Heart Surgery 101

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Cardiothoracic Surgeon

General Topics

- Coronary artery disease
- Aortic valve disease
- Mitral valve disease
- Aortic disease
- Heart failure
Coronary Artery Disease

Treatment Options?
Medical therapy
  anti-anginal
  anti-thromboitic
  lifestyle modification
Percutaneous revascularization
  angioplasty
  stent
Surgical Revascularization
  CABG
### TABLE 1.1 One Vessel Disease

<table>
<thead>
<tr>
<th>Indication</th>
<th>Asymptomatic</th>
<th>Ischemic Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not on AA Therapy</td>
<td>On 1 AA Drug (BB Preferred)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>CABG</td>
</tr>
<tr>
<td>No Proximal LAD or Proximal Left Dominant LCV Involvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Low-risk findings on noninvasive testing</td>
<td>M (5)</td>
<td>R (5)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>CABG</td>
</tr>
<tr>
<td>2. Intermediate- or high-risk findings on noninvasive testing</td>
<td>M (4)</td>
<td>R (5)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>CABG</td>
</tr>
<tr>
<td>3. No stress test performed or, if performed, results are indeterminate</td>
<td>M (4)</td>
<td>R (5)</td>
</tr>
<tr>
<td>FFR &lt;0.80*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximal LAD or Proximal Left Dominant LCV Involvement Present</td>
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<td></td>
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<tr>
<td>4. Low-risk findings on noninvasive testing</td>
<td>M (4)</td>
<td>R (5)</td>
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<td></td>
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The number in parentheses next to the rating reflects the median score for that indication. Substitution of a newer coronary pressure ratio that does not require hypotension for FFR may be considered provided the appropriate reference values are used.

A indicates appropriate, AA, antiplatelet; BB, beta blockers; CABG, coronary artery bypass graft; FFR, fractional flow reserve; LAD, left anterior descending coronary artery; LCV, left circumflex artery; M, may be appropriate; PCI, percutaneous coronary intervention; and R, rarely appropriate.

### TABLE 1.2 Two Vessel Disease

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<th>Ischemic Symptoms</th>
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<tbody>
<tr>
<td></td>
<td>Not on AA Therapy With AA Therapy</td>
<td>Not on AA Therapy</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>CABG</td>
</tr>
<tr>
<td>No Proximal LAD Involvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Low-risk findings on noninvasive testing</td>
<td>M (3)</td>
<td>R (3)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>CABG</td>
</tr>
<tr>
<td>8. Intermediate- or high-risk findings on noninvasive testing</td>
<td>M (4)</td>
<td>R (5)</td>
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<td>PCI</td>
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<tr>
<td>FFR &lt;0.80*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximal LAD Involvement With Diabetes Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Low-risk findings on noninvasive testing</td>
<td>M (4)</td>
<td>R (5)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>CABG</td>
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<tr>
<td>11. Intermediate- or high-risk findings on noninvasive testing</td>
<td>M (4)</td>
<td>R (5)</td>
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<td>PCI</td>
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<td>12. No stress test performed or, if performed, results are indeterminate</td>
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CAD - Three Vessel Disease

TABLE 3.3 Three-Vessel Disease

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<th>Indication</th>
<th>Asymptomatic</th>
<th>Ischemic symptoms</th>
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<tbody>
<tr>
<td>Low Disease Complexity (e.g., Focal Stenosis, SYNTAX ≤22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate- or high-risk findings non-invasive testing, Diabetes present</td>
<td>M (4)</td>
<td>M (6)</td>
</tr>
<tr>
<td>Intermediate- or high-risk findings non-invasive testing, Diabetes present</td>
<td>M (5)</td>
<td>A (7)</td>
</tr>
<tr>
<td>Intermediate or High Disease Complexity (e.g., Multiple Features of Complexity as Noted Previously, SYNTAX &gt;22)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The number in parentheses next to the rating reflects the median score for that indication.

A indicates appropriate; PCI, percutaneous coronary intervention; and SYNTAX, Synergy between PCI with Taxus and Cardiac Surgery trial.

Surgical Approach for CABG
Many Options...maybe too many!

- On-pump vs. Off-pump
- All arterial vs. artery/vein
- Single vs. Bilateral IMA
- Beating heart pump assist
- Mid-CABG
- Robotic CABG
- etc., etc....
Blue plate special...

- 3-vessel CABG with in-situ LIMA to LAD and SVG to RCA and OM
- Superior to medical management and PCI
  - Multivessel
  - Diabetics
  - Low EF
  - Anti-platelet intolerance

Total Arterial CABG

- Use of arterial conduits for all bypass grafts
  - Radial artery
  - RIMA/LIMA
  - Gastroepiploic
- Superior long-term (7-10 yr) survival in selected populations
Off-Pump CABG (OP-CAB)

- CABG without use of the heart-lung machine (CPB)
- Potential benefit in certain patient populations:
  - Renal failure
  - Advanced lung disease
  - Calcified aorta
- No studies have definitively demonstrated clear benefit over on-pump CABG in general population

Minimally Invasive CABG

- Mini-left thoracotomy vs. total endoscopic LIMA to LAD
  - +/- robotic LIMA harvest
  - +/- robotic LIMA to LAD anastomosis
- Potential benefit in certain patient populations where sternotomy is not tolerable
- Often performed as part of hybrid approach with PCI of other vessels
Aortic Valve Disease

Insufficiency

Stenosis

Concentric Remodeling

Eccentric Remodeling
**Treatment Options?**

Medical therapy depending on pathology
- Diuretics
- Afterload reduction

Percutaneous valve therapy
(aortic stenosis ONLY)
- Balloon valvuloplasty
- Transcatheter AVR (TAVR)

Surgical Valve Therapy
- Aortic valve replacement

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**Transcatheter AVR (TAVR)**

- Percutaneous approach via 14F sheath
- Indicated and approved for aortic stenosis and prosthetic valve failure across low – high risk categories
- Several expansion mechanisms
  - Balloon expandable
  - Self-expanding (nitinol)
  - Mechanically expandable
Surgical AVR

- Sternotomy approach
- Cardiopulmonary bypass and cardiac arrest
- Resection of native valve via aortotomy
- Placement of prosthetic valve
  - Mechanical vs Bioprosthetic
  - Mechanical favored in younger patients <50 yrs
  - Bioprosthetic favored in older patients >60 yrs or those intolerant of anticoagulation

TAVR vs. Surgery

- Heart-team based decision with multi-disciplinary input
  - Cardiology
  - Cardiac surgery
  - Palliative care
- Significant improvement in outcomes with modern generation devices
  - Mortality
  - Stroke
  - Pacemaker
- Outcome comparable to SAVR for low risk patients...however TAVR is favored for
  - Older
  - Prior cardiac surgery
  - Multiple co-morbidities
  - Not requiring concomitant coronary revascularisation
  - Not likely to need another valve replacement in their lifetime
Minimally Invasive Surgical AVR

- Right mini-thoracotomy access (Miami Method)
- Femoral cardiopulmonary bypass with cardiac arrest
- Standard valve replacement technique
- Limited to those with primary valve disease without co-existing coronary or other valve lesions

Mitral Valve Disease

- Insufficiency
- Stenosis
Mitral Valve Disease

LA Pressure Overload

Mitral Valve Disease

LA/LV Volume Overload

TRICUSPID VALVE DISEASE (INSUFFICIENCY)

Hemodynamic Cascade

LA compliance

Backward pulmonary veins pressure

Pathological changes in pulmonary veins and arteries
  • Muscularization of arterioles
  • Medial hypertrophy
  • Neointima formation of distal arteries

Increase in PVR

PA pressure

LEFT ATRIAL ENLARGEMENT

ATRIAL FIBRILLATION

RV Remodeling and Dysfunction

RV Afterload

Pulmonary Hypertension
Treatment Options?
Medical therapy depending on pathology
- Diuretics
- Afterload reduction
Percutaneous valve therapy
- Balloon valvuloplasty
- Mitra-Clip
Surgical Valve Therapy
- Mitral valve repair
- Mitral valve replacement
- Tricuspid valve repair
- Maze Procedure

Transcatheter – MitraClip
- Percutaneous approach via right femoral vein
- Trans-septal puncture for access to left atrium and MV
- Approved for degenerative (i.e. prolapse) and functional (i.e. heart failure) etiologies
  - moderate to severe or severe mitral regurgitation
  - prohibitive surgical risk for mitral surgery
- Two sizes... NT and larger XT
- Typically 1 – 2 clips to achieve a 2+ to 3+ reduction in MR grade
Mitral Valve Surgery

- Degenerative disease (i.e. prolapse, chordal rupture, annular dilatation) typically treated with valve REPAIR
- Stenotic disease (i.e. rheumatic) typically treated with REPLACEMENT
- Infection (endocarditis) typically treated with REPAIR if feasible but most commonly REPLACEMENT
- Placement of prosthetic valve
  - Mechanical vs Bioprosthetic
  - Mechanical favored in younger patients <60 yrs
  - Bioprosthetic favored in older patients ≥60 yrs or those intolerant of anticoagulation

Mitral Valve Repair

- Right brain activity...
  - Requires some creativity, intuition, and 3D/spatial awareness
- Also requires experience to anticipate a high (>90%) repair rate
- There are lots of techniques, but most rely on:
  - Annular remodeling with ring or band annuloplasty
  - Recreation of normal leaflet movement, coaptation zone, and dimensions
  - Re-creation of chordal support
Tricuspid Valve Repair

- Current American and European guidelines support tricuspid valve repair if there is annular dilatation (> 40 mm) regardless of severity of regurgitation
  - Chikwe et. al. JACC 2015;65:1931-38

- Typical treatment is concomitant tricuspid ring annuloplasty at time of mitral repair or replacement

Maze for Atrial Fibrillation

- Left atrial or bi-atrial Cox-Maze IV lesion sets may be performed at the time of mitral valve surgery for patients with atrial fibrillation to restore sinus rhythm
  - cryo- or radiofrequency ablation energy source
  - left atrial appendage ligation

- Consideration may also be given to patients at high risk for developing AF
  - large left atrium
  - long standing MV disease
Aortic Disease

- Indication for repair based upon size, presence of other risk factors, and surgical risk
  - connective tissue disorder
  - family history
  - recent growth
- Typical indication for considering surgery:
  - >5 cm in transverse diameter

Aortic Aneurysm Repair
Surgery for Heart Failure

Heart Transplant

- "Gold Standard" for chronic heart failure
- Limited by organ availability
  - approx. 2500 organs/yr
- Strict selection criteria
  - <65 years old
  - strong social support
  - non-obese, non-smoking
  - normal kidney function
Left Ventricular Assist Device (LVAD)

- Survival now approaching that of heart transplant with modern device technology
  - maglev technology
  - large blood paths for improved hemocompatibility
  - smaller footprint with intrapericardial placement
- Limited by device expense, need for extensive follow up care, and insurance access
  - 80-90K per device
  - not covered by AR Medicaid
- Less strict selection criteria compared to transplant
  - can consider older patients
  - bridge to candidacy for heart transplant

Thank You!