Open Trans-Sternal Technique is the Preferred Method

Patrick M. McCarthy MD, FACC
Director of the Bluhm Cardiovascular Institute
Chief of Cardiac Surgery Division
Heller-Sacks Professor of Surgery in the Feinberg School of Medicine

Sunday, May 5, 2013
AATS/STS Adult Cardiac Surgery Symposium
AATS 93rd Annual Meeting
Minneapolis, MN
Disclosures

- Co-inventor: Carpentier-McCarthy-Adams
- IMR ET Logix MV Ring
- Inventor: Edwards MC3 TV Ring
- Inventor: D-ETlogix MV Ring
- Consultant: Edwards Lifesciences
Personal Experience

- ‘80s-early ’90s Right Thoracotomy
  - MV Surgery
- Upper Hemisternotomy
- Heartport
- Lower Hemisternotomy ~ 50% @ NMH
- Mini Right Thoracotomy

Now - Near 100% full sternotomy
  - Small skin incision
  - Pain pump
  - Tell patients pre-op expect 4 day LOS
The Emperor Has No Clothes
My Opponent
The Top 10 Reasons I Prefer a Sternotomy
“There is a finite amount of pain in the world and mini-invasive surgery transfers it from the patient to the surgeon”

Having the surgeon in pain doesn’t sound like a good idea. Is it really less painful?
Reason #9
There is a learning curve and NOT many opportunities to learn.

Fig 3. Distribution of less-invasive mitral valve operations among centers performing this operation. (IQR = interquartile range.)

Less-Invasive Mitral Valve Operations: Trends and Outcomes From The Society of Thoracic Surgeons Adult Cardiac Surgery Database

James S. Gammie, MD, Yue Zhao, PhD, Eric D. Peterson, MD, MPH, Sean M. O’Brien, PhD, J. Scott Rankin, MD, and Bartley P. Griffith, MD
Division of Cardiac Surgery, University of Maryland Medical Center, Baltimore, Maryland; Duke Clinical Research Institute, Durham, North Carolina; and Centennial Medical Center, Vanderbilt University, Nashville, Tennessee

Ann Thorac Surg 2010;90:1401-10
Fig 4. Distribution of robotic mitral valve operations. (IQR = inter-quartile range.)

Less-Invasive Mitral Valve Operations: Trends and Outcomes From The Society of Thoracic Surgeons Adult Cardiac Surgery Database

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Ann Thorac Surg 2010;90:1401-10
### Minimally Invasive Versus Conventional Open Mitral Valve Surgery

**A Meta-Analysis and Systematic Review**

Dary C. Ji, Chang, MD, *Janet Martin, PharmD, MD, *SHT&SC, *Amar Lal, MD, PhD, *
Anna Degeger, MD, PhD, Thierry A. Folliguet, MD, L, Wiley Filling, MD, Patrick Povin, MD, 
Ebad Kazemi, MD, *J. Michael Smith, MD, *Ryan Sobelberger, MD, ** and Vithuram Full, MD, **

#### FIGURE 8. **Cross-clamp time (minutes).** Conv-MVS, conventional open mitral valve surgery; Mini-MVS, minimally invasive mitral valve surgery; RCT, randomized control trial.
Reason #8

If transfusions are decreased, that does not outweigh the risk of the procedure.

How Dangerous are Blood Transfusions?

Northwestern Memorial Hospital
The Bluhm Cardiovascular Institute

Fig 2. Cox plots, shown as the mean of the covariates, for transfused (XFN) vs nontransfused (no XFN) valve-only patients. (A) Complications are excluded from the analyses. (B) Complications are included in the analyses. The grey line is XFN patients; the black line is no XFN patients.
Reason #7

Most of my patients look like this:  

Not like this:
Reason #6

Scars can heal, Aortic Dissections persist
Minimally Invasive Versus Conventional Open Mitral Valve Surgery
A Meta-Analysis and Systematic Review

Davy C. H. Cheng, MD,* Janet Martin, PharmD, MSc (HTA&M),*† Avtar Lai, MD, PhD,*
Anno Diegeler, MD, PhD;‡ Thierry A. Folliguet, MD;§ L. Wiley Nifong, MD;|| Patrick Perier, MD;‡
Ehud Raanani, MD;¶ J. Michael Smith, MD;# Joerg Seeburger, MD,** and Volkan Falk, MD††

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Mini-MVS Events</th>
<th>Conv-MVS Events</th>
<th>Total Events</th>
<th>Weight</th>
<th>Risk Ratio M.H, Random, 95% CI</th>
<th>Risk Ratio M.H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.22.1 Propensity comparison</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gammie 2010</td>
<td>4</td>
<td>4322</td>
<td>4322</td>
<td>35.6%</td>
<td>9.00 [0.48, 167.11]</td>
<td></td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td></td>
<td>4322</td>
<td>4322</td>
<td>35.6%</td>
<td>9.00 [0.48, 167.11]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>4</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 1.47 (P = 0.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **5.22.2 Cohort studies** | | | | | | |
| Botalin 2004        | 0              | 38             | 33          |        | Not estimable                 |                               |
| Grossi 2001a        | 0              | 100            | 100         |        | Not estimable                 |                               |
| Grossi 2001b        | 0              | 69             | 69          |        | Not estimable                 |                               |
| Raanani 2010        | 0              | 61             | 61          |        | Not estimable                 |                               |
| Ryan 2010 Rpr       | 1              | 177            | 177         | 29.8%  | 3.00 [0.12, 73.15]            |                               |
| Suri 2009           | 3              | 350            | 363         | 34.7%  | 7.30 [0.36, 140.80]           |                               |
| Subtotal (95% CI)   | 795            | 809            | 1594        | 64.4%  | 4.84 [0.55, 42.43]            |                               |
| Total events        | 4              |                | 0           |        |                               |                               |
| Heterogeneity: Tau² = 0.00; Chisq = 16.16, df = 1 (P = 0.69); I² = 0% |
| Test for overall effect: Z = 1.42 (P = 0.15) |

| Total (95% CI)      | 5117           | 5131           | 100.0%      | 6.04   | 1.06, 34.47                  |                               |
| Total events        | 8              |                | 0           |        |                               |                               |
| Heterogeneity: Tau² = 0.00; Chisq = 28.29, df = 2 (P = 0.87); I² = 0% |
| Test for overall effect: Z = 2.02 (P = 0.04) |
| Test for subaraneous differences: Not applicable |

**FIGURE 6.** Aortic dissection. Conv-MVS, conventional open mitral valve surgery; Mini-MVS, minimally invasive mitral valve surgery.

Northwestern Memorial Hospital
The Bluhm Cardiovascular Institute
Innovations 2011;6:84-103
Conclusions: Current evidence suggests that mini-MVS maybe associated with decreased bleeding, blood product transfusion, atrial fibrillation, sternal wound infection, scar dissatisfaction, ventilation time, intensive care unit stay, hospital length of stay, and reduced time to return to normal activity, without detected adverse impact on long-term need for valvular reintervention and survival beyond 1 year. However, these potential benefits for mini-MVS may come with an increased risk of stroke, aortic dissection or aortic injury, phrenic nerve palsy, groin infections/complications, and increased cross-clamp, cardiopulmonary bypass, and procedure time. Available evidence is largely limited to retrospective comparisons of small cohorts comparing mini-MVS versus conv-MVS that provide only short-term outcomes. Given these limitations, randomized controlled trials with adequate power and duration of follow-up to measure clinically relevant outcomes are recommended to determine the balance of benefits and risks.
Minimally Invasive Versus Conventional Open Mitral Valve Surgery

A Meta-Analysis and Systematic Review

Davy C. H. Cheng, MD,* Janet Martin, PharmD, MSc (HTA&M),*† Avtar Lal, MD, PhD,*
Anno Diegeler, MD, PhD,† Thierry A. Folliguet, MD,§ L. Wiley Nifong, MD,‖ Patrick Perier, MD,‡
Ehud Raanani, MD,¶ J. Michael Smith, MD,# Joerg Seeburger, MD,** and Volkmar Falk, MD††

FIGURE 7. Phrenic nerve palsy/diaphragm elevation. Conv-MVS, conventional open mitral valve surgery; Mini-MVS, minimally invasive mitral valve surgery.
Reason #5
It’s NOT Easy to Deal with Inevitable Complications

CASE CONFERENCES
Linda Shore-Lesserson, MD
Mark A. Chaney, MD
Section Editors

CASE 3—2012
Iatrogenic Circumflex Artery Injury During Minimally Invasive Mitral Valve Surgery

Jennifer Banayan, MD,* Richa Dhawan, MD,*
William J. Vernick, MD,† and Patrick M. McCarthy, MD‡

Reason # 4

Beware of Anything in Cardiac Surgery that is Marketed
Reason #3
They Go Home at the Same Time

Table 4. Odds Ratios (OR) for Outcomes of Less-Invasive Mitral Operations (Versus Conventional Sternotomy) Adjusting for Participant Correlations and Other Potential Variables

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Adjusted OR</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital stay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postprocedure length of stay &gt; 14 days</td>
<td>0.88</td>
<td>0.70</td>
<td>1.11</td>
<td>0.284</td>
</tr>
<tr>
<td>Blood product</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perioperative red blood cell transfusion</td>
<td>0.86</td>
<td>0.76</td>
<td>0.97</td>
<td>0.014</td>
</tr>
<tr>
<td>Perioperative platelet transfusion</td>
<td>0.81</td>
<td>0.72</td>
<td>0.91</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

CI = confidence interval.

Less-Invasive Mitral Valve Operations: Trends and Outcomes From The Society of Thoracic Surgeons Adult Cardiac Surgery Database
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Division of Cardiac Surgery, University of Maryland Medical Center, Baltimore, Maryland, Duke Clinical Research Institute, Durham, North Carolina, and Centennial Medical Center, Vanderbilt University, Nashville, Tennessee

Ann Thorac Surg 2010;90:1401-10
Reason #2
I don’t want to meet these guys
Intuitive Surgical Inc. (ISRG), the maker of robots used in 367,000 U.S. operations last year, is facing accusations in lawsuits that it put patients at risk by marketing the machinery to doctors without providing adequate training.

Company e-mails introduced in a lawsuit filed against Intuitive in Kitsap County, Washington, suggest salesmen lobbied hospitals to scale back doctor training. One manager's e-mail lauded a salesman for persuading a hospital that five supervised operations were too many. In another, a manager told a sales team not to "let proctoring or credentialing get in the way" of meeting goals on the number of robot surgeries.

Intuitive's robots, which cost about $1.5 million each, are used in 1,371 U.S. hospitals. No universally accepted guidelines exist on how to train people...
And the #1 Reason I Prefer Sternotomy

I don’t want my patients to have this scan.
# Minimally Invasive Versus Conventional Open Mitral Valve Surgery

A Meta-Analysis and Systematic Review

Davy C. H. Cheng, MD,* Janet Martin, PharmD, MSc (HTA&M),*† Avtar Lal, MD, PhD,* Anno Diegeler, MD, PhD,‡ Thierry A. Folliguet, MD,§ L. Wiley Nifong, MD,‖ Patrick Perier, MD,‡ Ehud Raanani, MD,¶ J. Michael Smith, MD,# Joerg Seeburger, MD,** and Volkmar Falk, MD††

## TABLE 2. All-Cause Mortality, Stroke up to 30 Days Postoperative

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Incidence</th>
<th>n (N)</th>
<th>WMD (95% CI) or RR (95% CI)</th>
<th>P</th>
<th>I² (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mini-MVS</td>
<td>Conv-MVS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All-cause mortality</td>
<td>1.2%</td>
<td>1.5%</td>
<td>20 (13, 066)</td>
<td>1.03 (0.75, 1.42)</td>
<td>NS</td>
</tr>
<tr>
<td>RCT</td>
<td>0%</td>
<td>0%</td>
<td>2 (140)</td>
<td>NE</td>
<td>NE</td>
</tr>
<tr>
<td>Stroke</td>
<td>2.1%</td>
<td>1.2%</td>
<td>11 (12, 655)</td>
<td>1.79 (1.35, 2.38)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

CI indicates confidence intervals; Conv-MVS, conventional open mitral valve surgery; I², heterogeneity; Mini-MVS, minimally invasive mitral valve surgery; n, number of studies; N, number of patients; NA, not applicable; NE, not estimable; NS, not significant; RCT, randomized controlled trial; RR, risk ratio; WMD, weighted mean difference.
Minimally Invasive Versus Conventional Open Mitral Valve Surgery
A Meta-Analysis and Systematic Review

FIGURE 4. Stroke, sub-analysis by transthoracic or endo-aortic clamping up to 30 days postoperatively. Conv-MVS, conventional open mitral valve surgery; Mini-MVS, minimally invasive mitral valve surgery.
"The most significant finding of this study was the markedly higher rate of permanent perioperative stroke in the less-invasive group compared with the conventional sternotomy group in unadjusted, adjusted, and propensity analyses."

**Table 4. Odds Ratios (OR) for Outcomes of Less-Invasive Mitral Operations (Versus Conventional Sternotomy) Adjusting for Participant Correlations and Other Potential Variables**

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<thead>
<tr>
<th>Outcome</th>
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<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operative mortality</td>
<td>1.13</td>
<td>0.84</td>
<td>1.51</td>
<td>0.419</td>
</tr>
<tr>
<td>Complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any reoperation</td>
<td>1.12</td>
<td>0.95</td>
<td>1.32</td>
<td>0.177</td>
</tr>
<tr>
<td>Reoperation for bleeding/tamponade</td>
<td>1.22</td>
<td>1.01</td>
<td>1.48</td>
<td>0.040</td>
</tr>
<tr>
<td>Reoperation for valve dysfunction</td>
<td>0.89</td>
<td>0.48</td>
<td>1.64</td>
<td>0.702</td>
</tr>
<tr>
<td>Any infection</td>
<td>1.10</td>
<td>0.76</td>
<td>1.61</td>
<td>0.612</td>
</tr>
<tr>
<td>Permanent stroke</td>
<td>1.96</td>
<td>1.46</td>
<td>2.64</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative atrial fibrillation %</td>
<td>0.79</td>
<td>0.70</td>
<td>0.89</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Renal failure</td>
<td>1.09</td>
<td>0.85</td>
<td>1.39</td>
<td>0.483</td>
</tr>
<tr>
<td>Prolonged ventilation</td>
<td>1.09</td>
<td>0.93</td>
<td>1.27</td>
<td>0.273</td>
</tr>
<tr>
<td>Major morbidity or mortality</td>
<td>1.14</td>
<td>1.01</td>
<td>1.29</td>
<td>0.029</td>
</tr>
<tr>
<td>Hospital stay</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Postprocedure length</td>
<td>0.88</td>
<td>0.70</td>
<td>1.11</td>
<td>0.284</td>
</tr>
</tbody>
</table>

CI = confidence interval.
Operations That Didn’t Live up to the Hype

- Batista Procedure
- Ross Procedure
- Homografts
- Stentless Aortic Valves
- OP CAB
- Minimally Invasive MV Surgery?
What We Want From an Operation

• EFFECTIVE
• Simple
• Quick
• Reproducible
• SAFE
Most of You Agree with Me

Fig 2. Adoption of less-invasive mitral valve operations (hatched bars) compared with conventional operations (black bars) over time.

Less-Invasive Mitral Valve Operations: Trends and Outcomes From The Society of Thoracic Surgeons Adult Cardiac Surgery Database

James S. Gammie, MD, Yue Zhao, PhD, Eric D. Peterson, MD, MPH, Sean M. O’Brien, PhD, J. Scott Rankin, MD, and Bartley P. Griffith, MD

Division of Cardiac Surgery, University of Maryland Medical Center, Baltimore, Maryland; Duke Clinical Research Institute, Durham, North Carolina; and Centennial Medical Center, Vanderbilt University, Nashville, Tennessee

Ann Thorac Surg 2010;90:1401-10
Less-Invasive Mitral Valve Operations: Trends and Outcomes From The Society of Thoracic Surgeons Adult Cardiac Surgery Database

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Division of Cardiac Surgery, University of Maryland Medical Center, Baltimore, Maryland; Duke Clinical Research Institute, Durham, North Carolina; and Centennial Medical Center, Vanderbilt University, Nashville, Tennessee

Conclusions. In selected patients, LIMV operations can be performed with equivalent operative mortality, shorter hospital stay, fewer blood transfusions, and higher rates of MV repair than conventional sternotomy. However, perfusion and cross-clamp times were longer, and the risk of stroke was significantly higher. Beating- or fibrillating-heart LIMV techniques are associated with particularly high risks for perioperative stroke.
Less-Invasive Mitral Valve Operations: Trends and Outcomes From The Society of Thoracic Surgeons Adult Cardiac Surgery Database

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Division of Cardiac Surgery, University of Maryland Medical Center, Baltimore, Maryland; Duke Clinical Research Institute, Durham, North Carolina; and Centennial Medical Center, Vanderbilt University, Nashville, Tennessee

Fig 3. Distribution of less-invasive mitral valve operations among centers performing this operation. (IQR = interquartile range.)
Minimally Invasive Versus Sternotomy Approach for Mitral Valve Surgery in Patients Greater Than 70 Years Old: A Propensity-Matched Comparison

David M. Holzhey, MD, William Shi, Michael A. Borger, MD, PhD, Joerg Seeburger, MD, Jens Garbade, MD, PhD, Bettina Pfannmüller, MD, and Friedrich W. Mohr, MD, PhD

Department of Cardiac Surgery, Heart Center Leipzig, Leipzig, Germany

Results. The minimally invasive approach led to longer duration of surgery (186 ± 61 vs 169 ± 59 minutes, \( p = 0.01 \)), cardiopulmonary bypass time (142 ± 54 vs 102 ± 45 minutes, \( p = 0.0001 \)), and cross-clamp time (74 ± 44 vs 64 ± 28 minutes, \( p = 0.015 \)). There were no differences between the matched groups in 30-day mortality (7.7% vs 6.3%, \( p = 0.82 \)), combined major adverse cardiac and cerebrovascular events (11.2% vs 12.6%, \( p = 0.86 \)), or other postoperative outcome. Only the number of postoperative arrhythmias and pacemaker implants was higher in the sternotomy group (65.7% vs 50.3%, \( p = 0.023 \) and 18.9% vs 10.5%, \( p = 0.059 \)). Long-term survival was 66% ± 5.6% vs 56 ± 5.5% at 5 years and 35% ± 12% vs 40% ± 7.9% at 8 years, and did not show significant differences.
Conclusions. Despite longer cross-clamp and bypass times, early outcomes using a thoracoscopic port-access approach were similar to those for mitral valve repair performed through median sternotomy. Minimally invasive mitral valve repair was associated with a shorter time to extubation, but that did not translate into a diminished duration of postoperative hospitalization.
Results.
...Robotic repair was associated with slightly improved scores... during the first postoperative year; however, differences between treatment groups became indistinguishable after 1 year. Robotic repair patients returned to work slightly quicker (median, 33 vs 54 days, $p < 0.001$).

Conclusions. Functional QOL outcomes within the first 2 years after early MV repair are excellent using open and robotic platforms. A robotic approach may be associated with slightly improved early QOL and return to employment-based activities. These results may have implications regarding future evolution of clinical guidelines and economic health care policy.
Minimally Invasive Versus Open Mitral Valve Surgery
A Consensus Statement of the International Society of Minimally Invasive Coronary Surgery (ISMICS) 2010

Volkmar Falk, MD,* Davy C. H. Cheng, MD,† Janet Martin, PharmD, MSc (HTA&M),†‡ Anno Diegeler, MD,§ Thierry A. Folliguet, MD,¶ L. Wiley Nifong, MD,‖ Patrick Perier, MD,§ Ehud Raanani, MD,# J. Michael Smith, MD,** and Joerg Seeburger, MD††

In patients with mitral valve disease, minimally invasive surgery may be an alternative to conventional mitral valve surgery (Class IIb), given that there was comparable short-term and long-term mortality (level B), comparable in-hospital morbidity (renal, pulmonary, cardiac complications, pain perception, and readmissions) (level B), reduced sternal complications, transfusions, post-operative atrial fibrillation, duration of ventilation, and intensive care unit and hospital length of stay (level B). However, this should be considered against the increased risk of stroke (2.1% vs 1.2%) (level B), aortic dissection (0.2% vs 0%) (level B), phrenic nerve palsy (3% vs 0%) (level B), groin infections/complications (2% vs 0%) (level B), and, prolonged cross-clamp time, cardiopulmonary bypass time, and procedure time (level B). The available evidence consists almost entirely of observational studies and must not be considered definitive until future adequately controlled randomized trials further address the risk of stroke, aortic complications, phrenic nerve complications, pain, long-term survival, need for reintervention, quality of life, and cost-effectiveness.
Minimally invasive approach provides at least equivalent results for surgical correction of mitral regurgitation: A propensity-matched comparison

Andrew B. Goldstone, MD, a Pavan Atluri, MD, a Wilson Y. Szeto, MD, a Alen Trubelja, BS, a Jessica L. Howard, BS, a John W. MacArthur, Jr, MD, a Craig Newcomb, MS, b Joseph P. Donnelly, BS, a Dale M. Kobrin, BA, a Mary A. Sheridan, MPAS, PA-C, a Christiana Powers, MSN, CRNP, a Robert C. Gorman, MD, a Joseph H. Gorman III, MD, a Alberto Pochettino, MD, a Joseph E. Bavaria, MD, a Michael A. Acker, MD, a W. Clark Hargrove III, MD, a and Y. Joseph Woo, MD a

Methods: Between January 2002 and October 2011, 1011 isolated mitral valve repairs were performed in the University of Pennsylvania health system (455 sternotomies, 556 right minithoracotomies). To account for key differences in preoperative risk profiles, propensity scores identified 201 well-matched patient pairs with mitral regurgitation of any cause and 153 pairs with myxomatous disease.

Results: In-hospital mortality was similar between propensity-matched groups (0% vs 0% for the degenerative cohort; 0% vs 0.5%, P = .5 for the overall cohort; in minimally invasive and sternotomy groups, respectively). Incidence of stroke, infection, myocardial infarction, exploration for postoperative hemorrhage, renal failure, and atrial fibrillation also were comparable. Transfusion was less frequent in the minimally invasive groups (11.8% vs 20.3%, P = .04 for the degenerative cohort; 14.0% vs 22.9%, P = .03 for the overall cohort), but time to extubation and discharge was similar. A 99% repair rate was achieved in patients with myxomatous disease, and a minimally invasive approach did not significantly increase the likelihood of a failed repair resulting in mitral valve replacement. Patients undergoing minimally invasive mitral repair were more likely to have no residual post-repair mitral regurgitation (97.4% vs 92.1%, P = .04 for the degenerative cohort; 95.5% vs 89.6%, P = .02 for the overall cohort). In the overall matched cohort, early readmission rates were higher in patients undergoing sternotomies (12.6% vs 4.4%, P = .01). Over 9 years of follow-up, there was no significant difference in long-term survival between groups (P = .8).
Minimally invasive versus conventional mitral valve surgery: A propensity-matched comparison

Lars G. Svensson, MD, PhD,\textsuperscript{a} Fernando A. Atik, MD,\textsuperscript{a} Delos M. Cosgrove, MD,\textsuperscript{a} Eugene H. Blackstone, MD,\textsuperscript{a,b} Jeevanantham Rajeswaran, MSc,\textsuperscript{b} Gita Krishnaswamy, MS,\textsuperscript{b} Ung Jin, MD,\textsuperscript{a} A. Marc Gillinov, MD,\textsuperscript{a} Brian Griffin, MD,\textsuperscript{c} José L. Navia, MD,\textsuperscript{a} Tomislav Mihaljevic, MD,\textsuperscript{a} and Bruce W. Lytle, MD\textsuperscript{a}

Results: In-hospital mortality was similar for propensity-matched patients: 0.17\% (1/590) for those undergoing minimally invasive surgery and 0.85\% (5/590) for those undergoing conventional surgery (\(P = .2\)). Occurrences of stroke (\(P = .8\)), renal failure (\(P > .9\)), myocardial infarction (\(P = .7\)), and infection (\(P = .8\)) were also similar. However, 24-hour mediastinal drainage was less after minimally invasive surgery (median, 250 vs 350 mL; 
\(P < .0001\)), and fewer patients received transfusions (30\% vs 37\%, \(P = .01\)). More patients undergoing minimally invasive surgery were extubated in the operating room (18\% vs 5.7\%, \(P < .0001\)), and postoperative forced expiratory volume in 1 second was higher. Early after operation, pain scores were lower (\(P < .0001\)) after minimally invasive surgery.

Conclusion: Within that portion of the spectrum of mitral valve surgery in which propensity matching was possible, minimally invasive mitral valve surgery had cosmetic, blood product use, respiratory, and pain advantages over conventional surgery, and no apparent detriments. Mortality and morbidity for robotic and percutaneous procedures should be compared with these minimally invasive outcomes. (J Thorac Cardiovasc Surg 2010;139:926-32)
Minimally Invasive Port Access Versus Conventional Mitral Valve Surgery: Prospective Randomized Study

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Results. Mitral valve reconstructions were performed in 28 patients (70%) in both groups. Intraoperative procedure-associated problems were experienced in 9 patients (45%) in group I, and 6 of them (30%) had to be converted to direct transthoracic aortic clamping. Markers of myocardial and cerebral damage as well as pulmonary and neuropsychological tests did not show statistically significant difference between groups.

Conclusions. The minimally invasive port access technique for mitral valve surgery can be done with similar clinical safety as procedures through median sternotomy. The problems with endoclamping have forced us to change our practice to the more simple and economic transthoracic aortic clamping technique.
Comparison of Minithoracotomy and Conventional Sternotomy Approaches for Valve Surgery

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Measurements and Main Results: The 41 pairs of patients were correctly matched, except for left ventricular function (n = 1). Twenty patients underwent mitral valve repair and 62 aortic valve replacement. Preoperative demographic data and clinical characteristics were similar in both groups. Cardiopulmonary bypass, aortic clamping, and surgery times were longer in the minithoracotomy group (p < 0.05). In 3 patients, the minithoracotomy approach had to be converted into a sternotomy during the surgical procedure for better visualization. Minithoracotomy patients had significantly increased postoperative total blood loss (p < 0.05). No difference was found between the groups for extubation time and intensive care or in-hospital lengths of stay.

Conclusion: These results suggest that valve surgery is feasible in many cases through minithoracotomy. Nevertheless, this approach increases surgical complexity and in this comparative study no significant benefit was shown.
Minimally Invasive Versus Conventional Open Mitral Valve Surgery

A Meta-Analysis and Systematic Review

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Results: Thirty-five studies met the inclusion criteria (two randomized controlled trials and 33 nonrandomized studies). The mortality rate after mini-MVS versus conv-MVS was similar at 30 days (1.2% vs 1.5%), 1 year (0.9% vs 1.3%), 3 years (0.5% vs 0.5%), and 9 years (0% vs 3.7%). A number of clinical outcomes were significantly improved with mini-MVS versus conv-MVS including atrial fibrillation (18% vs 22%), chest tube drainage (578 vs 871 mL), transfusions, sternal infection (0.04% vs 0.27%), time to return to normal activity, and patient scar satisfaction. However, the 30-day risk of stroke (2.1% vs 1.2%), aortic dissection/injury (0.2% vs 0%), groin infection (2% vs 0%), and phrenic nerve palsy (3% vs 0%) were significantly increased for mini-MVS versus conv-MVS. Other clinical outcomes were similar between groups. Cross-clamp time, cardiopulmonary bypass time, and procedure time were significantly increased with mini-MVS; however, ventilation time and length of stay in intensive care unit and hospital were reduced.