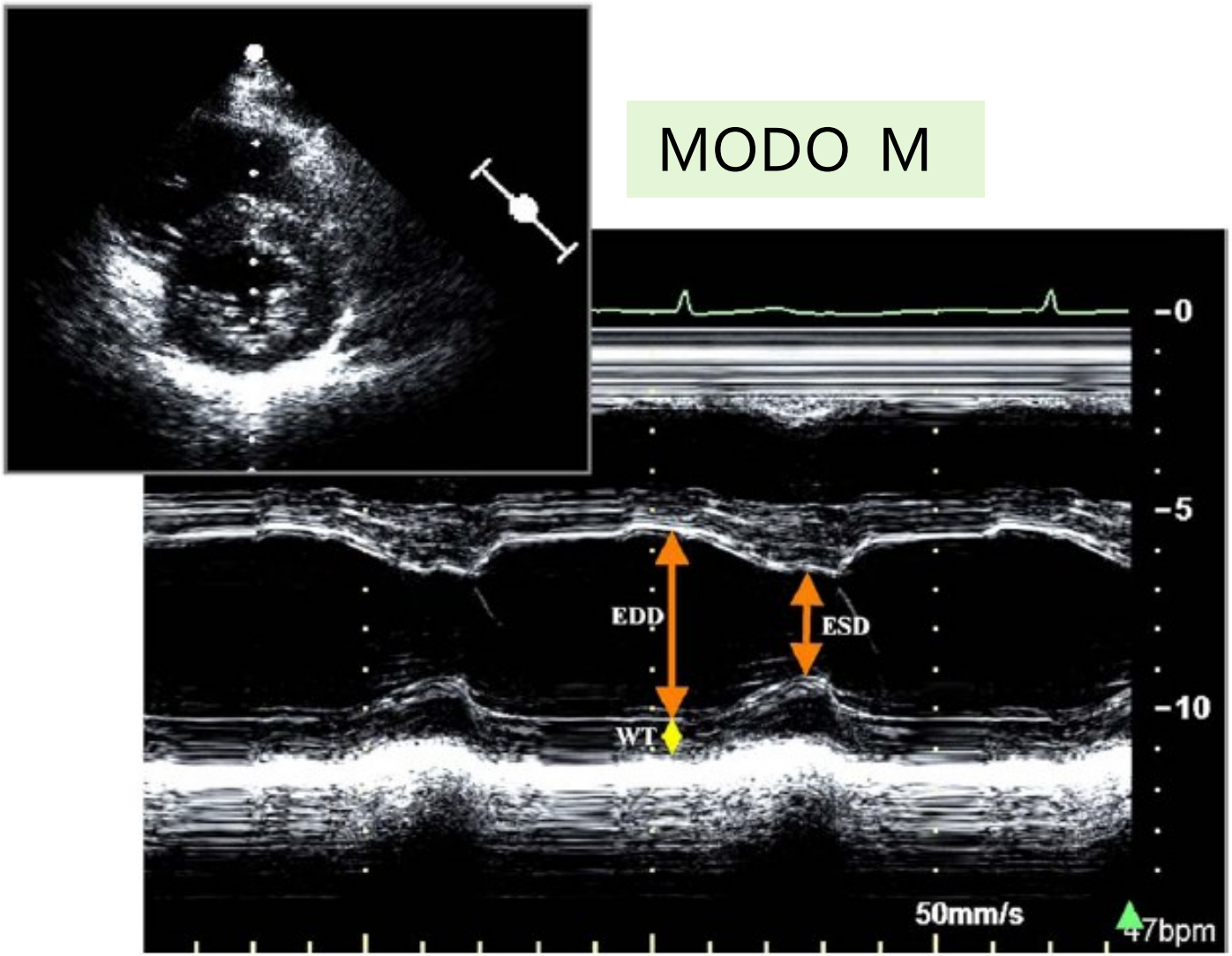
Fracción de acortamiento sistólico

FAS = (DTDVI-DTSVI)/DTDVI

Índice de masa ventricular izquierda

IMVI = (0.8 * {1.04 *[(DTDVI + septo en diástole + pared posterior en diástole)^3 - (DTDVI)^3]} + 0.6) / SC g/m^2

MODO M



Fracción de acortamiento sistólico

FAS = (DTDVI-DTSVI)/DTDVI

Fractional Shortening — Reference Values		
	♂	♀
Normal	25- 43%	27- 45%
Mild	20- 24%	22- 26%
Moderate	15- 19%	17- 21%
Severe	≤ 14%	≤ 16%

Fracción de acortamiento sistólico

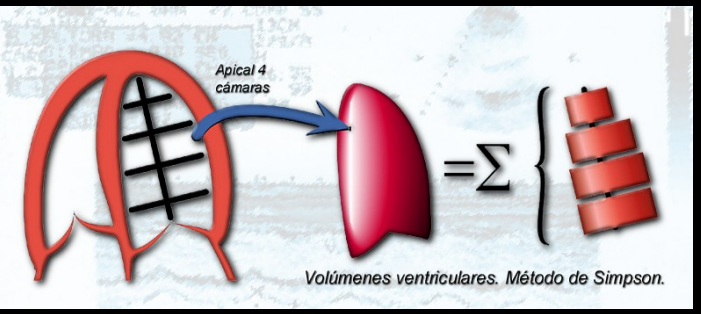
FAS = (DTDVI-DTSVI)/DTDVI

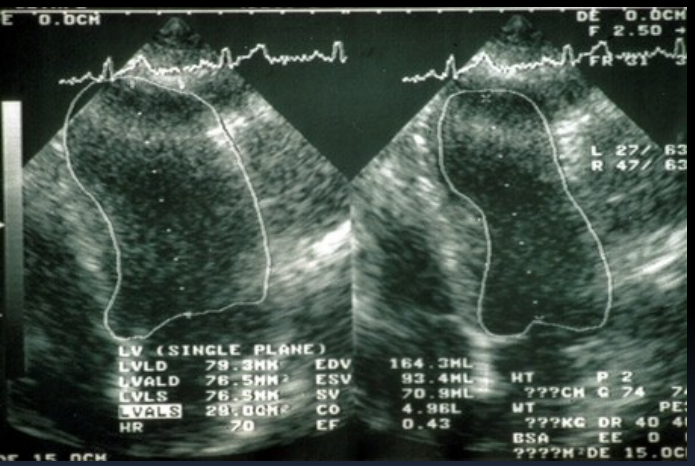
Fractional Shortening — Contraindications

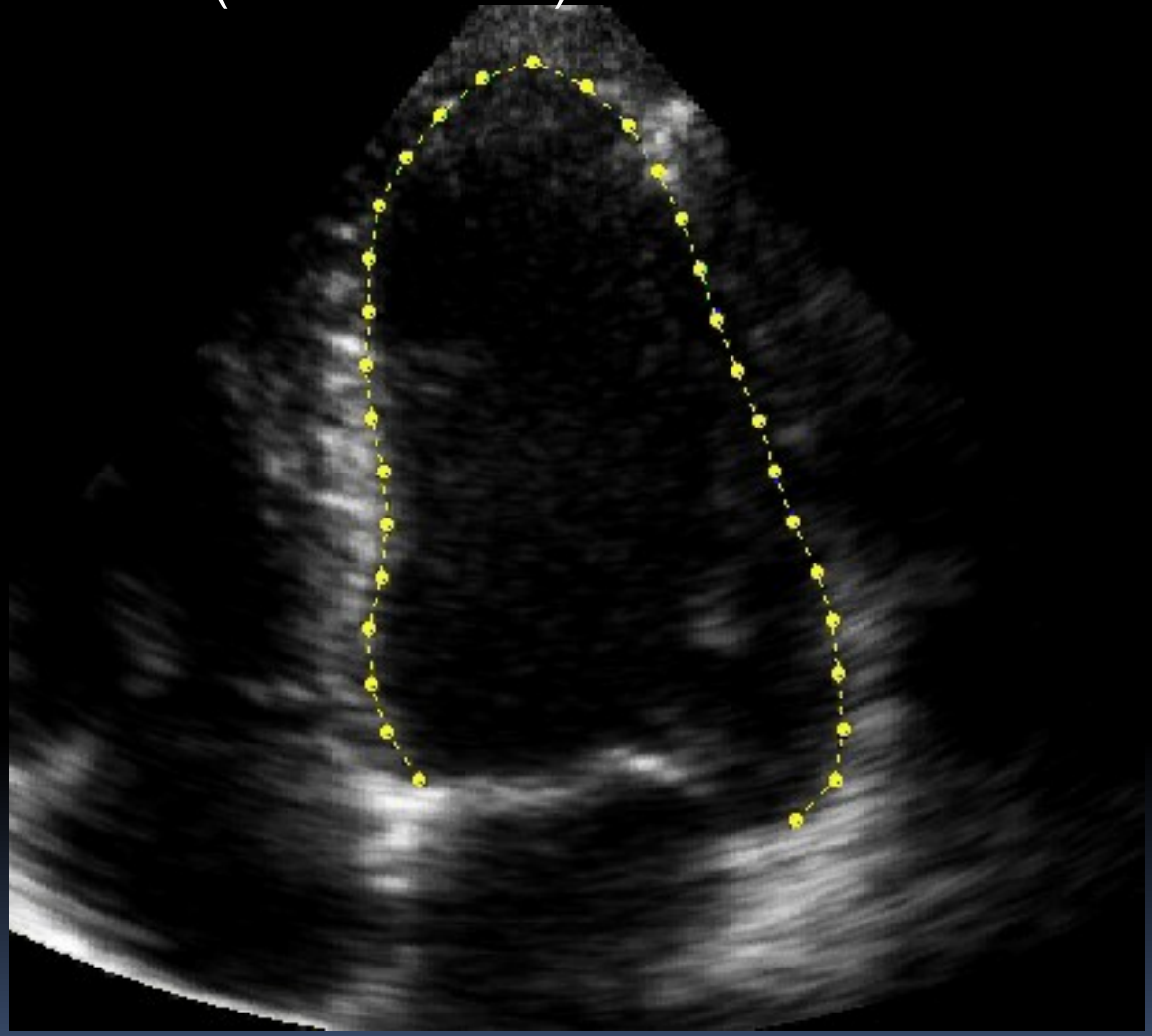
LBBB / Dyssynchrony	Abnormal septal motion
Regional wall motion abnormalities	Inadequate MMode orientation
Poor image quality	

Fracción de eyección

FE = (VTDVI-VTSVI) / VTDVI

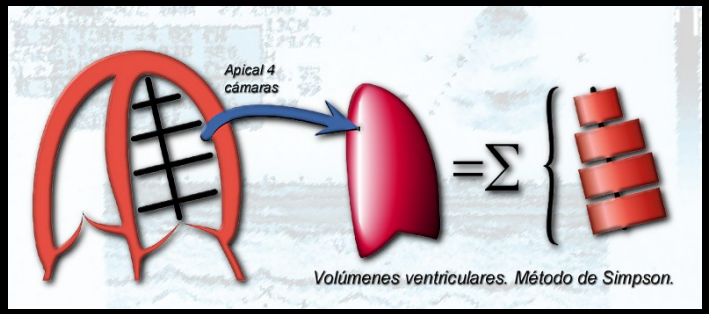


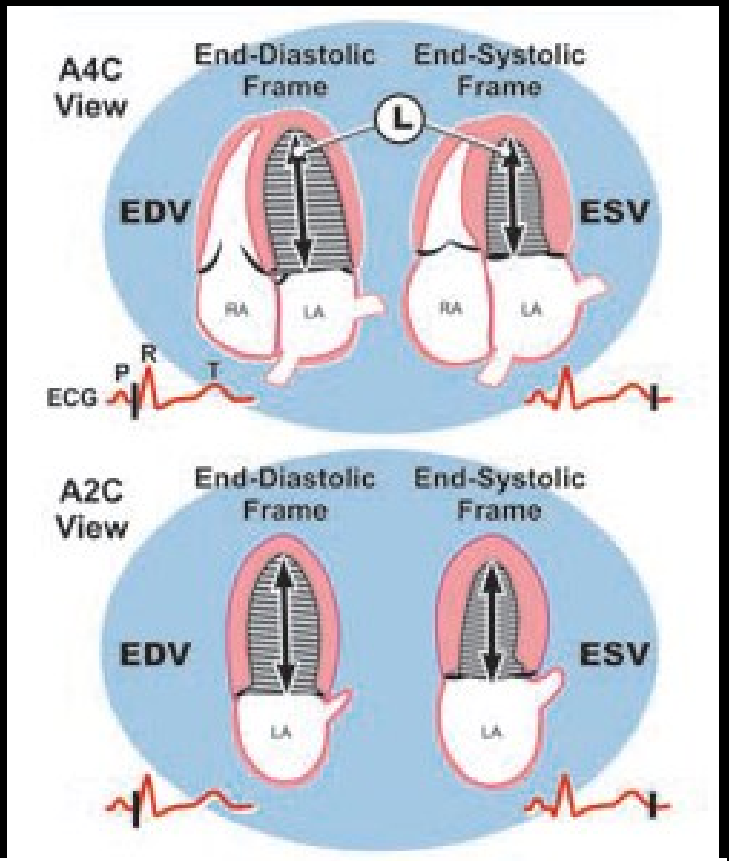




Fracción de eyección

FE = (VTDVI-VTSVI) / VTDVI

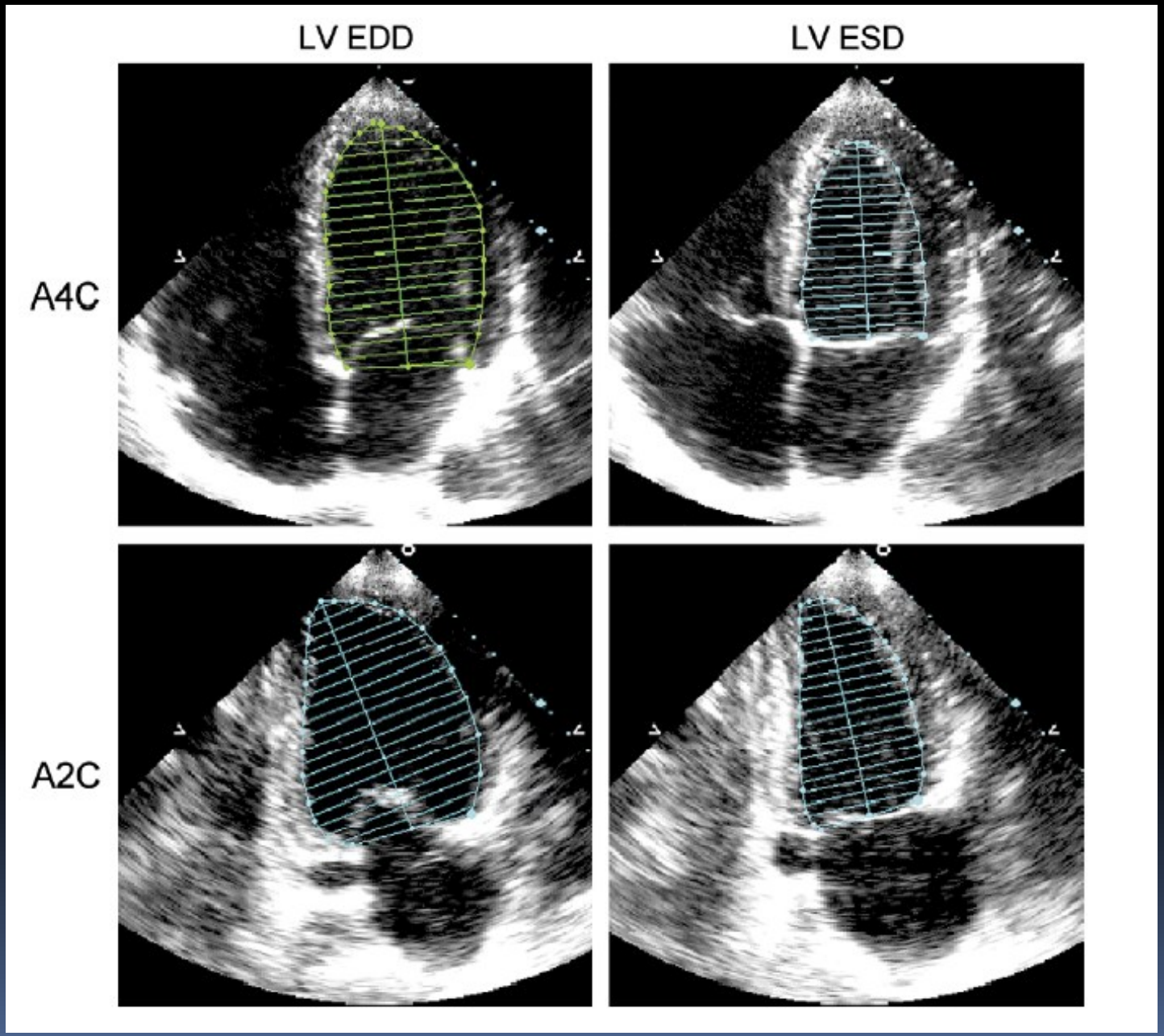




Ejection Fraction — Simpson Method

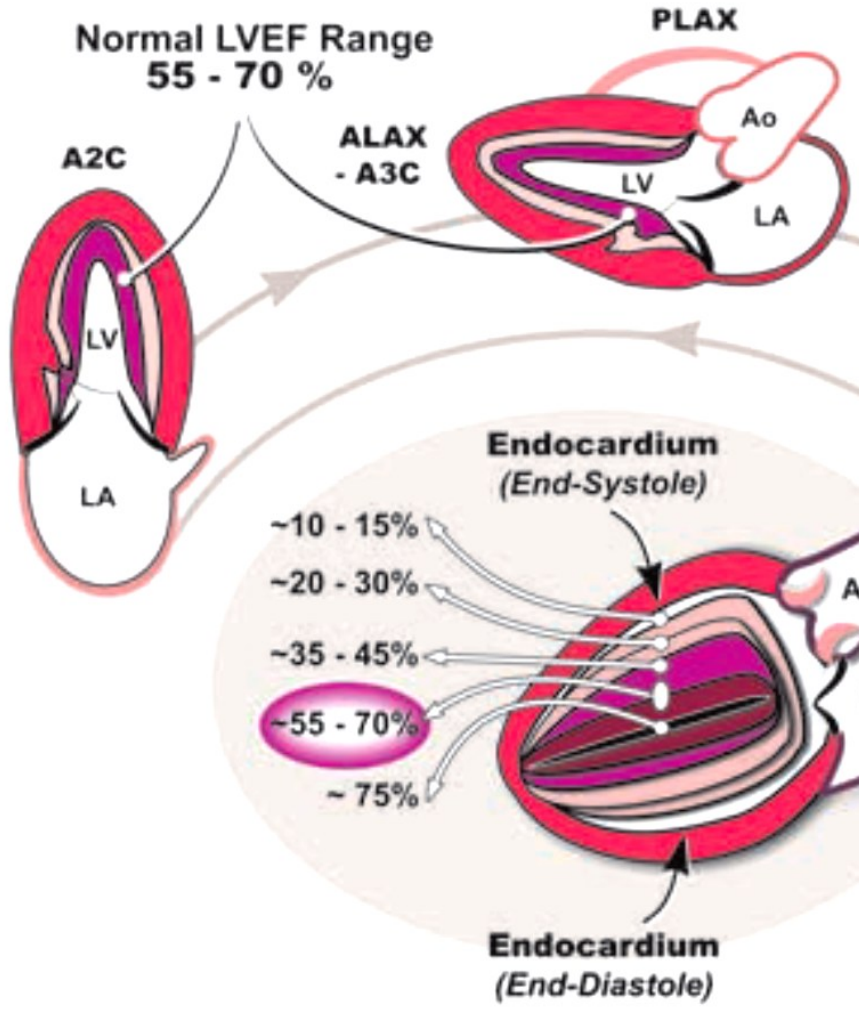
$$EF = \frac{ED_{vol} - ES_{vol}}{ED_{vol}} \times 100$$

Normal	> 55 %
Mild	45– 54 %
Moderate	30– 44 %
Severe	< 30%


LV EDD
LV ESD
A4C
A2C

Qualitative:

Visual Estimates of **LV Volumes** and **Left Ventricular Ejection Fraction (LVEF)**



Visual Estimates of LVEF

"Eyeball" LVEF

1. Routinely used
2. Practical, reproducible, accurate, and reliable with experience
3. Use multiple orthogonal views
4. Endocardial border visualization is crucial
5. Give report in 5 -10% increments
6. Quantitative Assessment recommended

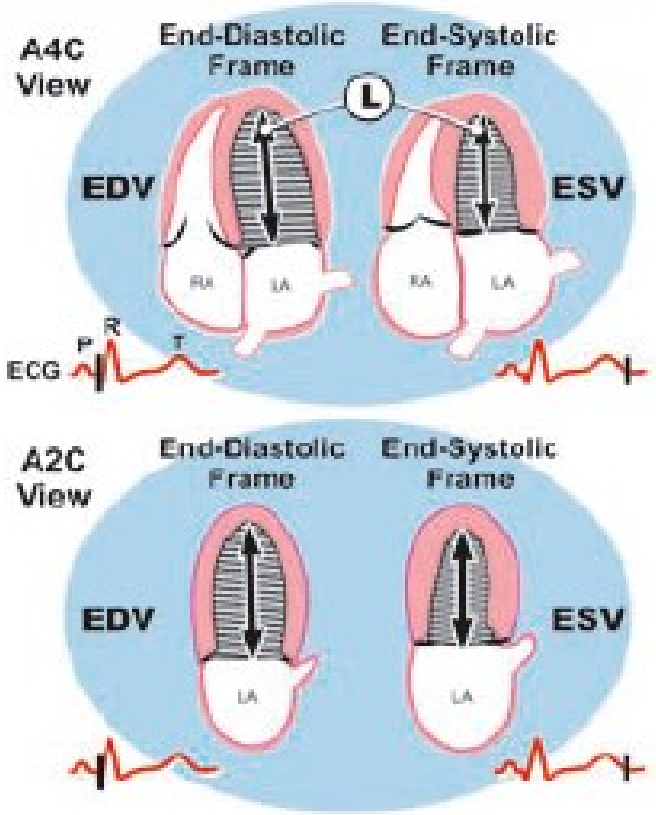
Caveats:

1. **Avoid foreshortened LV views**
2. **Ensure Endocardial Border Visualiztion** *(Use tissue harmonic imaging +/- contrast)*

BE Bulwer, MD

Quantitative Estimates of LVEF* (by 2-D or 3-D echocardiography)

Measurements of **End-Systolic** and **End-Diastolic Volumes** (**ESV**, **EDV**, and **LVEF** *(Biplane Simpson's Rule)*



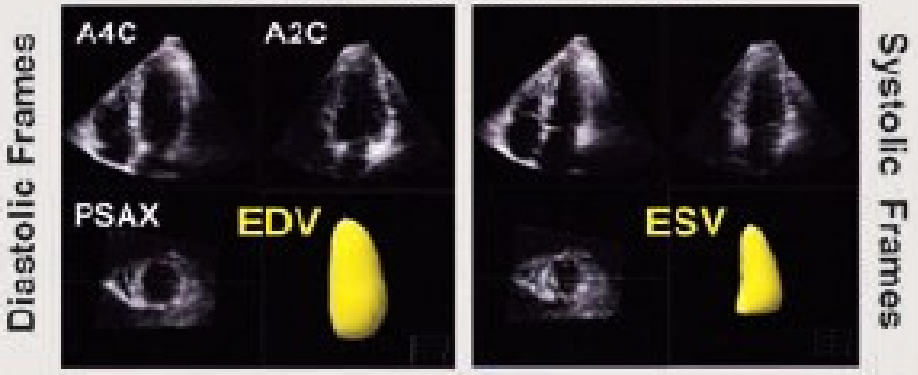
* Method also used for Left Atrial (LA) Volumes

Biplane Simpson's Method (2-D)

1. In **A4C View**, Scroll through frames and select **End-Diastolic Frame** (start of R-wave on ECG or frame with largest LV volume, just before AV opens
2. Trace endocardial border from septal to lateral MV annulus and join ends with straight line for **EDV**
3. Measure **LV cavity length** (**L**) - apex to MV annulus
4. Scroll A4C video loop; choose **End-Systolic Frame** (end of T-wave on ECG, or smallest LV diameter - frame before MV opens) and Measure **ESV**
5. Repeat steps 1 to 4 above for **A2C View** measures
6. Auto-calculate **LVEF**

Semi-Automated LV Volumes & EF (3-D)

LV Cavity Casts from 3D Dataset



$$\text{LVEF} = \frac{\text{EDV - ESV}}{\text{EDV}} \times 100\%$$

EDV - ESV = Stroke Volume (SV)
(Normal SV = ~75-100 ml; Index to Body Wt)

(If no mitral regurgitation)
Cardiac Output = SV x HR

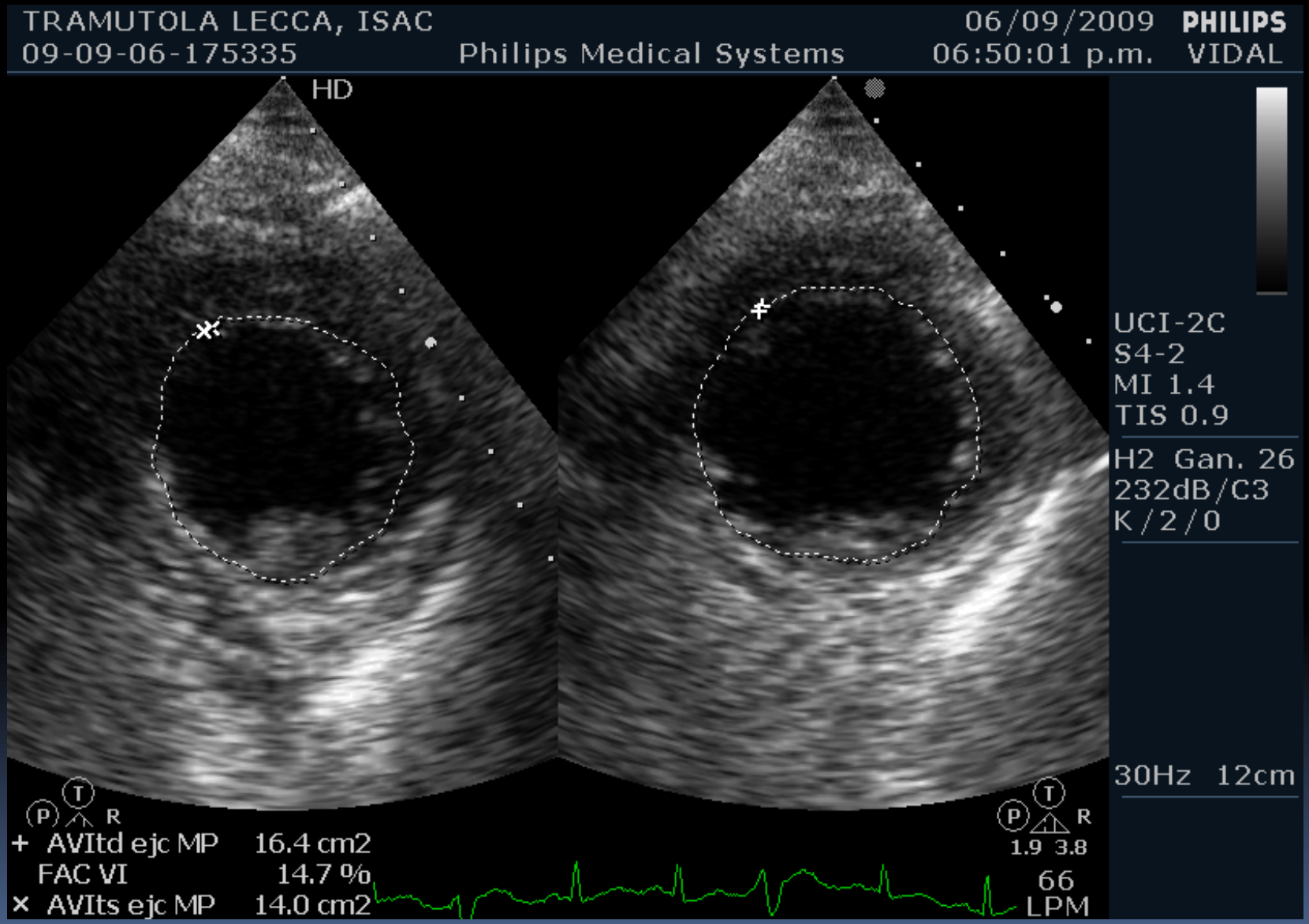
HR, Heart Rate

Table 6 Reference limits and values and partition values of left ventricular function

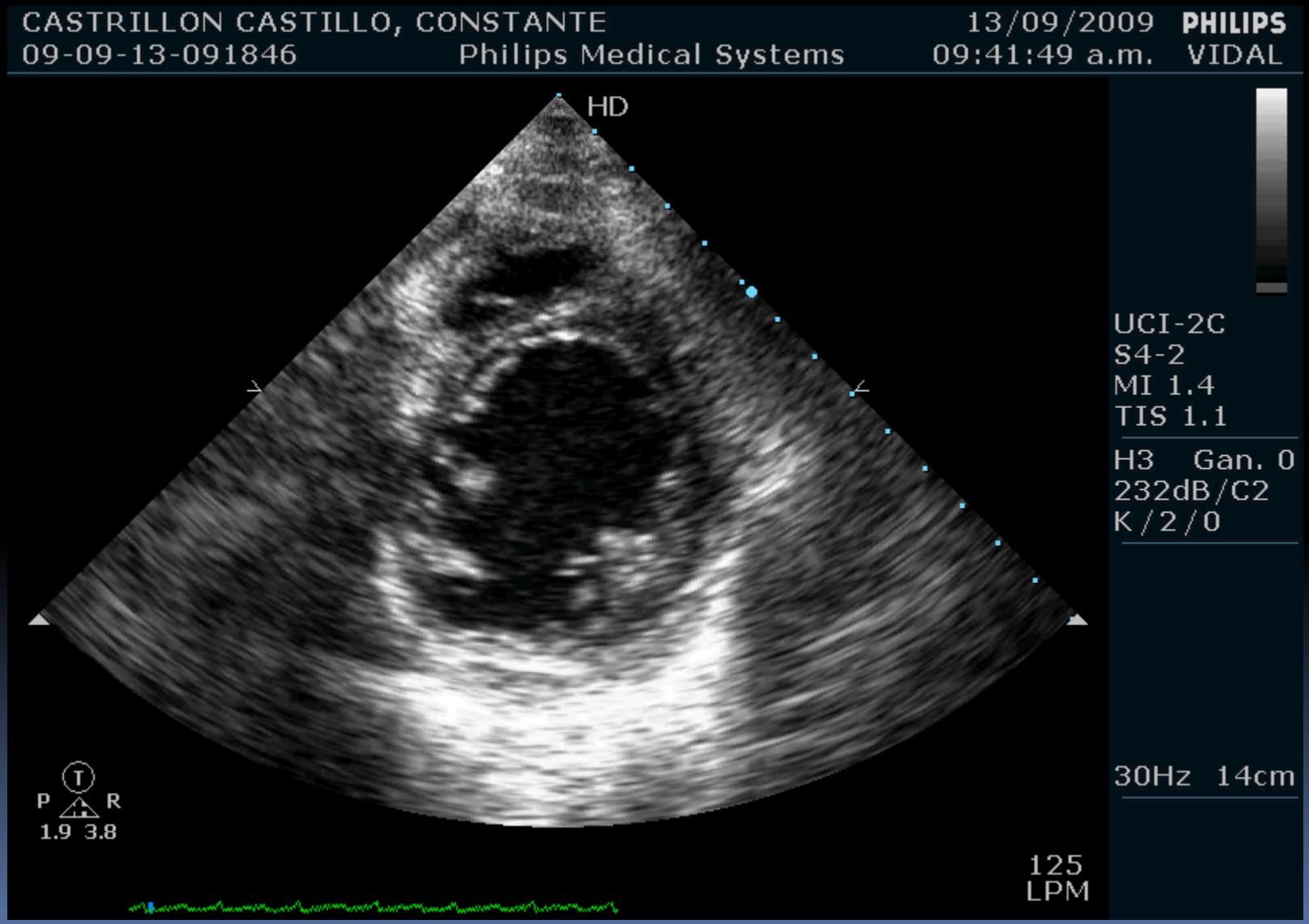
	Women				Men			
	Reference range	Mildly abnormal	Moderately abnormal	Severely abnormal	Reference range	Mildly abnormal	Moderately abnormal	Severely abnormal
Linear method								
Endocardial fractional shortening (%)	27–45	22–26	17–21	≤16	25–43	20–24	15–19	≤14
Midwall fractional shortening (%)	15–23	13–14	11–12	≤10	14–22	12–13	10–11	≤10
2-D method								
Ejection fraction (%)	**≥55**	**45–54**	**30–44**	**<30**	**≥55**	**45–54**	**30–44**	**<30**

Values in bold are recommended and best validated.

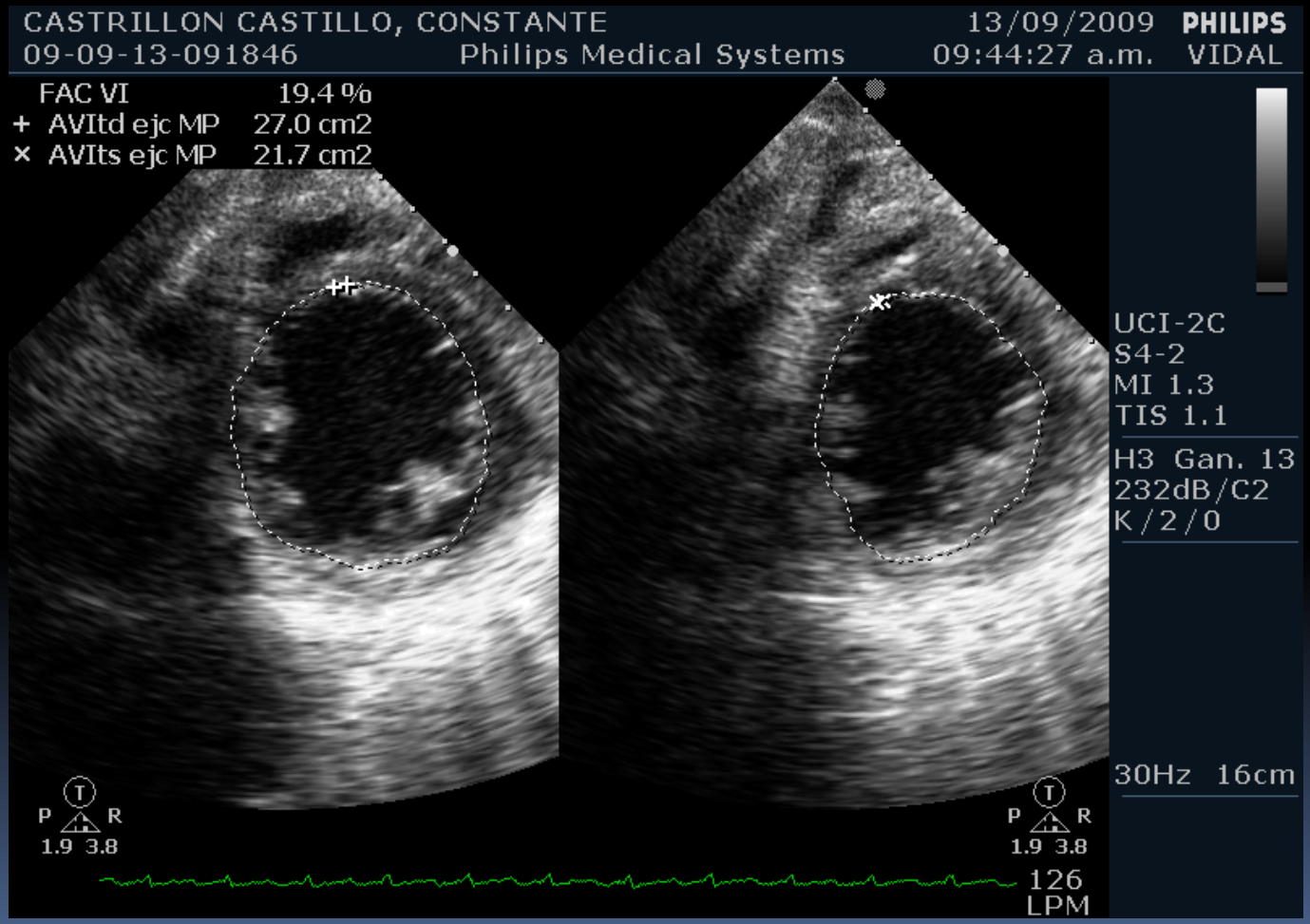
CAMBIO DE AREA FRACCIONAL VI – FAC VI



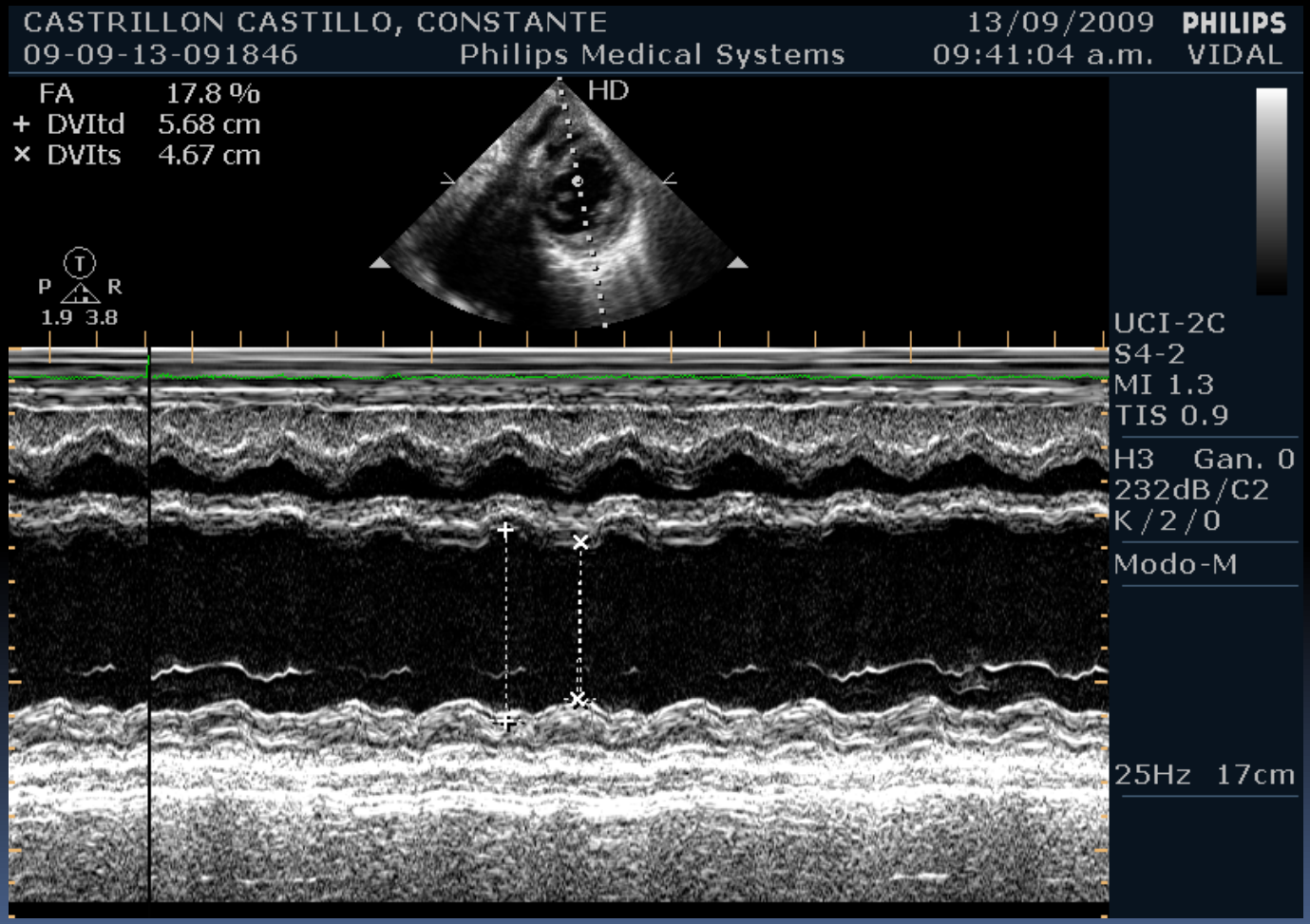
CAMBIO DE AREA FRACCIONAL VI – FAC VI



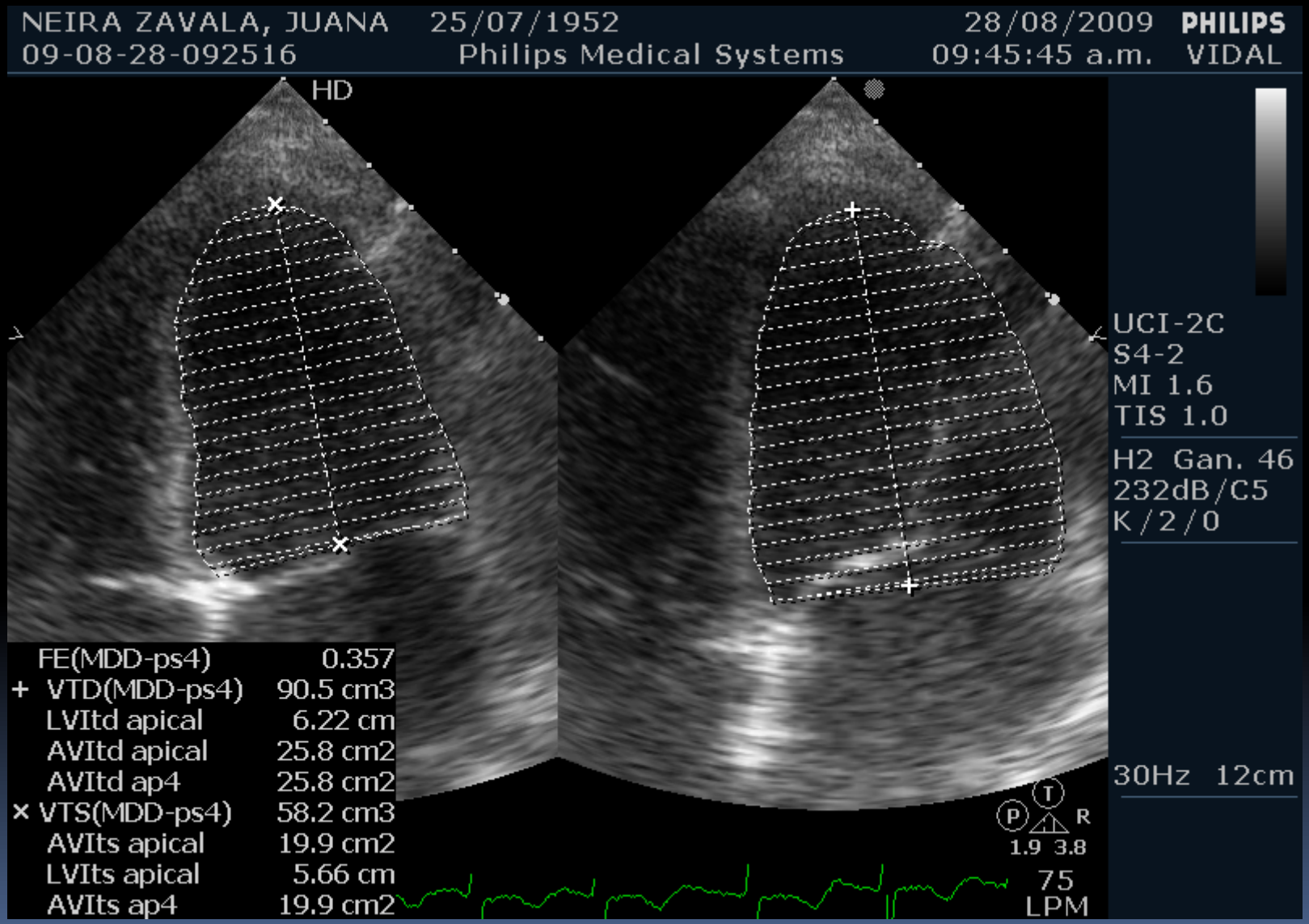
CAMBIO DE AREA FRACCIONAL VI – FAC VI



FRACCIÓN DE ACORTAMIENTO VI



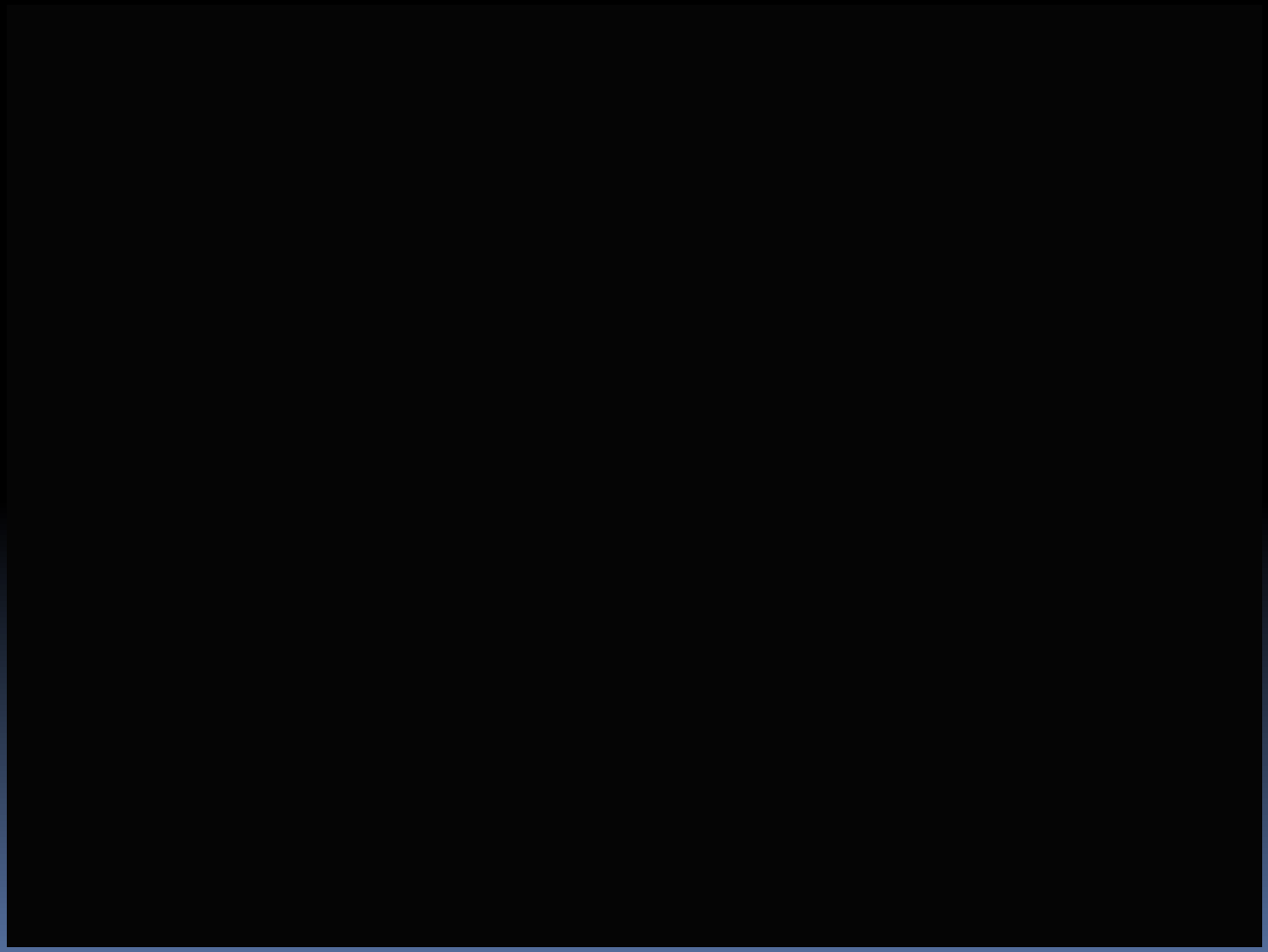
FRACCION DE EYECCIÓN VI



VISTA PARA ESTERNAL EJE LARGO

VISTA PARA ESTERNAL EJE LARGO

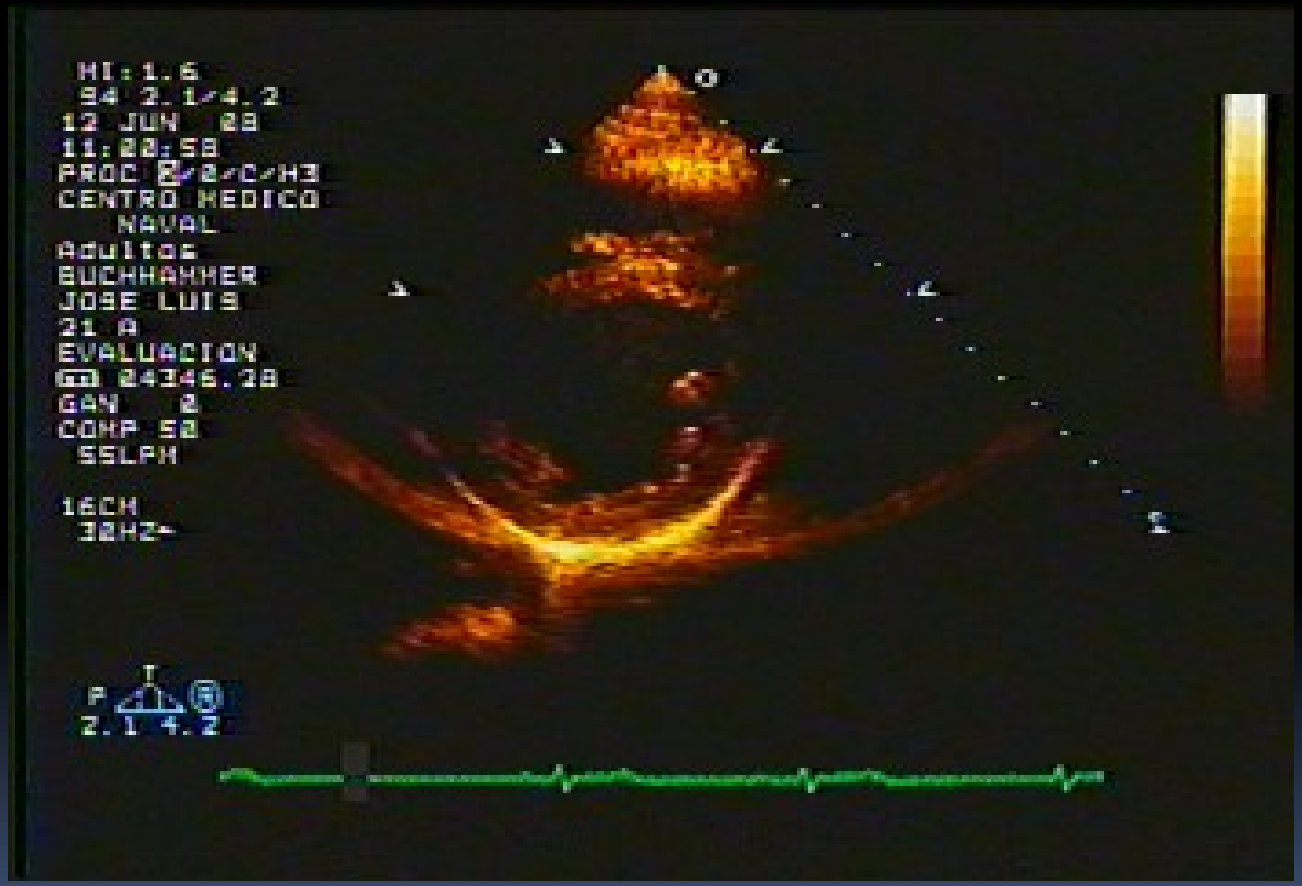
VISTA PARAESTERNAL EJE LARGO GEOMETRIA ALTERADA



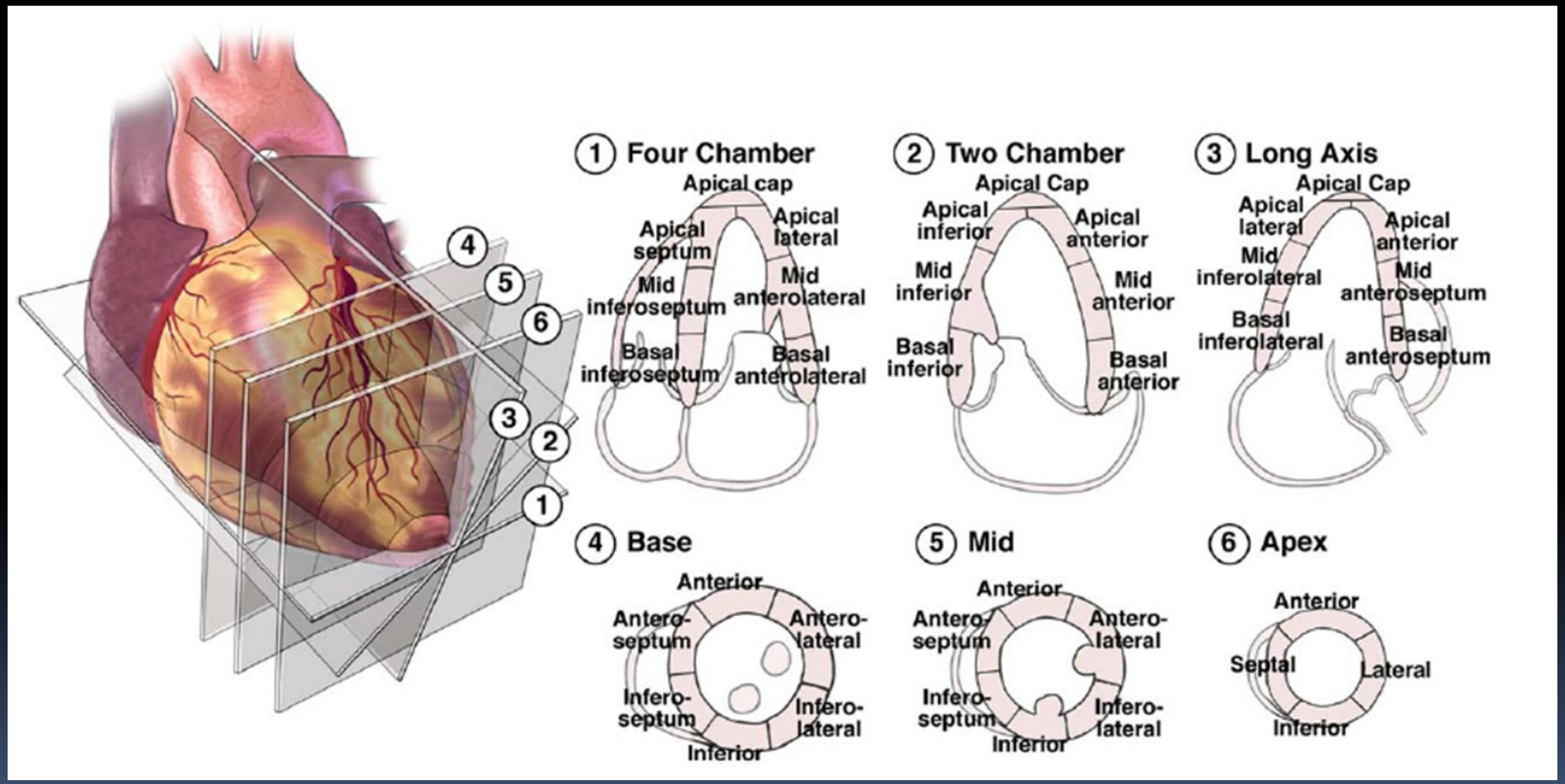
VISTA APICAL 4C

VISTA APICAL 2C

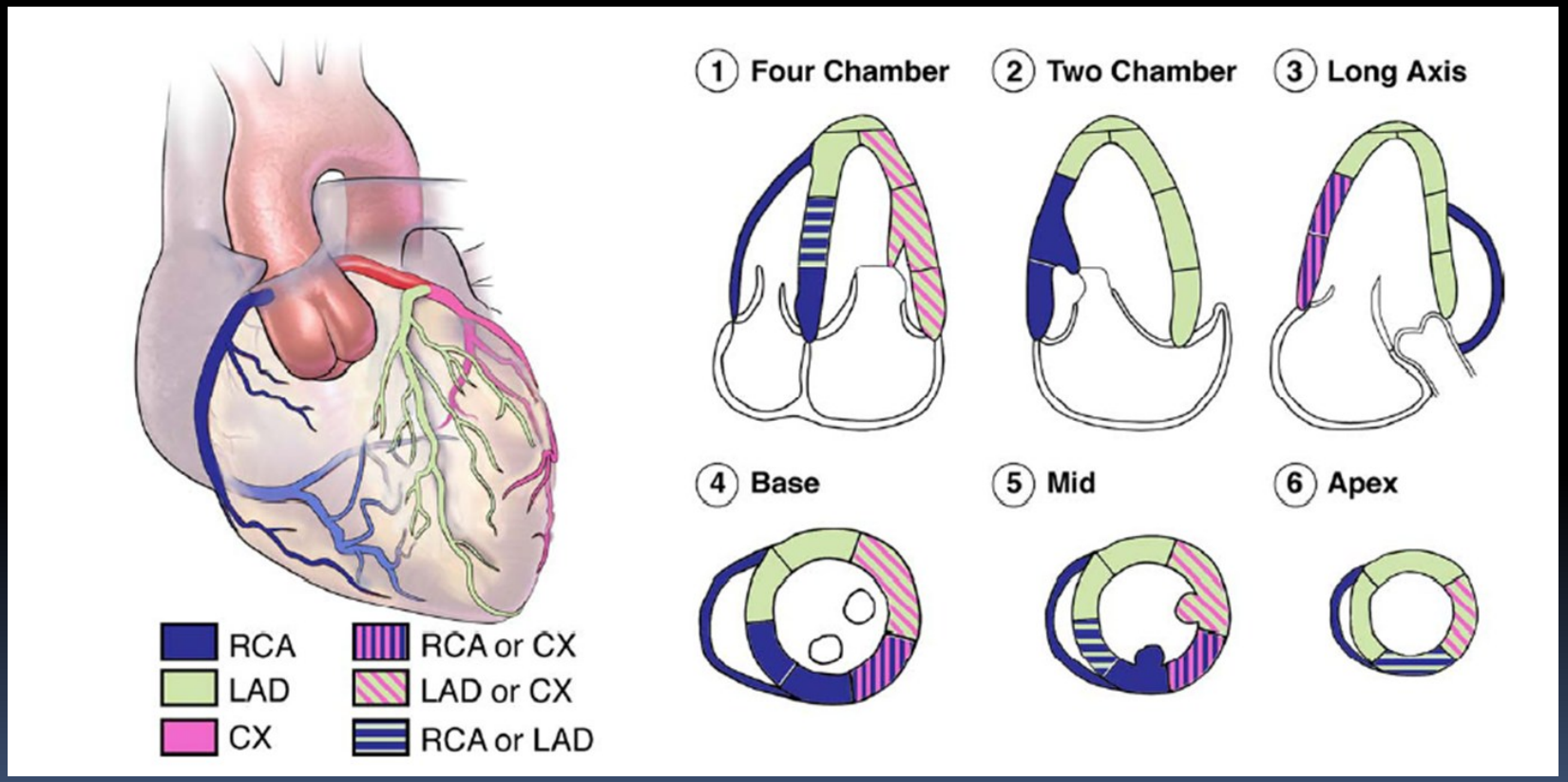
PARA ESTERNAL EJE CORTO NIVEL MUSCULOS PAPILARES



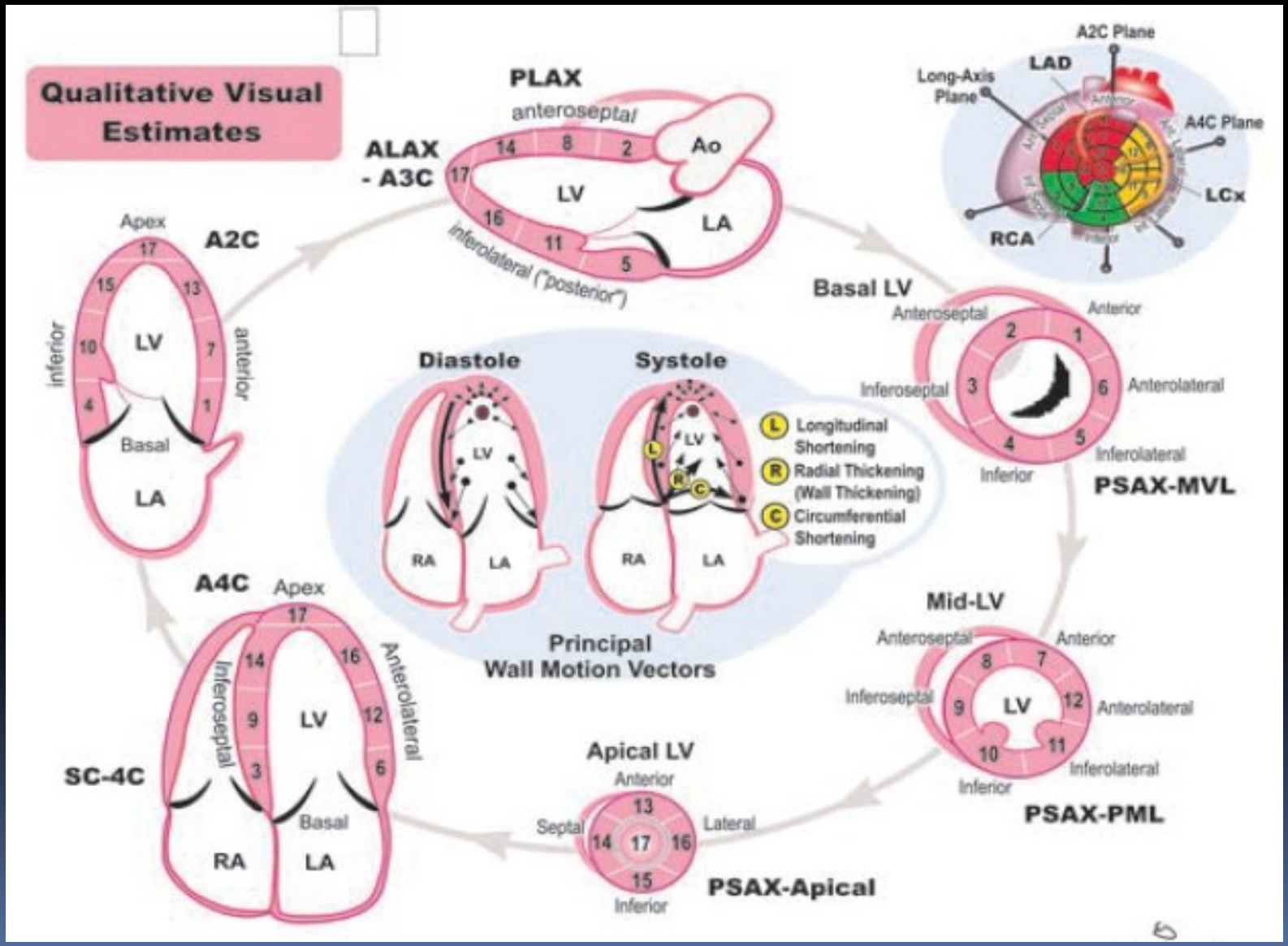
DENOMINACION DE SEGMENTOS POR ECO



CORRELACION DE SEGMENTOS CON TERRITORIO CIRCULATORIO



FUNCIÓN SISTÓLICA VI EVALUACION REGIONAL



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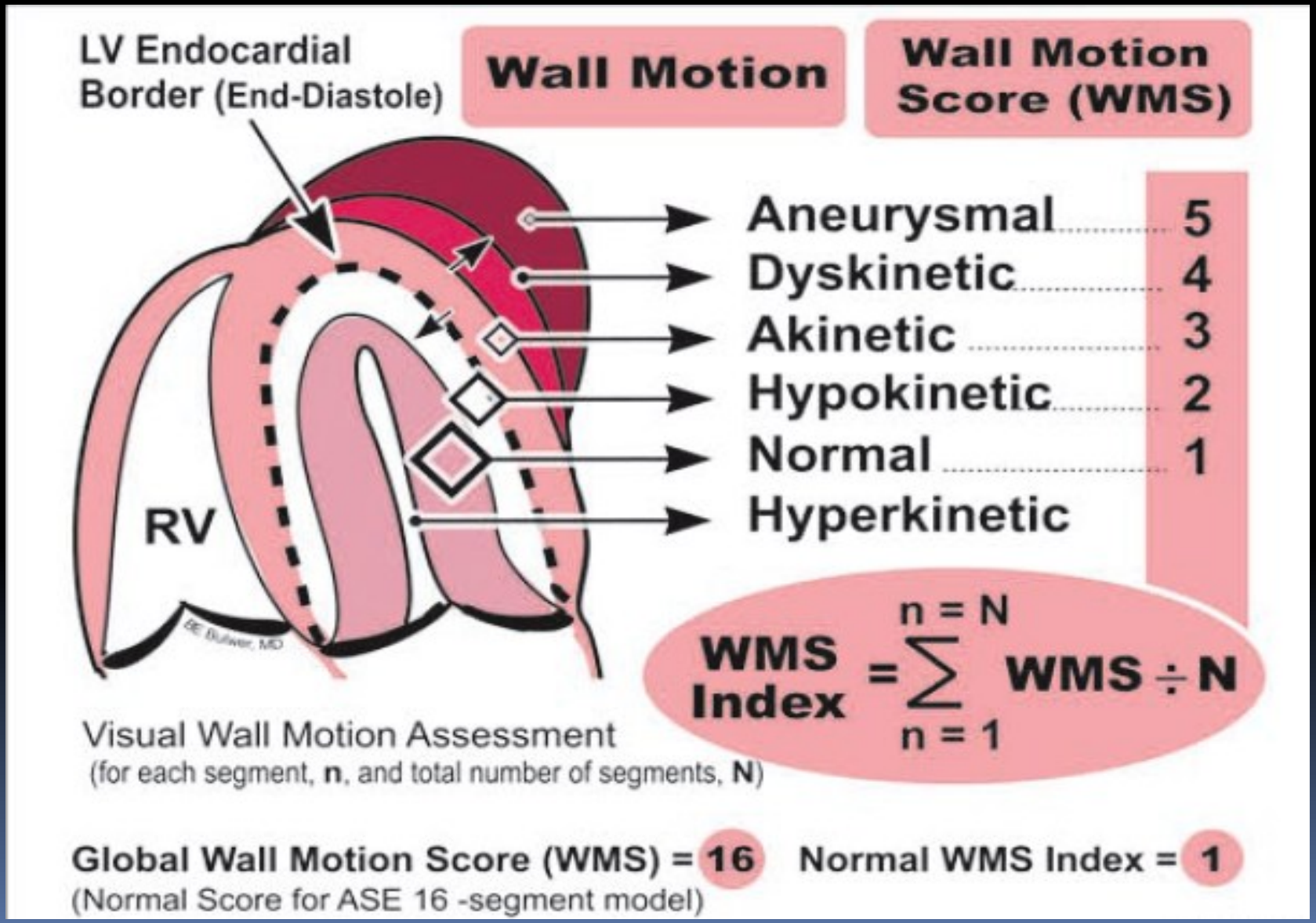
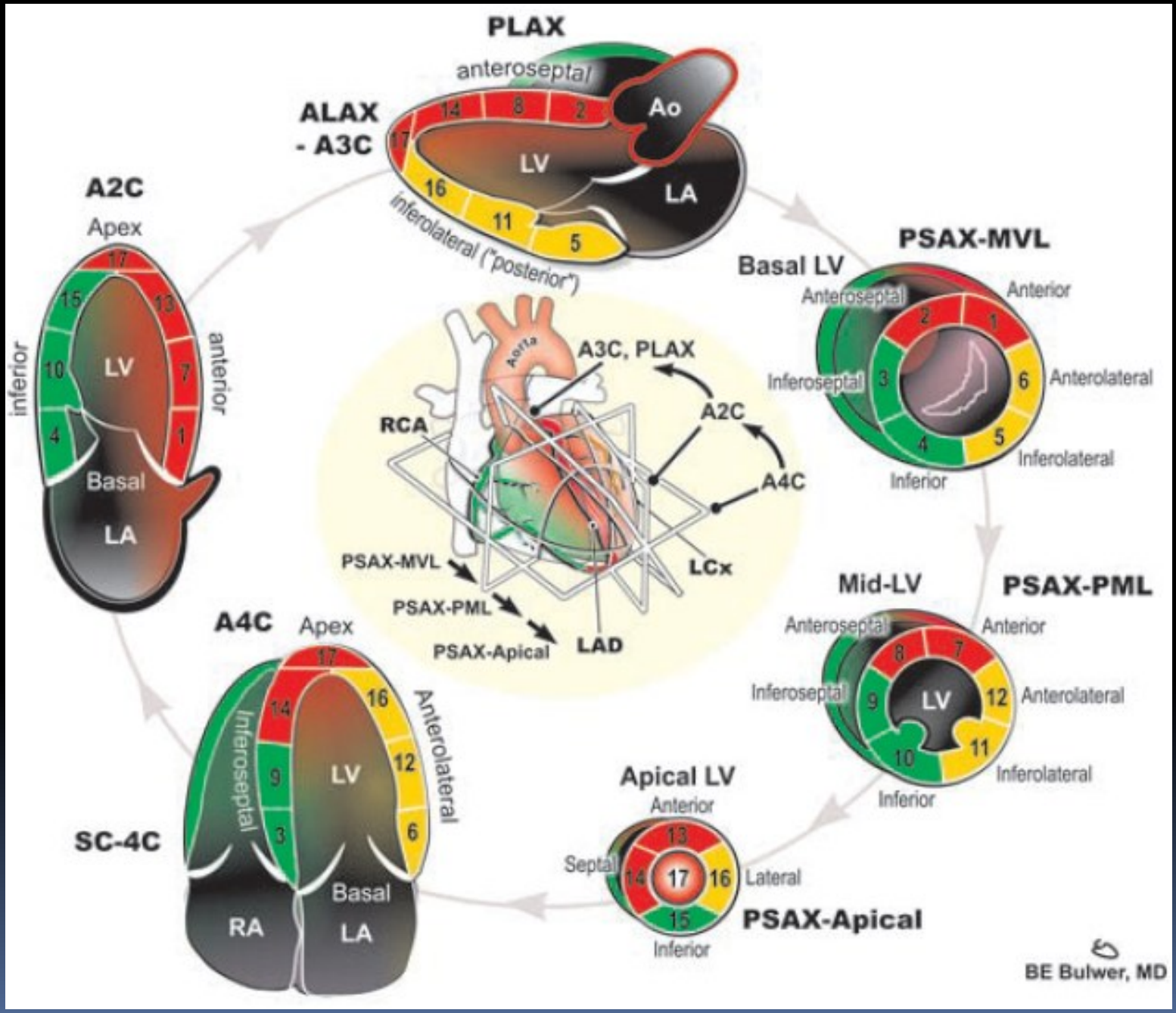



PLAX
anteroseptal
ALAX
- A3C
Ao
LV
LA
inferolateral ("posterior")
A2C
Apex
inferior
anterior
Basal
LA
PSAX-MVL
Basal LV
Anteroseptal
Anterior
Inferoseptal
Anterolateral
Inferolateral
Inferior
A3C, PLAX
A2C
A4C
RCA
Aorta
LCx
LAD
PSAX-MVL
PSAX-PML
PSAX-Apical
Mid-LV
PSAX-PML
A4C
Apex
Inferoseptal
Anterolateral
SC-4C
RA
Basal
LA
Apical LV
Anterior
Septal
Lateral
Inferior
PSAX-Apical
BE Bulwer, MD

VOLUMEN LATIDO (VL)

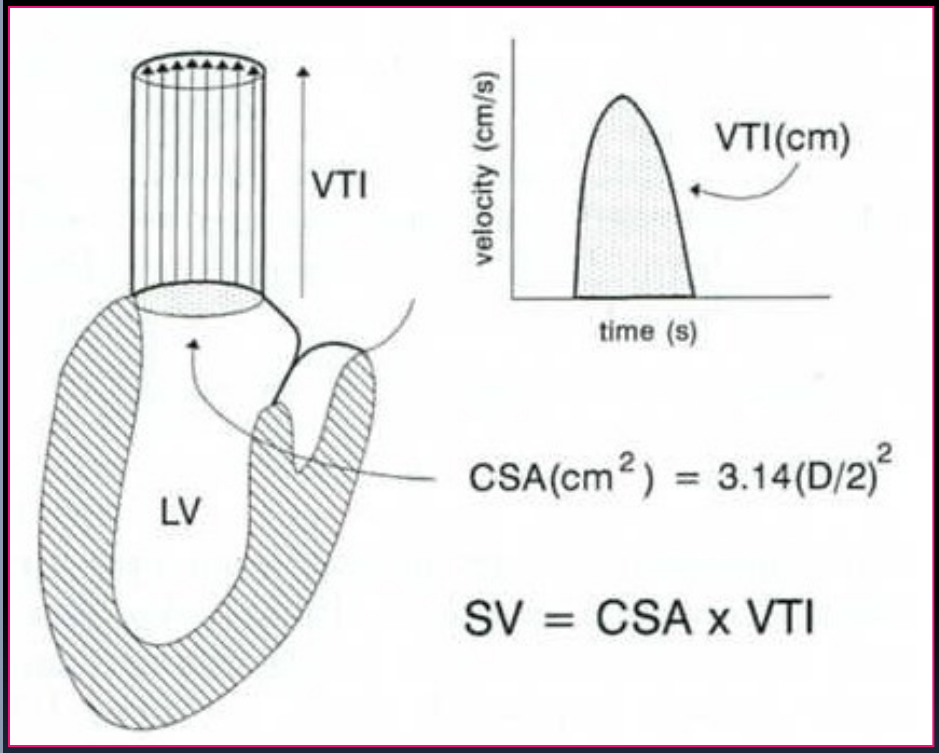
Volumen de sangre “ bombeado ” por latido.

GASTO CARDIACO (GC)

Volumen de sangre “ bombeado ” por minuto.

INDICE CARDIACO (IC)

Gasto cardiaco en relación al área de superficie corporal



¿Como calcular el Volumen Latido (VL)

1.- Medir diámetro (D) del TSVI a nivel del anillo aórtico, en vista paraesternal eje largo, amplificado y en sístole.

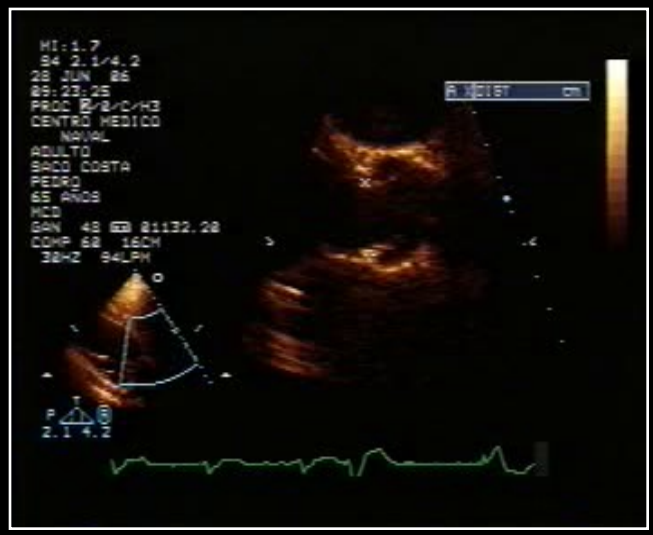
2.- Calcular el área del TSVI.

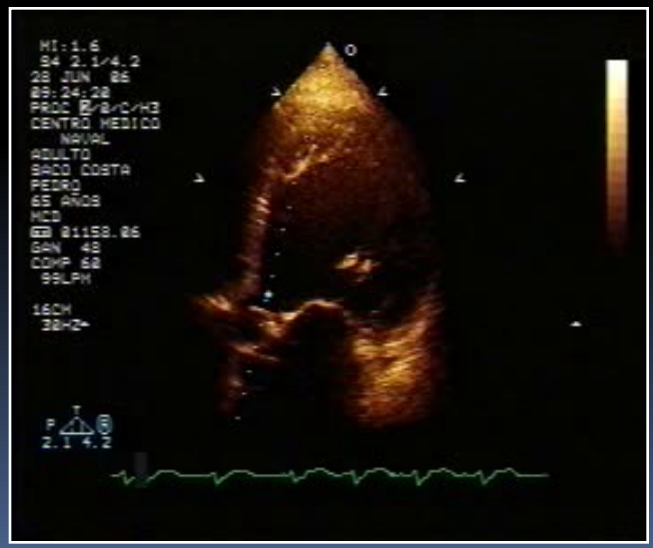
Área del TSVI= D2 X 0.785

3.- Medir la velocidad del TSVI e integral tiempo-velocidad en la vista apical eje largo, doppler pulsado.El Volumen de muestra en anillo Ao.

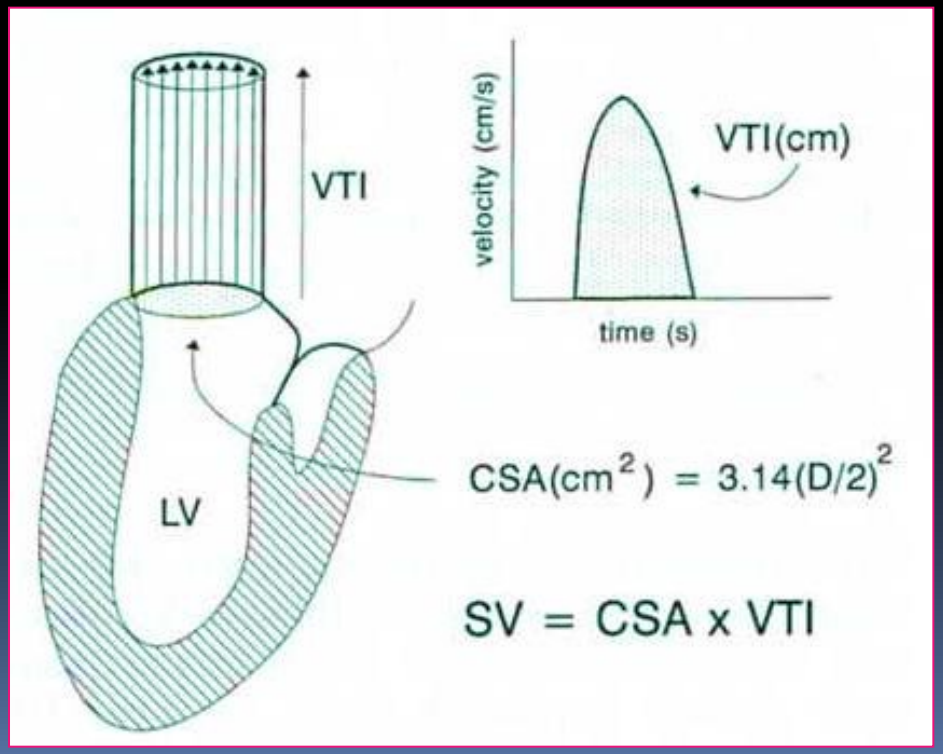
4.- Calculo del volumen latido (VL) a través del TSVI.

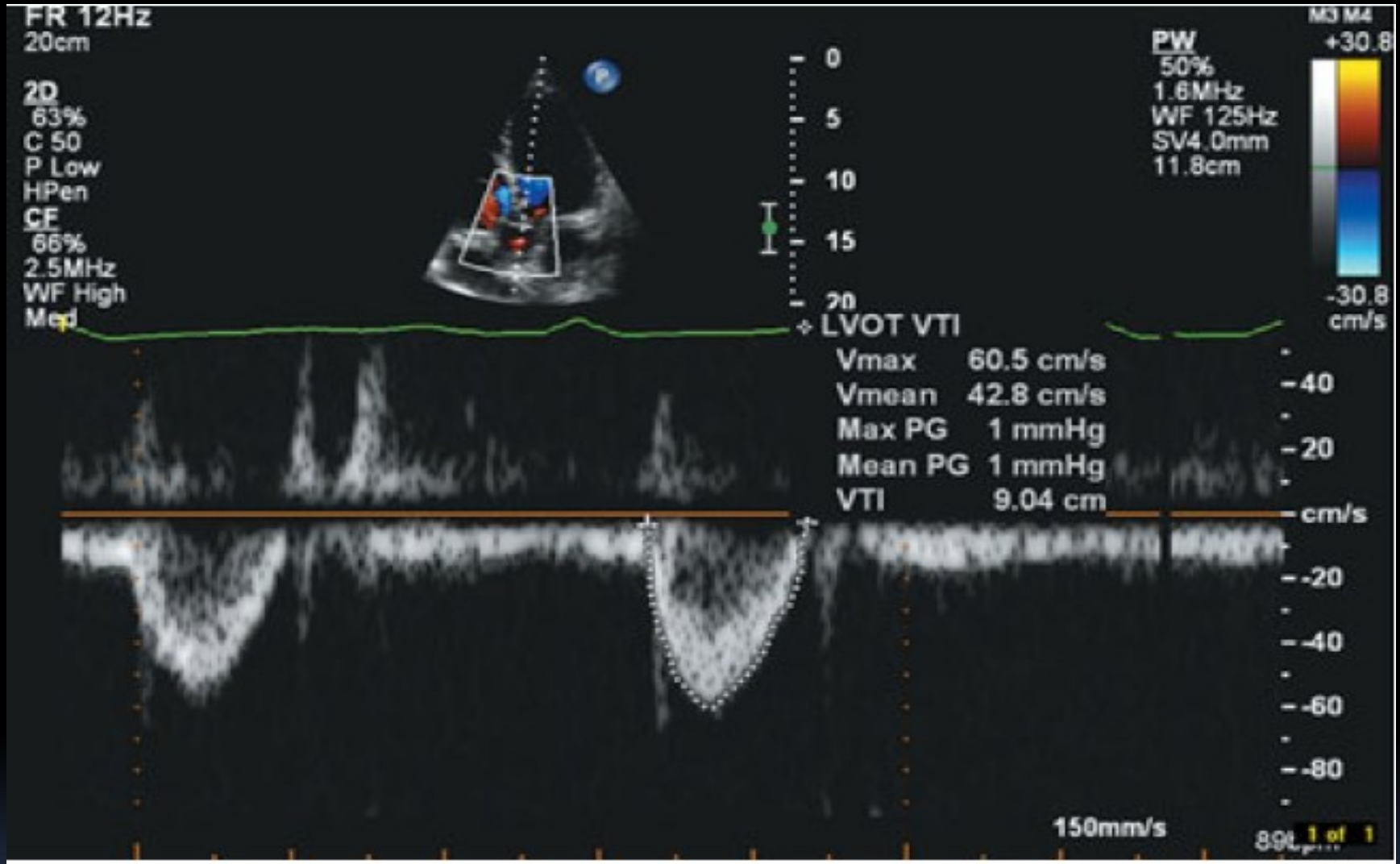
VL (ml.)= D2 x 0.785 x TVI





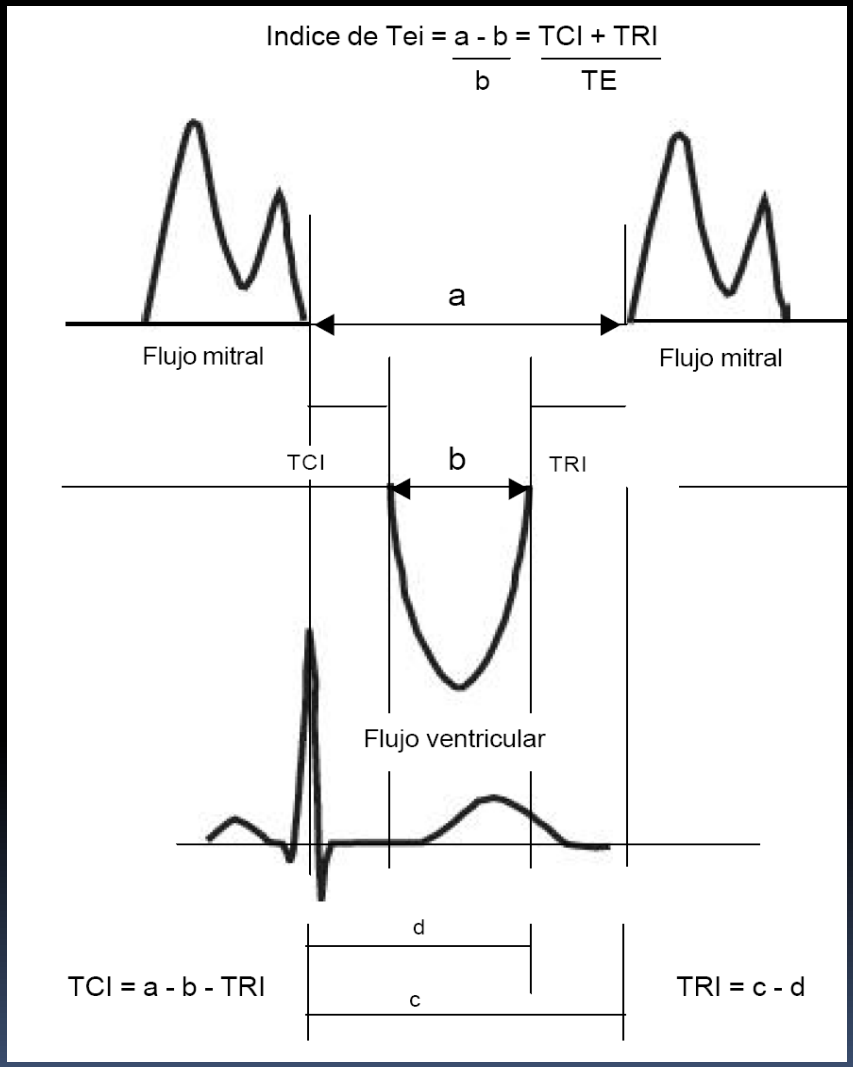
Stroke Volume, Cardiac Output, Cardiac Index — Reference Values		
	Rest	Exercise
Stroke volume	70 – 110ml	80 – 130ml
Cardiac output	5 – 8.5 L/min	10 – 17 L/min
Cardiac index	> 2.5 L/min/m^2	> 5 L/min/m^2

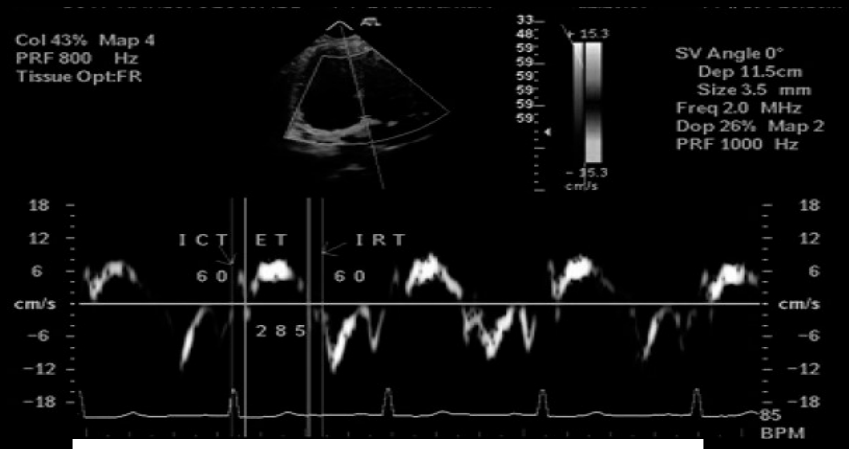


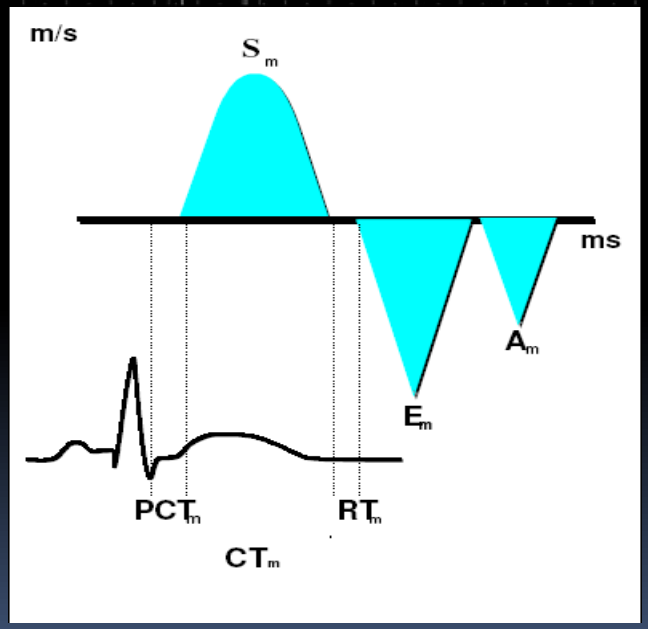


View	Apical 5-chamber
Modality	PW Doppler

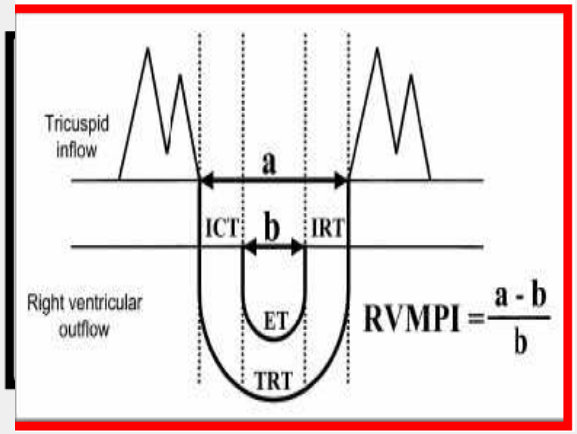
INDICE PERFORMANCE MIOCARDICO. TEI

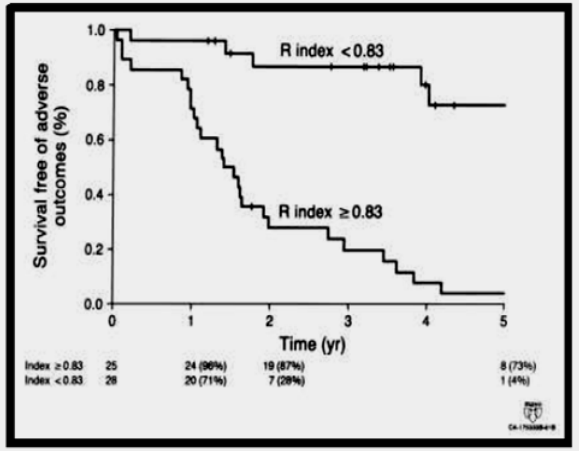


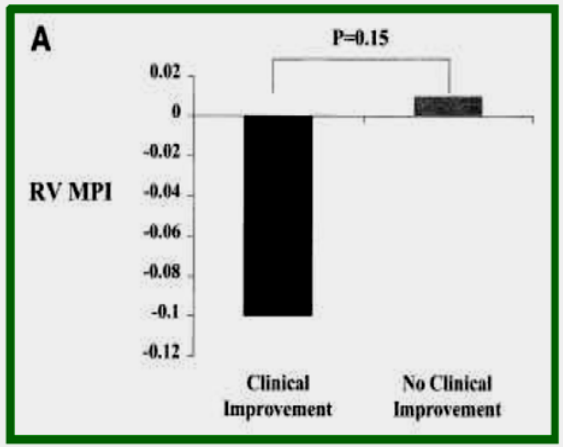




INDICE DE TEI



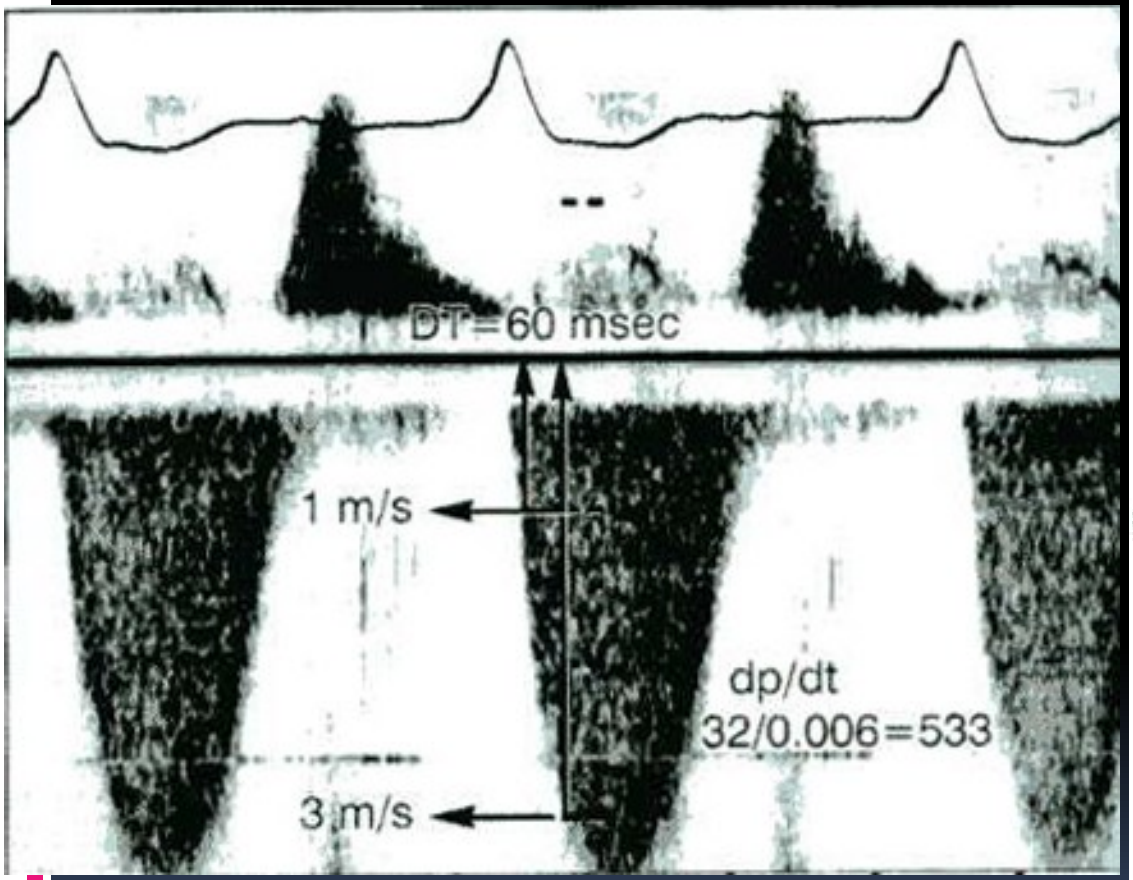


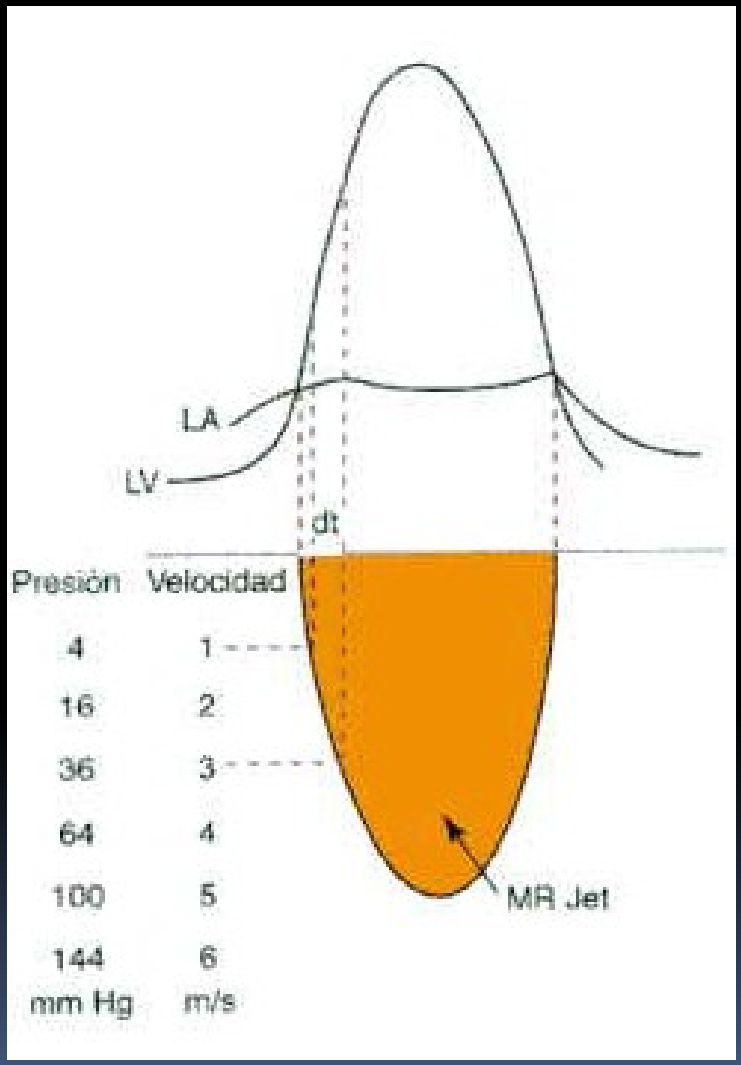


Tei C – JASE 1996

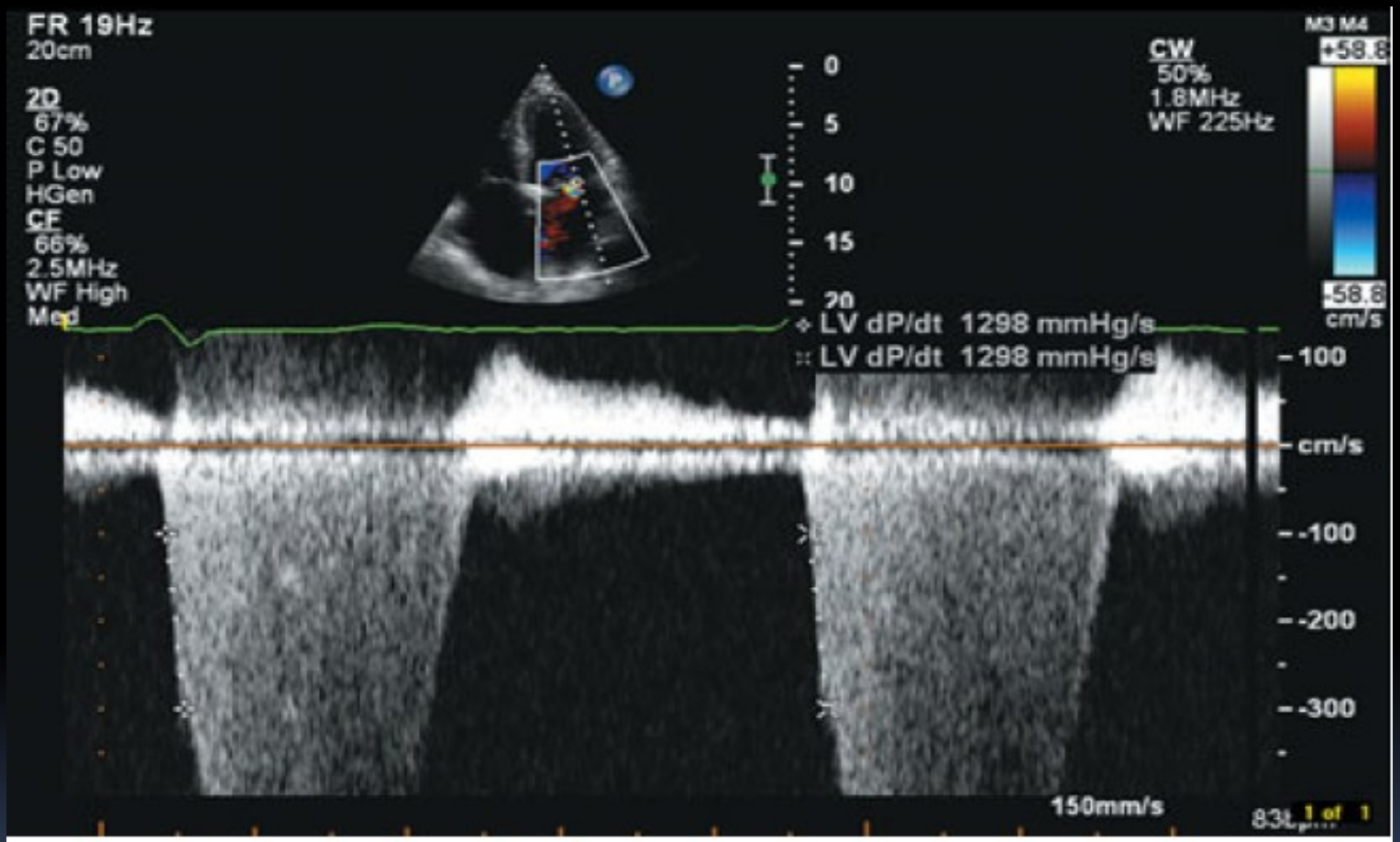
Yeo TC – Am J Cardiol 1998

PRESIONES INTRACARDIACAS: dp/dt





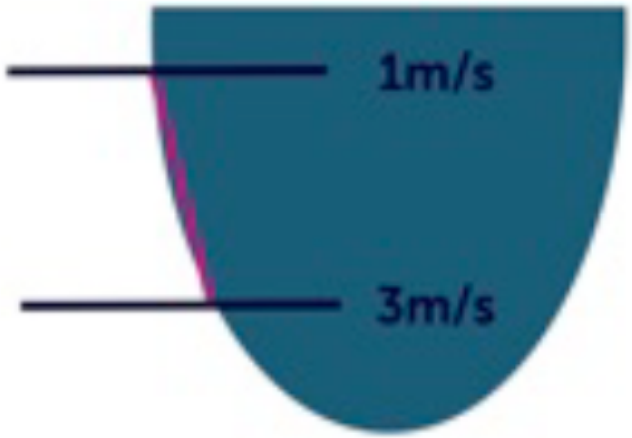
PRESIONES INTRACARDIACAS: dp/dt



View	Apical 4-chamber
Modality	CW Doppler

PRESIONES INTRACARDIACAS: dp/dt

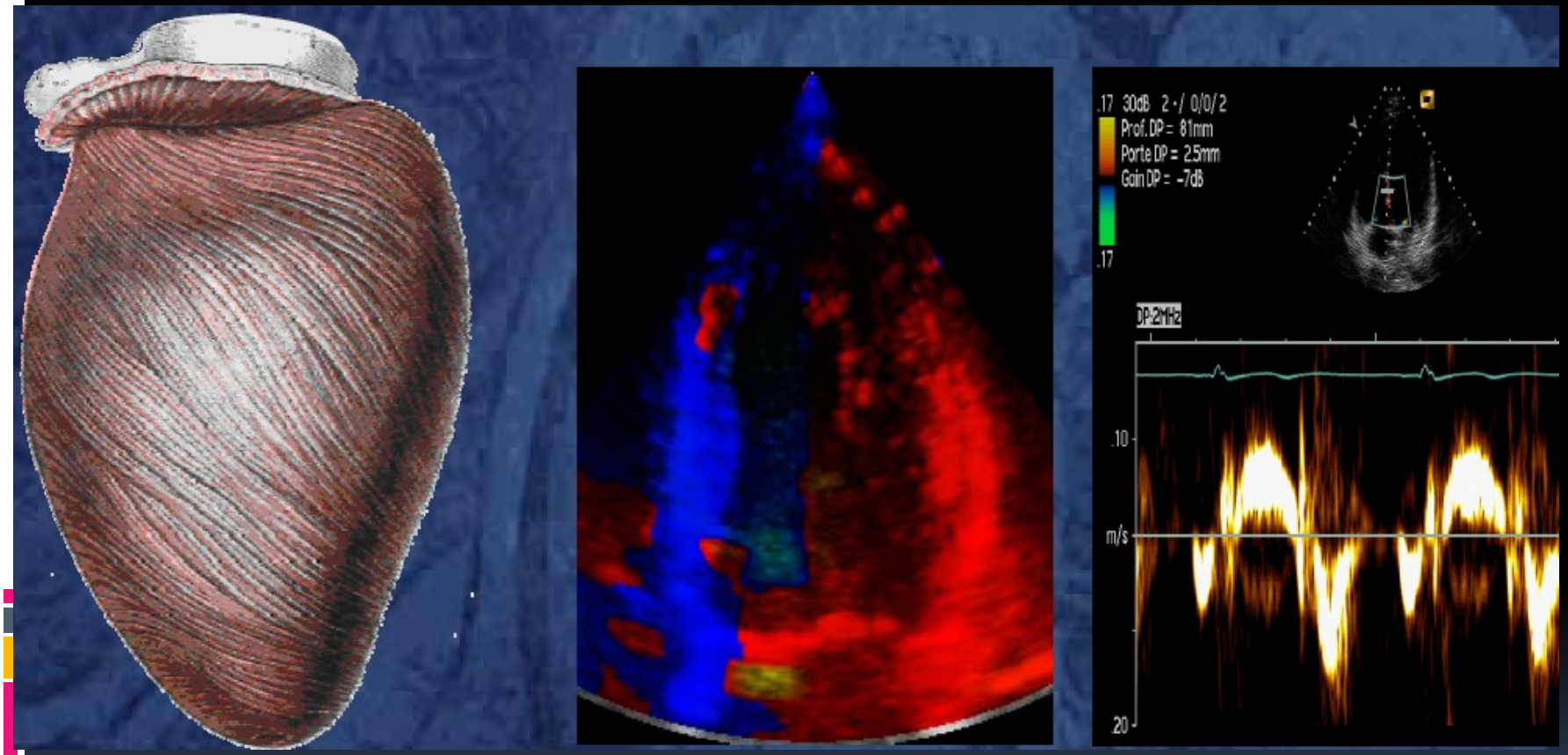
dp/dt — Reference Values



Normal	> 1200 mmHg/sec
Borderline	800— 1200 mmHg/sec
Reduced	< 800 mmHg/sec
Severly reduced	< 500 mmHg/sec

Limitations: MR signal needed, inexact, not completely load independent

FUNCION LONGITUDINAL

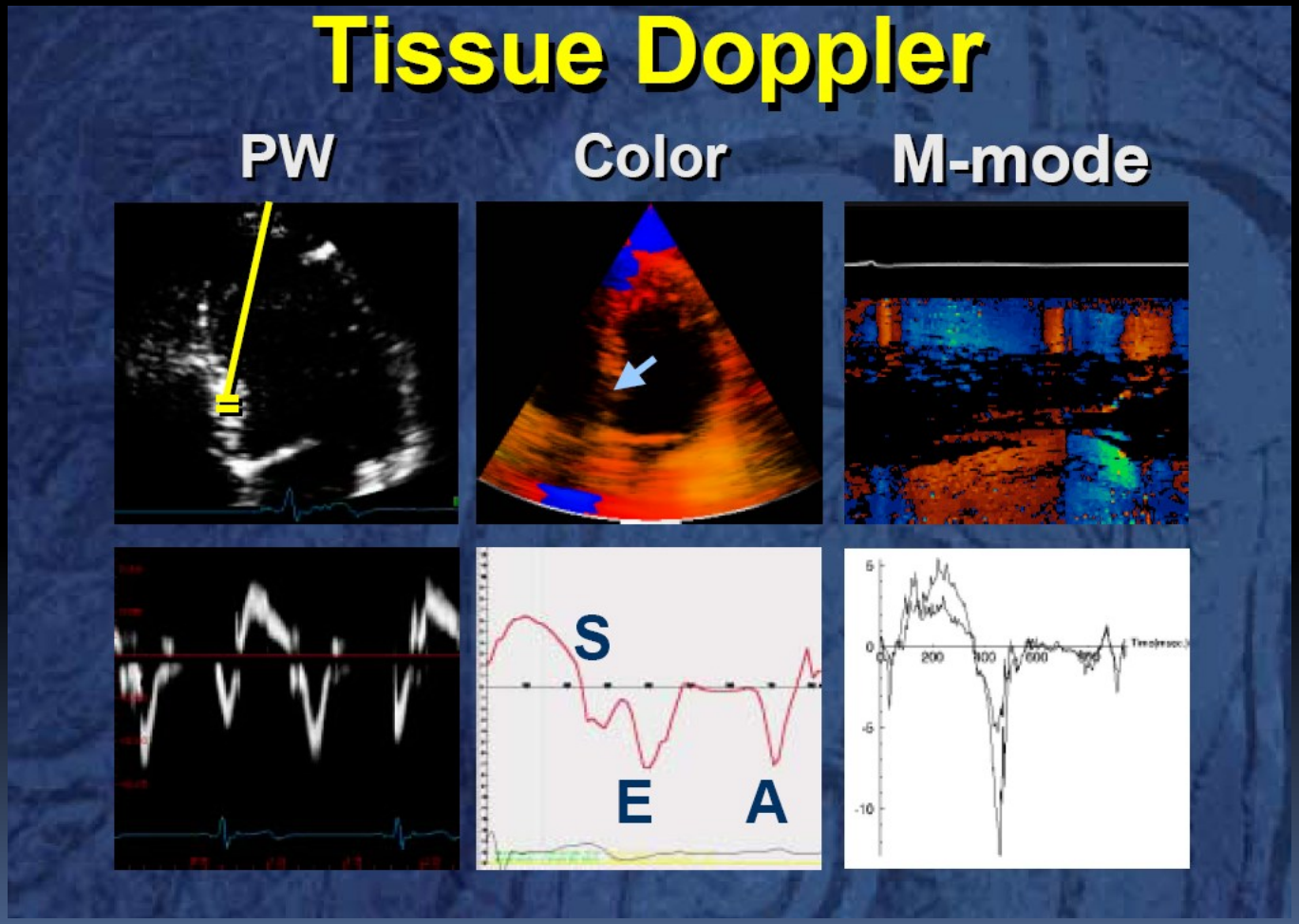


FIBRAS ENDOCARDICAS

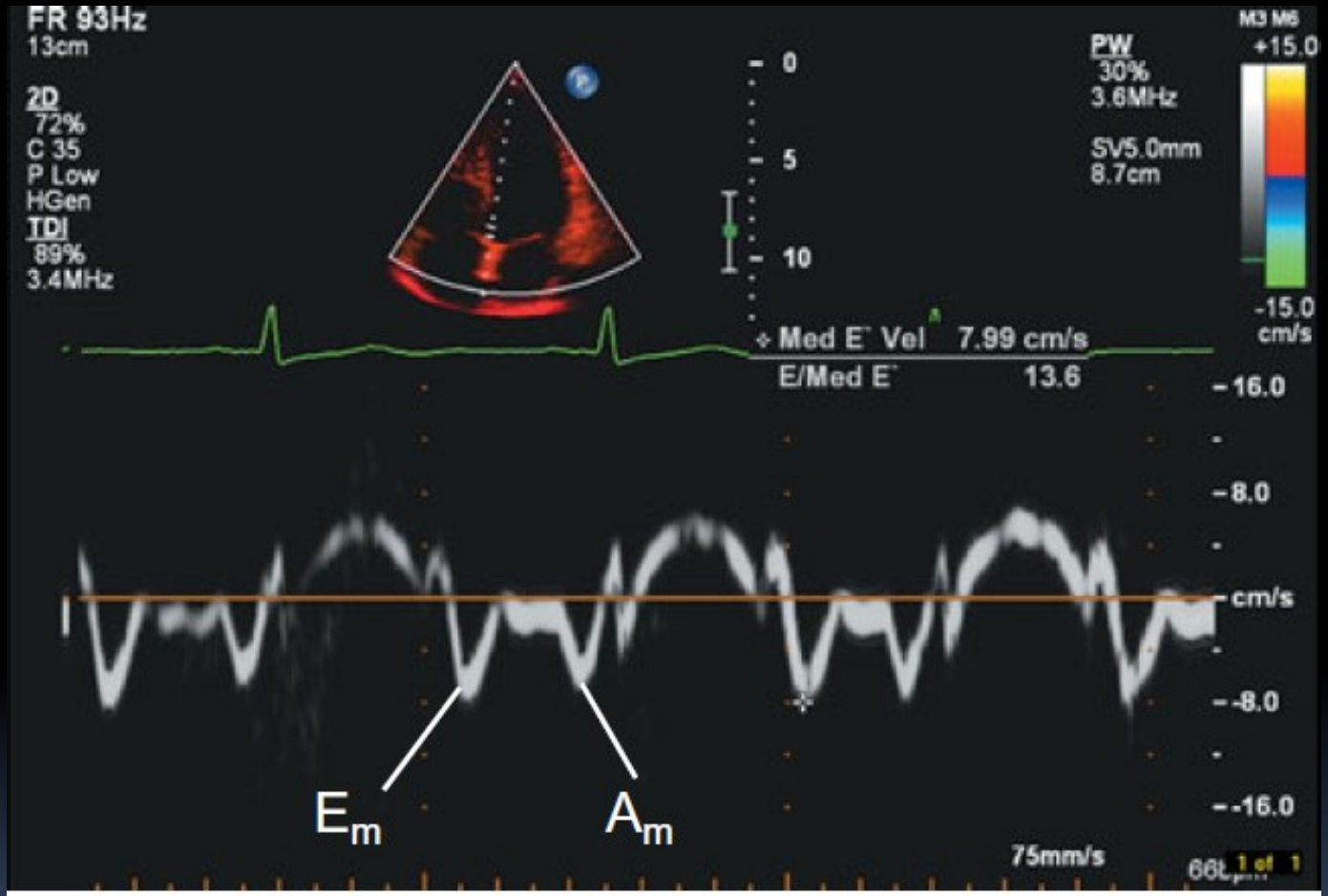
VELOCIDADES LONGITUDINALES

DOPPLER TISULAR

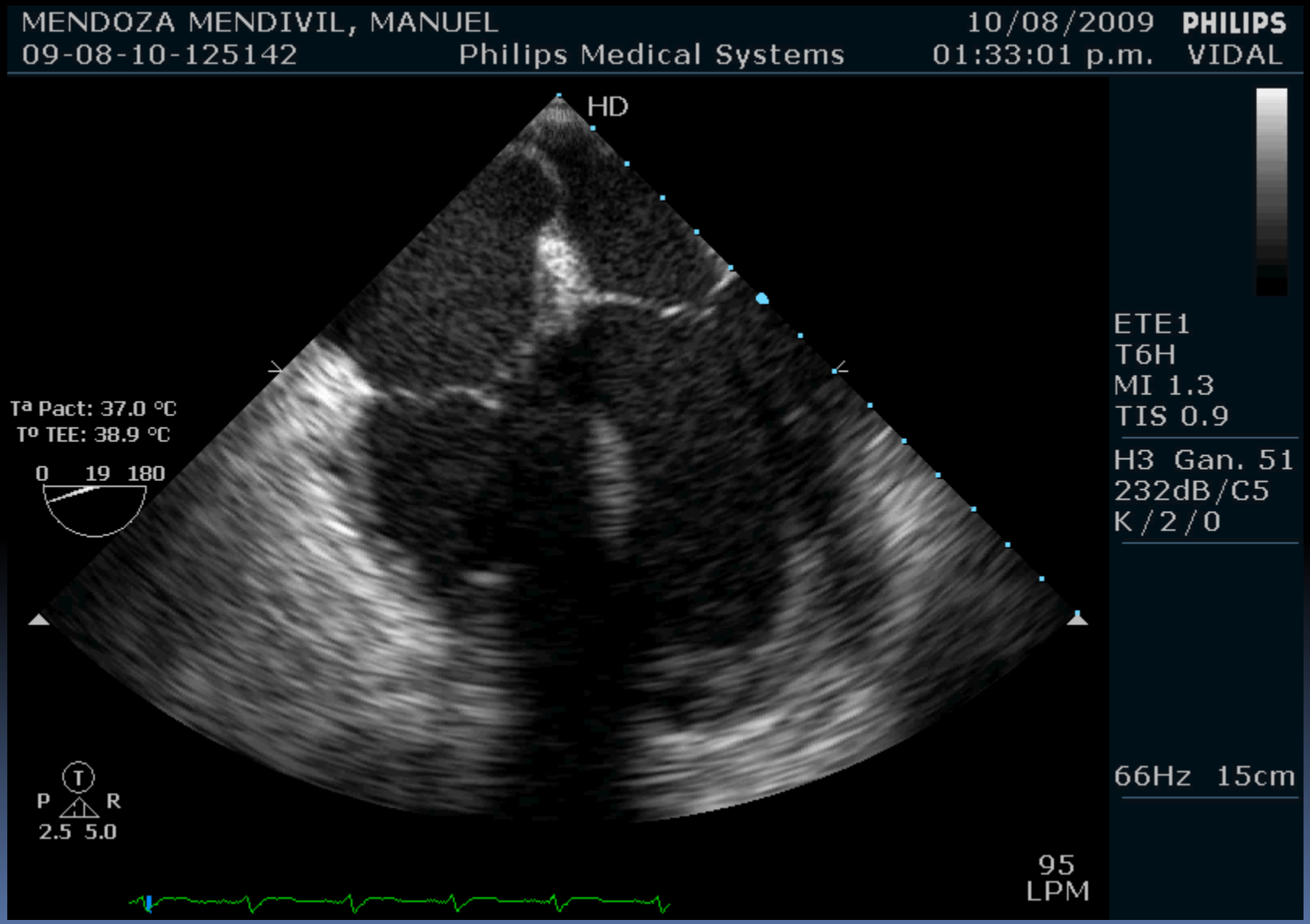
PULSADO COLOR MODO M

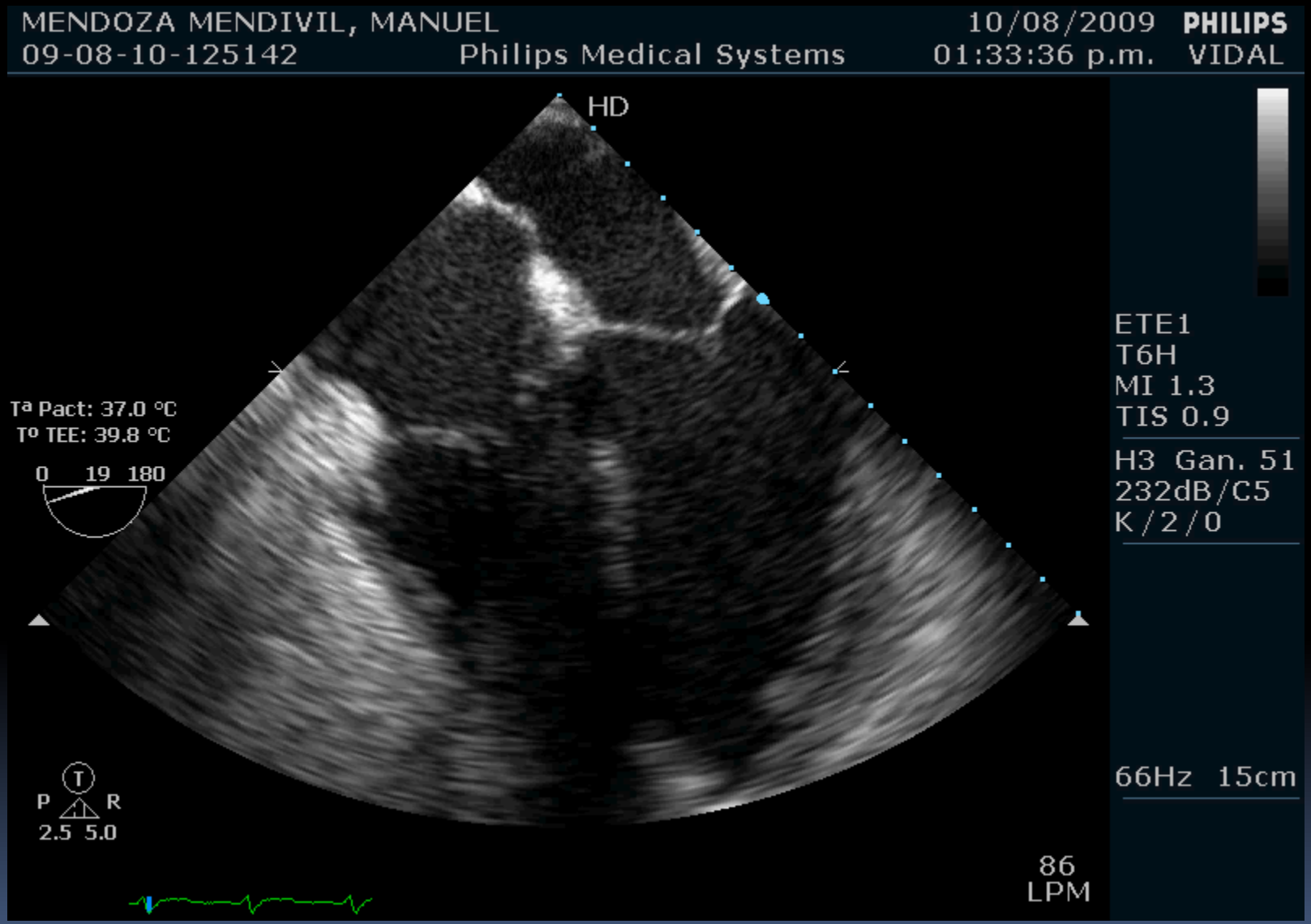


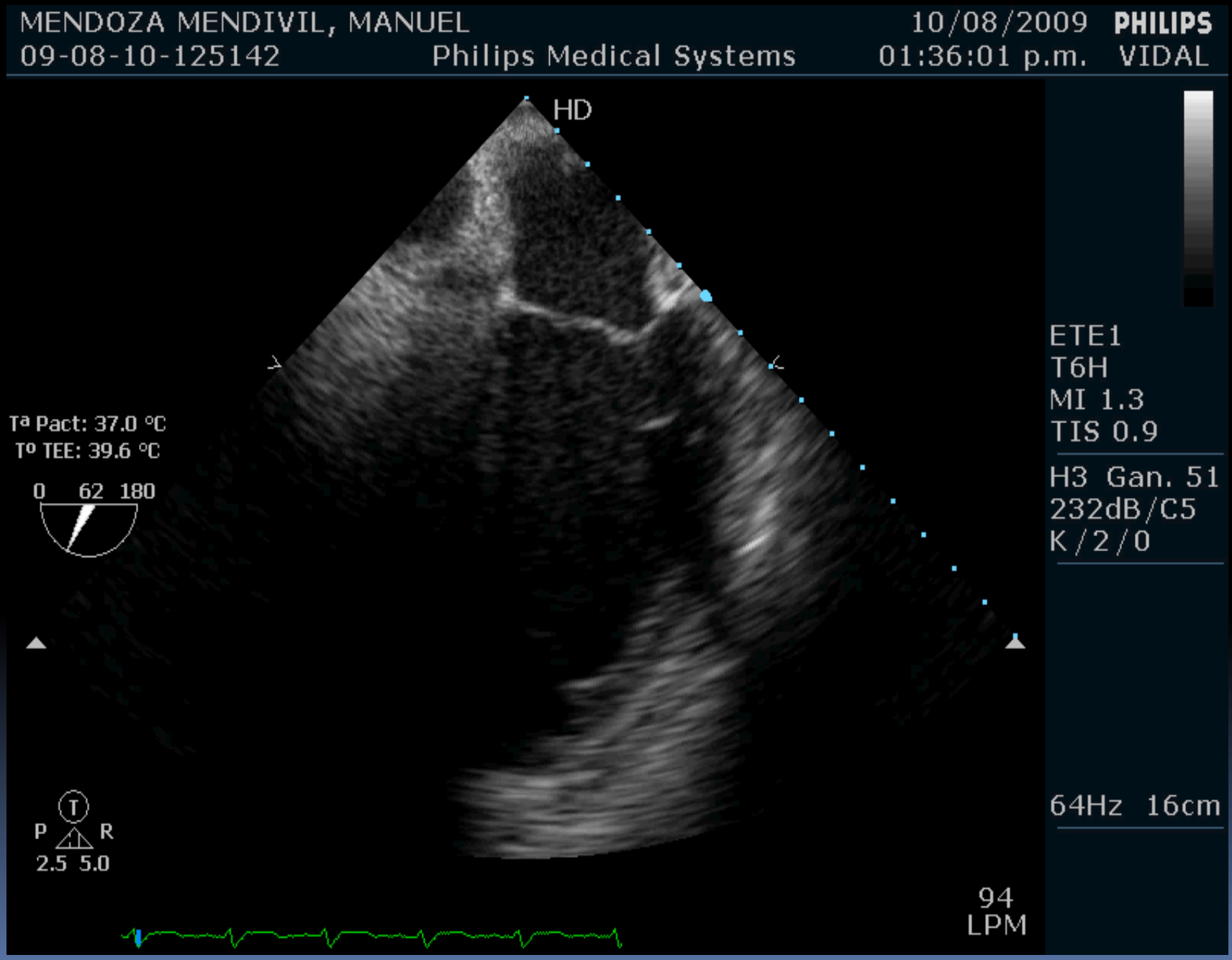
DOPPLER TISULAR

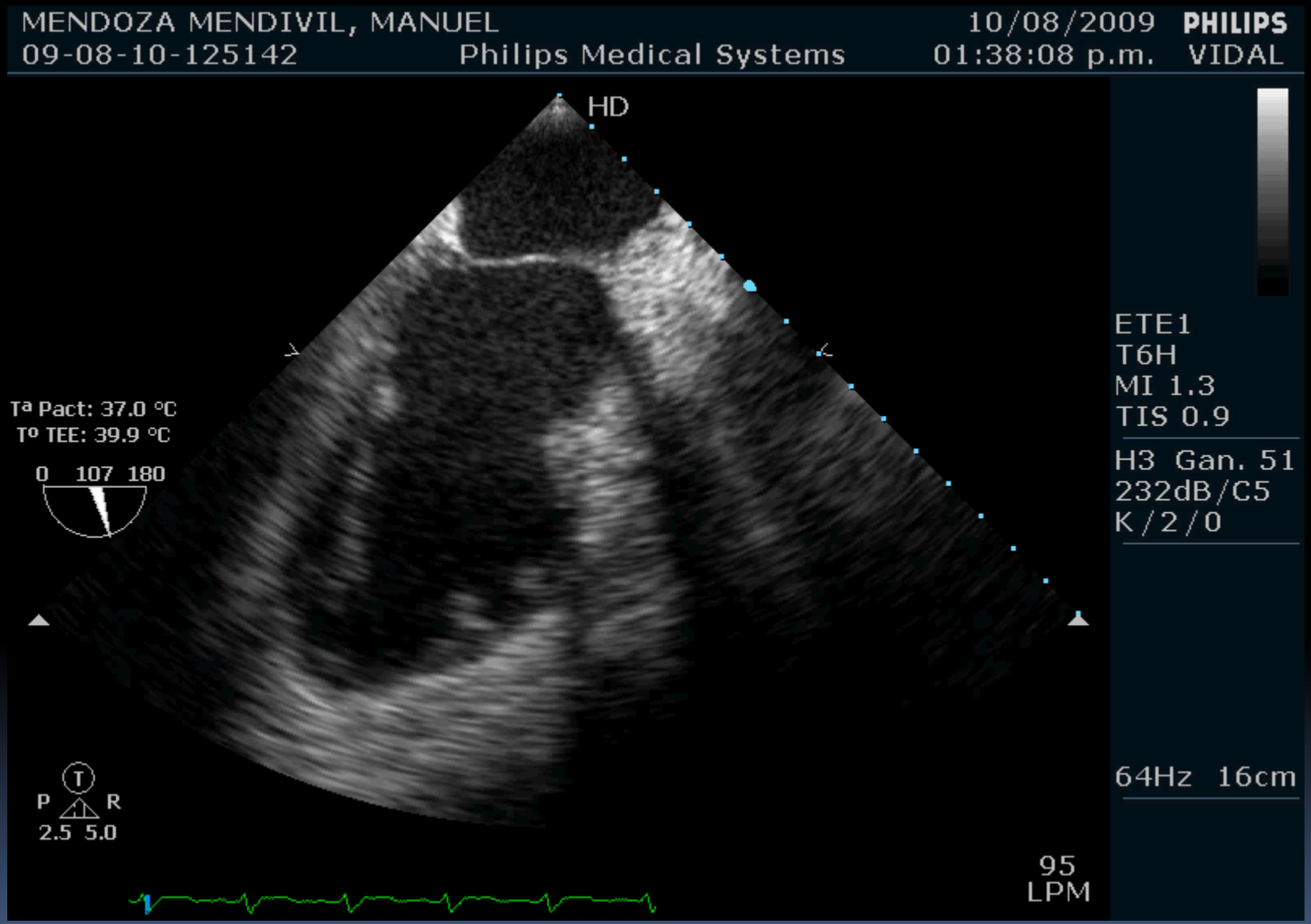


View	Apical 4-chamber
Modality	PW Tissue Doppler


MENDOZA MENDIVIL, MANUEL
09-08-10-125142
Philips Medical Systems
10/08/2009
01:33:01 p.m.
PHILIPS
VIDAL
HD
Tª Pact: 37.0 °C
Tº TEE: 38.9 °C
0 19 180
ETE1
T6H
MI 1.3
TIS 0.9
H3 Gan. 51
232dB/C5
K/2/0
66Hz 15cm
P R
2.5 5.0
95
LPM


MENDOZA MENDIVIL, MANUEL
09-08-10-125142
Philips Medical Systems
10/08/2009
01:33:36 p.m.
PHILIPS
VIDAL
HD
Tª Pact: 37.0 °C
Tº TEE: 39.8 °C
0 19 180
ETE1
T6H
MI 1.3
TIS 0.9
H3 Gan. 51
232dB/C5
K/2/0
66Hz 15cm
T
P R
2.5 5.0
86
LPM


MENDOZA MENDIVIL, MANUEL
09-08-10-125142
Philips Medical Systems
10/08/2009
01:36:01 p.m.
PHILIPS
VIDAL
HD
Ta Pact: 37.0 °C
To TEE: 39.6 °C
0 62 180
ETE1
T6H
MI 1.3
TIS 0.9
H3 Gan. 51
232dB/C5
K/2/0
64Hz 16cm
T
P R
2.5 5.0
94
LPM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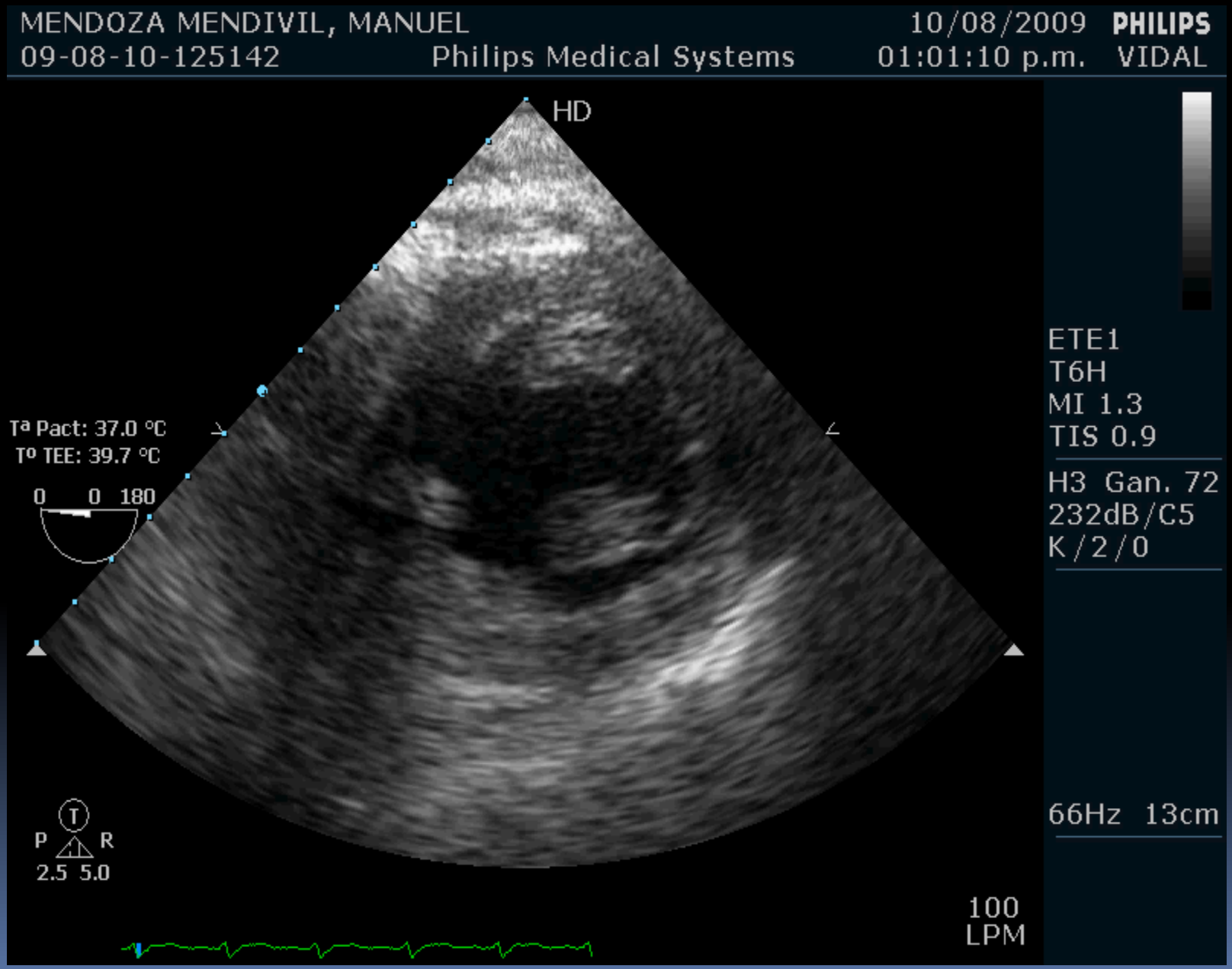
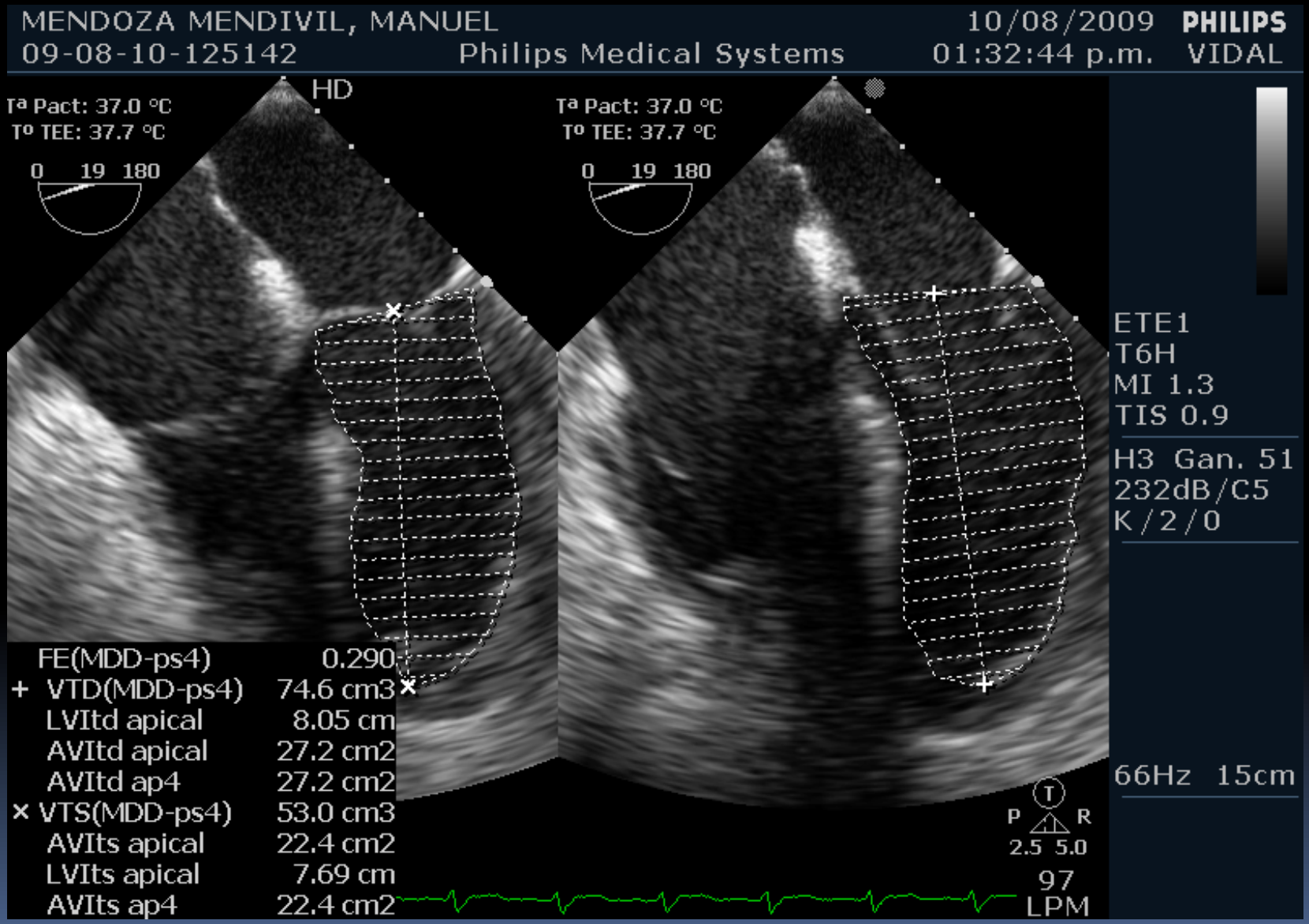
09-08-10-125142
Philips Medical Systems
10/08/2009
01:38:08 p.m.
PHILIPS
VIDAL
HD
Tª Pact: 37.0 °C
Tº TEE: 39.9 °C
0 107 180
ETE1
T6H
MI 1.3
TIS 0.9
H3 Gan. 51
232dB/C5
K/2/0
64Hz 16cm
T
P R
2.5 5.0
95
LPM


MENDOZA MENDIVIL, MANUEL
09-08-10-125142
Philips Medical Systems
10/08/2009
01:01:10 p.m.
PHILIPS
VIDAL
HD
Tª Pact: 37.0 °C
Tº TEE: 39.7 °C
0 0 180
ETE1
T6H
MI 1.3
TIS 0.9
H3 Gan. 72
232dB/C5
K/2/0
66Hz 13cm
T
P R
2.5 5.0
100
LPM


MENDOZA MENDIVIL, MANUEL
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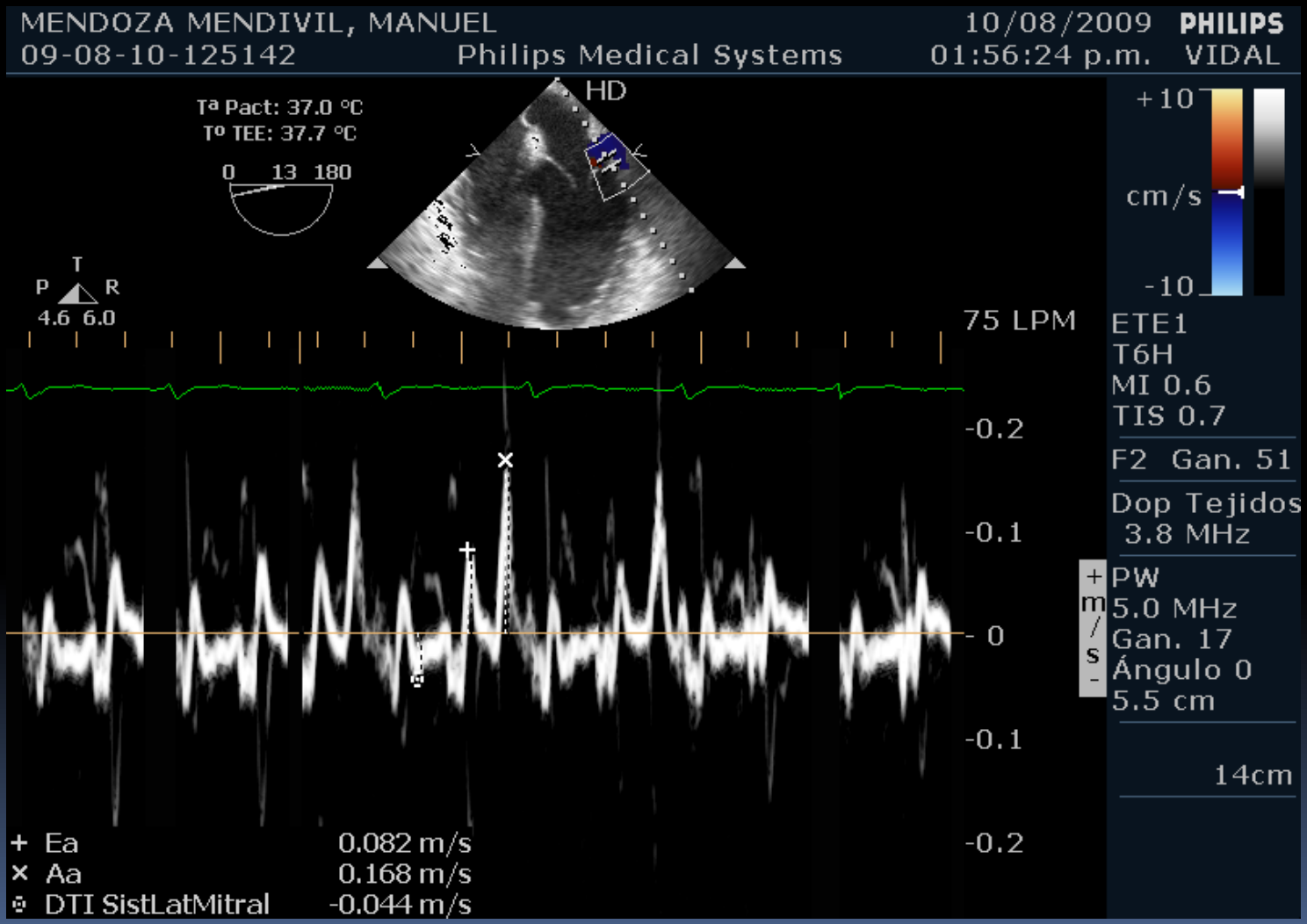
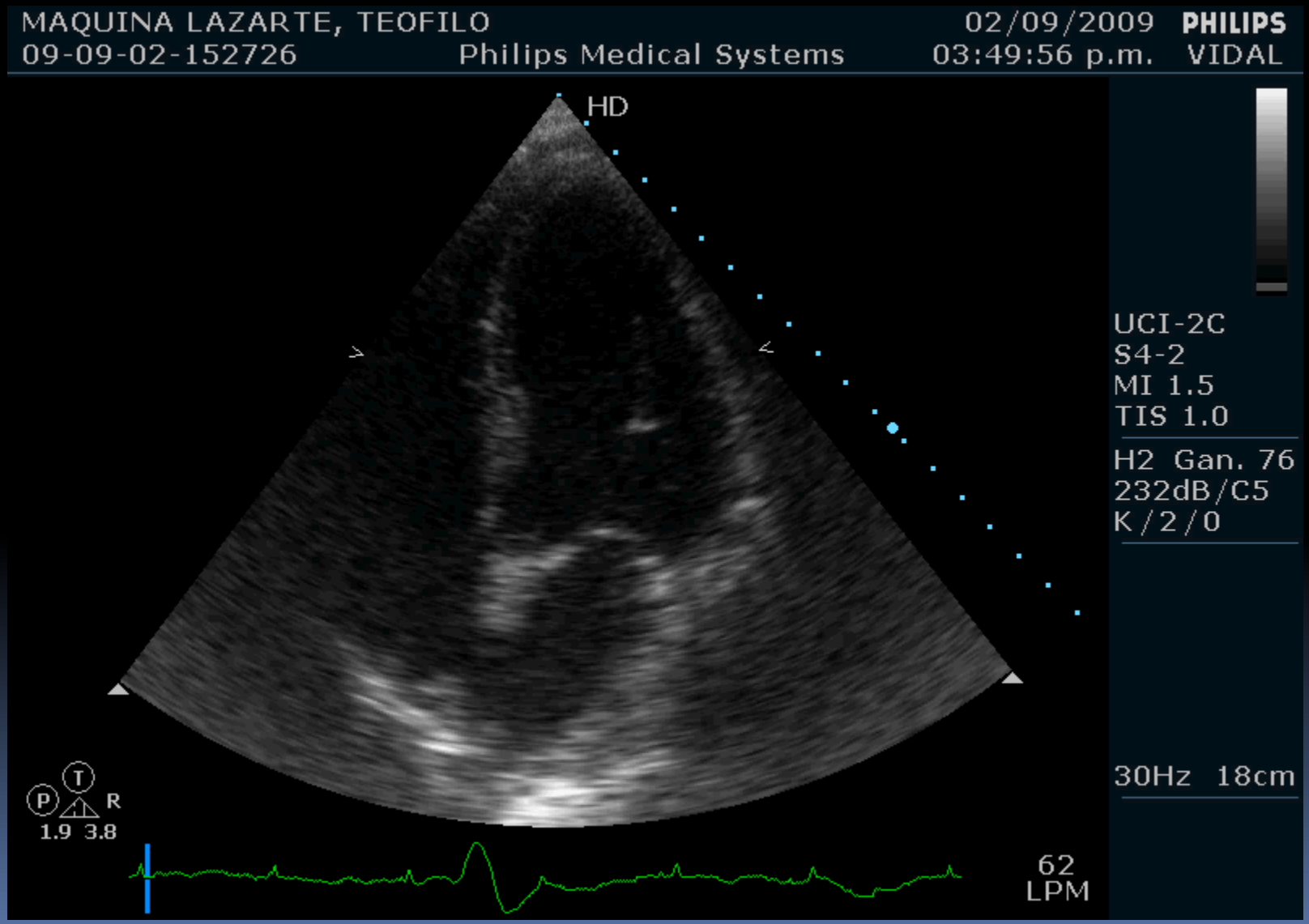
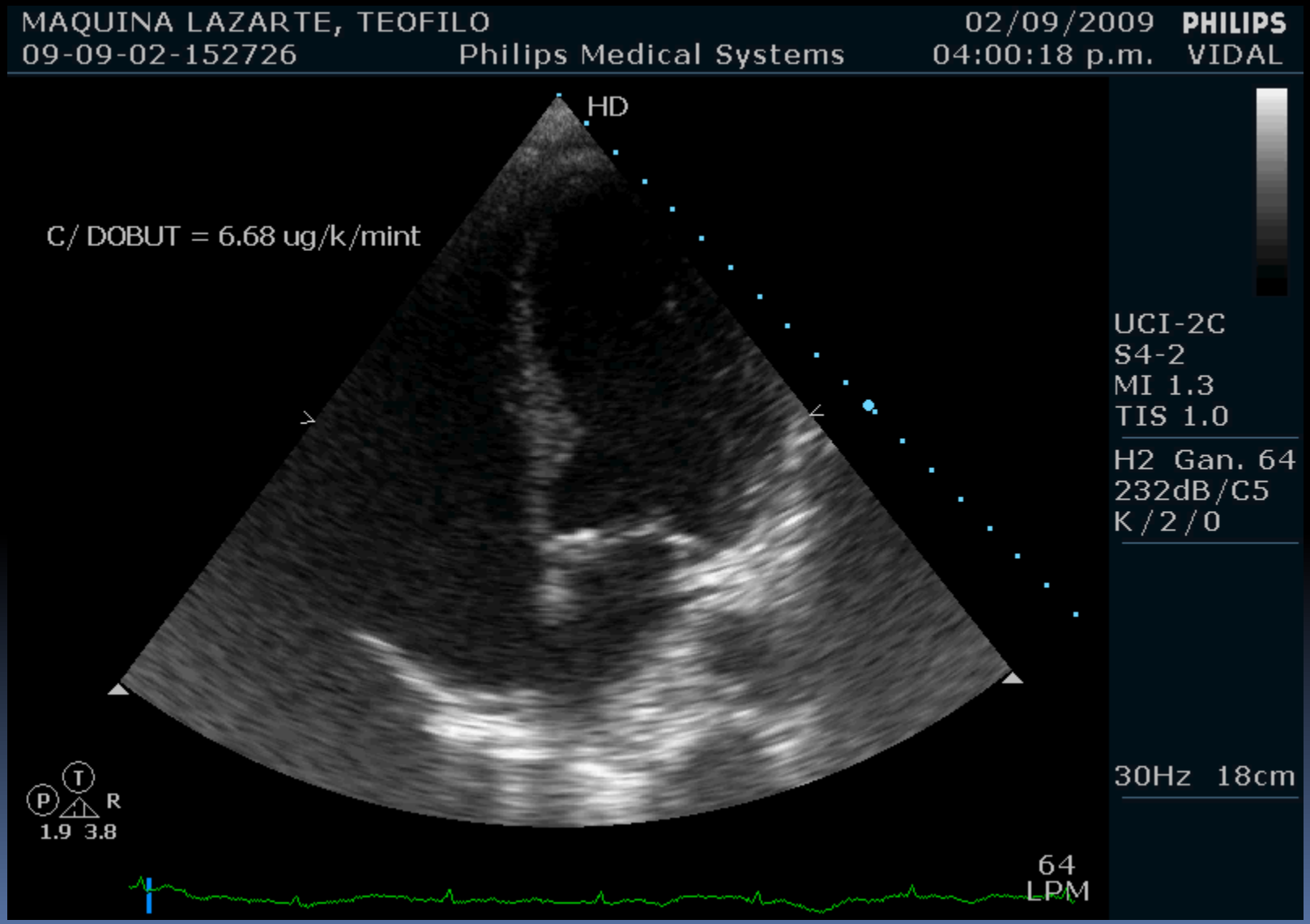
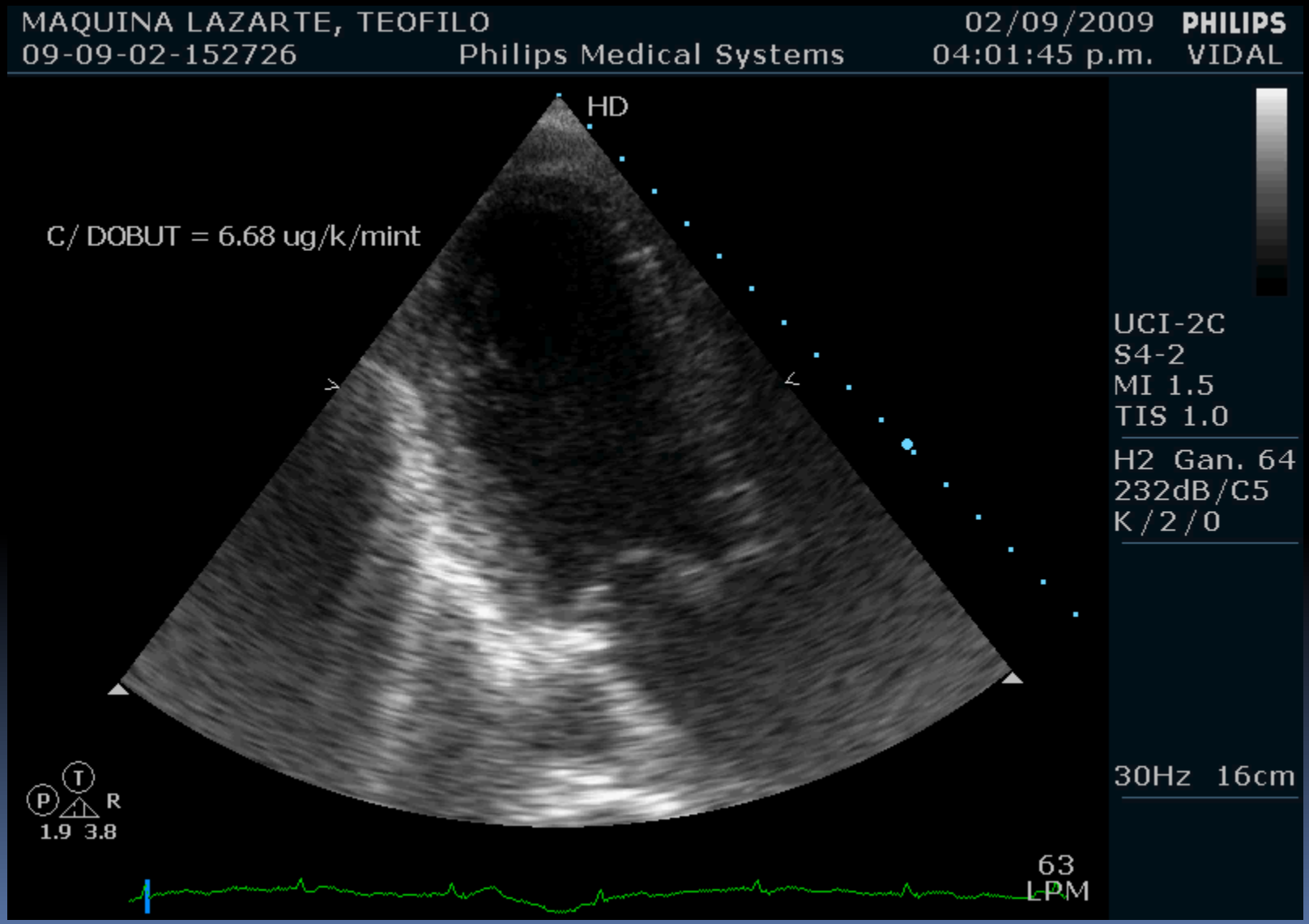
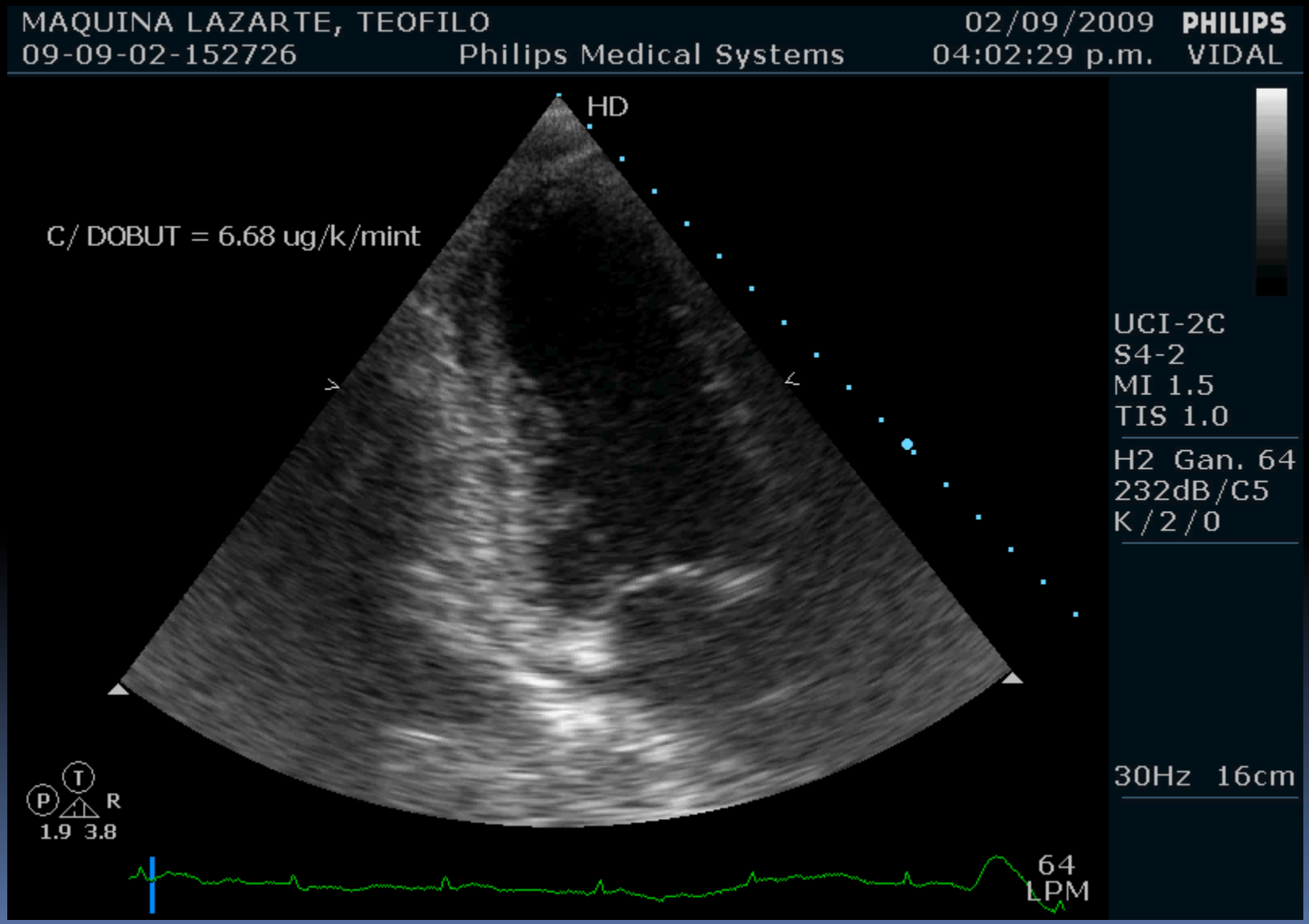
Philips Medical Systems
10/08/2009
01:32:44 p.m.
PHILIPS
VIDAL
HD
Tª Pact: 37.0 °C
Tº TEE: 37.7 °C
0 19 180
Tª Pact: 37.0 °C
Tº TEE: 37.7 °C
0 19 180
ETE1
T6H
MI 1.3
TIS 0.9
H3 Gan. 51
232dB/C5
K/2/0
FE(MDD-ps4) 0.290
+ VTD(MDD-ps4) 74.6 cm3
LVItd apical 8.05 cm
AVItd apical 27.2 cm2
AVItd ap4 27.2 cm2
× VTS(MDD-ps4) 53.0 cm3
AVIts apical 22.4 cm2
LVIts apical 7.69 cm
AVIts ap4 22.4 cm2
66Hz 15cm
P R
2.5 5.0
97
LPM

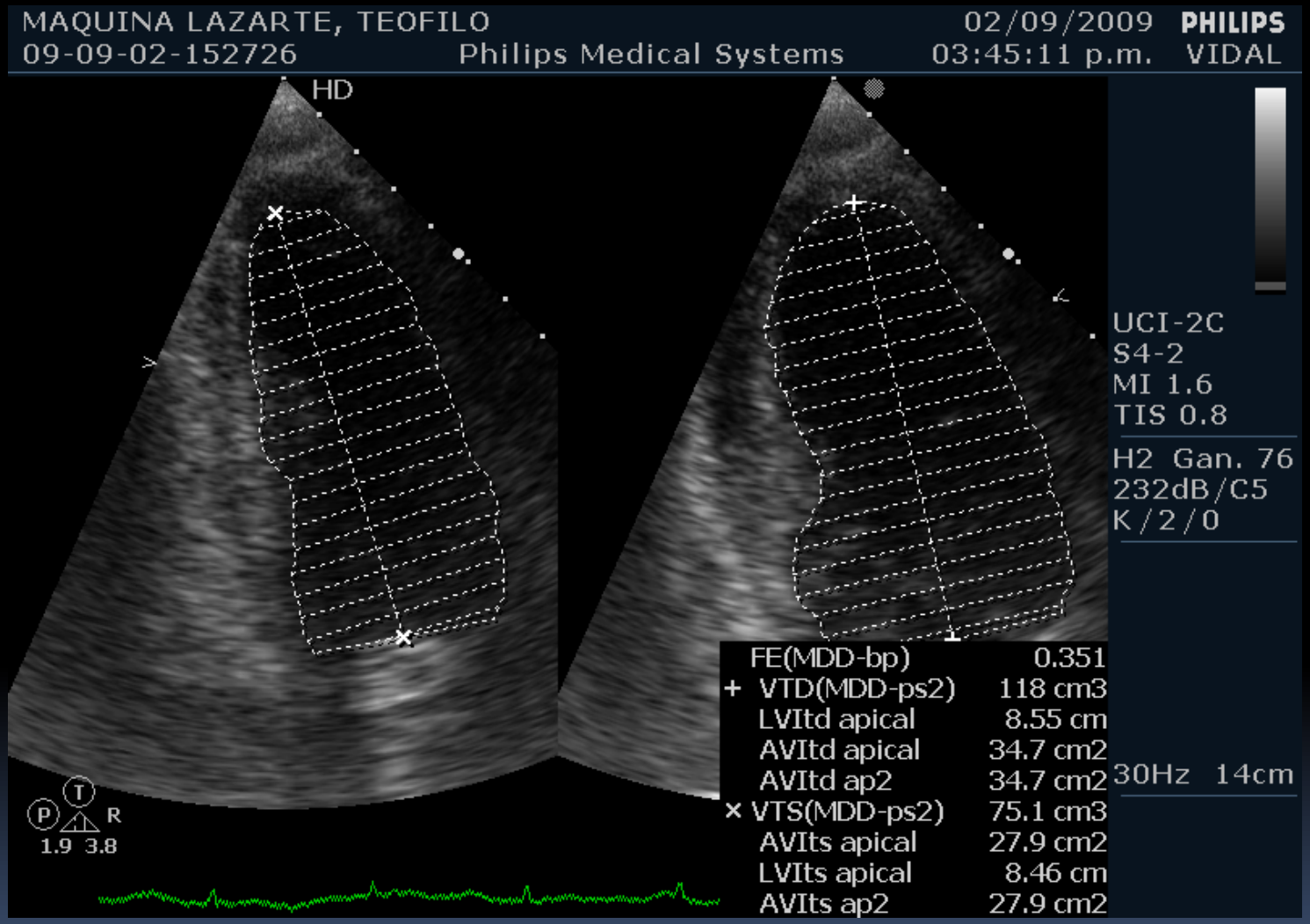

MENDOZA MENDIVIL, MANUEL
09-08-10-125142
Philips Medical Systems
10/08/2009
01:56:24 p.m.
PHILIPS
VIDAL
Tª Pact: 37.0 °C
Tº TEE: 37.7 °C
0 13 180
HD
+10
cm/s
-10
T
P R
4.6 6.0
75 LPM
-0.2
-0.1
0
-0.1
-0.2
ETE1
T6H
MI 0.6
TIS 0.7
F2 Gan. 51
Dop Tejidos
3.8 MHz
PW
5.0 MHz
Gan. 17
Ángulo 0
5.5 cm
14cm
+ m/s -
+ Ea 0.082 m/s
× Aa 0.168 m/s
DTI SistLatMitral -0.044 m/s

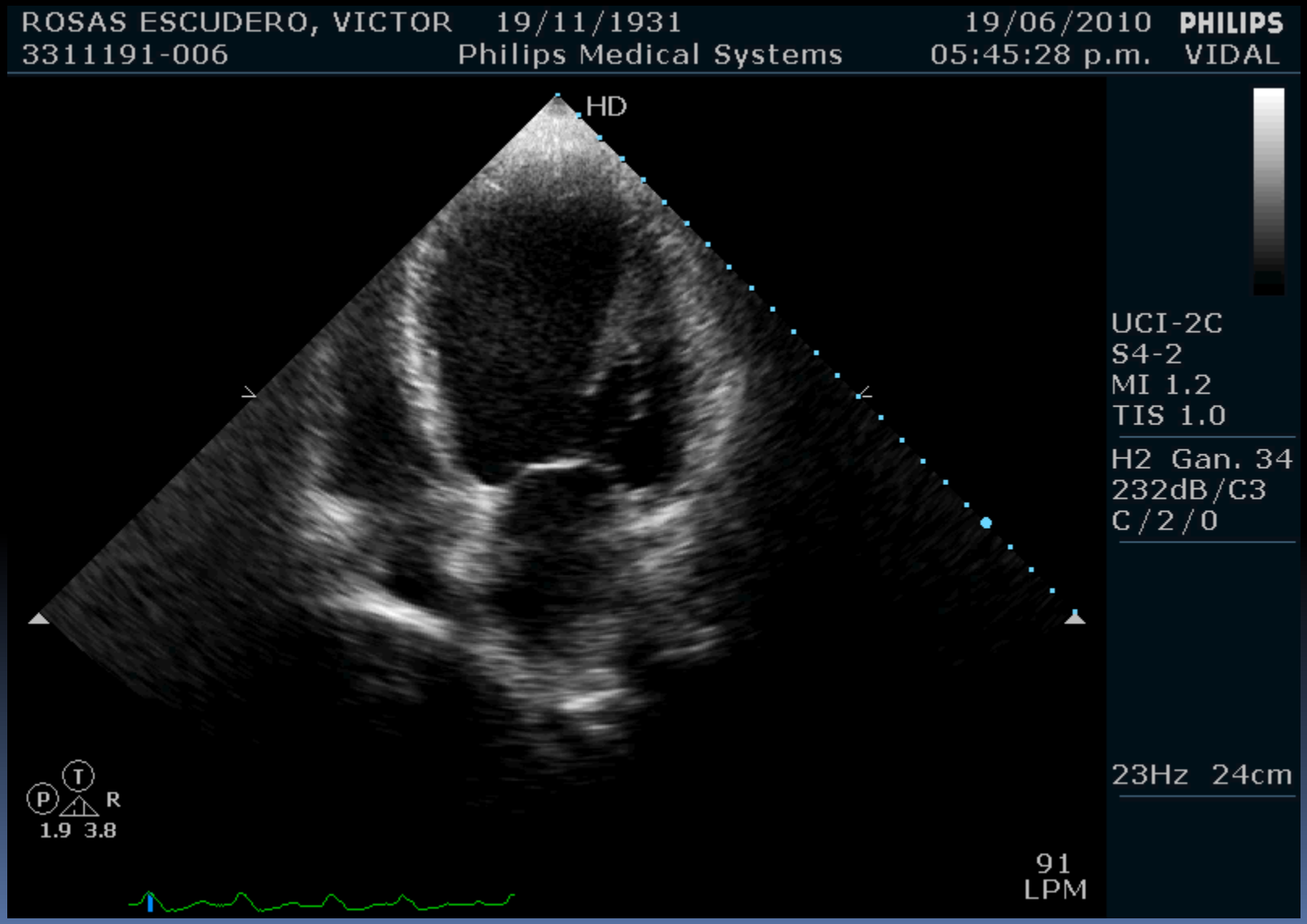

MAQUINA LAZARTE, TEOFILO
09-09-02-152726
Philips Medical Systems
02/09/2009
03:49:56 p.m.
PHILIPS
VIDAL
HD
UCI-2C
S4-2
MI 1.5
TIS 1.0
H2 Gan. 76
232dB/C5
K/2/0
30Hz 18cm
P
T
R
1.9 3.8
62
LPM

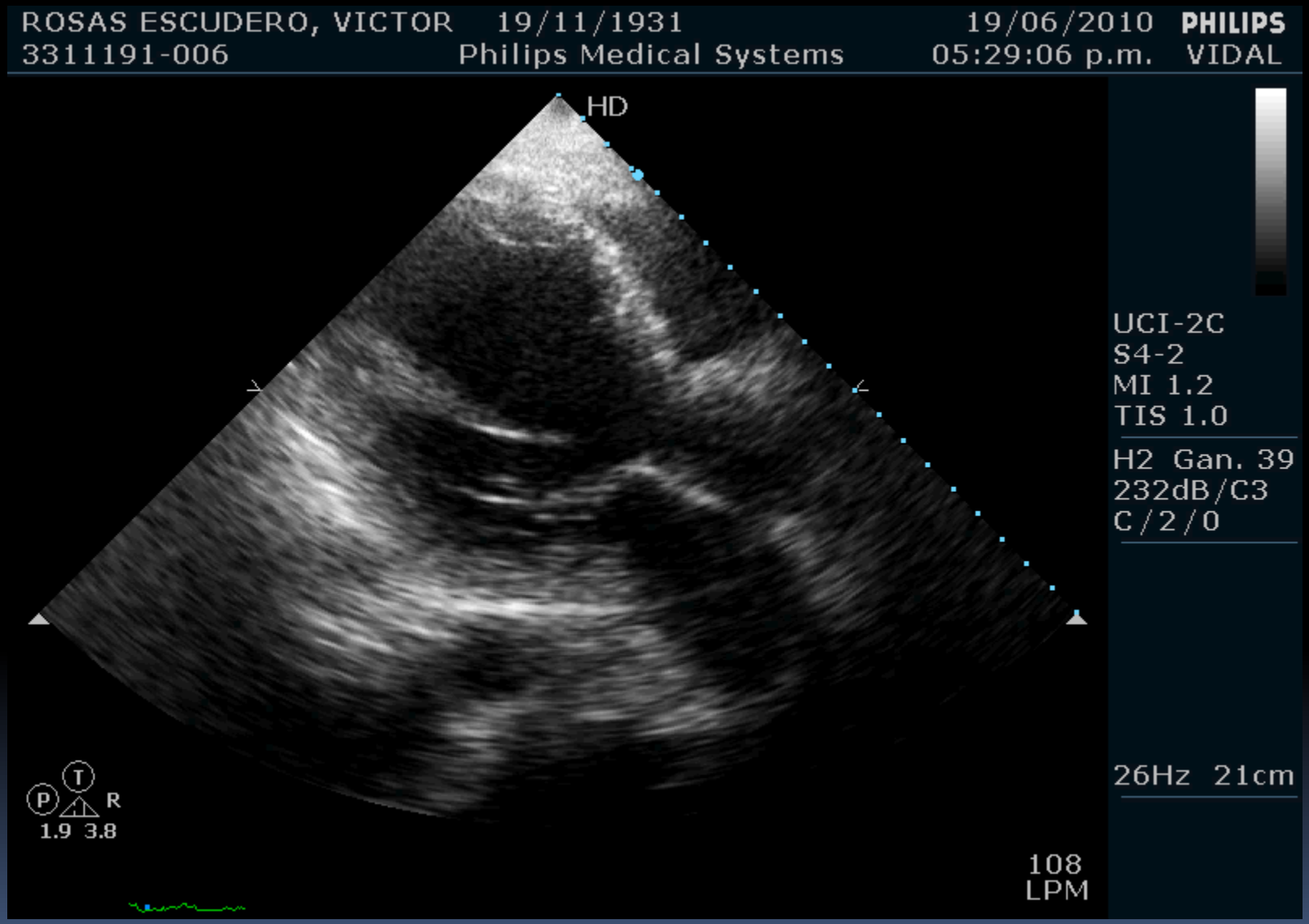

MAQUINA LAZARTE, TEOFILO
09-09-02-152726
Philips Medical Systems
02/09/2009
04:00:18 p.m.
PHILIPS
VIDAL
HD
C/ DOBUT = 6.68 ug/k/mint
UCI-2C
S4-2
MI 1.3
TIS 1.0
H2 Gan. 64
232dB/C5
K/2/0
30Hz 18cm
P
T
R
1.9 3.8
64
LPM

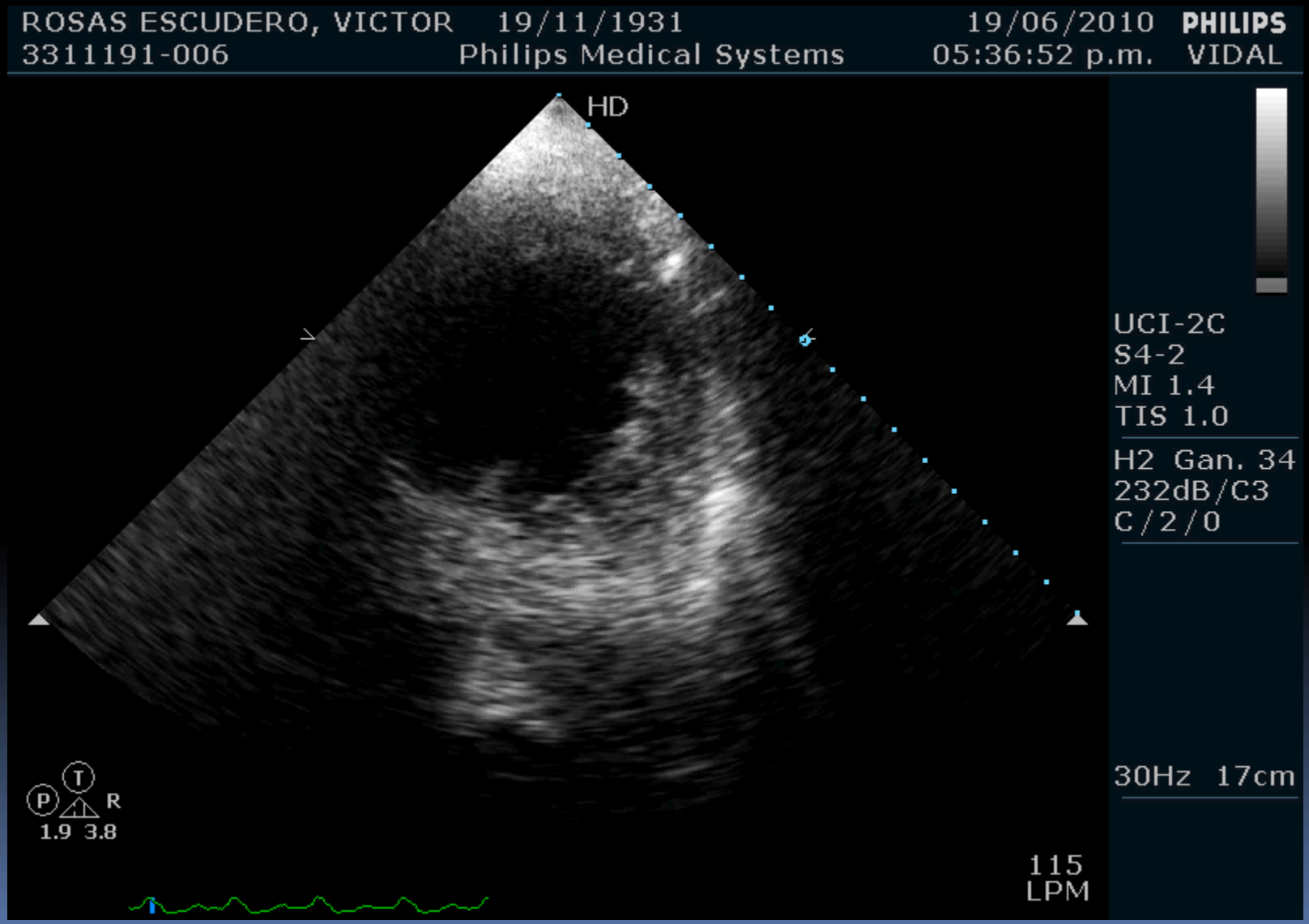

MAQUINA LAZARTE, TEOFILO
09-09-02-152726
Philips Medical Systems
02/09/2009
04:01:45 p.m.
PHILIPS
VIDAL
HD
C/ DOBUT = 6.68 ug/k/mint
UCI-2C
S4-2
MI 1.5
TIS 1.0
H2 Gan. 64
232dB/C5
K/2/0
30Hz 16cm
P
T
R
1.9 3.8
63
LPM


MAQUINA LAZARTE, TEOFILO
09-09-02-152726
Philips Medical Systems
02/09/2009
04:02:29 p.m.
PHILIPS
VIDAL
HD
C/ DOBUT = 6.68 ug/k/mint
UCI-2C
S4-2
MI 1.5
TIS 1.0
H2 Gan. 64
232dB/C5
K/2/0
30Hz 16cm
P
T
R
1.9 3.8
64
LPM


MAQUINA LAZARTE, TEOFILO
09-09-02-152726
Philips Medical Systems
02/09/2009
03:45:11 p.m.
PHILIPS
VIDAL
HD
UCI-2C
S4-2
MI 1.6
TIS 0.8
H2 Gan. 76
232dB/C5
K/2/0
30Hz 14cm
FE(MDD-bp) 0.351
+ VTD(MDD-ps2) 118 cm3
LVItd apical 8.55 cm
AVItd apical 34.7 cm2
AVItd ap2 34.7 cm2
× VTS(MDD-ps2) 75.1 cm3
AVIts apical 27.9 cm2
LVIts apical 8.46 cm
AVIts ap2 27.9 cm2
T
P
R
1.9 3.8


ROSAS ESCUDERO, VICTOR 19/11/1931 19/06/2010 PHILIPS
3311191-006 Philips Medical Systems 05:45:28 p.m. VIDAL
HD
UCI-2C
S4-2
MI 1.2
TIS 1.0
H2 Gan. 34
232dB/C3
C/2/0
23Hz 24cm
P T R
1.9 3.8
91
LPM


ROSAS ESCUDERO, VICTOR 19/11/1931 19/06/2010 PHILIPS
3311191-006 Philips Medical Systems 05:29:06 p.m. VIDAL
HD
UCI-2C
S4-2
MI 1.2
TIS 1.0
H2 Gan. 39
232dB/C3
C/2/0
26Hz 21cm
P T R
1.9 3.8
108
LPM


ROSAS ESCUDERO, VICTOR 19/11/1931 19/06/2010 PHILIPS
3311191-006 Philips Medical Systems 05:36:52 p.m. VIDAL
HD
UCI-2C
S4-2
MI 1.4
TIS 1.0
H2 Gan. 34
232dB/C3
C/2/0
30Hz 17cm
T
P
R
1.9 3.8
115
LPM

MUCHAS GRACIAS