GENITOURINARY TRACT TRAUMA

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I have no conflicts of interest
RENAL TRAUMA

• Epidemiology & general information in renal trauma
• Imaging evaluation and grading (case based review using AAST guidelines)
• Principles of management and follow-up in renal trauma
Epidemiology of Renal Trauma

• Renal injury occurs in 5% of trauma cases; up to 95% are blunt trauma
• Associated multi-organ injury is present in 80-95% of blunt and penetrating renal trauma
• 95% of blunt renal trauma is managed conservatively
• Grade 1-3 traumas can be managed non-operatively (>95%)
• Grades 4-5 injuries can be managed non-operatively in hemodynamically stable patients but there may be higher rates of infection
• Patients with urinary extravasation can be managed without major intervention in over 90% of cases
• Non-operative management for penetrating and high grade renal injuries is still debatable
Indications for Imaging Evaluation & Grading Injury

• Blunt trauma patients, hemodynamically stable
  – Gross hematuria
  – Microscopic hematuria with BP < 90mm Hg
• Trauma patients with mechanism of injury (high speed deceleration, falls) or penetrating injury (GSW, knife wounds)
  – Up to 34% of multisystem trauma patients will have renal injury in the absence of hematuria or hemodynamic instability
• The American Association of Surgery for Trauma (AAST) renal injury scale used to grade renal trauma. Validated as predictive of morbidity and the need for intervention to treat higher grade renal injuries.
  – Ambiguity in staging high grade injuries separating grade IV from V
  – No component accounting for contrast extravasation (bleeding) on CT nor size of perirenal hematoma
<table>
<thead>
<tr>
<th>Grade</th>
<th>Type</th>
<th>Description</th>
<th>Management (guided imaging and patient signs/symptoms)</th>
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<tbody>
<tr>
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<td>Contusion</td>
<td>Segmental hypo- or hyper-enhancement</td>
<td>➢ Non-operative</td>
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<td>➢ No follow-up needed if clinically stable and no devitalized segments*</td>
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<td>IV</td>
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**Early Enhanced**
- Normal

**Late Enhanced**
- Hypo-enhancement only seen on delayed
- Hyper-enhancement only seen on delayed

**Subcapsular Hematoma**
# Grade II Renal Injury

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![Image of Grade II Renal Injury](image)

**Shallow renal laceration**

**Early Enhanced**
- Perirenal hematoma

**Late Enhanced**
- Perirenal hematoma
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Deep renal laceration & large perirenal hematoma

Early Enhanced

No contrast extravasation on delayed scan

Late Enhanced
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**Early Enhanced**
- Deep Renal Laceration
- Urine extravasation

**Late Enhanced**
- Perirenal hematoma
- Ureter continuity maintained
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**Segmental infarct**

**Urine extravasation**

**Early Enhanced**

**Large perirenal hematoma**

**Deep laceration with dispersion of fragments**

**Deep renal laceration, large hematoma and IV contrast extravasation (active bleeding)**
### Grade V Renal Injury – UPJ Disruption

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| V     | Laceration | - Shattered kidney with dispersion of avulsed segments  
|       |         | - UPJ avulsion (no connection to ureter)                                   |
|       | Vascular | - Avulsion/laceration/thrombosis of main renal vessels with devascularized kidney |

- **Subtle stranding around proximal ureter**
- **Early Enhanced**
- **Extravasation confirmed on delayed scan**
- **Late Enhanced**
- **No connection to distal ureter; UPJ avulsion**

![Image of renal injury and enhanced imaging](image_url)
Grade V Renal Injury – RA avulsion & Shattered Kidney

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Early Enhanced

Non-enhancing right kidney

Early Enhanced

Shattered left kidney IV contrast extravasation

Occluded right renal artery
Additional Considerations

- Radiographic findings that predict higher risk for renal hemorrhage*
  - Intravascular contrast extravasation (not part of the AAST grading scheme)
  - Complex laceration (involves both the medial and lateral aspects of the kidney)
  - Perinephric hematoma larger than 3.5 cm (measured from the renal capsule to the margin of the hematoma)
    - 0 - 1 → 7% risk of hemorrhage requiring intervention
    - 2 - 3 → 67% risk of hemorrhage requiring intervention
  - 162 trauma related renal injuries from 2006-2013**
    - Active extravasation (25 patients); only 28% of these required operative repair
      - 12/25 patients had AAST grades 1-3 (48%): 3 required surgery
      - 13/25 patients had AAST grades 4-5 (52%): 4 required surgery
        - 9 managed conservatively
    - No contrast extravasation: no patients required operative management
  - Collecting system (CS) injury (22 patients)
    - 50% were not identified on initial CT (identified on f/u exams 2-18 days after initial imaging)
      - Perinephric hematoma > 2.0cm had significant correlation with collecting system injury


Management

• Changing trends in management of renal trauma recognizing that surgical exploration for renal trauma often results in nephrectomy with halving of residual renal functional status.

• Broad definition of non-operative management including angioembolization and endoscopic/percutaneous control of urine leak within 24 hours of admission
  • 83.4% of all renal trauma managed successfully with only rest/observation
  • 16.6% required additional intervention; surgical intervention required in 5.9% of those cases

• Independent predictors for failing non-operative management
  • Penetrating injury (thought to be due to frequent disruption of Gerota’s fascia losing the tamponade effect and injury to renal vascular system)
  • Highest abdominal injury grade for non-renal organs (> grade III); pancreatic and bowel injury commonly require surgical management
  • Highest renal grade injury

• 90% of patients that fail non operative management occur within 24 hours; mean of 17.6 hours

• Using a more traditional, narrow definition of non-operative failure (renal surgery), the failure rate is 0.8%.

Comparison of nonoperative and surgical management of renal trauma: Can we predict when nonoperative management fails? J Trauma Acute Care Surg 2016 Vol 82, no. 2
## Management

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<thead>
<tr>
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<th>2002</th>
<th>2012</th>
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<tr>
<td><strong>Blunt trauma</strong></td>
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<tr>
<td>Nephrectomy</td>
<td>8.2%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Endovascular</td>
<td>1.4%</td>
<td>53.3%</td>
</tr>
<tr>
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<td>Nephrectomy</td>
<td>19.3%</td>
<td>4.4%</td>
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<tr>
<td>Laceration repair</td>
<td>75.4%</td>
<td>70.9%</td>
</tr>
<tr>
<td>Endovascular</td>
<td>0%</td>
<td>11.3%</td>
</tr>
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- Grades 1-3 overwhelmingly managed conservatively
- Grades 4 and 5 injuries may be effectively managed by observation
  - 2013 study showed 6.5% of grade 4/5 renal injuries failed conservative management.
- Absolute indications for renal exploration**
  - Life threatening hemorrhage from renovascular injury
  - UPJ avulsion
  - Urinoma unresponsive to minimally invasive procedures

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REFERENCES

- Dugi DD et al. American Association for the Surgery of Trauma Grade 4 Renal Injury Substratification Into Grades 4a (Low Risk) and 4b (High Risk). The Journal of Urology Vol 183, 592-597, February 2010
- Ramchandani P, Buckler PM. Imaging of Genitourinary Trauma. AJR:192, June 2009, pages 1514-1523
ADRENAL TRAUMA

- Epidemiology & general information in renal trauma
- Imaging evaluation and grading (case based review using AAST guidelines)
- Principles of management and follow-up in renal trauma
History: Motor vehicle accident

Hemoperitoneum

Adrenal mass

June 1, 2001

Decreased size and density of the mass on CT 3 weeks later

65HU

20HU
History: Anticoagulated and incidental mass identified on CT

Findings: Large, heterogeneous but non-enhancing mass in the left upper quadrant. What is your differential diagnosis?

Diagnosis: Spontaneous adrenal hemorrhage
Adrenal Trauma

• Traumatic more common than spontaneous
  – 80% are unilateral
    • 85% right
    • 15% left

• Non-traumatic – often bilateral
  – Stress
  – Bleeding disorder or anticoagulation
  – Underlying tumor
  – Unknown

• Adrenal insufficiency occurs when > 90% of the gland is destroyed
BLADDER TRAUMA

• Epidemiology & general information in renal trauma
• Imaging evaluation and grading (case based review using AAST guidelines)
• Principles of management and follow-up in renal trauma
History: Motor vehicle accident.

Superior pubic ramus fracture

Space of Retzius

Extravasated Contrast
Paracolic gutters

Small bowel mesentery

Diagnosis: Intraperitoneal and Extraperitoneal Bladder rupture. Requires surgical repair
History: Motor vehicle accident.

Free fluid in the pelvis and around the liver/spleen

Blood clot in bladder
Diagnosis: Intraperitoneal bladder injury. Requires surgical repair
History: Motor vehicle accident.

Contrast in a laceration of the bladder wall

Diagnosis: Interstitial bladder injury. Managed conservatively
Bladder Injuries

• Contusion (I)
  – Most common minor injury
  – Incomplete or partial tear of bladder mucosa; ecchymosis of a localized portion of the bladder wall
  – Diagnosis of exclusion of more serious injuries
Bladder Injuries

• Intraperitoneal (II)
  – 25% of major bladder injuries
  – Direct blow to a distended bladder
  – Tear along bladder wall at the dome covered by peritoneum
  – Requires surgical repair
Bladder Injuries

• Interstitial (III)
  – Rare
  – Partial thickness laceration with intact serosa
Bladder Injuries

- Extraperitoneal (IV)
  - 62% of major bladder injuries; most common
  - Often with pelvic fractures and lacerations of the anterolateral bladder wall by the spicules but can be associated with blunt trauma without fractures
  - Sub types
    - Simple: Confined to the pelvis
    - Complex: Disruption of the fascial planes allowing contrast to track into the thighs, scrotum, perineum
  - Managed with drainage and conservative
Bladder Injuries

• Combined intra- and extraperitoneal (V)
  – 12% of major bladder injuries
  – Requires surgical repair
CT Cystogram Technique

- Delayed IV enhanced CT NOT adequate to exclude a bladder injury
- Exclude urethral injury first
- 300 mL dilute contrast passively instilled into the bladder through Foley
  - 10 mL Omnipaque 300 in 300 mL saline
- Scan pelvis with bladder full. Scan abdomen and pelvis with bladder empty
- 95-100% sensitivity detecting injury
External Genitalia Trauma
History: Blood at the urethral meatus noticed after ORIF of pelvis fracture.

Laceration and extravasation at urogenital diaphragm

Posterior (contrast contained above the UG diaphragm)

Partial; contrast in the bladder

Extravasation into corpus cavernosum
History: Porsche fell off the jacks onto patient. Blood at the urethral meatus

Laceration and extravasation at urogenital diaphragm

Contrast extravasating into the thigh soft tissues

Combined posterior & anterior (contrast above and below the UG diaphragm)

Complete; No contrast in the bladder
History: Motor vehicle accident

Contrast extravasation into the pelvic extraperitoneal space

Contrast extravasation into the scrotum and perineum
Contrast extravasation into scrotum and perinum

Contrast extravasation into pelvic extraperitoneal

Bladder neck with extension into the posterior urethra and extraperitoneal space

Contrast extravasation into peritoneum
Urethral Injury

• Type I: Posterior urethra is stretched but no extravasation
• Type II: Pure posterior urethra laceration with extravasated contrast above the UG diaphragm
• Type III: Combined anterior and posterior urethra laceration with extravasated contrast above and below the UG diaphragm
  — Most common type of injury
• Type IV: Bladder neck injury with extension into the proximal urethra
• Type V: Anterior urethra laceration
History: Motor vehicle accident.

Diagnosis: Urethral laceration with Foley catheter outside of the urethra/bladder

Blood in the space of Retzius

Diastasis of symphysis pubis

Foley catheter off midline
History: Zamboni driver hit by a hockey puck in the groin.

Diagnosis: Testicular Fracture
History: Hit by a baseball in the groin.

Hypoechoic avascular intra-testicular nodule
3 weeks later the nodule has decreased in size. Tumor markers negative

Diagnosis: Testicular hematoma
Testicular Trauma

• Testicular fracture
  – Irregular testicular contour with disruption of tunica albuginea
  – Heterogeneous parenchymal echogenicity
  – Distorted vascularity
  – Associated epididymal enlargement and hematocele
  – Discrete fracture plane seen in only 17% of cases
  – Surgery necessary
    • 90% salvage rate if done within 3 days; drops to 55% after that

• Testicular hematoma
  – Avascular intra-testicular nodule
  – May be hyperechoic or hypoechoic depending on age
The Worst
History: penile and scrotal swelling. Pain during intercourse.
Penile fracture

- Penile fracture is a disruption of the tunica albuginea and appears on US as a disruption of the echogenic line.
- Hematoma in 100%. If Buck’s fascia is intact then the hematoma is confined to the penis shaft. If Buck’s fascia is disrupted then the hematoma will spread out into the scrotum/perineum.
- Urethral injury in 10% of cases of penis fracture.
- Emergent surgery is indicated.
- Occurs during strenuous sexual activity.
4 years old. It’s a long road and you can’t start too soon.