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

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SCAI Fall Fellows Course 2013
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
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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

TEE for ASD/PFO Closure SCAI 2013
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

7.5 mm

5.5 mm

5.2 mm

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

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