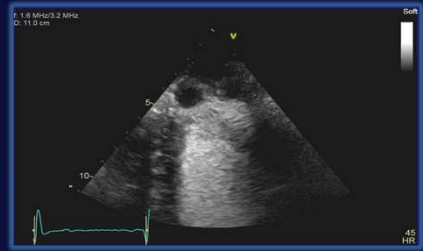
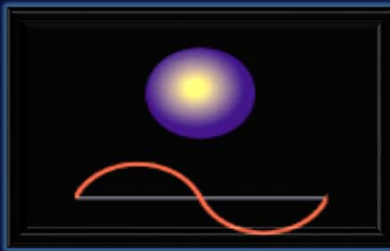


# Contrast Echocardiography

## Pitfalls in Contrast Imaging



Steven J. Lester, MD, FACC, FRCP(C), FASE  
Mayo Clinic

## DISCLOSURE

Relevant Financial Relationship(s)

None

Off Label Usage

None

## Computerized Tomography



## Magnetic Resonance

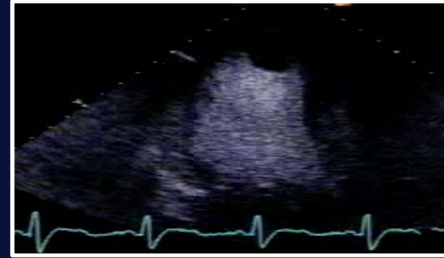
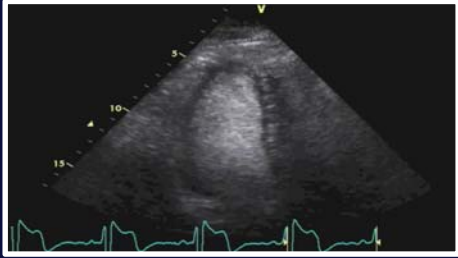


## Contemporary Ultrasound Contrast Agents

Stabilized gas microbubbles sized to pass through the smallest capillaries



# FDA Approved Contrast Agents



Agent	Size ( $\mu\text{m}$ )	Gas	Shell	Indication
Optison	3.0-4.5	Perflutren	Albumin	LVO/EBD
Definity	1.3-3.3	Perflutren	Phospholipid	LVO/EBD
Lumason	1.5-2.5	Sulfur hexafluoride	Phospholipid	<ul style="list-style-type: none"> <li>LVO/EBD</li> <li>Abdominal/Liver US</li> <li>Urinary Tract (peds)</li> </ul>

# Contrast Echocardiography

Positive Impact : Makes a Difference



Avoid the Pitfalls



# Pitfall #1

## Safety : Contraindications

### 1. Suspected hypersensitivity to the microsphere components.

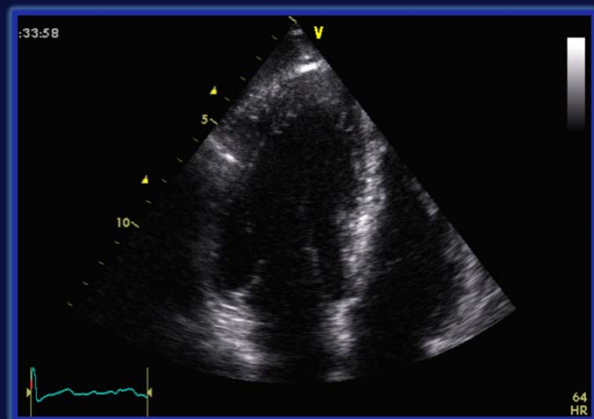
- Most serious reactions occur within 30 minutes of administration

**No 30 minute monitoring period!**

## Echocardiography and Left Ventricular Function

- Most common use of diagnostic echocardiography
- Global ventricular function
- Regional wall motion

Rest  
Stress



## Innovation



## Workflow

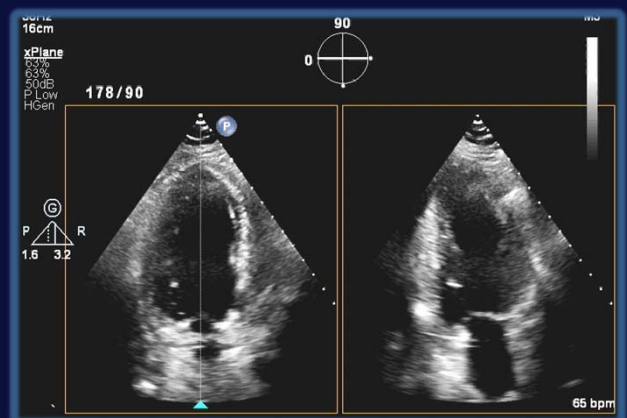


For any innovation in echocardiography to be widely adopted it must be equaled or paralleled by an innovation in workflow

## Pitfall #2

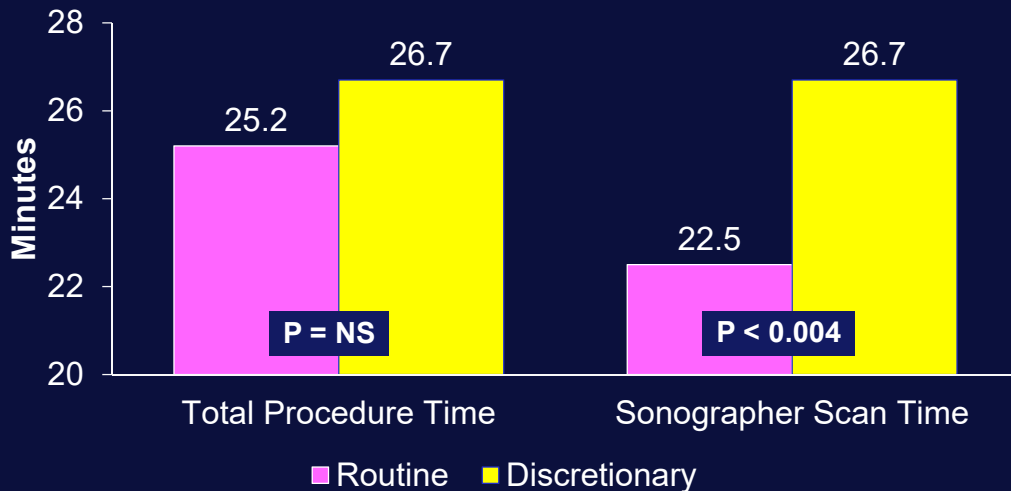
### Imaging Protocol (a) : Workflow Efficiency

#### The “60 Second Echo”



## Pitfall #2

### Impact of the "60 second Echo"



Lester SJ et al. J Am Soc Echocardiogr 2006 Jul; 19(7):919-23

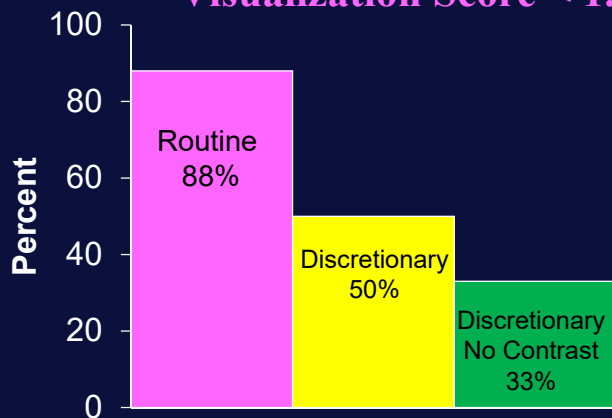
## Pitfall #3

### We Don't Use Enough Contrast

#### Visualization

- 1= Excellent or adequate full endocardial visualization
- 2= Incomplete endocardial visualization
- 3= only epicardium visualized
- 4= segment not visualized

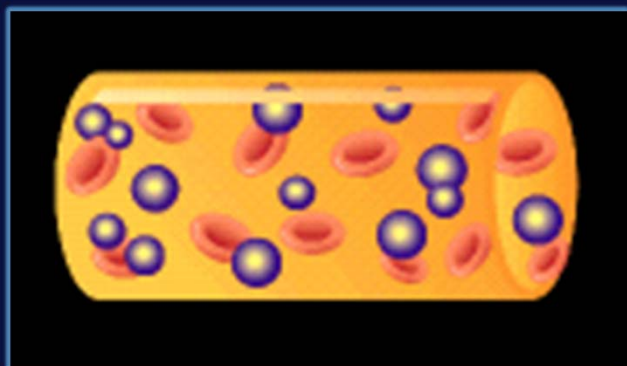
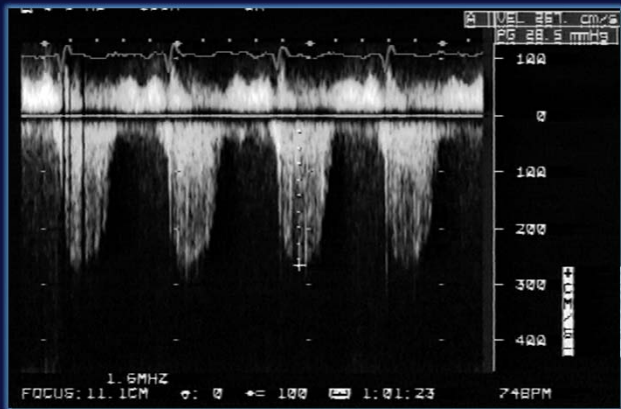
#### Visualization Score < 1.1



Lester SJ et al. J Am Soc Echocardiogr 2006 Jul; 19(7):919-23

# Pitfall #4

## Imaging Protocol (b) : Spectral Doppler

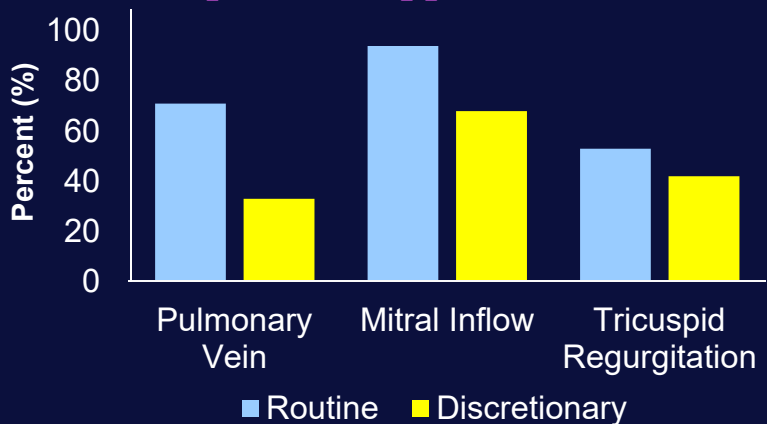


# Spectral Doppler

## Spectral Doppler

- 1= Excellent
- 2= Fair
- 3= Poor

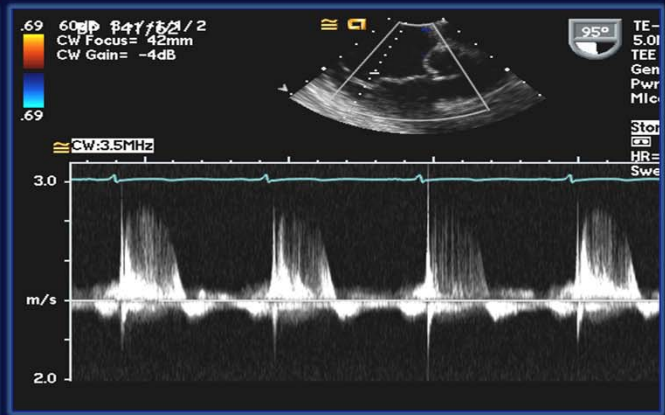
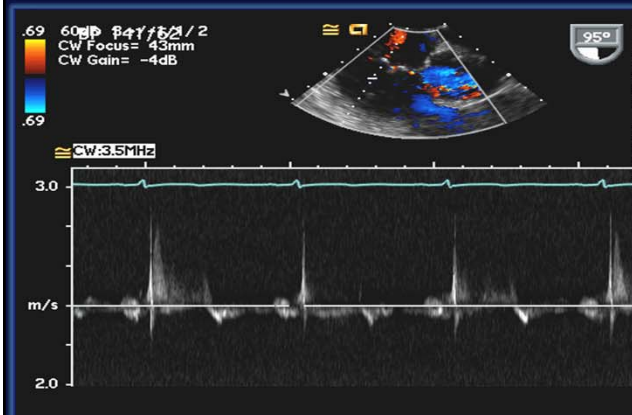
## Spectral Doppler Score = 1



Lester SJ et al. J Am Soc Echocardiogr 2006 Jul; 19(7):919-23



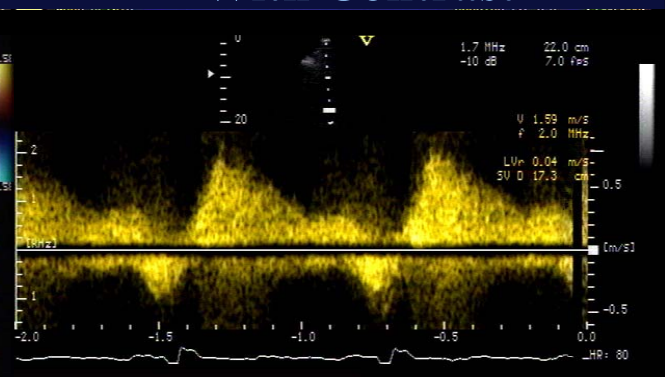
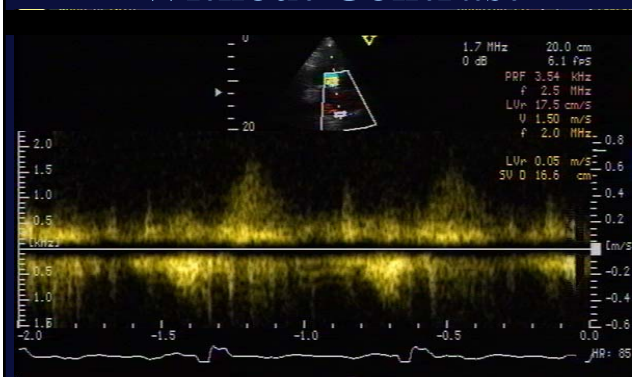
# TEE TR: Contrast



# PULMONARY VEIN FLOW

Without Contrast

With Contrast

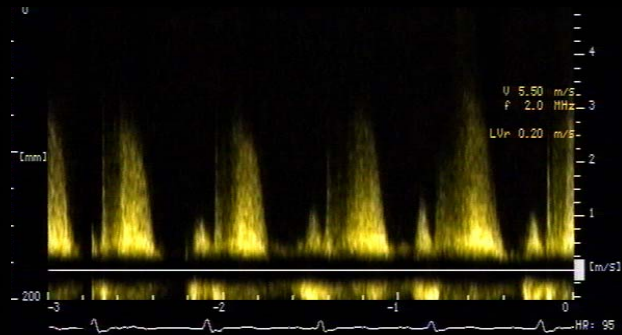
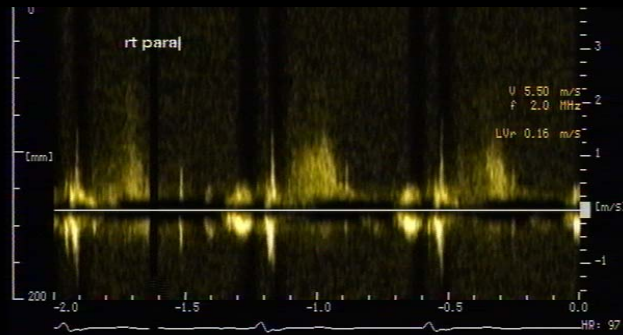




# AORTIC STENOSIS

Without Contrast

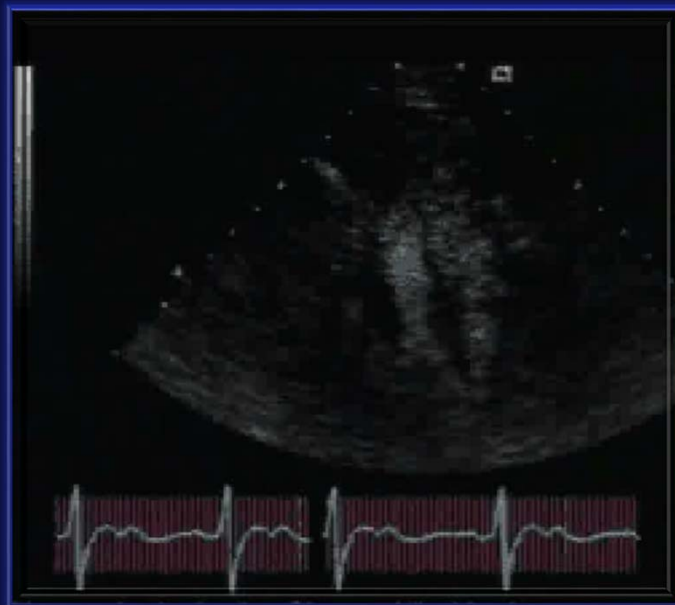
With Contrast



## Contrast Echocardiography Structural Definition

- 1. LV Structural Abnormalities**
  - Apical hypertrophy
  - Aneurysm / pseudoaneurysm
  - Thrombus
  - Noncompaction
  - Myocardial rupture

# What's Up At The Apex?



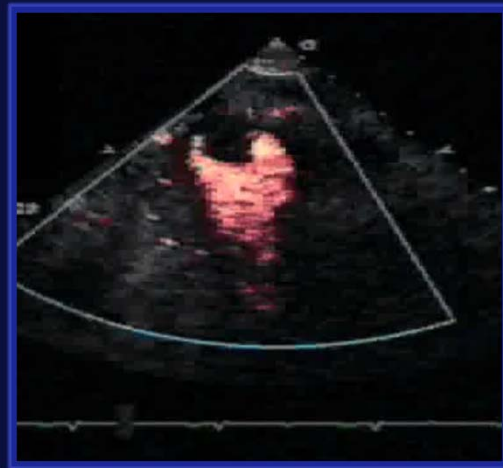
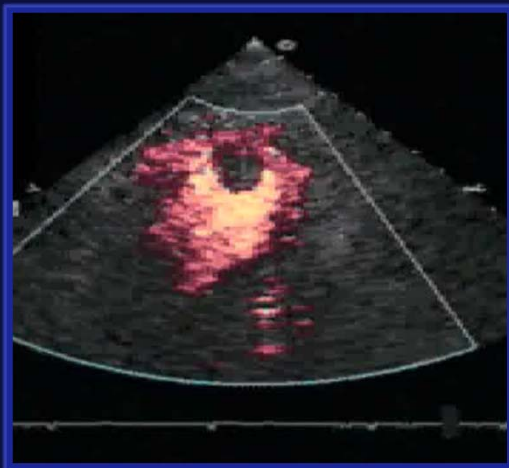
# LV Structural Abnormalities

## LV Aneurysm



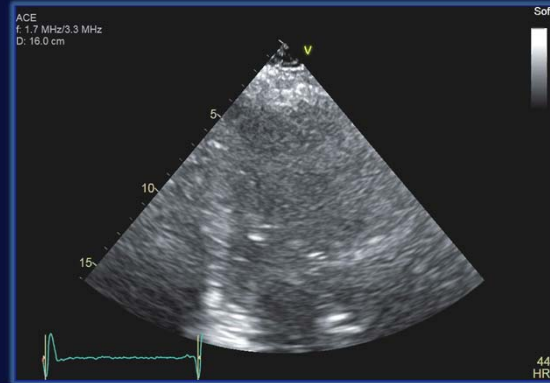
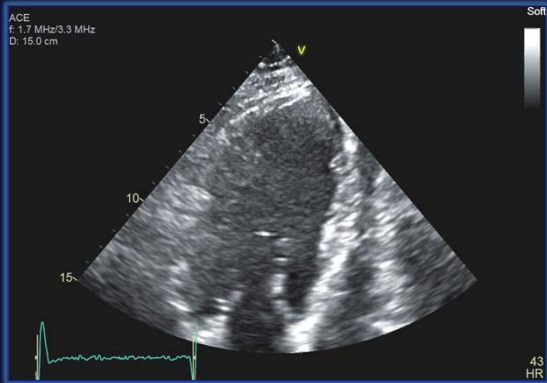
# LV Structural Abnormalities

## LV Aneurysm & More



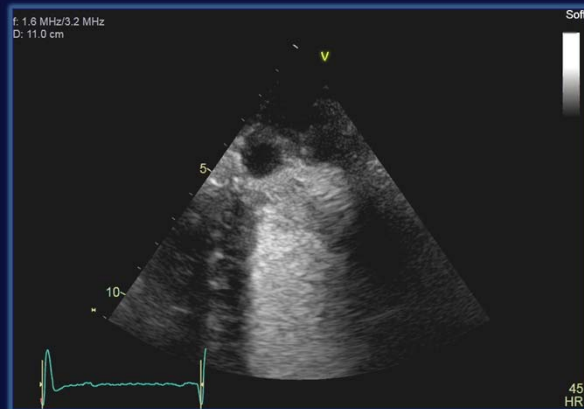
# LV Structural Abnormalities

## LV Aneurysm



# LV Structural Abnormalities

## LV Aneurysm & More



# Contrast Echocardiography

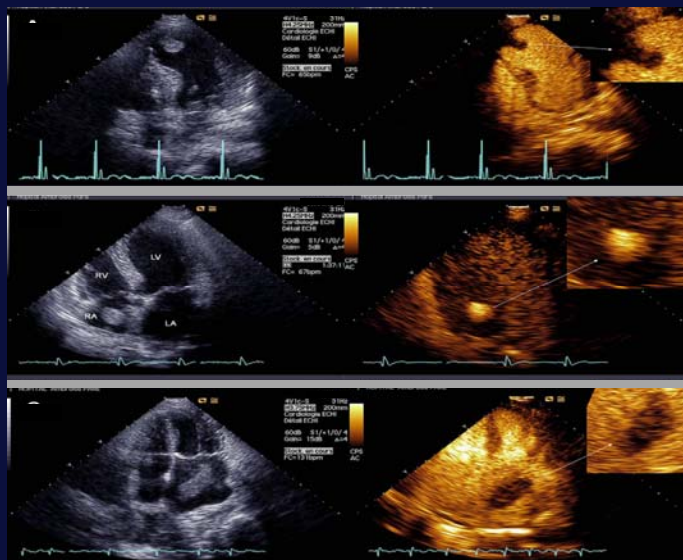
## Structural Definition

### 1. LV Structural Abnormalities

- Apical hypertrophy
- Aneurysm / pseudoaneurysm
- Thrombus
- Noncompaction
- Myocardial rupture

### 2. Characterize intracardiac masses (tissue characterization)

## Characterize Intracardiac Masses



LV apical thrombus in patient post MI, no enhancement

Secondary cardiac tumor (renal sarcoma) located in RA, complete enhancement

LA myxoma, partial enhancement

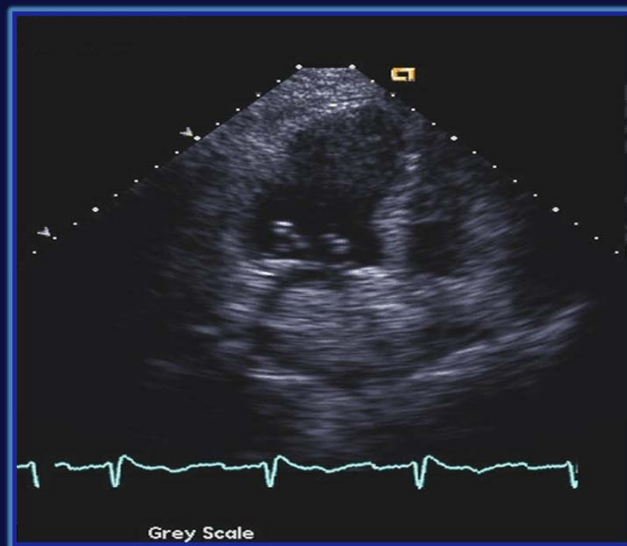
Mansencal et al. Archives of Cardiovascular Disease (2009) 102, 177—183

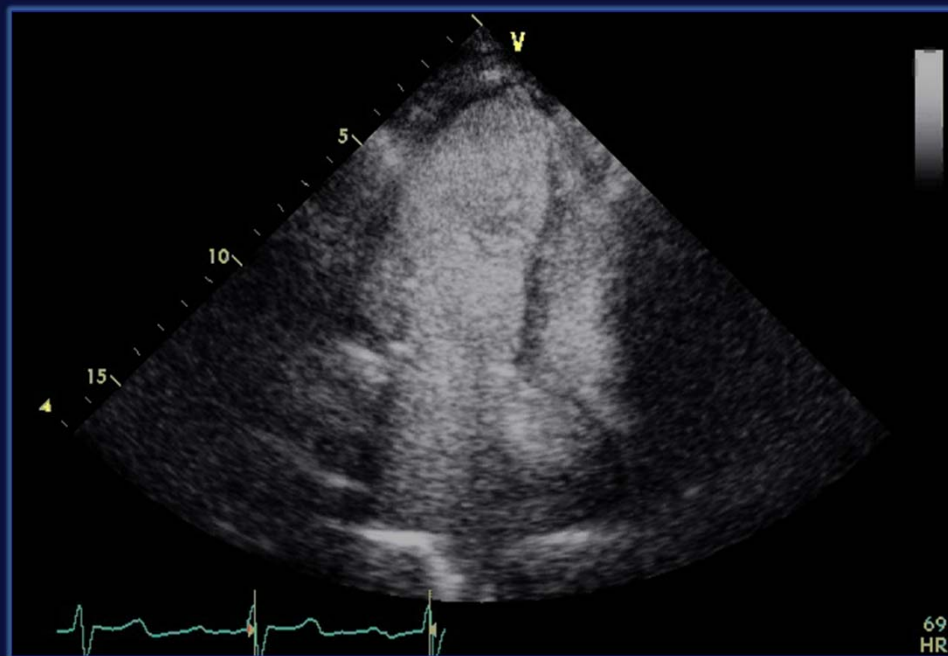
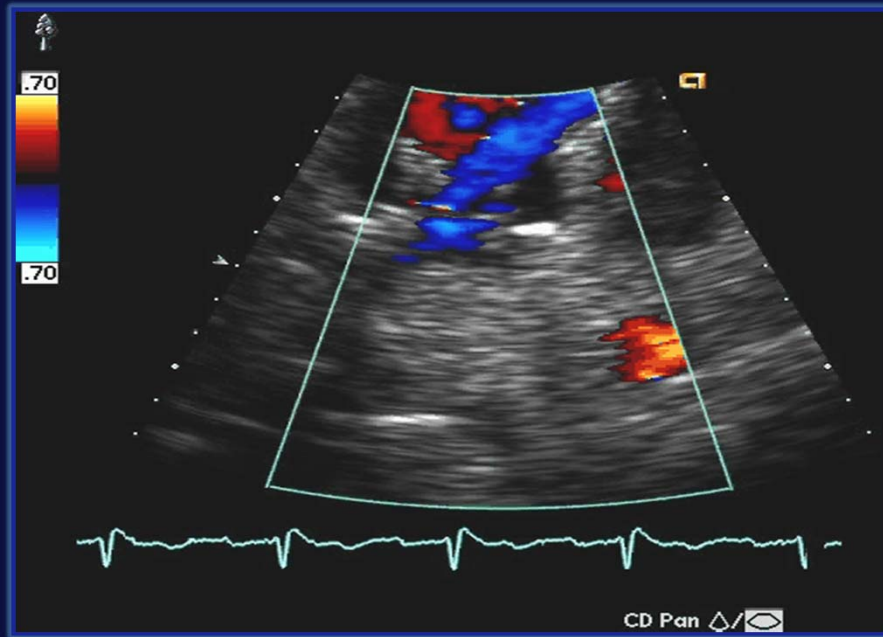
# Contrast Echocardiography

## Structural Definition

- 1. LV Structural Abnormalities**
  - Apical hypertrophy
  - Aneurysm / pseudoaneurysm
  - Thrombus
  - Noncompaction
  - Myocardial rupture
- 2. Characterize intracardiac masses (tissue characterization)**
- 3. Differentiate artifacts**

## Left Atrial Myxoma?

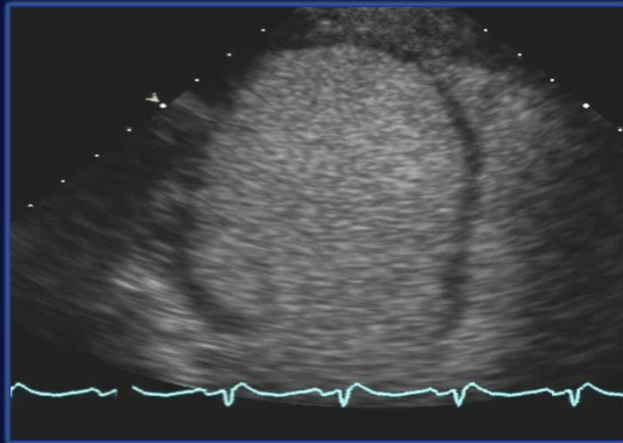




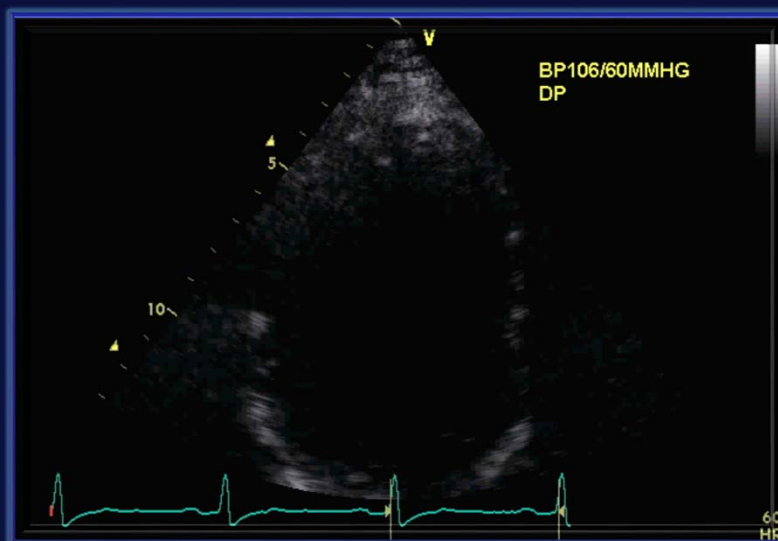


## Pitfall # 5

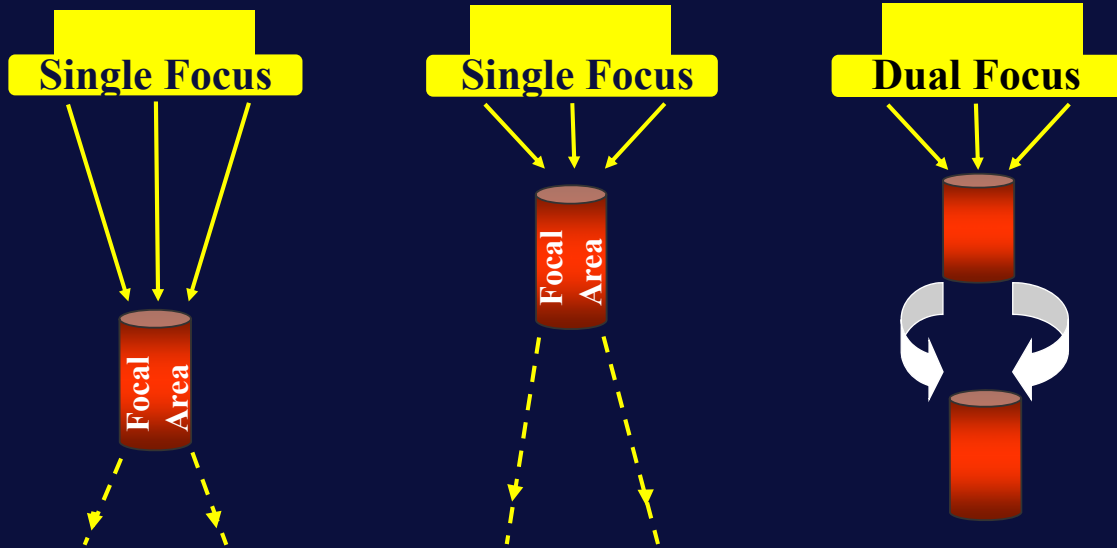
Machine and administration frequency adjusted to provide best image



## Initial Image



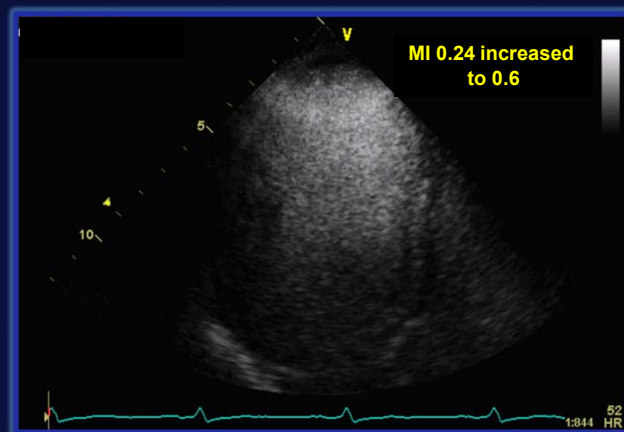
# Focus



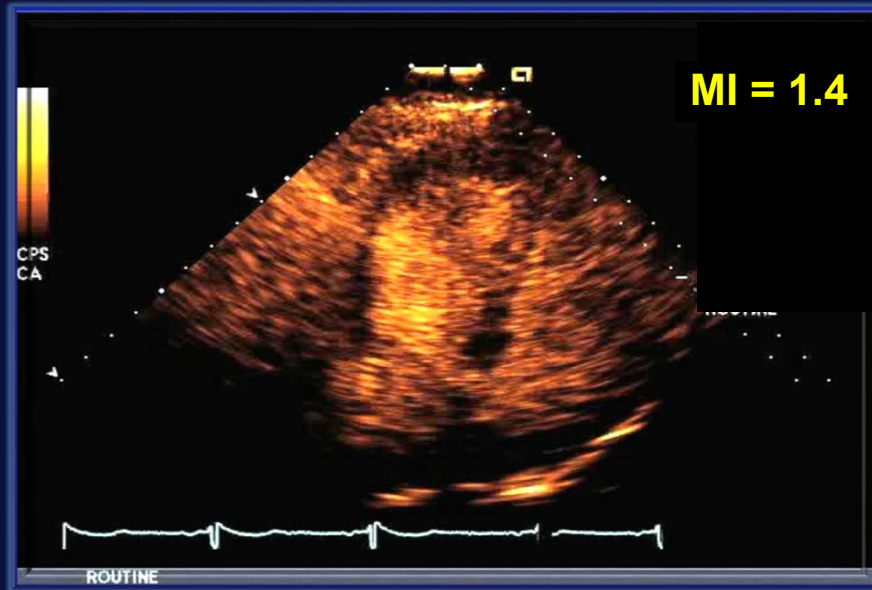
## Impact of Mechanical Index

### Mechanical Index

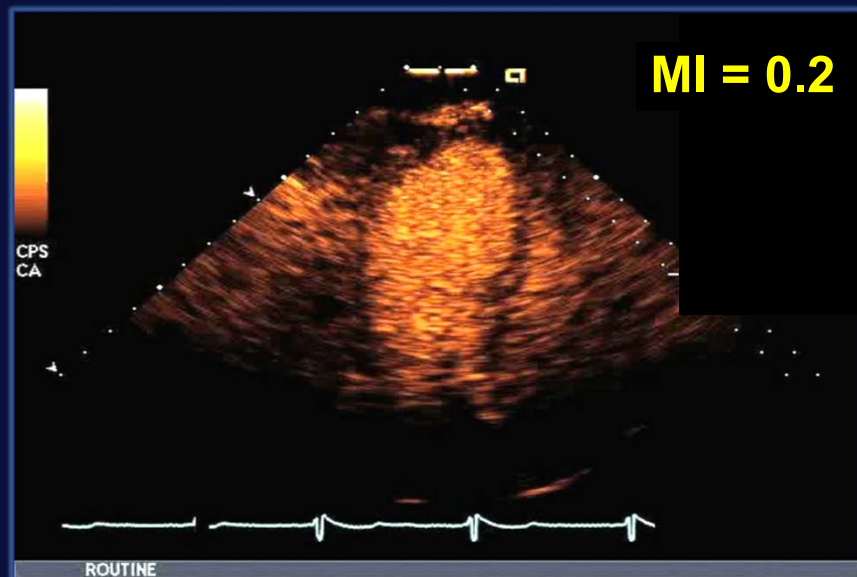
- Measure of output acoustic power
- High MI increases bubble destruction



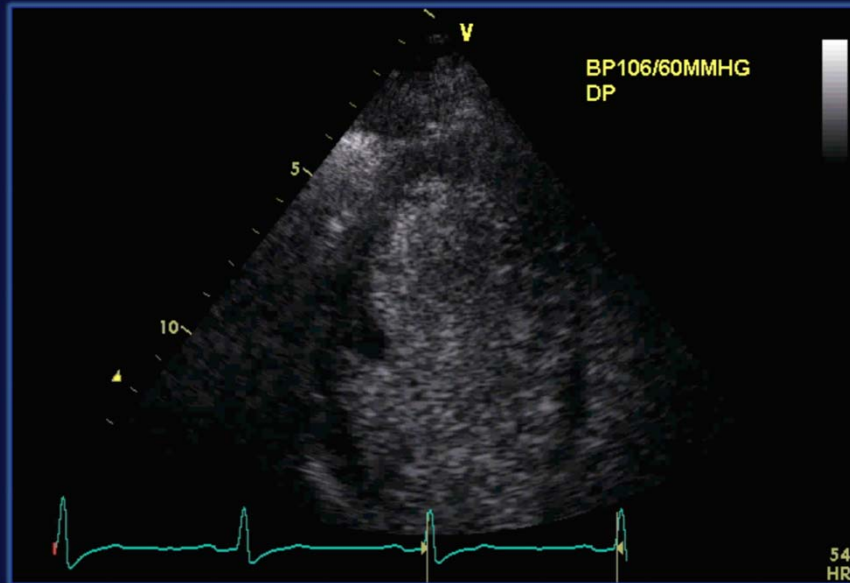
# Suboptimal LV Opacification



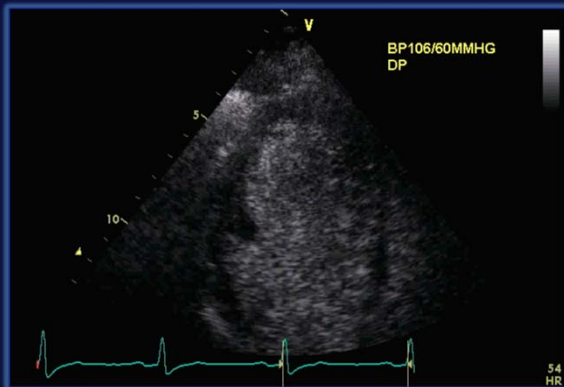
# Optimal LV Opacification



# Apical Dropout

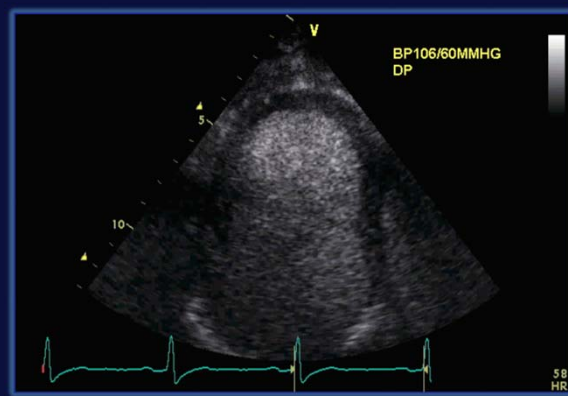


# Apical Dropout



## POTENTIAL CAUSES

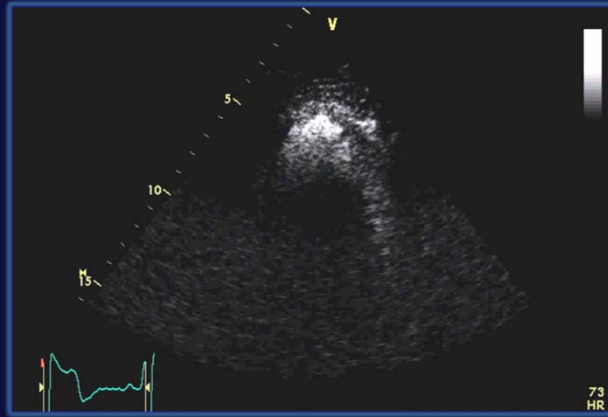
- System settings  
(*focal zone misplacement*)
- Dosing and administration  
(*low concentration*)



# Attenuation

## POTENTIAL CAUSES

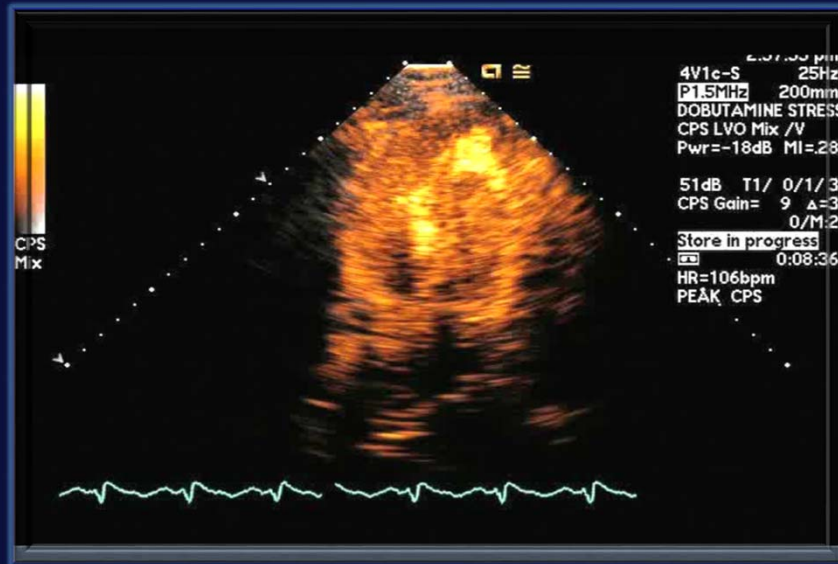
- Dosing  
(*high concentration*)
- Administration  
(*infusion rate too fast*)
- Clinician  
(*obtain off-axis windows*)



# Tincture of Time



# Burst Some Bubbles: Flash



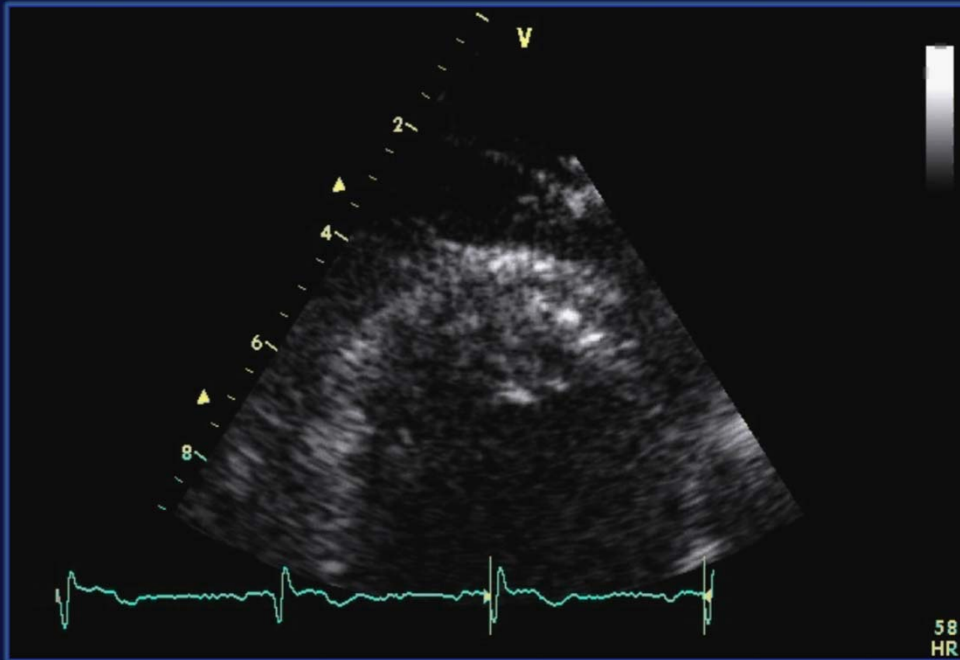
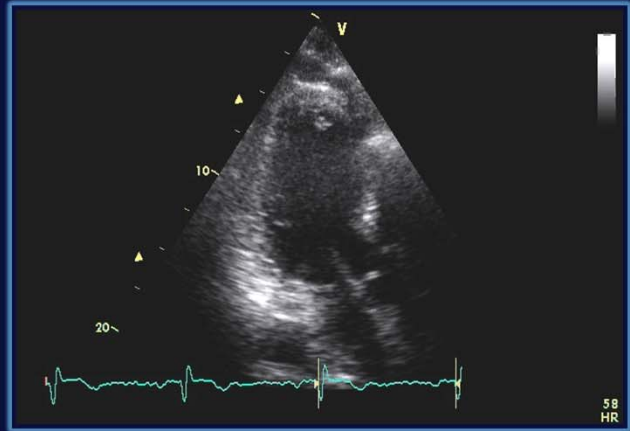
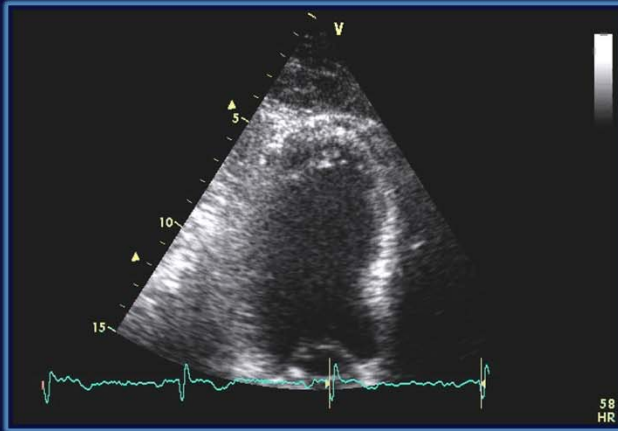
# Swirling

## POTENTIAL CAUSES

- System settings (*high MI*)
- Dosing (*low concentration*)
- Administration (*low infusion rate*)
- Poor LV function

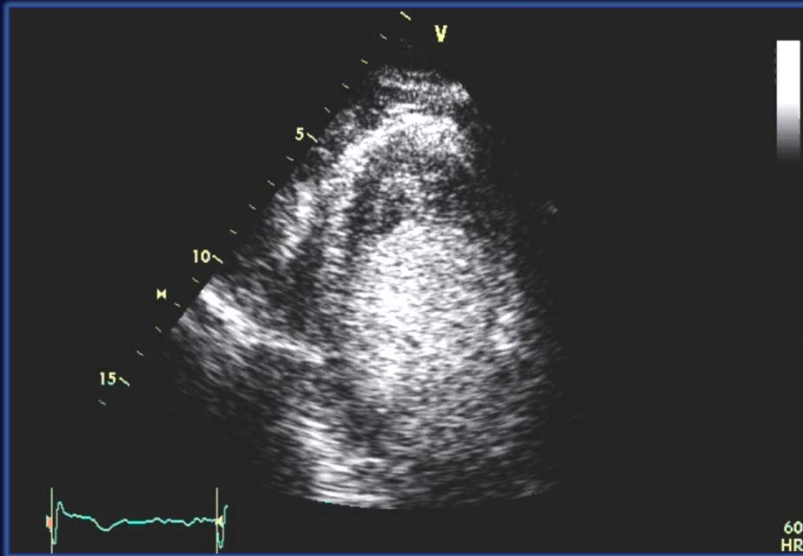


# Thrombus?

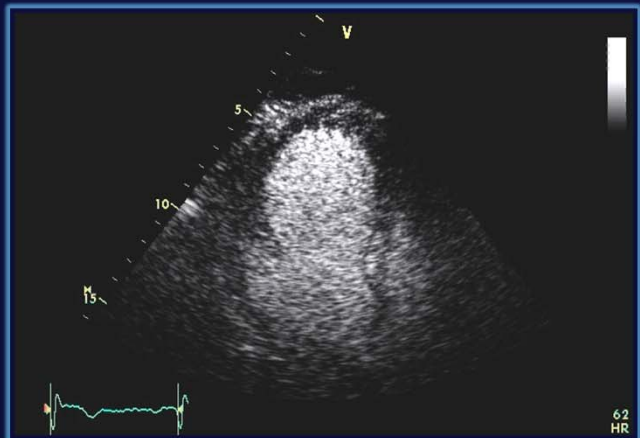
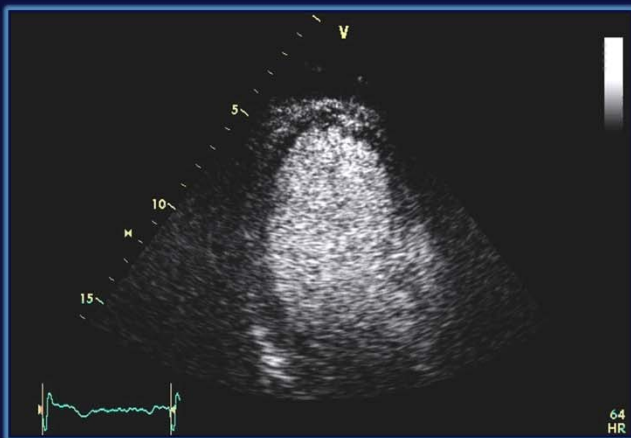




# Did Contrast Help?



# Instrument Set Up



# Contrast Echocardiography

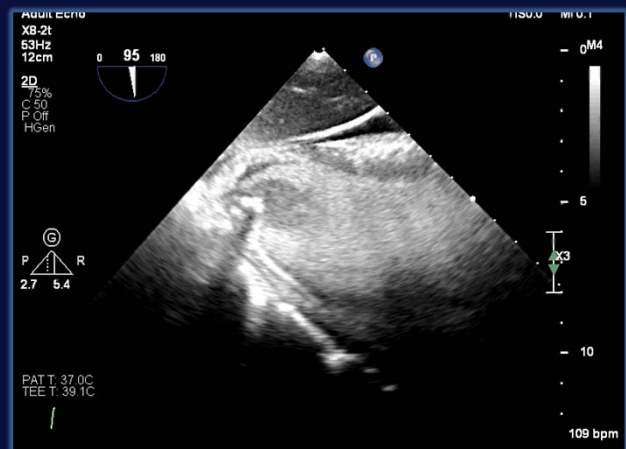
## Avoid The Pitfalls

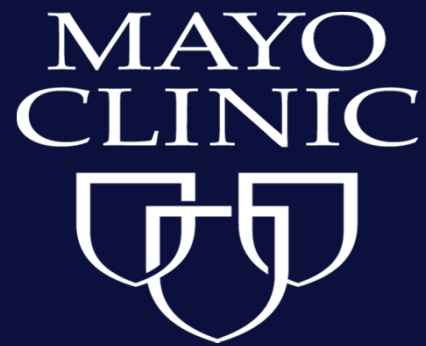


1. Contraindications (safety)
2. Protocol Development  
(The 60 second Echo)
3. Use It
4. Spectral Doppler
5. Instrument Settings

# Contrast Echocardiography

## Tool Used to Build Excellence in ECHO





**TABLE 2** Diagnostic Cost-Effectiveness: Cost to Identify Wall Motion or LVEF and Cost-Effectiveness Ratios in 100 Patients

Procedure	% Accuracy		Procedural Costs to Identify WM or LVEF		% Cost Compared With TEE		Cost-Effectiveness Ratio ( $\Delta$ cost/ $\Delta$ accuracy)	
	WM	LVEF	WM	LVEF	WM	LVEF	WM	LVEF
TTE F	48	25	\$31,087*	\$40,083*	-21*	2*	-\$154*	\$13*
TTE +H	58	38	\$30,008*	\$37,831*	-23*	-3*	-\$217*	-\$21*
TTE +H + C	70	84	\$37,814*	\$32,338*	-3*	-17*	-\$43*	-\$423*
TEE			\$39,115	\$39,115				

\*Cost reflects respective transthoracic echocardiographic procedure performed and TEE in inaccurate/nonevaluable cases.  
 F = fundamental; H = harmonic; H + C = harmonic plus contrast; WM = wall motion.