The Normal Echocardiogram

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Acknowledgments

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Disclosures

✓ No relevant financial disclosures
Question 1

Which aortic cusp is noted by the arrow?

A. Right
B. Left
C. Non-Coronary
D. Can’t tell
Question 2

✓ Which myocardial segment is denoted by the arrow?

A. Mid Anterior
B. Mid Anteroseptum
C. Mid Inferoseptum
D. Basal Anteroseptum
E. Mid Inferolateral
Question 3

Which scallop is noted by the arrow?

A. Non-coronary
B. A2
C. P1
D. A1
E. A3
Question 4

How do you optimize this acquisition?

A. Raise baseline
B. Lower baseline
C. Increase scale
D. Decrease scale
E. Pedoff transducer
Question 5

What does the arrow indicate?

A. Eustachian Valve
B. RA thrombus
C. Chiari Network
D. Catheter in RA
Normal Echocardiography

Why do we need to review this?

✓ Recognize pathology when it exists

✓ ASCeXAM
  – Standardized image acquisition
  – Image optimization
  – Anatomic identification
  – Chamber quantification
  – “Less known” normal structures
  – AUC/Indications/Contraindications
### Appropriate Use Criteria for Echocardiography

- *J Am Soc Echocardiogr* 2011;24:229-267

<table>
<thead>
<tr>
<th>Indication</th>
<th>Appropriate use score (1-9)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Murmur or Click With TTE</strong></td>
<td></td>
</tr>
<tr>
<td>34. Initial evaluation when there is a reasonable suspicion of valvular or structural heart disease</td>
<td>A (9)</td>
</tr>
<tr>
<td>35. Initial evaluation when there are no other symptoms or signs of valvular or structural heart disease</td>
<td>I (2)</td>
</tr>
<tr>
<td>36. Re-evaluation in a patient without valvular disease on prior echocardiogram and no change in clinical status or cardiac exam</td>
<td>I (1)</td>
</tr>
<tr>
<td>37. Re-evaluation of known valvular heart disease with a change in clinical status or cardiac exam or to guide therapy</td>
<td>A (9)</td>
</tr>
<tr>
<td><strong>Native Valvular Stenosis With TTE</strong></td>
<td></td>
</tr>
<tr>
<td>38. Routine surveillance (&lt;3 y) of mild valvular stenosis without a change in clinical status or cardiac exam</td>
<td>I (3)</td>
</tr>
<tr>
<td>39. Routine surveillance (≥3 y) of mild valvular stenosis without a change in clinical status or cardiac exam</td>
<td>A (7)</td>
</tr>
<tr>
<td>40. Routine surveillance (&lt;1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam</td>
<td>I (3)</td>
</tr>
<tr>
<td>41. Routine surveillance (≥1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam</td>
<td>A (8)</td>
</tr>
</tbody>
</table>
# TEE Guidelines

- TEE Indications & Contraindications
  - J Am Soc Echocardiogr 2013;26:921-964

<table>
<thead>
<tr>
<th>Absolute contraindications</th>
<th>Relative contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perforated viscus</td>
<td>History of radiation to neck and mediastinum</td>
</tr>
<tr>
<td>Esophageal stricture</td>
<td>History of GI surgery</td>
</tr>
<tr>
<td>Esophageal tumor</td>
<td>Recent upper GI bleed</td>
</tr>
<tr>
<td>Esophageal perforation, laceration</td>
<td>Barrett’s esophagus</td>
</tr>
<tr>
<td>Esophageal diverticulum</td>
<td>History of dysphagia</td>
</tr>
<tr>
<td>Active upper GI bleed</td>
<td>Restriction of neck mobility (severe cervical arthritis, atlantoaxial joint disease)</td>
</tr>
<tr>
<td></td>
<td>Symptomatic hiatal hernia</td>
</tr>
<tr>
<td></td>
<td>Esophageal varices</td>
</tr>
<tr>
<td></td>
<td>Coagulopathy, thrombocytopenia</td>
</tr>
<tr>
<td></td>
<td>Active esophagitis</td>
</tr>
<tr>
<td></td>
<td>Active peptic ulcer disease</td>
</tr>
</tbody>
</table>
Parasternal Long Axis
Depth Matters...
Down One Interspace
Up One Interspace
Off-Axis Measurements
On-Axis Measurements
ASE/AHA 17 Segment Model

ASE Chamber Quant Guidelines, JASE 2015
Short Axis LV

Parasternal

Subcostal

Anterior
Anteroseptum Anterox lateral
Interoseptum Inferolateral Inferior

Anterior
Anteroseptum Anterox lateral
Interoseptum Inferolateral Inferior

Anterior
Septal Lateral

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Apical Four Chamber
Tail Up
Apical 4 Chamber

Off-Axis

On-Axis
ASE/AHA 17 Segment Model

ASE Chamber Quant Guidelines, JASE 2015
Contrast for LV Opacification

✓ Commercial Contrast
  – Improve endocardial border definition
  – Eliminate foreshortening
  – Evaluate for mural thrombi
  – Restore diagnostic quality
ASCeXAM Focus

✓ How do you fix this image?
  – Recognize off-axis views
  – Imaging from wrong interspace
  – Foreshorten cardiac structure
  – Contrast use and optimization

✓ Anatomical identification
✓ Myocardial segment identification
✓ Extracardiac findings recognition
✓ Common Artifacts
Tissue Harmonic Imaging

✓ Non-linear distortion of acoustic signal in tissue generates harmonics

✓ Noise/artifacts generate no significant harmonic

✓ Tissue Harmonic Imaging takes advantage of increased SNR
Tissue Harmonic Imaging

Fundamental

Tissue Harmonic
Bubbles Have Harmonics too..

Harmonics 1.3/2.6 MHz

Fundamental 1.6 MHz
Doppler Echocardiography

✓ Optimal 2D images when ultrasound beam is perpendicular to structures

✓ Optimal Doppler imaging when ultrasound beam is parallel to flow

✓ Apical views allow alignment with most cardiac flows (i.e. aortic, mitral and tricuspid valves)
Doppler Echocardiography

✓ Color Doppler
  – Pulse wave modality that cannot resolve high velocities
  – Turbulence/variance maps can help define jet, direction and turbulence

✓ Pulse Wave Spectral Doppler
  – Range specific
  – Subject to aliasing at high velocities like CFD

✓ Continuous Wave Spectral Doppler
  – Able to resolve high velocities
  – Range ambiguous
Color Flow Doppler

✓ Pay attention to the baseline
✓ Make note of the Nyquist limit
✓ Color scales vary
✓ Variance maps
✓ Optimize size and sector for frame rate
Doppler Optimization
Doppler Optimization

Baseline Adjusted
ASCeXAM Focus

- Effects of harmonic imaging
- Appropriate indications for contrast
- Contrast Physics and optimization
- Types of Doppler and technique limitations
- Spectral Doppler signal optimization
- Color Flow Doppler optimization
Transesophageal Echocardiography
Left Atrial Appendage
Mitral Valve

Hahn et al. TEE Guidelines. JASE 2013;26:921-64
3D Mitral Valve
Aortic Valve

SAX

LAX
3D Aortic Valve
Bi-Caval View
Transgastric LV
ASCeXAM Focus

✓ TEE not heavily tested
✓ AUC, Indications and Contraindications for TEE
✓ Anatomical identification
✓ Standard 3D views of Mitral and Aortic valves
✓ Correlative anatomic imaging with TTE
Normal Anatomic Structures

Transthoracic and Transesophageal Echocardiography
## Persistent Venous Valves

### Chiari Network
- ✓ No known function
- ✓ Not present in every patient
- ✓ Netlike structure that is highly mobile
- ✓ Usually arises from the vicinity of the IVC not attached to the septum

### Eustachian Valve
- ✓ Directs IVC flow across fossa in fetus
- ✓ Present in every fetus
- ✓ Ridge of tissue - rarely mobile at all
- ✓ Arises from the IVC and runs to the fossa
Chiari Network

RV Inflow

Apical Four

PSAX
Eustachian Valve
Crista Terminalis

✓ Normal structure
✓ Often confused for a right atrial mass
✓ Smooth myocardial ridge from RA-SVC junction along posterolateral RA wall
Moderator Band
Coronary Sinus
Pericardial Sinuses
Transverse Sinus
Subcostal SAX Aortic Valve
Coronary Arteries

RCA

LMCA
Coronary Arteries
Coronary Arteries
TEE Aortic Valve
TEE Aortic Valve

LAD or Circumflex?
Papillary Muscles

PSAX TTE

Transgastric TEE

PM

AL
Pulmonary Veins

LUPV TEE

RUPV TEE
Suprasternal Notch
Suprasternal Notch
ASCeXAM Focus

✓ Normal Anatomic Structures

- Right Heart
  - Persistent Venous Valve
  - Crista Terminalis
  - Coronary Sinus
  - Moderator Band

- Left Heart
  - Pericardial Sinuses
  - Pulmonary Veins
  - Coronary Arteries
  - Papillary Muscles
  - Suprasternal Notch
Question 1
Which aortic cusp is noted by the arrow?
A. Right
B. Left
C. Non-Coronary
D. Can’t tell
Question 1 - Followup

Answer: B. Left Coronary Cusp
Question 2

✓ Which myocardial segment is denoted by the arrow?

A. Mid Anterior
B. Mid Anteroseptum
C. Mid Inferoseptum
D. Basal Anteroseptum
E. Mid Inferolateral
Question 2 - Followup

Answer: C. Mid Inferoseptum
Question 3

Which scallop is noted by the arrow?

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B. A2
C. P1
D. A1
E. A3
Question 3 - Followup

**Answer:** E. A3 Scallop
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D. Decrease scale
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Question 4 - Followup

Answer:  D. Decrease Scale
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What does the arrow indicate?

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Question 5 - Followup

**Answer:** C. Chiari Network

**Chiari Network**
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Thank You!