

# **Complications of Cardiac Valve Repairs & Replacements**

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# Complications after Valve Replacement

1. Thromboembolic bleeding
2. Ventricular failure
3. Pulmonary hypertension
4. Sudden death
5. Arrhythmias
6. Conduction abnormalities
7. Mechanical complications
8. Infective endocarditis

# Immediate Surgical Attention

1. Geometric mismatch
2. Moderate to severe valvular regurgitation
3. Paravalvular / Perivalvular leak- significant
4. “Stuck” mechanical valve leaflets
5. Valve dehiscence
6. Dysfunction of adjacent valves

# Abnormally high pressure gradient across newly seated aortic prosthetic valve

- **Physiologic factors:** high post-CPB cardiac output, hemodilution, high subvalvular velocities, and PPM.
- **Mechanical causes** of valve obstruction, such as stuck valve leaflets or occlusive thrombus.
- If echocardiographic assessment demonstrates no apparent mechanical cause, the surgery may proceed and the valve may be interrogated postoperatively.
- Inappropriately high gradients may also be assessed by alternate imaging modalities (epicardial or epiaortic ultrasound).

# Early and Late Complications of Prosthetic Valves

1. Patient Prosthesis Mismatch
2. Dehiscence
3. Primary failure
4. Thrombosis and Thromboembolism
5. Pannus Formation
6. Endocarditis
7. Hemolysis

# **Aortic Valve Pathology**

# Complications of Aortic Valve Surgery

1. Perivalvular Leak
2. Conduction System Abnormalities
3. Mitral Valve Injury
4. Coronary Artery Injury

# Perivalvular Leak

- Perivalvular leak after CPB is associated with a heavily calcified valve annulus.
- Mid-esophageal AV long axis (LVOT) view allows determination of presence of aortic regurgitation (AR).
  - Valve ring shadowing limits visualization
  - View is not adequate for localizing the regurgitant jet.
- Mid-esophageal AV short axis view is helpful for determining location of the leak site.
- Deep transgastric view can also provide beneficial information with color and continuous wave Doppler.
- Important to quantify the severity of AR (if the annulus was heavily calcified, the surgeon may opt to accept mild or even moderate AR, rather than risk other complications).
- Persistent significant AR after a valve repair procedure or valve resuspension is an indication for return to CPB and replacement of the valve.



# Conduction System Abnormalities

- Abnormalities can be as significant as complete heart block requiring a permanent dual chamber pacemaker.
- “Bundle of His” can be damaged if sutures are placed too deeply during insertion of the valve.
- Overly aggressive debridement of annular calcification can cause either perforation of the aorta, or destruction of the conduction system.
- AV pacing can manifest on TEE as septal wall motion abnormalities.
  - Easy to confuse the premature septal contraction with septal dyskinesis
  - To distinguish the two, look at the excursion of the myocardium
  - In early repolarization with the pacemaker, you will see normal septal myocardial thickening; it just occurs a fraction of a second prior to the myocardial thickening for the remainder of the ventricle.

# Mitral Valve Injury

- The anterior leaflet of the mitral valve is adjacent to the noncoronary cusp of the aortic valve and shares a common fibrous annular trigone.
- Overaggressive removal of the valve leaflet, or sutures placed too deeply in this region can cause serious damage to the mitral valve, manifesting as failure to wean CPB due to severe mitral regurgitation (MR) and pulmonary hypertension.
- TEE will show severe MR, with obvious structural abnormalities of the anterior leaflet of the mitral valve.
- Best viewed from the mid-esophageal windows

# Coronary Artery Injury

- On some occasions, the aortic annulus is small, and the surgeon will opt to insert a supra-annular valve, rather than perform an annular enlargement.
- One of the risks of this valve type is placement of the sewing ring too close to the ostia of the coronary artery, and resultant Ischemia due to obstruction to blood flow.
- Heavily calcified valves increase the risk of embolic phenomenon, either affecting the coronary arteries, or the arch vessels with concomitant coronary or cerebral Ischemia.
- Careful irrigation of the surgical field after debridement reduces this risk.

# Coronary Artery Injury

- To assess adequacy of flow in to the coronaries after valve replacement, the midesophageal windows are helpful.
- The short axis view allows color flow Doppler (CFD) evaluation of left main coronary flow.
- The coronaries are just distal to the valve, so by obtaining the short axis view of the valve and withdrawing the probe slightly, it is possible to see coronary flow.
- To see flow in to the right coronary artery; it is usually necessary to look along the anterior wall of the ascending aorta on the mid-esophageal long axis view.
- New regional wall motion abnormalities are a strong indicator that there is a problem with coronary blood flow, either due to ostial occlusion or embolic phenomenon.
- Either TEE evaluation of the coronaries, or surgical Doppler of the coronaries should be performed to determine the etiology of the problem.

# Mitral Valve Pathology

# Complications of Mitral Valve Repair

1. Systolic Anterior Motion / Left Ventricular Outflow Tract Obstruction
2. Coronary Artery Injury
3. Ventricular Rupture
4. Aortic Valve Leaflet Injury
5. Persistent Mitral Regurgitation

# Complications of Mitral Valve Repair

## **A. Systolic anterior motion / left ventricular outflow tract obstruction**

Echo Presentation:

1. Obstruction of the left ventricular outflow tract by mitral valve leaflet tip during systole in the ME AV SAX view.
  2. Color Doppler assessment shows turbulence in the left ventricular outflow tract and frequently a posteriorly directed mitral regurgitant jet.
  3. Quantitative Doppler shows elevated pressure gradient across the LVOT
  4. Pre-bypass measurements can be useful predictor of SAM / LVOTO and impact surgical plan. Risk factors include:
    - Height of posterior leaflet  $> 1$  cm
    - Anterior to posterior leaflet height ratio  $< 1$
    - Septal to mitral coaptation distance  $< 2.5$
    - Small, muscular LV
- Caveat: Post-bypass hemodynamics seen in setting of inotropes, vasodilation, and low volume exacerbate this condition. Correction measures should be undertaken before concluding repair is unsatisfactory.

# Complications of Mitral Valve Repair

## **B. Coronary artery injury**

Echo Presentation:

- New segmental wall motion abnormality in the lateral or inferoposterior regions may suggest circumflex artery injury.
- Caveat: Grafting of the distal coronary may be required.

## **C. Ventricular Rupture**

Echo Presentation:

1. Continuous entrapment of intracardiac air
2. This complication results from disruption along the A-V groove or rupture of the LV between the papillary muscle insertions and the A-V groove resulting in hemorrhage and unstable hemodynamics. Patient risk factors for this feared complication include female sex, advanced age, annular calcification. TEE exam useful for evaluating success of subsequent repair, often an endocardial patch.



# Complications of Mitral Valve Repair

## D. Aortic Valve Leaflet Injury

Echo Presentation:

- Severe aortic insufficiency
- Suture placement in the anterior annulus can injure the left or noncoronary leaflets of the aortic valve. If the leaflet has been torn an aortic valve replacement may be necessary.

# Complications of Mitral Valve Repair

## E. Persistent Mitral Regurgitation.

Echo Presentation:

1. MR jet area / atrial area >30%
  2. Vena contracta width >5.5 mm
  3. MR jet area >3 cm<sup>2</sup>
  4. MR fraction >30%
  5. Pulmonary vein flow showing S wave < D wave
  6. PISA calculation of orifice area >10mm<sup>2</sup>
- Post bypass hemodynamics will dramatically alter echocardiographic measures of mitral regurgitation.
  - Adjustments in hemodynamics (normalizing vascular resistance and cardiac output) are often used to better predict post-discharge MR.
  - The amount of mitral regurgitation that is acceptable is a difficult determination that must include a multitude of factors including the TEE findings, the prospects for an improved repair, the condition of the heart, and impact of a second bypass period with revision or insertion of a prosthetic mitral valve.