Preliminary Results of Anatomic Lung Resection Utilizing Energy-Based Tissue and Vessel Coagulative Fusion Technology

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Financial Disclosure

none
Background

Pulmonary Vascular Division

Manual suture ligation

Mechanical staplers

- N=713 patients; 2567 vessels divided
- Mini-thoracotomy with stapled vascular division
- 5 intimal fractures, one avulsion, one mis-fire

Limitations:
- Bulky, floppy cartridges
- Mechanical failure
- Cost
Background

Energy-Based Tissue Fusion

- Bipolar tissue fusion – RFA energy
- Fuses collagen and elastin to create a permanent vascular seal
- Utilized extensively in intra-abdominal applications (splenectomy, nephrectomy, colectomy et al.)
- Role in the division of the pulmonary vasculature is not well-established
Energy-Based Tissue Fusion

- Harmonic Scalpel (Ethicon Endosurgery, Inc)
- Ultrasonic Shears (Covidien)
- EnSeal PTS (SurgRx)
- Gyrus PK (Gyrus Medical)
- BiClamp VIO300D (ERBE Elektromedizin GmbH)
- Ligasure (Valley Lab)
Harmonic Scalpel (Ethicon Endosurgery, Inc)

Ultrasonic Shears (Covidien)

EnSeal PTS (SurgRx)

Gyrus PK (Gyrus Medical)

BiClamp VIO300D (ERBE Elektromedizin GmbH)

Ligasure (Valley Lab)

- Only device approved by the FDA for the pulmonary vasculature
Energy-Based Tissue Fusion

Pre-clinical Studies

- Durable burst pressure strength (~300 mmHg)
- Safely divides vessels ≤ 7mm in live swine and sheep models

Human Studies

- Albanese et al. (2003) - Pediatric series (n=14) of lobectomy for prenatal diagnoses of CCAM or sequestration
- Meehan et al. (2008) - Robotic pulmonary resection in 6 children using the Ligasure and Gyrus PK
- Santini et al. (2006) - Pulmonary vessel division in 36 patients up to 7 mm in size

No significant morbidity or bleeding complications
Nothing Happens Unless You Try!
Ligasure

- The **Ligasure Impact™** device working jaw achieves a seal 36 mm in length and a variable width from tip to base of 3.3-4.7 mm.
- The jaw also has a 14-degree curvature, facilitating passage around vascular structures.

- The **LigaSure Atlas™** instrument has a uniform coagulating surface of 22 mm in length and 6 mm in width.
Objectives

- Evaluate the safety and efficacy of an electrical thermo-coagulative device in accomplishing segmental pulmonary vasculature fusion and division during anatomic pulmonary resection.

- Primary outcome variables included operative data, hospital course, complications, and mortality.
Methods

Energy-Based Tissue Fusion of the Pulmonary Vasculature

- n= 211 anatomic lung resections from 2008-2010
- Ligasure Impact in 12 cases (2 basilar dehiscences)
- Ligasure Atlas utilized in the remainder of cases
- For vessels > 7 mm, first order branches are taken
- Two energy applications per fusion
## Patient and Tumor Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Patients (n=211)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td>113 F, 98 M</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>64.8 (19-88)</td>
</tr>
<tr>
<td><strong>Histology</strong></td>
<td></td>
</tr>
<tr>
<td>Adeno</td>
<td>79 (55%)</td>
</tr>
<tr>
<td>Squamous</td>
<td>42 (28%)</td>
</tr>
<tr>
<td>Large Cell</td>
<td>9 (6%)</td>
</tr>
<tr>
<td>Other Lung CA</td>
<td>27 (4%)</td>
</tr>
<tr>
<td>Metastatic</td>
<td>24 (1%)</td>
</tr>
<tr>
<td>Benign</td>
<td>30 (6%)</td>
</tr>
<tr>
<td><strong>Tumor Size (cm)</strong></td>
<td>2.9 (0.5-14.3)</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
<td>125 VATS, 86 Open</td>
</tr>
</tbody>
</table>
## Perioperative Data

<table>
<thead>
<tr>
<th></th>
<th>Patients (n=211)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessels Divided</td>
<td></td>
</tr>
<tr>
<td>Arteries</td>
<td>476</td>
</tr>
<tr>
<td>Veins</td>
<td>229</td>
</tr>
<tr>
<td>Vessel Size (range)</td>
<td>6 mm (0.4-1.2)</td>
</tr>
<tr>
<td>Vascular Dehiscences</td>
<td>2 Venous, 0 Arterial</td>
</tr>
</tbody>
</table>
### Perioperative Data

<table>
<thead>
<tr>
<th></th>
<th>Patients (n=211)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative Time (min)</td>
<td>60</td>
</tr>
<tr>
<td>Estimated Blood Loss</td>
<td>100</td>
</tr>
<tr>
<td>CT Duration</td>
<td>5</td>
</tr>
<tr>
<td>Length of Stay (Median)</td>
<td>6</td>
</tr>
<tr>
<td>Complications</td>
<td>53 (25.1%)</td>
</tr>
<tr>
<td>Mortality (30 Day)</td>
<td>1 (0.5%)</td>
</tr>
</tbody>
</table>
Video – Left Upper Division

Pulmonary Vein
Video – Left Upper Division

Pulmonary Artery
Potential Advantages

Ease of use – Open and VATS

Low profile jaws facilitate instrument positioning

Excellent hemostasis during the course of resection

Can assist in development of the fissures

Minimal thermal spread (2-3 mm)

Reduced operative costs
Conclusions

- The bipolar tissue fusion system represents a safe and effective technique for the division of both pulmonary arteries and veins (ideally ≤ 7 mm) during anatomic lung resection.

- This technology constitutes a valid alternative to stapling methods in this setting.

- Larger prospective series with long-term results and cost/benefit analyses will be necessary to better define the utility of this technology during anatomic lung resection.
Thank You