Implementing New Technology

PP16 Imaging Conference

Bicol Hospital, Legaspi City, Philippines

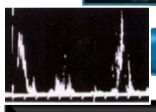
July 2016

David Adams, ACS, RCS, RDCS, FASE

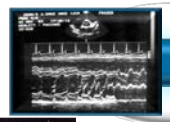
Duke University Medical Center

Echo Evolution

By Dr. Zoghbi



A-mode

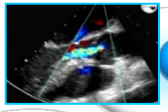


M-mode

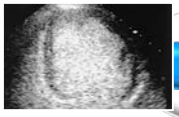
2 Dimensional

Doppler

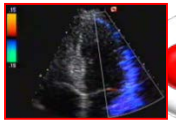
Color Doppler



TEE

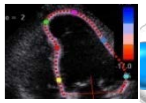


Contrast/Harmonics



Tissue Doppler

LIVE 3D



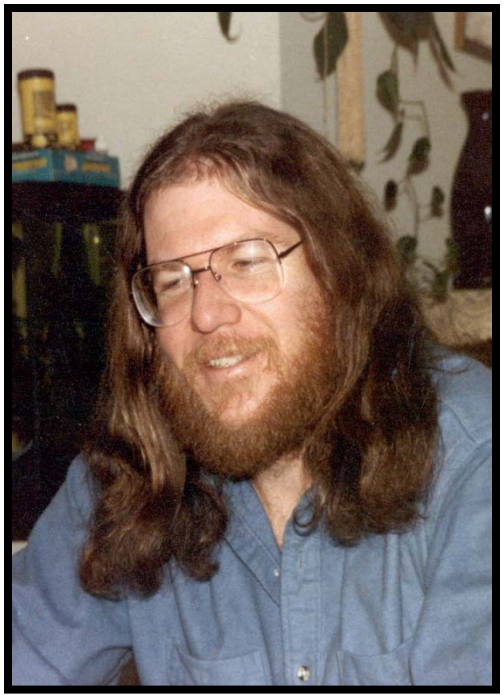
Speckle Tracking

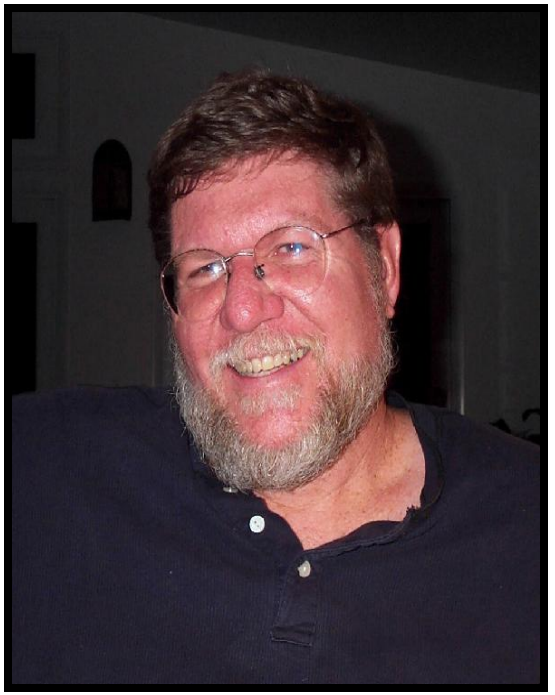
LIVE 3D TEE

Handheld/POC echo

1953 1975 1980 1985 1990 1995 2000 2005 2013

Scary Evolution





Echo Technology

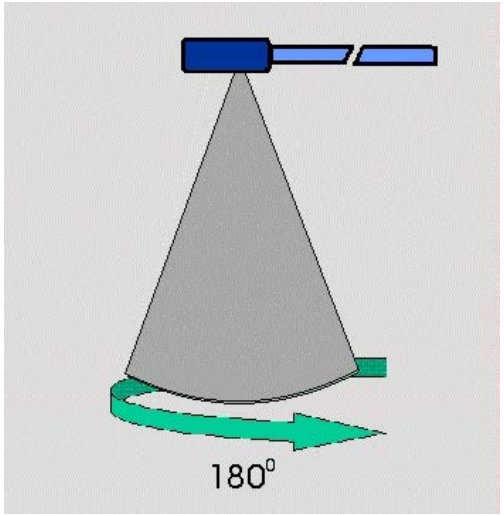
New Technology Requires New Questions

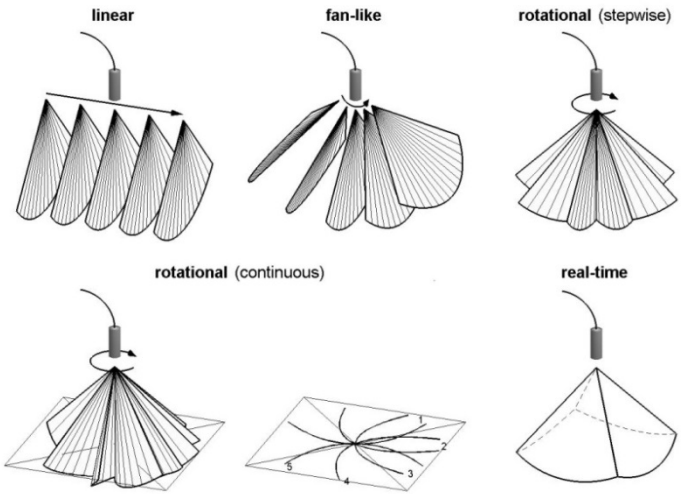
UNCLASSIFIED

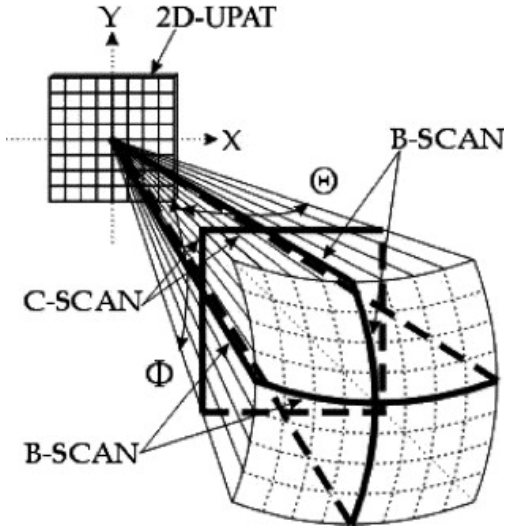
1st – What we are NOT Covering

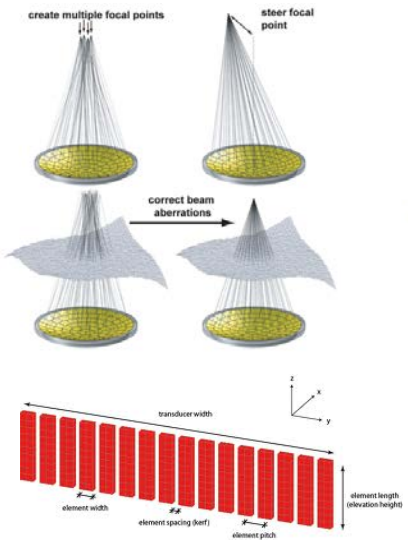
UNCLASSIFIED

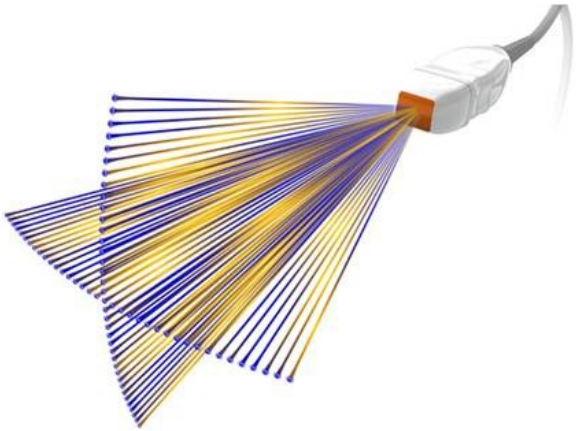
~~Physics~~

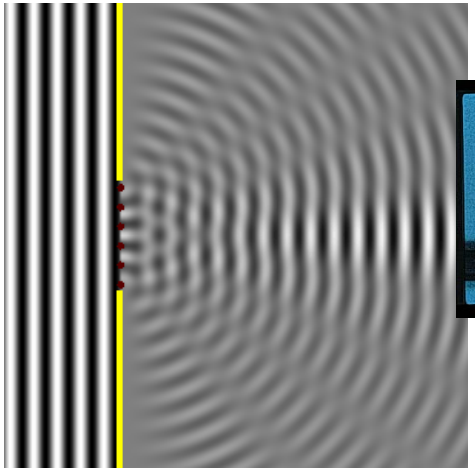

180⁰

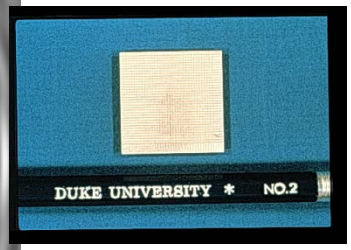

linear
fan-like
rotational (stepwise)
rotational (continuous)
real-time


Y
2D-UPAT
X
B-SCAN
H
C-SCAN
Φ
B-SCAN

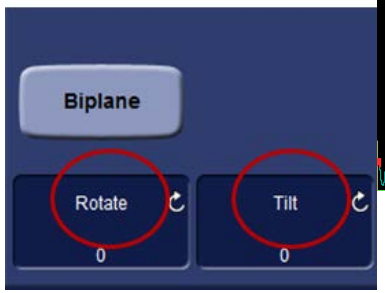

create multiple focal points
steer focal point
correct beam aberrations
transducer width
element width
element spacing (kerf)
element pitch
element length (elevation height)

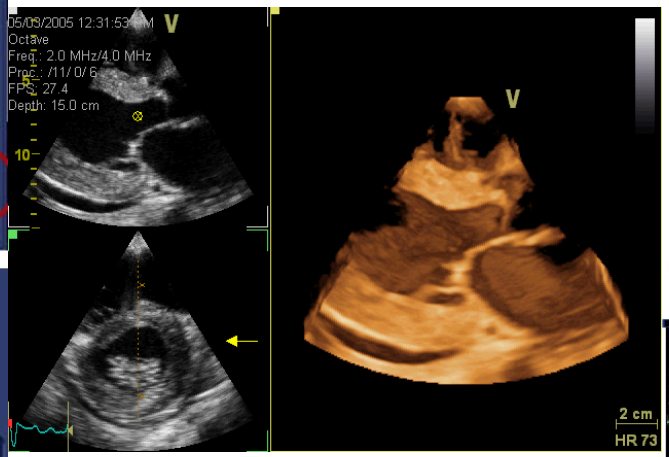


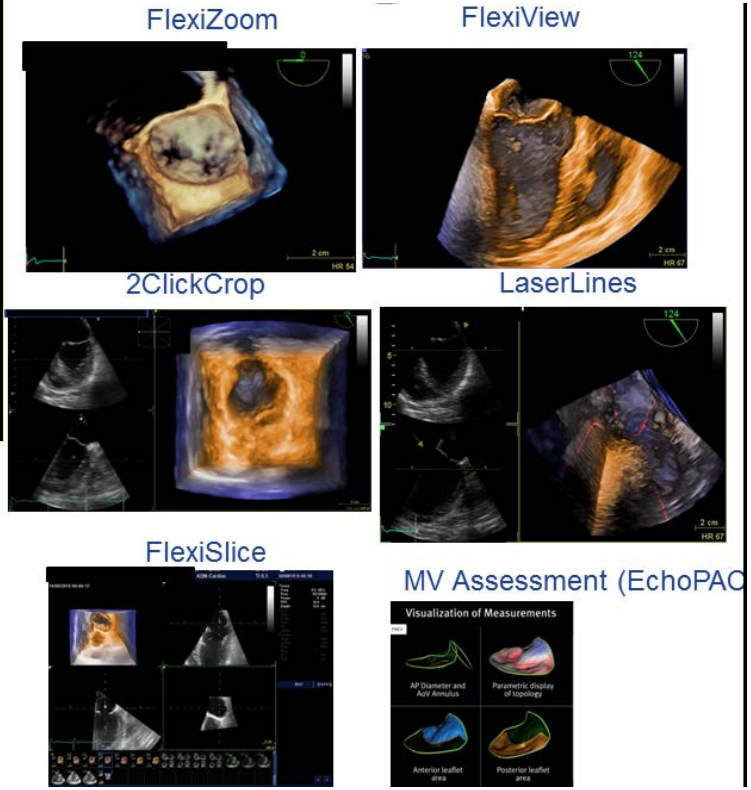



DUKE UNIVERSITY * NO.2

~~Knobology~~







DUKE: Adams

More why than how!

UNCLASSIFIED

Questions

- Who routinely does 3D?
- Who does strain imaging?

DUKE: Adams

Question

- Why should you care?

The Goal of Echo?

- Gives you a job
- Makes money for the lab
- Makes money for IAC
- To make a diagnosis
- To get the pt to therapy

Todays Talk

- Speckle Strain

UNCLASSIFIED

Echo Technology

My Interpretation

"It takes a strong man to make a tender chicken"

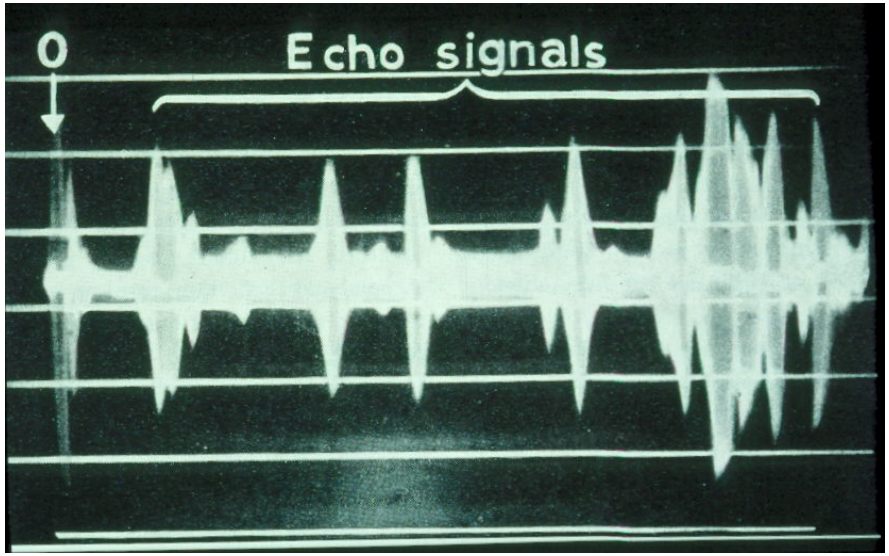
Frank Perdue

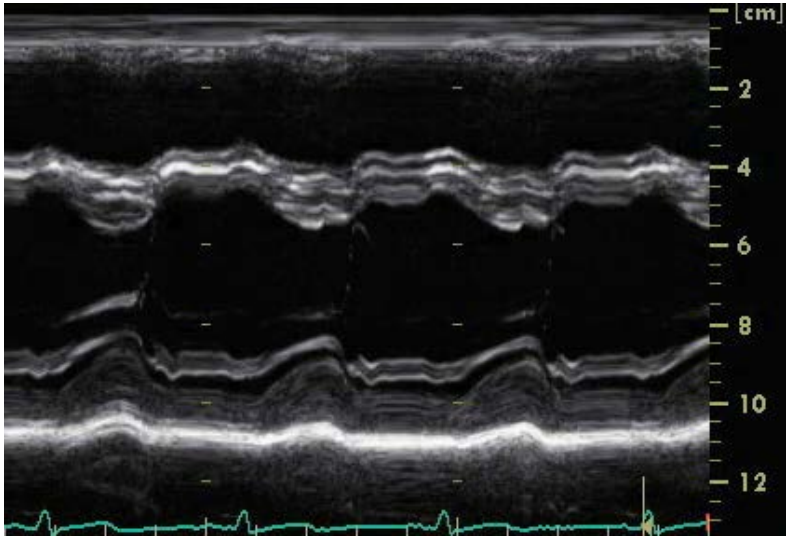
"It takes an aroused man to make a chicken affectionate"

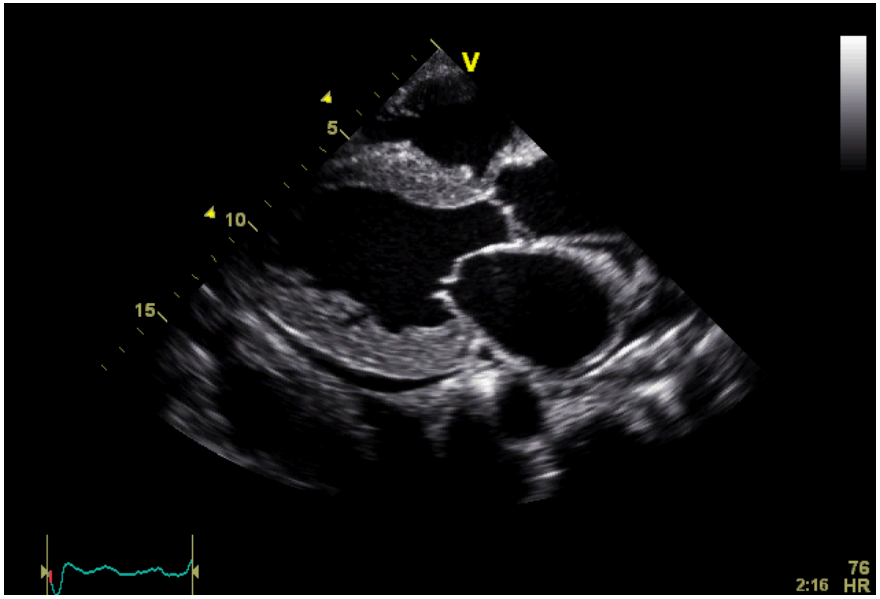
Spanish translation

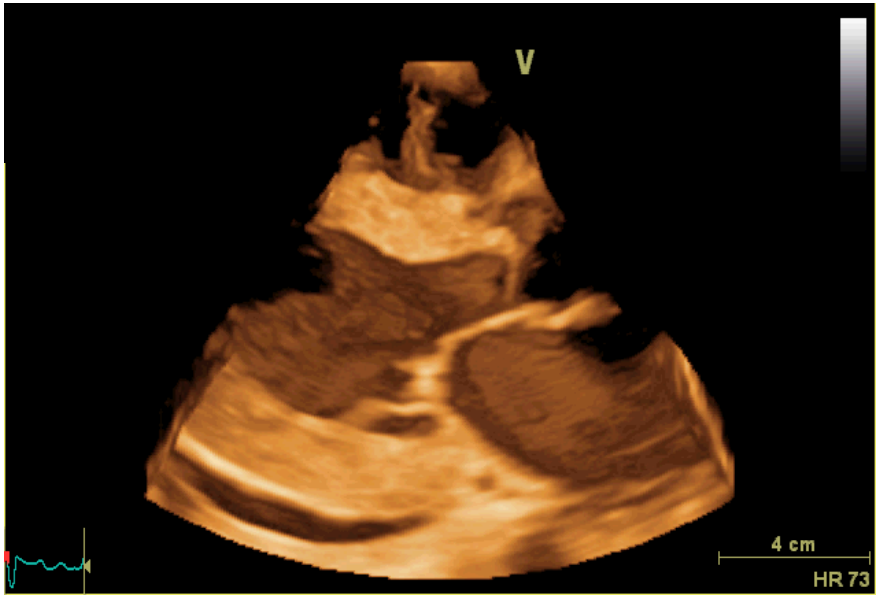
History of Echo

- One Slide


0
Echo signals


cm
2
4
6
8
10
12


V
5
10
15
76
2:16 HR


V
4 cm
HR 73

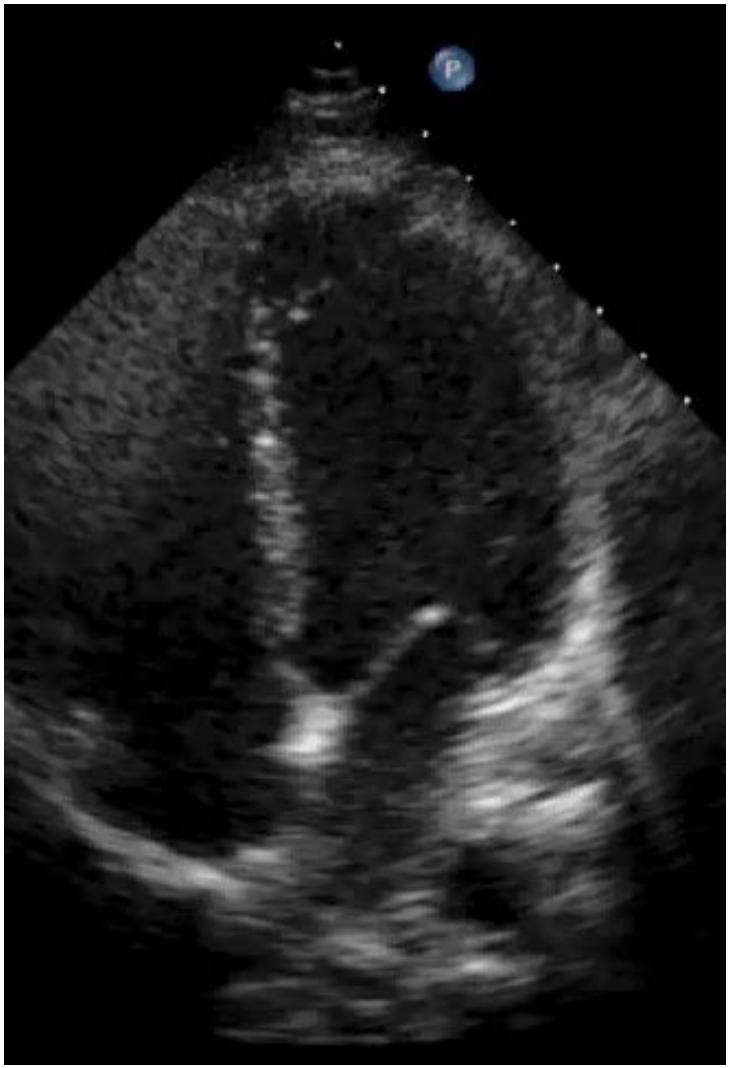
Questions for any New Technology

- Does it help you get thru the day?
- It is reproducible?
- Is it the same across Vendors?
  - EF is
  - Longitudinal strain is (kind of)
  - Others not

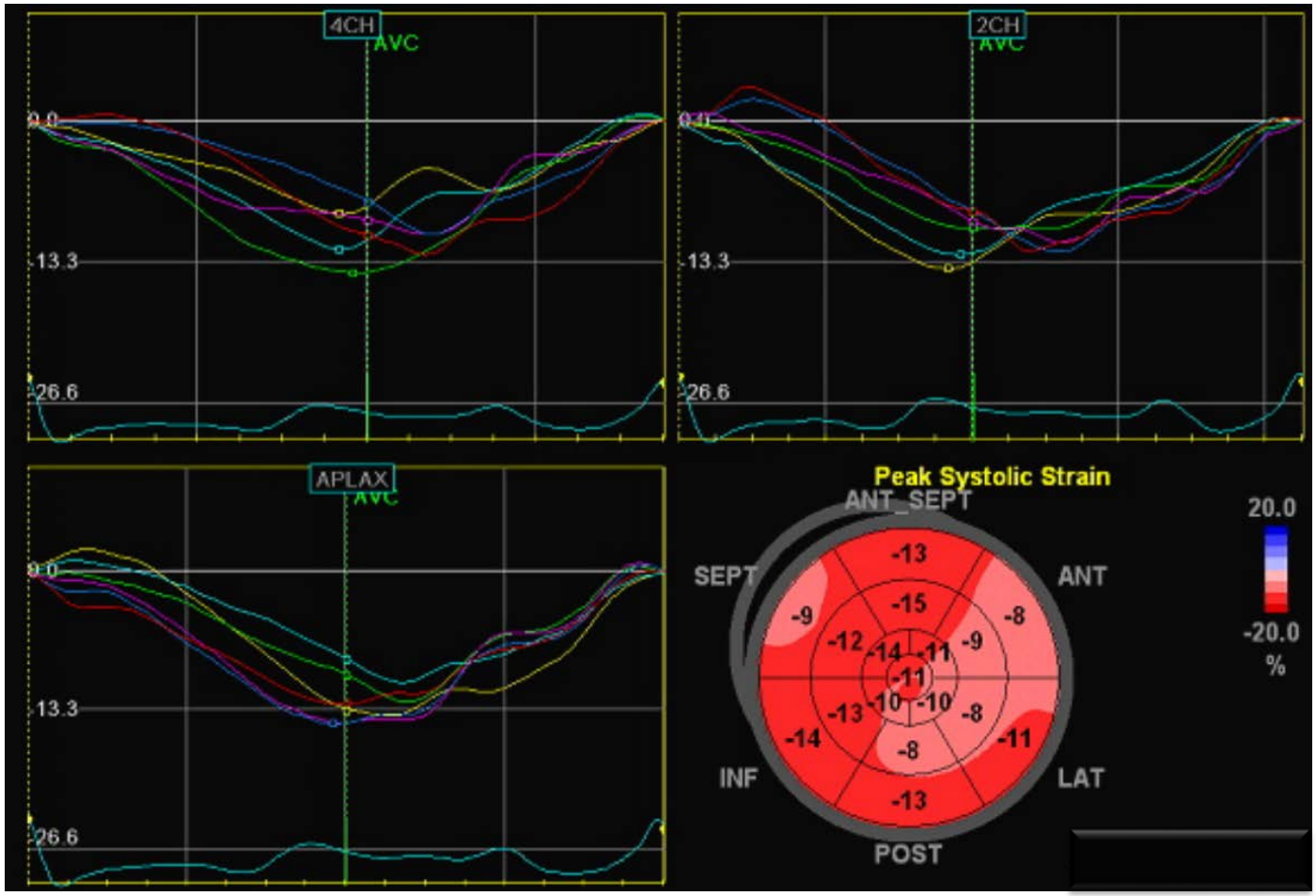
Strain Case

- 32 y/o F
- Breast CA dx 2012
- Older Sister dx'd 2010
- Started on chemotherapy – adriamycin
- Concern = cardiotoxicity

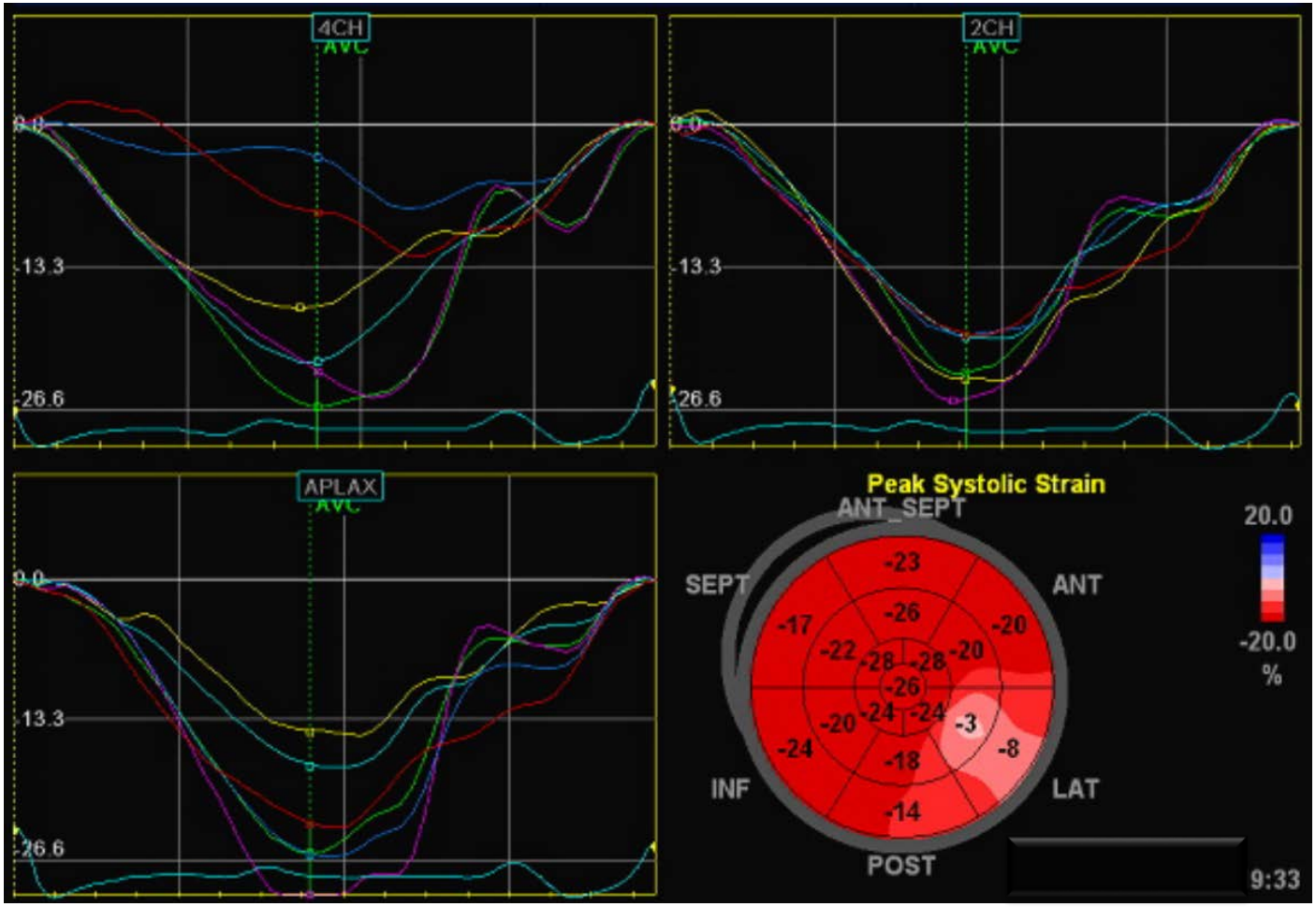
Chemo pt



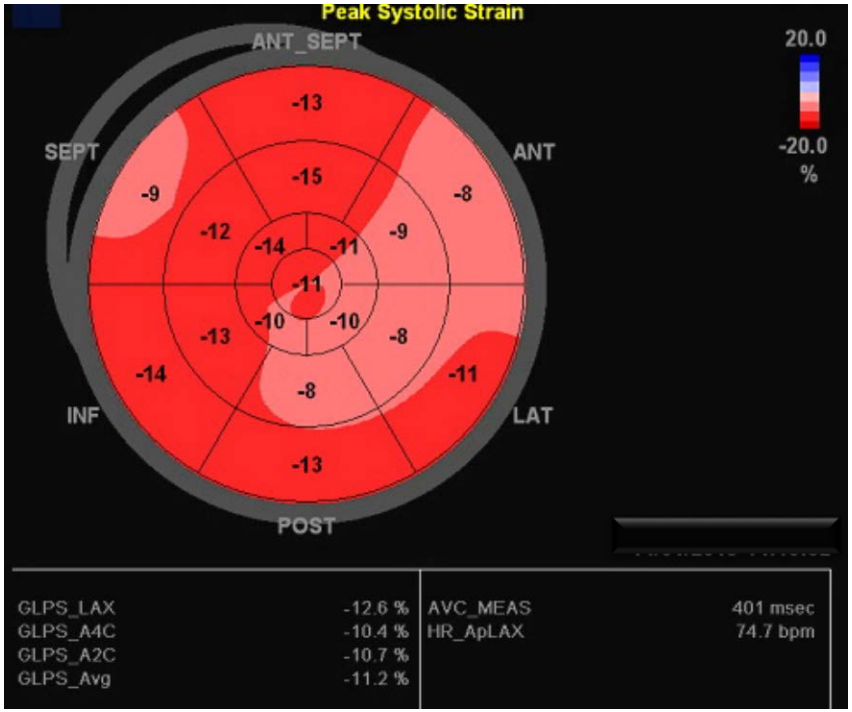
Strain #1 during chemo

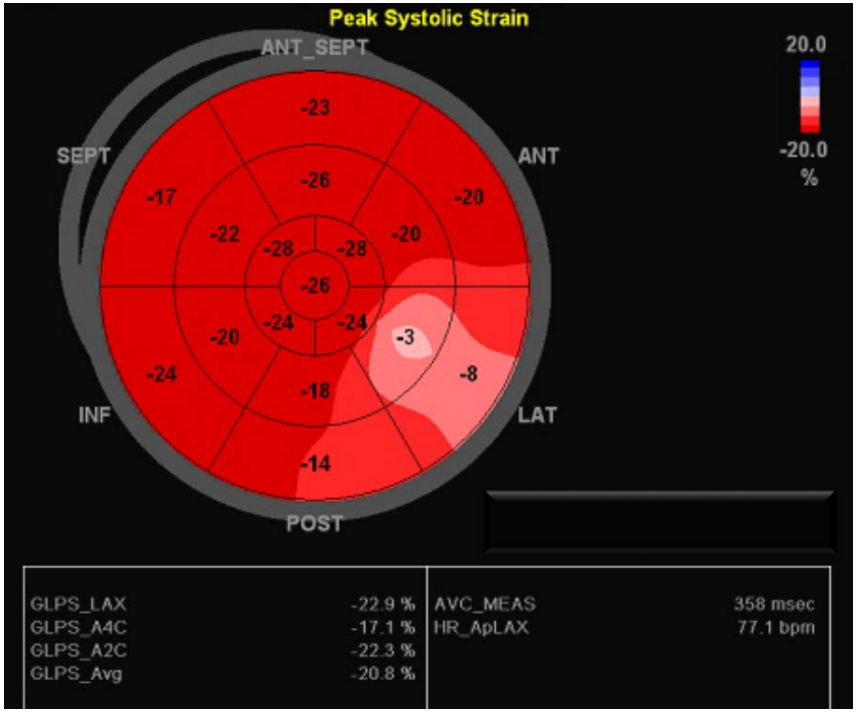


Strain #2 post change



Chemo pt – Strain #1 vs 2





GS = -11%

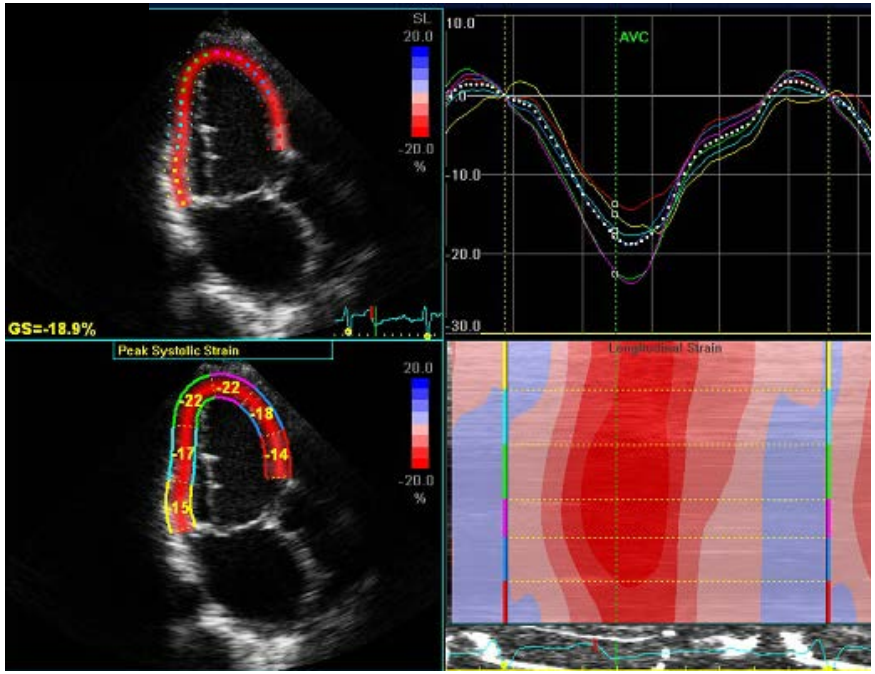
GS = -20%

We will come back to this patient.

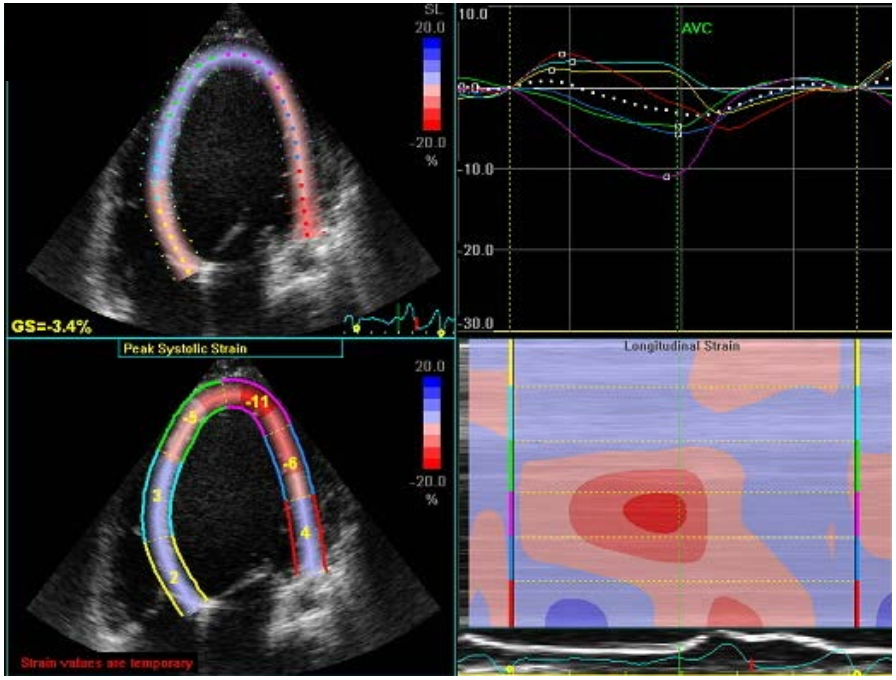
Strain's Bottom Line

- Strain changes before EF changes
- Serial studies – tracking small changes over time

Strain – pattern recognition



Good



Bad

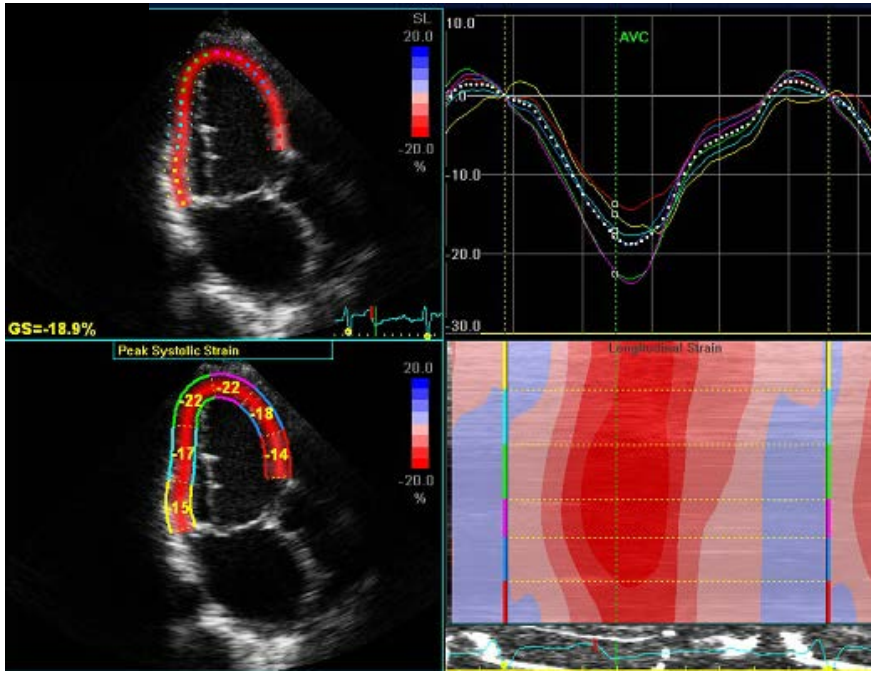
Strain

- Not for sissies
- Confusing
- Strains the brain
- My Goal – simplify
- Echo’s goal – get the pt to therapy
- Strain is just another tool

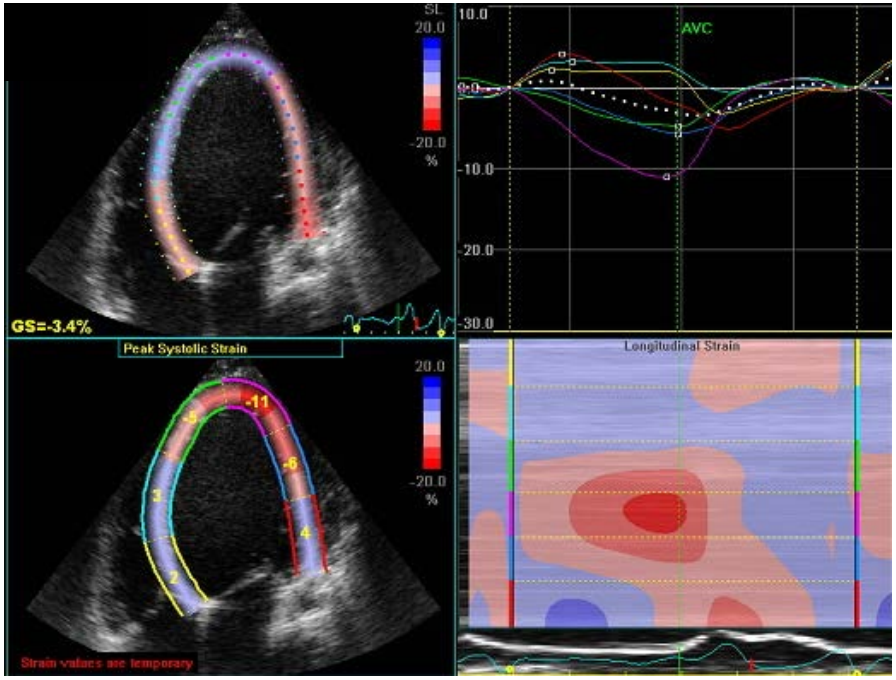
Some New Terms

- Parametric imaging
  - Measuring things the eye can’t see
  - Requires special software

Parametric displays



Good



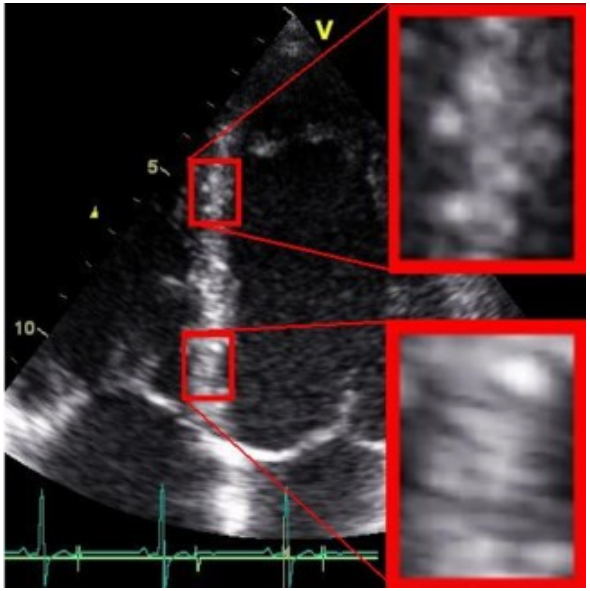
Bad

Some New Terms

- Parametric imaging
  - Measuring things the eye can’t see
  - Requires special software
- Speckle

Speckle

- Acoustic signature within tissue
- Myocardium = lots of speckles
- A “kernel” is a defined area of speckle



Some New Terms

- Parametric imaging
  - Measuring things the eye can't see
  - Requires special software
- Speckle
- Speckle-Tracking (STE)

Speckle tracking

Variability of Global Left Ventricular Deformation Analysis Using Vendor Dependent and Independent Two-Dimensional Speckle-Tracking Software in Adults

Niels Risum, MD, Sophia Ali, MD, Niels T. Olsen, MD, PhD, Christian Jons, MD, PhD, Michel G. Khouri, MD, Trine K. Lauridsen, MD, Zainab Samad, MD, Eric J. Velazquez, MD, Peter Sogaard, MD, DMSc, and Joseph Kisslo, MD, *Durham, North Carolina; Gentofte, Denmark*

Speckle tracking

- Acoustic signature within tissue
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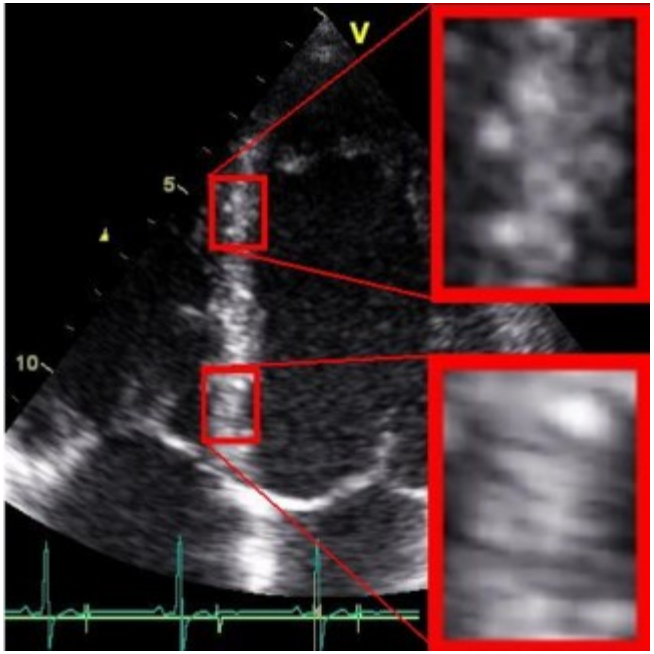
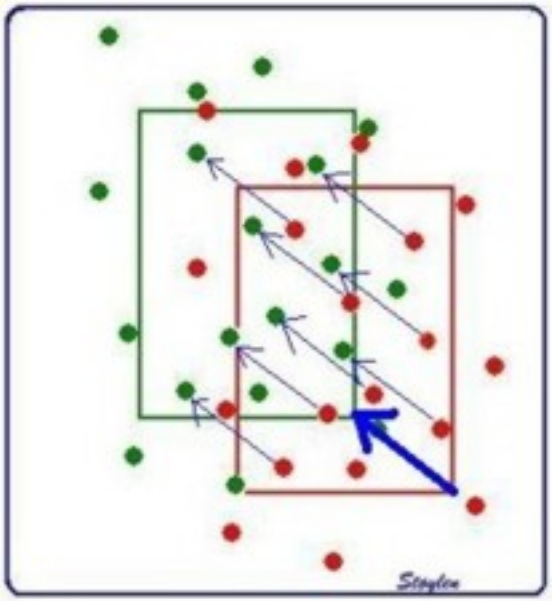


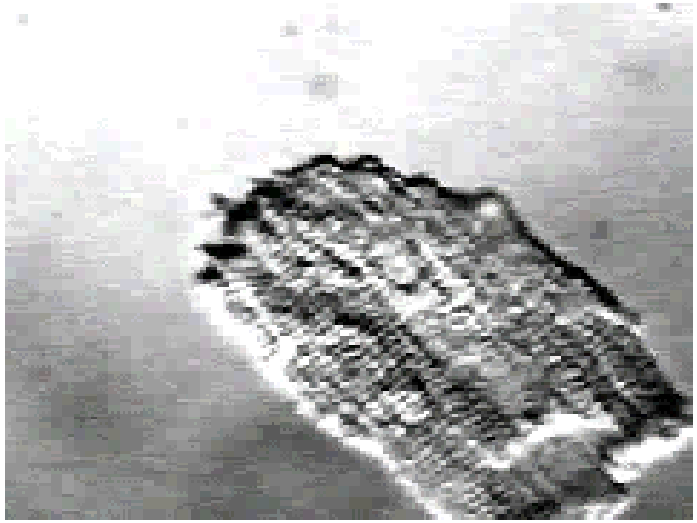


Strain software

- Identifies, tracks and displays speckle patterns (kernels) in the myocardium
- Why should you care (besides having a new toy)
- Helps clinically:
  - Chemo pts – more sensitive than EF
  - HCM / amyloid
  - CRT
  - CAD & Valvular Disease

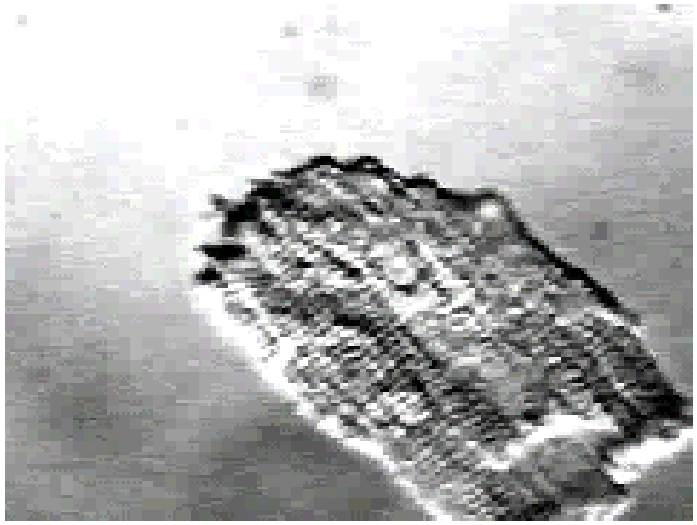
Strain

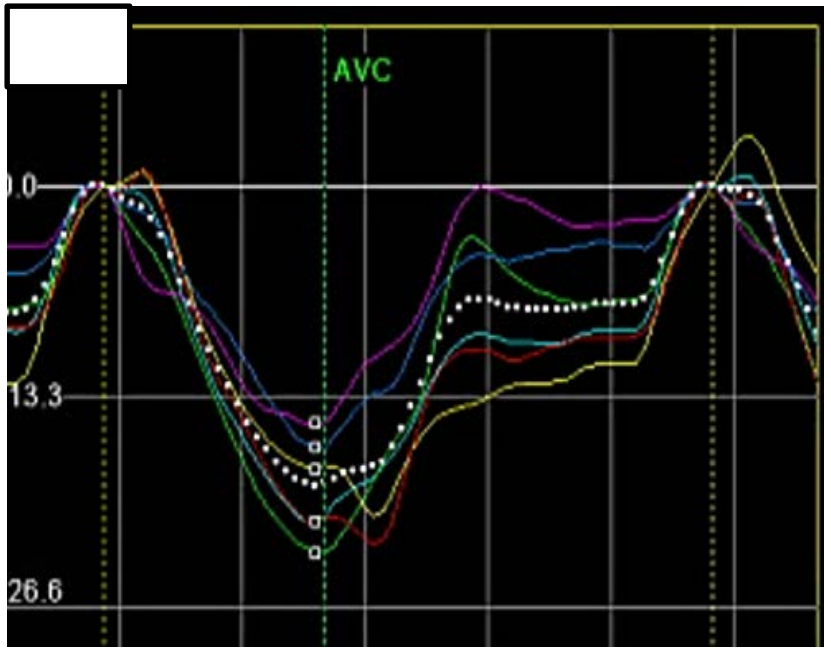
- Deformation dealing with shape and volume change
- Distance between speckle kernels changes



Strain

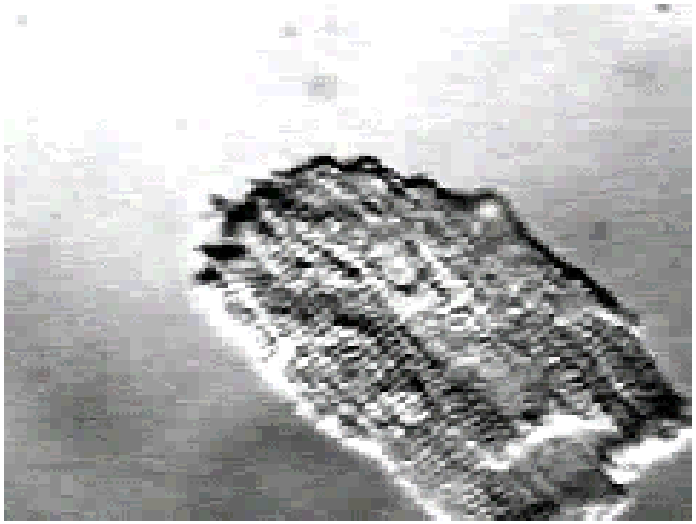
- During contraction (systole) in the long axis speckle gets closer (negative) – longitudinal strain

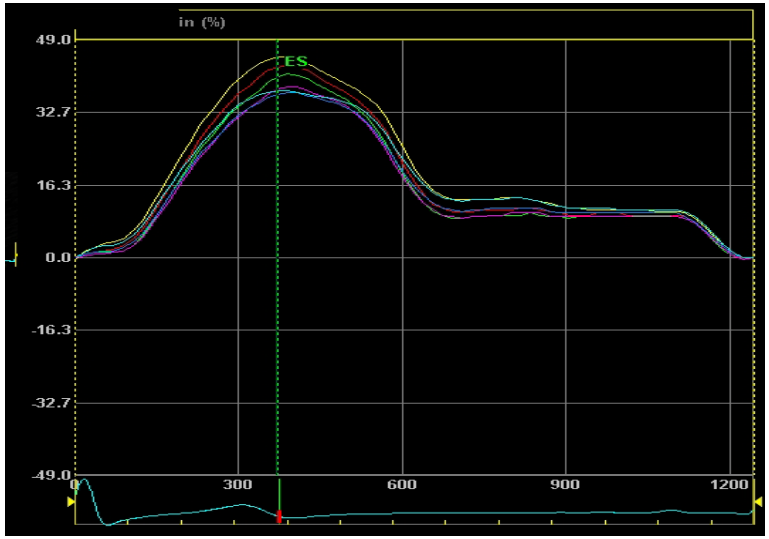




Strain

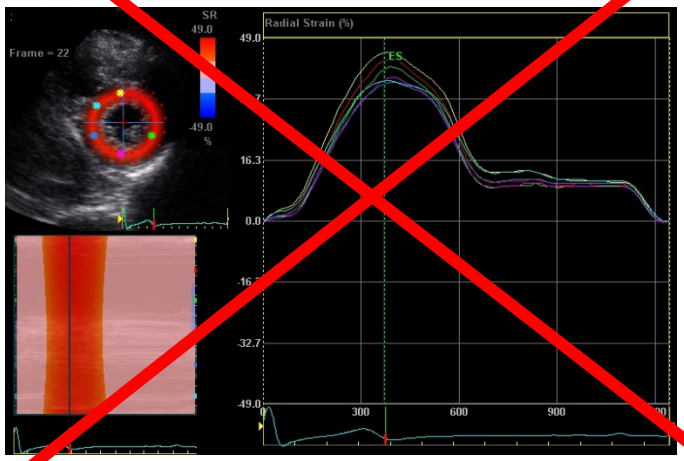
- During contraction (systole) in the long axis speckle gets closer (negative)
- In the short axis the speckle moves away (positive) – radial strain



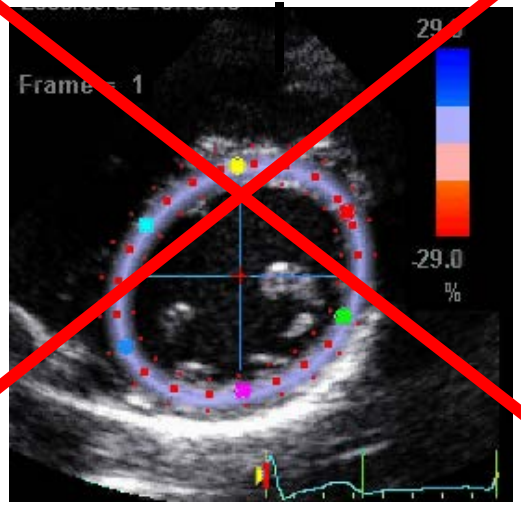


3 Types of Strain

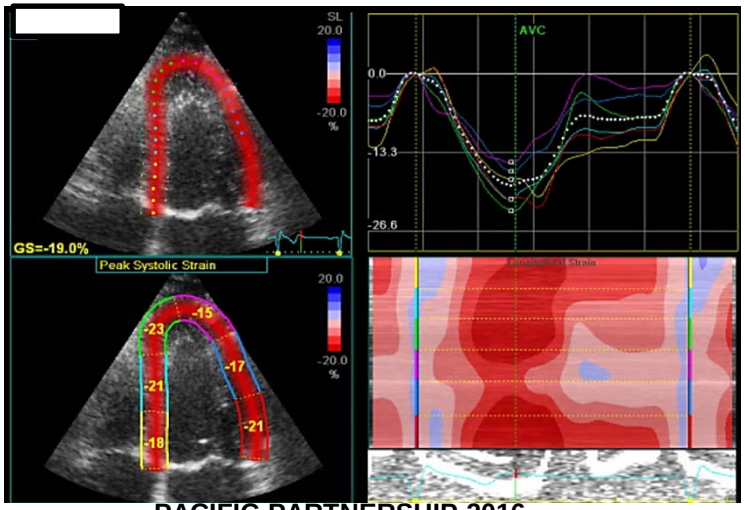
Radial



Circumferentia

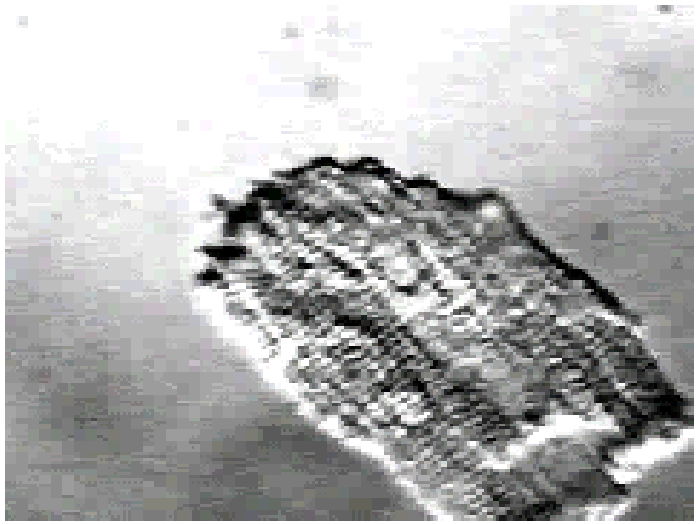


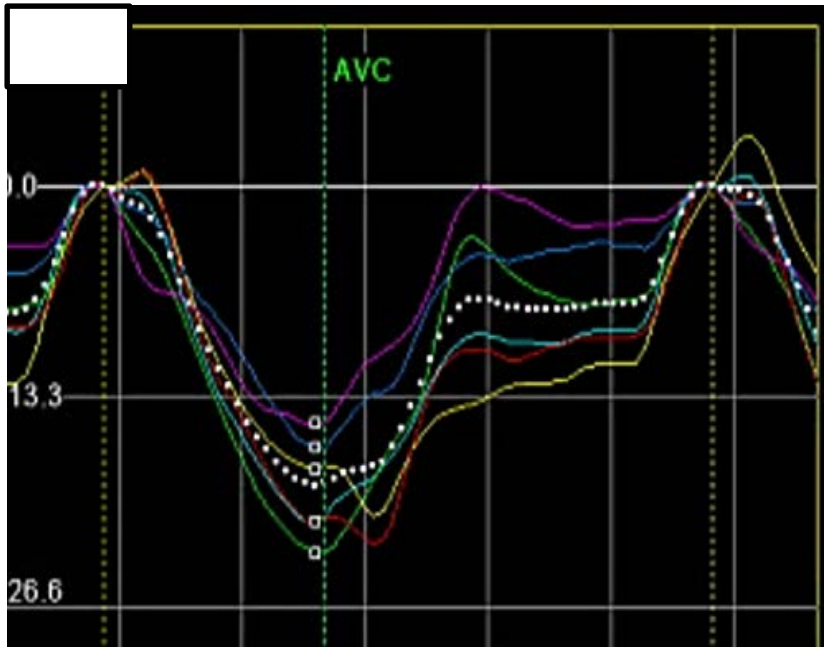
Longitudinal



Longitudinal Strain

- Negative
- Unitless (percentage)
- Normal (-19 or 20%)

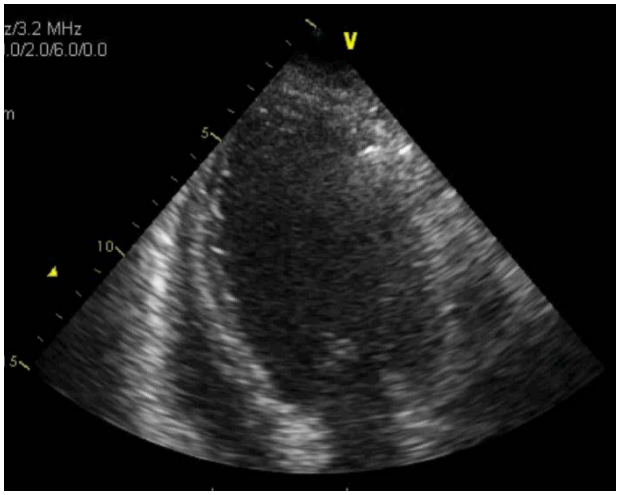


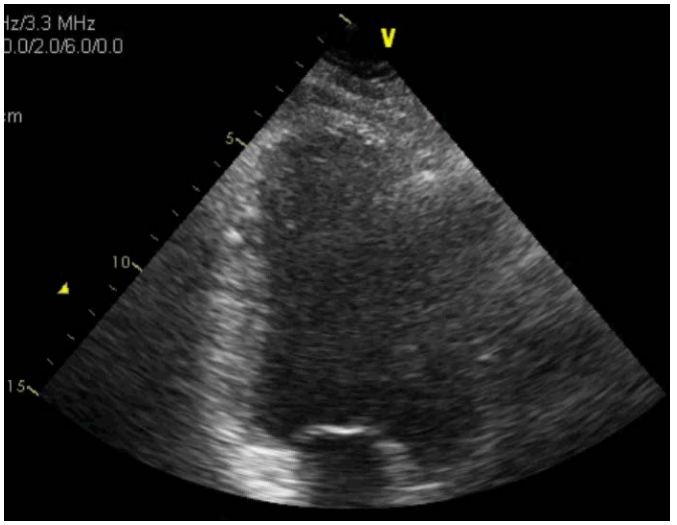


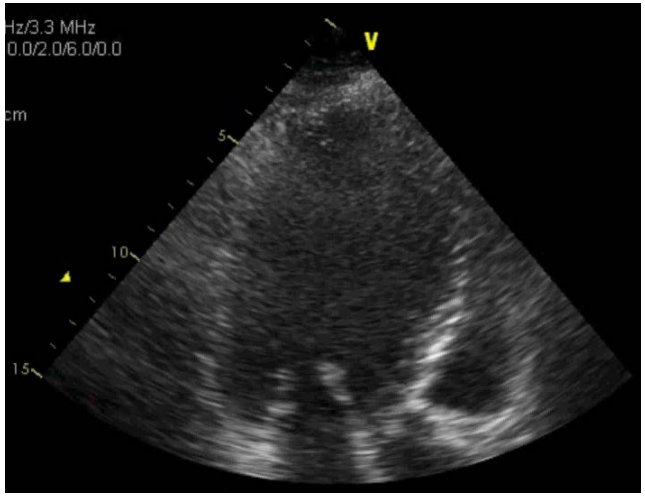
Getting started

- 2D Images Required:
  - Apical 4 chamber
  - Apical 2 chamber
  - Apical Long

Examples: 2D images



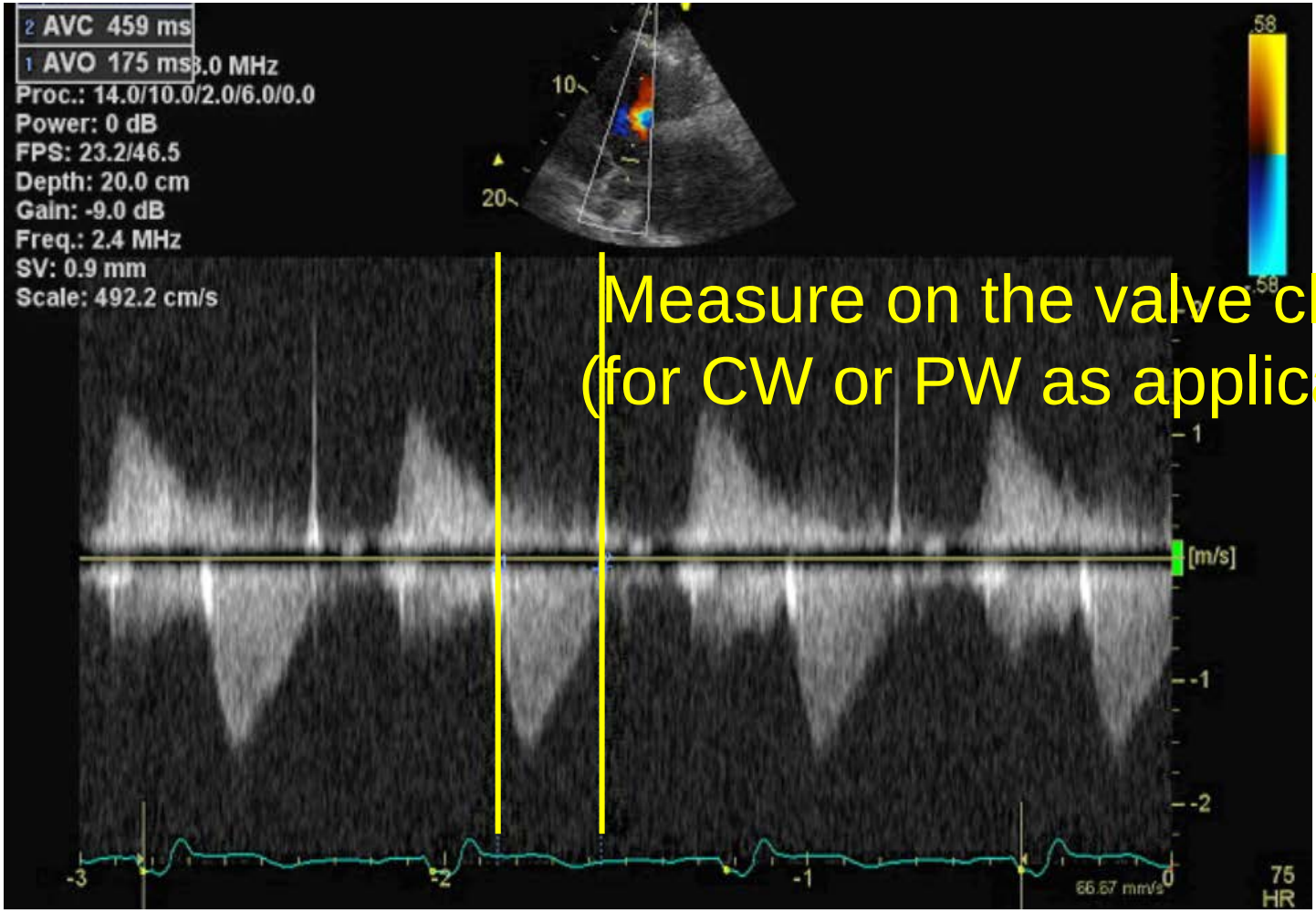




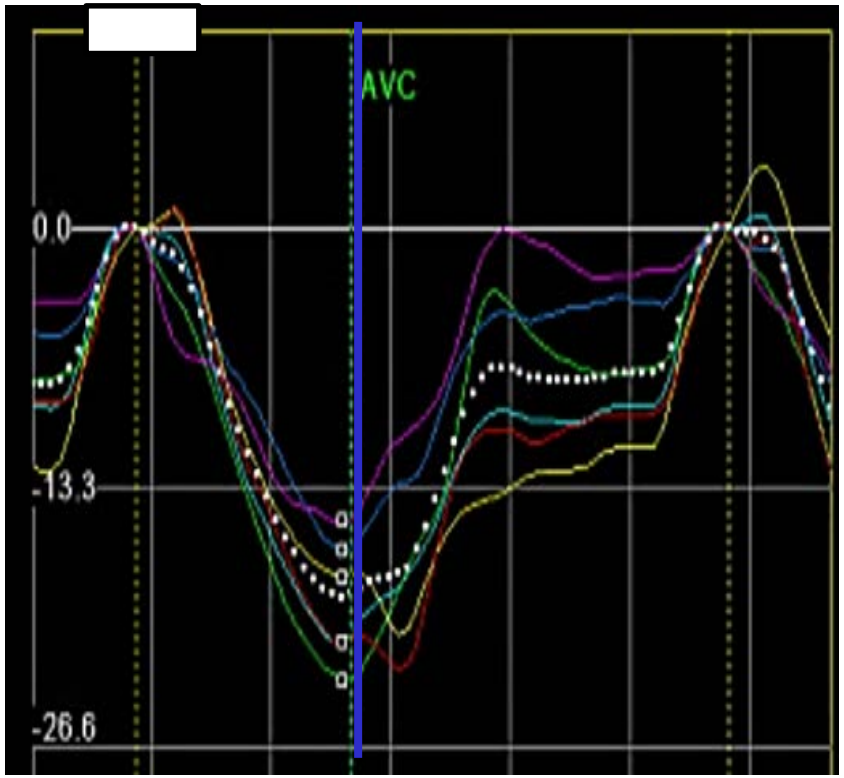
How to perform a Speckle-Tracking Strain Echocardiogram

- 2D Images Required:
  - Apical 4 chamber
  - Apical 2 chamber
  - Apical Long
- Doppler images Required (for AoV closure timing):
  - CW through AoV
  - PW of LVOT

Example: Spectral Doppler



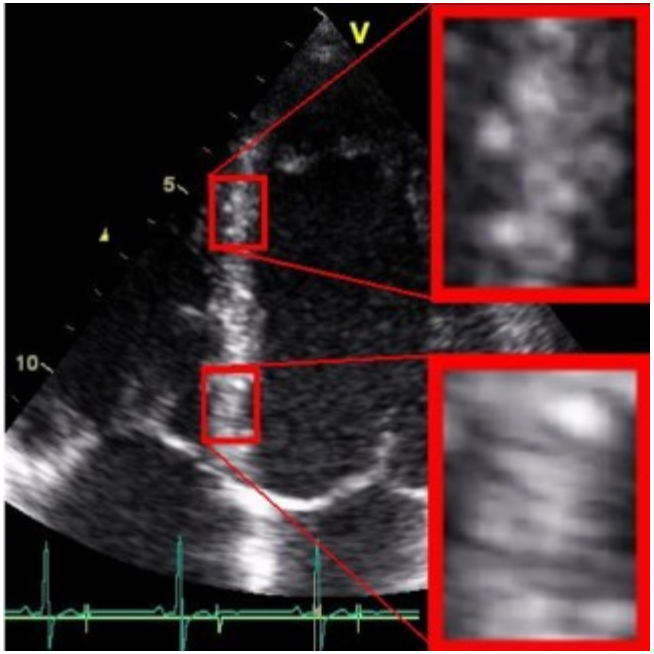
Why do we care about AoV closure?

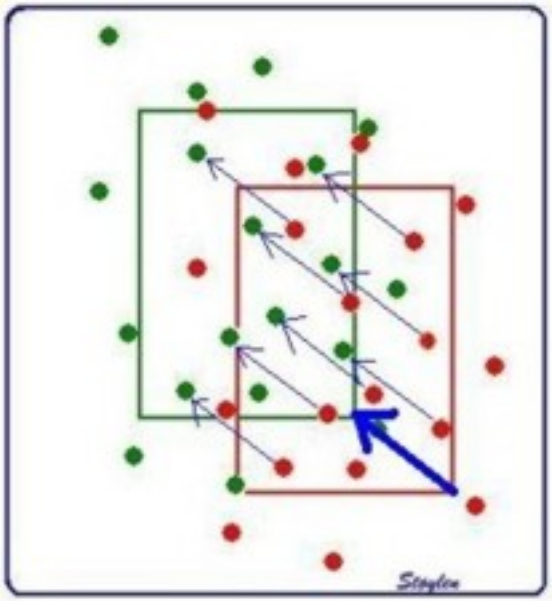


Contraction after AoV closure is wasted energy.

Why do we care about frame rate?

- Frame rate of 60-90Hz
- < 60 Hz kernels move too much
- > 90 Hz kernels don't move enough

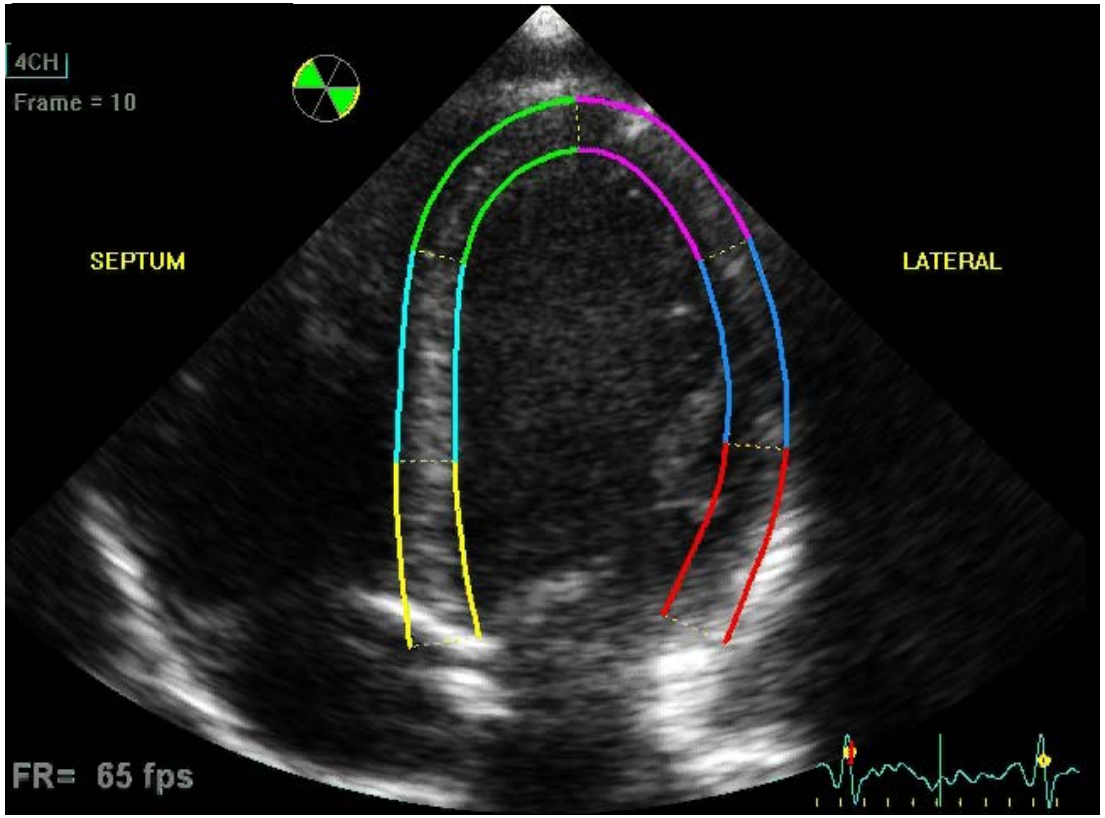




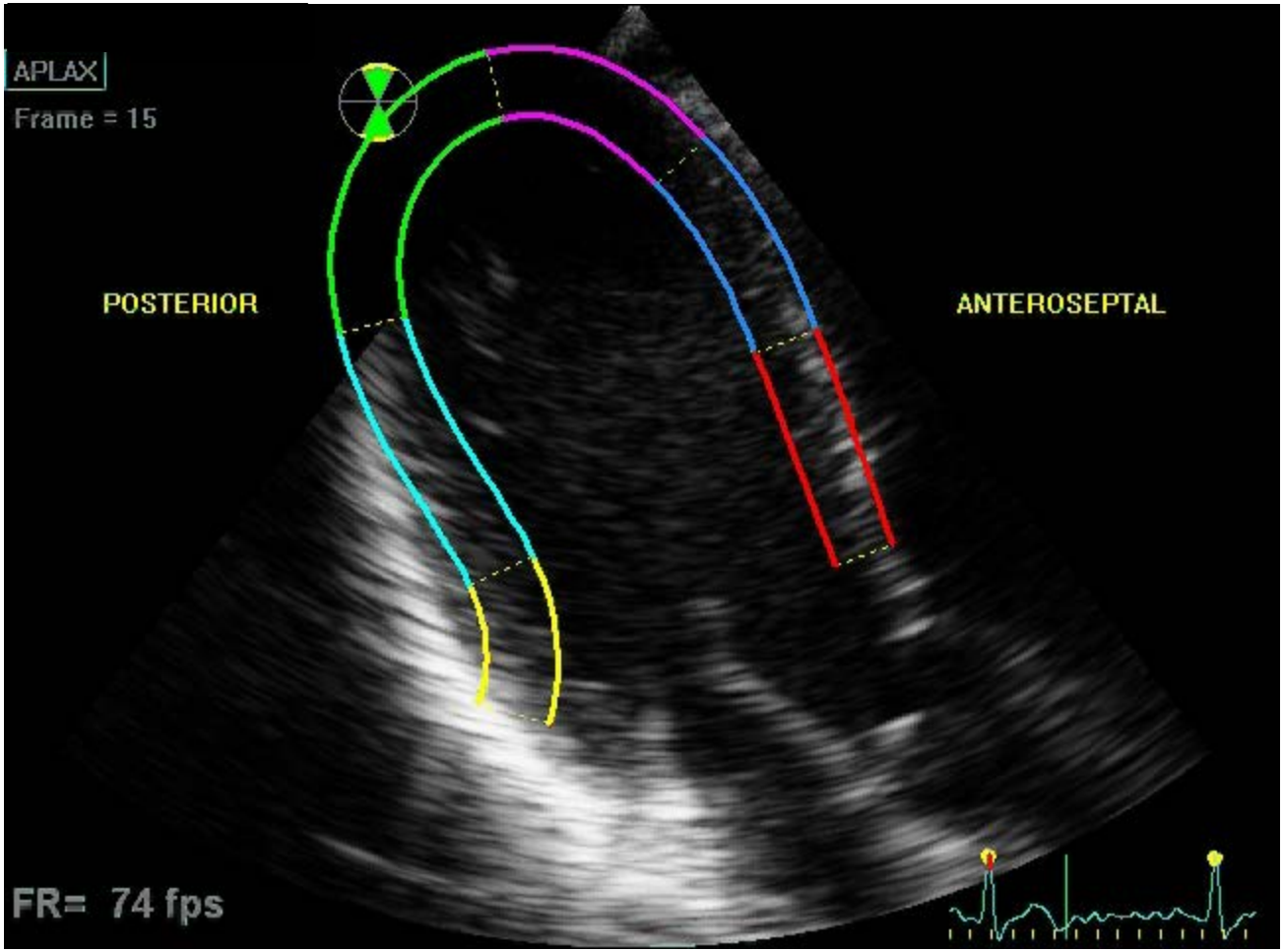
Analysis

- Check the waveforms!
- Do they make sense?
- What do they mean?
- What are the other things shown in the analysis?

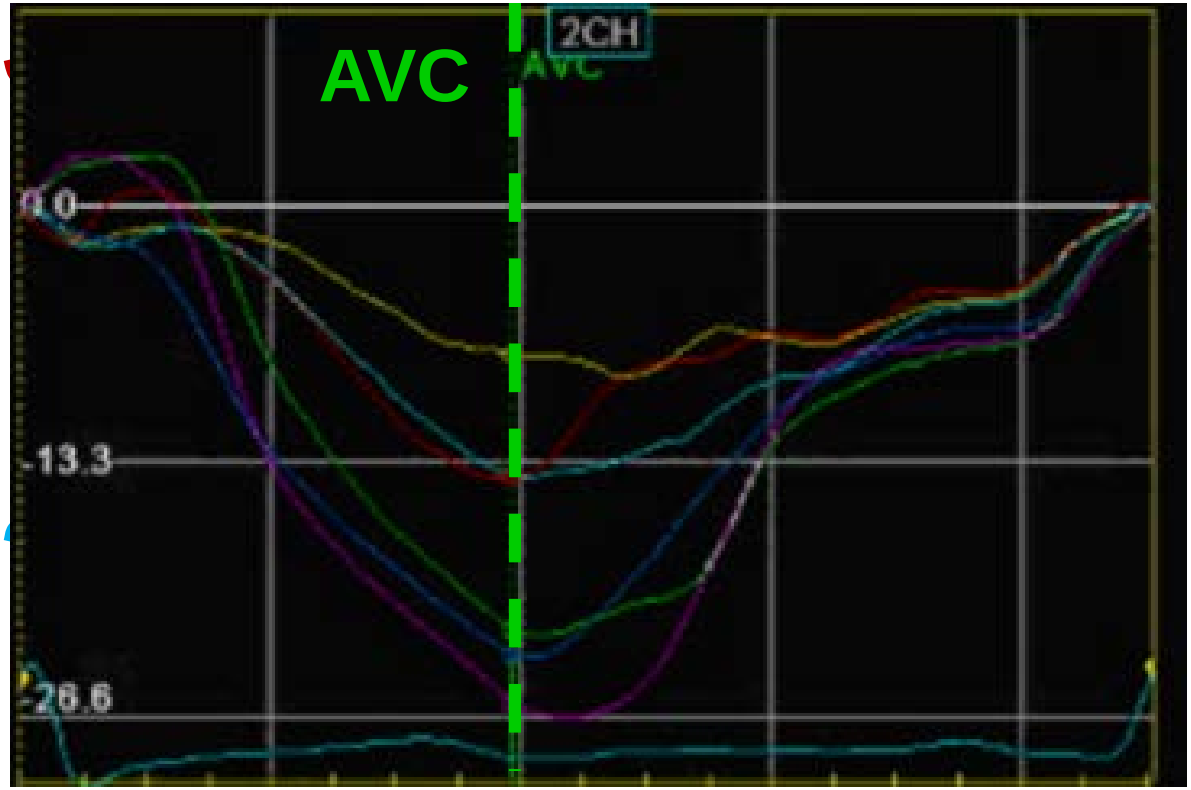
Good tracking



Bad tracking (stupid)

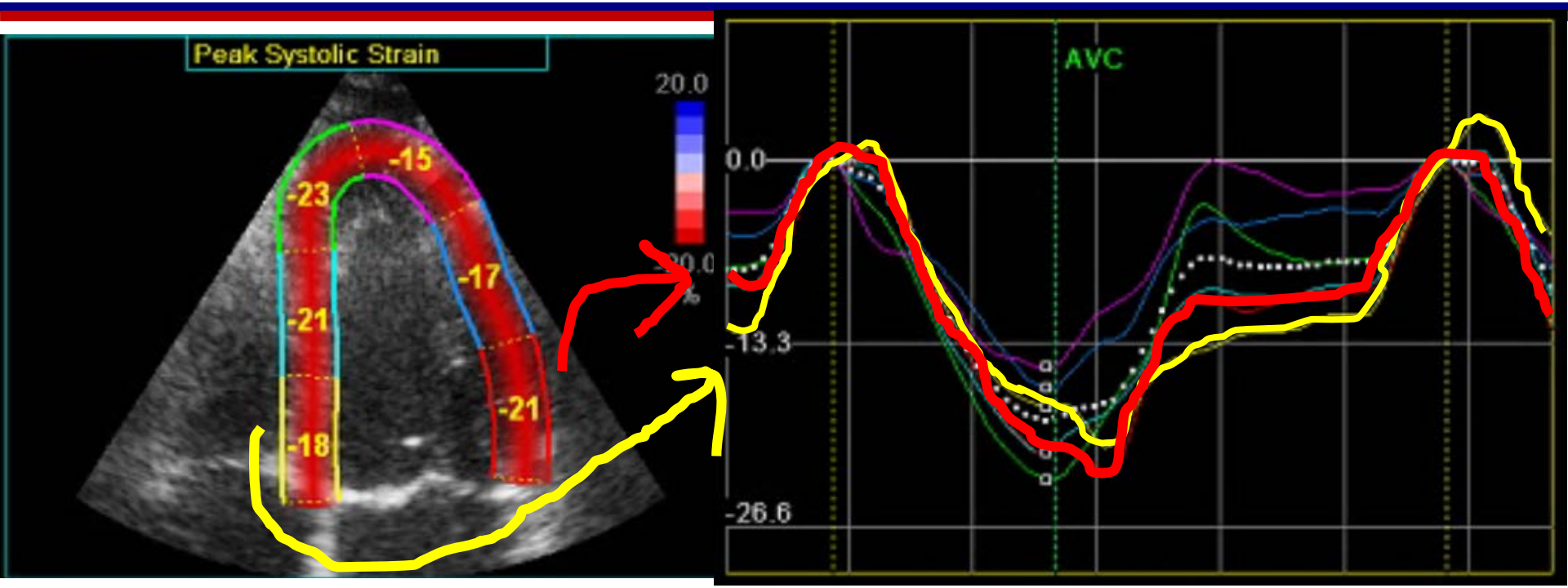


Waveforms

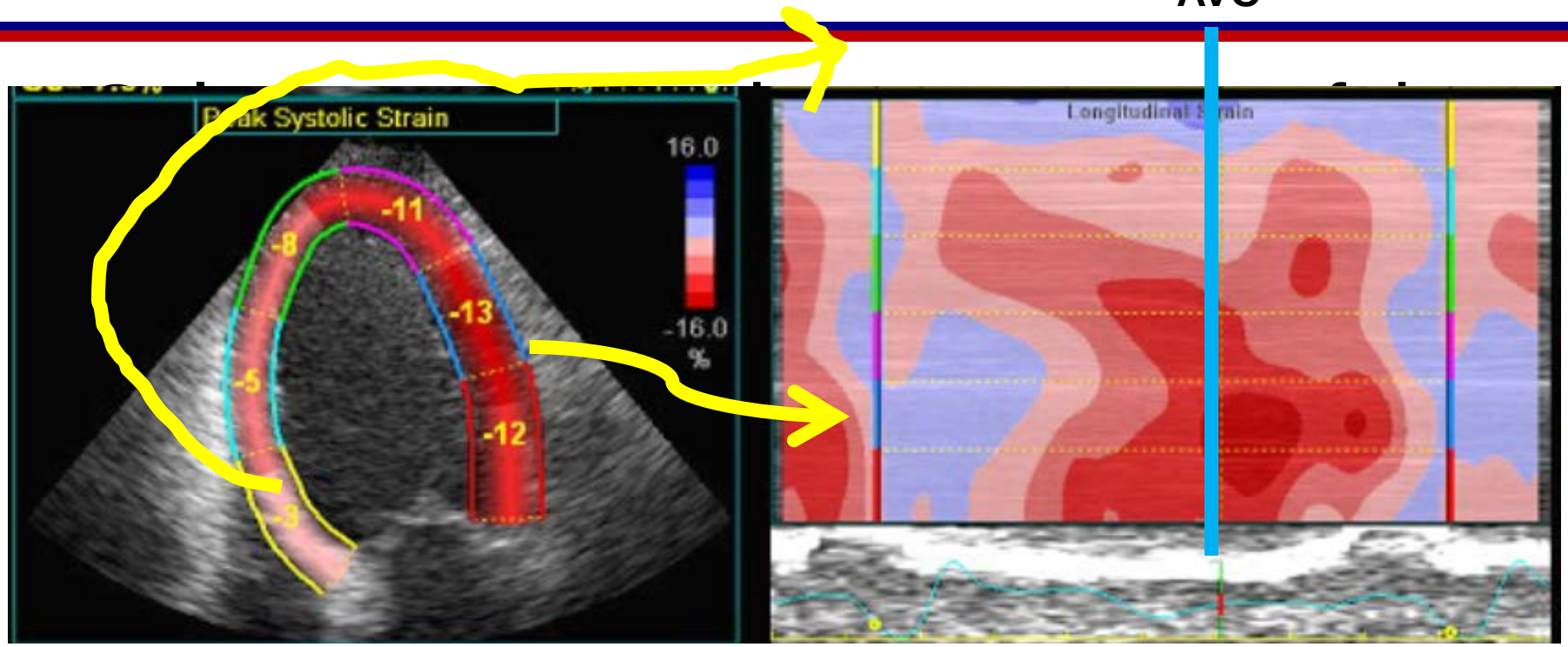


Waveforms trace the regional strain throughout the cardiac cycle

Waveforms & colors

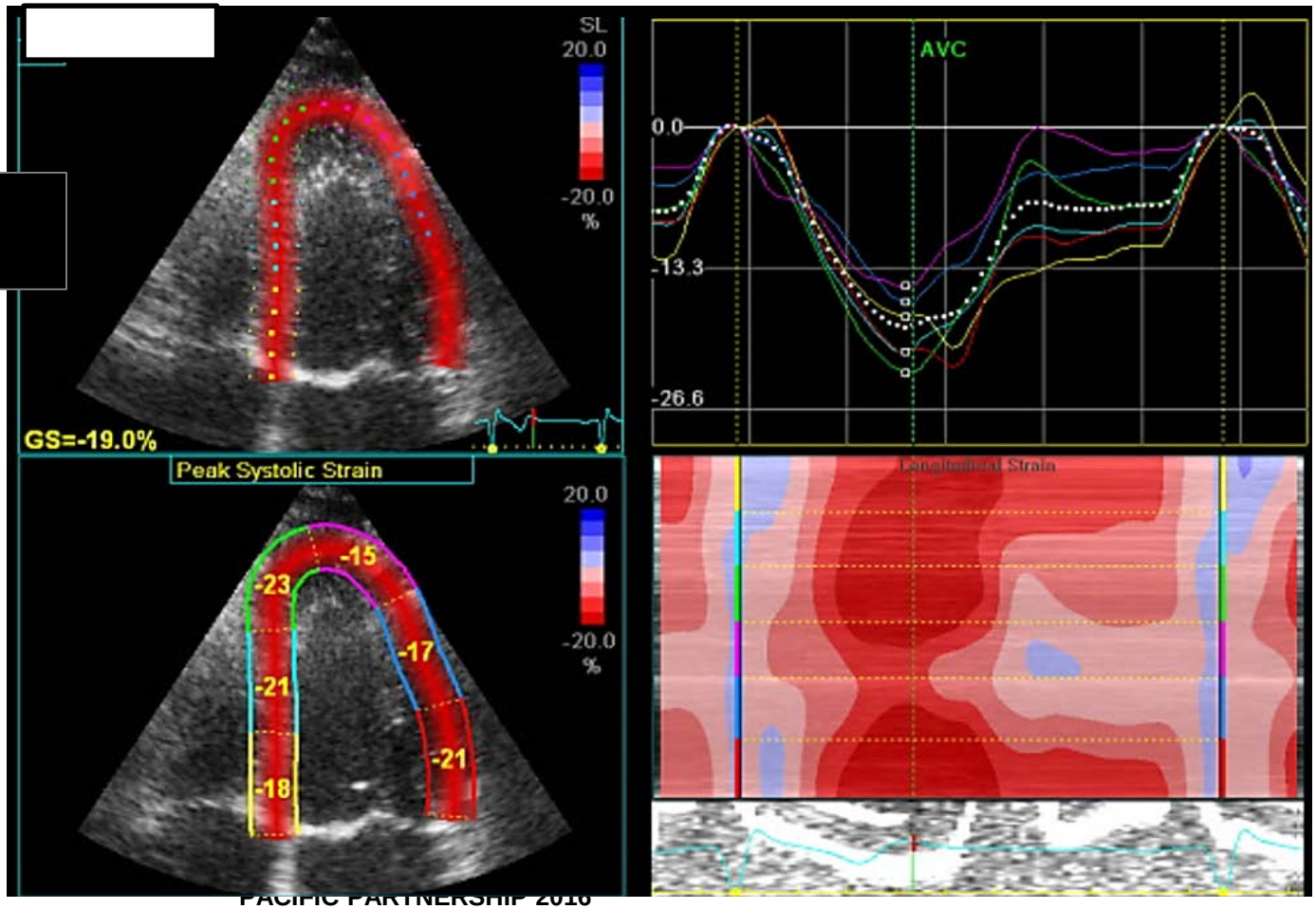


Analysis continued: M-Mode

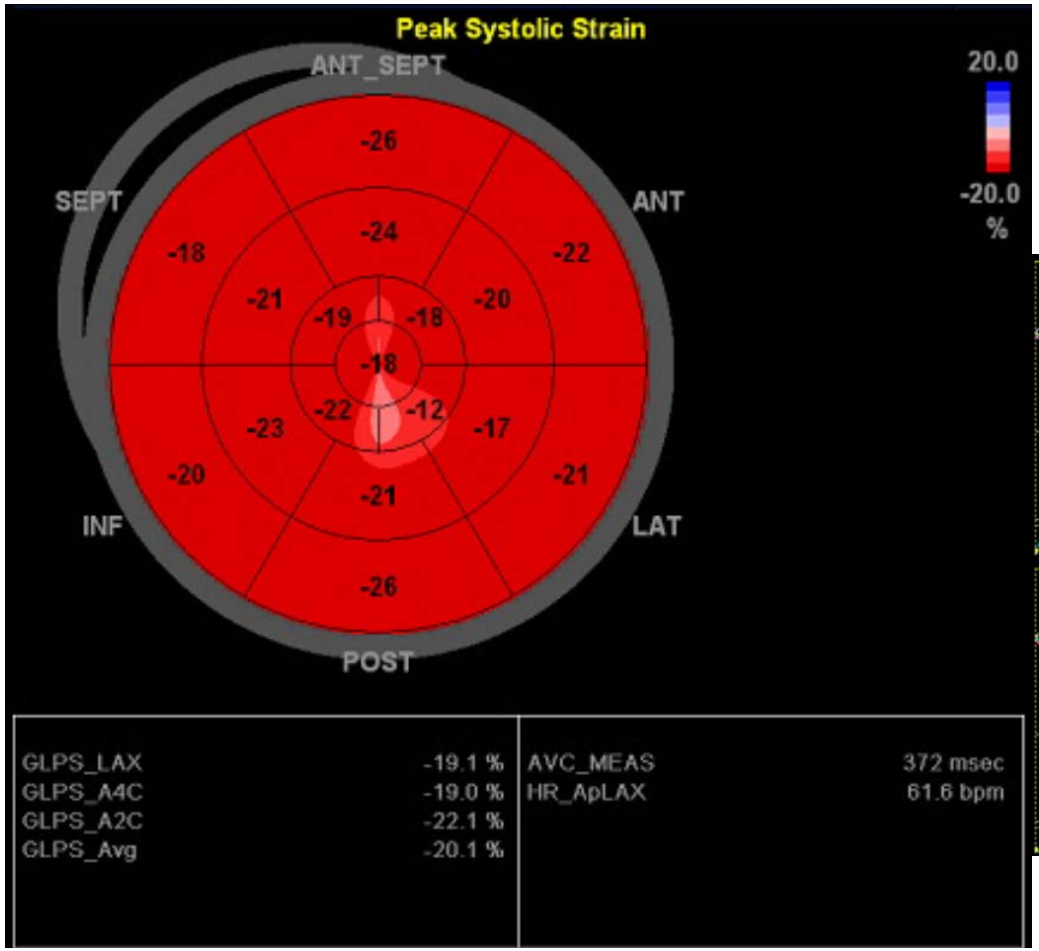


Normal LS?

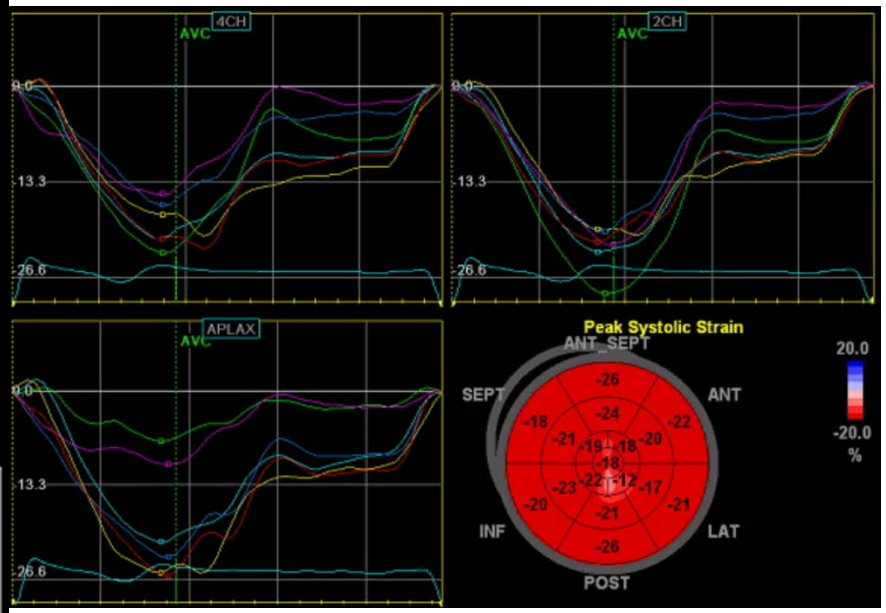
GS = -19%



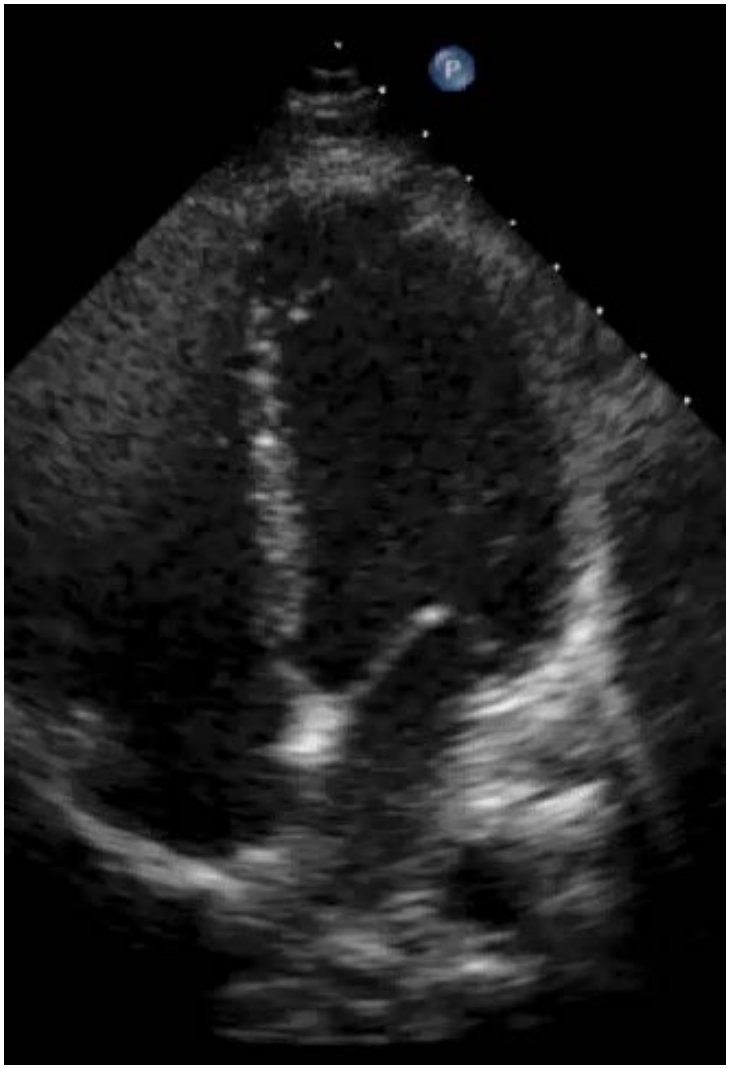
Example: End Products



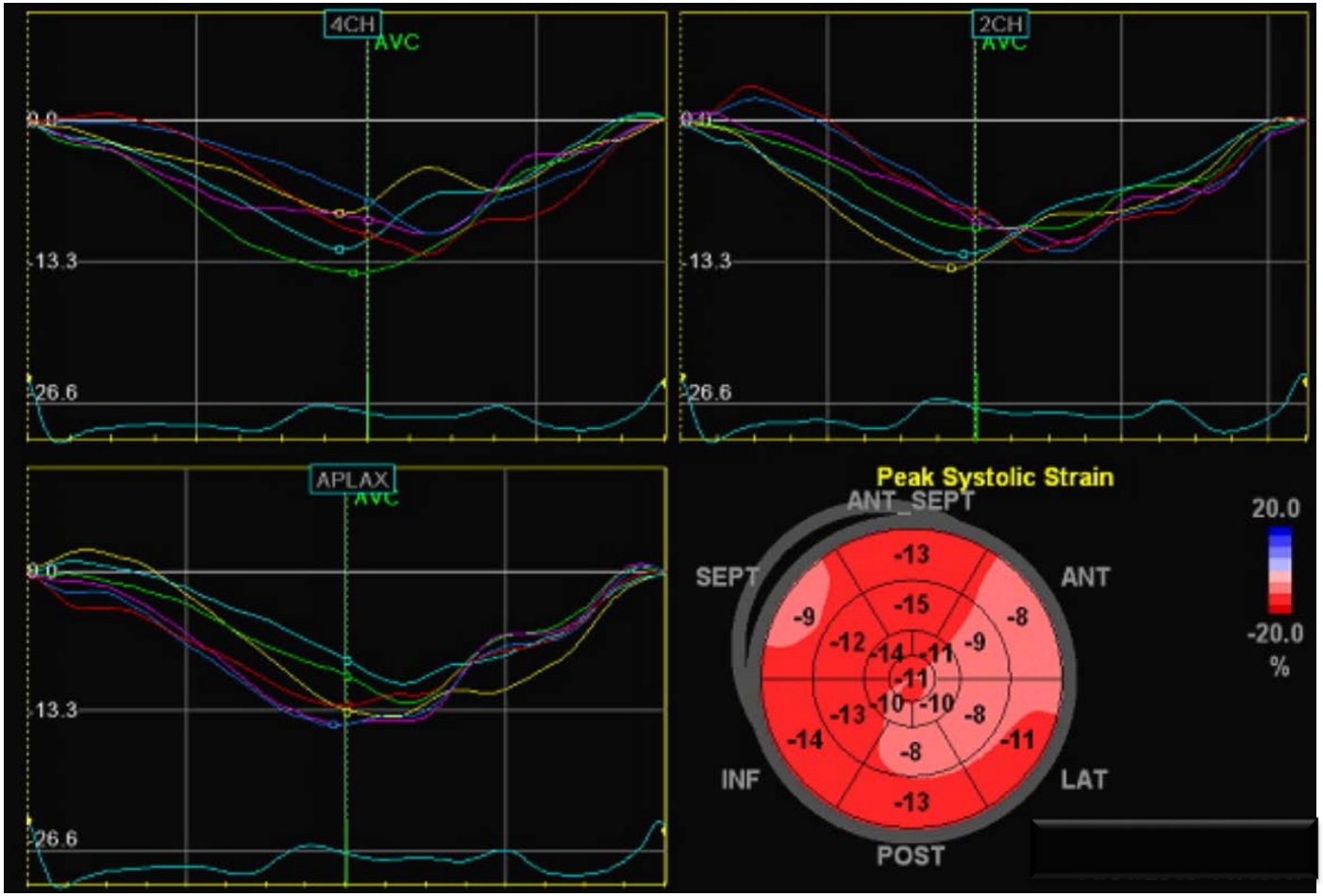
Average Global Peak Longitudinal Strain:



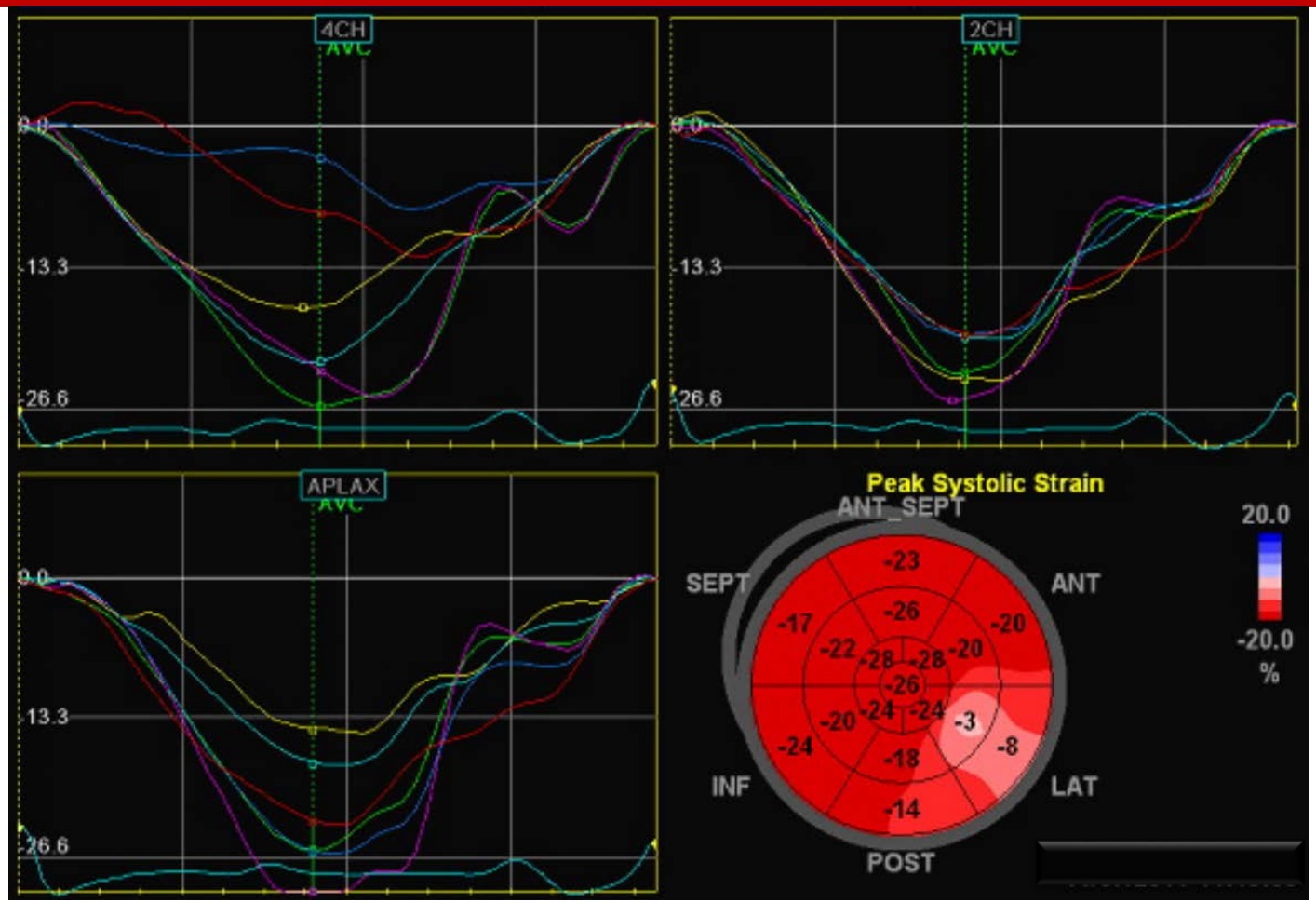
Chemo pt



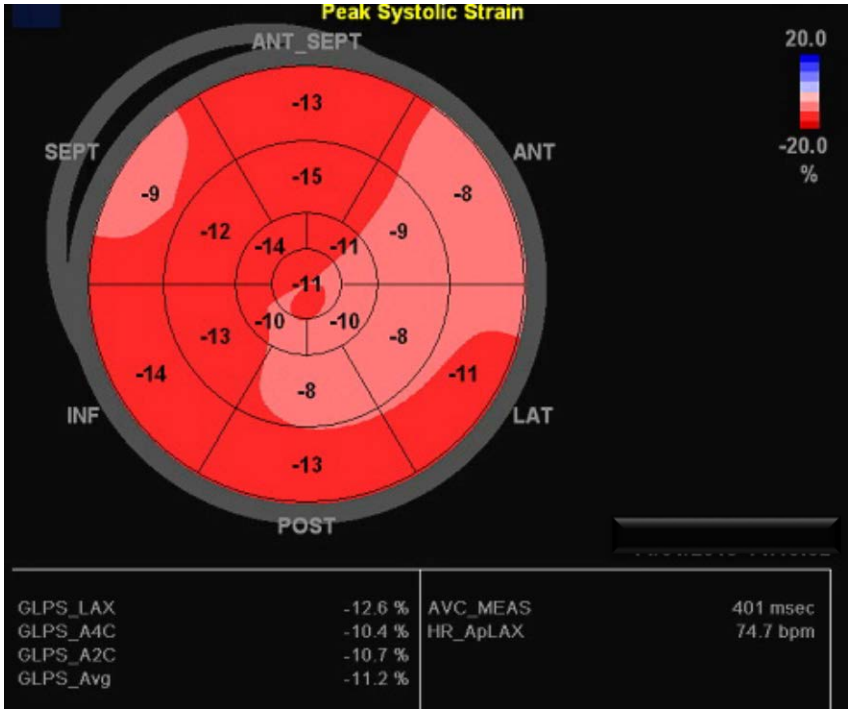
Chemo pt – Strain #1

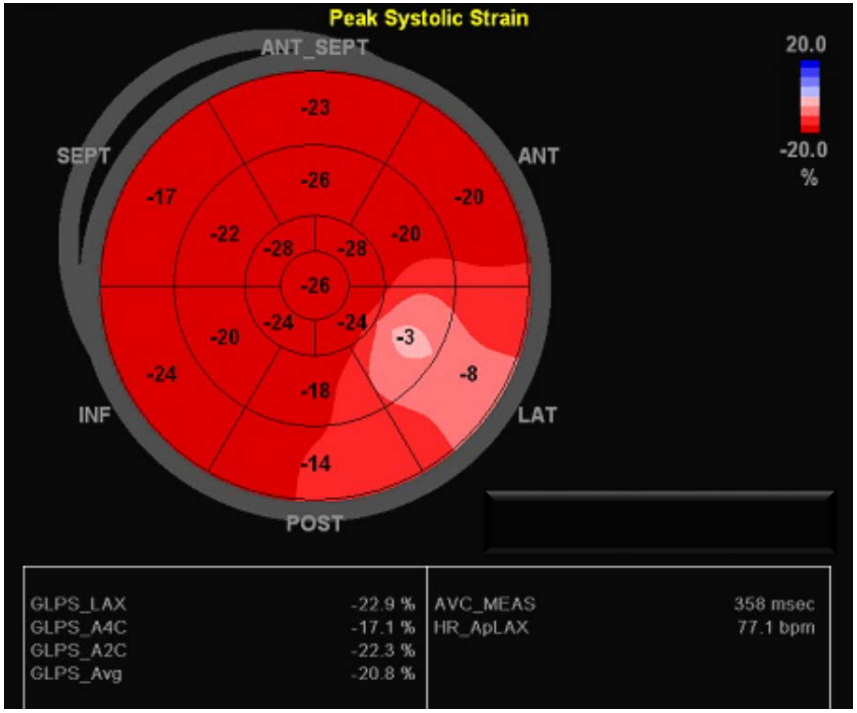


Chemo pt – Strain #2



Chemo pt – Strain #1 vs 2





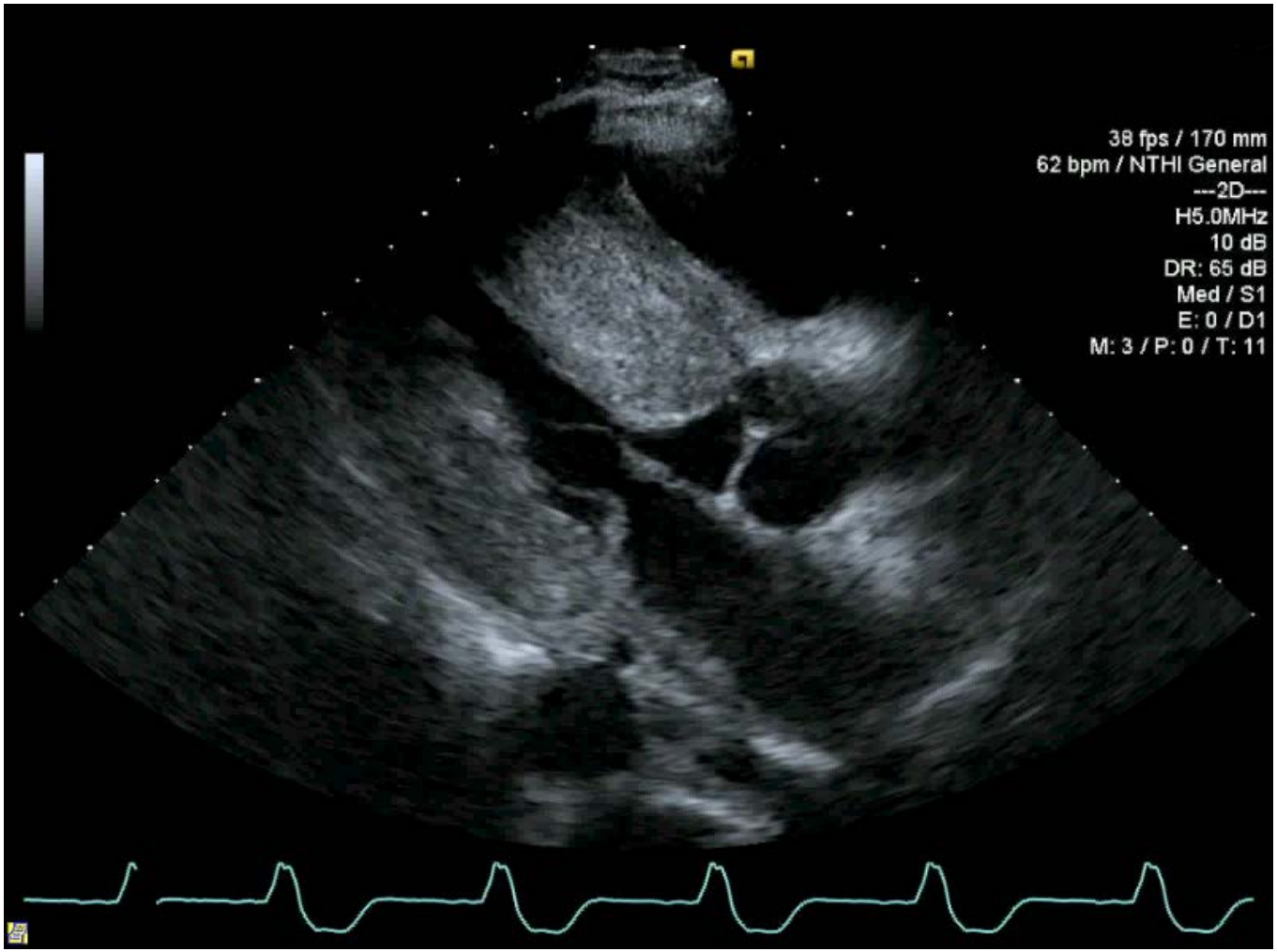
GS = -11%

GS = -20%

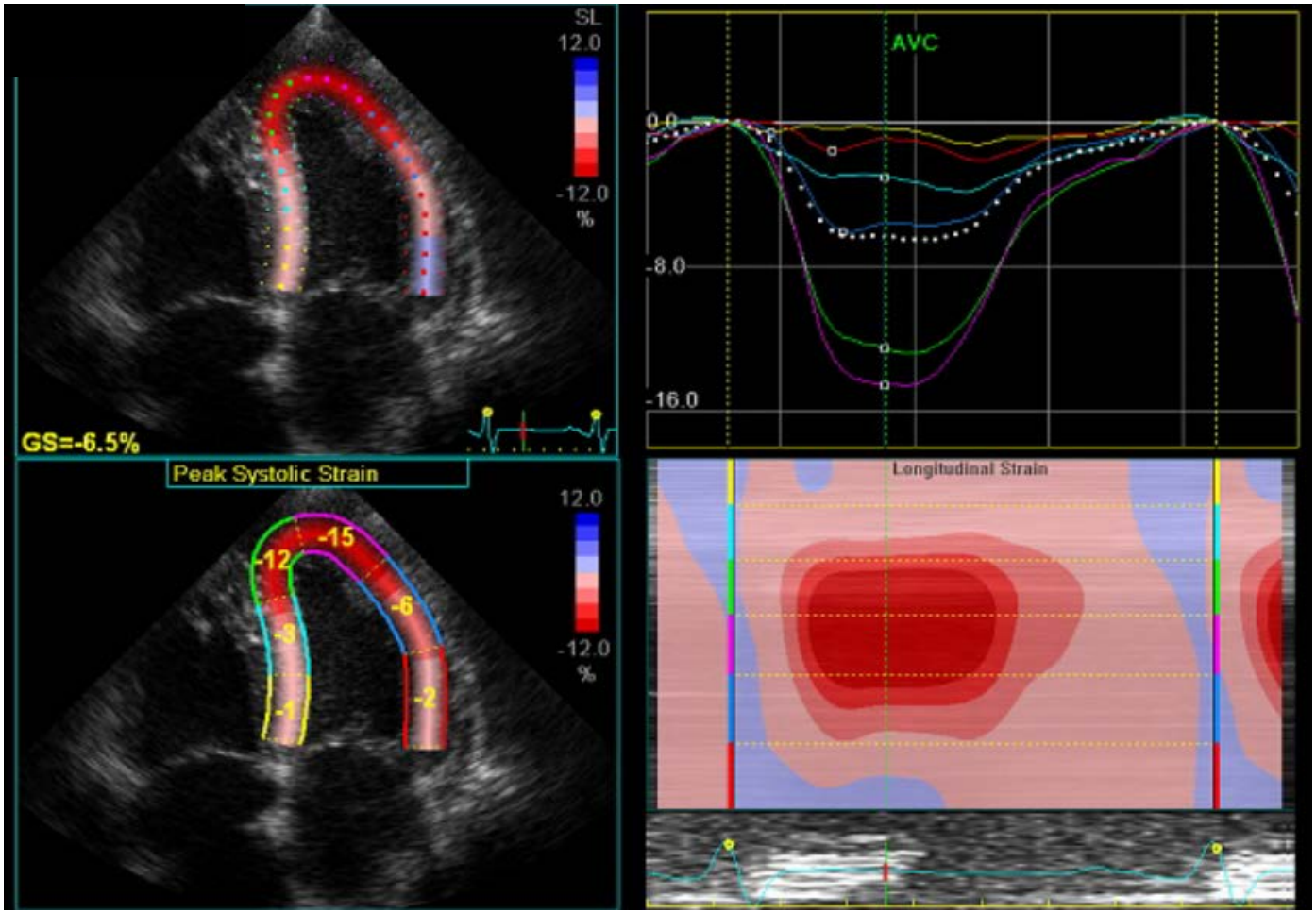
Clinical Balancing Act

- Strain improved but was chemo Rx effective?
- Not all cardiac toxicity is irreversible.
- Pick your poison?

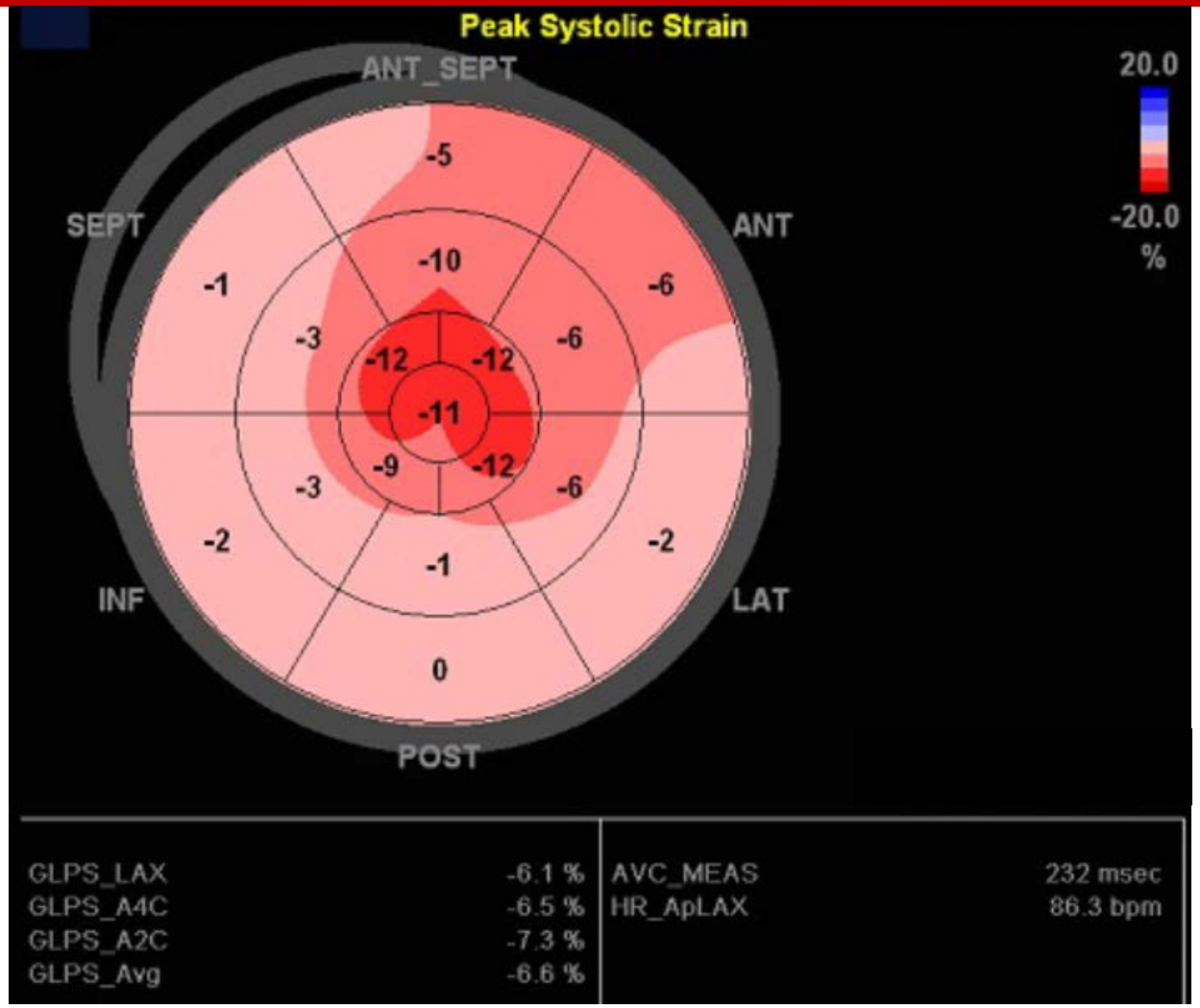
Amyloid pt?


38 fps / 170 mm
62 bpm / NTHI General
---2D---
H5.0MHz
10 dB
DR: 65 dB
Med / S1
E: 0 / D1
M: 3 / P: 0 / T: 11

Amyloid pt - Strain



Amyloid pt - Strain

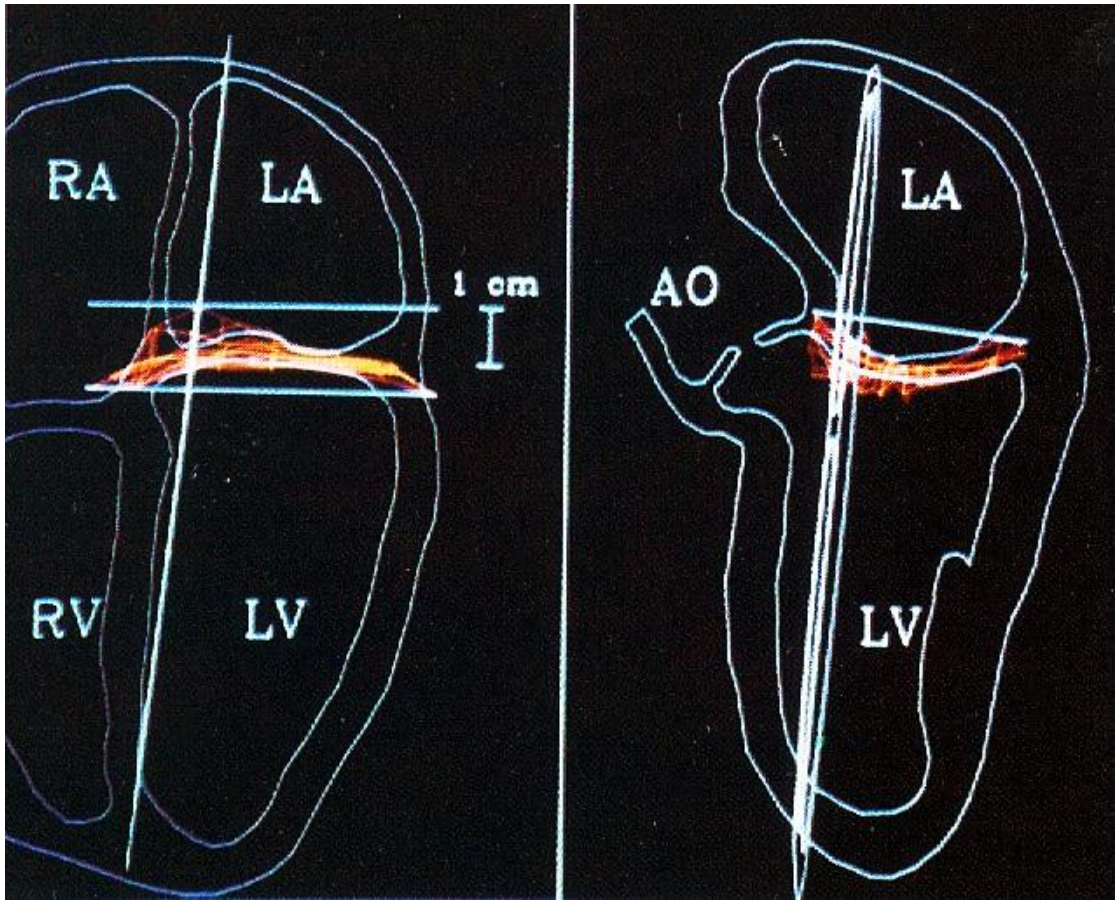


Other Strain Applications

- Cardiomyopathies (in general)
- Hypertrophic Cardiomyopathies (HCM)
- Athlete's Heart
- Sarcoidosis, Lupus
- Amyloidosis
- Myocardial Infarction
- Aortic Stenosis
- And the list is growing!

More Research

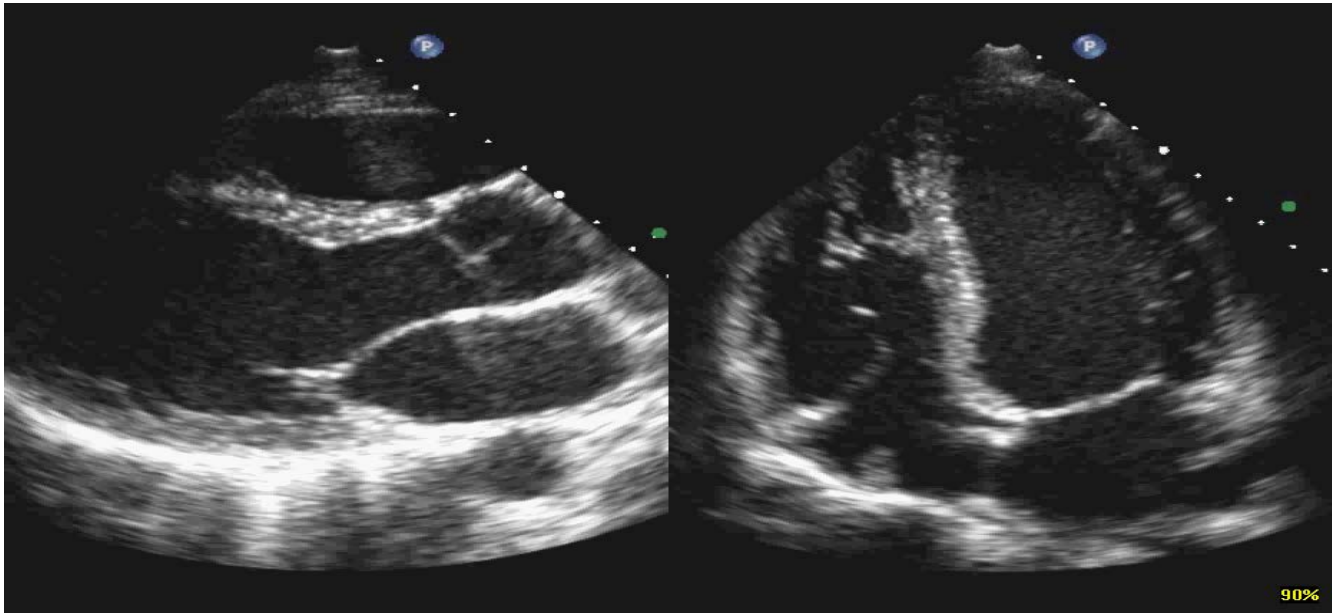
1989 MV Anatomy



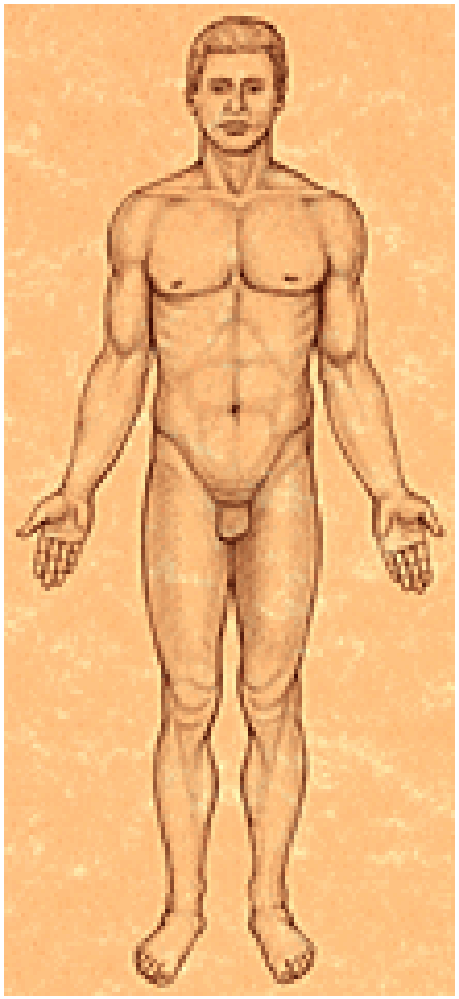
Dr. Bob Levine, et al at MGH

4 Chamber Long Axis

No MVP from Apical 4-Ch



Thanks to the Duke Echo Lab



The End

DUKE: Adams