The Case For Robotic Surgery

Yale Liver Cancer Symposium 2019: The Changing Landscape of Hepatocellular Carcinoma (HCC) Management

Session 2: The Patient With Early Stage Disease: What is the First Line Therapy?

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~ There is no commercial support for this presentation.

~ There are no conflicts of interest.
Robotic Surgery the Early Years

- Concept of telesurgery first explored by NASA, first remote surgery (gallbladder) performed 2001 (NYC to Paris)
- First surgical robot PUMA 560 used in 1985 for a stereotactic brain biopsy
- In 1988 the PROBOT used to perform a TURP
- In 1992 the ROBODOC used to prepare a femur
- By 1990’s 3 platforms emerging: Da Vinci, AESOP, Zeus
Adoption of Laparoscopic Liver Surgery

• Numerous studies support the use of MIS in liver resection
  – Less intraoperative EBL
  – Fewer complications
  – Less post op pain and lower LOS
  – R0 and 5 year outcomes comparable in HCC and CRC

• According to recent International Concensus on Lap Liver Resection
  – MIS minor liver resection is now standard of care
  – Major hepatectomy performed via MIS remains an innovative procedure

• Major Risks
  – Inherent risk of major bleeding during parenchymal transection or hilar transection
Advantages of Robotic Liver Surgery

• Improved 3-D visualization, Magnification
• Stable retraction (third and fourth arms)
• Fine dissection
• Parenchymal suturing
• Biliary anastomoses
• Decreased surgeon fatigue
Robotic Surgery Progression

Robotic Surgery Progression
Current Applications of the Technology

- Urology
- Ob/Gyn
- Txp
- General
- Cardiac
- ENT
- HPB
- Thoracic
- CRS
Intuitive Surgical – Da Vinci Robotics
Current Applications of the Technology

Platforms
- Da Vinci
  - Si
  - Xi
  - X
  - Single Port
  - Accessories

Photos obtained at www.intuitive.com
All-inclusive simulation program with SimNow

Get more out of your simulator program with SimNow®. Get unrestricted access to a growing library of virtual reality surgical procedures and skills trainings along with the latest hardware and software updates.

Skills training using virtual instruments
Refine individual techniques by progressing through a sequence of realistic exercises—novice to advanced levels.

Guided or freehand procedures simulation
Practice procedure-specific skills exercises from third party collaborators on detailed and responsive anatomical VR models.

Remote access to real-time metrics and management tools
Manage your SimNow program and your users by tracking performance and optimizing learning.
Robotics in Hepatobiliary Surgery

Liver
- Cyst Fenestration
- Major Lobectomies, Superior and Posterior Tumor Resections
- Favorable approach in cirrhotics

Biliary
- Cholecystectomy-induced bile duct injury repairs/reconstructions
- CBD exploration
- Roux-en-Y Hepaticojejunostomy
Robotic Liver Resection: A Case-Matched Comparison

T. Peter Kingham¹ · Universe Leung¹ · Deborah Kuk² · Mithat Gönen² · Michael I. D’Angelica¹ · Peter J. Allen¹ · Ronald P. DeMatteo¹ · Vincent P. Laudone¹ ·

Table 5 Comparisons of robotic versus laparoscopic liver resections

<table>
<thead>
<tr>
<th>Authors</th>
<th>Laparoscopic</th>
<th>Robotic</th>
<th>Clinically relevant differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spampinato [14]</td>
<td>25</td>
<td>25</td>
<td>(1) Pringle 32 % lap vs. 0 % robot ($p = 0.004$)</td>
</tr>
<tr>
<td>Troisi [13]</td>
<td>223</td>
<td>40</td>
<td>(1) Parenchymal preservation 55 % robot versus 34 % lap ($p = 0.01$)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(2) Conversion 20 % robot versus 8 % lap ($p = 0.034$)</td>
</tr>
<tr>
<td>Berber [15]</td>
<td>23</td>
<td>9</td>
<td>No differences</td>
</tr>
<tr>
<td>Tranchart [16]</td>
<td>28</td>
<td>28</td>
<td>(1) Superior and posterior segments resections 50 % robot versus 11 % lap ($p = 0.003$)</td>
</tr>
<tr>
<td>Tsung [12]</td>
<td>114</td>
<td>57</td>
<td>(1) OR time 253 min robot versus 199 min lap ($p &lt; 0.05$)</td>
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<tr>
<td></td>
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<td>(2) EBL minor resections 285 mL robot versus 50 mL lap ($p = 0.011$)</td>
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lap laparoscopic, robot robotic, OR operating room, EBL estimated blood loss
Robotics in Hepatobiliary Surgery

Robotic Surgery of the Liver and Biliary Tract

Francesco Guerra, MD, Michele Di Marino, MD, and Andrea Coratti, MD

• Overall data shows noninferiority of robotic system to conventional open and laparoscopic surgery
• Steep learning curve, but less so than laparoscopy
• Possible advantage over laparoscopy for superior & posterior tumors
• Liver resection studies show trends for decreased length of stay and increased operative times, with comparable morbidity, mortality, costs, blood loss and oncologic outcomes
• Cholecystectomy not cost effective, but complex biliary procedures such as redo bilioenteric anastomoses, choledochal cyst resection, iatrogenic CBD injury management and CBD exploration valid and cost effective
DaVinci X and Xi
Template For Robotic Liver Surgery

PORT PLACEMENT
1. Insufflate to the appropriate level.
2. Place initial endoscope port 3 in the umbilicus.
3. Place port 4 left lateral, 8 cm away from port 3.
4. Place ports 2 and 1 right lateral to port 3, 8 cm away from each other.
5. Place assistant port left lateral, at least 7 cm from port 4.

NOTE
Ports may be shifted according to habitus of the patient or the position of the internal anatomy. da Vinci port distance should range between 6–10 cm.

Straight line port placement enables access to complete upper abdominal workspace if required.

* Ports 1 and 2 may be repurposed as an EndoWrist® Stapler port.

† To aid in reach when using Harmonic ACE®, consider placing port 2 or 4 approximately 4 cm superior.
Patient Positioning

**GENERAL SURGERY — UPPER ABDOMINAL**

**TABLE PREPARATION**
- Reverse Trendelenburg: >15°
- Tilt: >5° Left
- Height: As low as possible

**SYSTEM DEPLOYMENT**
- Deploy for Docking
  - Select Anatomy: Upper Abdominal
  - Select Cart Location: Patient Right
  - Hold down "Deploy for Docking"
- Drive Cart to Endoscope Port
- Target
  - Superior right hypochondriac region
- Perform Manual Arm Adjustments
Robotics in Hepatobiliary Surgery

- Example of a caudate lobe resection
  - Benign adenoma 8.5 x 5.5 cm
  - Extraction site ~4 cm
  - LOS 3 days
Hepatic Adenoma
Cirrhotic with HCC
Current Applications of the Technology

Review of emerging surgical robotic technology

Brian S. Peters¹ · Priscila R. Armijo¹ · Crystal Krause¹ · Songita A. Choudhury¹ · Dmitry Oleynikov¹

https://doi.org/10.1007/s00464-018-6079-2

“Results A number of FDA-approved devices and platforms for robotic surgery were reviewed, including the da Vinci Surgical System, Sensei X Robotic Catheter System, FreeHand 1.2, invendoscopy E200 system, Flex® Robotic System, Senhance, ARES, the Single-Port Instrument Delivery Extended Research (SPIDER), and the NeoGuide Colonoscope. Additionally, platforms were reviewed which have not yet obtained FDA approval including MiroSurge, ViaCath System, SPORT™ Surgical System, SurgiBot, Versius Robotic System, Master and Slave Transluminal Endoscopic Robot, Verb Surgical, Miniature In Vivo Robot, and the Einstein Surgical Robot.”
Current Assessment of the Technology

Advantages of the robotic assisted approach:
• 3 dimensional magnified operational view
• Improved surgeon ergonomics
• Surgical dexterity resembling that of open surgery
• Enables delicate dissection
• Precise intracorporal suturing
• Elimination of tremor
• Access to regions of the body difficult to visualize open

Drawbacks:
• Time
• Money
• Lack of haptic feedback
Thank You!