ICE & TEE Monitoring in the Cath Lab
TEE for ASD/PFO Closure

Craig E Fleishman, MD FACC FASE
Director, Non-invasive Cardiac Imaging
The Heart Center at Arnold Palmer Hospital for Children, Orlando
SCAI Fall Fellows Course 2014
Las Vegas
As a faculty member for this program, I disclose the following relationships with industry:

(GRS): Grant/Research Support (C): Consultant (SB): Speaker’s Bureau
(MSH): Major Stock Holder (AB): Advisory Board (E): Employment
(O): Other Financial or Material Support

W.L. Gore Medical: C, Echo Core Lab
Topics to Address

- Complete evaluation of the heart
- Image stability
- Complications
- Real-time 3D TEE
- Micro-multiplane TEE
- Costs
- Efficiency
ASD Closure

- Size
- Number
- Location
- Rim tissue
- Surrounding structures
- Device placement/stability
Complementary techniques

**ICE**
- ASD and inferior rim in near field
  - Other structures seen with less detail without catheter movement
- Lack of multiplane requires frequent flexion/rotation for complete evaluation of intracardiac structures

**TEE**
- “Wide angle” view of heart
  - Multiplane imaging
  - Inferior rim difficult
- More complete evaluation
  - Not always available prior to intervention
  - Later review of echo
- High quality imaging of defect, device, and other cardiac structures
  - ? Better baseline for follow-up exams
Intracardiac Echo and TEE
Intracardiac Echo and TEE
Image Stability

• TEE
  – Fixed reference point to cardiac structures
  – Images are independent of catheter manipulations

• ICE
  – Very good images, but frequent catheter manipulations may be needed to stabilize image
  – Movement of catheters and sheaths frequently displaces ICE catheter
  – Region of interest may “disappear” at crucial time
  – Improves with experience
TEE Monitoring in Children

• Why not TEE for

• Logistics
  – Anesthesia
  – Echo
  – Timing
  – Scheduling
Potential Benefits of ICE

• Reduces room time
• More comfortable for patient
  – Patient able to express pain/discomfort
• Patient cooperation during procedure
  – Valsalva and other resp maneuvers
• Eliminates need for additional physicians
  – Echocardiographer
• Echocardiographer may have a role, even with ICE
ICE Complications

• 4% incidence in 94 patients*
  – Arrhythmia

• Anecdotal reports of vascular injury, thrombus

*Earing MG et al. Mayo Clinic Proc;79:24-34
TEE Complications

- Intraoperative TEE
- 7200 patients
- 0.2% morbidity
- Dysphagia most common (0.1%)

Kallmeyer IJ et al. Anesth Analg; 92:1126-1130
TEE Complications - Children

- 1650 patients
  - Mean wt = 17.2kg
- 3.2% incidence overall
  - 2.4% if failure to insert excluded
- 1% airway obstruction
  - Mean wt = 5.9kg
- 0.7% change in ET tube position
  - Mean wt = 7.15kg
- No significant bleeding or esophageal injury

Stevenson, JG J Am Soc Echocardiogr; 12: 527-532
Real-Time 3D TEE

- Real-time guidance
- Assessment of effectiveness
- Relationship to intracardiac structures
- Maximum diameter
- Shape of device

Real-Time 3D TEE

SVC

IVC

LA
Real-Time 3D TEE

SVC
TEE

- Real-time 3D TEE (>20-25 kg)
- Mini-multiplane TEE (>3-4 kg)
- Micro-multiplane TEE (>2-2.5 kg)
Micro-Multiplane TEE Probe

- 32 element phased array
- 3.2 – 7.4 MHz
- 2D, Color, PW, CW
- MMode, Color MMode
Multiplane: Tip to Tip
Size Matters

- Tip 18.5 mm
- Bending neck 28 mm
- Shaft 70 cm
Aneurysmal Atrial Septum
Costs

• Difficult to compare
  – Cost of materials vs cost of personnel
  – Anesthesia use varies between institutions
  – Charges vs costs
• Materials
• Depreciation
Charges - Example

- Compared 20 ICE/20 TEE
- Hospital + Physician charges
- Comparable total charges between groups
  - $33,563+/-2,732 ICE
  - $32,812+/-2,656 TEE
  - ICE catheter cost offset by anesthesia charges

Alboliras ET et al. Am J Cardiol 2004;94:690-692
Need for Additional Physicians - Echo

- Multitasking
  - Sedation
  - Teaching
  - ICE
  - And Device Deployment

- Additional staff allows Interventionalist to focus on procedure
  - Echocardiographer may bring something to the table
**Need for Additional Physicians - Anesthesia**

- Allay child and parental fear
- Cooperation of child
- Achieve immobilization
- Induce unawareness / amnesia
- Analgesia – discomfort / pain
- Maintain patient safety during procedure
  - Anesthesia mortality from 1/10000 decreased to 1/200,000-400,000

Is anesthesia “optional” for ASD closure in children?

- Minimize residual effects of sedation after the procedure
  - Short acting anesthetics and muscle relaxants
Clinical Advantages of Anesthesiologist Presence

- Difficult access issues: Neck / Transhepatic
- Familiarity with an OR – Hybrid mentality
- Expertise in Electronic monitoring and titration – BIS / Cardiac Output / Regional oximetry / Capnography
- Attention to nerve injury – Brachial plexus
- Sedation, Anesthesia, Spinal, Epidural, Regional
- Expertise with the “good drugs”; Regulatory
- Emergence Delirium: Recognition and treatment
- Emergency personnel
Case Example

- 12 y.o. with multifenestrated ASD
- Hx of cerebral palsy and severe scoliosis
- Left to right shunting with mild RV dilatation, but spinal surgery planned and desire for elimination of shunts
Case Example

- LSVC to coronary sinus
- Small coronary sinus ASD – 6.5 mm
- Secundum ASD with 3 fenestrations
  - Superior – PFO
  - Middle (10 mm inf to PFO) – 13 mm
  - Inferior (15 mm inf to PFO) – 4.5 mm
Case Example

- Coronary sinus ASD closed with 8 mm Amplatzer Septal Occluder (ASO)
- Secundum fenestrations closed with:
  - 14 mm ASO through middle fenestration
- Initial attempt with 25 mm Helex
  - 6 mm ASO through inferior fenestration
ICE – Conclusions

• Anesthesia may be required
  – Decision for ICE based on ASD location
  – Posterior/inferior rim deficiency

• Less complicated scheduling
  – Fewer personnel required

• Patient/family preference re anesthesia

• Co-morbidities increasing anesthesia risk
TEE – Conclusions

- Global view
- Minimal complications
- Less materials expense
- Real-time 3D (for older children and adults)
- Additional expertise
Thank You