Management of Surgical Ureteral Injury

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Surgical Grand Rounds
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Introduction

• Incidence of surgical injury
  – Gynecologic surgery incidence 0.5% – 1.5%
  – Abdominal-perineal colon resection 0.3% - 5.7%
  – Ureteroscopy (perforation) 1%-5%
  – Non-urologic ureteral injuries:
    • Gynecologic surgery 50-66%
    • General/Colorectal Surgery 15-30%
    • Abdominal vascular surgery 5-10%
Introduction - Anatomy

Anatomy

Upper

Mid

Lower
Ureteral Injury

- Most ureteral injuries occur during ‘routine’ and ‘uncomplicated’ surgery on patients with no identifiable risk factors
- Approximately two thirds of intraoperative ureteral injuries are missed
- High index of suspicion is required

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

- The distal third of the ureter is by far the most common site of iatrogenic injury.
- Hysterectomy
  - Ligation of ovarian and uterine vessels
  - Vaginal cuff closure
- APR
  - Division of the lateral ligaments of the rectum
- Pelvic surgery
  - Attempts to control bleeding
Avoiding Injury

• Avoidance of blind ligation during bleeding
• Avoid skeletonization of the ureter
• Generous surgical exposure
• Clear identification of the ureter throughout the operative field
• Ureteral stents may not prevent injury, but do make identification of injury more likely
Types of Injury

- Ligation
- Kinking by suture
- Transection/avulsion
- Partial transection
- Crush
- Devascularization (delayed necrosis/stricture)
Evaluation of Recognized Intraoperative Injury

- Isolation and visual inspection of the ureter
  - Contusion
  - Wall discoloration
  - Lack of capillary refill
- Indigo carmine/methylene blue
- RUPG/attempted stent placement
- Overall condition of the patient
  - Damage control surgery
Suture Ligation

• Usually minor injuries due to inclusion of other tissues
• If ureter appears viable, ureteral stenting is all that is required
• If ureter appears severely injured, reconstruction is warranted
Crush Injury

- Degree of injury is highly variable, but often significant
- Minor injury with small crushing instrument can be stented
- Any significant injury requires reconstruction
Devascularization

- Delayed presentation most common
  - Urine leak
  - Stricture
- Intraoperative recognition
  - Viability difficult to assess
    - Ureteral stent
    - Omental or peritoneal coverage may maximize survival
  - Obviously nonviable ureter should be excised and reconstructed
Transection

• Partial Transection
  – If less than ½ diameter
    • Primary closure over ureteral stent
    • Ureteral stent alone or in combination with closure has been successful in laparoscopic injury
  – If greater than ½ diameter
    • Excision with reconstruction

• Complete Transection
  – Reconstruction is required
Reconstructive Options

- **UPPER**
  - Direct ureteroureterostomy
  - Transureteroureterostomy

- **MIDDLE**
  - Direct ureteroureterostomy
  - Transureteroureterostomy

- **LOWER**
  - Reimplantation
  - Psoas hitch
Reconstructive Options

• Ureteroureterostomy
  – Debride (bleeding edge)
  – Spatulated, tension free anastomosis
    • Urine leak 5-10%
    • Stricture 5-12%
      – Endoscopic management usually successful
    • Can typically bridge a 2-5 cm gap
Ureteroureterostomy
Reconstructive Options

- **Psoas hitch**
  - Mainstay for distal ureteral injuries
  - Preferred over U-U due to tenuous blood supply of pelvic ureter
  - Can be used for injuries distal to iliac vessels
  - Combined with ureteral reimplantation
  - 95-100% success
  - 6-8 cm defect can be bridged

- **Ureteral reimplantation**
  - Straightforward
  - Short (<2 cm), extremely distal injuries only

- **Boari Flap**
  - Distal or even mid ureteral defects
  - Used when psoas hitch insufficient
  - 12-15 cm defect can be bridged
Psoas Hitch

Initial bladder shape distorted by retractors

Two retractors stretching taut back wall of bladder to construct long tunnel

Part of bladder to hitch after reimplant

Incise mucosa and lay back flaps

Bed for long tunnel reimplant

(Sometimes, can tunnel submucosally without opening flaps in a good bladder)

Retracting mucosal flaps
Psoas Hitch

- **C**: Ureter widely mobilized with all surrounding tissue and often gonadal vessels.
- **D**: Retractors out, reimplant completed.
  - Big deep bites of muscle; include tendon if present, avoid nerves.
  - Place 3 to 5 sutures; include bladder muscle but not mucosa. Don’t tie until all sutures are placed. Surgeon holds bladder against psoas while assistant ties.
- **E**: Note elongation and asymmetry of bladder after hitch.
  - Hitch lies just lateral to new hiatus, which is immobilized by this procedure.
  - Hitch can allow very long tunnel.
  - Completed hitch. Sutures must not be tight lest they cut through muscle.
Reconstructive Options

- Transureteroureterostomy
- Ileal ureter
- Ureterocalycostomy
- Renal autotransplantation
Missed Ureteral Injury

- **High index of suspicion**
- **Clinical clues**
  - Prolonged ileus
  - Flank pain
  - Fever
  - Elevated BUN/Cr
  - Anuria
  - Hematuria (unreliable!)
- **Evaluation**
  - CT IVP first step
  - Cystoscopy with RUPG (especially if ↑Cr)
  - Body fluid creatinine of drain fluid
Management in Delayed Recognition

- Anatomic imaging (CT IVP, RUPG)
- Decompression
  - Percutaneous nephrostomy
  - Ureteral stent (20-50% success)
- Percutaneous drainage of urinoma
- If stenting possible, a trial of nonoperative management is typically warranted
- If stenting impossible or patient fails stent, delayed operative or endoscopic intervention required
Postoperative recognition

CT with contrast (+ delayed films) ± retrograde pyelography

Minor ureteral injury

Ureteral stent 6 weeks

Follow-up retrograde pyelography and stent removal or replacement as needed

Success

After stent removal consider periodic Lasix renogram or surveillance ultrasound (detect hydronephrosis) to rule out recurrence

Fail

Consider endoscopic methods (laser, Acusize, balloon)

Primary stented ureteroureterostomy, psoas hitch, or Boari flap with or without kidney mobilization

Consider autotransplant or ileal loop in rare case of extremely long injury

Major ureteral injury

Attempted retrograde stent placement

Success

Percutaneous nephrostomy and antegrade stent placement, if possible

Fail

Fail, wait 6 weeks
Management – Vascular Surgery

- Postoperative hydronephrosis common
  - 12-20%
    - Intraoperative manipulation
  - 99% resolve spontaneously
    - 1-2% develop delayed symptomatic stenosis

- Risk factors for surgical injury
  - Reoperation
  - Emergent procedure/hemorrhage
  - Large, dilated aneurysms (RP inflammation)
Management – Vascular Surgery

- Nephrectomy for significant ureteral injury has been advocated due to significant morbidity if repair fails (Fry et al 1983)
- Repair of injury in the setting of sterile urine, especially with tissue interposition, probably does not increase graft infection rate or complications (Spirnak et al 1989)
- Omental interposition is advisable when primary repair is carried out
Conclusions

• Ureteral injury is an uncommon but potentially serious complication of abdominal and pelvic surgery
• If recognized intraoperatively, injuries can usually be successfully treated
• Delayed recognition is common and requires a high index of suspicion
Thank You