OBJECTIVE: Provide guidelines for the management of RENAL, URETERAL, BLADDER, AND URETHRAL INJURIES

A. RENAL INJURY: occur in 10-20% blunt traumas with increased susceptibility amongst pediatric population

Renal injury grading scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>I</td>
<td>Renal contusion, subcapsular non-expanding hematoma, no parenchymal laceration</td>
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<tr>
<td>II</td>
<td>&lt; 1 cm parenchymal laceration, no urinary extravasation</td>
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<tr>
<td>III</td>
<td>&gt;1 cm parenchymal laceration, no urinary extravasation, renal segments viable or devitalized</td>
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<tr>
<td>IV</td>
<td>Urinary extravasation, renal segments viable or devitalized OR injury to main renal vasculature with contained hemorrhage</td>
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<tr>
<td>V</td>
<td>Shattered kidney (multiple &gt;1cm lacerations with devitalized fragments), injury to main renal vasculature with uncontrolled hemorrhage, renal hilar avulsion</td>
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Indication for work-up:
- Presence of gross hematuria
- Microscopic hematuria with urinalysis (UA) > 50 RBCs after blunt trauma OR >5 RBCs with penetrating injury; *microscopic hematuria ALONE is not an indication to image*
- Significant deceleration injury
- Flank ecchymosis, rib injury
- Suspicion for renal injury due to mechanism of injury

Imaging workup: *consult to pediatric urology once patient has been triaged and workup has been initiated*
- Stable patients: triphasic abdominal and pelvic CT (CT IVP; noncontrast, contrast, delayed); call urology
- Labile patients: abdominal and pelvic CT with contrast; call urology
- Unstable patients: IV pyelogram (IVP)* intra-operatively to confirm presence of contralateral kidney

*2cc/kg IV contrast followed by single abdominal radiograph

Management
- If blunt or penetrating injury, but no indication for renal imaging (see indications above): serial clinical exam, bedrest until stable serial hematocrits, and serial blood pressure checks
- Low grade injury (I-II) and hemodynamically stable: serial clinical exam, bedrest until stable serial hematocrits, and serial blood pressure checks
- **Blunt Injury:**
  - < 50 RBC on UA, stable: serial clinical exam, hematocrits, and blood pressure checks
  - > 50 RBC on UA, gross hematuria, deceleration injury, concerning clinical history
    - **STABLE: triphasic CTAP**
      - Grade I-II: serial clinical exam, bedrest until stable serial hematocrits, and serial blood pressure checks
      - Grade III-IV: 25-50% will require intervention
        - Hematocrit Stable: serial clinical exam, bedrest until stable serial hematocrits, and serial blood pressure checks
        - Symptomatic Urinoma: cystoscopy with ureteral stent placement and/or percutaneous drain placement
        - Hemodynamically unstable: renal angiography, embolization
          - Stable: observe
          - Unstable: abdominal exploration
    - **UNSTABLE: abdominal exploration**
  - Intra-op IVP

- **Penetrating Injury:**
  - < 5 RBC on UA, stable: serial clinical exam, bedrest until stable serial hematocrits, and serial blood pressure checks
  - > 5 RBC on UA, gross hematuria, concerning clinical history:
    - **STABLE: triphasic CTAP**
      - Grade I-II: serial clinical exam, bedrest until stable serial hematocrits, and serial blood pressure checks
      - Grade III-IV: 25-50% will require intervention
        - Hematocrit Stable: continue serial clinical exam, hematocrits, and blood pressure checks
        - Symptomatic Urinoma: cystoscopy with ureteral stent placement and/or percutaneous drain placement
        - Hemodynamically unstable: renal angiography, embolization
          - Stable: observe
          - Unstable: abdominal exploration
    - **UNSTABLE: abdominal exploration**
  - Intra-op IVP

**Follow up:**
- No indication for repeat imaging in grade I-II injury; follow up in 1-2 weeks with repeat urinalysis
- Repeat renal ultrasound in 3 months for Grade III injury without devitalized renal fragments
- Repeat CT or MRI abdomen pelvis for grade IV- V injuries, grade III with devitalized tissue at 3 months
- If develops hypertension within 30 days, consider AV fistula, pseudoaneurysm, perinephric scarring
- Consider abstaining from contact activity for 6 weeks post-injury
B. URETERAL INJURY:
- rare amongst pediatric population- approximately 4% of penetrating injuries
- 40-88% of ureteral injuries detected within 24 hours of inciting injury

Indication for Workup:
- Suspicion for injury in setting of hyperextension or deceleration mechanism
- Any degree of hematuria
- Prolonged ileus, prolonged high output from drains, fever/sepsis, urinary obstruction, elevated creatinine or BUN, flank mass

Workup: consult pediatric urology if workup is indicated
- Triphasic CTAP
- Cystoscopy, retrograde pyelogram (better in delayed setting)

Management: early treatment is preferred
- Early detection:
  o Minimal ureteral contusion/close proximity to gunshot wound/renal pelvis laceration: ureteral stent
  o Severe or large ureteral contusions:
    ▪ STABLE: segmental excision or repair (based on location)
    ▪ UNSTABLE: damage control (ureteral ligation with nephrostomy tube)→possible repair in 48-72 hours
  o UPJ injury: repair (uretero-pyelostomy)
- Late detection: (> 5 days)
  o Ureteral injury: Percutaneous drain and/or ureteral stent and/or nephrostomy tube with delayed repair in 6-8 weeks VERSUS immediate open repair
  o UPJ injury: Percutaneous drain and/or ureteral stent and/or nephrostomy tube with delayed repair in 6-8 weeks

Follow up
- Outpatient follow up with urology to monitor for stricture formation

C. BLADDER INJURY:
- less common in children, associated with multi-organ trauma
- typically due to blunt trauma and seen in setting of pelvic fractures

Indication for Workup:
- Absolute indications:
  o gross hematuria with co-existing pelvic fracture
  o inability to void
- Relative indications:
  o Urinary clot retention
  o Perineal hematoma
  o History of bladder augmentation
  o If penetrating injury: in proximity to bladder and/or with free abdominal fluid on CT
PRACTICE GUIDELINES: MANAGEMENT OF PEDIATRIC UROTRAUMA

Workup: **please consult pediatric urology prior to initiating workup if bladder injury is suspected**
- CT cystogram or three film cystogram
  - **instill at least 50% of estimated bladder capacity**; stop instilling if capacity is reached or at 300cc with bladder contraction
*Bladder capacity: < 2 years: weight x 7kg, > 2 years: (age+2) x 30. Normal adult bladder, 300-500cc

Management: based on location of injury
- **Intraperitoneal**: communicating with abdominal cavity
  - Surgical repair + placement of perivesical drain, with urethral or suprapubic catheter
- **Extraperitoneal**:
  - urethral catheter placement
    - suprapubic tube if urethral catheter clotting off
  - if bony spicule protruding into bladder on CTAP, surgical intervention
- **Bladder neck laceration**:
  - surgical intervention

Follow up
- repeat cystogram in 7-10 days prior to catheter removal with urology

D. URETHRAL INJURY
- Posterior/proximal urethral injuries more common; associated with pelvic fractures and/or bladder neck injury, may involve sphincter
  - 2/3 confined to membraneous urethra
- Anterior urethral injuries most commonly at bulbar urethra due to straddle injuries
- If severe pelvic fracture and urethral injury, 15% associated with rectal involvement
- 75% female urethral injury with vaginal laceration
- Usually more severe in pediatric population versus adults

Indication for Workup:
- Perineal or genital hematoma
- Blood at meatus or vaginal introitus with or without hematuria
- Inability to void, severe pain associated with voiding
- Blunt trauma with fracture to pubic rami- *especially if pubic symphysis diastasis*

Workup: **please consult pediatric urology prior to initiating workup if suspect urethral injury**
- Digital rectal exam
- If undergoing CTAP for other injuries: early and delayed imaging to survey bladder, bladder neck, rectum

Management:
- Broad spectrum antibiotics and maximal urinary drainage are key
- **Females**: 
PRACTICE GUIDELINES: MANAGEMENT OF PEDIATRIC UROTRAUMA

- Attempt catheter placement; if difficult, stop immediately and proceed to second bullet
- Cystoscopy, vaginoscopy, rectal evaluation
  - If stable:
    - Minor laceration: repair laceration, urethral catheter placement
    - Significant urethral injury (usually with vaginal and bladder neck involvement) proceed with immediate repair
  - If unstable: suprapubic catheter

- Males:
  - Attempt catheter placement; if difficult, stop immediately and proceed to second bullet
  - Retrograde urethrogram and/or cystoscopy
    - Retrograde urethral catheter placement versus suprapubic catheter with delayed repair
    - If bladder neck involvement, proceed with immediate repair

Follow up:
- Follow-up RUG in 3-4 weeks prior to catheter removal
- Surveillance for urethral stricture

References: