When Do We Need Contrast? How Can It Be Implemented?

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At one time or another, I have been an Funded Investigator, Ad Hoc Consultant, Or Sponsored Speaker for virtually all echo contrast companies.

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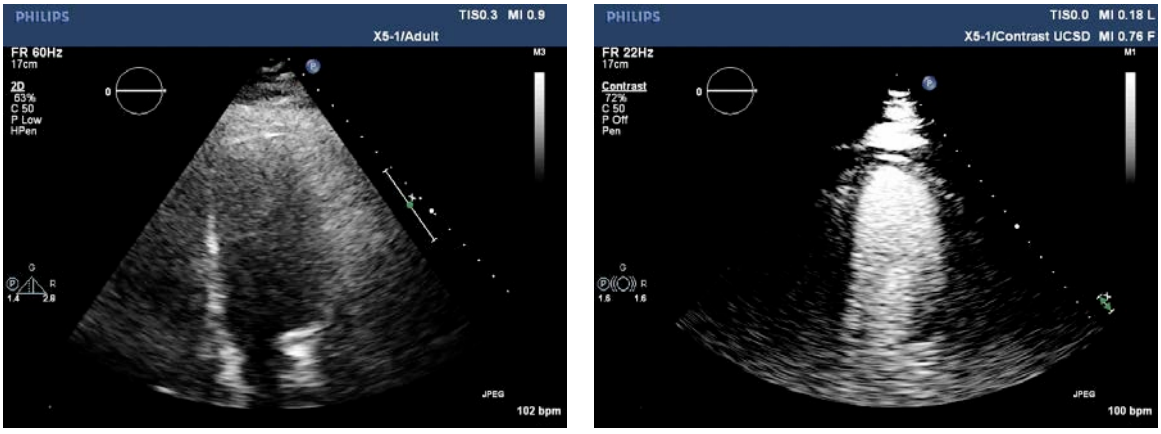

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How Common Are Suboptimal Echos for LV Size and Function?

Clinically
- 5%-25% in general population
- Higher % in stress studies

Research, General Population
- Framingham 20%
- Cardiovascular Health Study 35%

Vasan et al. *N Engl J Med*. 1997;336:1350.

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A Practical Approach to Echo Contrast

- Studies indicate about 15 to 30% of echo studies are inadequate (1)
  - The definition of inadequate is subjective
  - Stress echoes and those in ICU are more often inadequate
- Data suggests that less than 5% of echo studies receive contrast (2)
- Clearly, contrast echo is majorly underutilized
- Technical and procedural factors contribute greatly to underutilization
- Philosophical outlook on the role of contrast is critical

1. Kurt M et al; JACC: 2009; Waggoner AD et al; JASE:2001; Platts D et al; Crit Care Resuscitation: 2011)

2. Decision Resources LLC, Toronto, Canada

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Candidates for Contrast Echo

- Patients most likely to benefit from contrast echo include those with
  - Obesity
  - Congestive heart failure
  - Chronic obstructive pulmonary disease
  - Mechanical ventilation
  - Chest deformity (barrel chest)
  - Patients with limited acoustic windows
    - Inadequate imaging of 2/6 segments in any single view
    - Incomplete Doppler velocity profiles

Mulvagh et al. *J Am Soc Echocardiogr.* 2000;13:331.

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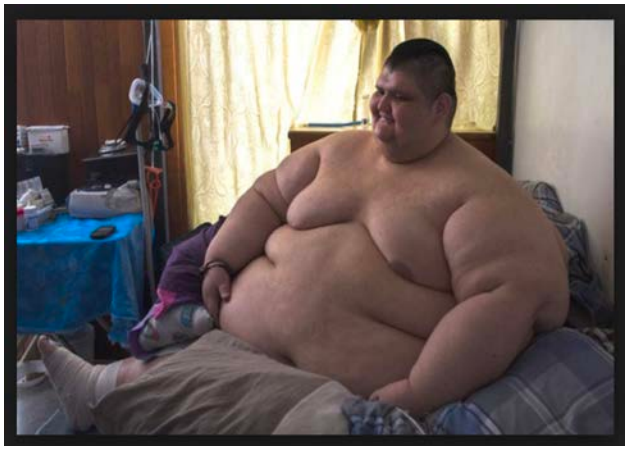

Always take a bottle of contrast agent to an ICU echo

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American Society of Echocardiography Consensus Statement on the Clinical Applications of Ultrasonic Contrast Agents in Echocardiography

Sharon L. Mulvagh, MD, FASE, Chair, Harry Rakowski, MD, FASE, Co-Chair, Mani A. Vannan, MBBS, Co-Chair, Sahar S. Abdelmoneim, MD, MSc, Harald Becher, MD, PhD, S. Michelle Bierig, MPH, RDCS, FASE, Peter N. Burns, PhD, Ramon Castello, MD, FASE, Patrick D. Coon, RDCS, FASE, Mary E. Hagen, RDCS, RN, James G. Jollis, MD, Thomas R. Kimball, MD, FASE, Dalane W. Kitzman, MD, Itzhak Kronzon, MD, FASE, Arthur J. Labovitz, MD, FASE, Roberto M. Lang, MD, FASE, Joseph Mathew, MD, FASE, W. Stuart Moir, MBBSc, Sherif F. Nagueh, MD, Alan S. Pearlman, MD, FASE, Julio E. Perez, MD, FASE, Thomas R. Porter, MD, FASE, Judy Rosenbloom, RDCS, FASE, G. Monet Strachan, RDCS, FASE, Srihari Thanigaraj, MD, FASE, Kevin Wei, MD, Anna Woo, MD, Eric H. C. Yu, MD, and William A. Zoghbi, MD, FASE,

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SYNOPSIS OF SUGGESTED APPLICATIONS FOR ULTRASOUND CONTRAST AGENT USE

- In difficult-to-image patients presenting for rest echocardiography with reduced image quality
  - To enable improved endocardial visualization and assessment of left ventricular (LV) structure and function when ≥2 contiguous segments are not seen on noncontrast images
  - To reduce variability and increase accuracy in LV volume and LV ejection fraction (LVEF) measurements by 2-dimensional (2D) echocardiography
  - To increase the confidence of the interpreting physician in LV functional, structure, and volume assessments
- In difficult-to-image patients presenting for stress echocardiography with reduced image quality
  - To obtain diagnostic assessment of segmental wall motion and thickening at rest and stress
  - To increase the proportion of diagnostic studies
  - To increase reader confidence in interpretation
- In all patients presenting for rest echocardiographic assessment of LV systolic function (not solely difficult-to-image patients)
  - To reduce variability in LV volume measurements through 2D echocardiography
    - To increase the confidence of the interpreting physician in LV volume measurement
- To confirm or exclude the echocardiographic diagnosis of the following LV structural abnormalities, when nonenhanced images are suboptimal for definitive diagnosis
  - Apical variant of hypertrophic cardiomyopathy
  - Ventricular noncompaction
  - Apical thrombus
  - Complications of myocardial infarction, such as LV aneurysm, pseudoaneurysm, and myocardial rupture
- To assist in the detection and correct classification of intracardiac masses, including tumors and thrombi
- For echocardiographic imaging in the intensive care unit (ICU) when standard tissue harmonic imaging does not provide adequate cardiac structural definition
  - For accurate assessment of LV volumes and LVEF
  - For exclusion of complications of myocardial infarction, such as LV aneurysm, pseudoaneurysm, and myocardial rupture
- To enhance Doppler signals when a clearly defined spectral profile is not visible and is necessary to the evaluation of diastolic and/or valvular function

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Guidelines

ESC European Society of Cardiology
European Heart Journal - Cardiovascular Imaging (2017) **18**, 1205
doi:10.1093/ehjci/jex182
EACVI RECOMMENDATIONS

Clinical practice of contrast echocardiography: recommendation by the European Association of Cardiovascular Imaging (EACVI) 2017

Roxy Senior[1]*, Harald Becher[2], Mark Monaghan[3], Luciano Agati[4], Jose Zamorano[5], Jean Louis Vanoverschelde[6], Petros Nihoyannopoulos[7], Thor Edvardsen[8], and Patrizio Lancellotti[9]

Reviewers: This document was reviewed by members of the EACVI Scientific Documents Committee for 2014–16 and 2016–18: Victoria Delgado, Alessia Gimelli, Bernard Cosyns, Bernhard Gerber, Erwan Donal, Frank Flachskampf, Kristina Haugaa, Nuno Cardim, Pier Giorgio Masci.

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EACVI Indications for Contrast Echo

- Endocardial Border Recognition – ***Should***
  - Two or more contiguous LV segments not visualized
  - When management dependent upon accurate measurement of LVEF
  - When identification of regional wall motion abnormalities is critical
- Cardiac Structure – ***May Be***
  - apical hypertrophy and diverticula, pseudoaneurysm, myocardial rupture, non-compaction and LV thrombi ***are suspected***
- Left Atrial Appendage and Aortic Syndromes- ***May Be***
- Stress Echo ***– Should***
  - Two continuous segments not visualized
  - Presence of deep inspiration
  - For myocardial perfusion
- Myocardial Perfusion – ***May Be*** (If expertise exists)
  - To improve accuracy of stress echo
  - To assess viability

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Who *Must* Have Contrast LVO?

- *Indication* for echo is evaluate LV function
- Endocardial border not visualized in either apical or *non-apical views*
- *LV shape* difficult to determine
- *Epicardial motion* not or poorly visualized
- Reproducibility is of paramount importance

- High suspicion of a structural lesion
  - Mass, apical HCM, Noncompaction

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A Practical Approach to Echo Contrast

- ***It all begins at the top***
- Physicians differ widely on what constitutes a suboptimal study
- The definition of "noninvasive" varies
- The tradition of "totally noninvasive" ultrasound is entrenched
- Some feel that contrast takes too much time
- Considerable inertia exists to expanding the examination
- Interpretation of the studies may be more complex
- Limited reimbursement provides a negative incentive

A contrast friendly philosophy must be fostered

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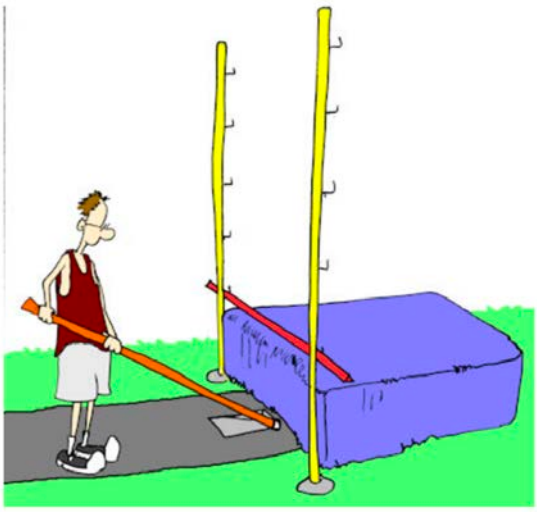
How High is the Quality Bar Set?



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Establish Protocols for Contrast-Enhanced Imaging Studies

- Team roles
  - Sonographer and Nurse
- Patient selection protocol
  - Identify appropriate patients rapidly
- Imaging protocols
- Administration protocols

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How to Make Imaging Protocols More Efficient

- Patients likely to benefit from contrast can be identified in minutes: eliminate struggle time
- Incorporate contrast early in imaging protocols
- If pasternal views are poor, reduce acquisition time by
  - Advancing quickly to apical views
  - Determining if acoustic windows are optimal
- Procedures should often be sonographer-driven

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Struggle Time

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Struggle Time

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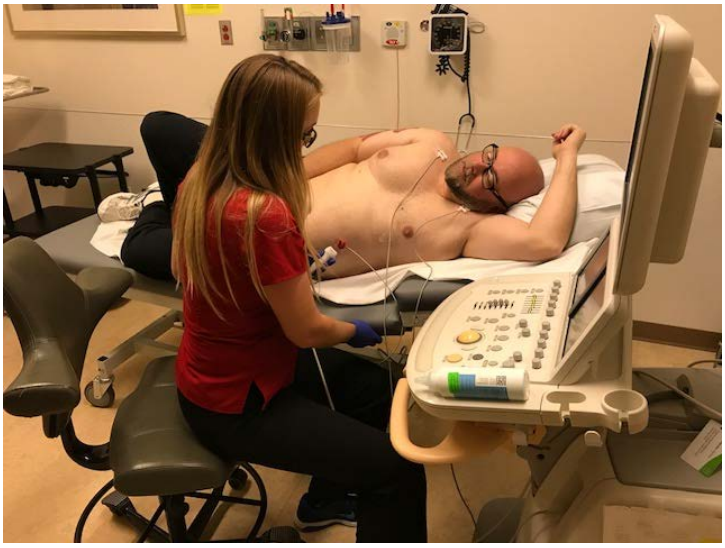
Struggle Time



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Struggle Time

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Struggle Time

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Struggle Time

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Struggle Time

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Stuggle Time

Efficacy and time-efficiency of a "sonographer-driven" contrast echocardiography protocol in a high-volume echocardiography laboratory

Ramon Castello, MD,[a] Jonathan N. Bella, MD,[a] Aleksandr Rovner, MD,[a] Jimmy Swan, MD,[a] John Smith, RN,[a] and Leslie Shaw, PhD[b] *Cleveland, Ohio, and Atlanta, Ga*

"After very extensive examinations in those technically difficult cases, adequate information may not be obtained in 25% to 50% of them.11,13 By eliminating **"struggle time"** and reducing the decision and administration times, the total time used in performing a contrast study may be less than that used with conventional imaging,"

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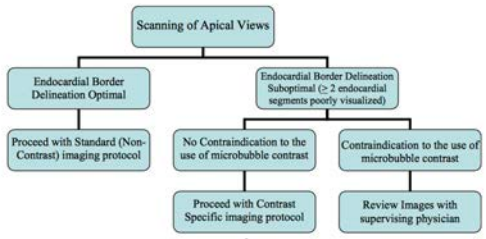
Contrast Echocardiography: Beyond a Black Box Warning?

Steven J. Lester, MD, FRCPC, FACC, FASE, Fletcher A. Miller, Jr., MD, FACC, FASE, and Bijoy K. Khandheria, MBBS, FACC, FASE, FESC, *Scottsdale, Arizona, and Rochester, Minnesota*

"We have adopted a policy whereby our sonographers begin imaging from the apical window. If by ***90 to 120 seconds***, the sonographer determines that contrast enhancement will be required because more than 2 endocardial segments of the left ventricle are not well visualized, he or she captures these noncontrast images to document the limitations of the baseline study and then proceeds with imaging according to a contrast-specific protocol if the nurse or supervising physician notes no contraindications to contrast use (Figure 1). "



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Overcoming the IV Issue

Radiology and Nuclear Medicine

Certified dialysis technicians

Respiratory therapists

GI technicians

Licensed psychiatric technicians

- A capable person needs to start the IV and inject contrast
- Finding a good vein may be an epic task
- A system must exist for an experienced individual to be readily available to start the IV and inject contrast
- Traditionally this has been a nurse or fellow
- **Sonographers are capable**

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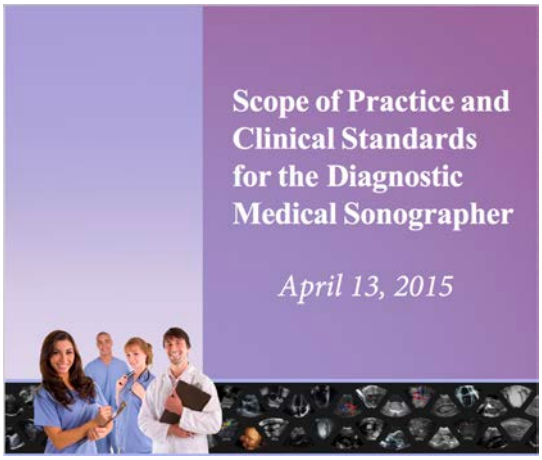
Sonographer IV Insertion and Injection



PARTICIPATING ORGANIZATIONS

The following organizations participated in the development of this document. Those organizations that have formally endorsed the document are identified with the "†" symbol. Supporting organizations are identified with the "*" symbol.

- American College of Radiology (ACR) *
- American Congress of Obstetricians and Gynecologists (ACOG) *
- American Institute of Ultrasound in Medicine (AIUM) *
- American Registry for Diagnostic Medical Sonography (ARDMS) *
- American Registry of Radiologic Technologists (ARRT) *
- American Society of Echocardiography (ASE) †
- American Society of Radiologic Technologists (ASRT) *
- Cardiovascular Credentialing International (CCI) †
- Joint Review Committee on Education in Diagnostic Medical Sonography (JRC-DMS) †
- Joint Review Committee on Education in Cardiovascular Technology (JRC-CVT) *
- Society of Diagnostic Medical Sonography (SDMS) †
- Society of Radiologists in Ultrasound (SRU) *
- Society for Maternal-Fetal Medicine (SMFM) †
- Society for Vascular Surgery (SVS) †
- Society for Vascular Ultrasound (SVU) †
- Sonography Canada (formerly the Canadian Society of Diagnostic Medical Sonography) *

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Factors Influencing Image Quality in ICU

- Mechanical ventilation
- Chest wounds and tubes
- Edema/anasarca
- Inotropic and vasopressor agents
- Suboptimal positioning
- ECG and other monitoring
- Dialysis
- Intraaortic balloon

Always take a bottle of contrast agent to an ICU echo

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Endocardial Border Definition
68 yo male with AS

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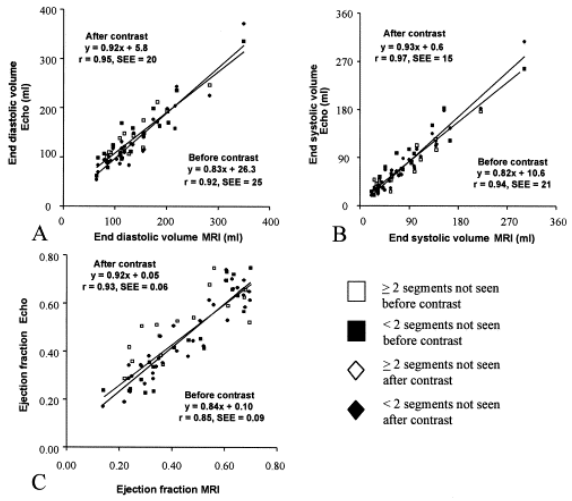
Contrast LVO for LV Volumes/EF vs MRI



Hundley et al; JACC, 1998

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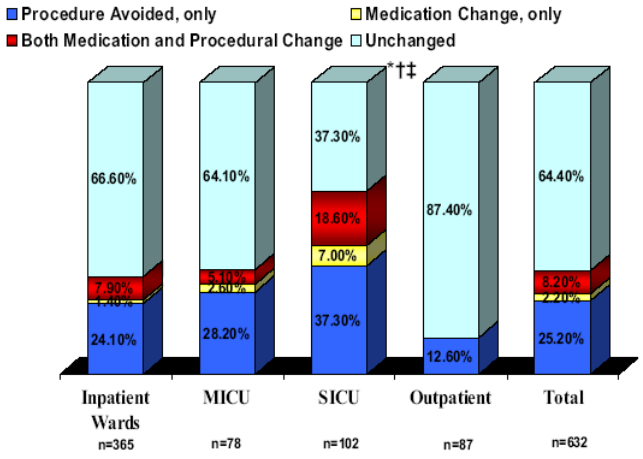
Impact of LVO on Management



Kurt et al: JACC, 2009

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Contrast and Stress Echo

- Contrast has unique role in stress echo
- ***A stress echo is positive if there is abnormal contraction of any single myocardial segment***
  - *Therefore, to be negative, all myocardial segments must be visualized*
- Contrast enhances endocardial definition
- Contrast improves image quality and confidence
- Contrast improves diagnostic accuracy
- Contrast enables prognostication
- Contrast provides ***myocardial perfusion***

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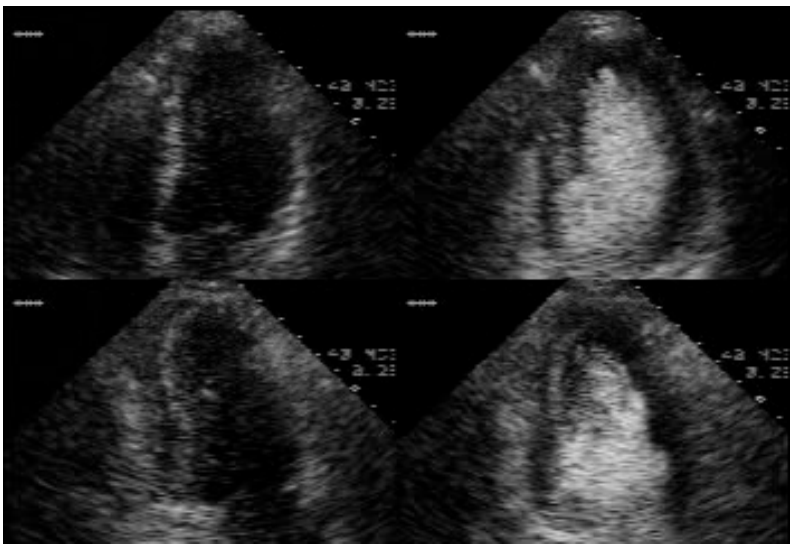

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Contrast Echo Other Than Border Definition

- Cardiac Shunts
- Doppler enhancement
- Cardiac Masses
  - Tumor vs Clot
- 3D enhancement
- Noncompaction
- Vascular enhancement

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65 yo male with heart failure post MI

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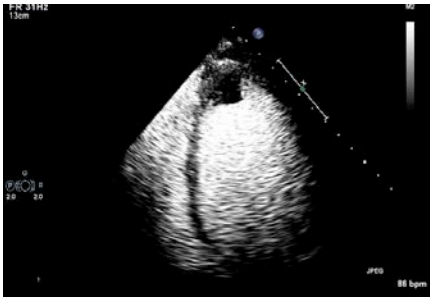

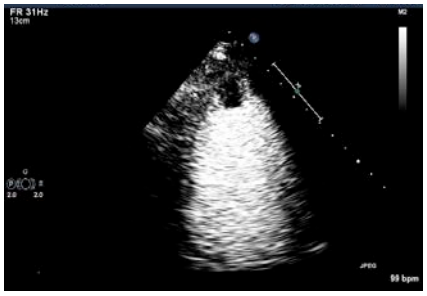

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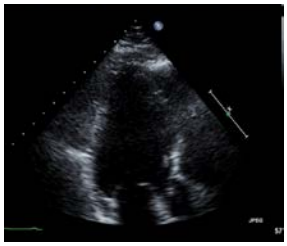
54 YO male with abnormal ECG



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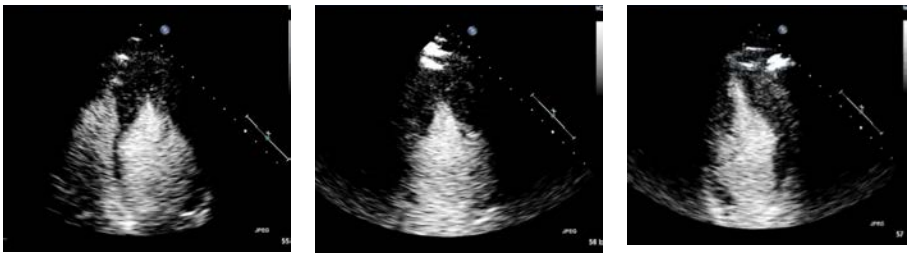
54 yo male with abnormal ECG and apical HCM



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Contrast for Non-Compaction

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Streamlining Ultrasound-Enhanced Echo Studies

- Establish policy and procedures
  - It all starts at the top
  - Standing orders Departmental guidelines
  - Reimbursement (coding, coverage, carrier)
- Determine staff roles and responsibilities
  - Sonographer triggers the study
  - IV training
  - Combine with stress/cath RNs
  - Involve personnel outside echo lab
- Ensure availability of supplies
- Plan ahead when performing portable studies

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