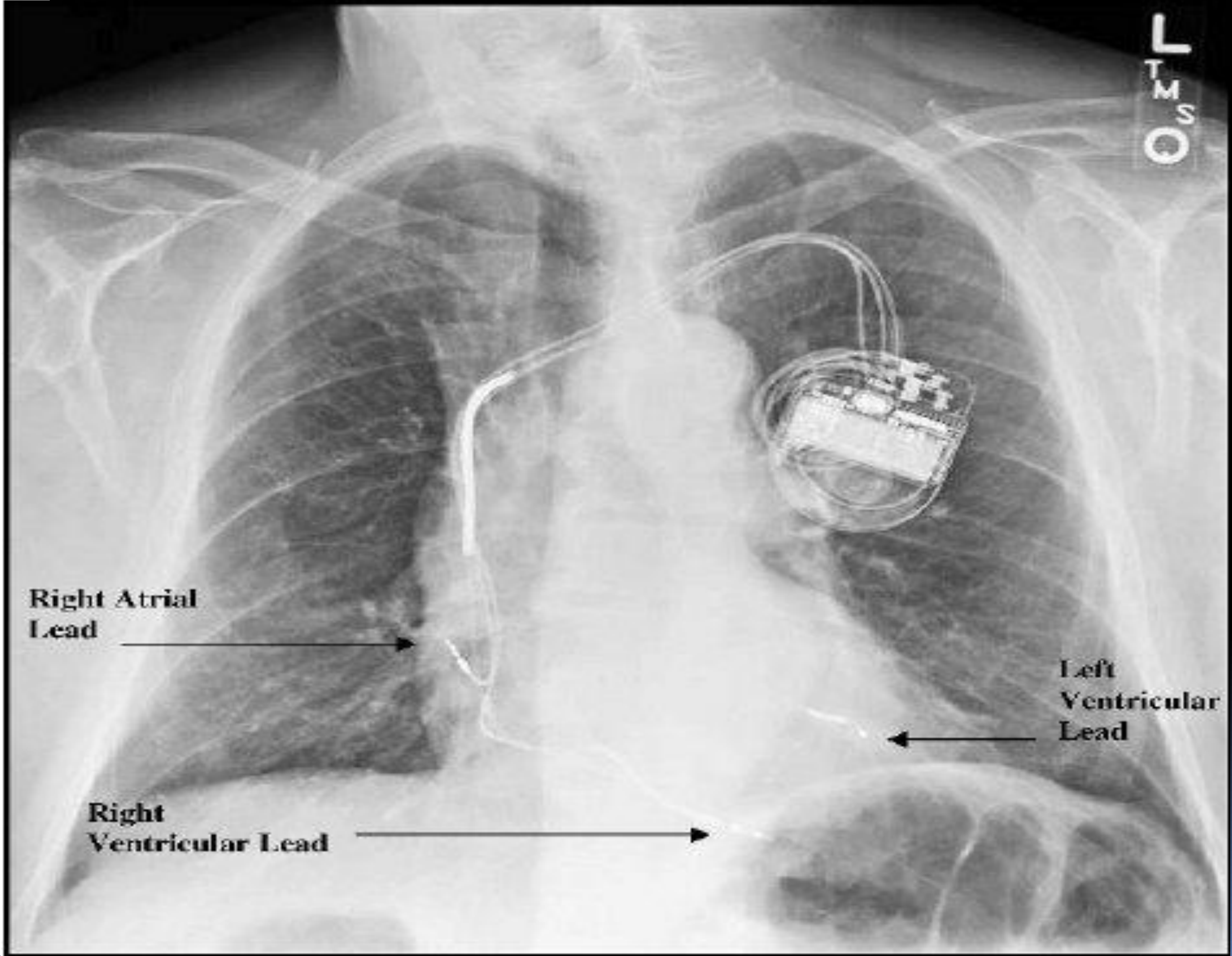
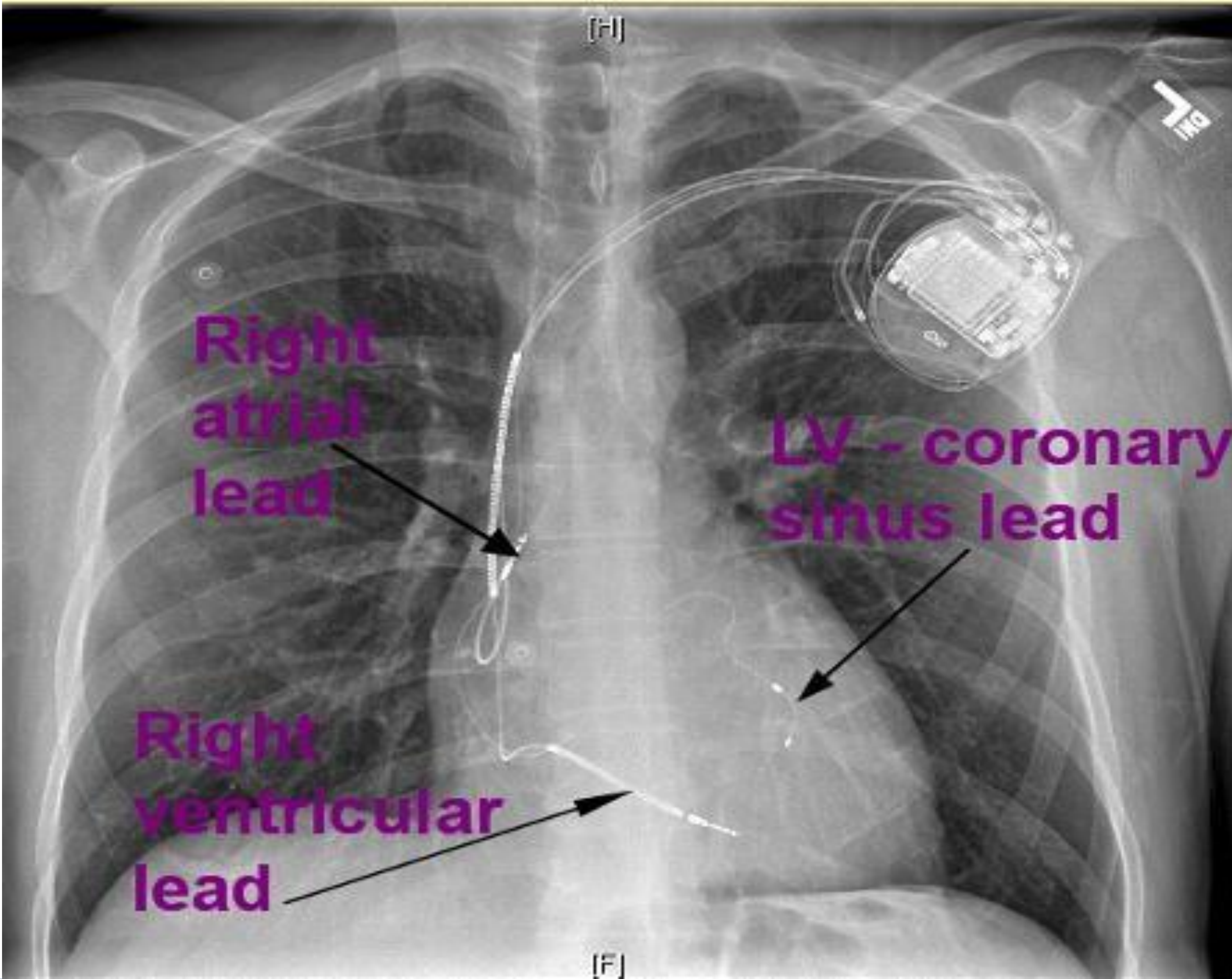
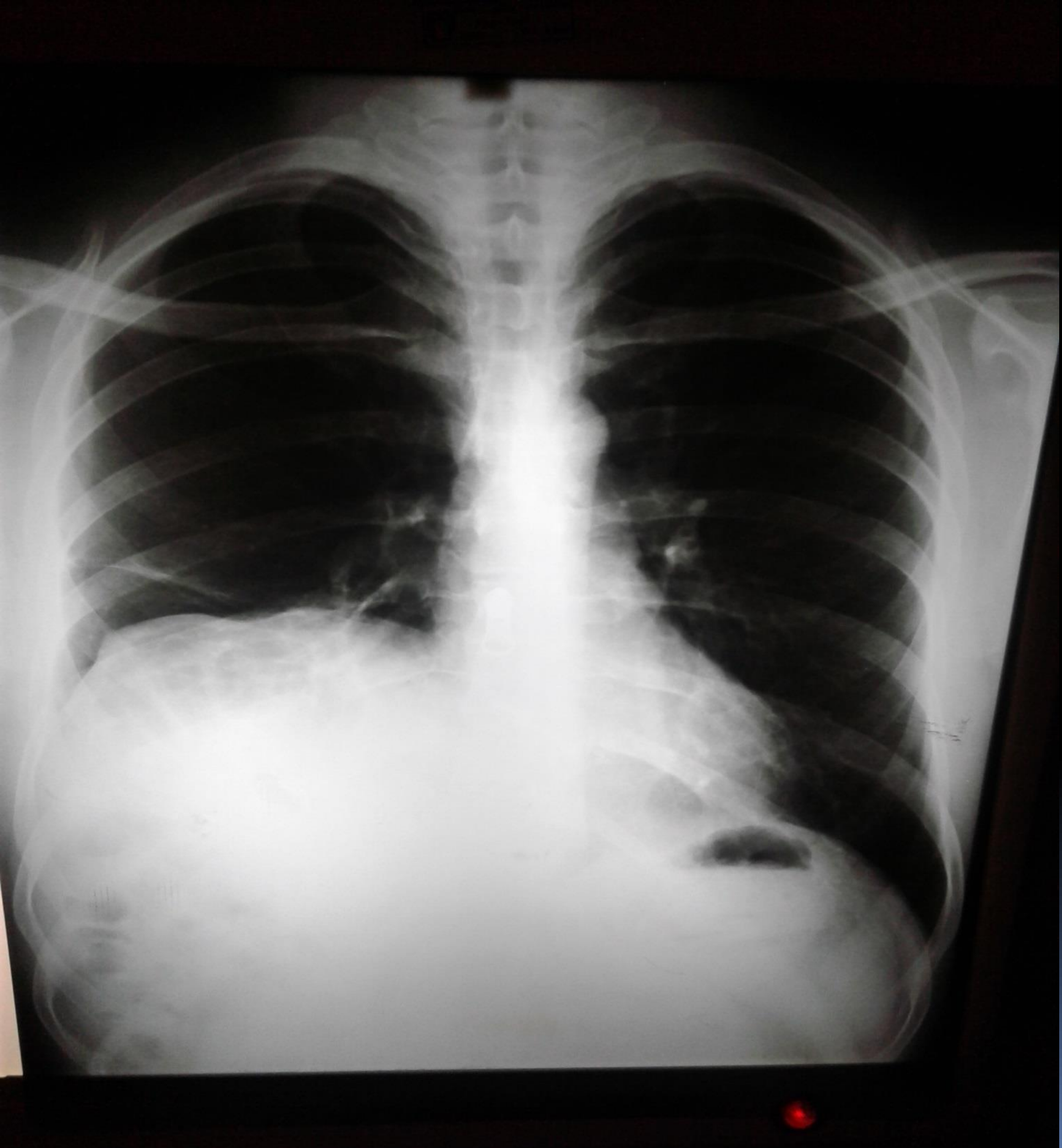
Dr.Azimivaghar

DYSSYNCHRONIA

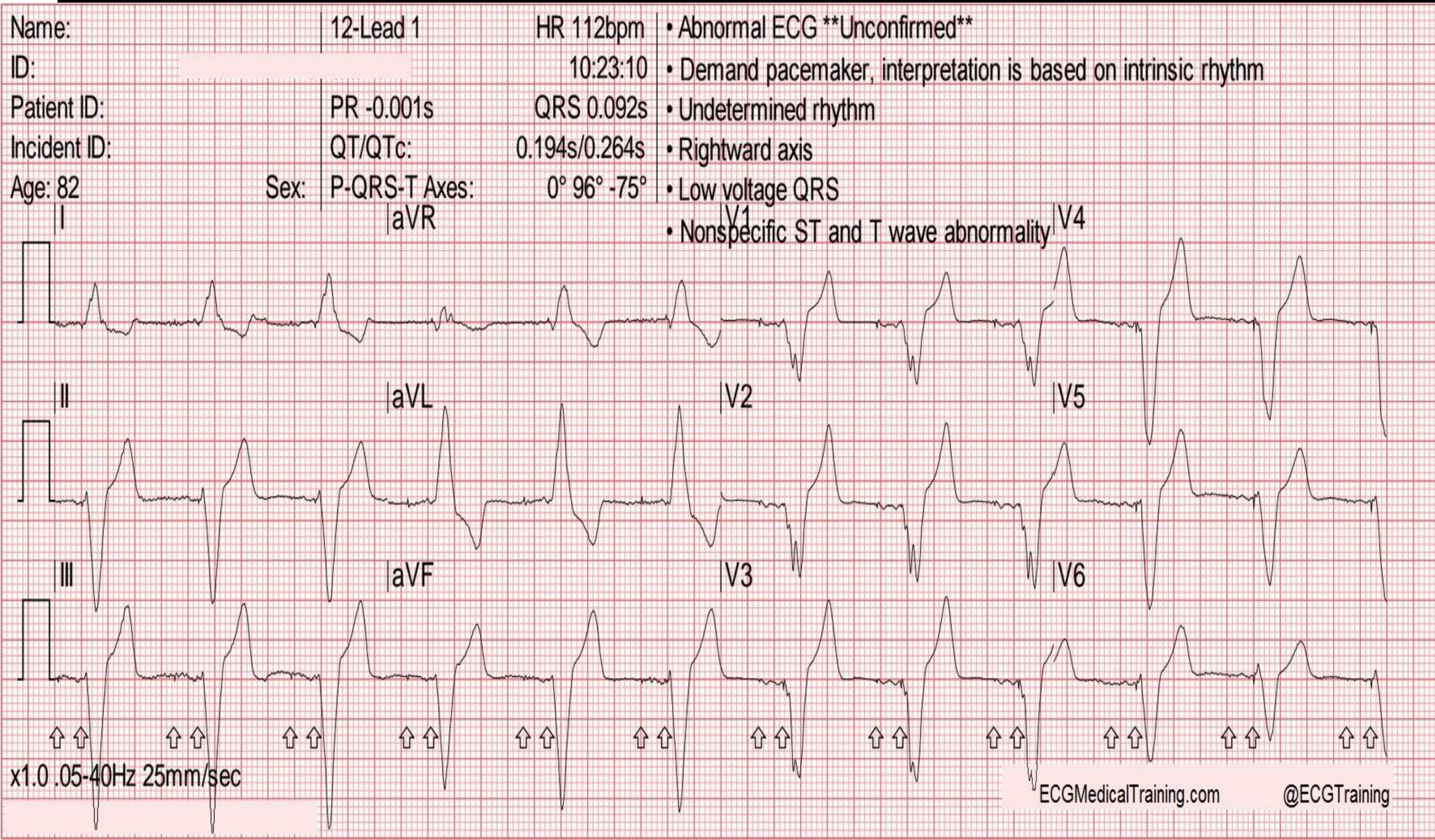


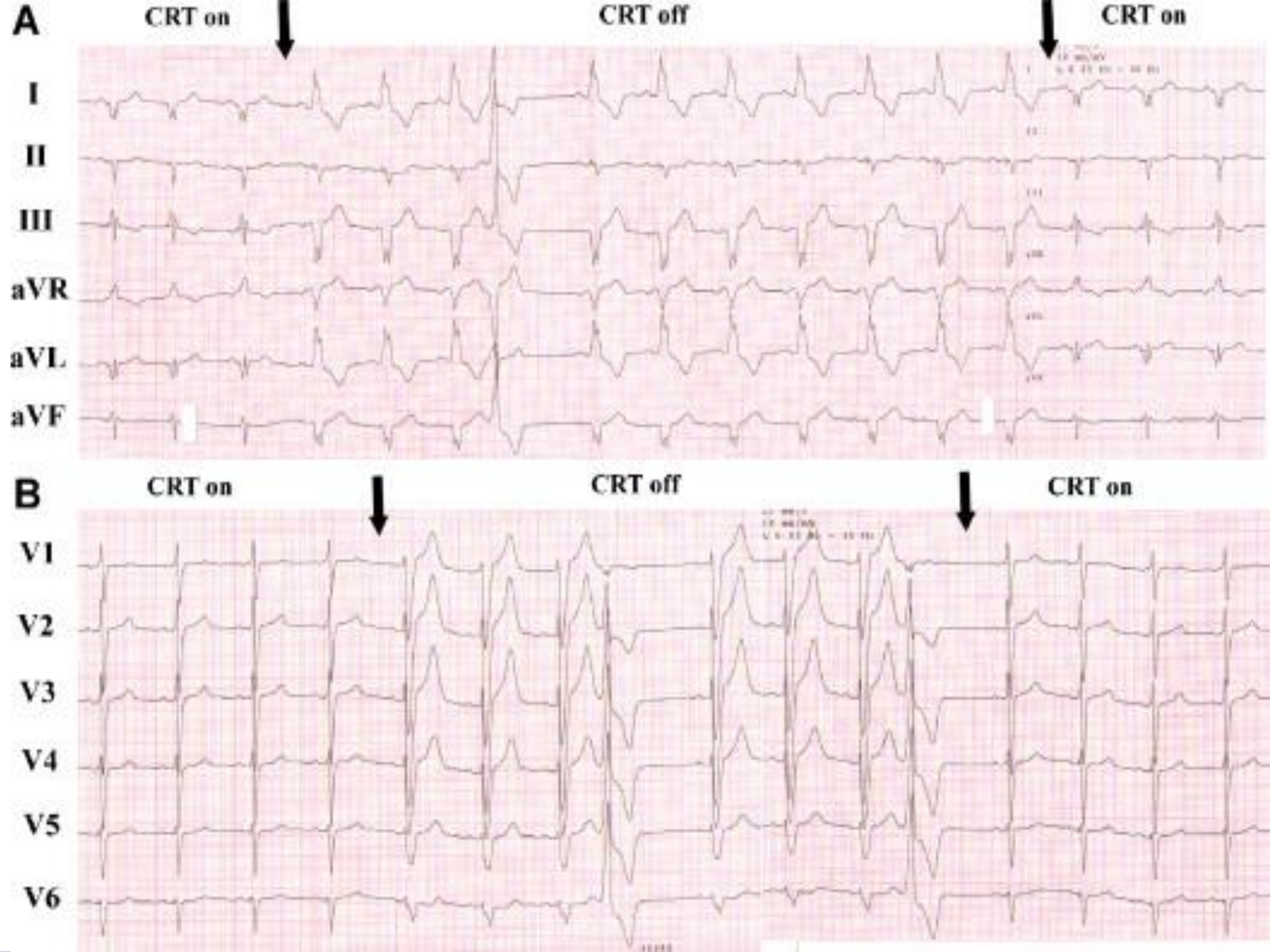
L
TMS
Right Atrial
Lead
Left
Ventricular
Lead
Right
Ventricular Lead


[H]
Right
atrial
lead
LV - coronary
sinus lead
Right
ventricular
lead
[F]

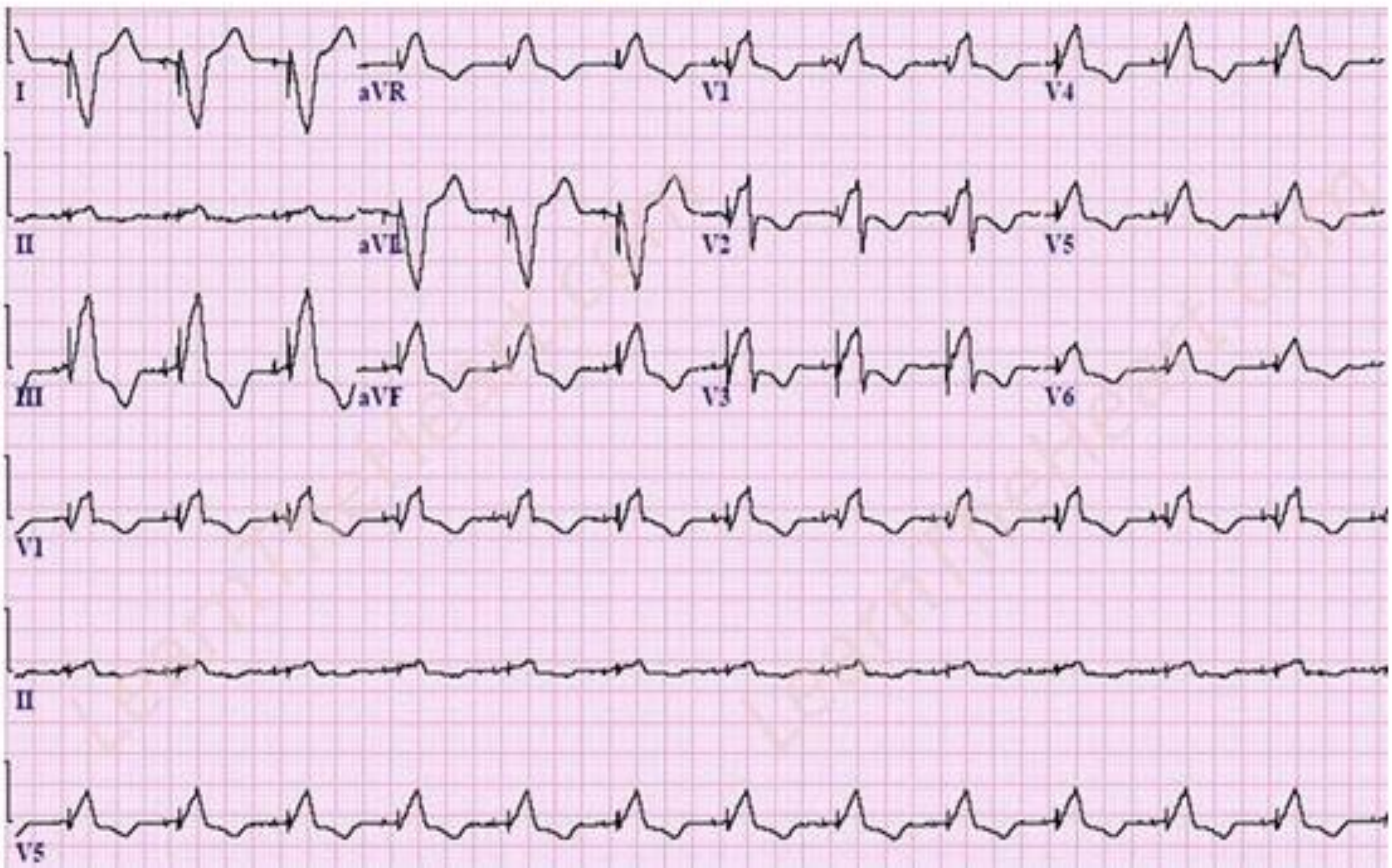


DDD


Name:
12-Lead 1
HR 112bpm
• Abnormal ECG **Unconfirmed**
ID:
10:23:10
• Demand pacemaker, interpretation is based on intrinsic rhythm
Patient ID:
PR -0.001s
QRS 0.092s
• Undetermined rhythm
Incident ID:
QT/QTc:
0.194s/0.264s
• Rightward axis
Age: 82
Sex:
P-QRS-T Axes:
0° 96° -75°
• Low voltage QRS
• Nonspecific ST and T wave abnormality
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
x1.0 .05-40Hz 25mm/sec
ECGMedicalTraining.com
@ECGTraining


A
CRT on
CRT off
CRT on
I
II
III
aVR
aVL
aVF
B
CRT on
CRT off
CRT on
V1
V2
V3
V4
V5
V6

Biventricular Pacemaker ECG



CRT

CRT

improve :

heart failure FC

exercise capacity

quality of life

reducing hospitalizations

prolonging survival

reductions in (MR)

improvements in LV function

TABLE 27G.1 ACCF/AHA Guidelines for Cardiac Resynchronization Therapy (CRT)		
CLASS	INDICATION	LE
I	CRT is indicated for patients who have LVEF of 35% or less, sinus rhythm, LBBB with QRS duration of 150 msec or greater, and NYHA Class II, III, or ambulatory IV symptoms on GDMT.	A B
IIa	[illegible]	[illegible]
IIb	[illegible]	[illegible]
III: no benefit	[illegible]	[illegible]

TABLE 27G.1 ACCF/AHA Guidelines for Cardiac Resynchronization Therapy (CRT)

CLASS	INDICATION	L
I	[illegible]	A B
IIa	CRT can be useful for patients who have LVEF of 35% or less, sinus rhythm, non-LBBB pattern with QRS duration of 150 msec or greater, and NYHA Class III/ambulatory Class IV symptoms on GDMT.	A
	[illegible]	B B C
IIb	[illegible]	B B C
III: no benefit	[illegible]	

TABLE 27G.1 ACCF/AHA Guidelines for Cardiac Resynchronization Therapy (CRT)

CLASS	INDICATION	LE
I	[illegible]	A B
IIa	[illegible]	A
	CRT can be useful for patients who have LVEF of 35% or less, sinus rhythm, LBBB with QRS duration of 120 to 149 msec, and NYHA Class II, III or ambulatory IV symptoms on GDMT.	B
	[illegible]	B
	[illegible]	C
IIb	[illegible]	B
	[illegible]	B
	[illegible]	C
III: no benefit	[illegible]	

TABLE 27G.1 ACCF/AHA Guidelines for Cardiac Resynchronization Therapy (CRT)

CLASS	INDICATION	LE
I	[illegible]	A
	[illegible]	B
IIa	[illegible]	A
	[illegible]	B
	CRT can be useful in patients with atrial fibrillation and LVEF of 35% or less on GDMT if (a) the patient requires ventricular pacing or otherwise meets CRT criteria and (b) atrioventricular nodal ablation or pharmacologic rate control will allow near-100% ventricular pacing with CRT.	B
	[illegible]	C
IIb	[illegible]	B
	[illegible]	B
	[illegible]	C
III: no benefit	[illegible]	

TABLE 27G.1 ACCF/AHA Guidelines for Cardiac Resynchronization Therapy (CRT)

CLASS	INDICATION	LE
I	[illegible]	A B
IIa	[illegible]	A
	[illegible]	B
	[illegible]	B
	CRT can be useful for patients on GDMT who have LVEF of 35% or less and are undergoing placement of new or replacement device with anticipated requirement for significant (>40%) ventricular pacing.	C
IIb	[illegible]	B
	[illegible]	B
	[illegible]	C
III: no benefit	[illegible]	

Indications for CRT in patients in sinus rhythm

Recommendations	Class	Level
1) LBBB with QRS duration >150 ms is recommended in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, and ambulatory IV despite adequate medical treatment. (*)	I	A
2) LBBB with QRS duration 120-150 ms should be considered in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, and ambulatory IV despite adequate medical treatment. (*)	I	B
3) Non-LBBB with QRS duration >150 ms should be considered in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, and ambulatory IV despite adequate medical treatment. (*)	IIa	B
4) Non-LBBB with QRS duration 120-150 ms may be considered in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, and ambulatory IV despite adequate medical treatment. (*)	IIb	B
5) QRS duration <120 ms CRT in patients with chronic HF with QRS duration <120 ms is not recommended.	III	B

* Patients should generally not be implanted during admission for acute decompensated HF. In such patients, guideline-indicated medical treatment should be optimized and the patient reviewed as an out-patient after stabilization. It is recognized that this may not always be possible.

TABLE 27G.1 ACCF/AHA Guidelines for Cardiac Resynchronization Therapy (CRT)

CLASS	INDICATION	LE
I	CRT is indicated for patients who have LVEF of 35% or less, sinus rhythm, LBBB with QRS duration of 150 msec or greater, and NYHA Class II, III, or ambulatory IV symptoms on GDMT.	A f B f
IIa	CRT can be useful for patients who have LVEF of 35% or less, sinus rhythm, non-LBBB pattern with QRS duration of 150 msec or greater, and NYHA Class III/ambulatory Class IV symptoms on GDMT.	A
	CRT can be useful for patients who have LVEF of 35% or less, sinus rhythm, LBBB with QRS duration of 120 to 149 msec, and NYHA Class II, III or ambulatory IV symptoms on GDMT.	B
	CRT can be useful in patients with atrial fibrillation and LVEF of 35% or less on GDMT if (a) the patient requires ventricular pacing or otherwise meets CRT criteria and (b) atrioventricular nodal ablation or pharmacologic rate control will allow near-100% ventricular pacing with CRT.	B
	CRT can be useful for patients on GDMT who have LVEF of 35% or less and are undergoing placement of new or replacement device with anticipated requirement for significant (>40%) ventricular pacing.	C
IIb	CRT may be considered for patients who have LVEF of 35% or less, sinus rhythm, non-LBBB pattern with QRS duration of 120 to 149 msec, and NYHA Class III/ambulatory Class IV on GDMT.	B
	CRT may be considered for patients who have LVEF of 35% or less, sinus rhythm, non-LBBB pattern with QRS duration of 150 msec or greater, and NYHA Class II symptoms on GDMT.	B
	CRT may be considered for patients who have LVEF of 30% or less, ischemic etiology of HF, sinus rhythm, LBBB with QRS duration of 150 msec or greater, and NYHA Class I symptoms on GDMT.	C
III: no benefit	CRT is not recommended for patients with NYHA Class I or II symptoms and non-LBBB pattern with QRS duration less than 150 msec.	
	CRT is not indicated for patients whose comorbidities and/or frailty limit survival with good functional capacity to less than 1 year.	

OUTCOME

- approximately 25% to 35% of patients undergoing CRT do not respond favorably

CRT

ECHO for CRT

- Case selection
- optimized device settings

Echo for CRT

- No ideal approach has yet been found.

CRT

- ECG:widened QRS is a suboptimal marker for dyssynchrony

dyssynchrony

- Mechanical dyssynchrony ⟷ WIDE QRS
- But not always
- Some patients with heart failure and depressed LV function and narrow QRS
- Some wide QRS but no mechanical dyssynchrony

DYSSYNCHRONIA

- A substantial minority of patients have little or no symptomatic improvement after CRT and some will deteriorate,

DYSSYNCHRONIA

- although this may reflect the natural history of the disease rather than the effect of CRT.

DYSSYNCHRONIA

- link between benefits to symptoms and prognosis may not be strong.

Echo : case selection

- Inter ventricular mechanical delay (aortic & pulmonic ejection time difference ≥49.2 ms was an **independent predictor of response to CRT.**

DYSSYNCHRONIA

- LV dyssynchrony (intraventricular) is associated with **improved outcomes** in patients treated with CRT.

DYSSYNCHRONIA

- (PROSPECT) trial :
- echo parameters of cardiac mechanical dyssynchrony showed a **modest** accuracy to predict response to CRT

ECHO FINDINGS

- LV mechanical dyssynchrony by echo is uncertain and should therefore not be used as a selection criterion for CRT.

DYSSYNCHRONIA

M-mode & COLOR CODED TDI M-mode

PULSED WAVE TDI

COLOR-CODED TDI

STRAIN BASED TDI

cardiac dyssynchrony

Atrioventricular

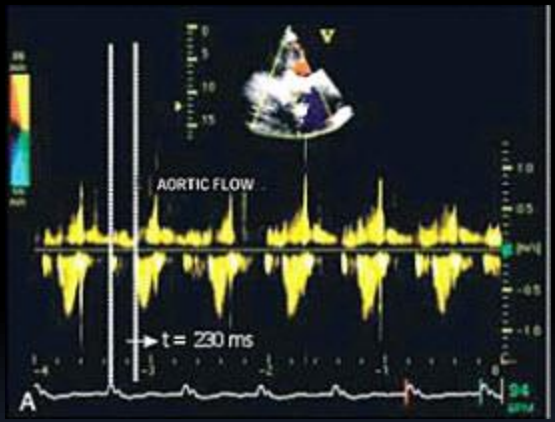
Intraventricular

Interventricular

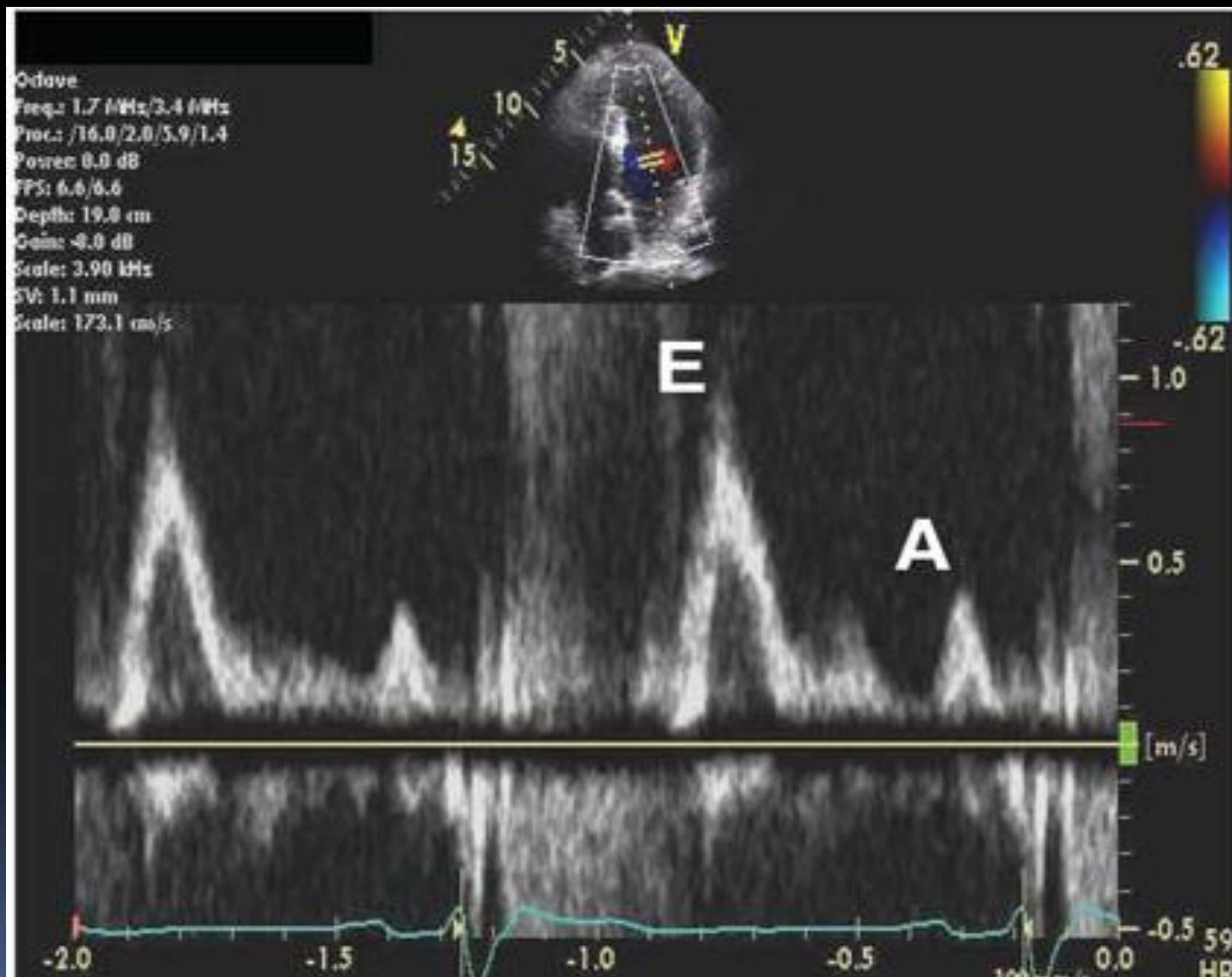
Atrioventricular dyssynchrony

- 1-PRE-EJECTION AORTIC TIME > 140ms
- 2-FILLING RATIO <40%

Atrioventricular dyssynchrony



Atrioventricular dyssynchrony



INTERVENTRICULAR dyssynchrony

Doppler view :

PRE-EJECTION AORTIC & PULMONIC>>>>>>> TIME DIFFERENCE > 40ms

APICAL 4.CH.VIEW :

RV FREE WALL & LATERAL WALL

DYSSYNCHRONIA by :

COLOR CODED/PULSED WAVE TDI

>>>>NO CONSENSUS CUT OFF POINT

INTERVENTRICULAR dyssynchrony

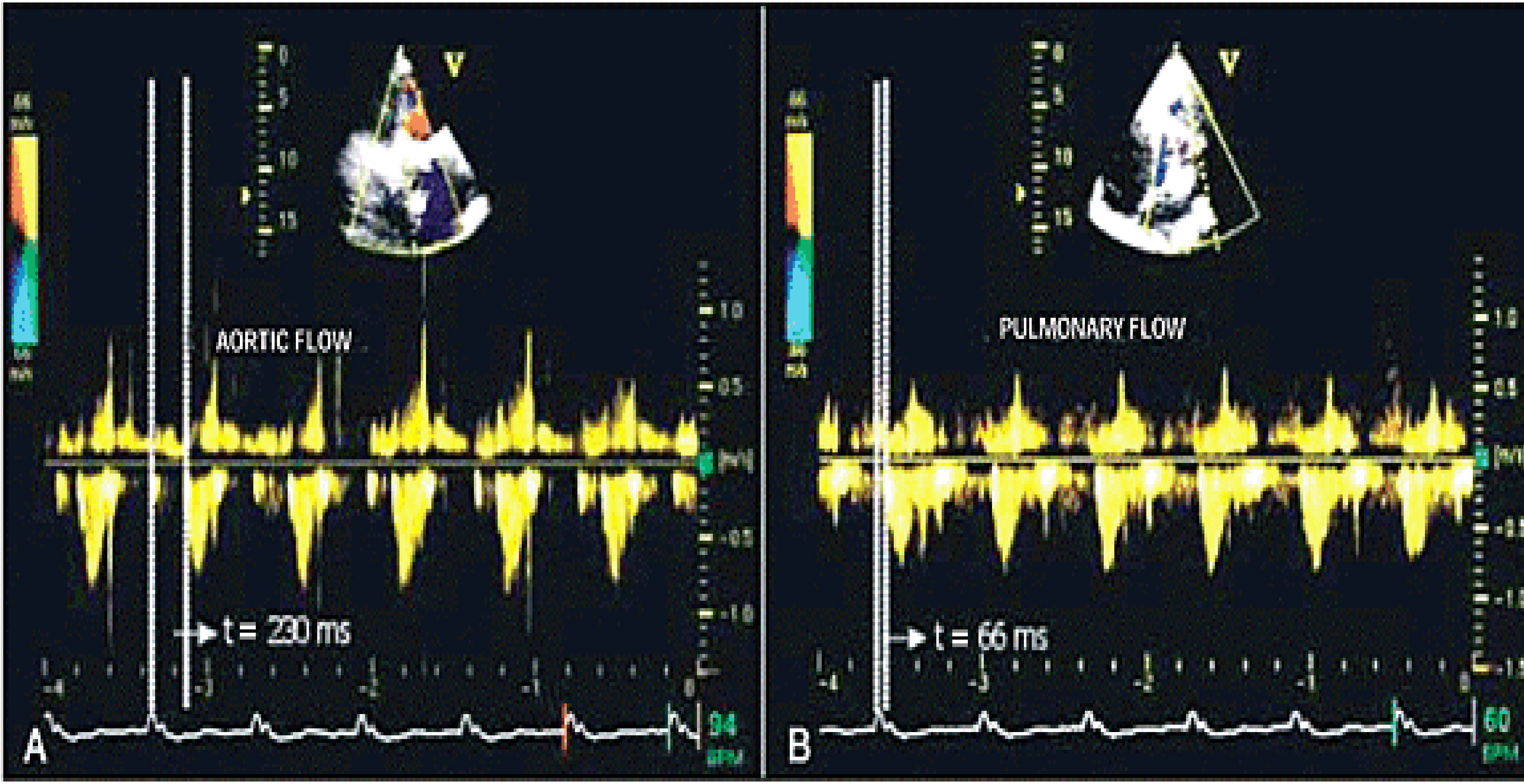
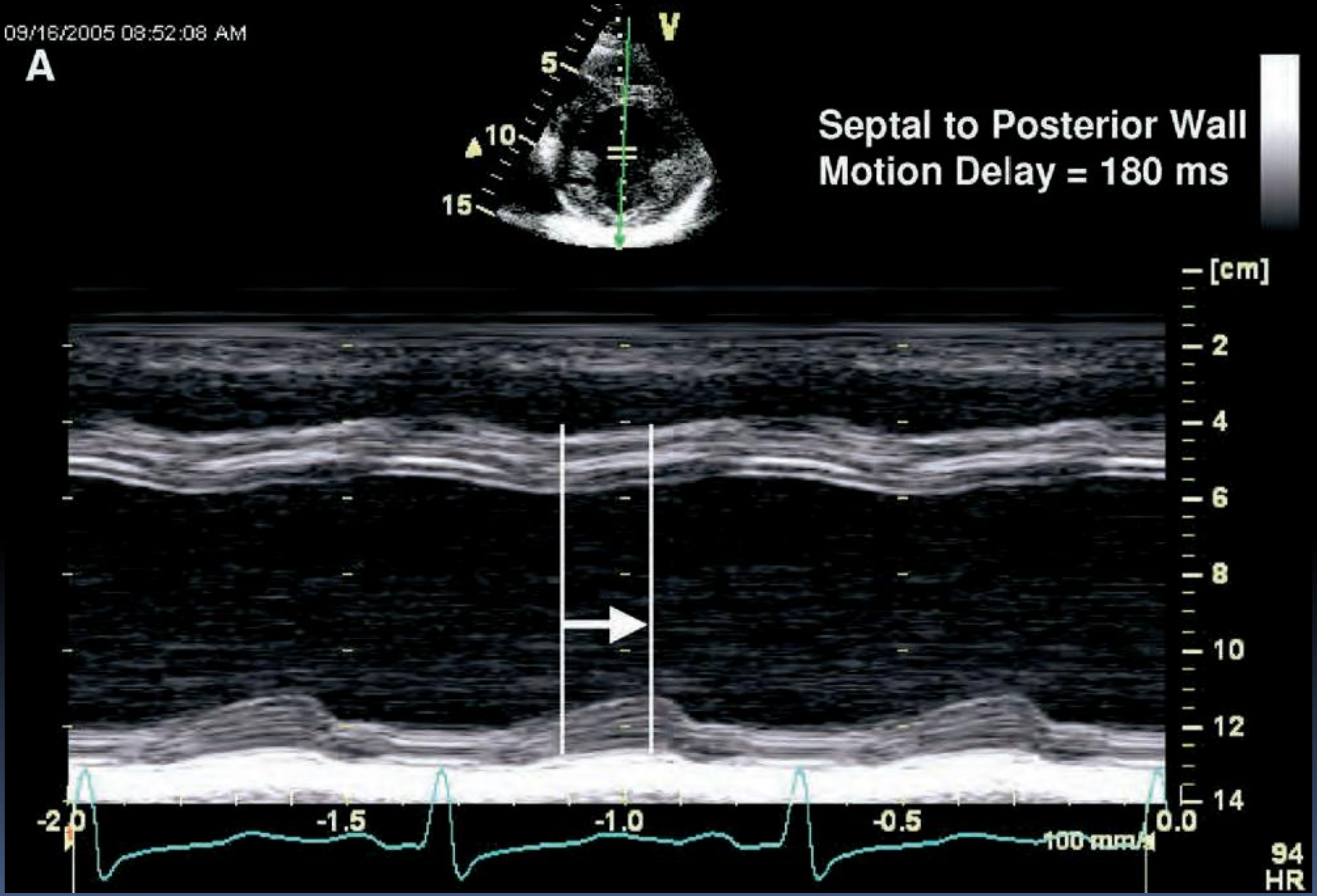


Fig. 1 - Mechanical interventricular delay measured in a patient with heart failure and left bundle-branch block. A) Time between QRS and aortic ejection of 230 ms. B) time between QRS and pulmonary ejection of 66 ms. The difference between those 2 measurements is the mechanical delay between the ventricles (164 ms, in this case).

Intraventricular dyssynchrony

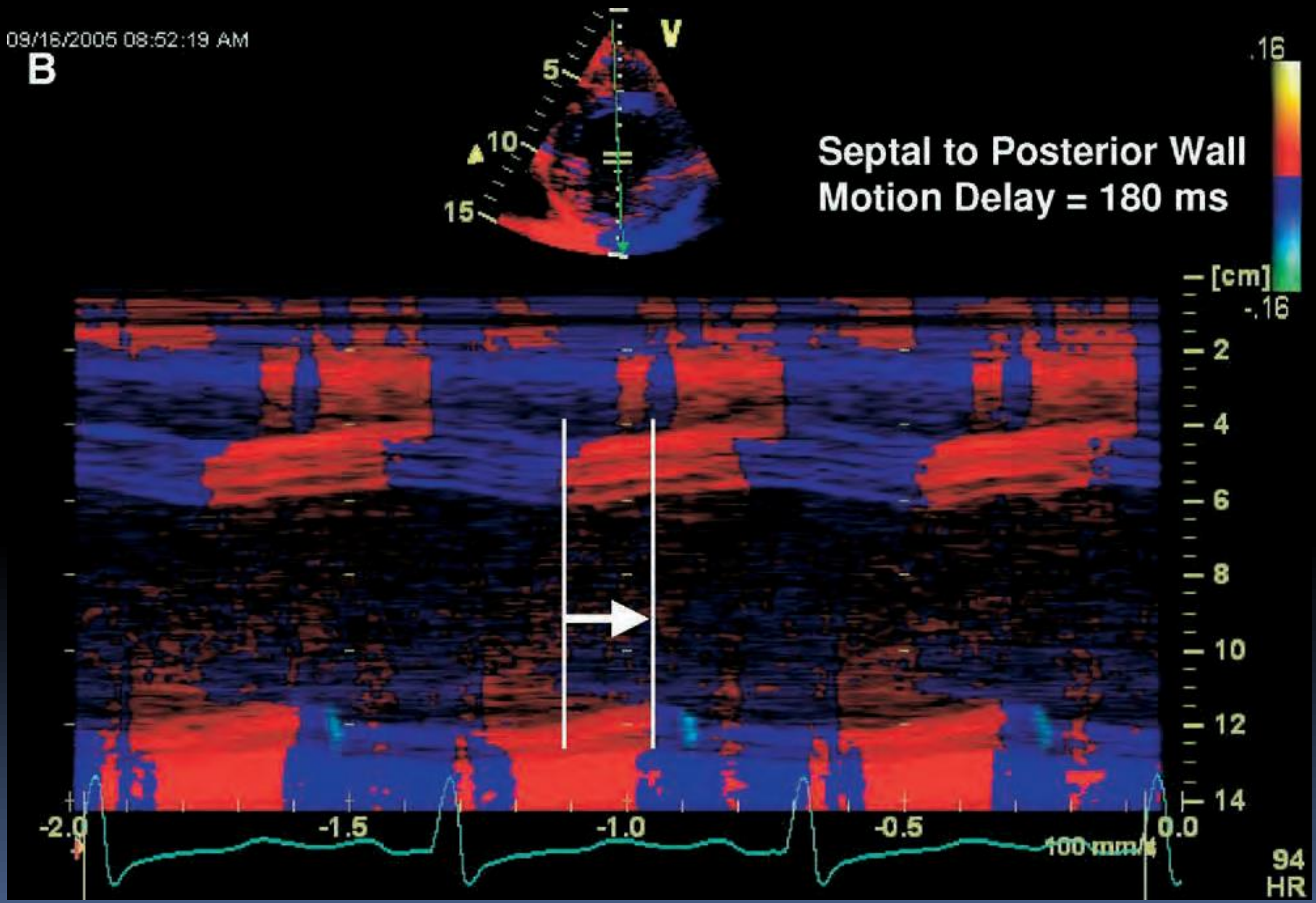
- M.MODE
- COLOR-CODED TDI
- PULSED waved TDI
- STRAIN STUDY

M.MODE



09/16/2005 08:52:08 AM
A
V
5
10
15
Septal to Posterior Wall
Motion Delay = 180 ms
[cm]
2
4
6
8
10
12
14
-2.0
-1.5
-1.0
-0.5
0.0
100 mm/s
94
HR

COLOR TD M-MODE



M.MODE

- Anteroseptal/posterior wall dyssynchrony : cut-off value of 130ms , with a sensitivity of 100 % and specificity of 63% to predict SUCCESSFULL CRT

M.MODE

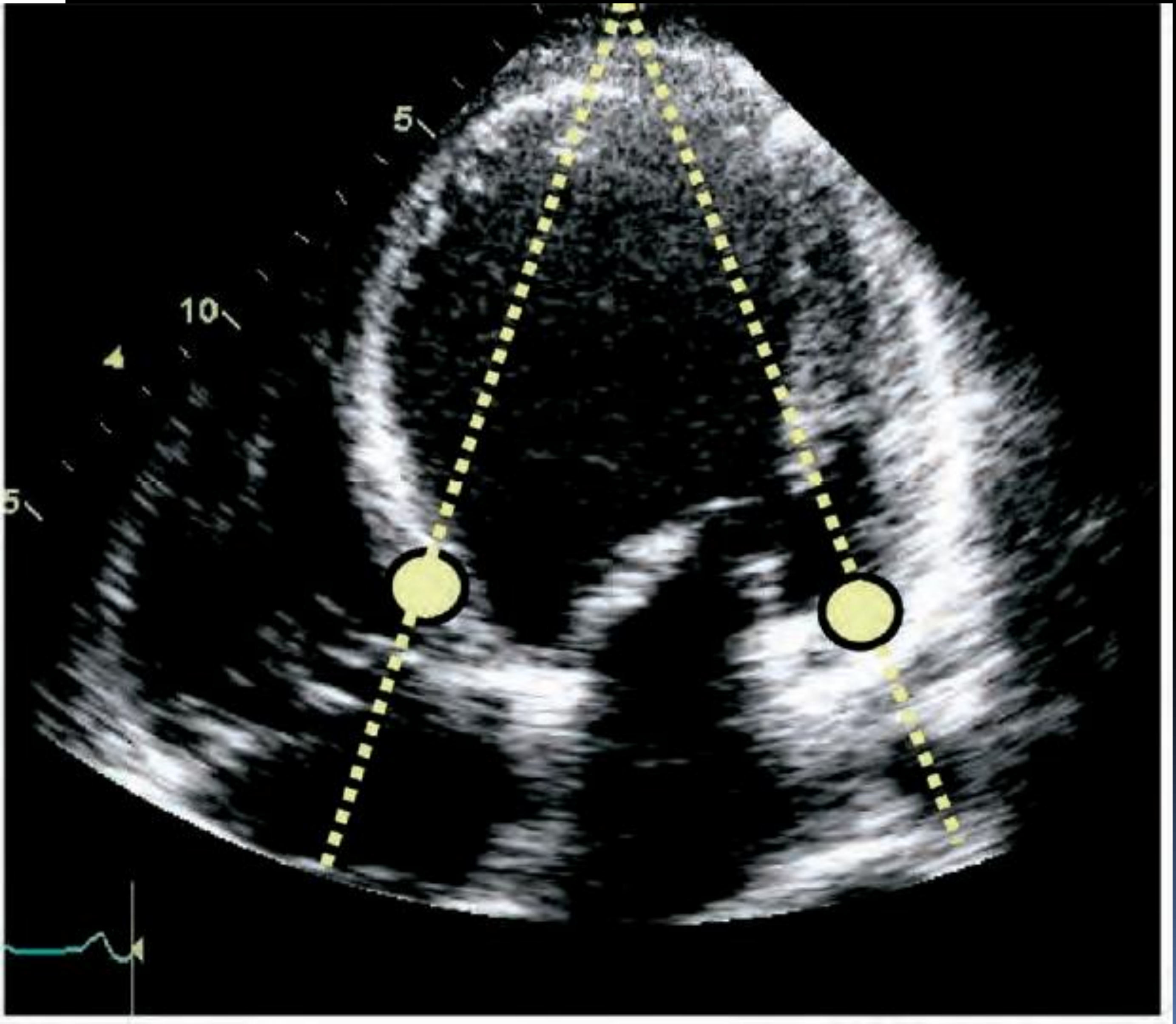
the utility of M-mode in patients with

ischemic cardiomyopathy has not been well demonstrated

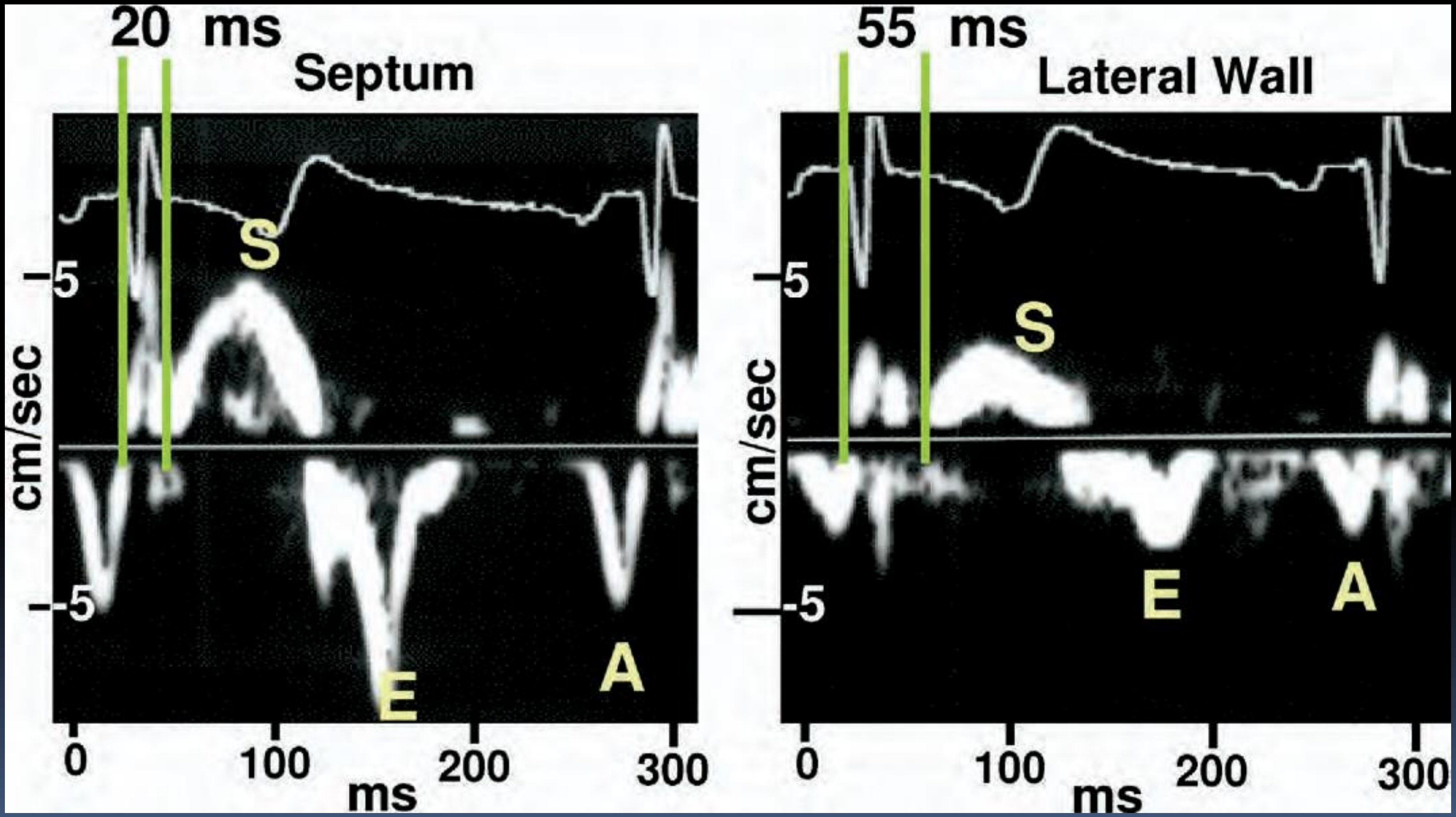
LONGITUDINAL TD VELOCITY

- PULSE WAVE TDI
- COLOR CODED TDI

PULSED TD



PULSED TD

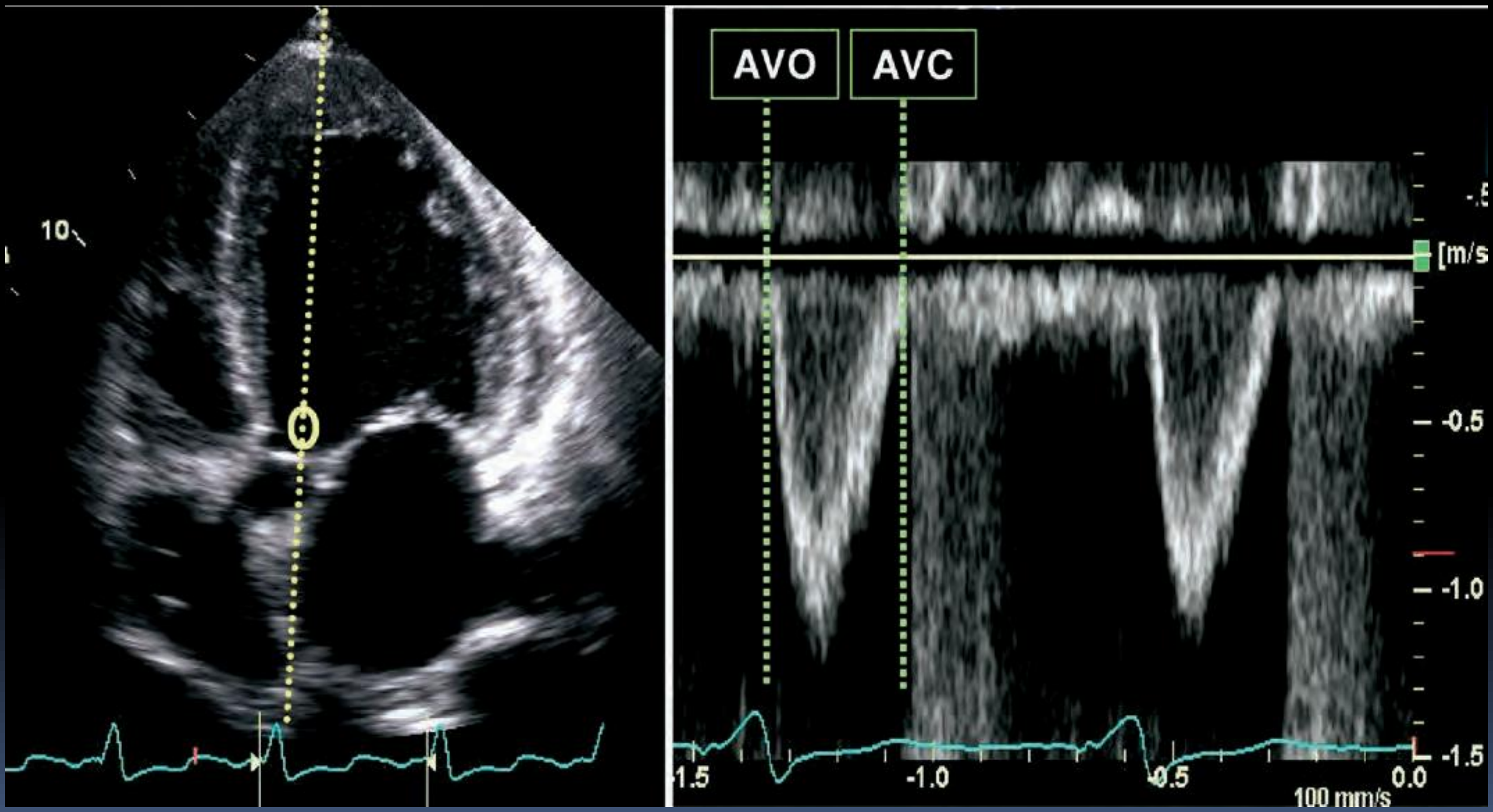


20 ms
Septum
S
E
A
-5
-5
cm/sec
0
100
200
300
ms
55 ms
Lateral Wall
S
E
A
-5
-5
cm/sec
0
100
200
300
ms

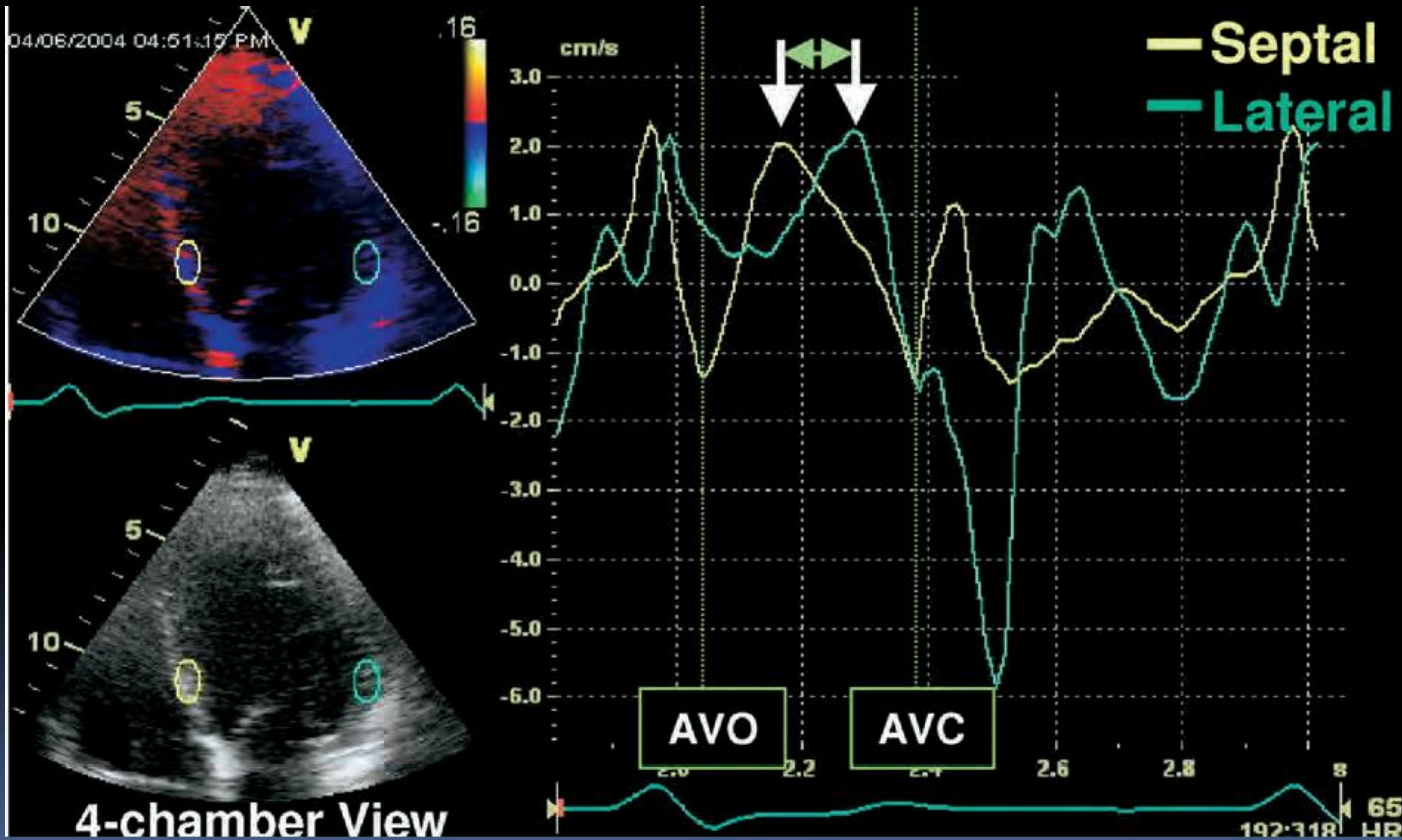
Color-coded TDI

- Color-coded TD data acquisition is simpler and more practical than pulsed TD and is the preferred method by consensus of this committee IF:
- high frame rates (usually 90 frames/s)
- Well image

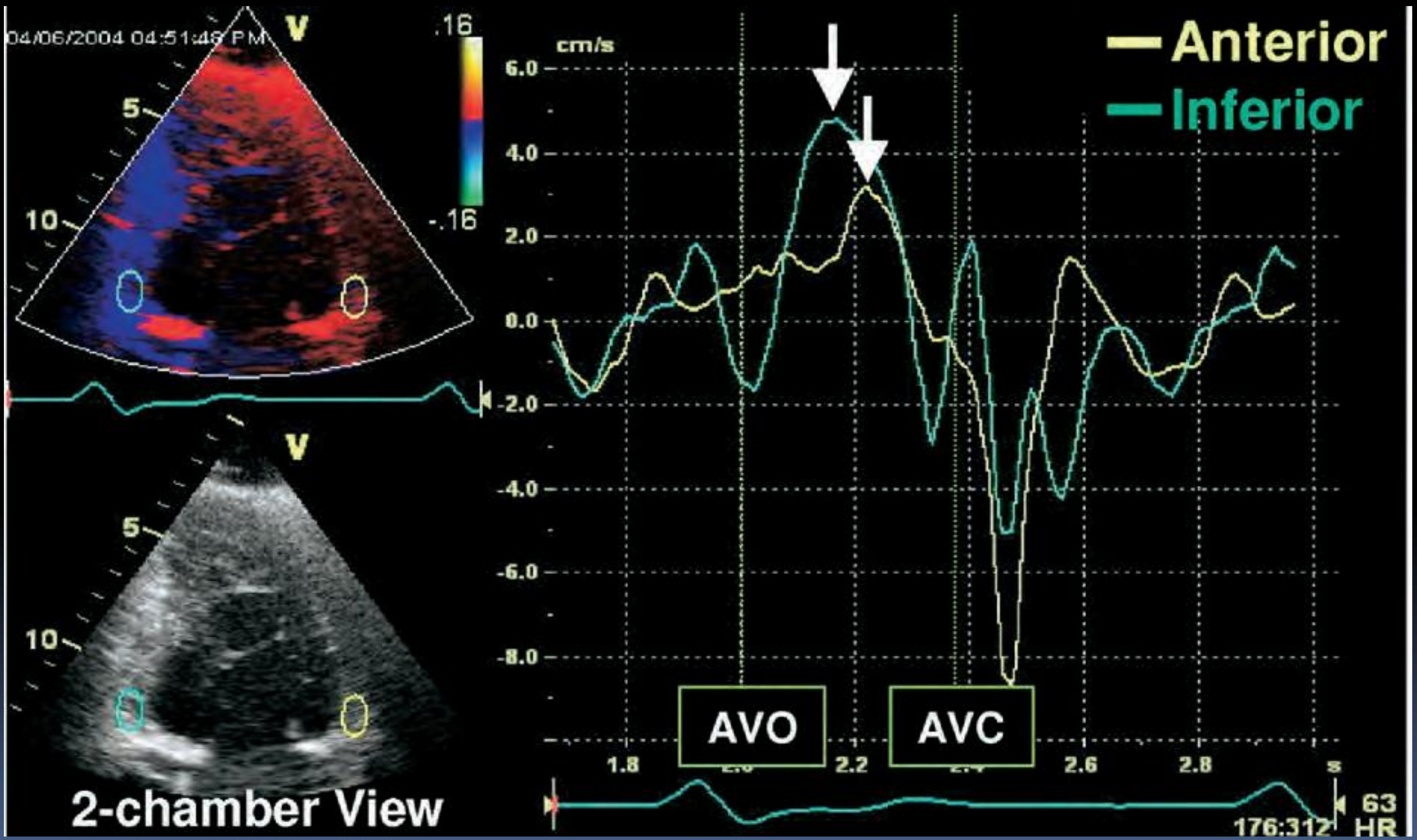
EVENT TIMING



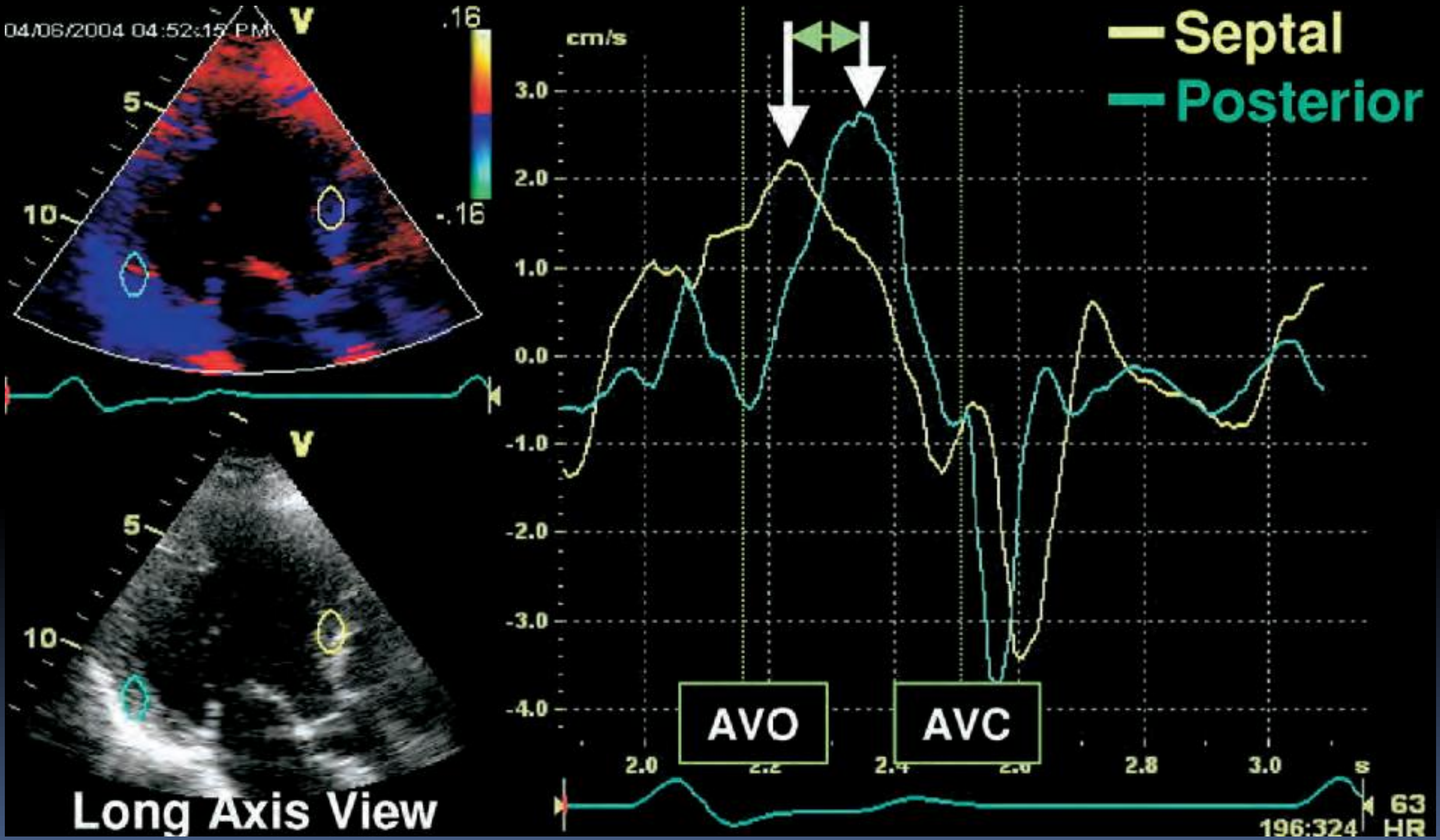
Color-coded TDI



Color-coded TDI



Color-coded TDI



Color-coded TDI

- The greatest sensitivity and specificity for predicting response to CRT be attained when analysis is limited to the interval from:
- AV opening to closure

Color-coded TDI

An BASAL opposing wall delay 65 ms

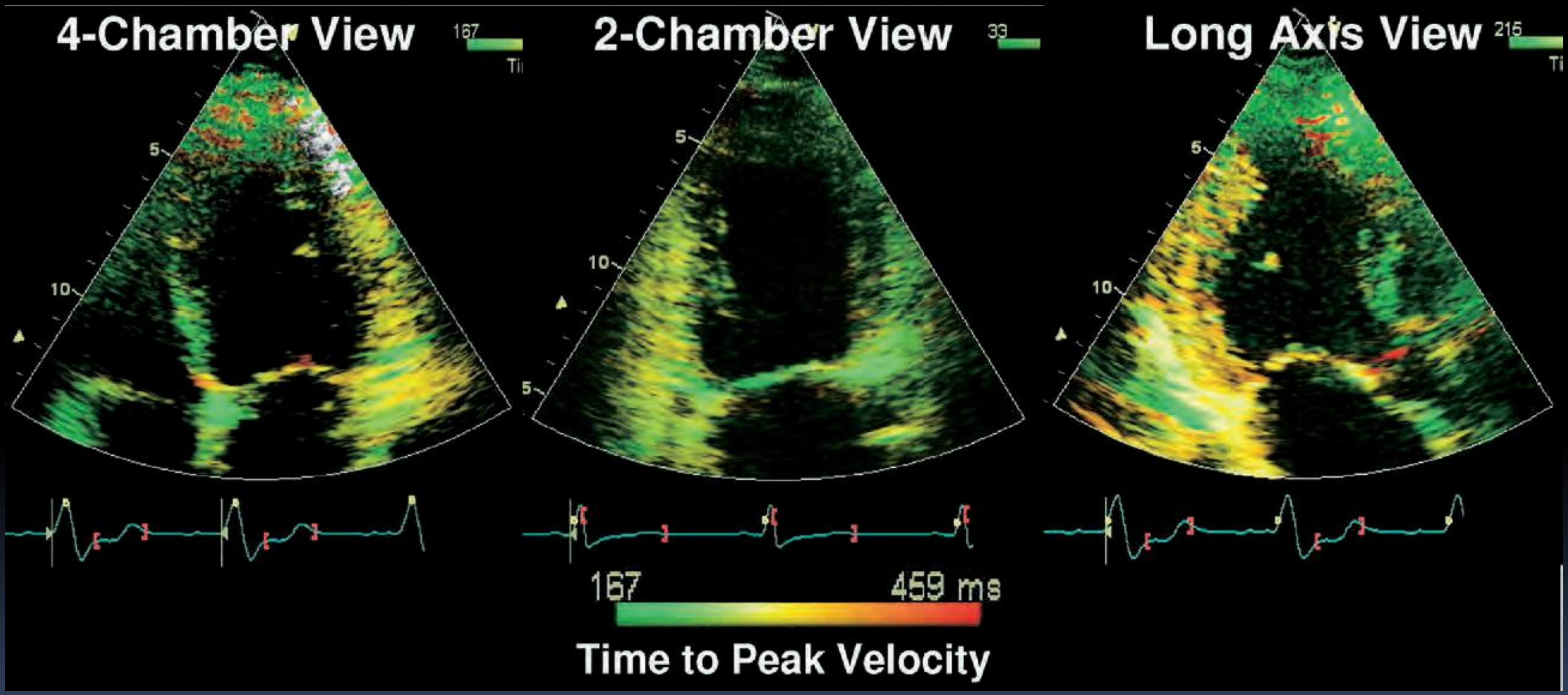
& ALL SEGMENTS wall delay 100 ms

& 12-site SD cut-off value of greater than or equal to 33 ms

The PROSPECT study reported :

12-site SD had a lower yield and higher variability than more simple approaches.

automated color coding of time-to-peak velocity data known as (TSI)



automated color coding of time-to-peak velocity data known as (TSI)

TSI :TISSUE SYNCHRONIZATION IMAGING

TIME between Q to peak S wave :

<150ms = Nl=GREEN myocardium

150-300ms = mild ABNl =YELLOW myocardium

>300ms = sig. ABNl = RED myocardium

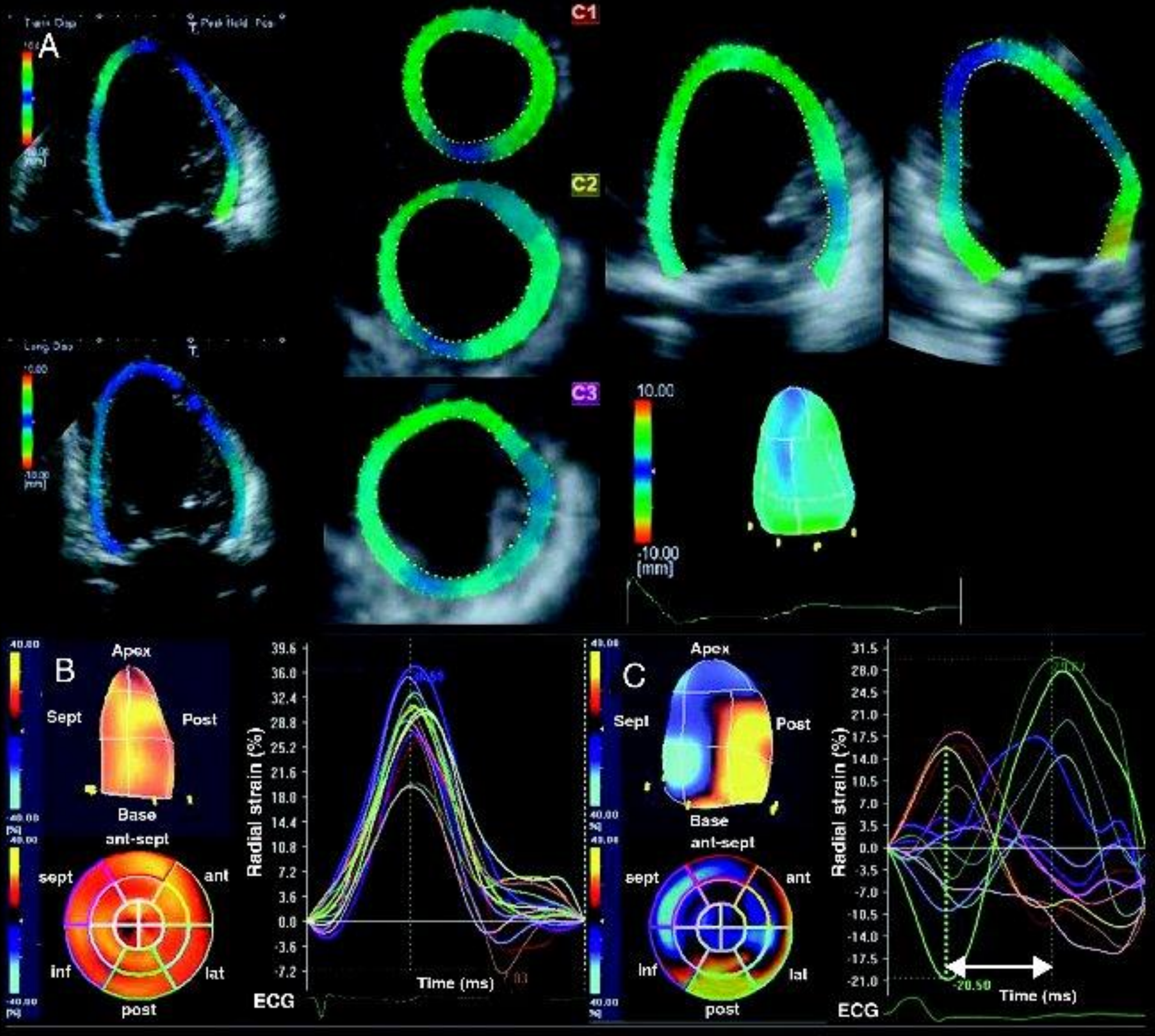
CAUTION IN APICAL SEGMENTS

all of the TSI parameters showed a slight , but consistently lower predictive value than data derived directly from the time-velocity curves

TISSUE TRACKING

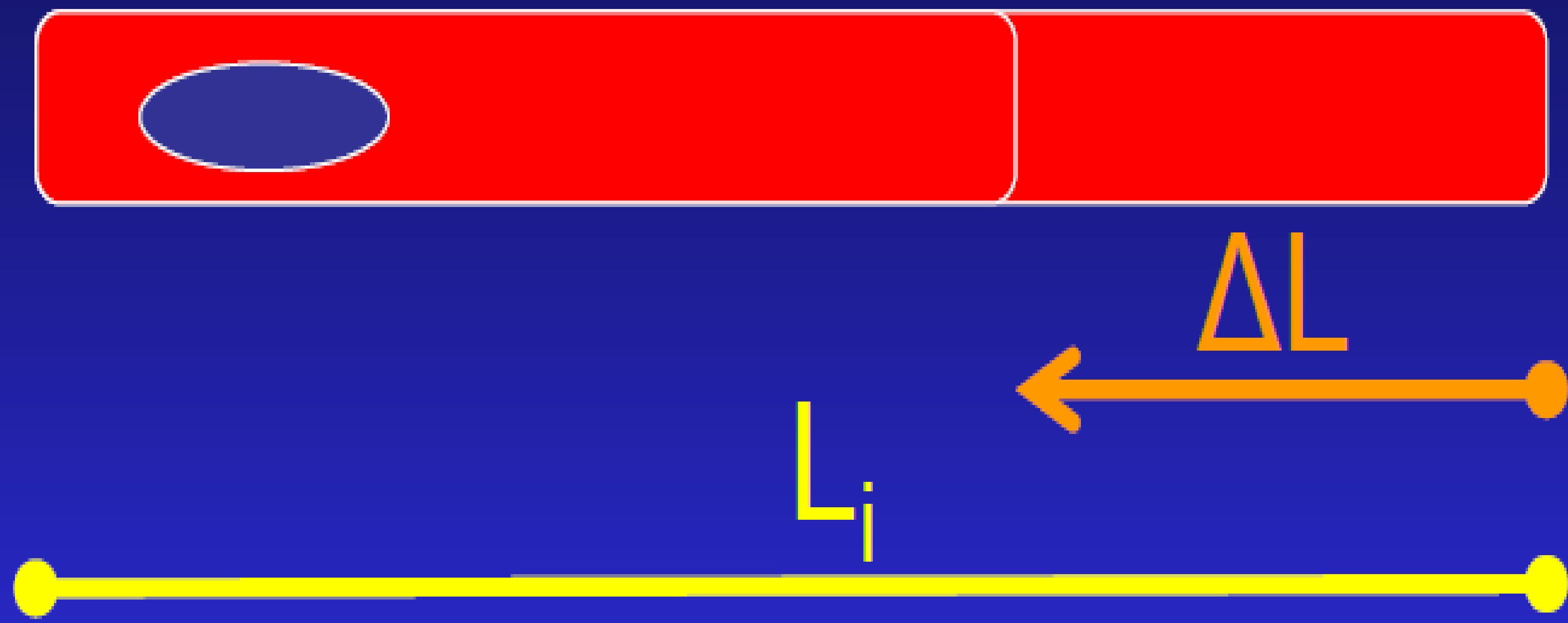
- ABSENCE OF DISPLACEMENT = ABSENCE OF COLOR

TISSUE TRACKING



Strain and strain rate

Strain and strain rate imaging have the **theoretic advantage** of differentiating active myocardial contraction or deformation from passive movement and have been utilized to identify dyssynchrony



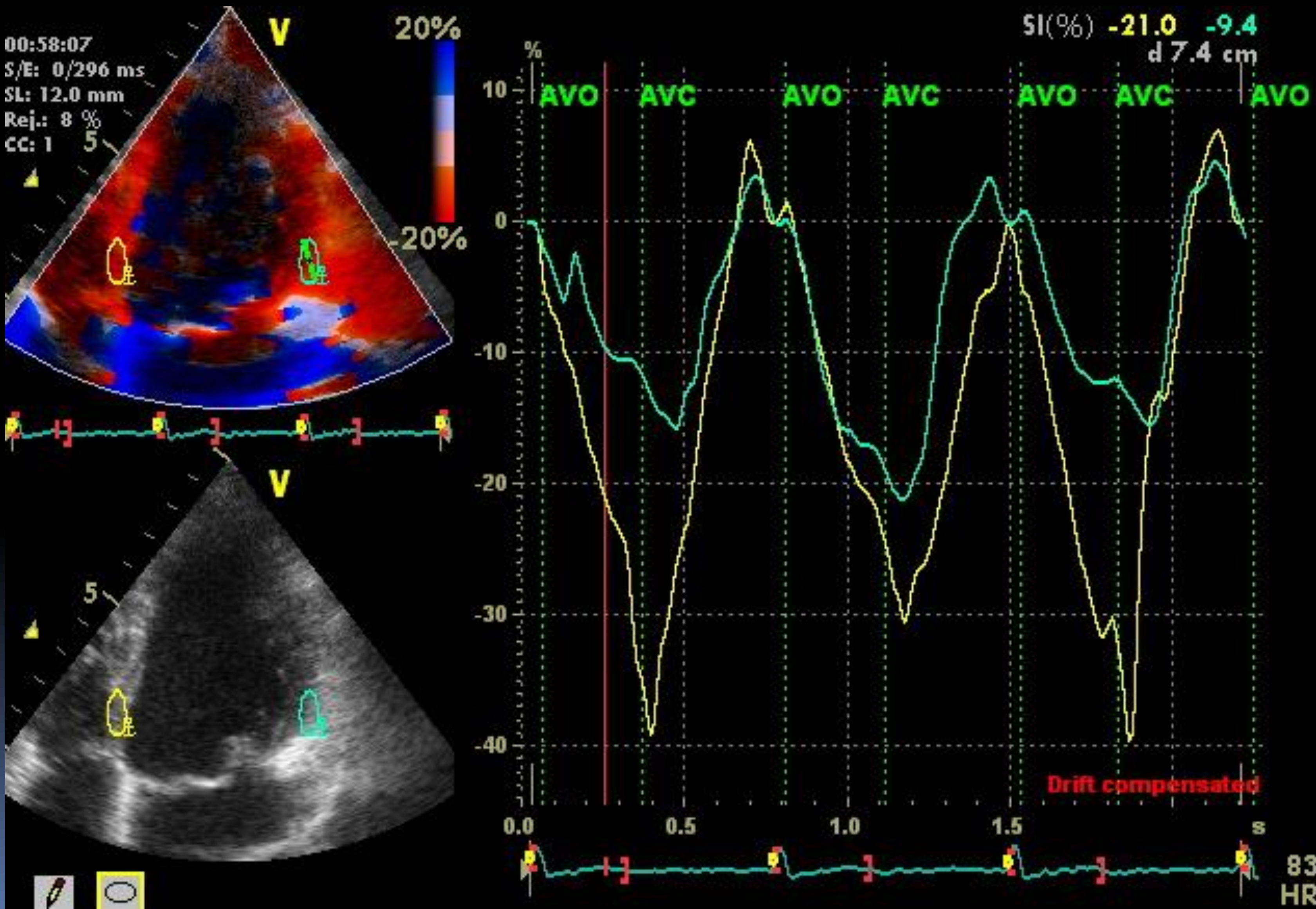
$$\varepsilon\ (\%) = \Delta L \,/\, L_i$$

$$SR = \varepsilon \,/\, t$$

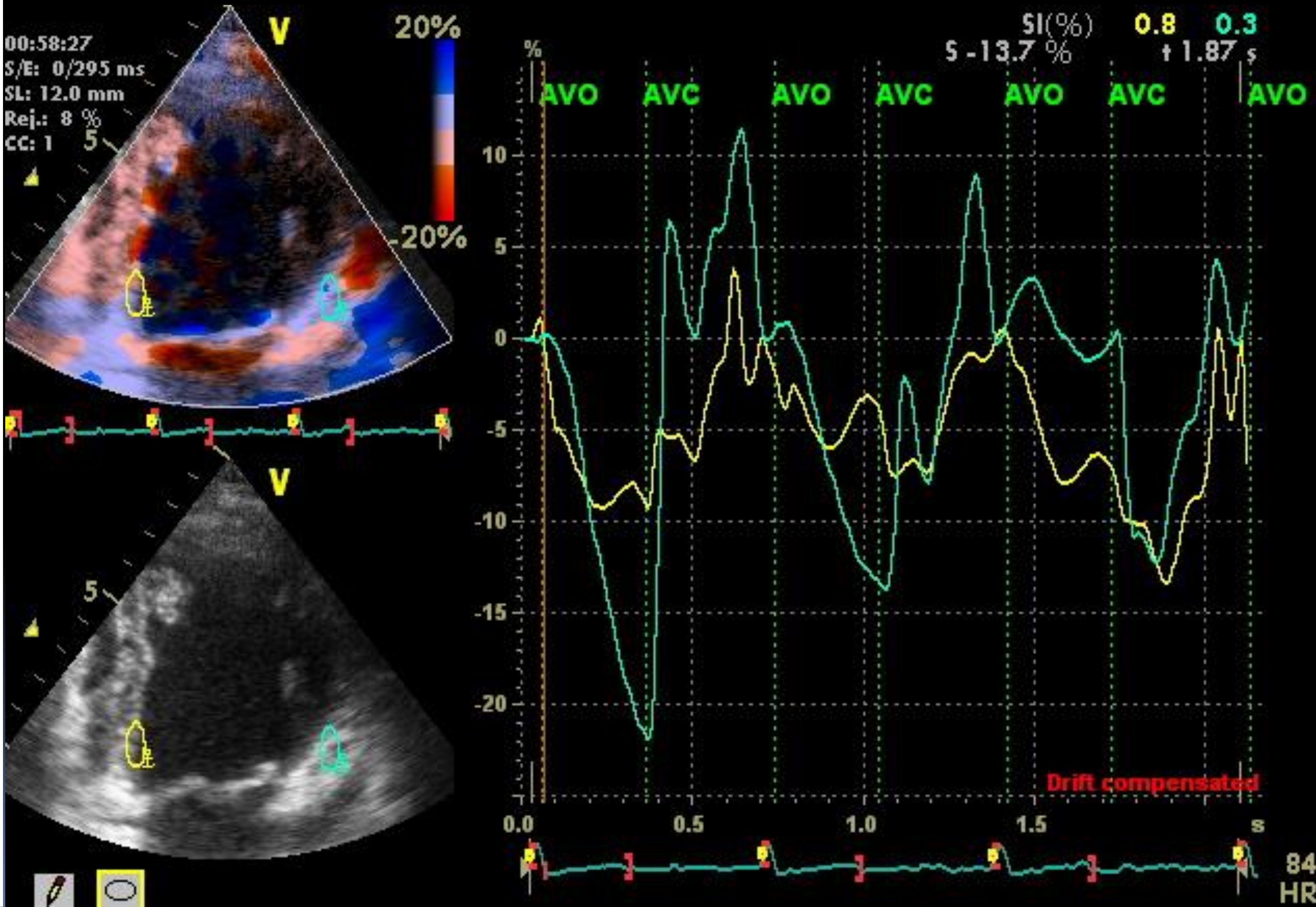
STRAIN

- TD - DERIVED LONGITUDINAL/RADIAL STRAIN
- 2D (SPECKLE TACKING) –DERIVED LONGITUDINAL/RADIAL/CIRCUMFERENTIAL STRAIN

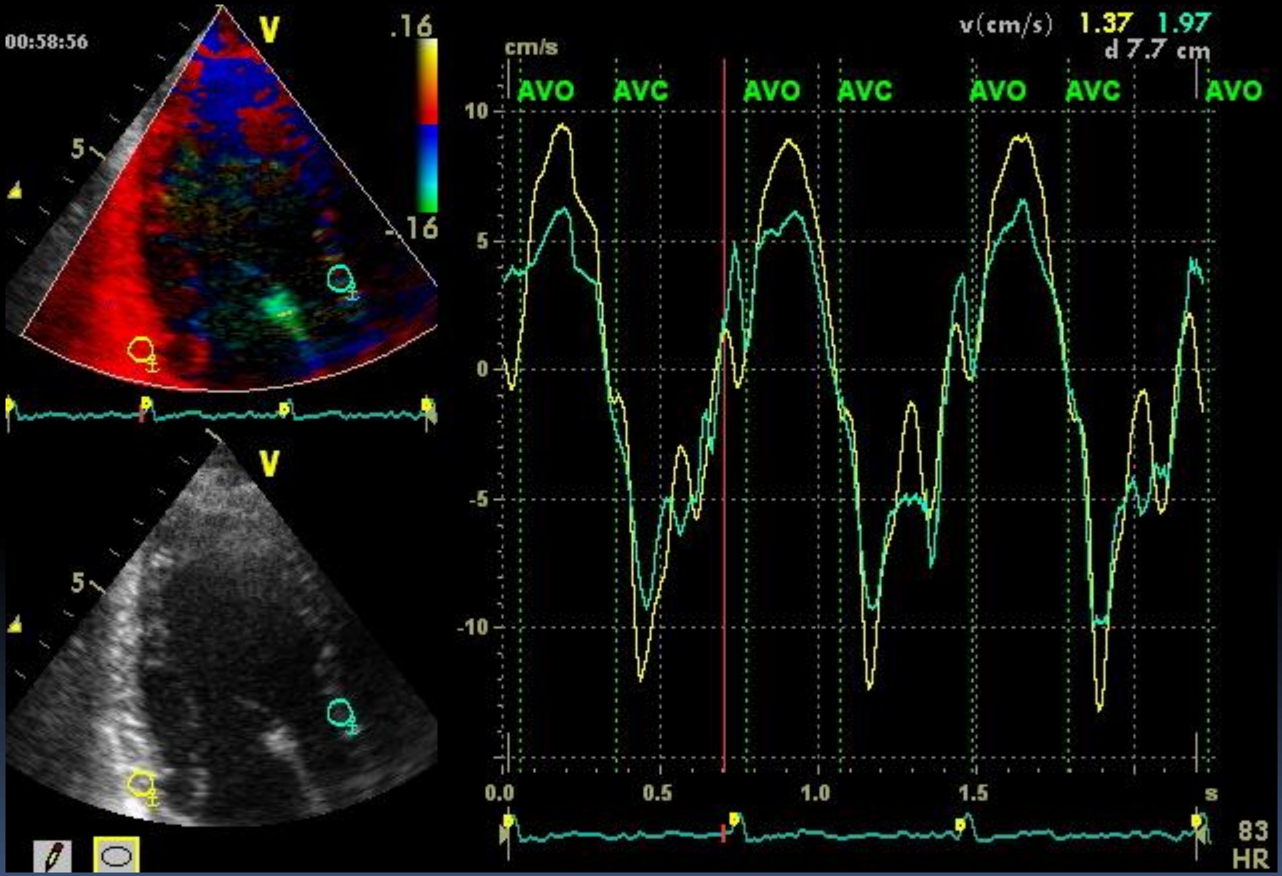
TD - DERIVED LONGITUDINAL STRAIN



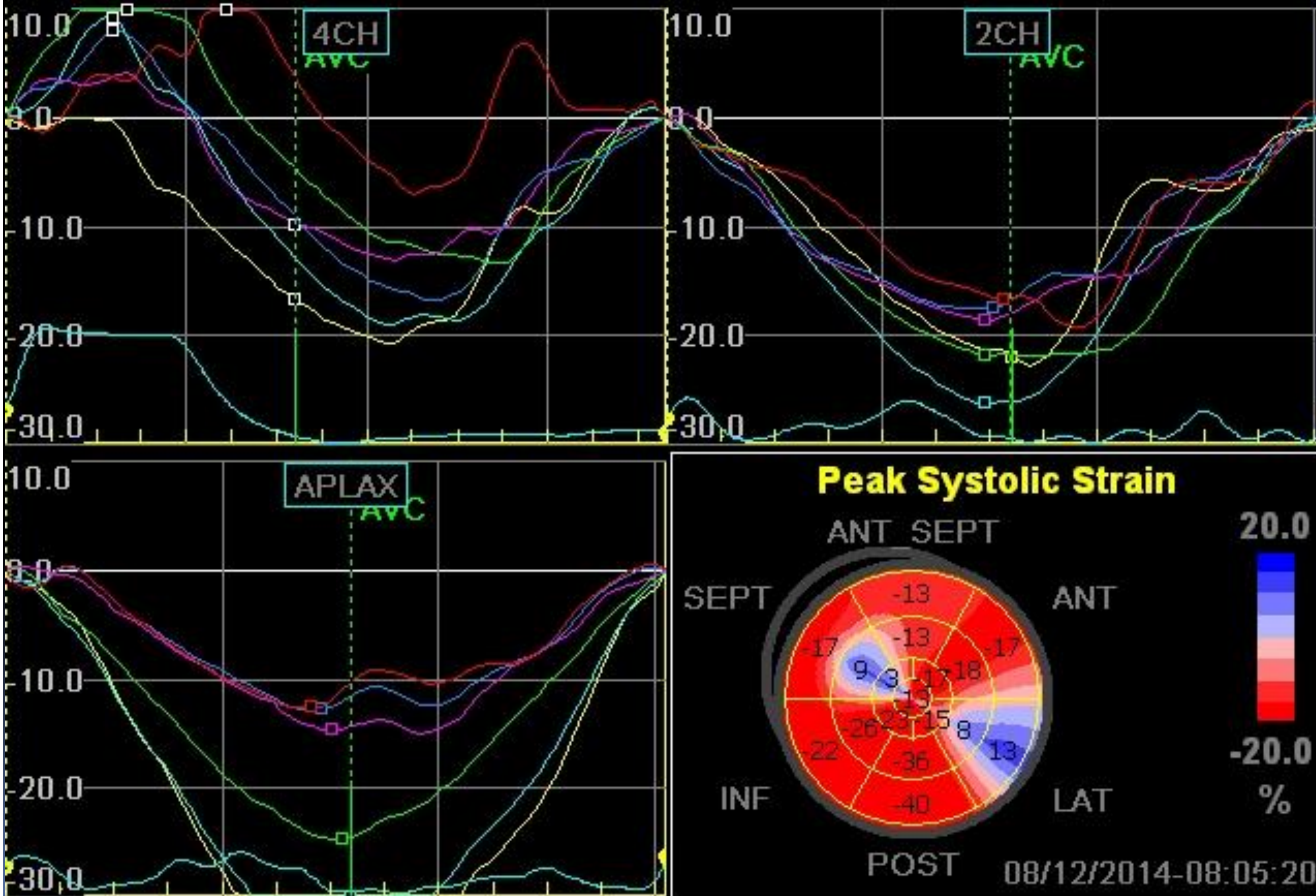
TD - DERIVED LONGITUDINAL STRAIN



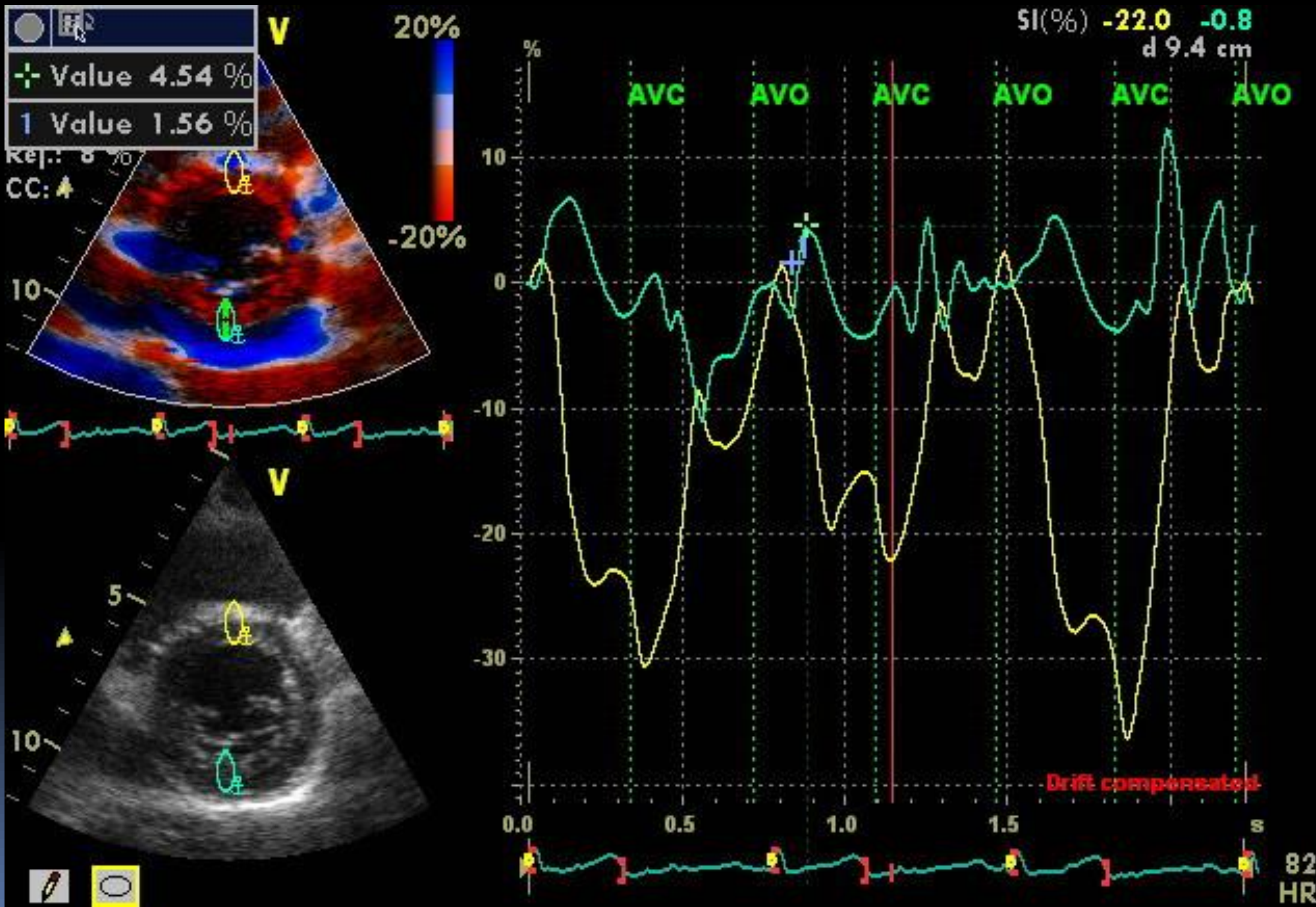
TD - DERIVED LONGITUDINAL STRAIN



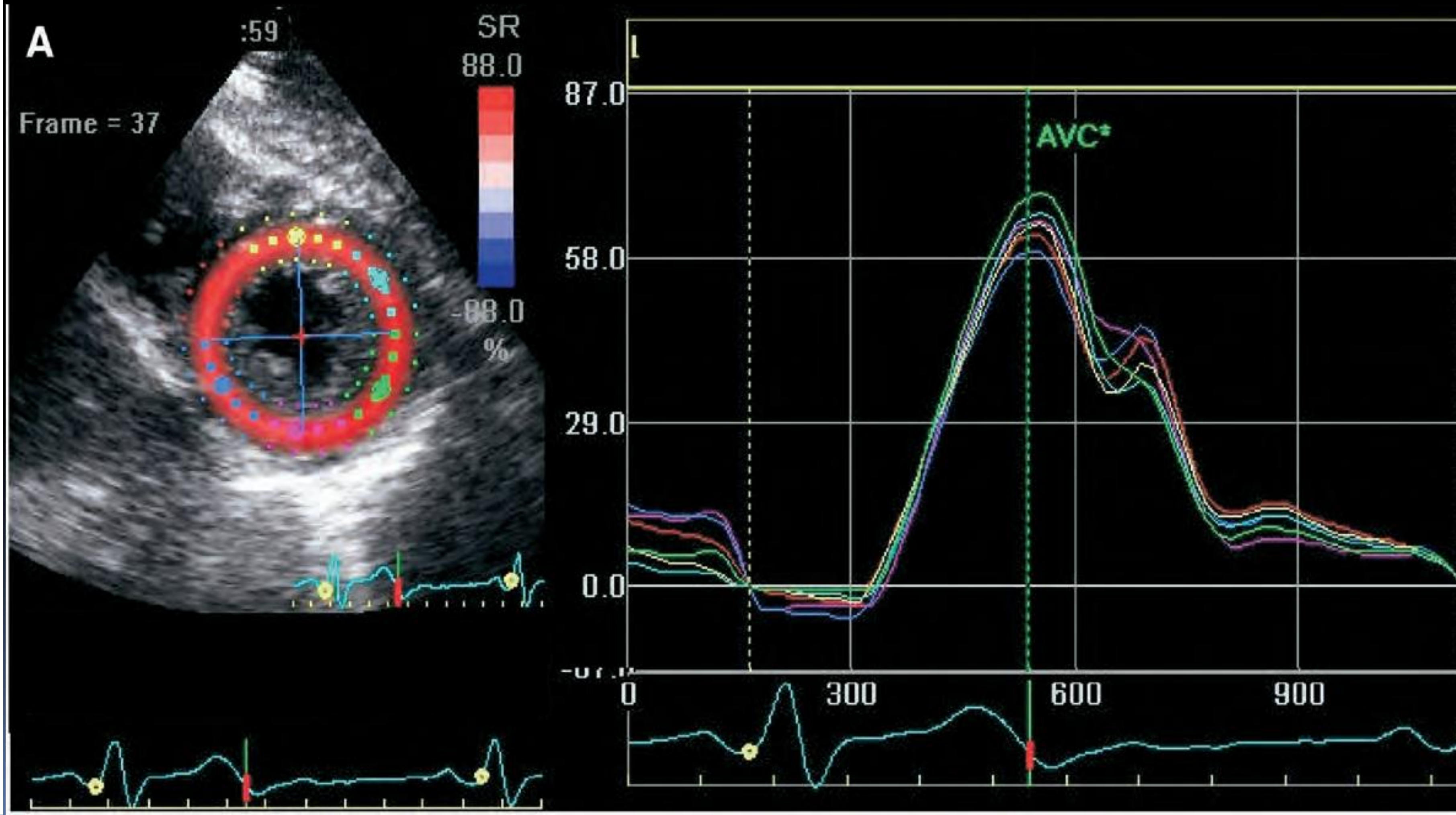
2D – DERIVED LONGITUDINAL STRAIN



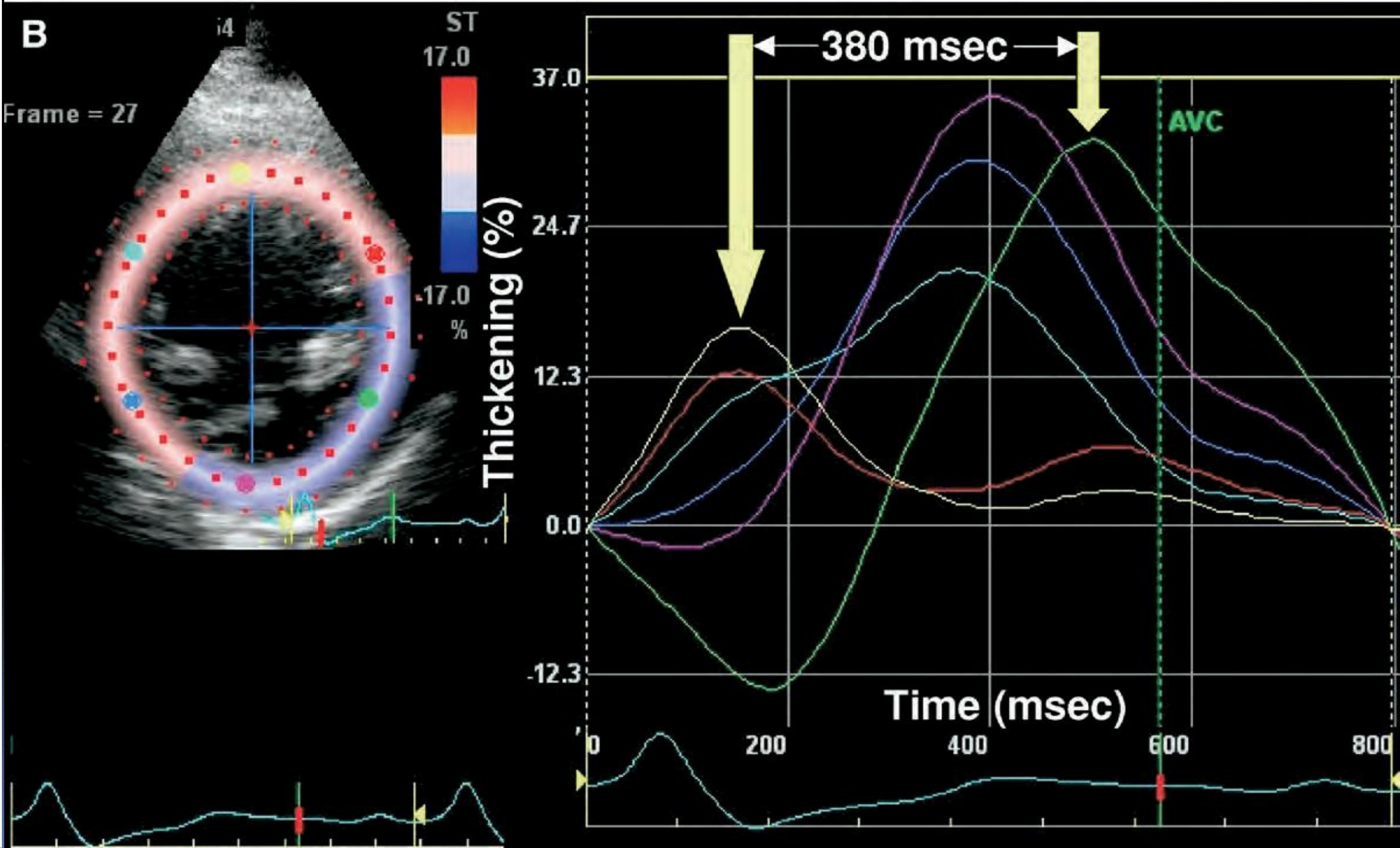
TD – DERIVED RADIAL STRAIN



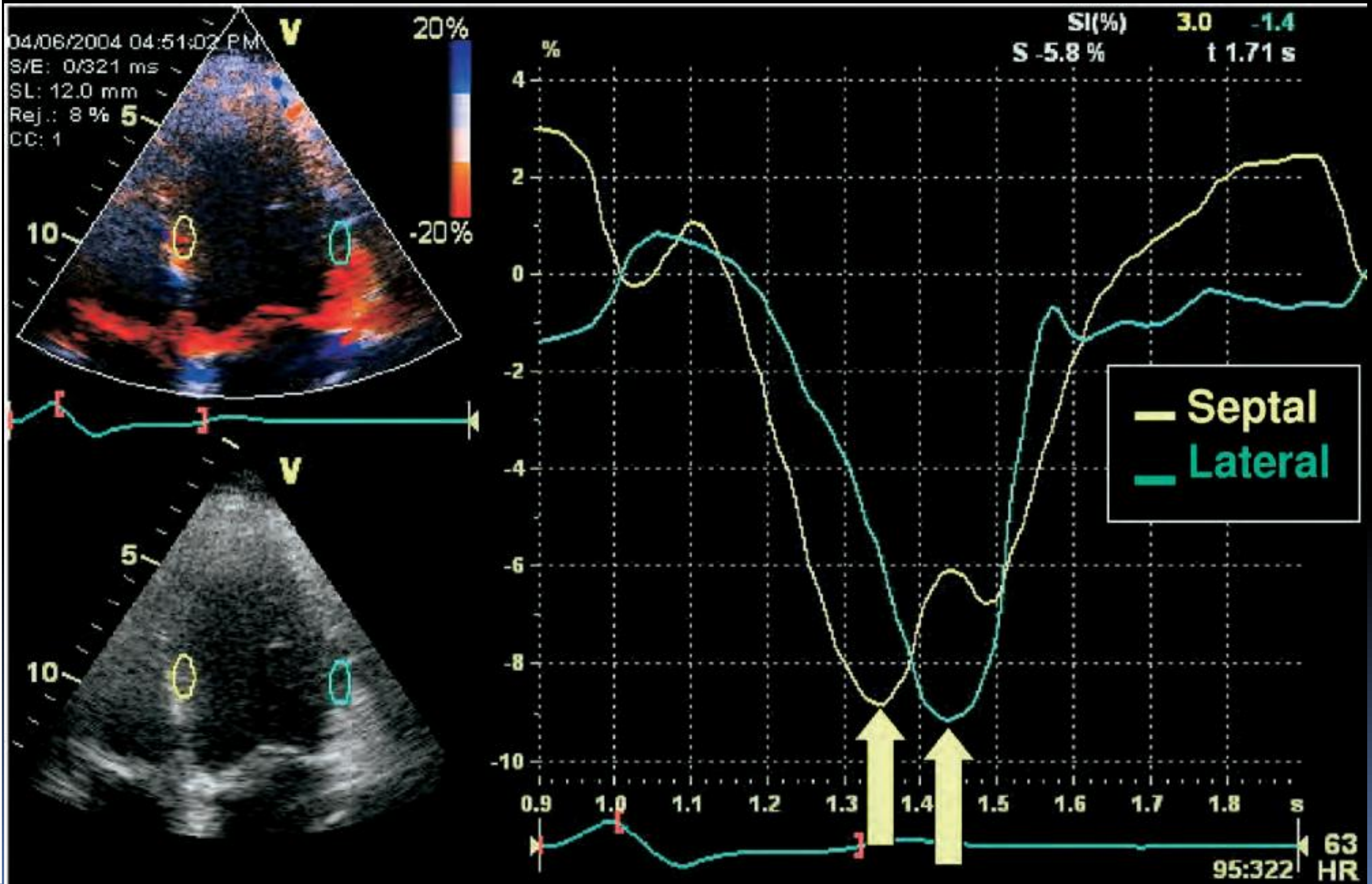
Speckle-tracking images demonstrating synchrony of peak segmental radial strain in healthy



Severe dyssynchrony(radial strain) in patient with heart failure and *LBBB*



Strain in LBBB



strain and strain rate

- strain and strain rate measurements are helpful in:

1-Early detection of myocardial dysfunction of different etiologies

2-assessment of myocardial viability

3-detection of acute allograft rejection

4-early detection of patients with CAD

5-selection of different therapies (CRT, coronary revascularization)

Strain and strain rate

Color-coded TD longitudinal strain can be technically challenging beacause **Doppler angle dependent**, and is difficult in patients with spherical LV geometry, often seen in severe heart failure

STRAIN & STRAIN RATE

- Yu et al : parameters of strain rate imaging are not useful to predict reverse remodeling response.
- TD strain rate is restricted by a poor signal-to-noise ratio, which adversely affects reproducibility.

  Improvements in strain analysis, including software developments such as strain determined by speckle tracking of routine gray-scale images, are promising as useful markers of systolic dyssynchrony

Speckle tracking derived 2D-strain

- Speckle tracking derived 2D-strain measurements have the advantage of angle independency but are sensitive to image quality

RADIAL STRAIN

- RADIAL or LONGITUDINAL STRAIN BY SPECKLE TRACKING IS MORE PREDICTIVE FOR RESPONDERS THAN TDI

It is not mentioned comparison of radial or longitudinal stain….(especially in speckle tracking)

radial Strain

- Strain has an advantage over M-mode of differentiating active from passive motion and identifying radial mechanical activation
- Radial strain was calculated from TD velocity data from the anteroseptum and posterior wall in the mid LV PSAX view

radial Strain

- Disadvantages of TD radial strain included signal noise without adequate image quality and the effect of the Doppler angle of incidence.

speckle-tracking RADIAL STRAIN

- Baseline speckle-tracking radial dyssynchrony (defined as a time difference in peak septal to posterior wall strain 130 milliseconds) predicted a significant increase in LVEF after CRT

DYSSYNCHRONY

- 1-TD OVERALLY NOT GOOD(ANGLE DEPENDENT)
- 2-TD-DERIVED Q ANALYSIS :PASSIVE MOTION
- 3-TD-DERIVED STRAIN/STRAIN RATE :REJECT PASSIVE MOTION BUT:SIGNAL TO NOISE IS POOR ESPECIALLY STRAIN RATE
- 4-STRAIN RATE IS VARIABLE AMONG DIFFERENT MASHINES(ELSE RADIAL STRAIN)
- STRAIN BY SPECKLE TRACKING :NOT CUT OFF POINT