Minimally-Invasive Cardiac Surgery

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Disclosure

– Medtronic, Inc: Advisory Board
Minimally-invasive CABG

- Patients want:
  - Quick recovery
  - Less invasive option
  - Lower risk of perioperative complications
  - Durable results
How I do it: Robotic-assisted CABG
LIMA harvest
Warning: Patient cart is able to move

No Instrument Installed
### Updated Emory Results Robotic-assisted CABG – 7/31/16

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N=671</th>
<th>First 307</th>
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<tbody>
<tr>
<td>30-day mortality</td>
<td>5 (0.7%)</td>
<td>4 (1.3%)</td>
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<tr>
<td>Stroke</td>
<td>2 (0.3%)</td>
<td>1 (0.3%)</td>
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<tr>
<td>Myocardial infarction</td>
<td>7 (1.0%)</td>
<td>5 (1.6%)</td>
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<tr>
<td>Conversion to sternotomy</td>
<td>22 (3.3%)</td>
<td>16 (5.2%)</td>
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<tr>
<td>Repeat revascularization</td>
<td>11 (1.6%)</td>
<td>8 (2.9%)</td>
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</table>

**FitzGibbon A patency** – (325/336) 97%
Surgery time = 333 - 32*(log of case experience)  R-square = 0.35 p < 0.001

J Thorac Cardiovasc Surg 2014;147:179-85
Trends in Robotic CABG at Emory

• 50% of all cases are for isolated LAD disease
• 70% of all HCR cases are for 2 vessel disease
• 30% of all HCR are for 3VD
• The 2VD patients and almost all isolated LAD patients would have been treated with PCI without minimally invasive option
Conclusions

• Robotic CABG safe and effective method for surgical revascularization
• Intraoperative completion angiograms if possible
• Postoperative angiograms if not
• Increased surgical coronary volume associated with minimally invasive CABG procedures
• Must be cost neutral
Treatment Options for CAD at Emory

**Single vessel LAD disease**
- PCI
- Medical Tx
- Robotic CABG

**Multi-vessel CAD**
- Multi-arterial CABG
- CABG (LIMA + SVGs)
- Hybrid Revascularization
- Multi-vessel PCI
- Medical Tx

**Medical Tx**
Robotic MV Repair
### Handheld:
- Suture hook
- Suction/retractor
- Knot Tyer
- Forceps
- Irrigator
- Cryoprobe

### Robotic:
- Needle driver
- Scissors
- Debakeys
- Long forceps
- Dynamic scope
- Dynamic retractor
Conventional MV repair

- Re-engineered the tasks to be performed with 2 robotic and 2-3 handheld instruments
- Disassembled into multiple tasks done by hand
- Reassembled robotic-handheld tasks

Diagram:
- Conventional MV repair
- Re-engineered the tasks to be performed with 2 robotic and 2-3 handheld instruments
- Disassembled into multiple tasks done by hand
- Reassembled robotic-handheld tasks
Lateral Endoscopic Approach using Robotics
LEAR
Technique
Robotic approach
LEAR PORTS

- Retractor Arm
- Right Arm
- Left Arm
- Service Port
- Endoscope
L.E.A.R. Technique

A Different Operating Room Paradigm
Femoral arterial perfusion with endo-balloon
Left atriotomy
Posterior leaflet resection
Neochords
Annuloplasty
Annuloplasty
Tricuspid
MV, TV, Ablation, Tumor, Thrombus
ASD

CTA with ileo-femoral runoff

Femoral perfusion with balloon occlusion
or
Femoral perfusion with transthoracic clamp occlusion
or
Ascending aortic perfusion with balloon occlusion
or
Axillary perfusion with femoral balloon

Needs CABG or AVR

S/P Right Lung resection

No access to the Aorta

Dense pleural adhesions

Endoscopic Robotic Technique

Median Sternotomy
The Expanding Role of Endoscopic Robotics in Mitral Valve Surgery: 1,257 Consecutive Procedures

Douglas A. Murphy, MD, Emmanuel Moss, MDCM, MS, Jose Binongo, PhD, Jeffrey S. Miller, MD, Steven K. Macheers, MD, Eric L. Sarin, MD, Alexander M. Herzog, BS, Vinod H. Thourani, MD, Robert A. Guyton, MD, and Michael E. Halkos, MD, MS

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Background. The role of robotic instruments in mitral valve (MV) surgery continues to evolve. The purpose of this study was to assess the safety, efficacy, and scope of MV surgery using a lateral endoscopic approach with robotics (LEAR) technique.

Methods. From 2006 to 2013, a dedicated LEAR team performed 1,257 consecutive isolated MV procedures with or without tricuspid valve repair or atrial ablation. The procedures were performed robotically through five right-side chest ports with femoral artery or ascending aortic perfusion and balloon occlusion. Operative videos and data were recorded on all procedures and reviewed retrospectively.

Results. The mean age of all patients was 59.3 ± 20.5 years, and 8.4% (n = 105) had previous cardiac surgery. The MV repair was performed in 1,167 patients (93%). The MV replacement was performed in 88 patients (7%), and paravalvular leak repair in 2 patients. Concomitant atrial ablation was performed in 226 patients (18%), and tricuspid valve repair in 138 patients (11%). Operative mortality occurred in 11 patients (0.9%) and stroke in 9 patients (0.7%). Predischarge echocardiograms demonstrated mild or less mitral regurgitation in 98.3% of MV repair patients. At mean follow-up of 50 ± 26 months, 44 patients (3.8%) required MV reoperation. Application of the LEAR technique to all institutional isolated MV procedures increased from 46% in the first year to more than 90% in the last 3 years.

Conclusions. Mitral valve repair or replacement, including concomitant procedures, can be performed safely and effectively using the LEAR technique. With a dedicated robotic team, the vast majority of patients with MV disorders, either isolated or with concomitant problems, can be treated using the LEAR technique.

Robotic Mitral Valve Surgery

Number of Cases

- Non-Robotic
- Robotic

Year | Non-Robotic | Robotic | Total
--- | --- | --- | ---
2002 | 78 | 0 | 78
2003 | 23 | 0 | 23
2004 | 33 | 0 | 33
2005 | 75 | 51 | 126
2006 | 72 | 22 | 94
2007 | 153 | 42 | 195
2008 | 170 | 41 | 211
2009 | 161 | 36 | 197
2010 | 170 | 30 | 200
2011 | 158 | 9 | 167
2012 | 187 | 8 | 195
2013 | 185 | 20 | 205
2014 | 194 | 31 | 225
2015 | 192 | 32 | 224
2016 | 180 | 36 | 216