Robotic approach in pancreatic surgery

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• Pancreatic surgery—one of the most challenging and complex procedures in general surgery

• Several conditions must be accomplished: wide incision, fine dissection, correct interpretation of the anatomy, safe reconstruction

• Until recently—pancreatic surgery belonged exclusively to open surgery
Minimally invasive techniques have revolutionized the field of general surgery over the few last decades.

Despite its advantages, in complex procedures such as pancreatic surgery, laparoscopy has not achieved a high penetration rate because of its steep learning curve, its relatively high conversion rate and technical challenges.
Robotic technology allows the surgeon to perform challenging tasks and procedures that are technically difficult in laparoscopic surgery.

Robotic surgery offers the opportunity to combine the advantages of both minimally invasive and open surgery.
Advantages of the robotic system -> an easier minimally invasive operation

- The high definition 3D view allows identification of the anatomic structures and dissection along blood vessels
- The Endowrist instruments facilitate the dissection and reconstructions
- The camera is held and moved by the first surgeon
- A fourth robotic arm is available as a fixed retractor and useful especially in obtaining adequate exposure; it is always manipulated by the surgeon

increase surgeon comfort and decrease fatigue
Fundeni Clinical Institute

- High volume center in pancreatic surgery: ~100 open PD/year, 35 open DP/year
  - 750 open PD in the last ten years
  - 400 open DP

- Extensive experience in robotic surgery
  January 2008 – September 2014
  More than 850 cases of complex robotic procedures
More than 6 years experience in robotic surgery
889 robotic procedures
January 2008 - September 2014

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracic surgery</td>
<td>88</td>
</tr>
<tr>
<td>(thymectomy, esophagectomy, intrathoracic goiter)</td>
<td></td>
</tr>
<tr>
<td>Esogastric surgery</td>
<td>208</td>
</tr>
<tr>
<td>(benign esogastric junction surgery, radical and palliative gastric cancer surgery)</td>
<td></td>
</tr>
<tr>
<td>Splenic surgery</td>
<td>89</td>
</tr>
<tr>
<td>(total and partial splenectomies)</td>
<td></td>
</tr>
<tr>
<td>Hepatobiliarypancreatic surgery</td>
<td>64</td>
</tr>
<tr>
<td>(hepatectomies, wedge resections, pancreaticoduodenectomies, enucleations, distal pancreatectomies, biliary-digestive diversions)</td>
<td></td>
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<tr>
<td>Adrenal gland surgery</td>
<td>37</td>
</tr>
<tr>
<td>Colorectal surgery</td>
<td>235</td>
</tr>
<tr>
<td>(right/left colectomies, rectal resections)</td>
<td></td>
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<tr>
<td>Gynecologic surgery</td>
<td>166</td>
</tr>
<tr>
<td>(Total/ radical hysterectomies w/ pelvic lymphadenectomy, anexectomies)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>889</td>
</tr>
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</table>
Experience in robotic pancreatic surgery
Step 1-enucleation

After performing a significant number of cases via robotic approach we decided to start pancreatic resections.

At the beginning we decided to perform easier cases.

4 robotic enucleation for insulinoma
-one case pancreatic leakage-conservative treatment
Robotic enucleation of insulinoma
Surgical Technique

- Case report

- 48 years-old M
- Investigated for severe hypoglycemia

- History:
  - severe hypertension
Trocar placement
Robotic enucleation of insulinoma
Surgical Technique
**Experience in robotic pancreatic surgery**

**Step 2**

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Surgical procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreatic papillary adenocarcinoma</td>
<td>1 distal splenopancreatectomy</td>
</tr>
<tr>
<td>Neuroendocrine</td>
<td>2 distal spleen preserving pancreatectomies</td>
</tr>
<tr>
<td>Chronic Pancreatitis</td>
<td>1 distal spleen preserving pancreatectomy</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>1 distal splenopancreatectomy</td>
</tr>
<tr>
<td>Pancreatic serous cystadenoma</td>
<td>4 distal splenopancreatectomies</td>
</tr>
<tr>
<td></td>
<td>1 distal spleen preserving pancreatectomy</td>
</tr>
</tbody>
</table>

**TOTAL =** 10
Robotic distal pancreatectomy-surgical technique

- Case report

42 years-old female
Investigated for pain in the right hypocondrium
CT exam – tumor in the body and tail of the pancreas- cystadenocarcinoma?
CEA, CA 19-9 – normal range
Normal upper and lower endoscopy
CT exam
Robotic distal pancreatectomy-surgical technique

Gastrocolic dissection

Entrance into the Lesser sac
Postoperative aspect
The specimen
Perioperative results- distal pancreatectomy

- **Operative time-70-180 min- mean 120 min**
- **Estimated blood loss-50-370 ml- mean 150 ml**
- **Conversions-none**
- **Reoperations-none**
- **Length of stay-7-22 days- mean 13 days**
# Morbidity after robotic distal pancreatectomies

<table>
<thead>
<tr>
<th>COMPLICATION</th>
<th>No/management</th>
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</thead>
<tbody>
<tr>
<td>Pancreatic leakage</td>
<td>3 – conservative treatment</td>
</tr>
<tr>
<td>Pancreatic abscess</td>
<td>1 – conservative treatment - CT guided percutaneous drainage</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1</td>
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</tbody>
</table>
Experience in robotic pancreatic surgery

Step 3

- One robotic central pancreatectomy – indication: neuroendocrine tumor
Experience in robotic pancreatic surgery

Step 4

Pancreaticoduodenectomy

- 4 ductal carcinoma of the pancreatic head
- 1 periampullary adenocarcinoma
- 1 carcinoma of the distal bile duct
- 1 neuroendocrine tumor of the pancreatic head
Robotic pancreaticoduodenectomy

- At the beginning: **Robotic pancreaticoduodenectomy with mini-laparotomy reconstruction-1 case**

- 4 cases **full robotic procedure**

- 2 cases **converted** to open surgery for intraoperative bleeding (1 case –pancreatic tumor with mesenteric vein invasion undiagnosed at preop imaging exams)
Robotic pancreaticoduodenectomy surgical technique

- Case report

70 years-old female
Investigated for jaundice
Cholecistectomy via a subcostal incision 20 years ago
MRI exam and ERCP- malignant stenosis of distal bile duct
CEA, CA 19-9 – normal range
Normal upper and lower endoscopy
Robotic pylorus preserving pancreaticoduodenectomy
The specimen was extracted via a small incision in the left hypochondrium.
The specimen:
Perioperative results-robotic pancreaticoduodenectomy

- Operative time- 280-600 min- mean 450min
- Estimated blood loss-70-700ml- mean 350ml
- Conversions- 2 (in cases of intraoperative bleeding-conversion to open surgery in 20 sec.)
- Reoperations-none
- Length of stay- 8-40 days- mean 21,6 days
Morbidity in robotic pancreaticoduodenectomy

- 1 grade A pancreatic leakage – conservative treatment
- 1 biliary fistula- conservative treatment
Initial experience in minimally invasive pancreatic surgery

- most pancreatic processes approached in a minimally invasive fashion are small benign or low-grade malignant lesions, located within the body or the tail, or are inflammatory in nature.
- enucleoresection of islet cell tumors

-> simple laparoscopic procedure
Procedures without reconstructions are preferred in laparoscopic approach: enucleations or distal pancreatectomies.
Laparoscopic distal pancreatectomy

Adoption rate of the technique -> higher then LPD

Resection of the left pancreas for benign or endocrine lesions has been universally adopted as a routine technique over the last few years. As technology and training in minimally invasive surgery improve, more surgeons are performing laparoscopic left pancreatectomy.
What is the reason to perform robotic distal pancreatectomy?

- Better identification of branches of the splenic vein and artery in spleen-preserving DP
- Easier sutures on the pancreatic stump

Conventional laparoscopic and robot-assisted spleen-preserving pancreatectomy: does da Vinci have clinical advantages?
Robotic central pancreatectomy

- Central pancreatectomy is a rare surgical procedure, even in open surgery.
- Few cases reported

Dissection of the pancreatic body is greatly facilitated by the use of the robotic system as well as reconstruction.

Robotic central pancreatectomy with stented pancreaticogastrostomy: operative details
Minimally invasive pancreaticoduodenectomy

- First laparoscopic pancreaticoduodenectomy-1994 by Gagner and Pomp
- The slow progression of the techniques is related to the technical challenges:
  - removal of the uncinate process
  - the reconstruction of both biliary and pancreatic ducts, often< 5 mm

LPD- procedure performed only in selected centers, few case reports, small series reported
Robotic pancreaticoduodenectomy

Robotic surgery has the potential to change this trend
Adherence to the method is high, lower learning curve

The first robotic pancreaticoduodenectomy was published in 2003 by Giulianotti et al.
### Current status of minimally invasive pancreaticoduodenectomy worldwide

<table>
<thead>
<tr>
<th>Author</th>
<th>Years</th>
<th>No. patients</th>
<th>Technique</th>
<th>OR time (min)</th>
<th>EBL (mL)</th>
<th>No. lymph nodes</th>
<th>R0 Resection (%)</th>
<th>DGE</th>
<th>Pancreatic fistula (%)</th>
<th>Length of stay (days)</th>
<th>Morbidity (%)</th>
<th>Mortality (%)</th>
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<tbody>
<tr>
<td>Palanivelu et al. [17]</td>
<td>2009</td>
<td>75</td>
<td>Lap</td>
<td>357</td>
<td>74</td>
<td>14</td>
<td>97.4</td>
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<td>8.2</td>
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<tr>
<td>Kendrick et al. [18]</td>
<td>2010</td>
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<td>Lap</td>
<td>368</td>
<td>240</td>
<td>15</td>
<td>89</td>
<td>15%</td>
<td>18</td>
<td>7</td>
<td>42</td>
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<td>Giulianotti et al. [11]</td>
<td>2010</td>
<td>60</td>
<td>Robotic</td>
<td>421</td>
<td>394</td>
<td>18</td>
<td>91.70</td>
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<tr>
<td>Zeh et al. [19]</td>
<td>2012</td>
<td>50</td>
<td>Robotic</td>
<td>568</td>
<td>350</td>
<td>18</td>
<td>89</td>
<td>20%</td>
<td>12</td>
<td>10</td>
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<td>Chalikonda et al. [20]</td>
<td>2012</td>
<td>30</td>
<td>Lap/Rob</td>
<td>476</td>
<td>485</td>
<td>13</td>
<td>100</td>
<td>3%</td>
<td>7</td>
<td>10</td>
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<tr>
<td>Kim et al. [21]</td>
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<td>100</td>
<td>Lap</td>
<td>487</td>
<td>NR</td>
<td>13</td>
<td>100</td>
<td>2%</td>
<td>6</td>
<td>11.5</td>
<td>25</td>
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<td>Asbun et al. [10]</td>
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<td>Lap</td>
<td>541</td>
<td>195</td>
<td>23</td>
<td>94.90</td>
<td>11%</td>
<td>1</td>
<td>8</td>
<td>46</td>
<td>6</td>
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</table>

Robotic assistance in pancreatic surgery

Several steps of the PD procedure are clearly improved with robotic surgery:

- Dissection of the pancreatic gland
- Lymph node dissection
- Retropancreatic tunnel
- Dissection and resection of the uncinate process
- Reconstructions, especially in patients with small pancreatic ducts

Robot-assisted laparoscopic pancreatic surgery: single-surgeon experience.
Surg Endosc. 2010 Jul;24(7)
What is the reason to perform robotic pancreaticoduodenectomy?

- not a short hospital stay and improved cosmesis!

......but better outcomes:

Several advantages of robotic technology can result in improved outcomes: a R0 resection and a low perioperative complications rate-factors affecting long term survival.

Robotic pancreatic resections

Safe and feasible
Short learning curve-operative time rapidly decrease
Low blood loss
Low conversion rate
Postoperative stay — similar with open surgery
Robotic approach does not increase morbidity!
Conclusion

- Technical advances marked, among others, the field of general surgery. Complex operations –like pancreatic procedures—which until few years ago were referred to open surgery alone can nowadays be performed safely via robotic approach.

- The advantages of the robotic system result in:
  - Better dissection of the portal and splenic vein
  - Better dissection and resection of the uncinate process
  - Easier reconstructions, especially in patients with small pancreatic ducts
  - Higher adoption rate compared to laparoscopy in difficult procedures
Thank you!