Ureteral Injuries: Damage Control to Reconstruction

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Disclosures

• None
Outline

• Case presentation
• Damage Control
• Iatrogenic Injury
• Ureteral Reconstruction
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Case

• 33 yo M o/w healthy GSW to RLQ
• GCS 12
• VS on arrival: 37.7, 134, 88/46, 95% on NRB
• CXR WNL
• Taken to OR for Exlap
Case

• Injuries
  – Right Common Iliac artery transection
  – Right mid ureteral transection
  – Right colon injury
  – Psoas hematoma
Right ureter transection

Right Common Iliac Artery Shunt
OR

• Bypass R-CIA
• Ureter tied off
• Bowel reconstruction
Case Questions

• When to reconstruct?
• How to reconstruct?
  – Length of defect ~2-3 cm
  – Bladder capacity = 400mL
  – Location = iliac crossing
• Optimal drainage until reconstruction?
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Damage Control for Ureteral Injury

- Identification
  - Contusion
    - Ureteral J Stenting
  - Transection
    - Tag ureter – nonabsorbable suture

- If transection → Diversion
  - Clip and place delayed Nephrostomy (w/in 24 hours)
  - Ureterostomy to skin as stoma
  - Stent to Skin

Damage Control for Ureteral Injury

– Ureterostomy to skin as stoma

– 5 French Ureteral stent tunnel to skin
Damage Control for Ureteral Injury

• Next 24 hours:
  – Imaging: CT Urogram (delay images) to stage contralateral ureter / kidney
  – Maximal urinary diversion: stent + Foley catheter
  – Thoughtful multidisciplinary discussion on timing of ureteral reconstruction

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Incidence

• Gynecologic surgery: 0.5% – 7%
• Colonrectal Surgery 0.3% - 5.7%
• Urology 1%-5%

Brandes et al Consensus on Genitourinary Trauma. BJU Int 2004; 94, 277-289
Occurrence

• Most ureteral injuries occur during ‘routine’ and ‘uncomplicated’ surgery on patients with no identifiable risk factors
• Approximately 2/3 are missed initially

→ High index of suspicion is required

Brandes et al Consensus on Genitourinary Trauma. BJU Int 2004; 94, 277-289
Common Locations of Injury

- Distal 1/3\textsuperscript{rd} is most common iatrogenic location of injury

- GYN:
  - At uterine vessels which pass in mesometrium / cardinal ligament
  - At pelvic brim posterior to IP Ligament (ovarian vessels)

- Colorectal:
  - Lateral rectal attachments
Early Recognition and Evaluation

- Isolate and visually inspect e.g. contusion
- Indigo Carmine leak test
- Retrograde pyelogram
- Stent placement

Delayed Recognition and Timing of Repair

• > 7d since injury $\rightarrow$ longer operative time
• No difference in outcomes, re-stricture rates
• Timing of Repair
  – Patient stability
  – Appropriate diagnostic work up

Injury Types and Treatment

• Transection
  – Partial (< ½ diameter): primary closure over stent
  – Complete (>½ diameter): reconstruction

• Suture ligation
  – Release of suture and stenting

• Crush Injury
  – Highly variable: stent → reconstruction

• Devascularization
  – Delayed urine leak / Stricture
  – Stent + Omental flap vs. reconstruction

Brandes et al Consensus on Genitourinary Trauma. BJU Int 2004; 94, 277-289
Prevention

- Anticipation
- Hemostasis
- Preoperative Ureteral Stenting

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Principles of Reconstruction

- Location
- Length
- Tension-free
Primary Ureteroureterostomy

- <1cm defect; mid ureter
- Devascularized segment removed
- Wrap with omentum
- 90% success rate
- 10% urine leak
- 5% stenosis
Blood Supply to Ureter

- **Abdomen** = medial
  - Spatulate laterally
- **Pelvis** = lateral
  - Spatulate medially
Ureteral Reimplant (Ureteroneocystotomy)

- Distal ureter divided
- Mobilization of healthy ureter
- Reimplant at dome
- Non-refluxing vs. Refluxing
- 95% success rate
- 5% urine leak
- 2% stenosis
Psoas Hitch + Reimplant

- Superior contralateral pedicle ligated
- Ipsilateral fixation of bladder to psoas with vertical non absorbable suture
- Uretero-neocystotomy
- 95% success rate

Boari Flap

• Perform Psoas Hitch
• U-shaped flap 4:1 ratio to width ureter
• Reimplantation and tubularization
• 95% success rate
Ileal Ureter

- Large defect
- Bowel prep necessary (not rec in trauma setting)
- Cr < 2.5
- 20cm TI approx 20cm prox to IC valve
- Sigmoid may be used for L ureter
- Isoperistaltic
- Hypercholelomic metabolic acidosis
- Success 81%
Auto-Transplantation

- Solitary kidney, complete avulsion
- Pyelovesicostomy
- Renal vein $\rightarrow$ CIV
- Renal artery $\rightarrow$ IIA, EIA, or CIA
Trans – Uretero-Ureterostomy

- Secondary option for distal ½ ureteral injury with small bladder capacity
- 1.5cm ureterotomy is made then end-to-side anastomosis
- Above IMA
- Contraindicated for pt with kidney stones
Principles of Reconstruction

- Location
- Length
- Tension-free
Any type of repair better for Kidney function?

- Objective: long term follow up of renal preservation by type of repair: psoas hitch, boari flaps, primary U-U
- Retrospective review: N = 100 (1986-2012) – 24 UNC, 58 Psoas hitch, 18 Boari flap
- Median f/u: 48 mos (12-250)

- No sig difference in type of repair vs. GFR
- Incr age and baseline GFR predictive of postoperative GFR decline
- 3% ureteral leakage
- 2% stricture
<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Procedure</th>
<th>F/U</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patil et al Urology 2008</td>
<td>12</td>
<td>UNC+Psoas hitch (robotic)</td>
<td>15 mo</td>
<td>Mild hydro 2 mos</td>
</tr>
<tr>
<td>Gozen et al WJU 2010</td>
<td>24</td>
<td>10 UNC + Psoas hitch, 9 boari flap, 5 LG reimplant (open)</td>
<td>20 mo</td>
<td>95% success, 1 major complication</td>
</tr>
<tr>
<td>Castillo et al Jurol 2005</td>
<td>9</td>
<td>Boari flap (lap)</td>
<td>17 mo</td>
<td>No evidence of stricture on IVP</td>
</tr>
<tr>
<td>Simmons et al Urology 2007</td>
<td>46</td>
<td>UU, UNC, Boari flap (lap + open)</td>
<td>43 mo</td>
<td>98% ureteral patency, no diff in technique</td>
</tr>
<tr>
<td>Modi et al Urology 2008</td>
<td>6</td>
<td>UNC (lap)</td>
<td>12 mo</td>
<td>No evidence of stricture on IVP</td>
</tr>
</tbody>
</table>
Back to Case

- When to reconstruct?
  - Deferred for 6 mo
  - Prolonged hospital course

- Optimal drainage until reconstruction?
  - R PCN tube

- How to reconstruct?
  - Concern about PTFE graft infection
Back to Case

- 6 month f/u
- Robotic transureteroureterostomy
  - Avoid dissection around graft
  - Avoid concern about ureteral fistula
  - R PCN capped then removed on POD#3

- Stent for 6 wks
- Lasix Renogram – no obstruction
Future Directions in Ureteral Reconstruction

– True long term re-stricture rate by location, technique, etiology
– Novel allografts (ie. Buccal, Appediceal interposition)
– Tissue engineering
– Ureteral Matrix
Conclusions

- Damage control > Reconstruction
- Type of ureteral repair is dictated by location, nature, and extent of injury
- Principles of repair: tension free anastomosis, preservation of adventitia, spatulate contralateral to blood supply, water tight, stenting
- Timing of repair dictated by patient stability – outcomes unaffected
- Type of ureteral reimplantation technique is not significantly associated w/ leak, renal function, or re-stricturing
- **BE CREATIVE**
Thank You
Questions?