Intraoperative Echocardiography: Cases Where Echo Made a Difference

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DISCLOSURE

Relevant Financial Relationship(s)
Siemens Healthcare, Ultrasound: Advisory Council

Off Label Usage
None
Team Approach

• Surgeon and Echocardiographer
  • Speaking a common language
  • Mutual respect and honesty

• Role of Echo
  • Triggers for surgical procedure
  • Evaluate the immediate intraoperative result and predictors of long term successful results
  • Cleveland Clinic: 14% of cases, surgical technique was altered on the basis of the echo information


There is only one Captain of the ship in the Cardiac OR— the Surgeon, the Echocardiopher plays the role of the Navigator.
Cases

1. “But I am a size 5”
2. “Let Lord Murphy reign”
3. “I do not like green eggs and ham”
4. “It’s a topsy turvy world”

Case

• 78 year old female
• Symptomatic aortic stenosis
• Referred to Mayo Clinic for AV replacement
Pre-op Coronary Angiogram

Pre-AVR: Normal LV EF
Aortic Valve: Significant Aortic Stenosis

- AV Long-Axis View
- AV Short-Axis View

No Aortic Regurgitation
LVOT TVI = 0.17 m  
AV TVI = 0.96 m

Mean AV Gradient 34 mmHg  
Dimensionless Index = 0.18  
Calculated AVA = 0.8 cm²

Aortic Annulus = 20 mm
...”The prosthesis was seated nicely, and the left and right coronary ostia were open. We then closed the aortic root with a two-layer Prolene stitch. The closure itself was difficult as the aortic wall was thin, and there was less room than initially anticipated”…
Post-op TEE: Very Severe LV Dysfunction

Mitral Valve: Failure of Leaflet Coaptation
AVR: No Aortic Regurgitation

What would you recommend now?

a. LV assist device (LVAD)
b. Coronary artery bypass grafting (CABG)
c. Go back on bypass, rest heart and try and come off again in 10-15 minutes
d. Redo AVR with aortic root enlargement
Surgical Note

…”Our hypothesis was that the orifice of the left coronary ostium was stretched upon closure of the small aortic root. Once we re-opened the aortic root and examined the coronary ostia with the aortotomy half open, we confirmed the same…”

Post-AVR with Aortic Root Enlargement
Normal LV function: No RWMA

Normal AVR

Mean AVR Gr = 11 mmHg
Mild Mitral Regurgitation

Take Home Points

• Sizing of aortic valve and knowing size of aortic root is very important
  • Echo can be helpful

• Perioperative TEE is very helpful in monitoring complications of cardiac surgery
  • Timely, rapid communication and dialogue with the surgeon is crucial
Case

• 74 year old female with mitral valve prolapse
• Now with symptomatic mitral regurgitation including paroxysmal atrial fibrillation
• Referred for MV repair

Intra-op TEE (Pre-op):
Flail Middle Scallop of Posterior Leaflet (P2)

Four Chamber View  Commissural View
Long Axis View

Severe Mitral Regurgitation

Moderate Tricuspid Regurgitation

3.99 cm
What would you recommend?

a. MV repair alone
b. MV repair, re-evaluate tricuspid regurgitation on post-op TEE
c. MV repair and TV repair

Secondary Tricuspid Regurgitation or Dilatation: Which Should Be the Criteria for Surgical Repair?

Gilles D. Dreyfus, MD, Pierre J. Corbi, MD, K. M. John Chan, AFRCS, and Toufan Bahrami, MD

Department of Cardiothoracic Surgery, Royal Brompton and Harefield NHS Trust, Harefield Hospital, Harefield, Middlesex, United Kingdom


STATE-OF-THE-ART PAPER

Tricuspid Regurgitation in Mitral Valve Disease

Incidence, Prognostic Implications, Mechanism, and Management

Avinoum Shiran, MD,* Alex Sagie, MD†‡

Haifa, Petah Tikva, and Ramot Aviv, Israel

• “In patient’s undergoing MV surgery, recommend TV repair when TV annulus ≥ 3.5 cm”
Progression of TR after MV Repair

- Trivial TR
- Moderate TR ≤40 mm²
- Severe TR ERO >40 mm²

*S*<0.0001

Cardiovascular Events (%) vs Years

Suri RM and Topilsky YJ Thorac Cardiovasc Surg 2014

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2014 ACC/AHA Guidelines Pertaining to the Surgical

Nishimura RA et al.

- Placement or annuloplasty is reasonable for severe symptomatic. *(Level of Evidence: C)*
- Placement is reasonable for severe TR secondary to tricuspid valve leaflets not amenable to annuloplasty. *(Level of Evidence: C)*
- Placement may be considered for less than severe TR in MV surgery when there is pulmonary hypertension or dilatation. *(Level of Evidence: C)*
- Placement or annuloplasty is not indicated in patients with TR whose pulmonary artery systolic pressure is less than 60 mm Hg in the presence of a normal MV. *(Level of Evidence: C)*
- Placement or annuloplasty is not indicated in patients with TR. *(Level of Evidence: C)*
Operative Report

- Mitral valve repair
  - Quadrangular resection of flail posterior leaflet
  - Posterior annuloplasty band
- Pulmonary vein isolation, modified Maze procedure
- Tricuspid valve repair by placing Kay stitches

Post-operative TEE: Successful TV Repair
Unexpected Finding

Moderate Mitral Regurgitation
What would you recommend?

a. MV replacement

b. Redo MV repair, use smaller annuloplasty ring

c. Medical therapy (fluids and beta-blocker)

Systolic anterior motion after mitral valve repair: Is surgical intervention necessary?

Morgan L. Brown, MD, Martin D. Abel, MD, Roger L. Cline, MD, Ronald G. Morford, MD, Joseph A. Dearani, MD, Thoralf M. Sundt, MD, Thomas A. Orszulak, MD, Harzel V. Schaff, MD

• Objective: to determine the incidence of SAM, evaluate risks of SAM with various surgical techniques, and assess the long-term outcome of nonsurgical management of SAM after MV repair

• Study: 1993 – 2002; 2076 patients MV repair; SAM in 174 cases (8.4%)

J Thorac Cardiovasc Surg 2007
By the time of dismissal echo SAM had resolved in 63% of patients.

Only 2 patients required re-repair during follow-up period (NOT related to SAM)

Late Follow-up
- 79% with none or mild MR
- 34% continued β-blockers
- 90% of patients NYHA I class

Mayo Experience
SAM ± LVOTO After MV Repair

- Most cases of SAM resolve with conservative measures (medical therapy)
- Persistent SAM ± LVOTO occurs in 2.3% of patients but reoperation is typically not necessary

After IV Esmolol and Fluids

Dismissal Transthoracic Echo

Final Impressions
1. Normal left ventricular chamber size.
2. Calculated left ventricular ejection fraction: 66%.
3. No regional wall motion abnormalities.
4. Trivial mitral valve regurgitation.
5. Mitrail valve diastolic mean Doppler gradient: 3 mmHg (heart rate 72 BPM).
7. Tricuspid valve diastolic mean Doppler gradient: 1 mmHg.
8. Estimated right ventricular systolic pressure 29 mmHg (systolic blood pressure 102 mmHg).
Schematic demonstrating the transesophageal echocardiographic measurements performed prior to and after mitral valve repair

Predictors of Post-op SAM
- C-Sept distance closer to LVOT (<2.5 cm)
- Smaller AL/PL ratio and C-sept distance
- Smaller LVIDs

Take Home Points
- The length of the MV leaflets and LV geometry can help predict if SAM is likely to occur post-op
- Intraoperative TEE is superb for detecting SAM post-op
  - A pulmonary artery catheter is not
- Consider TV repair in patients undergoing MV surgery when there is a dilated TV annulus
Case

- 56 year old male referred for MVR secondary to severe rheumatic mitral regurgitation

- Pre-op TEE
  - Severe mitral regurgitation

- Post-op after St. Jude MVR
  - Severe hypotension
  - Pulmonary Hypertension
  - TEE
What Happened?

A. Malfunctioning St. Jude MV Prosthesis
B. Thrombosed St. Jude MVR
C. Something Else
After Redo MVR

Upside Down

Correct
Take Home Points

• The value of TEE is only as good as the operator

• Guidelines
  • J Am Coll Cardiol. 2003 Feb 19;41(4):687-708
  • ACC/AHA clinical competence statement on echocardiography
  • Quinones MA, Douglas PS, Foster E, Gorcsan J 3rd, Lewis JF, Pearlman AS, Rychik J, Salcedo EE, Seward JB, Stevenson JG, Thys DM, Weitz HH, Zoghbi WA; American College of Cardiology; American Heart Association; American College of Physicians-American Society of Internal Medicine; American Society of Echocardiography; Society of Cardiovascular Anesthesiologists; Society of Pediatric Echocardiography.

Case

• 70 year old female
• NYHA class II CHF symptoms
• Mitral valve prolapse with severe mitral regurgitation
• No significant epicardial coronary artery disease
• Referred for minimally invasive, robotic mitral valve repair
MV Flail P2 (middle scallop)

Severe Mitral Regurgitation
Normal LV EF

Normal RV function
Surgical Procedure

1. Robotic-assisted minimally invasive mitral valve repair.
2. Triangular resection of middle scallop of the posterior leaflet.
3. Insertion of a posterior annuloplasty band.

No residual mitral Regurgitation
Post-op LV dysfunction

RV Dysfunction
Why is there LV and RV dysfunction?

a. Air down the right coronary artery
b. Annuloplasty band “clipped off” left circumflex artery
c. Acute right coronary infarction
d. Post-bypass stunning
e. Robotic malposition syndrome type B

Mitral Annulus, Left Circumflex Artery, and Coronary Sinus

Choure AJ…Kapadia SR. J Am Coll Cardiol 2006; 48:1938-45
Left Circumflex Artery Occlusion from MV Ring

Post-op: LV Systolic Dysfunction

10 Minutes later: No RWMA

Air down the RCA
Case

- No change after 10 minutes
- Further imaging performed....

Echocardiographic Identification of Iatrogenic Injury of the Circumflex Artery During Minimally Invasive Mitral Valve Repair

Ann Thorac Surg 201;89:1866-72

Joerg Ender, MD, Michael Selbach, MBBS, Michael A. Borger, MD, PhD, Eugen Krohhner, MD, Volkmar Falk, MD, PhD, Udo X. Kaisers, MD, PhD, Friedrich W. Mohr, MD, PhD, and Chirojit Mukherjee, MD

Inferior Wall Akinesis
Soon followed by…

Patient placed on ECMO

- What would you recommend now?
  a. Change from minimally invasive to open procedure and perform CABG to RCA
  b. Emergent cardiac catheterization
  c. Transfer to Surgical Intensive Care Unit
Left Circumflex OK

Problem with RCA
Why was there LV and RV dysfunction?

a. Air down the right coronary artery
b. Annuloplasty band clipped left circumflex artery
c. Acute right coronary infarction
d. Post-bypass myocardial stunning

Follow-up

- Patient recovered completely
- Discharge from hospital 7 days later
- Follow-up echo
Take Home Points

• Murphy’s Law
  • Anything that can go wrong, will go wrong

• Multiple reasons for new LV dysfunction after MV repair
  • Pre-op LV dysfunction unmasked
  • Air down coronaries
  • Left circumflex artery issues
  • New myocardial infarction

Echocardiography helps us avoid mistakes

You know it’s there somewhere, but unless you look for it, you might not see it !!!
Thank You!
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