The Role of Robotics in Urologic Surgery

~ Paul D. Maroni, MD

Objectives

- Review history of robotics in surgery/urology
- Identify areas where robotic surgery can be useful.
- Avoid pitfalls of robotic surgery.
- Learn a responsible way to integrate into your practice.

Brief history of robotic surgery

- “robot” coined by Karel Capek in 1921 from Czech word robota meaning forced labor
- 1985 – PUMA 560 used for brain biopsy
- 1987 – first robotic gall bladder removal
- 1988 – PROBOT for TURP
- Late 1980s – ROBODOC first FDA approved for hip surgery
- Late 1980s – NASA and US Army developed systems
Brief history of robotic surgery

- 1993 – AESOP approved for surgery
- 1997 – daVinci begins use
- 1998 – ZEUS first fully robotic surgery (Computer Motion)
- 2000 – daVinci approved by FDA (Intuitive Surgical, Inc)
- 2003 – Computer Motion merged with Intuitive Surgical, Inc.

Adoption of robotic prostatectomy

Market estimate

Adapted from Hu et al.
Adoption of robotic hysterectomy
Market estimate

Gold or Bubble Gum

- Winners
  - Early adopters
  - Intuitive Surgical, Inc./stockholders
  - Late patients (?)
- Losers
  - Late/non adopters
  - Healthcare system
  - Early patients

How are late patients helped?

- Forced most prostate surgeons to improve results/technique
- Regionalization
  or
  - Identify processes of care in high volume hospitals and implement at lower volume centers

Robotic procedures in Urology

- Radical prostatectomy
- Nephrectomy/partial
- Pyeloplasty
- Ureteral reimplant
- Cystectomy
- Adrenalectomy
- Simple prostatectomy
- Bladder diverticulectomy
- Urinary diversion
- Pelvic lymph node dissection
- RPLND
- Inguinal lymph node dissection
Lap versus robotic
- Would you close one eye while operating? NO
- 3-dimensional view with robot
- Would you lock your wrists? NO
- Wristed instrumentation with robot
- Would you prefer to move more precisely? YES
- Motion scaling and tremor filtering with robot
- Would you rather be comfortable? YES
- Ergonomic seated position with robot
- Would you prefer to be cost effective? YES
- Don’t use the robot for things safely done laparoscopically

Robotic assisted partial nephrectomy
- AUA Guidelines
  “… only a few small, single-institution reports offer limited information regarding this procedure, including whether robotic-assisted LPN offers any advantages over other forms of nephron-sparing surgery (NSS). At present there are insufficient data to evaluate outcomes.”

Healthy, clinical T1a enhancing renal mass
- Standard: Complete surgical excision by partial nephrectomy is a standard of care and should be strongly considered.
  Both open and laparoscopic approaches to PN can be considered… LPN can provide more rapid recovery, although this approach has been associated with increased warm ischemic times and an increased risk of urological complications including postoperative hemorrhage and urinary fistula… a solitary kidney, preexisting renal dysfunction, hilar tumor, multiple tumors or predominantly cystic tumor are best managed with an open surgical technique. With improved laparoscopic instrumentation and greater dissemination of expertise, improved outcomes and more widespread application of LPN is anticipated in the future.

J Urol September 2009
- 118 LPN, 129 RAPN – 3 surgeons
- No difference in OR time or positive margin rate (3.9% v. 1%)
- Less blood loss and warm ischemia time for RAPN (19.7 min v. 28.4 min)
- Similar post-op complications (10.2% v. 8.6%)
- Long-term oncologic outcomes unknown
My opinion RAPN

- Still a difficult operation for the novice roboticist
- Little information on learning curve, but probably not as shallow as LPN. Shapiro et al Curr Opin Urol 2009

Robotic assisted radical nephrectomy/nephroureterectomy

- No literature on RARN
- Probably no different than LRN

Robotic assisted Ureteral Surgery: Pyeloplasty

<table>
<thead>
<tr>
<th>Patient</th>
<th>Patients</th>
<th>ORtime (min)</th>
<th>Comps. (%)</th>
<th>Success (%)</th>
<th>F/U (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palese</td>
<td>35</td>
<td>216</td>
<td>11</td>
<td>94</td>
<td>7.9</td>
</tr>
<tr>
<td>Gettman</td>
<td>9</td>
<td>138</td>
<td>11</td>
<td>100</td>
<td>4.1</td>
</tr>
<tr>
<td>Siddiq</td>
<td>26</td>
<td>245</td>
<td>12</td>
<td>95</td>
<td>6</td>
</tr>
<tr>
<td>Schwenter</td>
<td>92</td>
<td>108</td>
<td>4</td>
<td>97</td>
<td>39.1</td>
</tr>
<tr>
<td>Patel</td>
<td>50</td>
<td>122</td>
<td>nil</td>
<td>96</td>
<td>11.7</td>
</tr>
</tbody>
</table>

Adapted Leveillee and Williams Curr Opin Urol 2009

Robotic assisted Ureteral Surgery: Ureteral reimplant

- Limited publications on this subject
- Leveillee and Williams Curr Opin Urol 2009
  - 8 patients with benign diseases
  - Mean follow-up 18 months
  - 1 recurrence treated successfully with balloon dilation
  - Psoas hitch and Boari flap still available

Opinion:
- Will probably become widely accepted for benign and malignant disease (oncologic results unknown – Glisianski et al J Endourol 2009)
Robotic assisted Cystectomy

- Around 300 cases published (size 1 to 67 patients)
- Complications (10-30%)
  - data largely incomplete
- Avg blood loss <300 ml
- Avg OR time ~ 7 hours
- Oncologic data remains to be seen

Robotic assisted cystectomy

Questions

- Will it decrease hospital stay? Complications?
- Can the OR times be shortened?
- Can an equivalent LND be done?
- How to handle the urinary diversion?
- Oncologic outcomes?

Opinion:

Long way to go. Probably good for benign disease.

Robotic assisted urinary diversion

- Intracorporeal ileal conduit and orthotopic bladder substitution have been done
  - OR time >10 hours
- Most make 8 cm incision to remove specimen and create urinary diversion.

Robotic assisted adrenalectomy

- Case series and a few comparison studies (1 RT)
- About 150 patients published
- Complications inconsistently published
- Most metrics similar to lap adrenalectomy
- Longer OR time and more expensive for robot
- "subjective improvement" with robot
- Use in malignant disease TBD
Robotic assisted simple prostatectomy

- Technically feasible
- Case series x 2, 3 and 7 patients
- Millin’s technique
- Modest EBL <600, 300 respectively
- 3-4 hours!!!

Opinion

Learn HoLEP. Probably not for robot.


Robotic assisted bladder diverticulectomy

- Little in literature
- Easy to do robotically
- Curl guidewire in diverticulum
- Unproven for cancer
- Can do PVP simultaneously

Opinion

Excellent training case. Quick and handles all comers. Not for malignancy yet.

Robotic assisted lymph node dissections

- Pelvic
  - Well described and can do extended lymph node dissections, but tedious
- RPLND
  - Only 2 patients in PubMed
  - Expect more will come
- Inguinal LND
  - Believe it or not (Josephson et al Urology 2009)
  - Leave this to the few

Medical Ethics

- Commercial
  - Caveat emptor
- Equal relationship
- Self-interest
- Professional
  - Primum non nocere
  - Fiduciary relationship
  - Self-sacrifice
Medical reality

- Practical constraints to practicing physician taking significant amount of time to learn new procedures.

Old credentialing process

- “Hey, do you want to use the robot?”
- Off-site training certificate and proctoring paid for by industry.
- Or
- Letter from program director.

Gold Rush
aka - The learning curve

- 2 of first 10 patients at place I did fellowship had rectourethral fistula after prostatectomy
- Bad complications common
  - Urinary leaks
  - Incomplete prostate removal
- Promises not delivered
  - More incontinence and impotence

University of Colorado Hospital
Robotic Credentialing

- Ongoing QI processes and M and M
  1. Training pathway
     - Significant residency or fellowship experience
     - 3 proctored cases
     - Period of observation (10 cases)
  2. Practice pathway
     - Device training – online, off-site certificate
     - 3 proctored cases
     - Period of observation (17 cases)
     - CME or advanced course
University of Colorado Hospital
Robotic Credentialing

3. Experience pathway
   - 20 cases as surgeon and 10 within last year.
   - List of complications
   - Verification of robotic privileges at other medical center
   - Supportive letter of recommendation from Chair of Surgery/Department.

Ways for practicing physician to train

- Fellowship
  - 6 months to 3 years
  - Hands-on required
- Mini-fellowships
- Self-directed
  - Dry-lab
  - Courses – hand-on and video observation

Prerequisites

- Experience with laparoscopy
- Understand an investment is necessary
- Discuss with partners (if any)
- Willingness to start slowly

How to incorporate

- Case observation
- Video observation
- Basic training
  - Online module
  - Hands-on off-site certification
  - Dry-lab time (very helpful)
- Honesty is the best policy/dispel myths/expectations
- Start with simpler procedures soon after training
  - Nephrectomy
  - Bladder diverticulectomy
How to incorporate

- Find reputable and experienced proctor for 3-5 cases
- Case is a failure if the proctor needs to do significant/important portions
- More dry lab
- Get help for first few cases on your own
- Advanced course after 10-15 cases
- Work into more complicated procedures slowly
- Continue to participate in courses

Tips to minimize complications/facilitate procedure

- Well-prepared team (good assistant important)
- Always keep hands in view
- Center hands every few minutes (minimizes need to clutch)
- Foot positioned by camera pedal
- Let hands lead the way
- Constant back and forth when suturing
- Blink

Technical improvement

- Record results
  - Use easy questionnaire
- Record procedures
  - Investigate causes of positive margin
- Ongoing review of literature, techniques, courses