Advances in Minimally Invasive Surgery for Pancreatobiliary Disease: Is Less More?

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Director, Minimally Invasive Hepatopancreatobiliary Surgery

Multidisciplinary Management of Pancreatic Cancer Symposium
Friday, February 2, 2018
No Disclosures
<table>
<thead>
<tr>
<th>Minimally invasive approach for:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liver</strong></td>
</tr>
<tr>
<td>Liver Cancer</td>
</tr>
<tr>
<td>Colorectal Liver metastasis</td>
</tr>
<tr>
<td>Primary liver cancer</td>
</tr>
<tr>
<td>Benign liver cysts and tumors</td>
</tr>
<tr>
<td><strong>Stomach and Esophagus</strong></td>
</tr>
<tr>
<td>Stomach cancer</td>
</tr>
<tr>
<td>Gastrointestinal Stromal Tumor (GIST)</td>
</tr>
<tr>
<td>Esophageal cancer</td>
</tr>
<tr>
<td><strong>Pancreas</strong></td>
</tr>
<tr>
<td>Pancreas/Periampullary cancer</td>
</tr>
<tr>
<td>Neuroendocrine</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
</tr>
<tr>
<td>Cystic lesions of the pancreas</td>
</tr>
<tr>
<td>Intraductal Papillary Mucinous</td>
</tr>
<tr>
<td>Neoplasm (IPMN)</td>
</tr>
<tr>
<td>Acute and chronic pancreatitis</td>
</tr>
<tr>
<td>Pancreatic pseudocyst</td>
</tr>
<tr>
<td><strong>Gallbladder and Bile ducts</strong></td>
</tr>
<tr>
<td>Bile duct cancer</td>
</tr>
<tr>
<td>Bile duct stricture</td>
</tr>
<tr>
<td>Bile duct injury</td>
</tr>
<tr>
<td>Choledochal cyst resection</td>
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</tbody>
</table>
Minimally Invasive Hepatopancreatobiliary Surgery Program

- Minimally-invasive (laparoscopic and robotic) approaches for liver, pancreatic and upper GI surgery
- Multi-disciplinary treatment approach through Tumor Boards for Gastrointestinal, Pancreatic, and Liver cancer
- Integrative therapy including surgical resection, radiofrequency ablation, chemotherapy, radiation, chemoembolization and radioembolization
Benefits of Minimally Invasive Surgery

- Less post-operative pain
- Less post-operative ileus
- Preserved immune function
- Decreased stress response
- Decreased complications?
- Shorter hospital stay
- Quicker return to activity/function
- Improved cosmesis
- Increased patient compliance
Drawbacks

- Learning curve
- Increased operative time
- Increased cost
- ? Risk
- ? Malignancy

- Extent of resection
- Adequate surgical margins
- Lymph node basin dissection
- Port site recurrence
Requirements for Laparoscopic Pancreatic Surgery

• Understanding of pancreatic disease (natural history, indications)
• Experience in open pancreatic surgery
• Advanced laparoscopic skill sets
• Intracorporeal suturing
• Ability to control bleeding
Laparoscopic/Robotic Pancreatic Resections

Enucleation  Distal Panc + Spleen

Pancreaticoduodenectomy
Indications for Laparoscopic Pancreatic Resections

- Neuroendocrine tumors
- Cystic neoplasms
- IPMN
- Adenocarcinoma
Laparoscopic Enucleation
Laparoscopic Pancreatic Enucleation

- Neuroendocrine tumors and benign cystic tumors
- No involvement of main pancreatic duct
- Associated with
  - Reduced operative time
  - Decreased blood loss
  - Similar complications to open
  - Preserved pancreatic function
## Laparoscopic Pancreatic Enucleation

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>N</th>
<th>Op time</th>
<th>Comp</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marbut</td>
<td>2005</td>
<td>21</td>
<td>120 min</td>
<td>24%</td>
<td>7 days</td>
</tr>
<tr>
<td>Fernandez-Cruz</td>
<td>2005</td>
<td>7</td>
<td>180 min</td>
<td>42%</td>
<td>5 days</td>
</tr>
<tr>
<td>Edwin</td>
<td>2004</td>
<td>6</td>
<td>120 min</td>
<td>-</td>
<td>5.5 days</td>
</tr>
<tr>
<td>Berends</td>
<td>2000</td>
<td>5</td>
<td>180 min</td>
<td>40%</td>
<td>7.0 days</td>
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</table>
Laparoscopic Distal Pancreatic Resections

- Splenic vessel preserving distal pancreatectomy
- Splenic preserving distal pancreatectomy without splenic vessel preservation (Warshaw technique)
- Distal pancreatectomy with splenectomy
Laparoscopic vs. Open Distal Pancreatectomy

- Retrospective multicenter analysis
- Eight academic medical centers in the US
- 667 cases at 8 centers over 5 years
  - 46% Malignant Histology
  - 54% Benign Histology

Kooby, et al. 2010
# Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>OpenDP (N=508)</th>
<th>LapDP (N=159)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Op time (min)</td>
<td>226±101</td>
<td>232±99</td>
<td>NS 0.58</td>
</tr>
<tr>
<td>Positive margin</td>
<td>41 (8%)</td>
<td>10 (6%)</td>
<td>NS 0.61</td>
</tr>
<tr>
<td>Spleen preserved</td>
<td>50 (10%)</td>
<td>50 (31%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Blood loss (cc)</td>
<td>712±915</td>
<td>371±526</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>9.2±6.0</td>
<td>5.9±3.7</td>
<td>&lt;0.001</td>
</tr>
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</table>
## Complications

<table>
<thead>
<tr>
<th>Variable</th>
<th>OLP (N=200)</th>
<th>LLP (N=142)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any complication</td>
<td>113 (57%)</td>
<td>57 (40%)</td>
<td>0.003</td>
</tr>
<tr>
<td>Major complication</td>
<td>33 (17%)</td>
<td>14 (10%)</td>
<td>NS 0.08</td>
</tr>
<tr>
<td>Wound infection</td>
<td>29 (15%)</td>
<td>7 (5%)</td>
<td>0.004</td>
</tr>
<tr>
<td>Any fistula</td>
<td>64 (32%)</td>
<td>37 (26%)</td>
<td>NS 0.28</td>
</tr>
<tr>
<td>Significant fistula**</td>
<td>36 (18%)</td>
<td>16 (11%)</td>
<td>NS 0.10</td>
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</tbody>
</table>
Laparoscopic distal pancreatectomy is safe and feasible and is associated with:

- Decreased blood loss
- Decreased complication rate
- Decreased hospital length of stay
- Similar oncologic results: margin, nodes, survival

Has become standard of care for benign and malignant disease of the distal pancreas
Distal Pancreatectomy
Limitations for laparoscopic pancreas surgery:

• Must have highly developed open pancreas resection skills

• Must have highly developed laparoscopic skills
  – Knot tying, suturing

• Reduced freedom of movement, particularly in the bony rib cage
  – Reduced movement of instruments
  – Fixed pivot point
Laparoscopic Suturing
Robotic surgery would allow for:

- More natural translation of hand motion to the instrument tip movement
- Instruments have a “wristed” motion with a 360-degree range of motion
- Visualization in 3D
- Tremor filtering
- Ergonomically ideal operating position
Robotic Cancer Surgery

- The surgical robot provides benefits for precise surgery required in limited spaces
  - Upper abdomen, pelvis, mediastinum
- “Zoomed in camera control” allows for visualization of fine structures of the pancreas
- Minimal intraoperative manipulation of the tumor mass, resulting in less trauma
- Suturing of fine structures in small spaces
Robotic Distal Pancreatectomy
Robotic Puestow
Cons: Robotic Pancreatectomy

- High cost of disposables, longer operative times
- Lack of tactile sense
- Difficulty in converting to open surgery
- Instrumentation is not optimized
- Often will require second surgeon at bedside with robotic and laparoscopic skills
- Lack of world experience (small case series, no longterm followup)
- No clear benefit over laparoscopic approach
  - More incisions, longer operative time
Minimally Invasive Whipple Procedure
Why hasn’t laparoscopic/robotic Whipple been widely adopted?

• Steep learning curve:
  • complex operation near large vessels
  • multiple anastomoses

• Resource utilization issue:
  • Need for 2\textsuperscript{nd} surgeon
  • Long operative times

• Long length of stay

• Cost increase of $7000, less if LOS decreases

• Benefit over open procedure debatable
# Laparoscopic Pancreaticoduodenectomy

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>N</th>
<th>Conv (%)</th>
<th>Op Time (Min)</th>
<th>Compl (%)</th>
<th>LOS (days)</th>
<th>Panc Can</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gagner</td>
<td>1997</td>
<td>10</td>
<td>40</td>
<td>510</td>
<td>30</td>
<td>22.3</td>
<td>4</td>
</tr>
<tr>
<td>Staudacher</td>
<td>2005</td>
<td>7</td>
<td>43</td>
<td>416</td>
<td>-</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Dulucq</td>
<td>2006</td>
<td>25</td>
<td>12</td>
<td>287</td>
<td>32</td>
<td>16.2</td>
<td>11</td>
</tr>
<tr>
<td>Zhou</td>
<td>2011</td>
<td>8</td>
<td>0</td>
<td>718 (robotic)</td>
<td>25</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Zeh</td>
<td>2012</td>
<td>50</td>
<td>8</td>
<td>568 (robotic)</td>
<td>30</td>
<td>10</td>
<td>37</td>
</tr>
</tbody>
</table>
Highly selected patient population

- Non-obese patients
- Minimal comorbidities
- Small tumors (< 3 cm)
- No evidence of vascular involvement
- No lymph node involvement
- No inflammation

• Oncologic outcome similar to open experience (Margin, survival)
Conclusion
Minimally invasive pancreas surgery:

- Laparoscopic and robotic enucleation and distal pancreatectomy appear to be safe and efficacious while being less invasive.
- Laparoscopic distal pancreatectomy has become standard of care for benign and malignant tumors of the distal pancreas.
- Laparoscopic and robotic Whipple is a less beneficial approach, but this may change as technology and experience improves.
Thank you