Prevention and Management of Intraoperative Complications

Todd L. Demmy
Disclosures/
Questions
## Catastrophic Complications

<table>
<thead>
<tr>
<th>Age, Sex</th>
<th>Lobe</th>
<th>Complication</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>72, F</td>
<td>LUL</td>
<td>Transection of entire left PV trunk</td>
<td>Primary anastomosis</td>
</tr>
<tr>
<td>54, M</td>
<td>RLL</td>
<td>Bleeding PV retracting into pericardium</td>
<td>Primary repair</td>
</tr>
<tr>
<td>80, F</td>
<td>RUL</td>
<td>Bleeding PA</td>
<td>Pneumonectomy stage</td>
</tr>
<tr>
<td>50, F</td>
<td>LUL</td>
<td>Bleeding PA</td>
<td>Pneumonectomy (delayed)</td>
</tr>
<tr>
<td>72, M</td>
<td>RUL</td>
<td>Transection of PA distal to truncus</td>
<td>Primary anastomosis</td>
</tr>
<tr>
<td>46, F</td>
<td>RUL (RML)</td>
<td>Transection of main PA</td>
<td>Primary anastomosis</td>
</tr>
<tr>
<td>61, M</td>
<td>LUL</td>
<td>Transection main bronchus and main PA</td>
<td>Pneumonectomy</td>
</tr>
<tr>
<td>60, F</td>
<td>RLL</td>
<td>Transection of RML bronchus</td>
<td>Bilobectomy</td>
</tr>
<tr>
<td>58, M</td>
<td>RUL</td>
<td>Membranous injury</td>
<td>Primary repair</td>
</tr>
<tr>
<td>57, M</td>
<td>LUL wedge</td>
<td>Splenic bleeding</td>
<td>Splenectomy</td>
</tr>
<tr>
<td>73, F</td>
<td>RUL</td>
<td>Bleeding azygos/SVC</td>
<td>Primary repair</td>
</tr>
</tbody>
</table>

• Flores, J Thorac Cardiovasc Surg 2011;142:1412-7
Objectives

• Preparation/Organization
• Exposure/Retraction
• Oozing control
• Major Bleeding Prevention/Control
• Other Major Injuries
CT Angio Planning (1)

- 95.2% (139 of 146) of PA branches precisely identified.

CT Angio Planning
• Pick a Preferred... 

- Flores
- Roswell
- Duke
- McKenna posterior chest
- Swanson
- Walker (Edinburgh)

Masters MITS '2013
- Choose your Best Approach:
  - Posterior vs. anterior
  - Bronchus vs. Fissures
  - Vein vs. Artery first
  - Emulate open vs. different order
  - But know the others!

- But know the others!
General Troubleshooting Approaches for Preferred System

- Access incision optimal for tedious dissection?
- Document system for primary maneuvers
  - Visualization (change least)
  - Retraction/tissue control
  - Dissection/division
- Multiple uses same port?
Posterior Camera Views

Diagram:
- P
- Dissect
- Hold
- View

Image:
- B1-3
- BI

Masters MITS '2013
Objectives

- Preparation/Organization
- Exposure/Retraction
- Oozing control
- Major Bleeding prevention/Control
- Other Major Injuries
Basic Moves – “Access View”


Masters MITS '2013
Visualization Tools
5 mm Optimal For Sharing ports
VATS WEDGE Bronchoplasty

Visualization Tools
High Definition Optimal

• Endocameleon™
Retraction Tools

www.sontecinstruments.com

www.scanlaninternational.com

www.karlstorz.com

www.wexlersurgical.com
Importance of Low Profile and Angles

VATS 2-point pivot (3rd generation)

Pivot Point 1

Pivot Point 2

(4th generation)

Pivot Point 1
Importance of Low Profile and Angles
Diamond-Flex Retractor

- Cardinal Health
Realize™ “Goldfinger”

• Ethicon

• Gastric Band Dissector
Making Space - Surgeon

- CO2
- Vent Bullae
- Retraction/Pack/Restraint
- Release diaphragm
- Hand-Assist
Getting Diaphragm Out of Way

- Suture and bring out of camera port
- 5 mm retractor with or without holder
Follow the “Fs” when you are stuck- 1

• **Free** All Adhesions, All Lobes
• **Find** Somewhere else to work
  – Pleurae and lymphatic tissue
  – Divide more distally
• **Fissure Division** (also opens camera angles)
  – Partially (outside in)
  – Completely (blunt clamp technique)
Fissure Division Videos

Follow the “Fs” when you are stuck - 2

• **Flip** order of anatomical divisions (eg. Change to Fissure Last Technique)

• **Fill** the port/access incisions (“fers”)  
  – Traction – Countertraction to define anatomy (eg. “Two-fer” and vessel loops)

• **Fresh** planes (eg. Open pericardium)
Objectives

- Preparation/Organization
- Exposure/Retraction
- Oozing control
- Major Bleeding prevention/Control
- Other Major Injuries
Topical Oozing Control
Methods - Tissuelink
Cold Cautery - Aquamantys™
JK - Index Case 9/2011

- 71 yo female
- yT2N0 RLL Squamous Cell
- Induction chemo VATS resect Dec 2008
- R hilar recurrence 4/2009 rx by concurrent chemo/RT
Oozing Lung

- Make Space
- Cold Cautery
- View inferiorly
- Depress diaphragm
- Mass suture lung

2:28
Objectives

• Preparation/Organization
• Exposure/Retraction
• Oozing control
• Major Bleeding prevention/Control
• Other Major Injuries
Curve Tip Innovation

• Mayfield

Alternate Enbodiments

Demmy

Demmy
Curved Tip Cartridge for Thoracic Surgery

- Demmy & Mayfield, Ann Thorac Surg 2012;93:1280-1284
Low Profile TA Stapler & 5mm Vessel Sealing Technology
Low Profile Stapler

MicroCutter xChange™ 30

5 mm 80° Articulation

Scardica®

Masters MITS '2013
Low Profile TA Stapler - Resealing
Use of Leaders

• CHEST 1999; 116:450S–454S

Masters MITS '2013
Bleeding Control Algorithm

Vessel injury (n=26)

Compress by cotton stick or tissues

Exploring

PA branches (n=17)

Main PA or trunks
PV trunks
Major Vessel (Aorta, Azygos vein) (n=9)

Approach

Thoracoscopy (n=7)

Minithoracotomy (n=10) → failure

Thoracotomy (n=4)

Thoracotomy (n=9)

Closure

Sealant (n=5) → Stapler or Clip (n=2) → Thoracotomy (n=4) → Primary closure (n=9)

Primary closure (n=5)

Blood loss (ml)
188 ± 123
240 ± 171
1001 ± 794

Mean ± SD


Masters MITS '2013
## VATS PA Operations

<table>
<thead>
<tr>
<th>Ref</th>
<th>N</th>
<th>Deaths</th>
<th>Complications</th>
<th>EBL (ml)</th>
<th>Time</th>
<th>Hosp Stay</th>
<th>MAIN PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nakanishi, 2008</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>270</td>
<td>375</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Nakanishi, 2009</td>
<td>13</td>
<td>0</td>
<td>4</td>
<td>351</td>
<td>400</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Kamiyoshihara, 2011</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>210</td>
<td>180</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Kamiyoshihara, 2012</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>55/56</td>
<td>176/200</td>
<td>5 / 10</td>
<td></td>
</tr>
<tr>
<td>Mei, 2012</td>
<td>17</td>
<td>0</td>
<td>6</td>
<td>350</td>
<td>180</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Zhang, 2012</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>300</td>
<td>300</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>
Experimental PA Occlusion

- 30 Swine
- Custom Swan-Ganz pulmonary artery catheters
- 19mm, 2.5-3cm length balloon
- 0.030” optical fiber
- 5 displacements

Importance of Low Profile and Angles

D’Amico DeBakey

Chitwood Knot Pusher
PA control RU & RML Sleeve – Chitwood Knot Pusher
Methods - Bleeding Control
PA control Suffusion Experience

• \( N = 11 \)

• “off-label”
Methods-Bleeding Control
PA control

Methods-Bleeding Control
PA control

Methods-Bleeding Control
PA control


Masters MITS '2013
Methods-Bleeding Control

PA control

• Mei, Surg Endosc (2013) 27:530–537
Methods-Bleeding Control
PA control

• Mei, Surg Endosc (2013) 27:530–537
Methods - Bleeding Control

PA control


Masters MITS '2013
Methods-Bleeding Control

PA control

Methods-Bleeding Control
PA control

# Methods-Bleeding Control

PA control

- #1 Silk


Masters MITS '2013
Methods-Bleeding Control
PA control

• NK-Stapler
(Endopath ETS45-Flex No Knife NAW; Johnson & Johnson, Cincinnati, OH, USA)

Methods-Bleeding Control
PA control

Locking Clips

- Teleflex medical
- Conmed Reflex™
Thermal Sealing Technology

N=211 Lobes/Segments

• J Thorac Cardiovasc Surg 2010;140:1168-73

Masters MITS '2013
Thermal Sealing Technology

- Burst experiments from fresh lung cancer lobectomy specimens
  - 13 arteries < 5 mm
  - 12 arteries > 5 mm
- Clinical series
  - 84 lobectomy or segmentectomies
  - 203 pulmonary arteries divided.

Thermal Sealing Technology – Open Experiment

• Ligasure vs Suture
• 15 large and 15 small
  • Equal controls

• Lesser T, J Thorac Cardiovasc Surg 2013;145:1525-8
Thermal Sealing Technology – Open Experiment

• No bleeding but . . .

• Lesser T, J Thorac Cardiovasc Surg 2013;145:1525-8
RS - Index Case 6/2013

- 55 yo male
- Left lung occlusion
- Palliative XRT
- Induction Chemo
RS - Index Case 6/2013

- 55 yo male
- Left lung occlusion
- Palliative XRT
- Induction Chemo
PA Control

Attempt at LUL Sleeve

- Open Pericardium
- Third retractor
- PA control - proximal
- Small anvil stapler/Ligasure™
- Divide more distal
- Failed Ligasure™
- Repair PA
- PA control - Distal

05:29
Azygous Vein Injury

- Sponge stick control
- Stapler control proximal
- Suture control distal
Sequestration

• Liu, J Thorac Cardiovasc Surg 2013; -:1-5)
LIMA Dissection

Masters MITS '2013
LIMA Dissection

MB - Index Case 7/2013

- 82 yo male
- 7 stents, LIMA LAD
- DLCO 75%
- FEV-1 127%
- LUL Squam
MB - Index Case 7/2013

- 82 yo male
- 7 stents, LIMA LAD
- DLCO 75%
- FEV-1 127%
- LUL Squam
MB - Index Case 7/2013

- 82 yo male
- 7 stents, LIMA LAD
- DLCO 75%
- FEV-1 127%
- RML Adeno VATS resection 6/2013
MB - Index Case 7/2013

- 82 yo male
- 7 stents, LIMA LAD
- DLCO 75%
- FEV-1 127%
- Progression of LUL lesion
MB - Index Case 7/2013

- 82 yo male
- 7 stents, LIMA LAD
- DLCO 75%
- FEV-1 127%
- Progression of LUL lesion
Anchor™ Tissue Pouch
Acute Innovations Biobridge™

- 18 holes
- Maintains strength during healing process (6 months)
- Metabolizes in body within 24 months

100 mm long
15 mm wide
Lung Stuck to Median Sternotomy – LIMA Dissection

- Adhesions
- Oozing
- Dissect IMA
- Tunnel for Stapler
- Free Lung from Sternum
- Debride devitalized lung
- Divide Vein/Fissures/PA branch/Bronchus
- Main PA control/Remaining branches/Bag
Objectives

• Preparation/Organization
• Exposure/Retraction
• Oozing control
• Major Bleeding prevention/Control
• Other Major Injuries
Visualization Tools
Keeping Lens Clean

- Internal fluid jet
- Gauze wick in port
- Gas Jet on oversheath