From median sternotomy to minimally invasive mitral valve surgery

Michael A. Borger
Friedrich W. Mohr
Leipzig Heart Center, Germany

AATS Adult Cardiac Symposium
May 1, 2010
For the first time, minimally invasive mitral valve surgery ...

Chirurgie à cœur ouvert par vidéo-chirurgie et mini-thoracotomie
Premier cas (valvuloplastie mitrale) opéré avec succès

First open heart operation (mitral valvuloplasty) under videosurgery through a minithoracotomy

Alain Carpentier, Didier Loulmet, Alexandre Carpentier, Emmanuel Le Bret, Béatrice Haugades, Patrick Dassier, Pierre Guibourt

Département de chirurgie cardio-vasculaire et de transplantation d’organes, Hôpital Broussais, 96, rue Didot, 75674 Paris Cedex 14, France
... became routine ...

Five Years of Less Invasive Mitral Valve Surgery: From Experimental to Routine Approach

(#2001-6930 ... June 27, 2001)

Joerg-Friedrich Onnasch, MD, Felix Schneider, MD, Volkmar Falk, MD, PhD, Marco Mierzwa, MD, Jan Bucerius, MD, Friedrich Wilhelm Mohr, MD, PhD

Department of Cardiac Surgery, Heartcenter, University of Leipzig, Leipzig, Germany
Mitral Valve Surgery Can Now Routinely Be Performed Endoscopically

Filip P. Casselman, MD, PhD, FETCS; Sam Van Slycke, MD; Francis Wellens, MD, FETCS; Raphael De Geest, MD; Ivan Degrieck, MD, FETCS; Frank Van Praet, MD, FETCS; Yvette Vermeulen, MSc; Hugo Vanermen, MD, FETCS

Background—There is an increasing interest in minimally invasive cardiac surgery.

Methods and Results—Since February 1, 1997 till April 1, 2002, 306 patients underwent endoscopic mitral valve surgery (226 repair, MVP; 80 replacement, MVR). Predominant valve pathology was degenerative in MVP (83.6%) and rheumatic in MVR (65%). Mean age was 61.5±12.9 years. Median preoperative functional class (MVP+MVR) and mitral regurgitation (MVP) were II and 4+. Statistical analysis included Kaplan-Meier and Cox regression methods. Mean follow-up was 19.6±17.3 months and complete. The procedure was successfully performed in all but 6 patients. Hospital mortality included 3 patients (1%) and was technology related in one. Postoperative morbidity included aggressive re-exploration (8.5%), new onset atrial fibrillation (17.0%), and pacemaker implantation (2.3%). There were 1 early and 10 late reoperations, 5 of which were because of endocarditis. Freedom from mitral valve reoperation at 4 years was 91±3.5%. No risk factors for reoperation could be detected. Echocardiographic follow-up showed a median degree of mitral regurgitation (MVP) of 0 and a small paravalvular leak in four patients (MVR). Ninety-four percent of the patients reported no or mild postoperative pain and 99.3% felt they had an esthetically pleasing scar. Ninety-three percent would choose the same procedure again and 46.1% were back at work within 4 weeks.

Conclusions—Endoscopic mitral valve surgery can be performed safely but definitely requires a learning curve. Good results and a high patient satisfaction are guaranteed. It is now our exclusive approach for isolated atrioventricular valve disease. (Circulation. 2003;108[suppl II]:II-48-II-54.)
Up to routine practise

Mineral invasive mitral valve repair for mitral regurgitation: results of 1339 consecutive patients


Department of Cardiac Surgery, Heartcenter, Leipzig University, Struempelstrasse 39, 04289 Leipzig, Germany

Received 3 September 2007; received in revised form 30 April 2008; accepted 7 May 2008; Available online 30 June 2008

• Repair rate 87%
• 0.3% conversion to sternotomy
• 30-day mortality 2.4%
• Safe and effective procedure
Minimal Invasive MV Surgery

- Procedure of choice at Leipzig Heart Center for isolated MV surgery +/-:
  - TV surgery
  - AF ablation
  - PFO / ASD closure

- Exclusion criteria:
  - previous right thoracotomy
  - heavily calcified MV annulus?
  - descending aorta pathology
Different valve complexity

Comparison of outcomes of minimally invasive mitral valve surgery for posterior, anterior and bileaflet prolapse

Joerg Seeburger*, Michael A. Borger, Nicolas Doll, Thomas Walther, Jurgen Passage, Volkmar Falk, Friedrich W. Mohr

Heart Center, University of Leipzig, Leipzig, Germany

Received 4 September 2008; received in revised form 11 March 2009; accepted 24 March 2009

Abstract

Objective: We sought to compare the outcomes of minimally invasive mitral valve (MV) surgery for anterior (anterior mitral leaflet, AML), posterior (posterior mitral leaflet, PML) or bileaflet (BL) MV prolapse. Methods: Between August 1999 and December 2007, 1230 patients who presented with isolated AML (n = 156, 12.7%), isolated PML (n = 672, 54.6%) or BL (n = 402, 32.7%) MV prolapse underwent minimally invasive MV surgery. The preoperative mitral regurgitation (MR) grade was 3.3 ± 0.8, left ventricular ejection fraction (LVEF) was 62 ± 12% and mean age was 58.9 ± 13.0 years; 836 patients (68.0%) were male. Mean follow-up time was 2.7 ± 2.1 years, and the follow-up was 100% complete. Results: Overall, the MV repair rate was 94.0% (1156 patients). Seventy-four patients (6.0%) received MV replacement. MV repair for PML prolapse was accomplished in 651 patients (96.9%), for AML in 142 patients (91%) and for BL in 363 patients (90.3%). Repair techniques consisted predominantly of leaflet resection and/or implantation of neochordae, combined with ring annuloplasty. Concomitant procedures were tricuspid valve surgery (n = 56), atrial fibrillation ablation (n = 286) and closure of an atrial septal defect or patent foramen ovale (PFO) (n = 89). The overall duration of cardiopulmonary bypass was 127 ± 40 min and aortic cross-clamp time was 78 ± 33 min. The mean postoperative hospital stay was 11.6 ± 9.7 days for the overall group. Early echocardiographic follow-up revealed excellent valve function in the vast majority of patients, regardless of the repair technique, with a mean MR grade of 0.3 ± 0.5. For the overall group, 5-year survival rate was 87.3% (95% CI: 83.9–90.1) and 5-year freedom from cardiac reoperation rate was 95.6% (95% CI: 94.1–96.7). The log-rank test revealed no significant difference between the three groups regarding long-term survival or freedom from reoperation. Conclusions: Minimally invasive MV repair can be achieved with excellent results. Long-term outcomes and reoperation rates for AML prolapse are not significantly different from PML or BL prolapse.

© 2009 European Association for Cardio-Thoracic Surgery. Published by Elsevier B.V. All rights reserved.

Keywords: Mitral valve repair; Prolapse; Minimally invasive
MV Reoperation According to Valve Lesion

Braunberger et al.

Leipzig Experience

8-years:
- PML 95.1% (95% CI: 91.9 - 97.0)
- AML: 92.4% (95% CI: 84 - 96.5)
- Bileaflet: 95.9% (95% CI: 93.2 - 97.5)

Log-rank: p=.5
... and robotics.
The future ... ???

Editorial

Percutaneous Mitral Valve Repair
A Fertile Field of Innovative Treatment Strategies

Michael J. Mack, MD

Type II mitral valve leaflet mobility is defined as the presence of a percutaneous device to control mitral regurgitation. The pathology was originally classified using the etiological classification, but resultant modifications were made when new devices are used. The classification of Type II, defined by the American College of Cardiology (ACC) and the European Society of Cardiology (ESC), is based on a combination of echocardiographic and angiographic techniques. This classification helps identify more advanced stages of mitral regurgitation and assists in the decision-making process for therapeutic interventions.
Many ways to the heart
Concept: beating heart, transapical MV repair

NeoChord DS 1000 Device
Grasping & application of suture

Confirmation of grasp (Fiber optics)

Needle with suture & Exchangeable cartridge 8 mm diameter
Minimally invasive mitral valve surgery at Heart Center Leipzig
Current standard: Minimally invasive approach
Minimal Invasive MV Surgery: Equipment

- Arterial cannula
- Cardioplegia
Operative Technique I

- Camera
- Mitral valve
- Nipple
- Left atrial retractor
- Rib spreader
- Vent
Operative Technique II

Transthoracic aortic (Chitwood) clamp

Femoral cannulation for CPB
Minimal Invasive MV Surgery: Tips and Tricks

• use the long instruments for full sternotomy MV repair procedures
• choose the right first patient (male, normal BMI, dilated mitral annulus or isolated P2 prolapse, EF > 50%)
• one intercostal space higher for men, two spaces higher for women (almost never too high)
• optimize venous drainage before giving cardioplegia
• optimize MV exposure before starting repair
Minimal Invasive MV Surgery: Tips and Tricks

• learn the Loop Technique

Kuntze et al EJCTS 2008;33:566-72

Early and mid-term results of mitral valve repair using premeasured Gore-Tex loops (‘loop technique’)

Thomas Kuntze *, Michael A. Borger, Volkmar Falk, Joerg Seeburger, Evaldas Girdauskas, Nicolas Doll, Thomas Walther, Friedrich Wilhelm Mohr

Department of Cardiac Surgery, Heart Center Leipzig, University of Leipzig, Strümpellstr. 39, 04289 Leipzig, Germany

Received 5 September 2007; received in revised form 26 December 2007; accepted 4 January 2008; Available online 12 February 2008

Abstract

Objective: Mitral valve repair is associated with excellent short- and mid-term outcomes for treatment of mitral regurgitation. Our objective was to present our results of reparative surgery using Gore-Tex loops in a ‘loop technique’. Exposure was via a full sternotomy with cardiopulmonary bypass. Operative time was less than 275 min in all cases. The overall success rate was 97.4 ± 1.4%. Three years postoperatively, moderate to severe mitral regurgitation was noted in 3.7 ± 1.5% of patients. Patients undergoing mitral valve repair for all types of leaflet pathology had comparable early and mid-term outcomes. The mean hospital stay was 16 ± 3 days and mean follow-up time was 35 ± 18 months. The actuarial survival rate at 5 years was 90 ± 3%.

Keywords: Mitral valve repair, Gore-Tex, Loop technique, Cardiac surgery
Decrease of complication rate with increase of surgical experience (HZL, n=1.441)

Holzhey et al JTCVS 2007
## Minimal Invasive MV Surgery: Patient Demographics

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>2798</td>
</tr>
<tr>
<td>5/1999 – 07/2009</td>
<td></td>
</tr>
<tr>
<td>Mean age, y</td>
<td>60.9 +/- 12.8</td>
</tr>
<tr>
<td>Male sex, n</td>
<td>1520 (54%)</td>
</tr>
<tr>
<td>Mitral regurgitation</td>
<td>2650 (94%)</td>
</tr>
<tr>
<td>Mitral stenosis</td>
<td>240 (8.6%)</td>
</tr>
<tr>
<td>Preoperative euroscore</td>
<td>6.1 +/- 7.8</td>
</tr>
<tr>
<td>Previous cardiac operations</td>
<td>236 (8.4%)</td>
</tr>
</tbody>
</table>
Mitral valve pathology (% of overall cohort)
**Intraoperative Data**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation time</td>
<td>178 +/- 58 min</td>
</tr>
<tr>
<td>CPB duration</td>
<td>133 +/- 72 min</td>
</tr>
<tr>
<td>Aortic clamp time</td>
<td>75 +/- 38 min</td>
</tr>
<tr>
<td>Mitral valve repair</td>
<td>2278 (81.4 %)</td>
</tr>
<tr>
<td>Mitral valve replacement</td>
<td>520 (18.6 %)</td>
</tr>
</tbody>
</table>

**Overall number of surgeons**

20
Repair rate 96.9%

PML

651

Repair rate 91.0%

AML

142

Repair rate 90.3%

Bileaflet

363
Repair strategies I (% of the overall cohort)

- Resection AML: 1.7%
- Resection PML: 18.8%
- Sliding plasty AML: 0.2%
- Sliding plasty PML: 2.6%
- Annuloplasty: 79.1%
- Loops AML: 15.6%
- Loops PML: 28.6%
- Edge-to-edge: 2.5%
9 "expert" surgeons > n=50 cases
<table>
<thead>
<tr>
<th>Clinical outcome</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion to sternotomy</td>
<td>32 (1.1 %)</td>
</tr>
<tr>
<td>30 day mortality</td>
<td>2.1 %</td>
</tr>
<tr>
<td>Postoperative MR</td>
<td>0.3 +/- 0.6</td>
</tr>
<tr>
<td>Hospital stay</td>
<td>12.5 +/- 9.6 days</td>
</tr>
<tr>
<td>Follow up</td>
<td>98 % complete</td>
</tr>
</tbody>
</table>
Survival and Freedom from Reoperation

Seeburger et al EJCTS 2008;34:760-5
Conclusions

• moving from sternotomy to minimal invasive (and robotic?) MV repair requires:
  • new equipment
  • new skills
  • commitment from entire OR team

• minimal invasive MV repair can be:
  • safe, feasible and effective
  • rewarding for patient
  • rewarding for surgeon
Minimal invasive MV surgery: A long climb, but worth it.

Thank you!

michael.borger@med.uni-leipzig.de