Retroperitoneal Injury in Blunt Trauma – Focus on Renal Injury

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Goals

- Indications for CT in renal trauma
- CT- grading system versus management
- Appearances of injuries on CT
- Injury of the abnormal kidney
- Adrenal injury and other ..... 
- Retroperitoneal injuries
Renal injury in 3% trauma all admissions and 10% with abdominal trauma
Blunt >> Penetrating injury
Most blunt trauma is minor (>90%) – observed

Indications for **renal** CT

- Penetrating flank/back trauma
- Shock with any hematuria
- Gross hematuria - stable (84% have renal injury)
- Microscopic hematuria with evidence of impact over kidneys (lower posterior rib, transverse process fracture, contusion)
- Known renal injury with dropping hematocrit or increased flank pain
- Microscopic hematuria alone is not an indication (serious injury <0.2%)
- Complications of renal trauma
**Renal Trauma Grading System - 1989**

**Grade I**: contusion or non-enlarging subcapsular hematoma, but no laceration  
**Grade II**: superficial laceration < 1 cm depth and does not involve the collecting system; non-expanding perirenal hematoma  
**Grade III**: laceration > 1 cm, without extension into the renal pelvis or collecting system and with no evidence of urine extravasation  
**Grade IV**: laceration extends to renal pelvis or urinary extravasation  
**Grade V**: shattered kidney; devascularization of kidney due to hilar injury.

CT Grading of Blunt Renal Injury – MD Shock-Trauma Center

**Grade 1:** Superficial laceration – cortex
- Renal contusion (intravasation)
- < 1 cm subcapsular hematoma
- Segmental renal infarct
- No active bleed
- Perinephric hemorrhage not filling Gerota’s fascia

**Grade 2:** Renal laceration extends to medulla
- > 1 cm subcapsular hematoma not delaying renal function
- Stable perinephric hematoma not distending Gerota’s capsule
- No active bleed or urine leak
CT Grading of Blunt Renal Injury

**Grade 3:** Laceration into collecting system; extravasation contained within retroperitoneum

- Perinephric hematoma distending Gerota’s space or involving pararenal spaces; no active bleed
- Renal split (2-fragments) with > 50% parenchymal viability
- Subcapsular hematoma causing delay in renal perfusion

**Grade 4:** Fragmentation of 3 or more segments (usually with major devitalization and large perinephric hematoma) “shattered”

- Devascularization > 50% of parenchyma
- Renal pseudoaneurysm
- Urine leak confined to retroperitoneum
- UPJ or pelvic tear
- Renal artery dissection (flow-limited)
Grade 5 Renal Injury - Intervention

- Active bleeding with expanding hematoma
- Urinary leak into peritoneal cavity
- Complete pelvic avulsion
- Main renal artery injury
- Main renal vein injury
Grade 1 and 2 injuries usually non-surgical (74-98%)

Grade 4 and 5 often require intervention

#Surgery vs. injury grade: 2467 pts.

- grade 1= 0%, grade II=0%, grade III=3%, grade IV =9%, grade V = 86% .
- OR- vascular injuries (active bleeding or pseudoaneurysm), collecting system disruption, major hematoma and persistent or enlarging urinoma

Decrease in renal function correlates with injury grade


Grade 1 renal injury

Superficial laceration - small perinephric hematoma
Contusion - segmental infarct
Subcapsular hematoma normal perfusion
No treatment
Grade 1 renal injuries: medical management
G1 - Renal contusion: contrast leak
Grade 1 Renal injury contusion; delayed flow

? Subcapsular hematoma
Segmental renal infarct

Grade 1 injury
No treatment needed
Segmental or capsular artery occlusion
Often isolated injury
No treatment
Lower pole segmental occlusion
CT Grade 2-3 Renal Injury

Typically medical management with F/U CT imaging

CT Grade 3 Renal Injury
Grade 2 injury

Grade 3 injury

6 hour delay
Grade 3 renal injury

Renal split and extension of hematoma to pararenal space
Urinoma: Grade 3 renal injury

Most resolve without treatment if there is antegrade urine flow
Urinoma

- Usually self-limited
- Need to maintain low pressure collecting system (antegrade flow, nephrostomy, stent)
- Requires delayed images to opacify
- Rarely become infection - drainage
Grade 3 Injury: No intervention with resolution f/u at 9 months
Grade 3 subcapsular hematoma
MAJOR RENAL INJURY – Grade 3
CT Grade 4 Renal Injury

Fragmentation
Devascularization
Grade 5 (4) renal injury (UPJ obstruction)

Rupture UPJ

Renal vein avulsion

Grade 5 renal injury
Blunt trauma: Horseshoe with UPJ leak
Horseshoe ectopic, polycystic kidneys, and congenital UPJ obstruction

Chronic hydronephrosis, renal infection, simple renal cysts, and renal cell cancers

Always follow hematuria to resolution

19% of patients who sustained a renal injury had a preexisting renal anomaly*

Ruptured Pelvis (G4 or G5)
Sledding accident – 15 yr.
CT Grade 4

Renal Angiomyolipomatosis
Tuberous Sclerosis
Bleeding renal vein pseudoaneurysm-bleeding (Gr. 5)
Renal Vein Pseudoaneurysm & Bleeding (Gr. 5)
CT Grade 5 Renal Injury

Active bleeding
Bleeding versus urine leak
Penetrating flank/back trauma

- Limited to retroperitoneum with no direct involvement of organs.
- Involves visceral structure(s), but limited to retroperitoneum
- Extends into the intraperitoneal compartment
- Higher likelihood of vascular injury - pseudoaneurysm
- Consider cavitation energy and secondary missiles with bullets
Renal Angiography / Embolization

- Active bleed by CT or progression of hematoma size
- High grade (4-5) injury in blunt trauma
- Consider in any penetrating renal trauma
- Preserves maximal functioning parenchyma
Grade 4: Renal Artery Dissection
Blunt trauma: Right renal artery dissection, intimal flap, emboli
Renal artery occlusion

- Probably secondary to stretching of artery
- Variable time from injury to complete thrombosis (Warm ischemic time)
- Abrupt proximal renal artery occlusion – can be long dissection
- Very rare to salvage kidney unless multiple renal arteries, well developed collaterals, stenting possible
CT Grade 5

Renal artery occlusion
31 y man - weight lifting

23 y woman blunt
Renal Vein Thrombosis

- Increased renal vein size
- Increased kidney size
- High attenuation intraluminal mass (non-enhanced)
- Delayed nephrogram/pyelogram – prolonged nephrogram
- Renal infarcts (entire kidney on right, collaterals on left usually allows return of function)

Etiologies
- Dehydration
- Nephrotic syndrome
- Trauma (3-4% renal based injuries)
- Pro-coagulant factors
- Severe illness
- Transplant kidney
- Renal cancer
Ureteropelvic injury: Diagnosis on delayed CT
Uretero-pelvic junction tear

Need delayed imaging
Common site of tear in ureter
Complications of Renal Trauma

- 3-10% - increases with injury Grade
- Early: urinoma, delayed bleeding, fistula, abscess, hypertension, renal artery stenosis, pseudoaneurysm
- Late: hydronephrosis, AV fistula, calculus formation, pyelonephritis, hypertension, ureteral stricture
- High-grade blunt and penetrating kidney injuries managed nonoperatively associated with 11.1% and 20.0% complication rate identified on follow-up CT usually in 8-10 days

Retroperitoneal Hematoma

Zone 1: Centrally located; pancreaticoduodenal or major vascular injury most common surgical

Zone 2: Flank or perinephric regions: associated with injuries to GU system or colon: 2\textsuperscript{nd} most common

Zone 3: Pelvic location, associated with pelvic fractures or ileal-femoral vascular injury (most common)
Retroperitoneal hematoma

- Poor sensitivity by exam
- Can accumulate 4L
- Pain abdomen, flank, back, distension, mass, hypotension, femoral neuropathy
- Sonography insensitive, about 60%
- Central zone more likely than lateral zone to need surgery
- Lateral zone seen with renal injury, often Rx non-op.
Adrenal hematoma

- vs. adenoma (HU < 10) or 50% drop density at 10 min. post contrast
- Hematoma 40-60 HU, no enhancement
- Decreases size / may calcify vs. tumor
- Periadrenal hemorrhage
- Direct compression, shear, venous pressure elevation
Adrenal Hematoma

- 2% blunt abdominal trauma
- Rarely isolated, commonly assoc. w/liver contusion
- Majority on the right (77%); left 15%, bilat 8%
- Proposed mechanisms-
  - Direct crush injury
  - Increased adrenal venous pressure, thrombosis
  - Shear injury

IVC Pseudoaneurysm – Massive Retroperitoneal Hematoma
Right iliac vein rupture
Spinal Fractures
Intercostal Bleeding