NYU School of Medicine
ENDOSCOPIC ROBOTIC REPAIR OF
COMPLEX MITRAL LESIONS
EUGENE A. GROSSI AND DIDIER F. LOULMET
DISCLOSURES:

IP & ROYALTIES – EDWARDS LIFESCIENCES & MEDTRONINCS
• What is a complex repair?

• Can we perform complex repairs with robotics?

• What can we accomplish?
What makes MV repair difficult?

- Lack of leaflet tissue
- Bad quality of tissue
- The extent of lesions (number of segments involved)
- Limited exposure
- The type of techniques we use to treat the lesions:
  - Level I complexity
  - Level II complexity
  - Level III complexity
History - Robotics and the Mitral Valve – late 1990s

Paris

New York
Robotics and the Mitral Valve – late 1990s

Technology not quite there
Lacking:
- exposure tools
- facilitating suture tech
- good results

Both groups stepped back from robotic mitrals
WR Chitwood – pursued with mini-thoracotomy robotic assisted approach
2010 @ NYU
2 surgeons became colleagues

2012 started a team TEMVR program. For 3 months we re-trained with clinical scenarios, simulations, wet lab courses, & ‘expert’ observation.

We refused to compromise integral parts of operation:
Cardioplegic arrest
Use of annuloplasty device
Totally endoscopic robotic mitral repair (TERMVR): could not afford a significant learning curve – practice in the competitive environment of New York
Totally Endoscopic Robotic Mitral Repair: TERMVR

- Training – Dedicated Team Commitment (Institutional)
- Team Participants – Communication – no music
- Process Control – Attention to detail
- Team Brief / Debrief Model
TERMVR: Team Competency

Cardiac Surgeons With Sternotomy Access to the Heart: Masters of Our Universe
TERMVR: Team Competency
Preop Evaluation

- Preop eval CTA C-A-P
- 8-12% change (minor / major) in monitoring / operative strategy
Current OR Plan

• Single lumen endotracheal tube (except reoperations, prior right chest surgery)
• Bilateral radial a-lines
• Right arm dropped below bed on floating board
• 2-3” egg crate foam under right hemithorax
• RIJ Triple lumen; if >1+AI – coronary sinus cardioplegia catheter; or at least 1x week
Standard Perfusion Approach

- Preop eval CTA C-A-P
- 2.5 cm incision groin
- Seldinger technique and echocardiographic guidance for cannula and endo-balloon placement
- No flouroscopy/x-ray used
- If occlusive aortic disease – axillary perfusion
Port Placement

Working port and scope in same interspace (3rd) XX-Small Alexis soft tissue retractor – have to force index finger thru to check interspaces

Left arm - 2\textsuperscript{nd}
Right arm – 6\textsuperscript{th}
Retractor arm - medial
Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>60.5</td>
</tr>
<tr>
<td>Men</td>
<td>286 (64%)</td>
</tr>
<tr>
<td>Women</td>
<td>164 (36%)</td>
</tr>
</tbody>
</table>
### Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Etiology</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barlow</td>
<td>302</td>
<td>67</td>
</tr>
<tr>
<td>Fibroelastic deficiency</td>
<td>40</td>
<td>9</td>
</tr>
<tr>
<td>Functional</td>
<td>37</td>
<td>8</td>
</tr>
<tr>
<td>Rheumatic MR</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>Healed endocarditis</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>40</td>
<td>9</td>
</tr>
</tbody>
</table>

76%
### Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Leaflet prolapse</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Bileaflet</td>
<td>86</td>
<td>20</td>
</tr>
<tr>
<td>Posterior</td>
<td>250</td>
<td>60</td>
</tr>
</tbody>
</table>

No prolapse: 60, 14%

Anterior prolapse: 26%

Bileaflet prolapse: 80%
### Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Repair rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degenerative</td>
<td>99.4%</td>
</tr>
<tr>
<td>Functional</td>
<td>100%</td>
</tr>
<tr>
<td>Rheumatic MR</td>
<td>95%</td>
</tr>
</tbody>
</table>
Robotic Mitral Repair (450 patients 2011 – 2017)

### Posterior leaflet repair

<table>
<thead>
<tr>
<th>Procedure</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangular excision-suture</td>
<td>180</td>
</tr>
<tr>
<td>Quadrangular excision</td>
<td>140</td>
</tr>
<tr>
<td>• Hemislapping plasty</td>
<td>99</td>
</tr>
<tr>
<td>• Classic sliding plasty</td>
<td>34</td>
</tr>
<tr>
<td>• Folding plasty</td>
<td>2</td>
</tr>
<tr>
<td>• Annulus plication</td>
<td>5</td>
</tr>
<tr>
<td>P1-P2 or P2-P3 cleft closure</td>
<td>116</td>
</tr>
<tr>
<td>Bovine patch augmentation</td>
<td>8</td>
</tr>
</tbody>
</table>

### Posterior subvalvular repair

<table>
<thead>
<tr>
<th>Procedure</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial chord implant</td>
<td>67</td>
</tr>
<tr>
<td>PM repositioning</td>
<td>13</td>
</tr>
<tr>
<td>MAC excision</td>
<td>42</td>
</tr>
<tr>
<td>A-V groove patch repair</td>
<td>15</td>
</tr>
</tbody>
</table>
# Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Anterior leaflet</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangular excision-suture</td>
<td>29</td>
</tr>
<tr>
<td>Alfieri</td>
<td>13</td>
</tr>
<tr>
<td>Closure of an aberrant cleft</td>
<td>9</td>
</tr>
<tr>
<td>Leaflet peeling</td>
<td>7</td>
</tr>
<tr>
<td>Bovine patch augmentation</td>
<td>5</td>
</tr>
<tr>
<td>Plication of the margin</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anterior subvalvular</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary chordae division</td>
<td>241</td>
</tr>
<tr>
<td>PM repositioning</td>
<td>50</td>
</tr>
<tr>
<td>Artificial chordae</td>
<td>32</td>
</tr>
<tr>
<td>Chordal transfer</td>
<td>11</td>
</tr>
<tr>
<td>Aberrant muscle band excision</td>
<td>10</td>
</tr>
</tbody>
</table>
Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>MAC</th>
<th>54</th>
<th>12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC limited to the posterior annulus</td>
<td></td>
<td>7.5%</td>
</tr>
<tr>
<td>• 1 segment</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>• 2 segments</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>• 3 segments</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Calcified PM band</td>
<td>20</td>
<td>4.5%</td>
</tr>
<tr>
<td>• Anterior PM</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>• Posterior PM</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>MAC</th>
<th>54</th>
<th>12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited to the posterior annulus</td>
<td>34</td>
<td>7.5%</td>
</tr>
<tr>
<td>• Excision and bovine patch</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>• Excision and mattress sutures</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>• Excision</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>• No excision</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Calcified PM band</td>
<td>20</td>
<td>4.5%</td>
</tr>
<tr>
<td>• Excision</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>• No excision</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
## Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Combined procedures</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA appendage closure</td>
<td>424</td>
<td>94</td>
</tr>
<tr>
<td>PFO or ASD closure</td>
<td>90</td>
<td>20</td>
</tr>
<tr>
<td>CryoMaze</td>
<td>87</td>
<td>19</td>
</tr>
<tr>
<td>Hybrid revascularization</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td>Tricuspid annuloplasty</td>
<td>25</td>
<td>6</td>
</tr>
</tbody>
</table>
Robotic Mitral Repair (450 patients 2011 – 2017)
Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Intraoperative complications</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Going back on bypass:</td>
<td></td>
</tr>
<tr>
<td>• MV repair revision</td>
<td>18</td>
</tr>
<tr>
<td>• Aortic dissection</td>
<td>3</td>
</tr>
<tr>
<td>• Epicardial bleeding</td>
<td>2</td>
</tr>
<tr>
<td>• MV replacement</td>
<td>1</td>
</tr>
<tr>
<td>• RV dysfunction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Conversion to sternotomy:</td>
<td></td>
</tr>
<tr>
<td>• Aortic dissection</td>
<td>3</td>
</tr>
<tr>
<td>• MV repair revision</td>
<td>1</td>
</tr>
<tr>
<td>• MV replacement</td>
<td>1</td>
</tr>
<tr>
<td>• Epicardial bleeding</td>
<td>1</td>
</tr>
<tr>
<td>• MAC</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td>IABP or LVAD</td>
<td>0</td>
</tr>
</tbody>
</table>
# Robotic Mitral Repair (450 patients 2011 – 2017)

## In-hospital complications

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>12/450 (2.8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take back to OR:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleeding</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>MV repair revision</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Stenting left iliac dissection</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hepatic hematoma</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>RVAD</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>5/450 (1.2%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without residual</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>With residual</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>6/450 (1.4%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacemaker or AICD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>1/450 (0.2%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Late complications</th>
<th>n</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pericarditis</td>
<td>33</td>
<td>8%</td>
</tr>
<tr>
<td>Right pleural effusion</td>
<td>25</td>
<td>6%</td>
</tr>
<tr>
<td>Late MV repair revision</td>
<td>3</td>
<td>0.7%</td>
</tr>
<tr>
<td>Late MV replacement</td>
<td>1</td>
<td>0.2%</td>
</tr>
<tr>
<td>Transcatheter intervention</td>
<td>3</td>
<td>0.5%</td>
</tr>
<tr>
<td><strong>Late deaths:</strong></td>
<td></td>
<td>1.6%</td>
</tr>
<tr>
<td>- PE</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Brain hemorrhage</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Infection</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Stroke</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Robotic Mitral Repair (450 patients 2011 – 2017)

<table>
<thead>
<tr>
<th>Postoperative ventilation</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR extubation</td>
<td>316</td>
<td>70%</td>
</tr>
<tr>
<td>&lt;24h</td>
<td>123</td>
<td>28%</td>
</tr>
<tr>
<td>&gt;24h</td>
<td>11</td>
<td>2%</td>
</tr>
</tbody>
</table>
Robotic Mitral Repair (450 patients 2011 – 2017)

Length of stay
Av = 4.5 days
Robotic Mitral Repair (450 patients 2011 – 2017)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair rate in degenerative diseases</td>
<td>99.4%</td>
</tr>
<tr>
<td>Conversion to sternotony</td>
<td>1.5%</td>
</tr>
<tr>
<td>OR extubation</td>
<td>70%</td>
</tr>
<tr>
<td>Median LOS</td>
<td>3 days</td>
</tr>
<tr>
<td>In-hospital/30 Day mortality</td>
<td>0.2%</td>
</tr>
</tbody>
</table>
Robotic Mitral Repair (450 patients 2011 – 2017)

- Extubated in the OR
- One night stay in the CT Recovery Room
- Discharge home on postop Day 3
- ASA 162 mg for 3 months
- Amiodarone for 3 weeks
- Steroid taper for pericarditis prevention
THANK YOU