Surgical Treatment in Recurrent and Complicated Pectus Excavatum

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Conflict of Interest
• none

Adult patients
20 yo – Pre-Op

Adult patients
23 yo – 3yrs Post Repair

Results of Patients aged 18 and older
• Total number 424
• Primary 374
• Redo 50
• Mean length of stay
  - Primary 5.2 days
  - Redo 6.2 days

Patients 18 and older

Data collected through 12/31/2014
Results of Patients aged 18 and older

- 360 Primary Patients
- Number of bars
  - 1 bar only: 135 (37.5%)
  - 2 bars: 217 (60.3%)
  - 3 bars: 8 (2.2%)
- Complications
  - Pneumothorax (w/chest tube): 8 (2.2%)
  - Pleural Effusion w/drainage: 8 (2.2%)
  - Bar displacement: 29 (8.1%)
  - Wound Infection: 7 (1.9%)
  - Hemothorax: 1 (0.3%)

Data collected through 12/31/2014

Results of Patients aged 18-35 yrs

- Total number of primary patients: 360
- Total number w/bar removed: 280
  - Excellent result: 257 (91.8%)
  - Good result: 23 (8.2%)
  - Fair result: 1 (0.4%)
  - Poor result: 0
  - Failed: 1 (0.4%)

Data collected through 12/31/2014

Re-do Minimally Invasive Surgeries n=121

<table>
<thead>
<tr>
<th>Procedure</th>
<th>N</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed Ravitch</td>
<td>59</td>
<td>Pneumothorax w/tube: 14 (11.8%)</td>
</tr>
<tr>
<td>Failed Nuss</td>
<td>62</td>
<td>Late Hemothorax: 0 (0.0%)</td>
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<tr>
<td>Failed Leonard</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Median Age</td>
<td>17 yrs</td>
<td></td>
</tr>
<tr>
<td>Median CT index</td>
<td>4.8 (2.4-20)</td>
<td></td>
</tr>
<tr>
<td>Single pectus bar</td>
<td>55 (46.2%)</td>
<td></td>
</tr>
<tr>
<td>Double pectus bar</td>
<td>61 (51.3%)</td>
<td></td>
</tr>
<tr>
<td>Three pectus bar</td>
<td>3 (2.5%)</td>
<td></td>
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<tr>
<td>Initial Results:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent:</td>
<td>83 (69.7%)</td>
<td></td>
</tr>
<tr>
<td>Good:</td>
<td>35 (29.4%)</td>
<td></td>
</tr>
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<td></td>
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</tbody>
</table>

Bar Displacements: 7 (5.8%)
No stabilizer: 1 (14.3%)
Stabilizer: 6 (85.7%)
With PDS Sutures: 3 (42.9%)
Displacements requiring Revision: 7/7(100%)

Failed Ravitch procedures: 59
Failed Nuss procedures: 62
Failed Leonard procedures: 0
Median Age: 17 yrs
Median CT index: 4.8 (2.4-20)
Single pectus bar: 55 (46.2%)
Double pectus bar: 61 (51.3%)
Three pectus bar: 3 (2.5%)
Initial Results:
- Excellent: 83 (69.7%)
- Good: 35 (29.4%)
- Fair: 3 (2.5%)
- Failed: 8 (0.0%)

Data Collected through 12/31/2014

Statistics beginning with median age are based on 119 patients who consented.

Recurrent Pectus Excavatum

- After Nuss procedure should be rare
- Our series has a <1% recurrence
- Defined as deformity of sufficient severity that requires reoperation
- Majority in 1st 10 years
- Bar needs to be in place minimum of 2 years
- Complicated patients we leave bar in for 3 years

Data collected through 12/31/2014

Results of Redo Patients

- Total number of redo patients: 119
- Total number bar removed: 93
  - Excellent: 64 (68.8%)
  - Good: 27 (29.6%)
  - Fair: 3 (3.2%)
  - Poor: 0 (0.0%)

Data collected through 12/31/2014
Technical Issues Associated with Recurrence

- Nuss repair is good for both failed Ravitch and failed Nuss
- Our preoperative approach is similar for recurrent PE
- Since there is definite increased risk we feel all patients should have symptoms as well as a higher HI (>3.7)
- These are relative indications and each patient should be individualized

M.M. 18 yo Failed Ravitch

M.M. 23 y/o
18 mo Post bar removal/4.5 years Post Redo

M.M. 18 y/o – Failed Ravitch Procedure

Failed Ravitch

- Stiffer Chest with varying degrees of acquired thoracic chondrodystrophy
- 2 – 3 bars required
- Can be significant pleural adhesions
- There will be a physiologic and cosmetic improvement but to a lesser degree due to stiff chest
- Rib and sternal fractures can occur

Factors that will increase recurrence in a Nuss procedure

- Entry and exit sites lateral to top of pectus ridge
- Bending the bar with too much convexity
- Removing bar before 2 years
Failed Nuss Procedure

- Toxic intrathoracic adhesions
  - Vessel sealing devices a must
  - Prepare for extensive adhesiolysis/decortication
  - Routine chest tubes
- Any mechanism to lift sternum
- Flexible chest will lead to a better physiologic and cosmetic outcome

Contraindication to redo Nuss

- Patient with failed Ravitch who developed severe debilitating acquired thoracic chondrodystrophy
- Frozen chest with PFT’s < 30%
- Higher risk of vagal events
- Cosmetic and physiologic benefits have been negligible

Asymmetry

D.P. Age 16 – Pre-Op

Asymmetric Pectus Excavatum

D.P. – One Year Post Op
Asymmetric Pectus Excavatum

D.P. – One Year Post Op

Asymmetric Pectus Excavatum

D.P. One year after surgery

D.P. 1 year Post Bar Removal

Asymmetric Pectus Excavatum

JH Pre-op

Asymmetric Pectus Excavatum

JH Pre-op

CT Index of 30, Cardiac Compression and Displacement
A.B.

**History**
- Harrington Rods placed in 2001
- Ravitch repair in 2007 – 18 years old
- Stage Breast implants within first 3 months
- Metal strut in chest after 6 years post op Ravitch – was told by thoracic surgeon that it can stay permanently

A.B.

**Physical Exam**
- Recurrent Pectus Excavatum
- C/O Fatigue, LOE, SOB and Exercise intolerance
- Allergy to phenergan and No metal allergy

A.B.

- PFT’s
  - FVC - 48%
  - FEV\_1 - 54%
  - FEF\_25-75\% - 108%

- HI - 7.5

A.B.

- Cardiology
  - Echo: Normal; Trivial to mild tricuspid regurgitation
  - EKG: NSR
OR findings

- Toxic adhesions bilaterally
- Previous strut had not only migrated into thoracic cavity but entrapped the RML on the right and was burrowing into pericardium on left
- Bilateral ant thoracotomies to get strut out that was fused into sternum and large gap in rib spaces after elevation
- 11 hour case
A.B
Before After

7 months postop

23 months postop

Minimally Invasive Technique