AAST Acute Care Surgery Didactic Curriculum

Blunt and Penetrating Kidney Trauma

Tom Carver, MD

Epidemiology/Pattern of Injury:

Highlights:

- Renal injuries are relatively uncommon, occurring in approximately 1-3% of all trauma cases and in about 10% of abdominal trauma cases in the United States.
- The majority (90%) of significant renal injuries result from blunt trauma, and even minor blunt abdominal trauma can cause significant kidney damage, especially in cases with pre-existing anatomic issues like renal cysts, ureteral pelvic junction obstruction, or renal tumors.

Diagnosis:

Highlights:

- Hematuria is the most frequent sign of renal trauma, but the amount of hematuria does not always correlate with the severity of the injury. Penetrating injuries can be present without visible hematuria.
- Certain clinical features should prompt radiographic imaging for renal injury:
    - Penetrating trauma (abdomen, flank, lower chest) with a trajectory in proximity to the kidneys based upon traumatic wounds.
    - Blunt abdominal trauma and gross hematuria.
    - Blunt abdominal trauma and microhematuria (>5 RBCs per hpf) with hypotension
    - High-index of suspicion based on the mechanism (i.e., high-energy deceleration trauma)
- A standard CT scan of the abdomen/pelvis with IV contrast will identify the location and severity of parenchymal and vascular renal injuries. Obtaining delayed images (also termed a delayed contrast CT or a CT urogram) assesses the collecting system and ureters. Different phases are required since the renal cortex and collecting system enhance at different timeframes (corticomedullary phase vs. excretory phase). A CTA, which contains a separate arteriovenous phase, can help diagnose a pseudoaneurysm or arteriovenous malformation. These diagnoses are uncommon; therefore, a CTA should be considered only if there is persistent or intermittent gross hematuria despite a normal CT program.

Non-Operative Management:

Highlights:

- Approximately 90% of renal injuries can be managed without surgery if the patient is hemodynamically stable and does not have peritonitis. This includes most blunt and some penetrating injuries, as Gerota's fascia can effectively tamponade bleeding and contain urine leaks. Successful non-operative management is reported in 75% of Grade IV-V kidney traumas, with higher success rates in grade IV versus grade V injuries (89% versus 52%).
- According to the 2019 WSES-AAST Guidelines, patients who are hemodynamically stable with Grade I-V penetrating or blunt kidney injury can safely undergo non-operative management.
- Non-operative management requires close monitoring, along with serial abdominal examinations and lab tests. Initial trauma labs should include CBC, BMP, lactate, INR, ABG and Type and Cross. For blunt and penetrating Grade III-V injury, consider admission to the ICU, bedrest, serial abdominal exams and CBC q6-8 hours until deemed clinically stable. For clinically stable patients with Grade I-II injuries, admission to non-ICU care can be considered.
- According to the 2019 WSES-AAST Guidelines, follow-up imaging is not required for Grade I-II injuries managed conservatively. Repeat CT urogram in 48 hours should be considered in patients with Grade IV or V injuries (looking for urinoma).
- Clinical signs during observation that may prompt repeat imaging include worsening abdominal exam, vitals concerning for bleeding, decreasing hematocrit, coagulopathy, and persistent hematuria. There is a low threshold for re-imaging in patients with underlying renal pathology (i.e., renal cysts) and in neurologically impaired patients where a physical exam is unreliable.
- According to the 2019 WSES-AAST Guidelines, angiography with eventual super-selective angioembolization is a safe and effective procedure and may be indicated in hemodynamically stable or stabilized patients with arterial contrast extravasation, pseudoaneurysms, AV fistula and non-self-limiting gross hematuria. In hemodynamically stable or stabilized patients with severe renal trauma with main renal artery injury, dissection or occlusion, angioembolization and/or percutaneous revascularization with stent or stent-graft is indicated in specialized centers and in patients with limited warm ischemia time (<240 min).

Operative Management:

Highlights:

- Indications for surgical exploration of a renal injury may include hemodynamic instability, ongoing significant hemorrhage necessitating transfusion, evidence of pulsatile or expanding hematoma during exploration, or avulsion of the renal pedicle. However, renal salvage rates are generally better when surgery can be avoided. Grade V renal injuries are typically not suitable for non-operative management.
- If considering a nephrectomy and pre-operative imaging is unavailable, assess the contralateral kidney's presence and normalcy before exploration.

- Early renal vascular control proximal to the injured location before renal exploration can facilitate the repair of renal artery injuries. Midline vascular control of the renal pedicle can be achieved by incising the posterior peritoneum lateral to the aorta and individually dissecting and looping the renal vessels on the injured side. While this approach is advocated to reduce unnecessary nephrectomy, proximal control with massive hemorrhage may not be feasible.
- A more rapid approach is to mobilize the colon to access the hilum. In this approach, the colon is reflected medially in order to clamp the pedicle if significant bleeding is encountered upon opening Gerota's fascial envelope.
- If the patient is not stable enough for CT imaging prior to the operating room, remember the principles for the management of retroperitoneal injury:
    - Zone II Penetrating Injury: explore the kidney for active hemorrhage or an expanding hematoma
    - Zone II Blunt Injury: explore for an expanding hematoma, do not explore a contained, non-expanding hematoma.

Renal Salvage Maneuvers – Repair versus Partial Nephrectomy:

Highlights:

- Interpolar renal injuries are best managed by debridement of devitalized parenchyma, control of vessels with absorbable sutures, closure of collecting system injuries and consideration of internal stent placement with a bladder catheter or nephrostomy tube to reduce the risk of urinary leakage and urinoma formation. Thrombin-soaked Gelfoam can be placed into a parenchymal defect with suture placement into the surrounding perirenal fascia to provide tissue compression.
- Blunt upper or lower pole parenchymal injuries that require exploration are best managed with partial nephrectomy.
- Capsular approximation is crucial as the renal parenchyma does not hold sutures well. Use polypropylene sutures and pledgets for capsule closure, and fill any gaps with fibrin sealant, thrombin-soaked Gelfoam, or omentum. Place a drain near the kidney to prevent urine leakage.
- Achieving hemostasis can involve various approaches, including using a local fat pedicle, topical hemostatic agents, or an argon beam coagulator.

Management of Renal Artery Injuries:

Highlights:

- Injury to the renal artery following blunt trauma is rare (0.05-0.08%). Injuries such as avulsion of the pedicle or large lacerations present with hemodynamic instability will require primary arterial repair, renal auto-transplantation or nephrectomy. Results of renal artery surgical revascularization are poor, with long-term kidney function preservation rate of less than 25%.
- A 2021 review in Clinical Radiology sought to address the management of renal artery dissection as the therapeutic implications are debated due to the lack of large meta-analysis. Their review makes management recommendations of renal artery injuries

based on five main imaging patterns encountered in clinical practice. Endovascular treatment with stenting is the preferred option in cases of flow-limiting main renal artery dissection.

- Non-operative management with anticoagulation is the preferred option in cases of non-critical stenosis (<70%) without flow limitation because the dissection tends to resolve spontaneously in most cases. Segmental vascular injuries may be treated with angioembolization. Embolization of the renal artery stump may be the best option in cases of occlusive dissection, as catheter manipulation carries a high risk of vessel rupture. The therapeutic window for kidney revascularization in cases of flow-limiting dissection of the main renal artery may be variable. Endovascular stenting >4 hours after trauma should be performed only if residual flow with preserved parenchymal perfusion is detected at angiography. Antiplatelet therapy administration is recommended in cases of stenting.
- Of note, half of AAST grade V blunt renal injuries, mainly those with “shattered kidney”, may be selected for non-operative management if hemodynamically stable, with a renal salvage rate of 90%.