Basics of Contrast Echocardiography
Echo Hawaii 2017

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DISCLOSURES

NONE
OBJECTIVES

• Indications for contrast utilization
• Challenges in implementation and Potential Solutions
• Dosing/administration/documentation
• Tools for optimization
• Common Pitfalls
• Case presentations

Sonographer’s Role with the Utilization Of Ultrasound Enhancing Agents

• Understand microbubble physics and ultrasound instrumentation
• Recognize indications for the use of contrast media
• Establishment of IV access privileges if necessary
• Develop written policies for contrast utilization

ASE position paper 2001
Transpulmonic Contrast Agents
Current Indications / Uses

Currently (FDA) Approved
- Endocardial Border Definition (LVO)
  - When 2 or more contiguous LV segments not well visualized

Off label Uses
- Thrombus
- Apical Hypertrophy-Asymmetric Septal Hypertrophy
- Left Ventricular Aneurysm/Pseudoaneurysms/Rupture
- Intracardiac Masses
- Enhancement of Doppler signals
- Stress Echocardiography
- Myocardial Perfusion Imaging

Currently Available Transpulmonic Contrast Agents

- Optison (1995)
- Definity (2001)
- Lumason (October 2014)
Why Should You Use Contrast?  
Consequences of Suboptimal Images

• Misdiagnosis
• Decreased diagnostic confidence
• Increased interobserver variability
• Need for additional testing

NEW PROCEDURES

• Introducing new procedures such as contrast present challenges as well as opportunities

• Challenges / barriers as well as potential solutions
Challenges / Potential Barriers with Contrast Echocardiography

• **Need Policy/Consent**
  - Establish a written policy for your lab
  - Outline indications for use
  - Determine if there is a need to obtain consent (varies by institution)

• **Need IV**
  - Nurse / IV team / Sonographer
  - Possibly provide training for your sonographer staff to obtain IV insertion privileges
  - Follow the individual policies/recommendations of your institution and also state and local requirements

• **Who Decides**
  - Within your policy state that the need for contrast is based on not seeing two contiguous LV segments
  - Sonographers should be empowered to make this decision

Challenges / Potential Barriers with Contrast Echocardiography

• **Who and How to Order**
  - Put into place a method of obtaining a physician order
  - Contrast agents are considered drugs - thus a physician order is necessary
  - Consider having a standing order

• **Who Administers**
  - Trained personnel: Registered Nurse / Physician / Sonographers

• **Monitoring** (only necessary if reaction happens)
  - All labs need an area to monitor the patients if there should be a reaction
  - All labs need to be able to handle an emergency
  - Code cart / trained personnel

• **Cost/ reimbursement**
  - Contrast is currently reimbursed
  - Work with billing personnel
Who is administering Contrast?

FIGURE 34
Within your Cardiac Imaging (ECHO) Department which clinical support professionals are permitted to administer contrast agents (non-saline)? (CHECK ALL THAT APPLY)

- 93.3% RNs 209 respondents
- 50% Sonographers 112 respondents
- 16.1% Other 36 respondents
- 11.6% APPs 26 respondents
N = 224

2016 ASE/MEDAXIOM ECHO BENCHMARKING SURVEY SNAPSHOT

Administration of Microsphere Contrast at OSU

- Sonographer identifies need for contrast
- MD screens patient and writes order for contrast
- RN prepares patient and contrast agent
- Patient education
- Administration of contrast
- Documentation/monitoring for adverse reactions
Contraindications / Cautions

**Contraindications:**

- Known / suspected right to left, bidirectional or transient right-to-left cardiac shunt
  - **As of September 2016 the presence of a shunt is no longer a contraindication for the use of Optison**
- Known hypersensitivity to agent
- Intra-arterial injection
- Pregnancy/nursing mothers (warning on package)

**Contrast Preparation**

- Definity:
  - Vial mixer needed
  - 2 needles/one to vent the vial and one to draw back into the saline solution if diluted or draw back undiluted directly into a syringe
  - Saline flush

- Optison
  - Need to re-suspend by rolling solution back and forth in syringe between hands

- Lumason
Methods of Administration

- **IV bolus (undiluted)**
  - Optison
    - Recommend .3-.5 ml (SLOW ADMINISTRATION)
    - May use 1-2 ml slow saline flush
  - Definity
    - 10 microliters/kg
    - Follow with 10 cc slow saline flush
  - Lumason
    - 2ml followed by saline flush if needed

- **Diluted Method (Definity)**
  - Imaging agent diluted in saline solution
    - 1.5 ml Imaging agent in 8.5ml saline = 10ml
    - Recommend .5ml-1ml slowly administered over 10sec/followed by 1-2 ml slow saline flush if needed

- **Continuous IV infusion**
  - Imaging agent introduced into 50-100ml IV solution
  - Infused slowly

Contrast Side Effects

- Contrast agent related side effects are minor and infrequent (rate of severe reactions < 1 in 10,000), comparable to or lower than other routinely utilized radio-opaque or MR contrast agents
- With Definity severe back pain may occur (reported frequency 1/300 to 1/10,000)
- Albumin based (Optison) contrast agents should not be used if a patient has experienced a blood transfusion reaction

Abdelmoneim et al ECHO 2014
Contrast Echocardiography

- Documentation
  - Dose and time of administration
  - Reaction noted in medical record
  - Note: if a reaction occurs-this should be entered as an allergy in the patient’s medical record

System Optimization:
Available Tools / System Settings

- Mechanical Index Optimal set at 0.2-0.4
- Harmonic Imaging
- Adjust TGC’s
- Near Gain
- Narrow Dynamic Range
- Adjustment the Focal Zone

- Vendor Application Representatives can help develop contrast specific pre-sets which simplifies and streamlines workflow
Pitfalls With Contrast Administration: Attenuation

- The contrast agent was given too fast

- Attenuation happens when too much contrast agent in the LV; most of the transmitted ultrasound is reflected at the apex so that the basal portion of LV cavity is not well visualized

Well Opacified Left Ventricle

- Injection of contrast should be given slowly
- Either method used: Bolus vs. Diluted method-- Slow steady injection is essential for the Left Ventricular opacification
- If using the bolus method a slow saline injection should follow contrast injection (stop when contrast is in the Right Ventricle)
Pitfalls With Contrast Administration: Mechanical Index Too High

• MI is a measure of transmitted power emitted from the ultrasound transducer and it is displayed on the 2D monitor

• To increase penetration a relatively high MI (1.5 to 1.9) is used for standard 2D images

MI Set Correctly

• Low MI’s are preferable to resonate or vibrate bubbles without bursting them

• Resonating microbubbles are highly reflective and provide densely opacified LV cavity during imaging

• Recommended MI setting for LVO is 0.2–0.4
Pitfalls With Contrast Administration: Swirling

- Too Slow of an injection
- MI may be too high
- Improper focal zone
- Seen commonly when EF’s are low and poor overall function

**Moving the focal zone to the apex may help to visualize the apex better**

Case Presentations
Case One: Contrast Essential

• 59 y/o man admitted for elective Thyroidectomy
• Postop developed Atrial Fibrillation with a rapid ventricular response at a rate of 140 bpm
• Rate responded to IV Esmolol
• Echocardiogram ordered to assess LV function
  • No LAX view and only a limited Apical four chamber

Case One: Salvage

Contrast administered
• Study salvaged by use of contrast
• Overall LV function can be confidently assessed and appears normal
Case 2: Who Would Use Contrast?

- 44 y/o Asian man with no prior cardiac history
- Developed frequent PVC’S post op
- Cardiology consult requested for PVC’S / abnormal ECG
- Patient was asymptomatic, physical exam normal, troponins normal
- Consult team requested Transthoracic Echo

NSR with PVCs possible septal infarct & anterior lateral T wave inversion
Case 2: Who Would Use Contrast?
Non Contrast Images

Case 2: Who Would Use Contrast?
What is the diagnosis?

- Differential Diagnosis:
  - CAD
  - Apical MI
  - Hypertrophic cardiomyopathy

- Based on the Echo, ECG and clinical history would you do a Stress Test, Cath, or repeat Echo with contrast?
Case 2: Who Would Use Contrast?  
What is the diagnosis?

Apical Hypertrophic CMP
Use of contrast resulted in a management change
Nuclear stress test was cancelled
Therapy with BB instituted

Non- Contrast Cardiomyopathy

- 45yo Male admitted with increasing SOB
- History of Dilated Cardiomyopathy
Addition of Contrast

- Non-traditional views
- Apical Short axis demonstrates thrombus well

NON-COMPACTION

- 35 y/o man complained of palpitations and dyspnea
- ECG revealed a LBBB
- Physical exam revealed an S3 gallop
- Echocardiogram ordered
- Non contrast images suboptimal but revealed a dilated LV
- Contrast images demonstrates prominent trabeculations with contrast in the deep inter-trabecular recesses
Stress Echo Case

- 60 y/o male with new complaints of exertional chest pain
- Patient exercised 9 minutes of a Bruce protocol
- Stopped because had complaints of 7/10 chest pain that persisted well into recovery
- 1.5-2mm ST depression
- BP dropped at peak exercise
Cardiac Catheterization Results

- 99% stenosis of the proximal LAD/followed by 75% stenosis in the mid LAD
- 85% stenosis mid right coronary artery
- 60% stenosis in the mid left circumflex that extended into the first obtuse marginal
- Underwent a successful PCI with stent placement
- Aggressive medical management
There is room for improvement

Overcoming the Challenges:
Safe Implementation of Contrast Echocardiography

- Develop a policy and procedure
  - Work with pharmacy / P&T committee and the medical director
  - Identify a “Champion” in the lab

- Institute staff training
  - Educate sonographers on when to use a contrast agent
  - Teach trouble shooting methods (system settings)
  - Nurse training on administration and dosing
  - Fellow teaching

- Ongoing process for continual improvement

- TEAMWORK IS KEY!!
Summary

- Contrast is a valuable tool
  - Currently approved for LVO
  - Proven value in salvaging suboptimal studies
  - Improves accuracy / reproducibility of EF assessment
  - Improves stress echo accuracy
  - Detecting LV thrombus
  - Defining LV geometry
  - Cost savings: LVO enables determination of LV function and prevents the need to resort to other imaging modalities

- Safe to use
  - Monitoring: necessary only when there is a reaction

- Work flow issues must be addressed
  - Identifying specific roles for staff members is essential
  - Staff education

GUIDELINES AND STANDARDS

Guidelines for the Cardiac Sonographer in the Performance of Contrast Echocardiography: A Focused Update from the American Society of Echocardiography

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(J Am Soc Echocardiogr 2014;27:707-810.)

Keywords: Echocardiography, Sonographer, Contrast, Imaging
Thank you!