Perventricular Closure of Muscular VSD

John P. Cheatham, MD, MSCI
George H. Dunlap Endowed Chair in Interventional Cardiology
Co-Director, The Heart Center, Nationwide Children’s Hospital
Professor, Pediatrics & Internal Medicine, Cardiology
The Ohio State University
Columbus, Ohio, USA
Disclosures

• As a faculty member of SCAI, I have the following disclosures:
  – None

• Off label use of FDA approved devices will be discussed
Historical Facts

• In the US, the Amplatzer Muscular VSD Occluder was approved in September, 2007
  – However, there continues to be a PMA trial
  – The device was approved for percutaneous delivery, but not for percutaneous delivery despite more than ½ of all implants that supported the approval were implanted by this technique
Amplatzer Devices Available When We Started Closing VSDs

Before AVP, AVPII, AVPIII, AVPIV, ADO2, ADO2AS, mVSD2
Catheter Closure of Muscular VSD

Muscular Devices: Congenital

0.003-0.005” Nitinol
6-8Fr
4-18mm
Waist 7mm long
LV/RV discs 4mm rim larger than waist
Muscular VSD
N=80 (Holzer, et, al)

Age
Weight
Gender
Cardiac History

- CHF 36.3%
- Arrhythmias 11.3%
- Recurrent Resp. Inf. 3.8%
- FFT 30%
- Previous Cardiac Surgery 42.5%

EKG’s

- LVH 41.3%
- RVH 56%
- BVH 26.7%
## Muscular VSD

**N=80**

### TTE

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single VSD</td>
<td>57.9%</td>
</tr>
<tr>
<td>Two or more</td>
<td>42.1%</td>
</tr>
<tr>
<td>Primary VSD size</td>
<td>$7.1 \pm 2.4$ (3-17 mm)</td>
</tr>
<tr>
<td>Secondary VSD size</td>
<td>$4.7 \pm 2.9$ (1-18 mm)</td>
</tr>
<tr>
<td>LAE</td>
<td>53.2%</td>
</tr>
<tr>
<td>RVE</td>
<td>57%</td>
</tr>
<tr>
<td>LVE</td>
<td>59.5%</td>
</tr>
</tbody>
</table>

### Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>32.5%</td>
</tr>
<tr>
<td>Posterior</td>
<td>11.3%</td>
</tr>
<tr>
<td>Apical</td>
<td>33.8%</td>
</tr>
<tr>
<td>Mid-muscular</td>
<td>56.3%</td>
</tr>
</tbody>
</table>
**Muscular VSD**

**N=80**

Technical Failure

Unable to cross the defect 1
Defect too big 2
Patient developed hypotension & bradycardia 1
Device embolized to LV-surgical removal 1
Catheter dislodgment, blood loss, death 1
Cardiac perforation, death 1

***Most SAE related to size of patient: 5.2 Kg or less***
Two infants with Swiss Cheese VSDs

Top Panels: 11 mo/old with 8mm, 6mm, & 8mm AMVSDO (only 3.5 Kg at 1st device)

Left Panel: 2 y/o with 6mm & 8mm AMVSDO. Also has 3 ASOs: 11,9,& 6mm

Getting Carried Away In Orlando ??
Interventional Cardiologist | Cardiac Surgeon

Risk Taker | Conservative
Percutaneous Device Closure
Congenital MVSD

An attractive alternative to surgery

However, it is difficult:

- In small infants (<5.2Kg and maybe even <10Kg)
- Children with poor vascular access
- In patients with unusual septal planes
Hybrid Perventricular Closure

Requires collaboration with a surgeon
No limit in size of patient
No limit in size and number of defects
Little hemodynamic compromise
Technique

Operating room vs Cath lab vs Hybrid suite
Technique in The Operating Room or Hybrid Suite

TEE guidance: A MUST

Sternotomy vs subxyphoid incision
Determine the best course for the puncture
5-0 polypropelene purse string suture
Puncture RV free wall using a 18 G needle
Cross the VSD with a 0.035” angle glide wire to LV
Pass a short sheath over the wire to LV mid cavity
Technique: Perventricular Muscular VSD Occlusion
4 month old weighing 4 kg

Large anterior muscular VSD and complex ASD
Also with ASD and Septal Aneurysm
Discharged Day 3
NCH Experience with Hybrid MVSD Closure

• From 2002 – 2015
• 13 patients
  – Age: 22 days – 4 years, median 4.3 months
  – Weight: 3.1 – 7.6 Kg
  – PerVentricular: 11
  – TransAortic: 1
  – PerAtrial: 1
• All with Amplatzer MVSD Occluder
  – Sizes: 6mm – 16mm
  – Multiple devices - 2
• 1 furry infant: 18mm Amplatzer MVSD Occluder
Hybrid Perventricular Muscular VSD Closure
Preparing Perventricular Access
2 mo/old with large mid muscular VSD

Pushing on RV free wall
10 mm AMVSD Occluder placed
4 y/o weighing 7.6 Kg with multiple muscular VSDs, PA band, & R-BTS.

Perventricular Delivery Of AMVSDOs

Smaller Defect

Larger Defect
A 12mm Amplatzer Muscular VSD Occluder being delivered by percutaneous technique.
2 wk, 2 Kg: 6mm AMVSDO before PmVSD & IAA
After 3 months, residual CoA: Live Case PICS
What about follow up?

  - 10 patients: median age 8.9 mos, wt 6.6 kg
  - After median 6.5 years, 5 had complete closure, 4 had trivial leak, 1 device removal secondary to entanglement of TV
  - No late complications
A Different Hybrid Setting... a new sick “baby”
Perventricular Closure – Feb 2009

18mm Amplatzer MVSDO
Post-Hybrid CXR
“Sparky” – ICU Post Hybrid
7 month old Cavalier King Charles Spaniel
Conclusions

Perventricular (atrial) closure for muscular VSD is an effective technique that requires collaboration between the surgeon & interventionalist.

It is an ideal technique for small infants (definitely <5Kg & maybe <10Kg) and those with complex anatomy or patients with other CHD requiring concomitant surgical repair.

An experienced “interventional” echocardiographer is a must...they are the surgeon’s loops and IC’s fluoro.

The time required for closure is much shorter and with less hemodynamic compromise compared to percutaneous technique.
THANK YOU

Ms. Mya

Mr. Cooper

The Heart Center