Percutaneous Approaches to Aortic and Mitral Valve Disease

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Conflicts of interest: GE, Abbott, Edwards (honoraria)

Guidance of Valvular Interventions

- Transcatheter aortic valve replacement (TAVR)
- Percutaneous mitral valve repair and replacement
- Percutaneous tricuspid annuloplasty

Transcatheter Aortic Valve

Sapien Valve

- Balloon or self expandable
- Stainless steel or nitinol stent
- Bovine (equine) pericardium
- Optimal hemodynamics

Core Valve

- Balloon or self expandable
- Stainless steel or nitinol stent
- Bovine (equine) pericardium
- Optimal hemodynamics

Two Approaches to TAVR

Femoral or Apical

Plus, a few others:
Transsillary, transcarotid, transcaval, via ministernotomy

In my cardiology career, I’ve never seen anything go from gee whiz to ho hum as rapidly as TAVR

- Previously: Conducted under general anesthesia with TEE needed for guidance and assessment of complications
- Currently: With improvement in device technology (S3, Evolut-R), procedural complications very rare
  - Moderate sedation
  - No TEE, just TTE to assess paravalvular leak

What is the Role of Imaging in TAVR??

- Pre-procedural
  - Severity of AS, cusp anatomy, annular size, vascular access
- Intra-procedural – Guidance of intervention
  - Recheck all measurements, positioning of balloon and valve
- Intra-procedural – Assessment of complications
  - Regurgitation, LV dysfunction, device displacement, tamponade, MR, SAM
- Post-procedural
  - Pretty standard follow-up for AVR
  - Will need to be vigilant for several years, as we are defining the natural history at this time
Assessing Annular Size
More challenging than you’d think

- The annulus is not circular
  - Medial-lateral distance ~10% more than A-P, but variable
- Need 3D guided imaging for accuracy
  - TEE with x-plane and CTA are best (CTA usually trumps TEE)
- Overlying Ca++ can be challenging to find true annulus

PARTNER SAPIEN Platforms
Device Evolution

<table>
<thead>
<tr>
<th>Valve Technology</th>
<th>SAPIEN</th>
<th>SAPIEN XT</th>
<th>SAPIEN 3</th>
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<tbody>
<tr>
<td>Sheath Compatibility</td>
<td>22-24F</td>
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<td>Available Valve Sizes</td>
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SAPIEN XT
More challenging than you’d think
Medial-lateral distance ~10% more than A-P, but variable

Available Technology
Regurgitation, LV dysfunction, device displacement, Valve
Overlying Ca++ can be challenging to find true annulus
Will need to be vigilant for several years, as we are

Valve Sizes
Assessing Annular Size
•
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What is the Role of Imaging in TAVR??

- Pre-procedural
  - Severity of aortic stenosis, annular size, vascular disease
- Intra-procedural – Guidance of intervention
  - Recheck all measurements, positioning of balloon and valve
- Intra-procedural – Assessment of complications
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Chest-Abdomen-Pelvis CT for Access
Minimum Vessel Size is Shrinking, Now ~5 mm

CoreValve Evolut R

Retrievable valve

90yo Man, Class III, s/p CAGB

First Implant Oct 30, 2012
Valve Deployment

Result
Patient is playing golf 1 year later!

Positioning the Device
It’s Harder Than you Think!

Live 3D Guidance of TAVR

What is the Role of Imaging in TAVR??

- Pre-procedural
  - Severity of Ao valve anatomy, annular size, vascular access
- Intra-procedural – Guidance of intervention
  - Redo all measurements, positioning of balloon and valve
- Intra-procedural – Assessment of complications
  - Regurgitation, LV dysfunction, device displacement, tamponade, MR, SAM
- Post-procedural
  - Pretty standard follow-up for AVR
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The Constellation of Mild-Moderate AR
The Constellation of Mild-Moderate AR

A1, A2: Trivial paravalvular AR
B: Trivial valvular AR
C: Moderate paravalvular AR (resolved with reballooning)

Severe Valvular AR
What's Going On?

Severe AR
Marked flow reversal in descending aorta

Severe Valvular AR
One Leaflet is Stuck Open!

Leaflet in LCC position does not close
Required redo valve-in-valve TAVR

Valve Implanted Too Low
TAVR Embolization into LV

It tumbled and tumbled around the LV

An Hour Later: Back in the LVOT
But It's UPSIDE DOWN!

Leaflets open due to the AR.
Remarkably, BP could be supported, and it was off to the OR.

Echo Post Deployment
Pt Hypotensive and in Distress

Only the inferior wall is moving...
Echo Post Deployment

Left main appears blocked with no color flow seen

TandemHeart Inserted

RAO Projection
LAO Projection

LA cannula
TEE Probe

Tandem Heart

Echo after LMT Stenting

What Else Can Go Wrong??

Aortic dissection
Courtesy of Dr. Chirojit Mukherjee

What Else Can Go Wrong??

Severe MR from misdirected applicator
Courtesy of Dr. Chirojit Mukherjee
What Else Can Go Wrong??

Severe MR from perforated AML

Guidance of Interventions

- Transcatheter aortic valve replacement (TAVR)
- Percutaneous mitral valve repair/replacement
- Paravalvular leak closure
- ASD/PFO/VSD closure
- Left atrial appendage closure

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For optimal interventions, you need optimal imaging

Next generation real time rendering

84 yo Man with Class III DOE
Mixed Organic and Functional MR
Moderately Severe LV with LAD and LCx Scars

Anatomic Imaging with Biplane C-C and A-P Views

A1-P1  A2-P2
X-C view  A-P view  X-C view  A-P view

Main pathology A1 & A2

Closure of Paravalvular Leaks

Anterior and inferior holes

Relationship of Native & Prosthetic MV
Clock vs Scallops

DeCicco et al. EJCTS 2006; 30:887-891

Direct visualization of paravalvular leak

Transseptal lasso catheter capturing retrograde wire through leak
Two closure plugs in place

In the early days, we didn’t know much about interventional guidance

Repeat x 5 hours

Further Refinement of Criteria

German Echo Suitability by Echo Criteria

Optimal  Limited suitable  Inappropriate

Pathology in segment 2  Pathology in segment 1 or 3  Leaflet perforation or cleft

No calcification

Slight calcification outside the grasping area

Ring calcification

Anomalies with ring

Valve area >4cm²

Valve area >5 cm² & good leaflet mobility

Mitra stenosis (>3 cm², gradient >5mmHg)

Length of the posterior leaflet >10mm

Length of the posterior leaflet 7-10mm

Length of the posterior leaflet 7mm

Coaptation depth < 11mm

Coaptation depth >11mm

Normal thickness and mobility of the leaflets

Restriction (Carpentier 1B)

Rheumatic thickening and restriction (Carpentier 5A)

Mitr mit prolaps

Pall size >15mm

Pall size >15mm only with large intravasal and option for more than 1 clip


The MitraClip System

Learning the System is the Crucial First Step!

Steerable Guide Catheter – Overview

Guide

Deflection

+/– Knob causes the tip to deflect

‘+’ Tightens curve

‘-’ Straightens curve

+/– Knob
**MitraClip Septal Puncture is Critical**

- Aim for the thin portion, fossa ovalis
- X-plane very helpful
- Puncture should be ~4 cm above annular plane
- Up to 5 cm for prolapse, 3.5 cm for functional

**Advancing MitraClip Catheter Through Guide**

**80 yo Man with Severe MR**

* Biplane Anatomic Imaging

* Flail posterior, P1 ± P2

**Transesophageal Echo**

* 3D Rendering

* Flail posterior, P1 ± P2

**Transesophageal Echo**

* Assessing Flail Gap

* Acceptable gap for clipping

* Precision puncture to reach P1
Steering Clip into Position

Grabbing Leaflets, Testing Gradient

Final Color Check, then Release

Final Look
Assessing Clip Location

Future Directions
Percutaneous Mitral Replacement

Neovasc TIARA Mitral Valve
Early Feasibility Study

Tiara Delivery System – 32 Fr
84 yo Man with Class III DOE
Mixed Organic and Functional MR

Initiating the Procedure
Finger Poke to Localize the Needle Stick
Assures deployment is coaxial with the MV

Centering the Device
Must be Free of Chordal Entanglements
Both X-plane and 3D are helpful

Opening the Atrial Portion
Assure it Remains Above the Valve and Centered

Orienting the Device
Assure Flat Portion Goes Trigone-Trigone
Typically lies under the aortic valve

Seating the Device
Leave No Space Between Valve and LA Wall
Then deploy LV portion and release three tabs while holding constant 8 Newton tension on the device
Checking the Deployment
Well-Seated without Paravalvular Regurgitation

Some central MR may be seen from the wire

Final Check
No MR, mean gradient 1 mmHg

Final Check
Flat portion aligned with trigones, no MR

One Month Post-Procedure
Class I Symptoms, Toured Europe Last Summer

Moderate LV dysfunction, no MR
Mean gradient 3 mmHg

What About Tricuspid Regurgitation?
Frequent Complication of Mitral Regurgitation

Exciting new trial of percutaneous TV repair

SCOUT Trial: Percutaneous TV Annuloplasty System
Requires precise catheter guidance
Turns the Tricuspid Valve into a Bicuspid Valve
Mimics the Kay annuloplasty

75 yo Woman with Severe TR
s/p MV Repair 1988, AF s/p CVA
Severe functional TR, annulus 5.0 cm

Procedure Steps Overview

Anatomical Relationships
1 atrioventricular node
2 aortic valve
3 right coronary artery
4 coronary sinus
5 inferior vena cava

Placement of First Wire
Septal Commissure of Posterior Leaflet
Snaring Wire, Placement of Pledget

Placement of Second Wire
2.5-2.8 cm Anterior to First Wire

Plication of Posterior Leaflet

Pre
Post
75% reduction in TR

ROA = 1.7 cm²
ROA = 0.37 cm²

What About Fusion Imaging?
Combining echo and fluoro for better guidance

What About Fusion Imaging?
Some technical issues (frequent calibration)
Big issue: echo and angio eqpt must be same brand
Needed: “DICOM” standard for fusion imaging
How Can We Afford to Provide Guidance?

One Major Step towards a New Interventional TEE code

It is pleased to announce the creation of a novel new interventional transthoracic echocardiography code for use beginning in 2013. This code, 00235, is designed to be used by interventional cardiologists to report TEE services during an interventional procedure. The code includes guidance, real time imaging, monitoring, documentation and interpretation during transcatheter interventional procedures.

For several years ASE has dedicated significant resources including numerous volunteers who have worked to establish the essential interventional TEE code. The code now accurately reflects the time and effort of the intraoperative physician during these procedures. Working with many other societies, ASE was able to collect and present compelling evidence that the current codes do not accurately reflect the physician work, time and intensity required during an interventional procedure and that further codes were needed.

The final code language is now found in the 2013 CT (Table the AHA has just released). The final distribution is in 2013. Please distribute the appropriate valuations in the 2013 final book as soon as this manual is available. The manual is a recommended step in ensuring comprehensive, proper, and accurate coding.

But Some Days We Feel Pretty Important!

The Echo Guy in the Cath Lab

"please be dolphins, please be dolphins"