Robotic Upper Tract Reconstruction

Mathew C. Raynor, MD
Assistant Professor
Division of Urology
The University of North Carolina at Chapel Hill
School of Medicine
Disclosures

• Consultant – Teleflex Medical
• Consultant – Intuitive Surgical
Robotics in Urology

• Dramatic increase in last decade
  – 15% of all prostatectomies in 2004
  – Over 80% of prostatectomies in 2008 (~72,000)

• Why the increase?
  – Marketing
  – Patient preference
  – Increased visualization, ergonomics, surgeon comfort
    • Especially over laparoscopy

• Evolution to other procedures
  – Cystectomy, pyeloplasty, partial nephrectomy, ureteral surgery
Robotics in Urology

• Definite benefit seen with reconstruction
  – Ergonomics and increased range of motion
  – Finer dissection
  – Ease of intracorporeal suturing
# Robotics in Urology

<table>
<thead>
<tr>
<th>Prostate</th>
<th>Bladder</th>
<th>Kidney</th>
<th>Ureter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot-assisted radical prostatectomy</td>
<td>Robot-assisted radical cystectomy</td>
<td>Robot-assisted partial nephrectomy (malignant or benign disease)</td>
<td>Robot-assisted ureteroneocystostomy</td>
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<tr>
<td>Robot-assisted simple prostatectomy</td>
<td>Robot-assisted partial cystectomy</td>
<td>Robot-assisted radical nephrectomy (malignant or benign disease)</td>
<td>Robot-assisted ureteroureterostomy</td>
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<td></td>
<td>Robot-assisted diverticulotomy</td>
<td>Robot-assisted pyeloplasty</td>
<td>Robot-assisted ureterectomy</td>
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<td></td>
<td>Robot-assisted anterior pelvic exenteration</td>
<td>Robot-assisted nephroureterectomy with or without excision of bladder cuff (malignant or benign disease)</td>
<td>Robot-assisted ureterolympholysis</td>
</tr>
<tr>
<td>Female urology</td>
<td>Robot-assisted vesicovaginal fistula repair</td>
<td>Robot-assisted heminephroureterectomy</td>
<td>Robot-assisted ureteral stump excision</td>
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<td>Robot-assisted vesicouterine fistula repair</td>
<td>Robot-assisted extended pyelolithotomy (staghorn calculi or multiple stones)</td>
<td>Robot-assisted ureterosciatic hernia repair</td>
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<tr>
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<td>Robot-assisted ureterovaginal fistula repair</td>
<td>Robot-assisted pyeloplasty and pyelolithotomy</td>
<td>Robot-assisted ureteropyelostomy</td>
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<td></td>
<td>Robot-assisted sacrocolpopexy</td>
<td>Robot-assisted pyelo-pyeloplasty and pyelolithotomy</td>
<td>Robot-assisted ureterocalicostomy</td>
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<tr>
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<td>Robot-assisted bladder neck suspension</td>
<td>Robot-assisted renal cyst decortication/ excision</td>
<td>Adrenal</td>
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<td>Robot-assisted donor nephrectomy</td>
<td>Robot-assisted adrenalectomy</td>
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<td></td>
<td></td>
<td>Robot-assisted nephropexy</td>
<td></td>
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<td></td>
<td></td>
<td>Robot-assisted management of chyluria</td>
<td></td>
</tr>
</tbody>
</table>

*Bold = Commonly used procedures at present*
Robotic Pyeloplasty

• New standard of care for UPJ obstruction?
  – Previously, laparoscopic pyeloplasty considered preferable to open
    • excellent long-term outcomes
    • Decreased morbidity
Robotic Pyeloplasty

• Long-term outcomes
  – 6-year multi-institutional study\(^1\)
    • 140 patients, mean 29 month follow-up
    • 16% secondary repair
    • 9% concomitant stone procedures
    • 95.7% radiographic success
    • 7% major complication rate (urinoma, migrated stent)
  – Meta-analysis of lap/robotic pyeloplasty\(^2\)
    • Excellent long term outcomes
    • Low morbidity
    • Robotics likely emerging gold standard

Robotic Pyeloplasty

• Comparison to lap pyeloplasty
  – Single-institutional report\(^1\)
    • 98 robotic, 74 lap
    • OR time similar (189 vs 186 min, rob vs. lap)
    • anastomosis time 48 vs. 60 min (rob vs. lap, p=0.3)
    • Complication rates similar
    • Outcomes (radiographic success → diuretic renogram)
      – Robotic, 93.4%
      – Lap, 95%

Robotic Pyeloplasty

• Defining success
  – Diuretic renography
    • Provides functional assessment of drainage
    • $T_{1/2} < 10$ min or $T_{1/2} < 20$ min??
    • Pitfalls of lasix renogram
      – Hydration status
      – Hydronephrosis
  – IVU
    • May demonstrate patent anastomosis
    • Requires IV contrast
    • Subjective assessment
  – Symptom improvement
    • Silent obstruction?
Robotic Pyeloplasty

• Radiographic success >90% in most series
  – Unclear definition of radiographic success
    • “resolution of obstruction on postoperative imaging”

  – UC-Irvine study
    • Stringent definition of success ($T_{1/2} < 10 \text{ min}$) AND long-term follow-up (mean 18 months)
      – Success rate 81%
      – Additional 10.5% had $T_{1/2} < 20 \text{ min}$
      – 75% cured of pain (12% improved)

Robotic Pyeloplasty: Controversies

• Crossing Vessel
  – Identified in about 50% of cases
  – Is transposition necessary?
    • Performed in most cases
    • Retrospective evaluation of UPJO with crossing vessel
      – 18 transposed, 30 no transposition
      – No difference in post-op differential renal function (41.1 vs. 40.9%) or diuretic renography ($T_{1/2}$ 7.4 vs 8.0 min)
      – 100% success at mean follow-up of one year

Robotic Pyeloplasty: Controversies

• Observation
  – Rationale
    • Newborn hydronephrosis initially managed non-operatively\(^1\)
      – Progressive hydro or renal function deterioration proceed to surgery
  – 21 patients with UPJO followed (mean 48 months)\(^2\)
    • 6 (29%) required pyeloplasty
      – Greater than 10% loss of renal function (2)
      – Worsening pain (4)
    • 15 (71%) remain on surveillance
  – One occurrence of late failure (over 6 years out)
    • Can failure be predicted?
    • Compliance of surveillance protocol
    • Can renal function improve after pyeloplasty?

Robotic Pyeloplasty: Controversies

• Stent or No Stent?
  – Only 2 recent studies\(^1,2\)
    • 22 adult patients total
    • 3 required post-op stent (transient obstruction)
    • No radiologic evidence of failure at follow-up

• Is reduction necessary?
  – No literature in adult pyeloplasty
  – Pediatric pyeloplasty with or without reduction\(^3\)
    • No difference seen at 6 months on ultrasound or differential function
    • Improved T\(_{1/2}\) at 6 months

Robotic Pyeloplasty
UNC Technique

• Results
  – 69 patients over past 3 years
    • 44% crossing vessel
  – 66 discharged POD#1
• Complications
  • 4 post-op complications
    – One migrated stent requiring replacement POD#3
    – 2 calcified stents requiring laser lithotripsy (at weeks 2 and 3)
    – 1 lower extremity weakness from pre-existing spinal stenosis
  • No urine leaks
• Results
  • 2 failures – both with recurrent pain despite improved drainage
Robotic Ureteral Reconstruction

• Management of variety of conditions
  – Benign stricture
  – Stones
  – Malignancy
  – Obstruction (idiopathic, malignant)
Robotic Ureteral Reconstruction

• Variety of surgical options
  – Reimplant
    • +/- psoas hitch
  – Boari flap
  – U-U
  – Ureteral interposition
    • Onlay flap
    • Replacement
  – Ureterolithotomy
  – Etc.
Robotic Ureteral Reconstruction
UNC Experience

<table>
<thead>
<tr>
<th>55 patients (57 ureters)</th>
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<tbody>
<tr>
<td><strong>Age</strong></td>
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<tr>
<td><strong>M/F</strong></td>
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<tr>
<td><strong>BMI</strong></td>
</tr>
<tr>
<td><strong>Side</strong></td>
</tr>
<tr>
<td>Left</td>
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<tr>
<td>Right</td>
</tr>
<tr>
<td>Bilateral</td>
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<tr>
<td><strong>Etiology</strong></td>
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<tr>
<td>Benign</td>
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<tr>
<td>Malignant</td>
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<tr>
<td><strong>Days from injury</strong></td>
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<tr>
<td><strong>Nephrostomy</strong></td>
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# Robotic Ureteral Reconstruction

## UNC Experience

<table>
<thead>
<tr>
<th>Procedure</th>
<th>N</th>
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<tbody>
<tr>
<td>Ureteroneocystostomy +/- psoas hitch</td>
<td>35</td>
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<tr>
<td>Boari flap</td>
<td>9</td>
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<tr>
<td>Ureterolysis</td>
<td>5</td>
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<td>Ureteroureterostomy</td>
<td>5</td>
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<tr>
<td>Ureterolithotomy</td>
<td>2</td>
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<tr>
<td>Reimplant in neobladder</td>
<td>1</td>
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<td>--------------------------</td>
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<tr>
<td>OR time</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>(IQR 177-269)</td>
</tr>
<tr>
<td>with endoscopy (n=31)</td>
<td>234</td>
</tr>
<tr>
<td>without endoscopy (n=24)</td>
<td>202</td>
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<tr>
<td>EBL</td>
<td>50</td>
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<td>Conversions</td>
<td>0</td>
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<tr>
<td>LOS</td>
<td>1.6 days</td>
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<tr>
<td>discharge POD 1</td>
<td>39 (71%)</td>
</tr>
<tr>
<td><strong>Major complication</strong></td>
<td>2</td>
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<tr>
<td>(Clavien ≥ III)</td>
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Robotic Ureteral Reconstruction
UNC Experience

• Follow-up
  – 181 days (IQR 57-392)

• Malignant surveillance
  – Positive margin – 0
  – Local recurrence or obstruction – 0
  – Bladder recurrence in 4 patients
Robotic Ureteral Reconstruction
UNC Experience

• Overall success 94.7%

• 3 reinterventions
  – Patient 1 – postop prolonged ureteral stent for persistent flank pain
  – Patient 2 – recurrent pain and anastomotic stricture 24 months after Boari flap treated with balloon dilation
  – Patient 3 – persistent pain and obstruction after Boari flap for long mid-ureteral stricture
Robotic Ureteral Reconstruction
Controversies

• Distal ureteral strictures
  – Reimplant or U-U?
Robotic Ureteral Reconstruction
Tips and Tricks

• Use of fluorescence
  – Localization of obstruction
    • With or without indocyanine green
  – Characterization of vascular supply
    • With intravenous indocyanine green