2026 SDMS Annual Conference

“Let’s Talk Strain”, what is new in the 2025 American Society of Echocardiography, European Association of Cardiovascular Imaging, and the European Society of Cardiology Guideline and Standards Consensus Document on Strain

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SDMS 2026 Annual Meeting Atlanta, Georgia

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Learning Objectives

By the end of this talk, attendees will be able to:

1. Apply standardized acquisition techniques required for accurate and reproducible longitudinal strain assessment and reporting (LV, RV, LA).
2. Identify common acquisition and tracking pitfalls that lead to inaccurate GLS measurements and implement corrective strategies.
3. Recognize disease-specific patterns of GLS interpretation and Integrate strain curve analysis and bull's-eye displays into your assessment.
4. Integrate a multi chamber strain approach into routine echocardiographic practice.
5. Explain the sonographer's role in ensuring reliable serial strain measurements for longitudinal patient follow-up.

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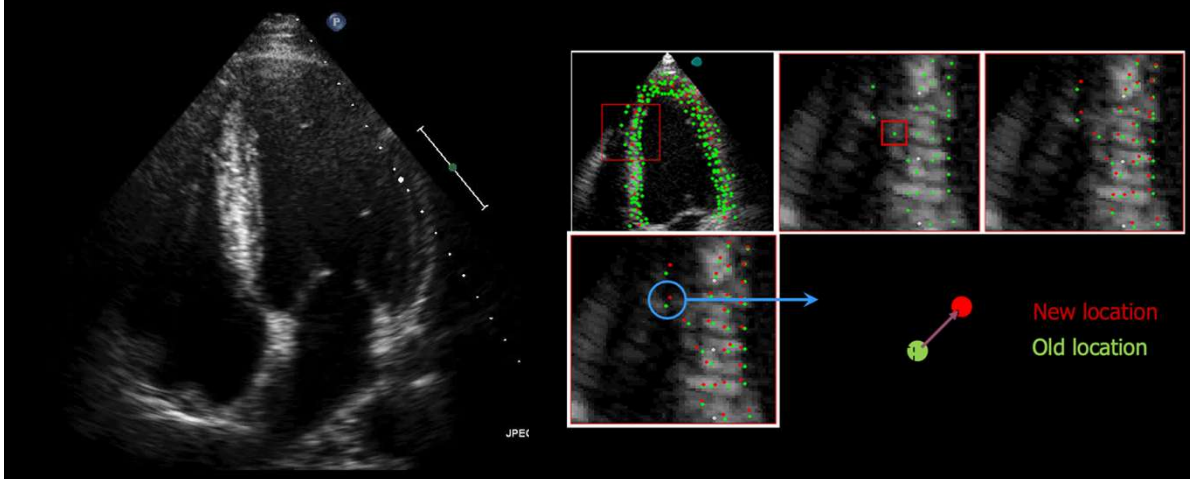
Speckle Tracking Strain



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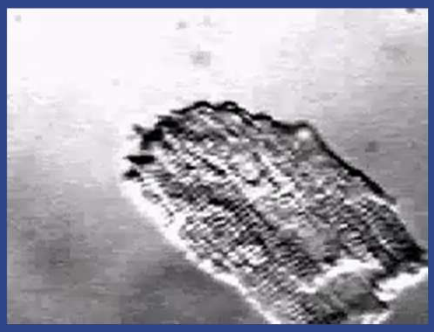
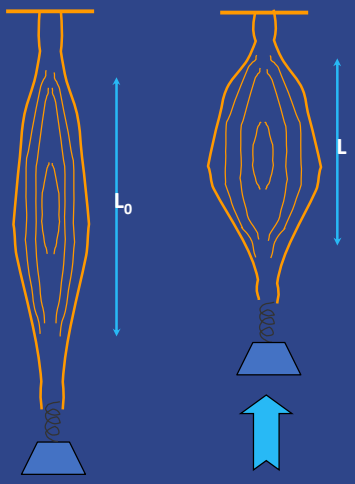
Strain is a dimensionless index of change in length

Strain (ε) = $(L-L_0)/ L_0$





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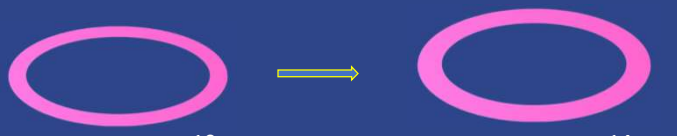
Strain Calculation

- End – diastole
  (LV short axis)
- End – systole
  (LV short axis)



10mm 14mm

Strain calculates % thickening or shortening
Strain = 14 – 10/10 = 40%
Ending thickness - starting thickness / starting thickness = % strain

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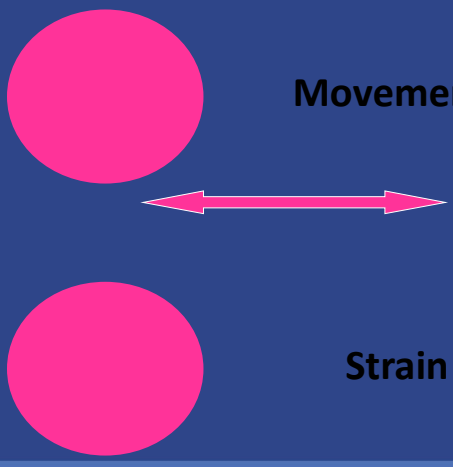
Movement vs Deformation



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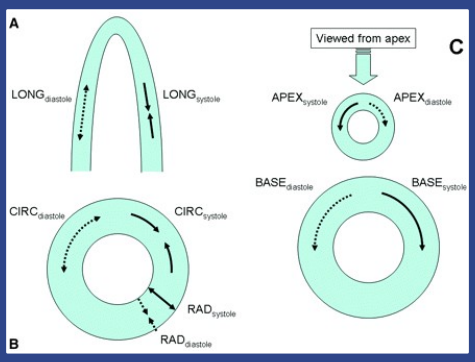
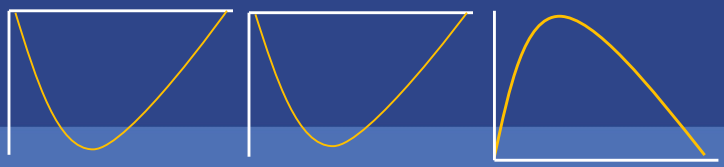
Three Main Types of Strain

- Longitudinal strain – systolic myocardial *shortening* from base to apex (negative strain)
- Circumferential strain – reflecting intramural circumferential *shortening* (negative strain)
- Radial strain – % thickening of the heart muscle toward the center from the endocardium- to epicardium (transmural)





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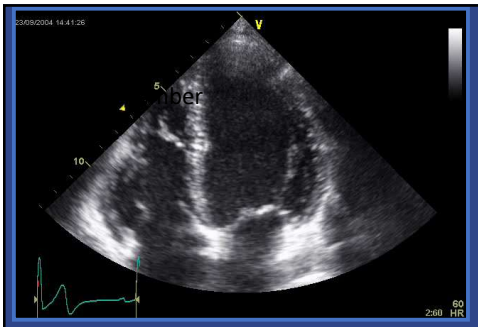

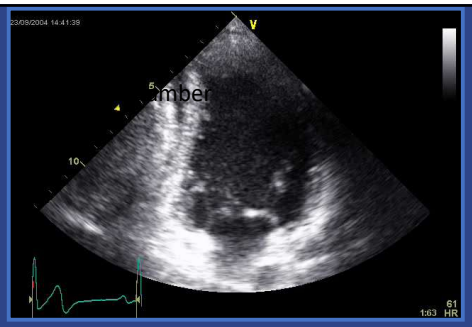

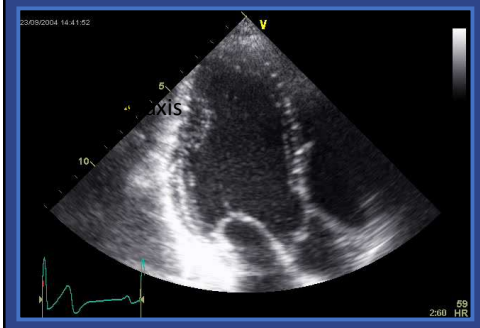

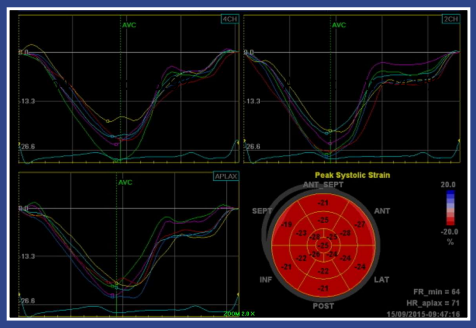

Global longitudinal strain (GLS) reflects the average shortening from the three views and is the most reported strain parameter.

It is a negative number but "increase" or "decrease" by convention refers to distance from zero.

GLS: -24.1%

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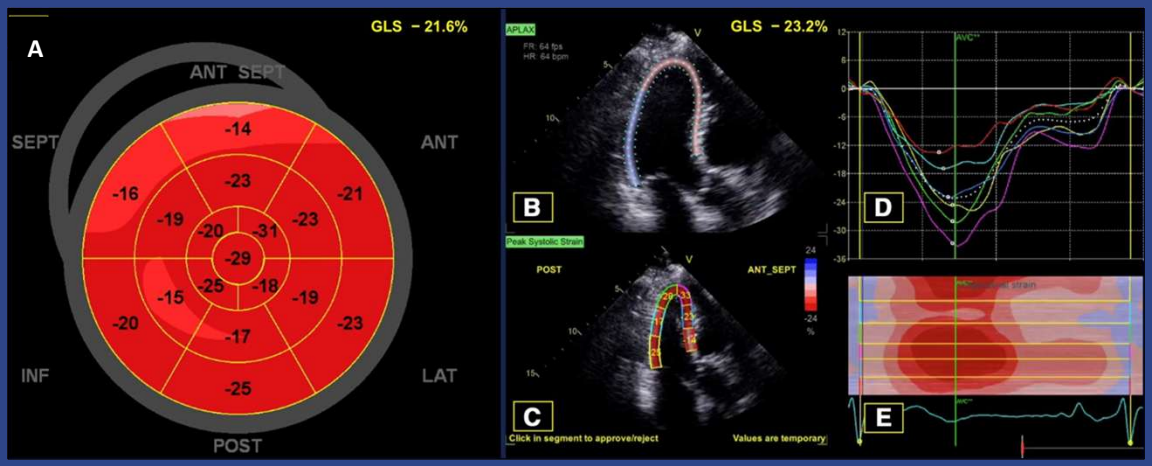
Typical Strain Output



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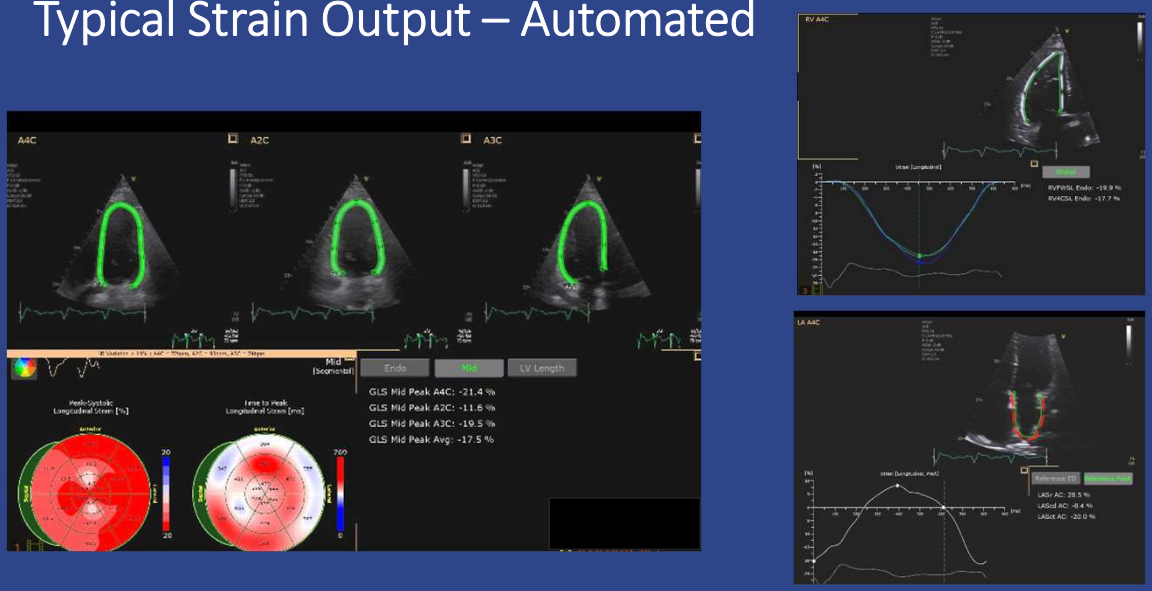
Typical Strain Output – Automated



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Gating and Acquisition

	Optimal ECG signal	Pay attention to ECG Heart rate with minimal variability – 3 best clips AVC
	Frame rate between 50-90 fps	Reduced temporal resolution Speckle drop out Inadequate tracking
←	**Sequential capture of images**	Longitudinal 4C, 2C, 3C Circumferential Base, Mid, Apical

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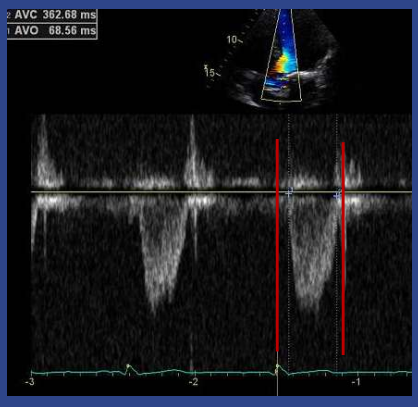
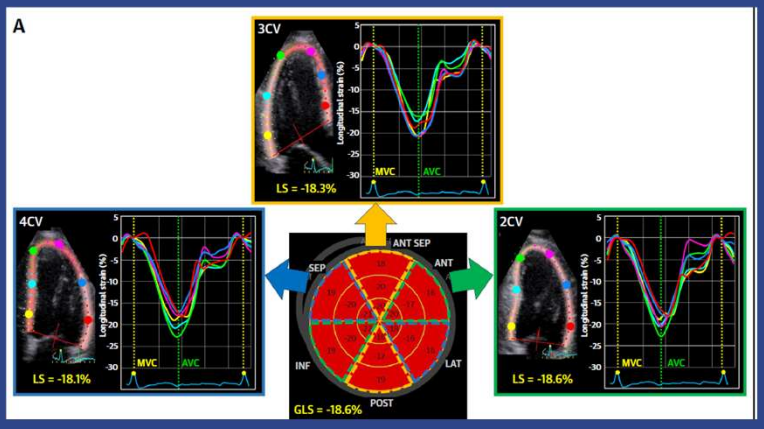
Aortic Valve Closure Timing





JJACC: Cardiovascular Imaging, Vol 18, No.3, 2025, Smiseth-et-al
Myocardial Strain Imaging: Theory, Practice, and Future

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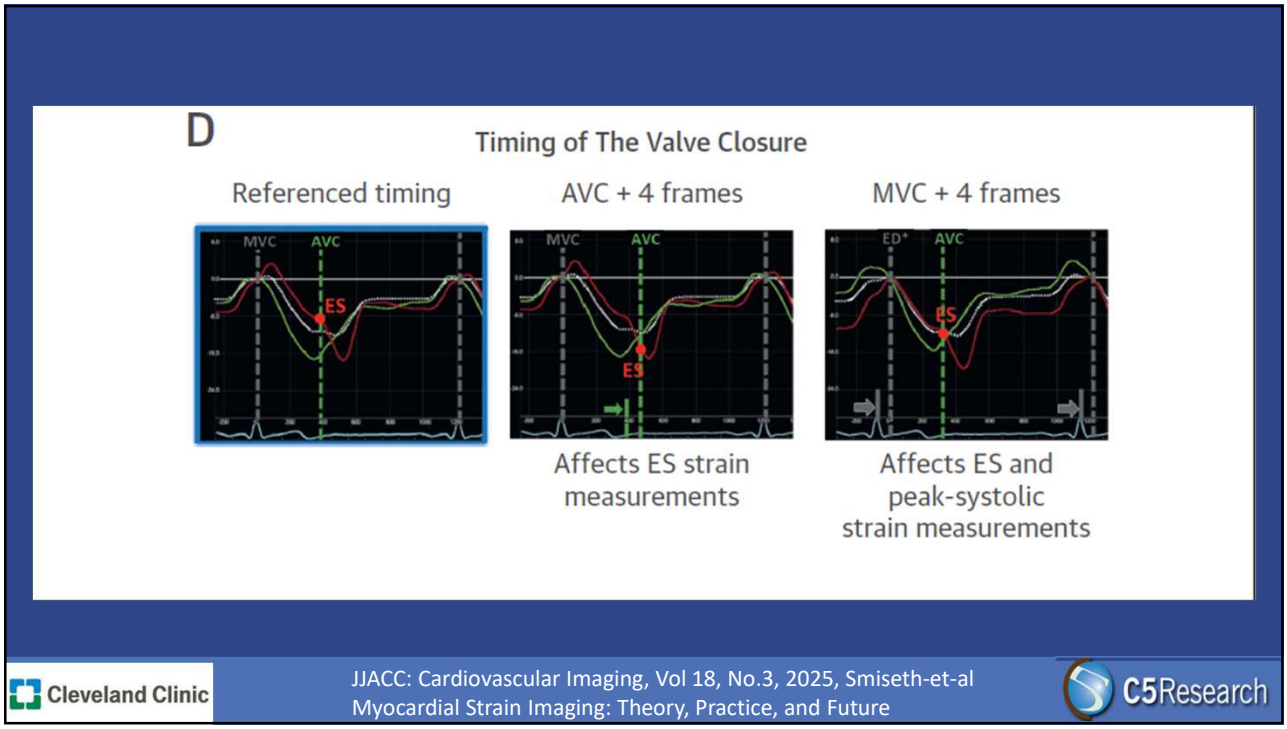

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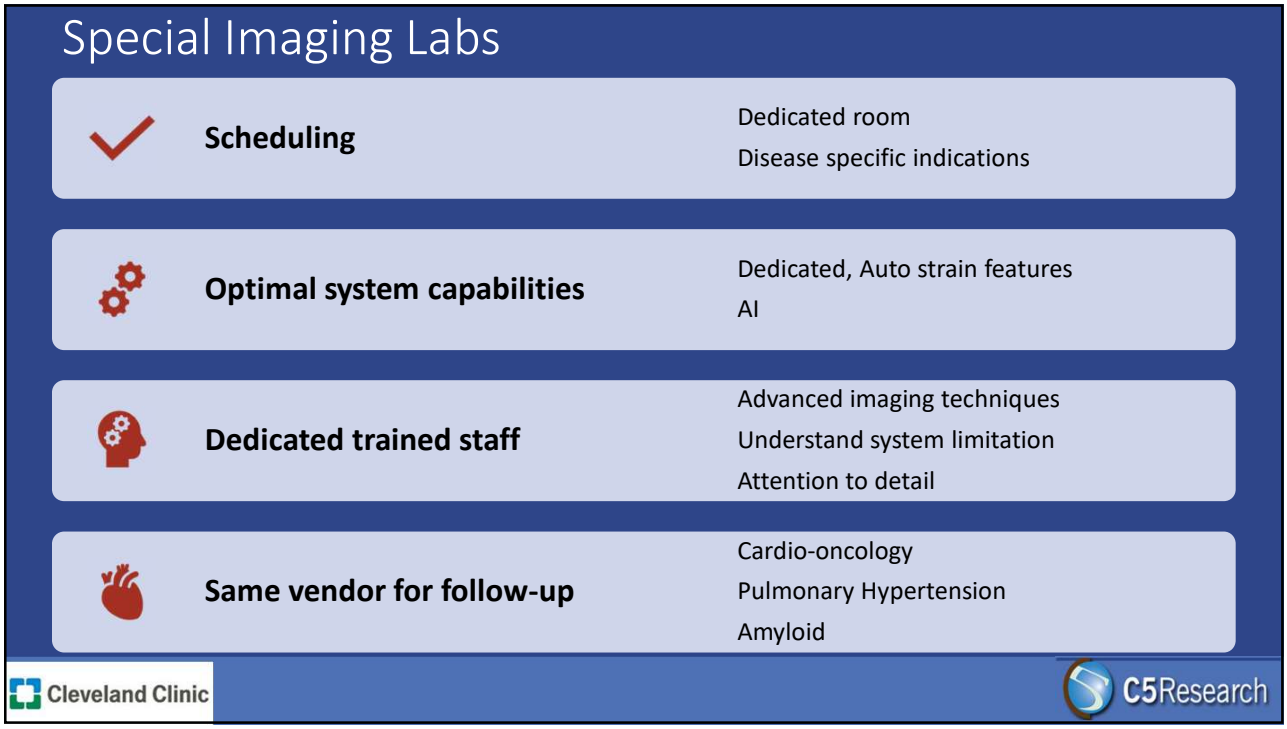

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Longitudinal Strain- LV Global

- Assure stable ECG
- AVC timing
- Optimize apical images (non foreshortened!)
- Check frame rates
- Acquire sequentially, 4C, 2C, 3C images (breath hold)



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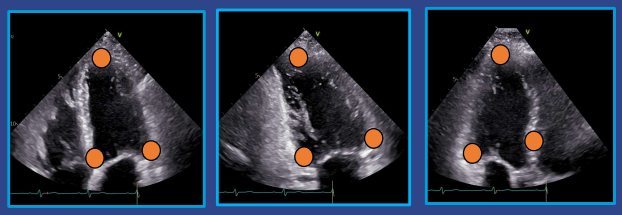
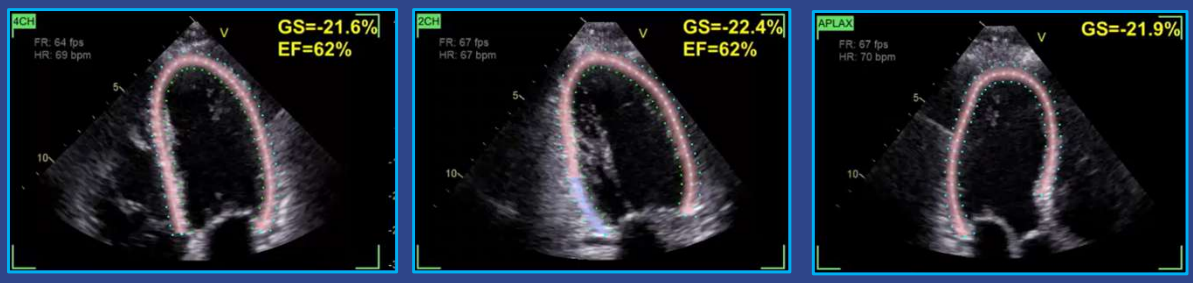
Setting ROI

- **Watch wall motion carefully**
- **Avoid pericardium, papillary muscles and trabeculations**
- **Adjust ROI width when necessary**
- **Consensus statement recommends full-wall/mid-wall capture rather than endocardial**





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Technical Pitt falls

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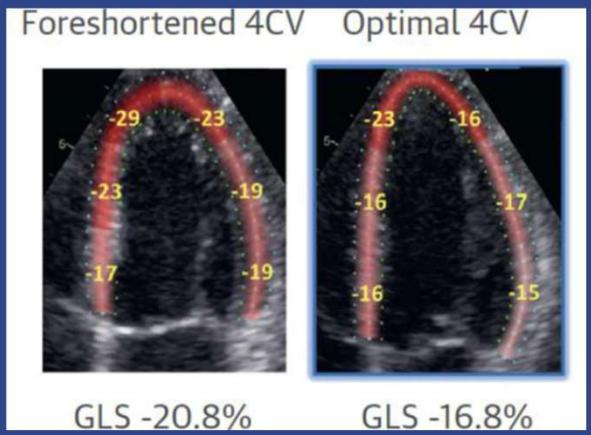
Foreshortening the LV Apical Windows

- Ensure the true apex is visualized during acquisition
- Foreshortening of the LV apical windows increases apical segmental strain values



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Thomas et al, https://doi.org/10.1016/j.echo.2025.07.007

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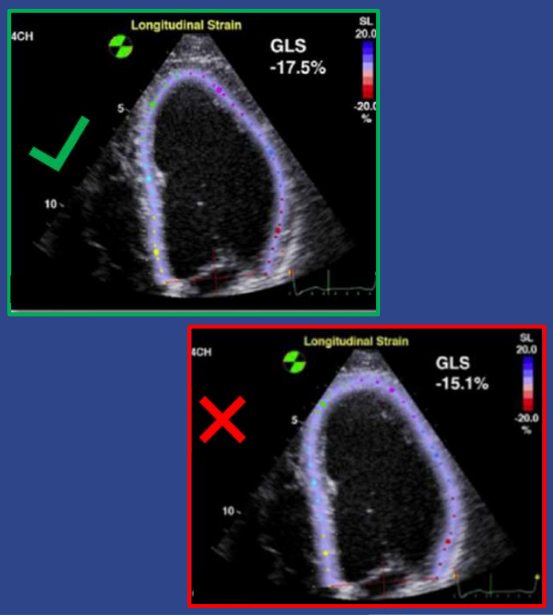
Proper ROI Thickness

- Ensure only the full myocardial wall is included in the ROI
- ROI should not include the pericardium
- Too thick ROI will underestimate true strain value
- Too thin ROI will overestimate true strain value



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Thomas et al, https://doi.org/10.1016/j.echo.2025.07.007

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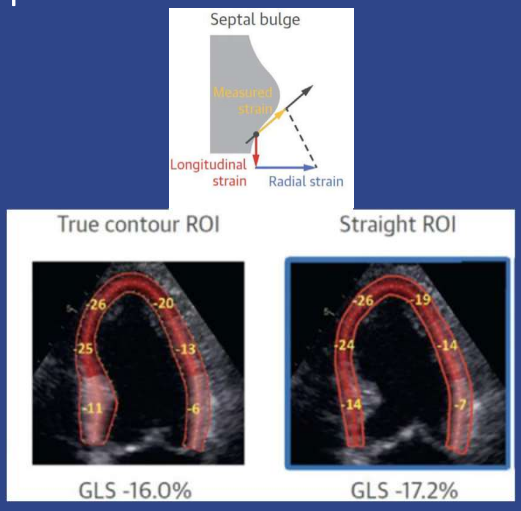
ROI Thickness in Hypertrophic Hearts

- Localized thickening
- Draw ROI straight ignoring septal bulge
- When increased thickening extends across more than a full wall segment recommendation is to thicken the entire region



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Thomas et al, https://doi.org/10.1016/j.echo.2025.07.007

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ROI Thickness in Hypertrophic Hearts



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Smiseth et al JACC:CARDIOVASCULARIMAGING,VOL.18,NO.3,2025
Myocardial Strain Imaging: Theory, Practice, and Future MARCH2025:340–381

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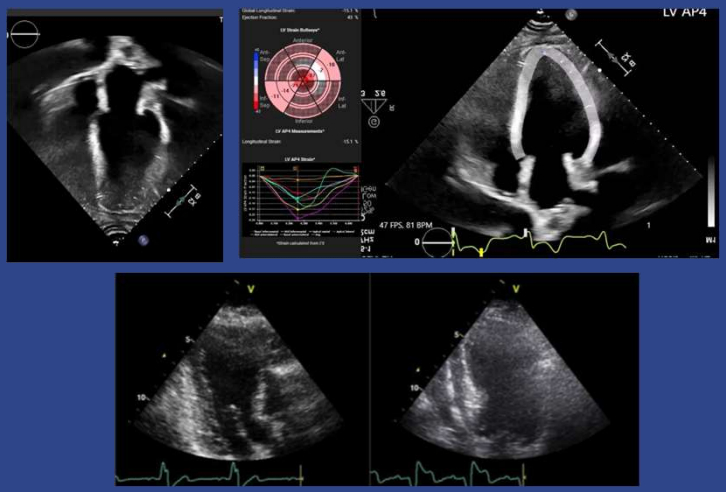
Technical Pitfalls Affecting Strain Accuracy

- Poor quality images
- Inaccurate ROI selection
- Tracking errors
- End-diastole and End-Systole timing errors
- ECG rhythm irregularities
- Extreme blood pressure affecting preload



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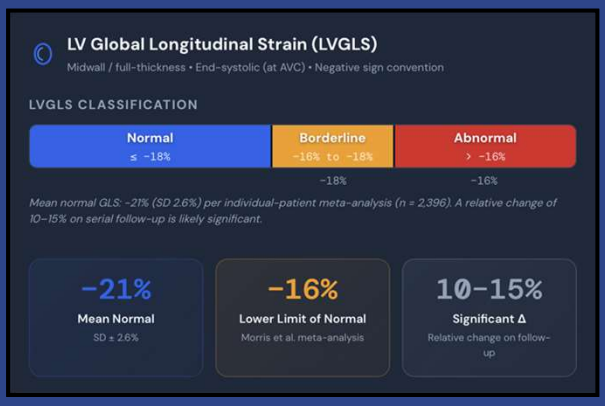
Clinical Consensus Statement

LV Global Longitudinal Strain (GLS)

- Borderline GLS -16% to -18%.
- Abnormal GLS < -16%.
- The optimal use of LV GLS is in sequential follow-up, by comparison with baseline. Used in this way, a relative change of 10% to 15% is likely to be significant.



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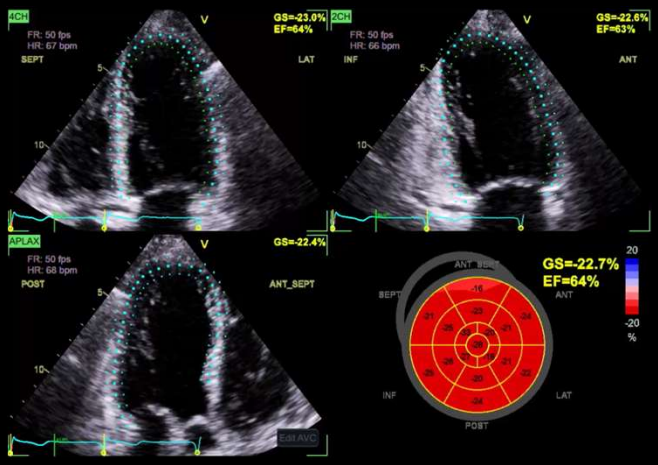
Reproducibility and Accuracy - Recommendations

- Optimal gain settings
- Frame Rates (50-90)
- Endocardial and epicardial border delineation (D&S)
- Adjust sector width and depth to focus on chamber of interest
- Avoid apical foreshortening
- Avoid non-standardized views
- Avoid image translation
- Breath hold capture technique



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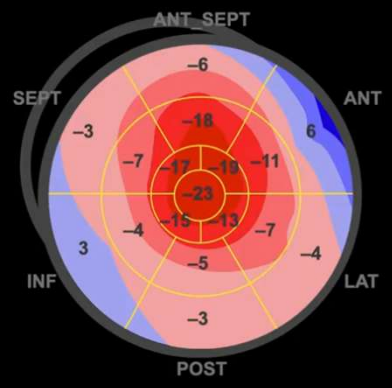
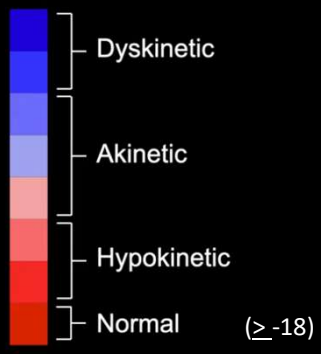
LV Strain Bulls Eye Pattern Recognition





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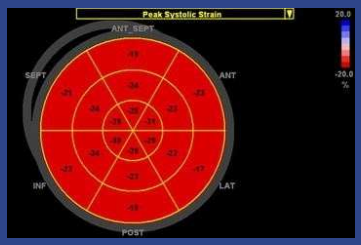
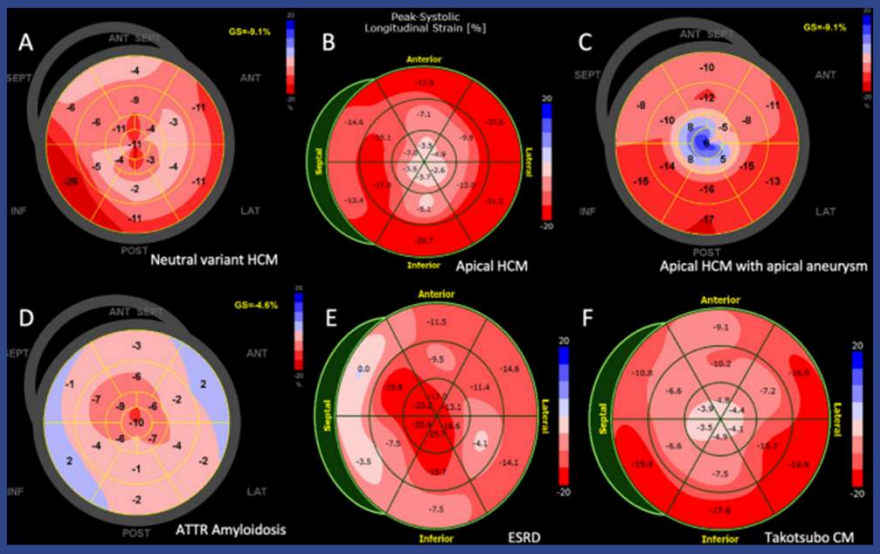
GLS for Etiology of LV Hypertrophy



Normal Strain Pattern



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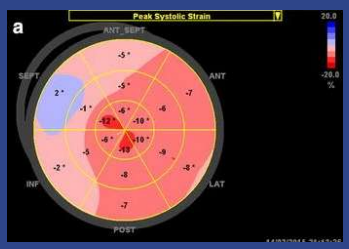
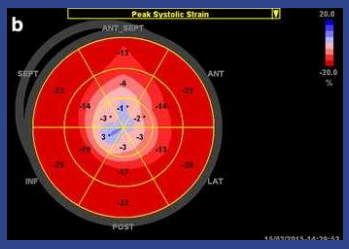
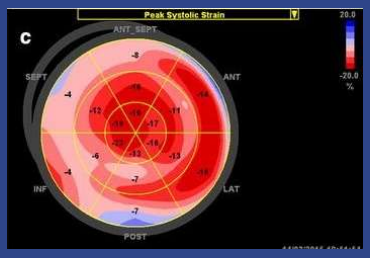
Hypertrophic Cardiomyopathy Patterns



HCM – ASH, LVEF 70%



Isolated Apical Hypertrophy
LVEF 60%



HCM – Concentric LVH
LVEF 60%

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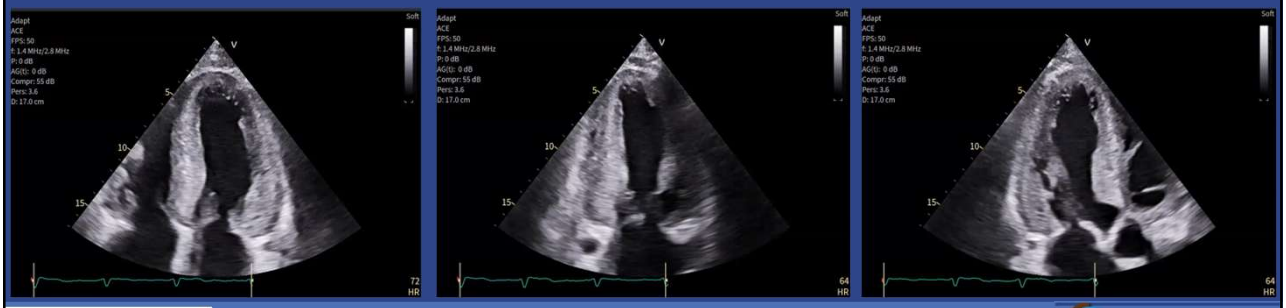
Case Study

- 79 y/o male, complaints of SOB and arrhythmias
- BP 124/53, HR 74 BPM
- Height 180 cm, weight 109 kg, BMI 33.6
- Evaluate LVFX
- Echo exam : Arial fibrillation, Sub-optimal positioning and respiratory interference



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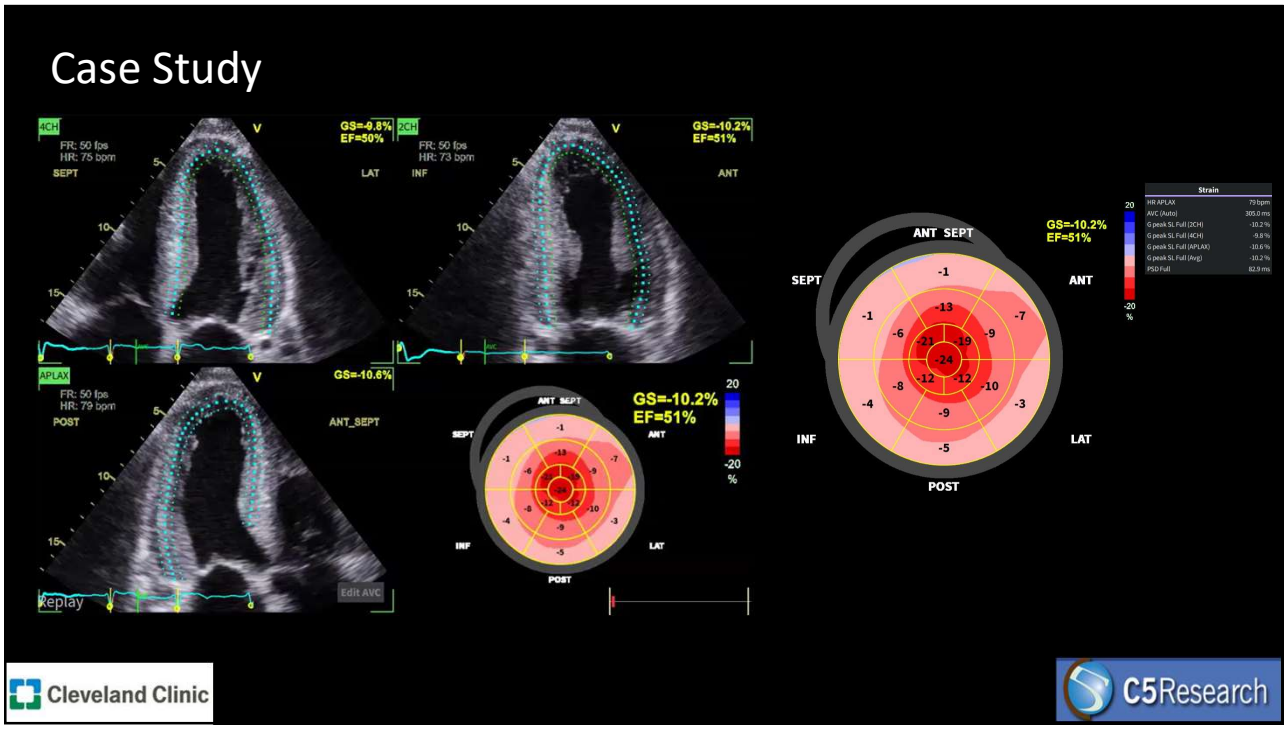

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Reporting Longitudinal Strain

- Report heart rate and blood pressure at onset of exam
- Accurate timings of end-diastole and end-systole is very important
- Consensus recommends end-systolic longitudinal strain obtained at aortic valve closure
- Alternate timings used, report alternate method to avoid confusion
- Report strain values with the negative sign
- If the negative sign is omitted use the term “global longitudinal shortening”
- Follow-up exams on same vendor and software release version

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Strain Software Pitt falls/Follow-ups

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Inter-Vendor Differences

- 372 echo exams on 62 subjects
- Consecutively scanned on 6 different manufacturers
- LV – 3 apical views (2 sets)
- 5 vendor specific and 5 vendor independent systems
- Comparable narrow range (mean GLS of vendors 17.25 ± 0.3% and 15.36 ± 0.3% respectively).
- Moderate inter-vendor bias in GLS measurements (6.3% on average for mean GLS)
- Efforts of the strain standardization task force successful
- Task force consensus recommendations



European Heart Journal (2024) 45 (Suppl 1)
Imaging – Echocardiography, Tissue Doppler, Speckle Tracking and Strain Imaging

Inter-Vendor differences in speckle tracking strain - A ten year follow-up on the Strain Standardization Task Force Inter-Vendor Comparison Study

A.E. Balinisteanu[1], J. Duchenne[1], A. Puvrez[1], L. Wouters[1], S. Bezy[1], A. Youssef[1], K. De Groef[1], L. Van Langenhoven[1], K. Papangelopoulou[1], A. Cieplucha[2], I. Cattapan[3], P. Tostes[1], D. Vinereanu[4], J.U. Voigt[1]

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[2]Poznan University of Medical Sciences, Department of Cardiology, Poznan, Poland
[3]University Hospital of Padova, Pediatric Cardiology, Department of Women and Children's Health Health, Padua, Italy
[4]University of Medicine and Pharmacy Carol Davila, University Emergency Hospital Of Bucharest, Department of Cardiology and Cardiovascular Surgery, Bucharest, Romania

Funding Acknowledgements: None.

Background: Global longitudinal strain (GLS) derived from two-dimensional speckle-tracking echocardiography is feasible and accurate. Nonetheless, in 2013, the Inter-Vendor Comparison Study showed significant differences of measurement results among vendors. In order to make tracking-based strain imaging a clinically accepted and useful parameter, it is of outmost importance to have interchangeable and accurate measurement results from all vendors.

Purpose: To investigate if the efforts of the EACVI/ASE/Industry Task Force to Standardize Deformation Imaging have led to a reduction of inter-vendor differences during the past ten years.

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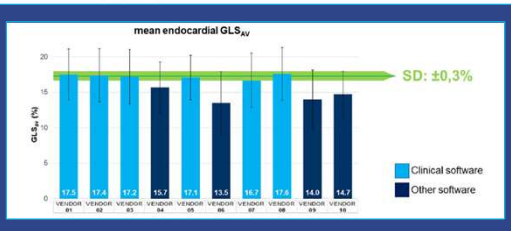

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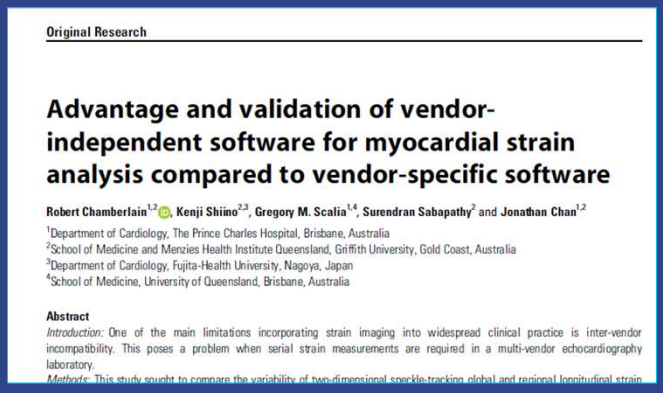
Vendor Independent Software (VIS)

- Multi-vendor Lab, 40 patients
- Longitudinal strain derived from vendor-independent software (VIS) was comparable to global longitudinal strain derived from vendor-specific software(VSS).
- There was good overall agreement and high inter- and intra-observer reproducibility using VIS for regional and GLS
- Regional strain was lower in agreement compared to global longitudinal strain.
- Minor variability exists for regional strain measurements VIS and Vender Specific Software (VSS)
- VIS was performed using fully automated Auto strain



Original Research

Advantage and validation of vendor-independent software for myocardial strain analysis compared to vendor-specific software

Robert Chamberlain[1,2], Kenji Shiino[2,3], Gregory M. Scalia[1,4], Surendran Sabapathy[2] and Jonathan Chan[1,2]

[1]Department of Cardiology, The Prince Charles Hospital, Brisbane, Australia
[2]School of Medicine and Menzies Health Institute Queensland, Griffith University, Gold Coast, Australia
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Abstract

Introduction: One of the main limitations incorporating strain imaging into widespread clinical practice is inter-vendor incompatibility. This poses a problem when serial strain measurements are required in a multi-vendor echocardiography laboratory.

Methods: This study sought to compare the variability of two-dimensional speckle-tracking global and regional longitudinal strain

2020 Australasian Society for Ultrasound in Medicine, AJUM February 2021 24 (1)

"VIS has the advantage over VSS to accurately analyze images acquired from multi-vendor systems for serial strain measurements"

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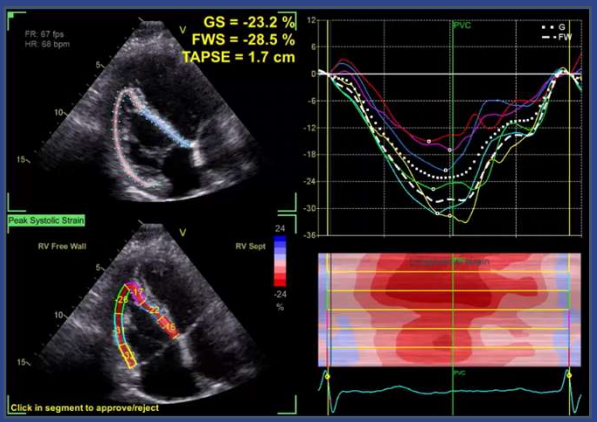
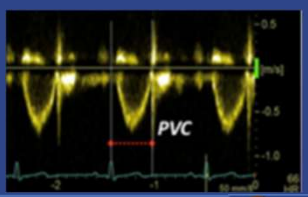
RV Strain

- Dedicated RV Strain Software
- Maintain high frame rates (50-80 fps)
- Focused RV view!
- Optimize Depth
- RVOT Doppler (PVC) timing
- Full wall ROI thickness
- Avoid trabeculations
- ✓ Accuracy in tracking





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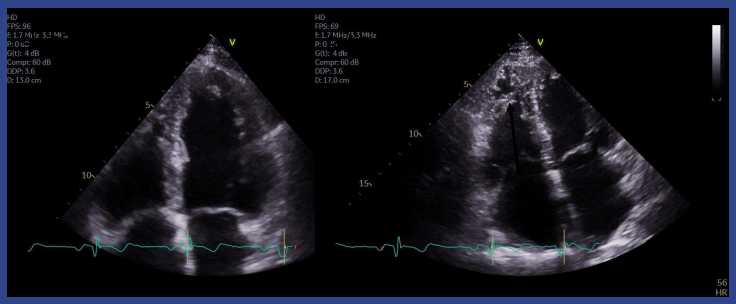
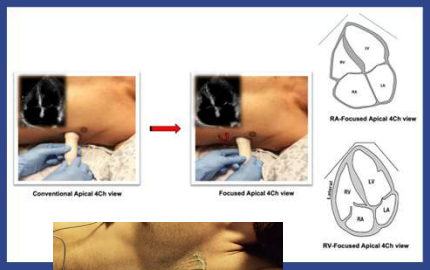
RV Focused view







Slide laterally and below the apex from a conventional 4C view and slightly rotate the transducer until the maximum plane is obtained without foreshortening

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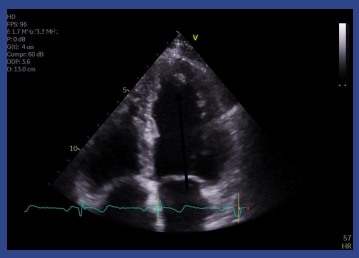
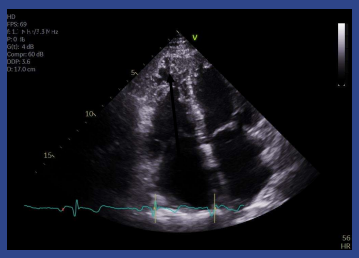
RV Focused view













Slide laterally and below the apex and slightly rotate the transducer until the maximum plane is obtained without foreshortening

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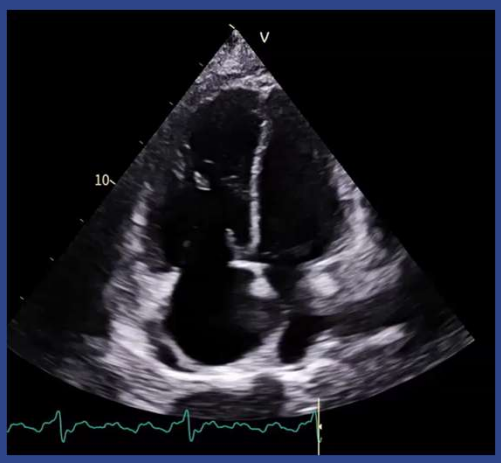
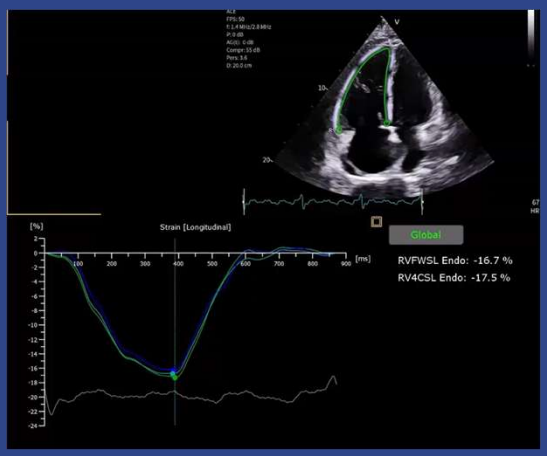
RV Modified View





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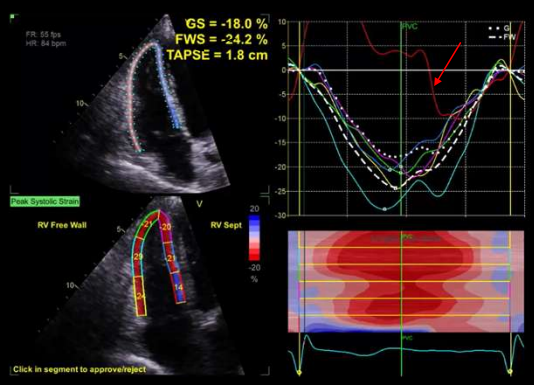
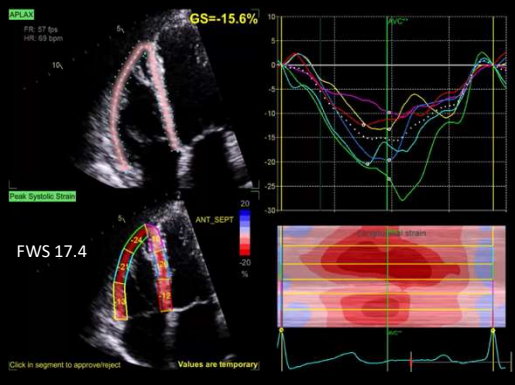
RV Strain, Good vs Bad





- Basal septal not anchored
- Non optimal view (LVOT)

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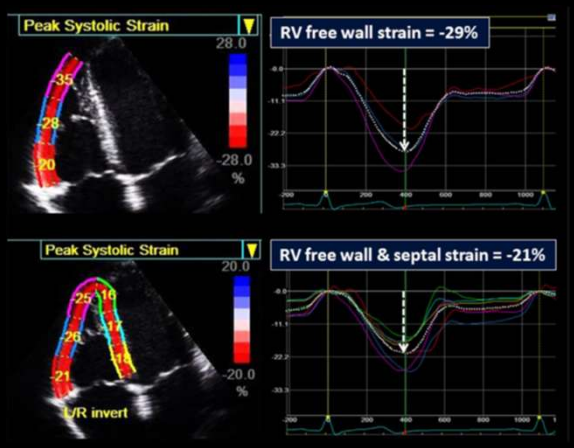
Reporting Nomenclature for RV Strain

- RVFWLS - 3 segment RV free wall- advised reporting method
- RVGLS - 6 segment free wall and IVS
- Vendor variability- serial studies, same system & same software
- Width adjusted to the full thickness of the RV free wall (5mm)
- Report if a non-focused view has been used



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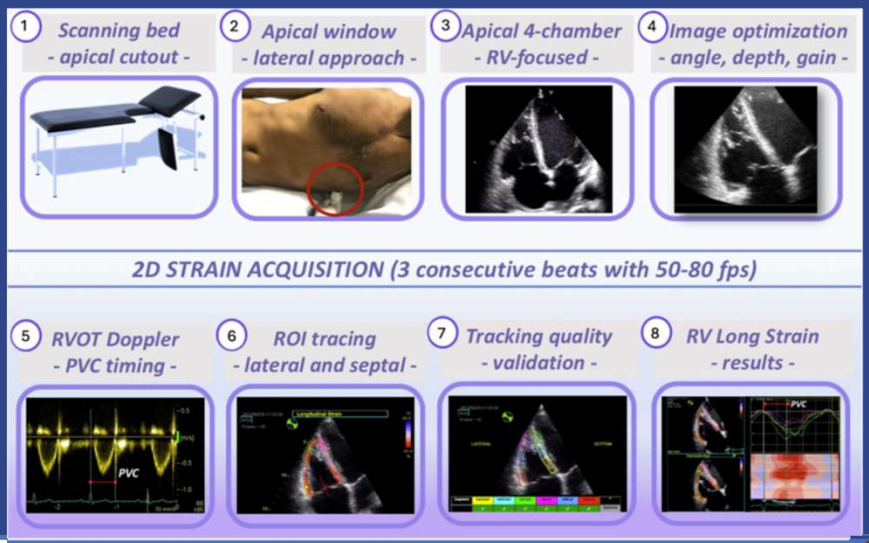
RV Strain Highlights



Thomas et al, https://doi.org/10.1016/j.echo.2025.07.007

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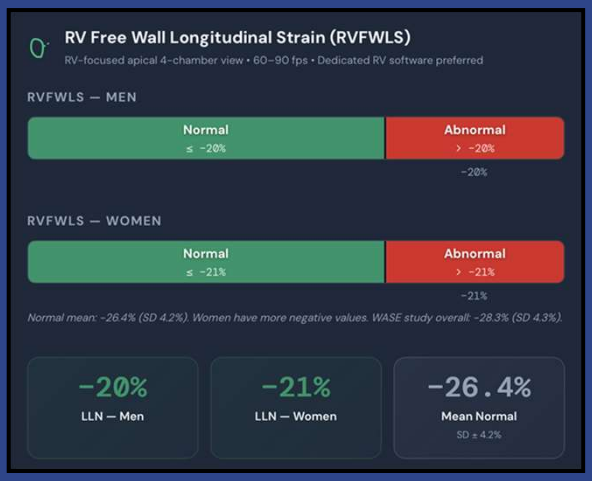
Clinical Consensus Statement

- RVFWLS normal -20% or higher (subject to the same qualifications of load dependence)
- Mean -26%
- LLN for RVFWLS: -20% in men and -21% in women
- below -20% should be considered abnormal



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Case Study 1

- 51 y/o female
- Normal sinus rhythm, HR 67 bpm
- BP 114/55
- Established diagnosis Pulmonary Arterial Hypertension
- Complaints of fatigue, **sob** with exercise, ankle edema
- New specialty therapy added
- Echocardiogram to evaluate LV and RV function
- RV Strain

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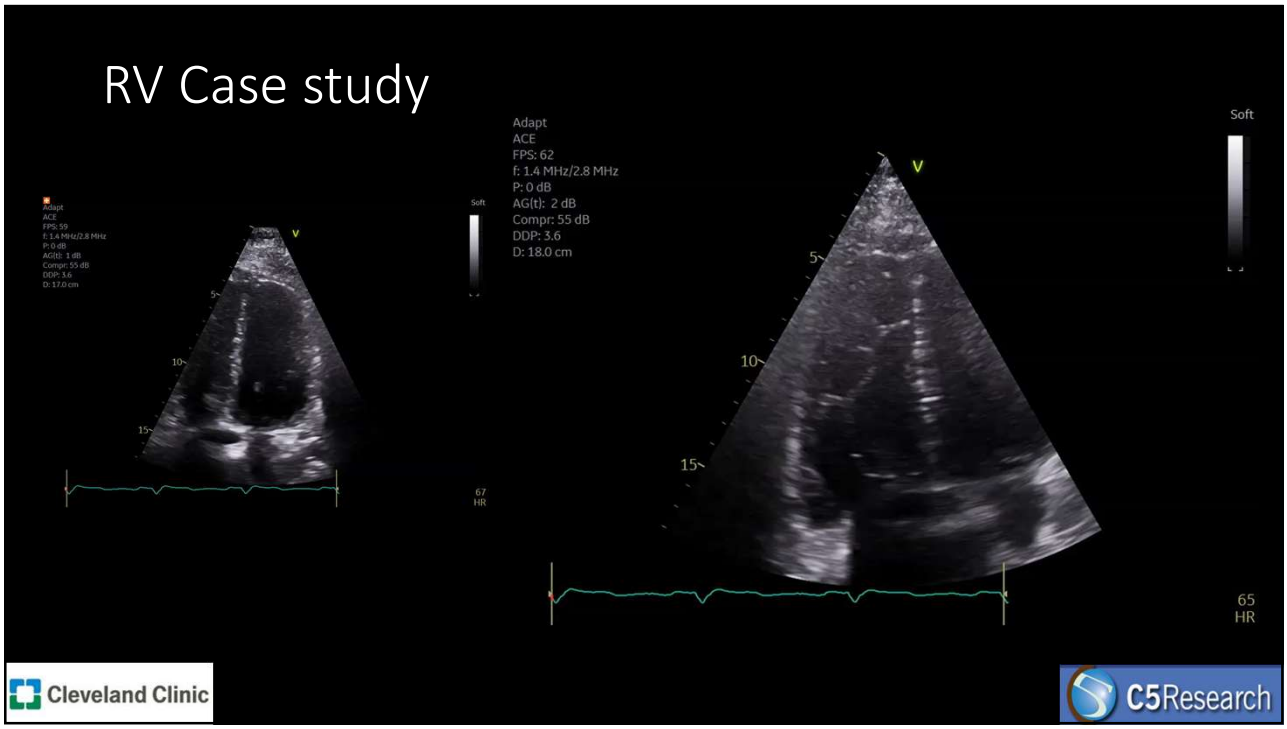

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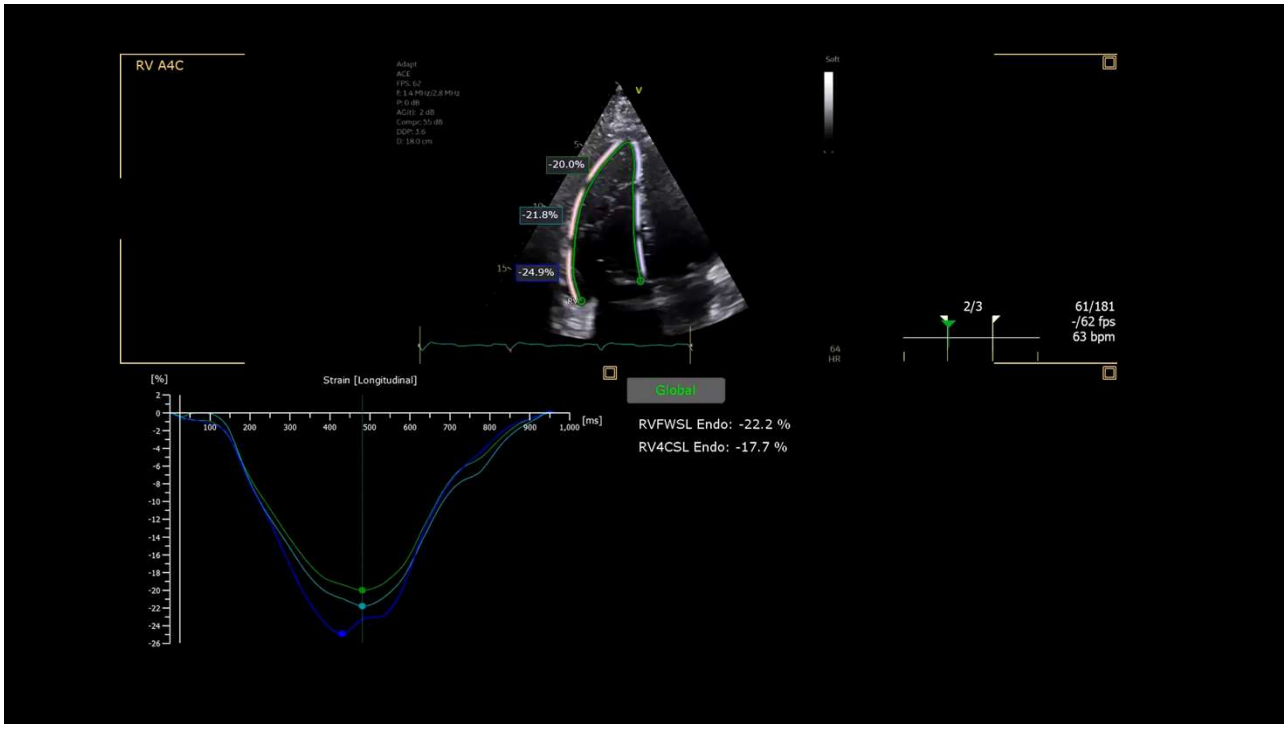

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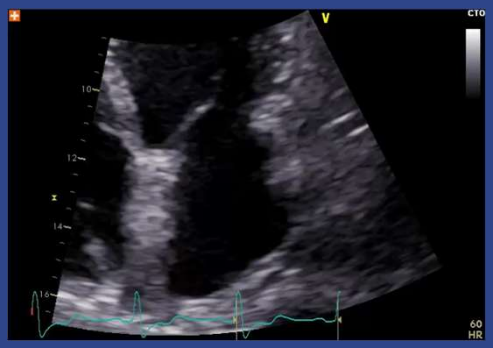
LA Strain – Image Quality really matters!

- Good Quality Optimized Image & clean ECG
- High Frame Rates (50-90 fps)
- LA wall visibility throughout S&D
- LA Focused View
- Optimal clean visible ECG
- Capture three complete Cycles
- Breath hold technique
- Dedicated LA Strain Software



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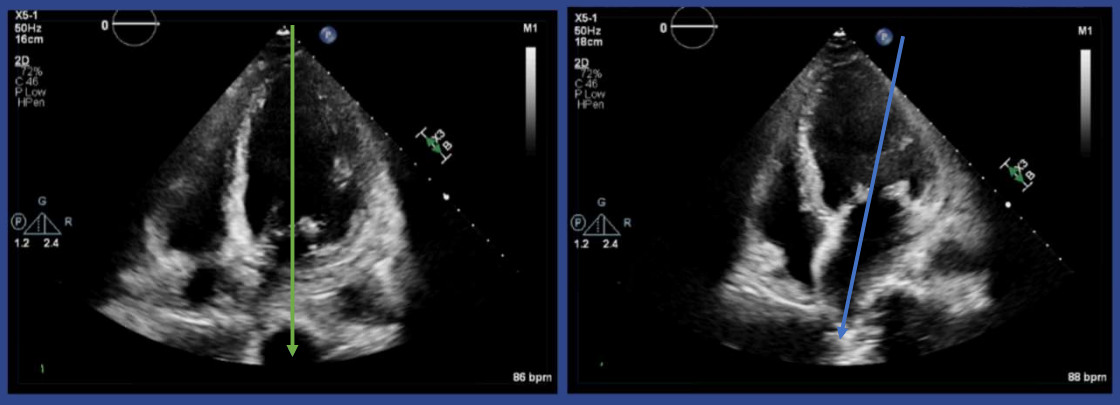
Optimizing LA for Strain - LA Focused View



Cleveland Clinic Images compliment of James Thomas C5Research

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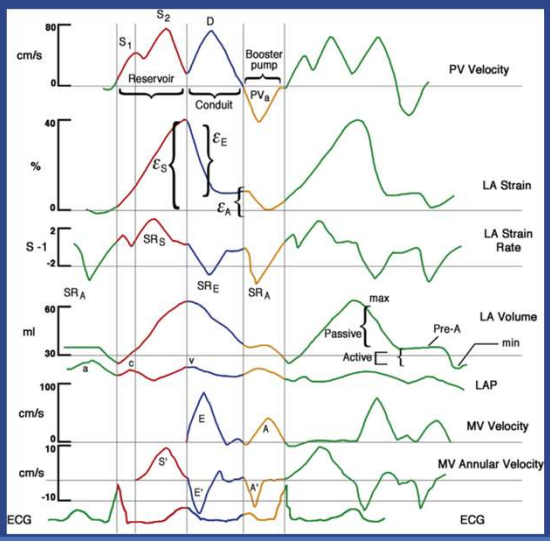
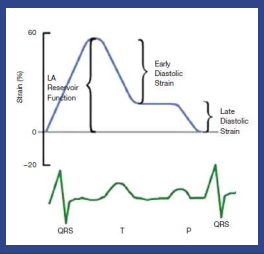
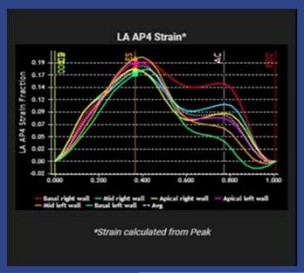
Relationships with Cardiac Cycle



- R-R Timed cycle
- ✓ Reservoir
- ✓ Conduit
- ✓ Contraction





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(J Am Coll Cardiol 2014;63:493–505), Left Atrial Size and Function, Brian Hoit

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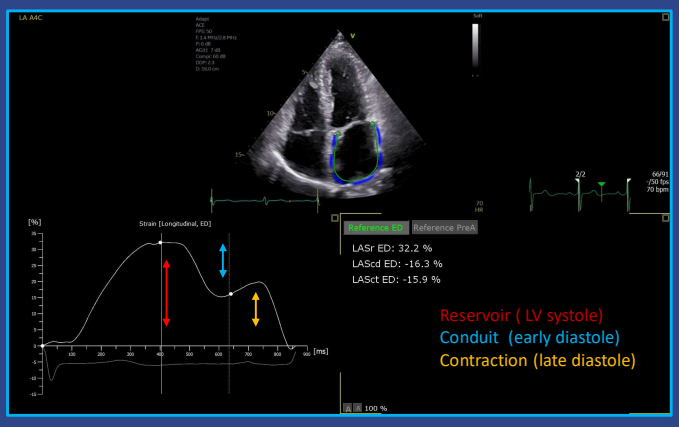
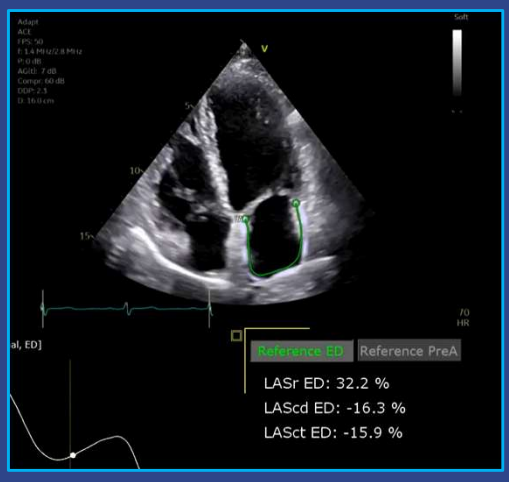
LA Strain – Good tracking





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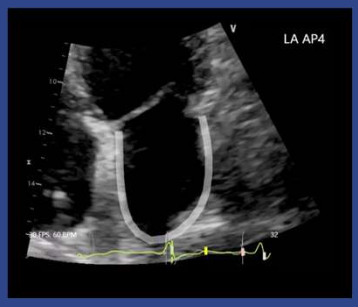
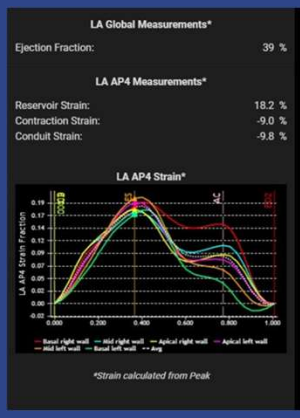
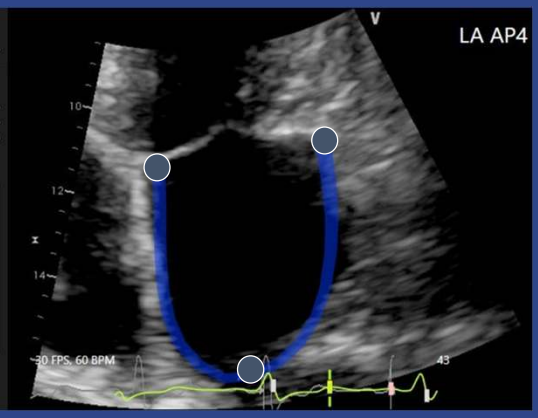
LA Strain







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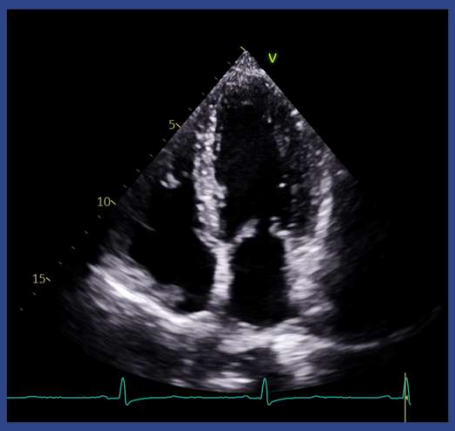
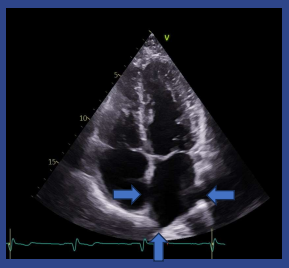
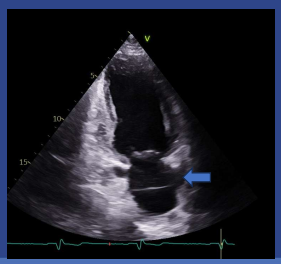
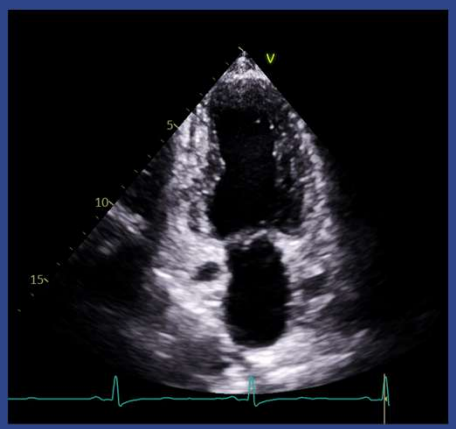
Common Areas Poor Tracking









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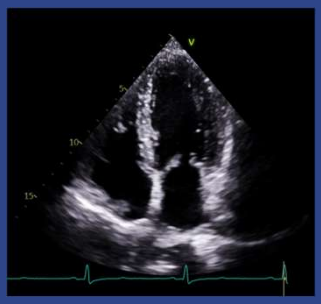
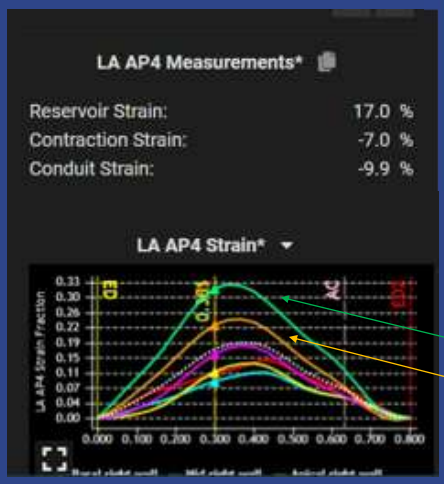
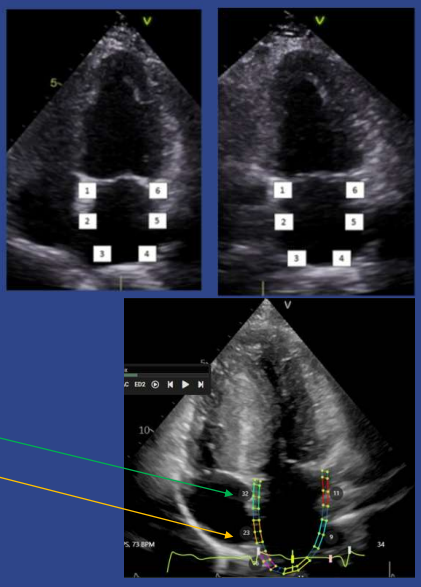
Segmental Nomenclature







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Clinical Consensus Statement

- LA Reservoir Strain (LASr)
  - ➢ Normal 30-60%, mean 39%
  - ➢ Borderline 23-30%
  - ➢ Abnormal < 23%
  - ➢ Elevated filling Pressures suggested @ < 18%



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Strain Recipe for Success

- Quality Images
- Appropriate Frame Rates (60-90 fps)
- Non-Foreshortened Views
- On-axis Focused Views (reduced depth)
- Good ECG (timing and rhythm)
- Sequential 3-Beat Captures (Breath Hold)
- Appropriate ROI Thickness
- Good Tracking Quality
- Recognition of Patterns
- Training and Experience

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Best Practice

- Dedicated labs and personnel
- Experience worth its weight in gold
- Same Vendor specific system for cardio-oncology & other specific pathologies
- In a perfect world, same vendor & same operator
- Vendor specific software vs vendor independent software

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Thank you for your attention!





parkm@ccf.org

Sydell and Arnold Miller Family Heart, Vascular and Thoracic Institute
Cleveland Clinic Foundation, Cleveland Ohio

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Strain Rate

- Strain rate measures the time course of deformation, and is the primary parameter of deformation derived from tissue Doppler
- Strain is an analog of regional function
- Increased preload = increased strain
- Increased afterload = reduced strain
  - Strain rate
    - Less related to pre-load and after-load than strain

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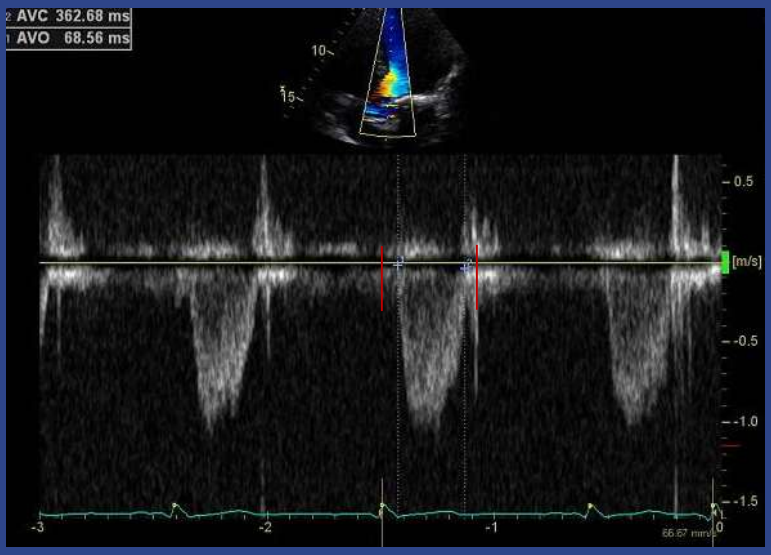
Aortic valve closure timing



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