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.
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%


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

2. Decision Resources LLC, Toronto, Canada
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


Always take a bottle of contrast agent to an ICU echo
American Society of Echocardiography Consensus Statement on the Clinical Applications of Ultrasonic Contrast Agents in Echocardiography

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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 non-contrast images
  - To reduce variability and increase accuracy in LV volume and LV ejection fraction (LVEF) measurements by 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 vascular function
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
### 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

### 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*
How High is the Quality Bar Set?

Establish Protocols for Contrast-Enhanced Imaging Studies

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

Struggle Time
Struggle Time

24

Struggle Time

25
Struggle Time

Struggle Time
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)."
Overcoming the IV Issue

• 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

Radiology and Nuclear Medicine
Certified dialysis technicians
Respiratory therapists
GI technicians
Licensed psychiatric technicians

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 on 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) *
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• 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) *
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

Endocardial Border Definition
68 yo male with AS
Contrast LVO for LV Volumes/EF vs MRI

Hundley et al; JACC, 1998

Impact of LVO on Management

Kurt et al: JACC, 2009
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
Contrast Echo Other Than Border Definition

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

65 yo male with heart failure post MI
54 YO male with abnormal ECG
54 yo male with abnormal ECG and apical HCM

Contrast for Non-Compaction
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