Minimally Invasive Cardiac Surgery

Presented by:
Wilson M. Clements M.D.
Disclosures

• No financial disclosures

- 11 year retrospective analysis
- 707 patients
- Access
  - Lower ministernotomy
  - Right parasternal incision
  - Right thoracotomy
  - Upper ministernotomy
- 707 repairs
- 3 (0.4%) operative deaths
- Stroke 1.9%
- Direct aortic clamp
- 4.8% failed repairs necessitating reoperation

10 year retrospective analysis single institution
1601 patients with degenerative disease
  - 1071 minimally invasive
  - Right anterior thoracotomy with direct vision
Mortality 2.2% for all
  - 1.3% for isolated minimally invasive
  - 1.3% for isolated sternotomy
  - 3.6% for valve plus concomitant procedure
8 year freedom from reoperation
  - 95% for minimally invasive
Stroke
  - 2.3 % MIS
  - 1.7% sternotomy
Ascending aortic perfusion/Direct Cross Clamp

Glower et al. Innovations 2009

- 68 pts retrospective review
- Right mini-thoracotomy with mitral valve repair and edge-to-edge technique
- Direct cross clamping or fibrillatory arrest
- No mortality
- Stroke not recorded
- No reoperations
Grossi et al. JTCVS 2001

- 100 consecutive patients undergoing primary mitral reconstruction via HeartPort
- 100 patients undergoing primary mitral repair via sternotomy
- 1 year followup
- 1 mortality via sternotomy
- Zero via MIS
- Freedom from operation
  - 94.4% vs 96.8% not significant
- Endoaortic occlusion
- Stroke
  - 1% sternotomy
  - 2% MIS


- Single institution retrospective review
- 1339 valve repairs
- MIS 5-6 cm right lateral mini-thoracotomy
- Direct transthoracic cross clamping
- Hospital mortality
  - 2.4%
- Neurological Impairment
  - 3.1%
    - 2.1% minor
    - 1.0% major (editorial aside, these were not defined)
- 5 year freedom from reoperation
  - 96.3%
Chitwood et al. JCTVS 2008

- Single institution retrospective review
- 300 patients undergoing robotic mitral valve repair
- 3-4 cm right inframammary incision
- Transthoracic aortic clamping
- Hospital mortality - 0.7% early
- Later mortality 2.0%
  - 6 patients
    - Four non cardiac
    - 2 died after MV reoperations
- 0.7% stroke — 2 patients
- 0.7% TIA — 3 patients
- 16 pts required reoperation (5.3%)

Single institution retrospective review

127 patients undergoing endoscopic robotic mitral surgery

121 patients completed operation endoscopically

- Repair 114
- Replace 7
- 2 pts required reoperation
- 1 hospital death (0.8%)
- 1 late death

Stroke 2 pts (1.6%)
Modi et al. 2009 JCTVS

- 2 institution 12 year retrospective analysis
- 4 cm right mini thoracotomy with video assist
- 1178 patients
  - 941 repair
  - 237 replace
- Isolated mortality
  - 0.8% repair
  - 3.9% replace
- Stroke 2%
- Clamp
  - 48% transthoracic
  - 40.7% endoaortic balloon occlusion
  - 10.1% hypothermic fibrillation
- Reoperation for failure 1.9% @ 2 years


- 5 year single institution retrospective review
- 187 patients with right chest small incisions allowing direct vision
- Direct aortic clamping
- 180 repair
- 7 replace
- Zero mortality
- Zero stroke
- Freedom from MR> mild was 92% @ one year
- 3 patients required reoperation

VanErman et al. 2003 Circulation

- Single institution retrospective review
- 306 pts
  - 226 repair
  - 80 replacement
- Video assist 4 cm working port right chest
- Endoaortic occlusion
- Thirty day mortality was 1%
- Stroke 0.3%
- Freedom from reoperation
  - 99.7% @ 30 days
  - 97.7% @ 1 year
  - 91% @ 4 years

Byrne et al. 2004 Annals of Surgery

- 1000 pts. 474 mitral valve operations
- 7 year retrospective review from a single institution
- Incisions
  - Lower sternal
  - Right parasternal
  - Right thoracotomy
- Repair 416
- Replace 58
- Mortality 0.2%
- Freedom from reoperation was 95% @ 6 years
- Direct crossclamp
- Stroke 1%
- Survival 95% @ 5 years

Prospective randomized study
40 pts randomized to sternotomy or mini right thoracotomy
14 pts in each arm underwent repair
6 in each arm underwent replace
Endoclamp with 6 conversions to transthoracic
Zero mortality
Zero stroke
201 patients scheduled for robotic endoscopic mitral valve surgery
- 186 repair
- 15 replace
8 conversions
2 deaths
2 reoperations for valvular issues
No comment on neurological injuries
Endoaortic occlusion
Nifong et al. JTCVS 2005

• Phase II FDA trail
• Robotic mitral valve repair with da Vinci telemanipulation
• 4-5 cm mini right thoracotomy
• 112 patients in 10 institutions
• End point
  • Grade 0 or I mitral regurgitation @ 1 month
• Zero deaths
• Zero strokes
• @ 1 month followup
  • 9 (8.0%) pts had grade 2 mitral regurgitation
  • 6 (5.4%) had reoperations


- Outcomes data from STS database
- 2004-2008 28143 patients undergoing isolated MV operations
  - 23,821 conventional
  - 4,322 less invasive mitral valve (LIMV)
- Less invasive defined by cannulation site
- Combination of transthoracic clamp, endoaortic balloon occlusion, and fibrillatory arrest
- Mortality was similar between the groups (less than 2% in all studied groups!)
  - Adjusted OR 1.13
- Stroke was higher in the LIMV group in unadjusted, adjusted, and propensity analyses.
  - Adjusted OR 1.96 for less invasive
  - Three-fold higher risk of stroke for LIMV performed without aortic occlusion
  - Femoral cannulation was not an independent predictor of stroke
Svensson et al. JTCVS 2009

- Single institution propensity matched analysis
- 2124 MIS patients and 1047 conventional approach
- 590 matched pairs
  - MIS approach
    - Paramedian
    - J incision
    - Partial lower sternotomy
- Central cannulation and direct cross clamping
- Mortality similar
  - 0.17% MIS
  - 0.85% Conventional
- Stroke similar
  - 1.2% MIS
  - 1.0% Conventional
- Survival similar at 1, 5, and 8 years
  - 98%, 91%, and 86% MIS
  - 96%, 89%, and 84% Conventional
- No right thoracotomy or robotic assist patients in this study
Seeburger et al. EJCTS 2009

• Single institution review encompassing 8 years and 1708 patients
• 1230 diagnosed with predominant prolapse of
  • Anterior mitral leaflet n=156
  • Posterior mitral leaflet n=672
  • Bileaflet disease n=402
• Transthoracic clamp and right mini thoracotomy
• 94% successful repair overall
  • 90.3% bileaflet, 91% anterior leaflet, and 96.9% posterior leaflet
• 6% replacement
• 30 day mortality 1.8%
• Stroke 2.4 % n=30
• Reoperation 4.1% n=51

Introduction

- Until 1995, cardiac surgery lagged behind other fields
- Reduced incision sizes first for aortic and mitral valve
- Port access with endoaortic occluders
- Skepticism abounded
Ideal Cardiac Valve Operation

- Small incisions
- Antegrade perfusion
- Tactile feedback
- Clear visualization
- Easy secure valve attachment
- Intracardiac access

- No instrument conflicts
- Same or better quality as open procedures
  - Repair in 60-80%
  - Few reops
  - Low mortality
Types of Incisions

Hemisternotomy

Right MiniThoractomy
Levels Of Minimal Access

• 1: direct vision-mini 10-12cm incisions
• 2: video assisted: micro incisions 4-8cm
• 3: video directed and robot assisted-1cm ports and micro incisions
• 4: robotic telemanipulation: ports and micro incisions
Suitable Candidates

- Patients with primary mitral valve disease
- Reoperative mitral valve patients
- Bileaflet and/or anterior leaflet disease
- Combined tricuspid and mitral operations
- Mild annular calcification
- Obese or large patients
- Elderly patients
Unsuitable Candidates

- Highly calcified mitral annulus
- Severe pulmonary hypertension, especially with a small right coronary artery
- Significant untreated coronary disease
- Severe peripheral atherosclerosis
- Prior right chest surgery
Da Vinci System

- Stereoscopic vision
- Small yet fine instrumentation
DaVinci
dVMVR Patient Markings
dVMVR Port Placement

- Arm #1
- Camera Port
- Arm #2
- AAL
- Cross-clamp
- Arm #3
- PAL
- Pericardial Retraction Stitches
dVMVR Patient Positioning
dVMVR Ports in Place
Incisions after case
Triangular Resection

- P2 resection
- Posterior annuloplasty band
PreProcedure TEE
PreProcedure TEE
PreProcedure TEE
Post Repair
PreProcedure TEE
TEE
POST REPAIR
POST REPAIR