3D Echo: Acquisition, cropping and display

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No Disclosures

ASE American Society of Echocardiography
Heart & Circulation Ultrasound Specialists

GUIDELINES AND STANDARDS

EAE/ASE Recommendations for Image Acquisition and Display Using Three-Dimensional Echocardiography

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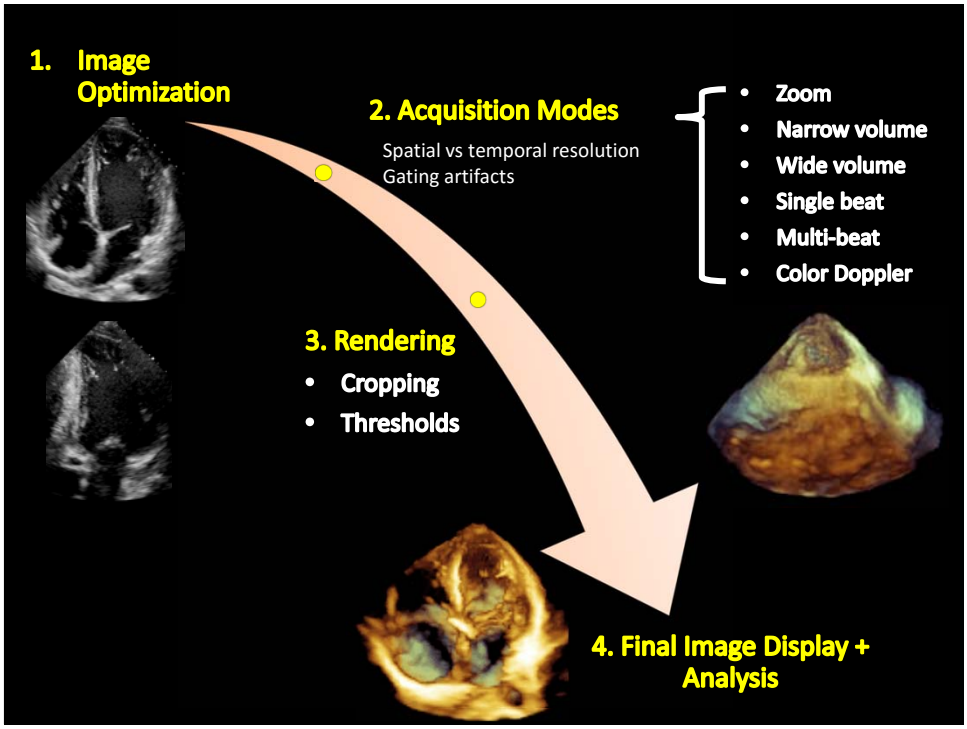
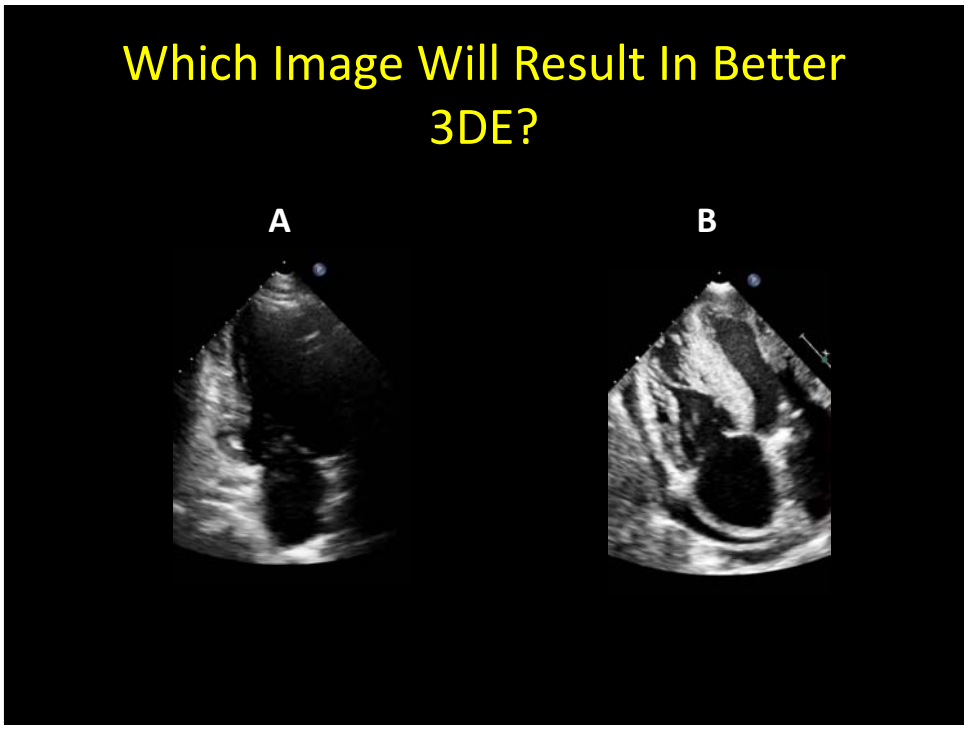
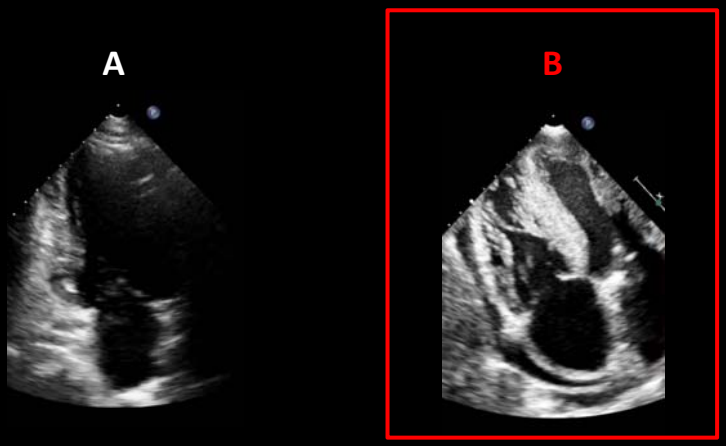
(J Am Soc Echocardiogr 2012;25:3-46.)


1. Image Optimization
2. Acquisition Modes
Spatial vs temporal resolution
Gating artifacts
Zoom
Narrow volume
Wide volume
Single beat
Multi-beat
Color Doppler
3. Rendering
Cropping
Thresholds
4. Final Image Display + Analysis

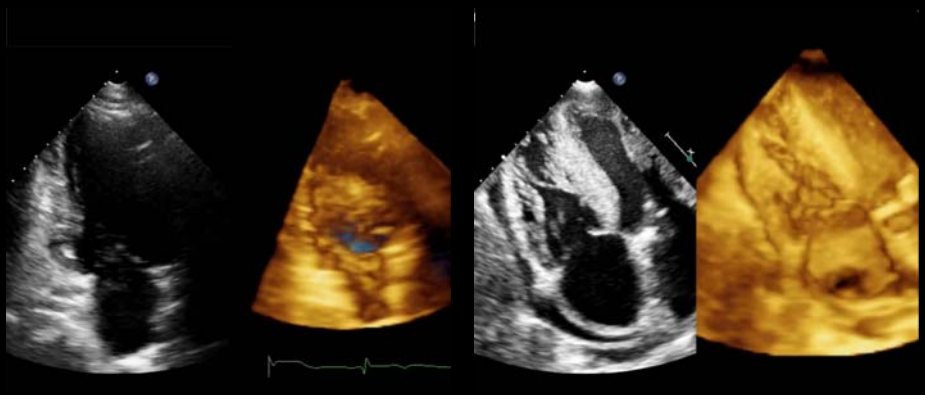

Which Image Will Result In Better 3DE?
A
B

Which Image Will Result In Better 3DE?

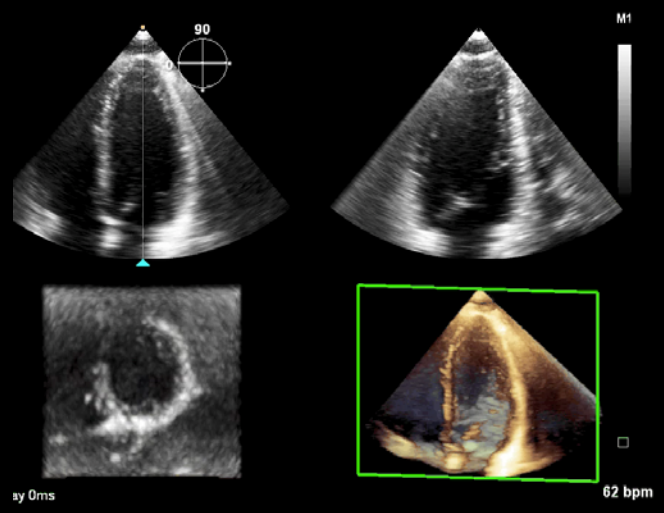


Acquisition: 2D Image Quality

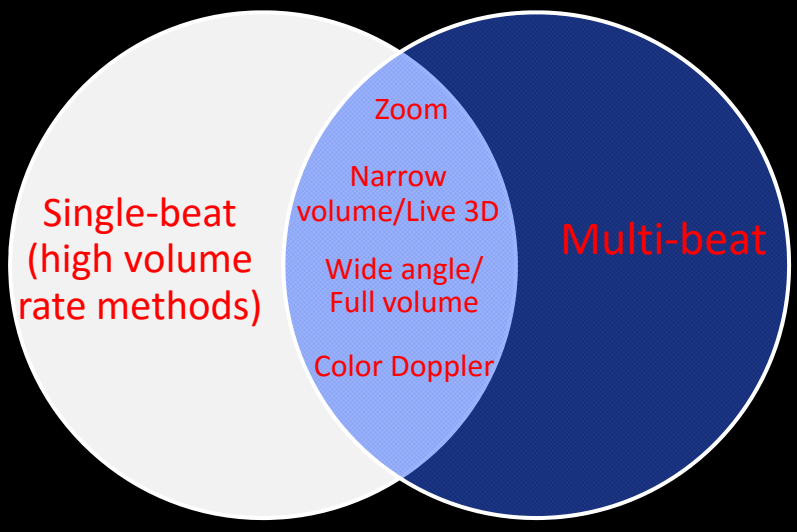
- Before 3DE acquisition, the 2D image should be optimized
  - Poor 2D images, poor 3D images

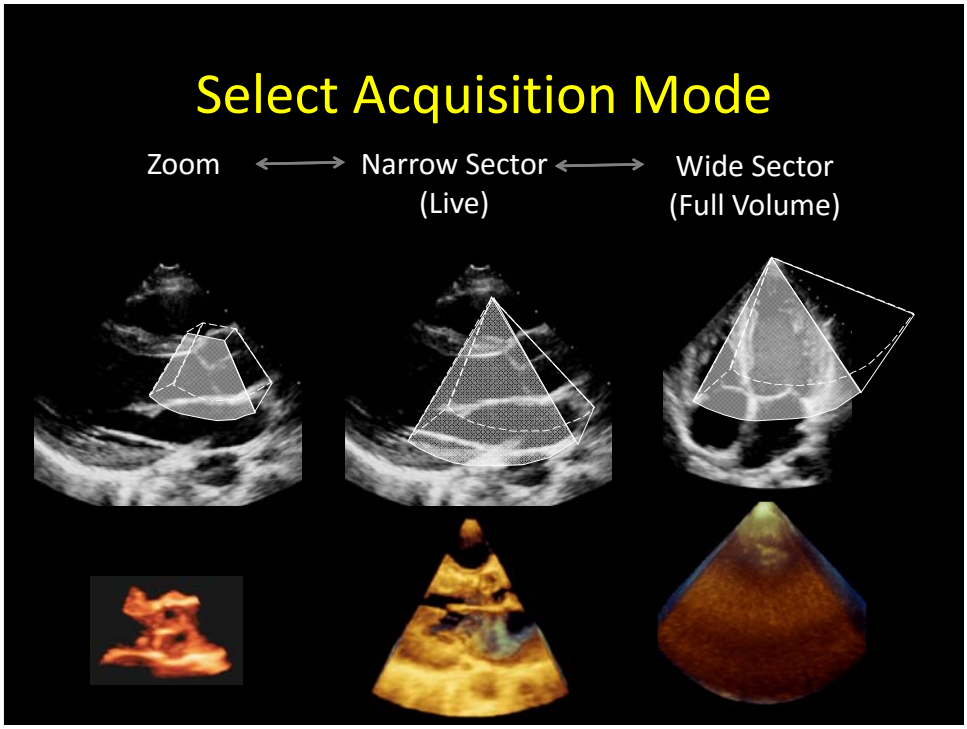


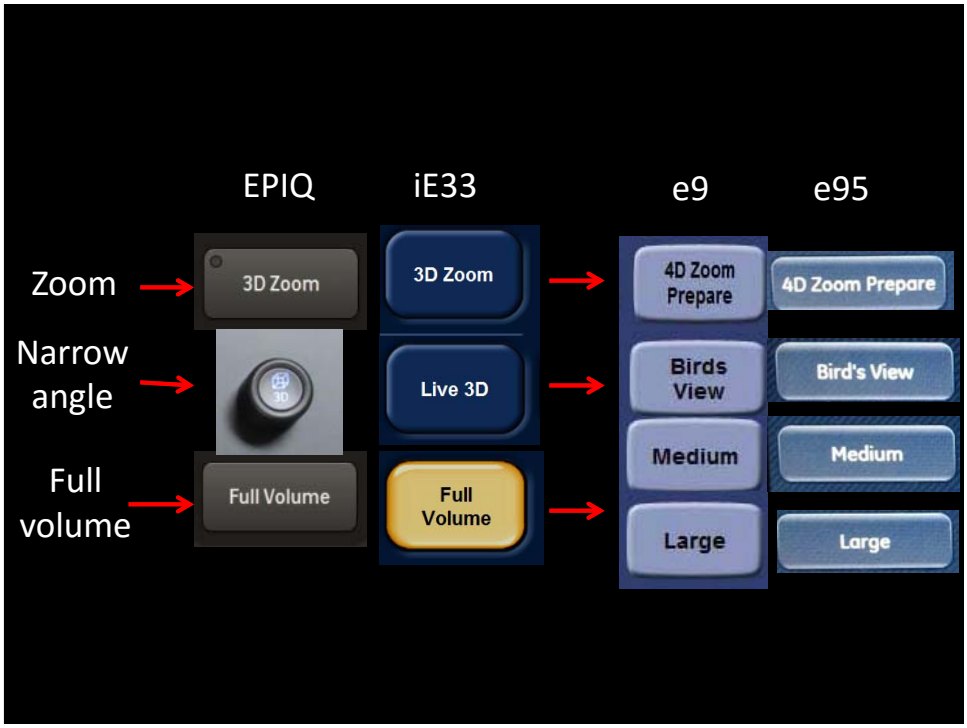
Acquisition: Image Optimization
Biplane Imaging/Multi-View



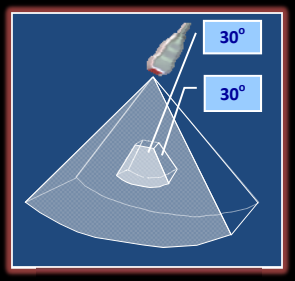
Modes of Acquisition

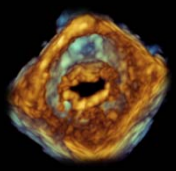


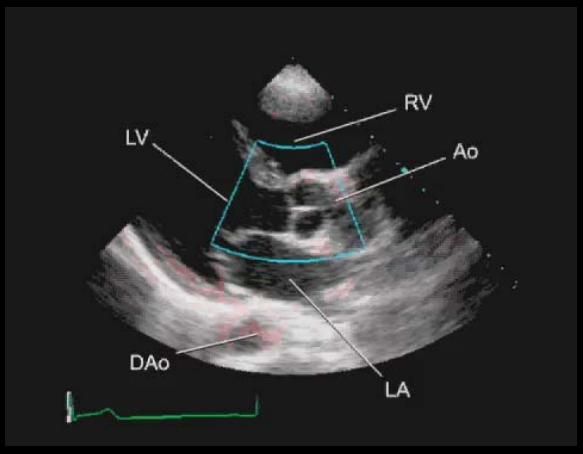

Select Acquisition Mode
Zoom
Narrow Sector
(Live)
Wide Sector
(Full Volume)


EPIQ
iE33
e9
e95
Zoom
Narrow angle
Full volume
3D Zoom
Full Volume
3D Zoom
Live 3D
Full Volume
4D Zoom Prepare
Birds View
Medium
Large
4D Zoom Prepare
Bird's View
Medium
Large

Zoom Mode

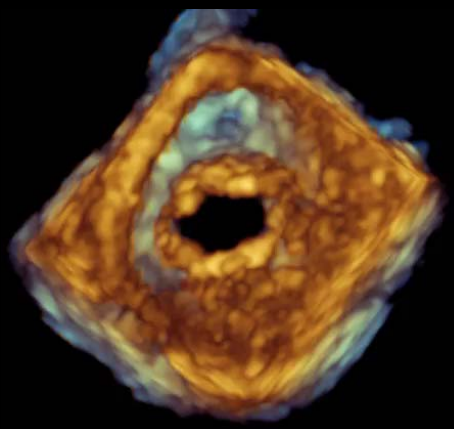




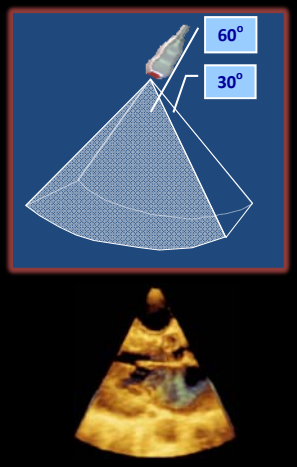


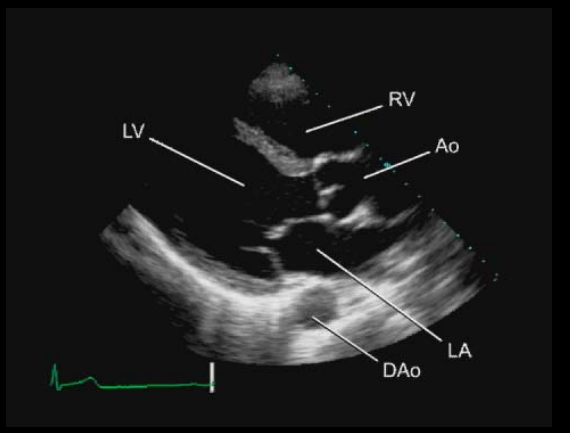
Zoom Mode

- Indications:
  - Valves
  - ASD
  - VSD
  - small, fast moving structures
- Beware of losing spatial orientation



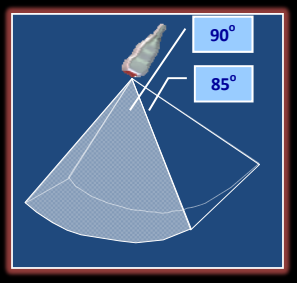
Narrow Volume

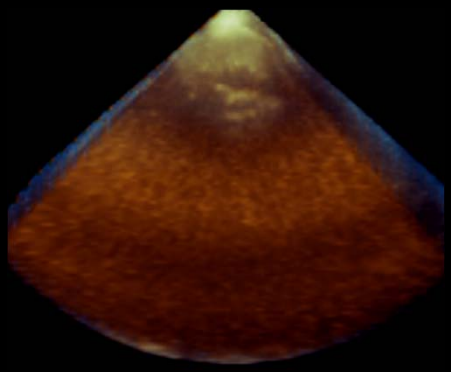




- Useful for procedures

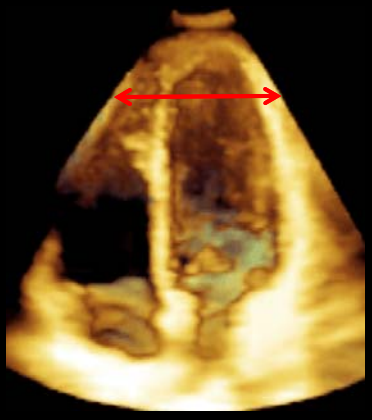
Wide Angle



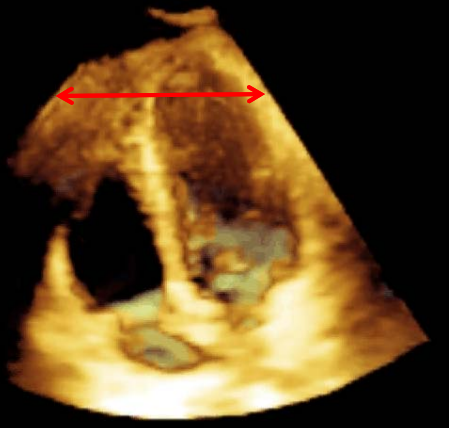


Pyramidal size

4- Beat, 30 Hz



4- Beat, 20 Hz



What size to choose?

Narrow angle/Zoomed

- Valves
- Inter-atrial septum
- Inter-ventricular septum

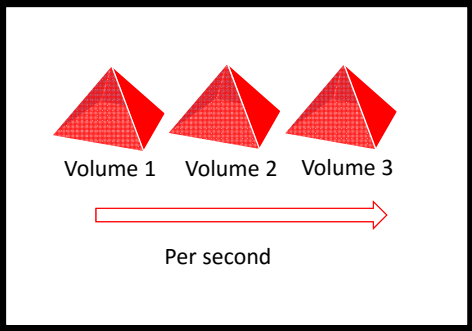
Wide angle

- LV
- RV
- Whole heart

Single or Multi-beat?

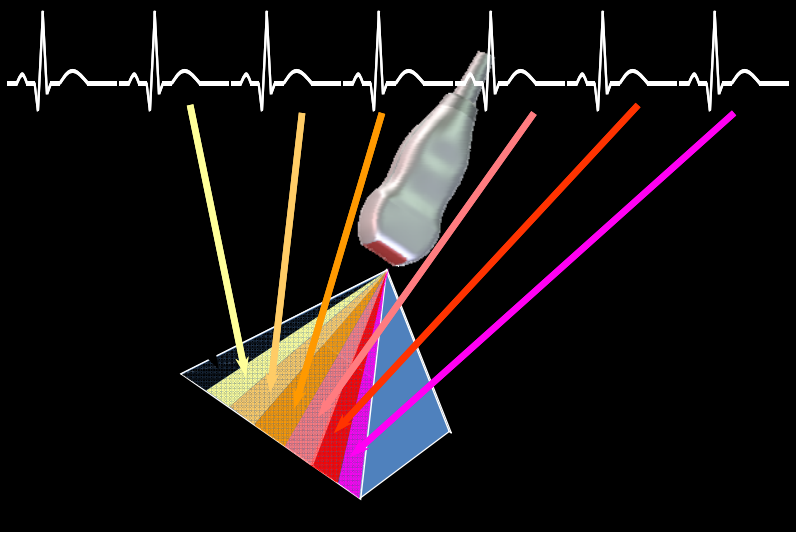
Single-beat acquisition

– acquisition of multiple pyramidal data sets per second in a single heartbeat

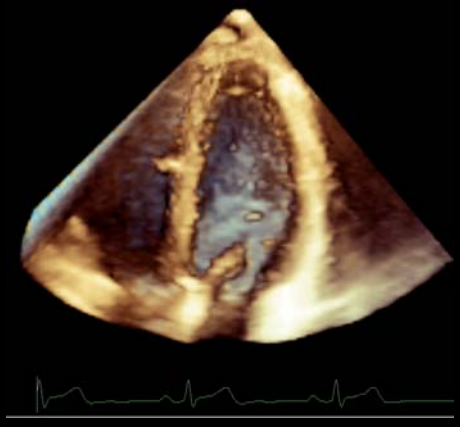


Single or Multi-beat?

ECG-triggered multiple-beat acquisition

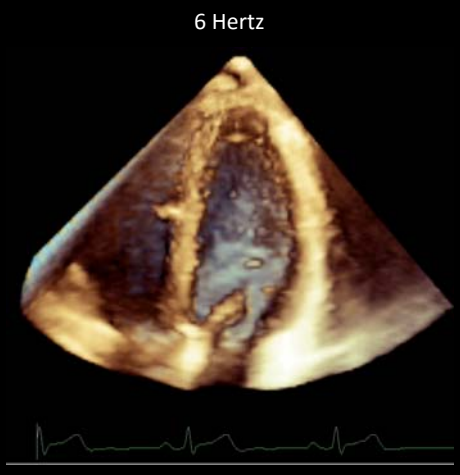


What is the Problem?



a) Nothing
b) Low frame rate
c) Stitch artifact
d) LV is not centered

What is the Problem?



a) Nothing
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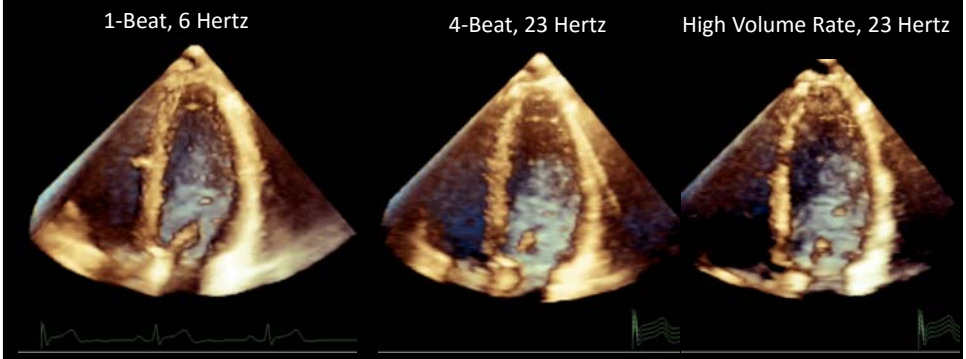
c) Stitch artifact
d) LV is not centered

Solution

- Multi-beat or high volume rate mode

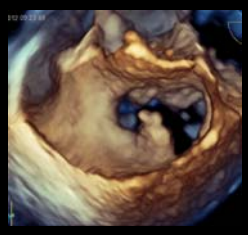


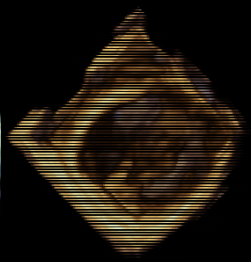
Single or Multi-beat?

Single Beat	Multi-beat
• Advantage – Overcomes limitations from rhythm disturbances and respiratory motion • Disadvantage – Limited by poor temporal resolution	• Advantage – Images with higher temporal resolution • Disadvantage – Gated images are susceptible to artifacts from respiratory motion or cardiac arrhythmias

Vendor Dependent

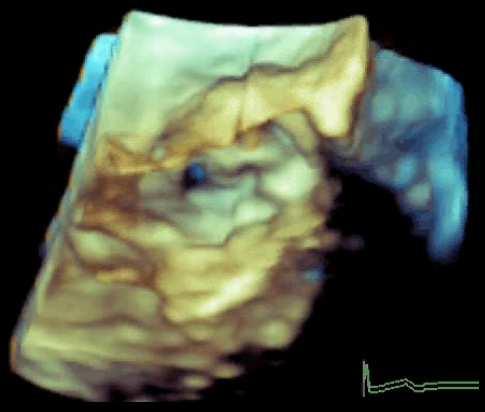
	GE	Philips	Siemens
Single Beat	**X**	**X**	**X (High Volume)**
Multi-beat	**X**	**X**	
High Volume		**X**	





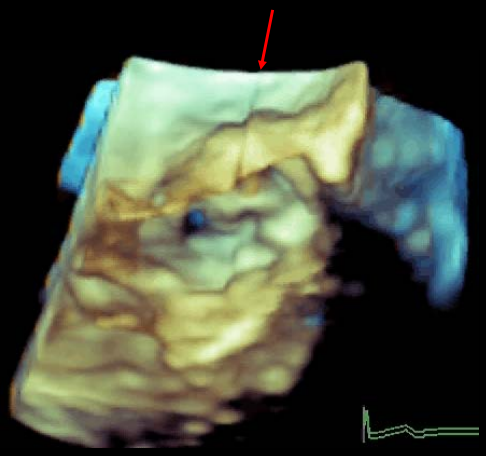
Courtesy Drs Muraru and Badano

What is the Problem?



a) Too bright
b) Too zoomed
c) Stitch artifact
d) Nothing, it's perfect

What is the Problem?



a) Too bright
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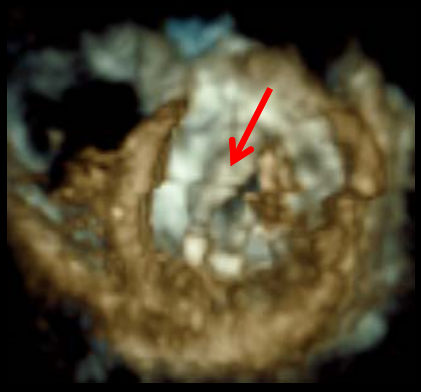
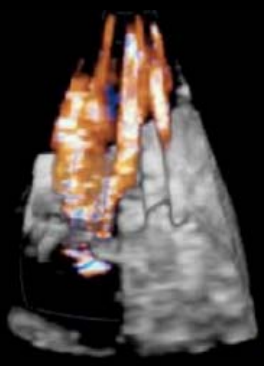
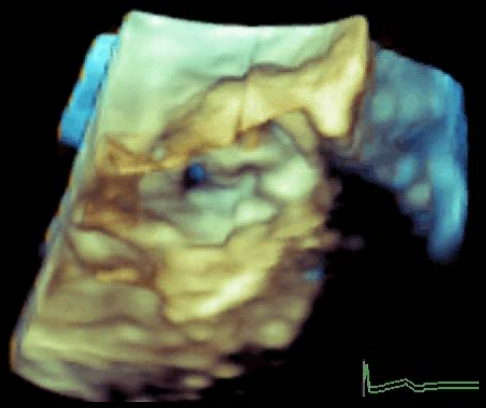
Stitch Artifact





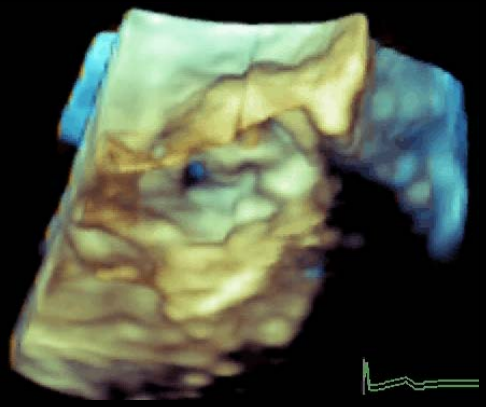
- MUST examine the imaging planes perpendicular to the sweep plane
  - Apical 4-chamber acquisition → check SAX/side

What Can Cause This Problem?



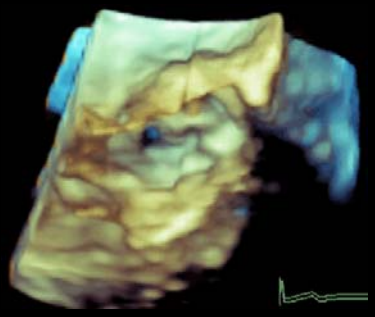
a) Motion
b) Arrhythmia
c) Early acquisition in multi-beat mode
d) a and b

What Can Cause This Problem?



a) Motion
b) Arrhythmia
c) Early acquisition in multi-beat mode
d) a and b

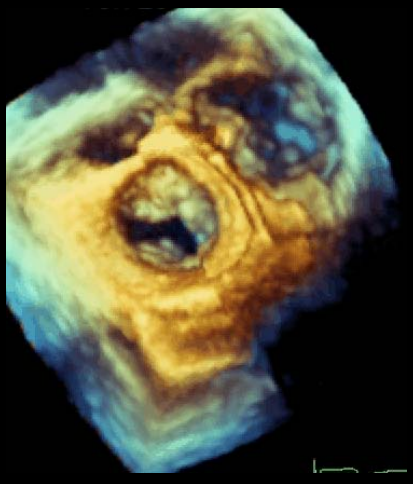
Solutions



Problem	Solution*
Motion	• Stabilize probe • Breath Hold • Single beat acquisition
Arrhythmia	• Retrospective acquisition setting using freeze/cine play/trim • Single beat/high volume rate acquisition

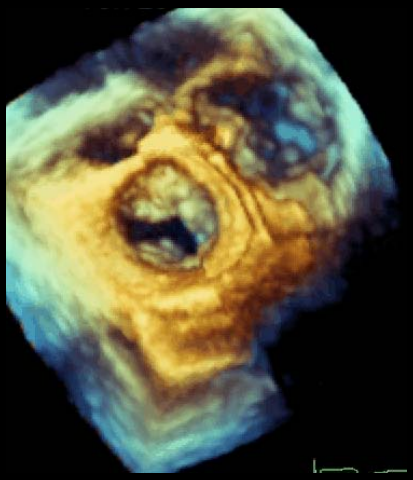
*Always check ECG

Why Do We Have This Problem?



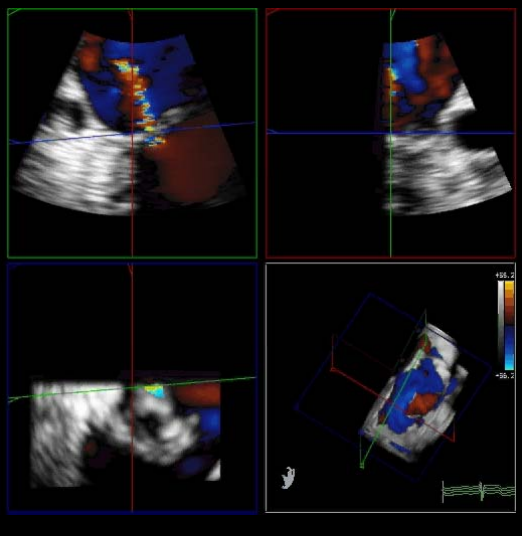
a) Motion
b) Arrhythmia
c) Early acquisition in multi-beat mode
d) I still don't think we have a problem

Why Do We Have This Problem?



a) Motion
b) Arrhythmia
c) Early acquisition in multi-beat mode
d) I still don't think we have a problem

Solution: Acquire on Multiplane View



Select Density

Mode of Acquisition

	High Density 	Medium Density 	Low Density 
Narrow angle	46° x 23°	58° x 29°	N/A
3D Zoom	30° x 30°	38° x 38°	45° x 45°
Multi-beat	62° x 56°	78° x 70°	93° x 84°
3D Color	28° x 28°	35° x 35°	42° x 42°

Density: Determines volume resolution and size

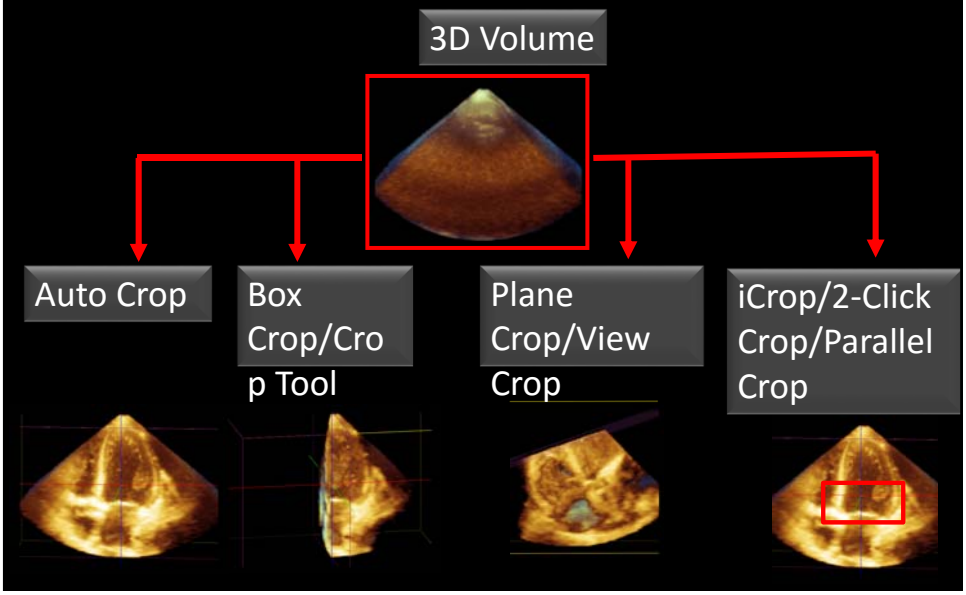
3DE color Doppler

Can be obtained with single beat or multi-beat

Cropping

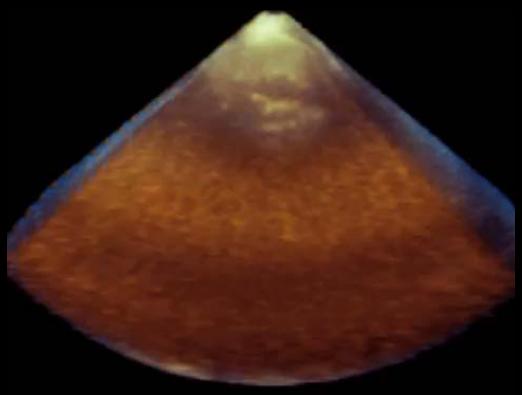
- Can be performed before or after data acquisition
- Before acquisition allows better temporal and spatial resolution
- However if cropped image is stored, image may not be amenable to 'uncropping'
- Wide data set can be acquired and then cropped, retains information but at expense of spatial and temporal resolution

Cropping Cut-planes



Cut-Planes

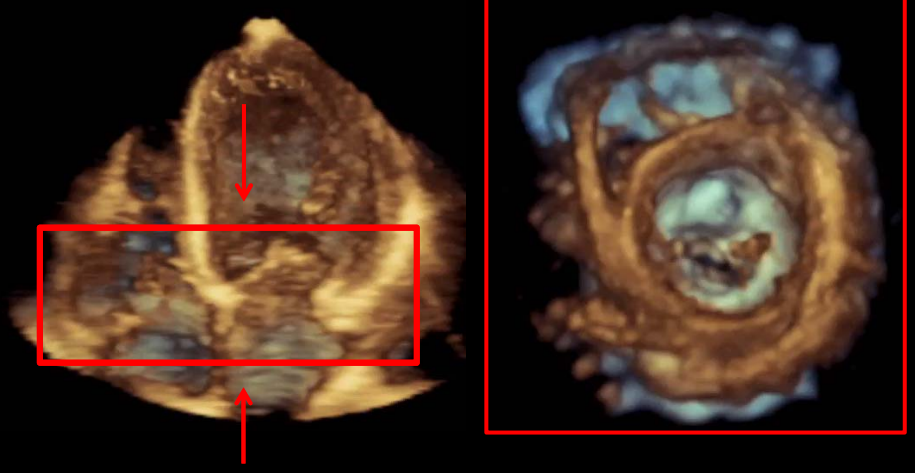
- **Box Crop**
  - Auto Crop
  - Box Crop/Crop Tool



Cut-Planes

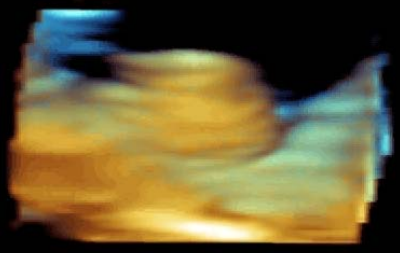
- **Arbitrary Crop (Plane/View Crop)**

Cut Planes – iCrop/ 2-Click Crop/Parallel Crop



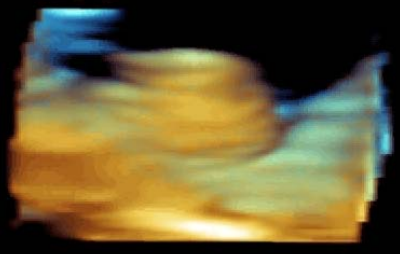
GE e9 (e95)

What is the Problem?



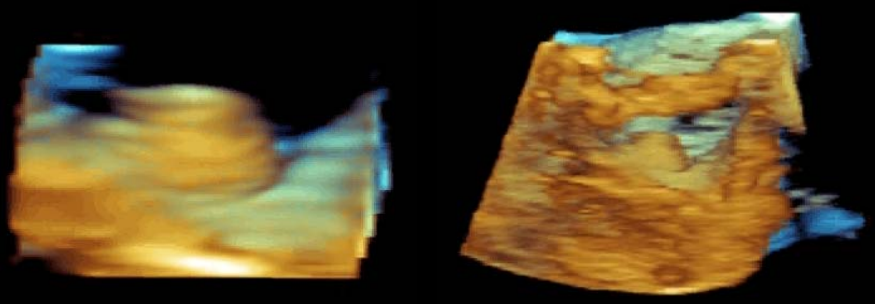
a) Too zoomed
b) Leaflet dropout
c) Too bright
d) Too smoothed

What is the Problem?



a) Too zoomed
b) Leaflet dropout
c) Too bright
d) Too smoothed

Solution: Larger acquisition box/less cropping

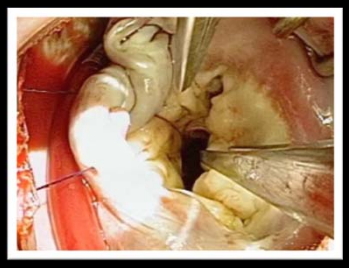


Acquire or Render and Crop

- *Remember <u>rendering and cropping</u> can be adjusted after acquiring your 3D volume*

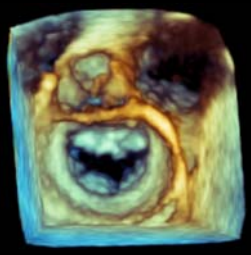
Rendering

3D object



Gain
Compress
Vision
Smoothing
Brightness

2D image



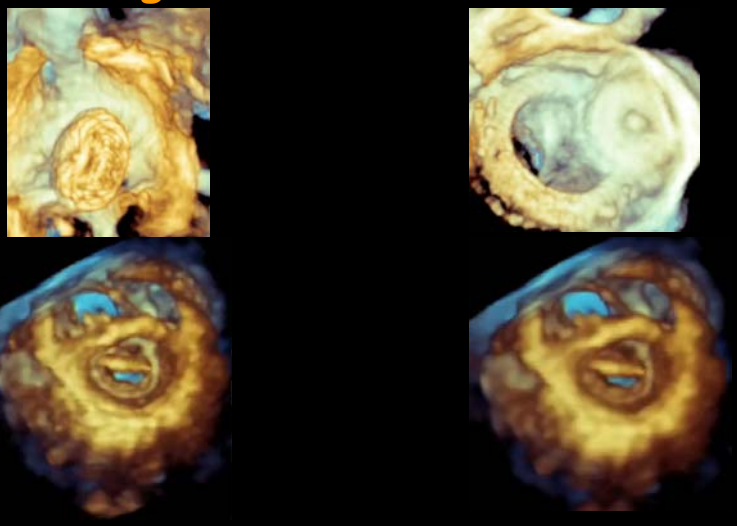
Gain

↑ "Snow"

↓ Drop-out

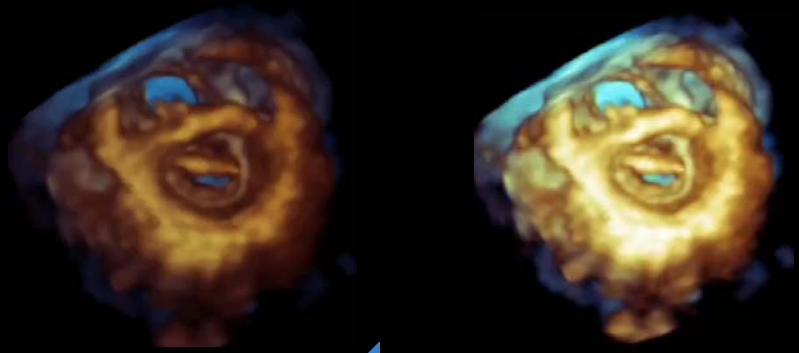
GE 4D Active Mode
- effects are opposite

Smoothing



Decrease ⟷ Increase

Brightness



Decrease ⟷ Increase

GE Gamma
- affects only midtone values
- lower gamma brighter images
- Higher gamma darker image

Colorization /Depth Color Maps

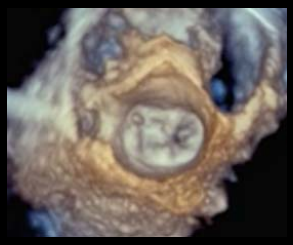
- Predefined Chroma maps which are colorized post-processing setting applied to the image data to highlight the data
- 1-8

Vision/Volume Opt

- Menu of predefined combinations of contrast, transparency, lighting and compositing algorithms
- Affects the spatial filtering and depth of colorization seen
  - Ranges from A - H

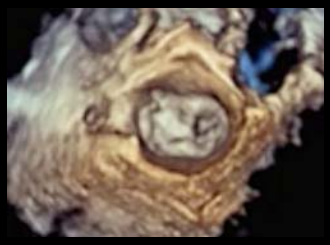
GE- UD Clarity

- edge preserving speckle and noise reduction filter that reduces speckle while preserving or even enhancing significant boundaries in the volume data
- Affects cut-planes and the 3D volume



Decrease

Smoother



Increase

Less speckle noise

How Can You Fix This Problem?

a) Look at the 2D images
b) Adjust total gain
c) Adjust TGCs
d) All of the above

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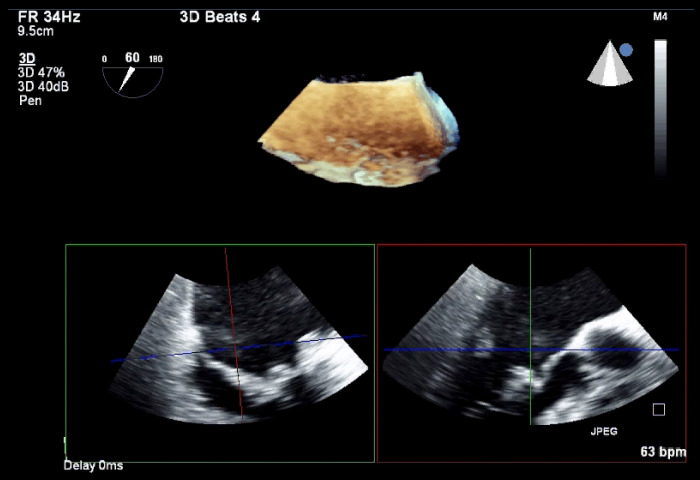
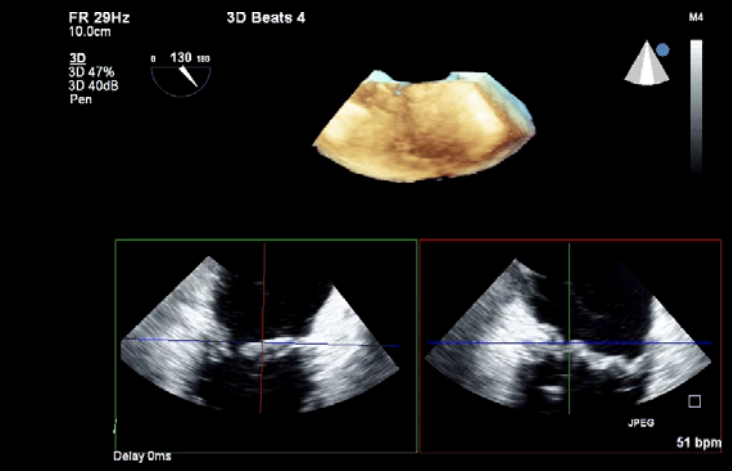
Solutions

- Check 2D image



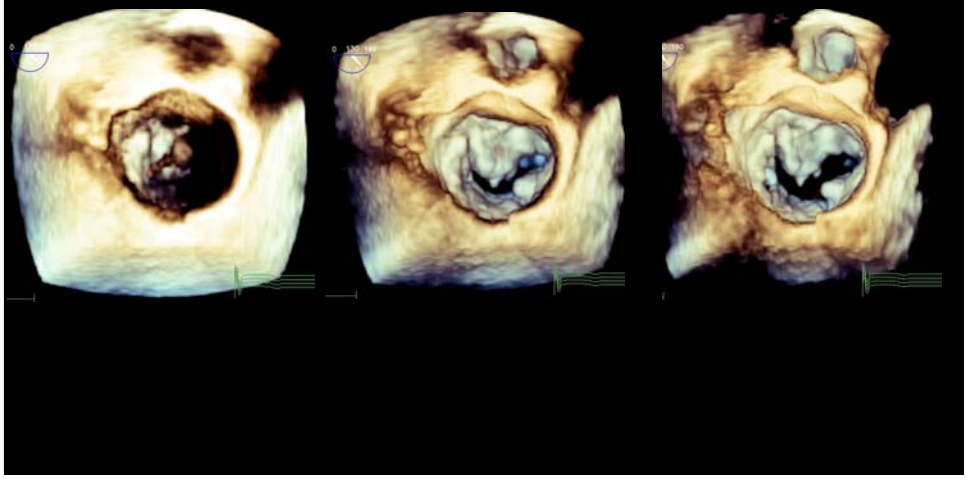
Solutions

- Check 2D image



Solutions

Over ⟷ Under



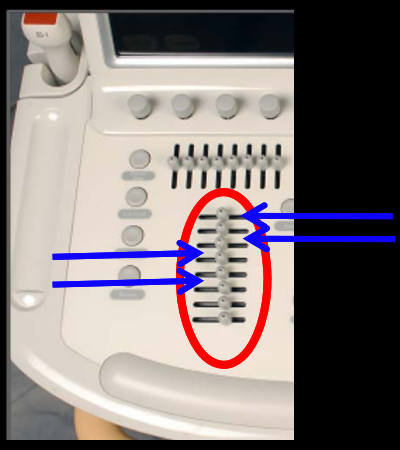
1. Overall gain

↑ "Snow"

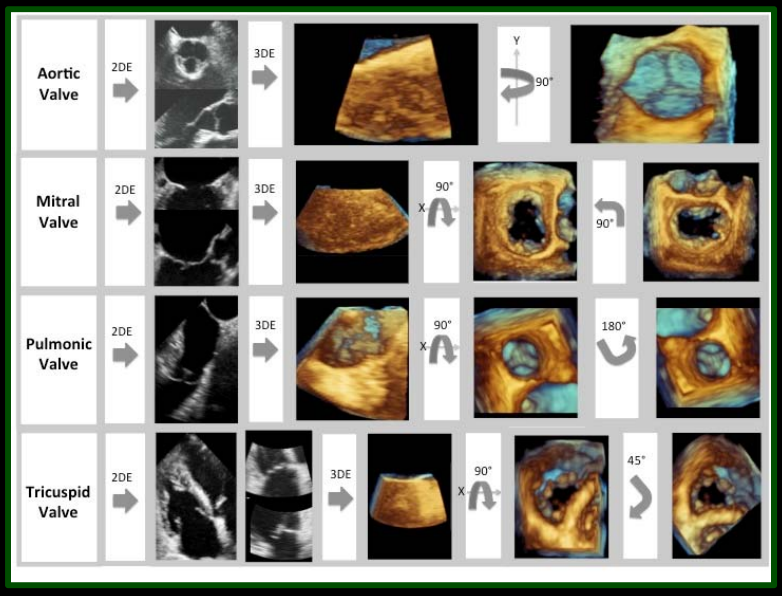
↓ Drop-out

2. Regional gain

- Adjust TGCs



Acquisition & Presentation



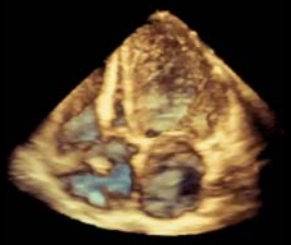
Lang, Badano et al. EAE/ASE 3D Guidelines JASE 2012

MV Valve: Acquisition and Display

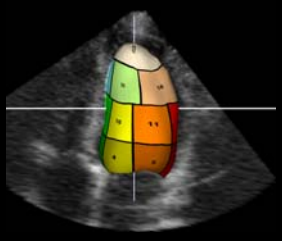
Ao Valve: Acquisition and Display

Display

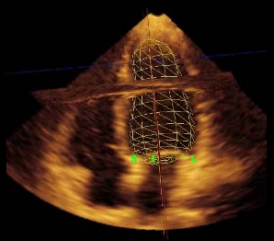
Volume Rendering



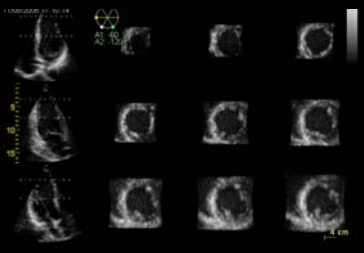
Surface Rendering

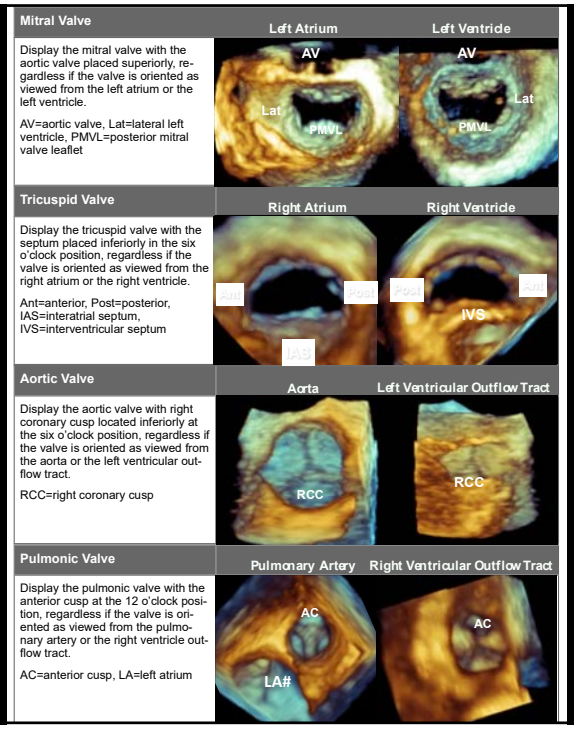


Wire-Frame



2D Tomographic Slices



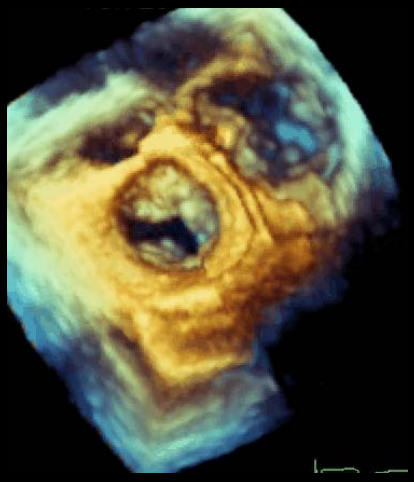


Display

Lang, Badano et al. EAE/ASE 3D Guidelines JASE 2012.

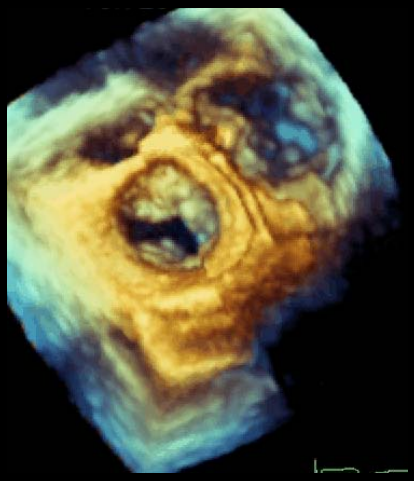
Thank you for listening

What is the Problem?



a) Too bright
b) Too zoomed
c) Stitch artifact
d) Nothing, it's perfect

What is the Problem?



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