

Renal Trauma: Grading and Management

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Abstract

Renal trauma most commonly occurs because of blunt force trauma in the pediatric population. When renal trauma is suspected, a CT should be performed. The American Association for the Surgery of Trauma grading system is used to describe renal injuries and guide management. Treatment of renal injuries ranges from observation to hemodynamic stability. Outcomes depend upon the injury grade and associated injuries. Patients with grade 4 and 5 injuries have a longer hospital stay and a higher risk of complications.

Keywords: Trauma, Retroperitoneum, Renal

Case Summary

An adolescent was injured riding a sled being pulled behind an All-Terrain Vehicle.

Imaging Findings

Contrast-enhanced CT of the abdomen (Figure 1) showed a grade 5 renal laceration with devascularization of the lower two-thirds of the kidney and a laceration in the upper pole. Delayed images showed increasing density of the hematoma adjacent to and within the kidney. A subsequent renal artery angiogram (Figure 2) was performed. Again, there was vascularization of the upper pole of the kidney and devascularization of the lower pole. There is no contrast extravasation. Renal US (Figure 3) showed similar findings with a large hematoma of the lower pole of the right kidney and no color Doppler flow within the lower pole.

Diagnosis

Grade 5 renal trauma

Discussion

Renal trauma is relatively common in the pediatric population. The odds of renal injury are 48% higher in children compared with adults aged 30-50 years.¹ Children have a greater risk of renal injury due to their smaller volume of perirenal fat and the kidney's relative mobility within Gerota fascia. These factors make the kidney more prone to deceleration-related trauma.²

Patients present after blunt trauma with varied symptoms, including flank pain, bruising, tenderness, hematuria, and in severe cases, hypovolemic shock.¹

Microscopic hematuria is often present in children with renal trauma. One study showed that 25-50% of individuals had microscopic hematuria depending on the

severity of renal injury.³ In instances where there is a concurrent decrease in hematocrit alongside any level of hematuria, imaging is advised.¹ However, relying solely on this criterion for imaging is not advised since the absence of hematuria does not rule out significant renal injury.³ Similarly, hypotension is a late manifestation of hypovolemia in children due to their ability to compensate by vasoconstriction; therefore, normal blood pressure does not exclude the possibility of a significant renal injury.

Motor vehicle collisions are the most common cause of renal trauma, accounting for 46% of reported injuries. Bicycle riding is the most common activity associated with renal injuries in children, accounting for 57% of cases.² Contact sports are a less common cause of renal injury. However, in teenagers, these sports represent the most common cause of injury, accounting for nearly 63% of cases.⁴

The current gold standard imaging modality for renal trauma is contrast-enhanced CT of the abdomen and pelvis.^{1,5} Contrast is necessary for visualization of the renal parenchyma and vasculature. Many pediatric institutions perform a single-phase CT in the venous phase as the overall incidence of renal injury is low in patients with blunt abdominal trauma. Images are checked at acquisition

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Figure 1. (A, B) Axial and (C) coronal contrast-enhanced CT images showing a laceration (arrow) of the upper pole of the right kidney and a large hematoma (arrowhead) of the lower pole. (D, E) Axial and (F) coronal 5-minute delayed images showing the renal laceration and increasing density (dashed arrow) of the hematoma; however, no definite active extravasation was visible.

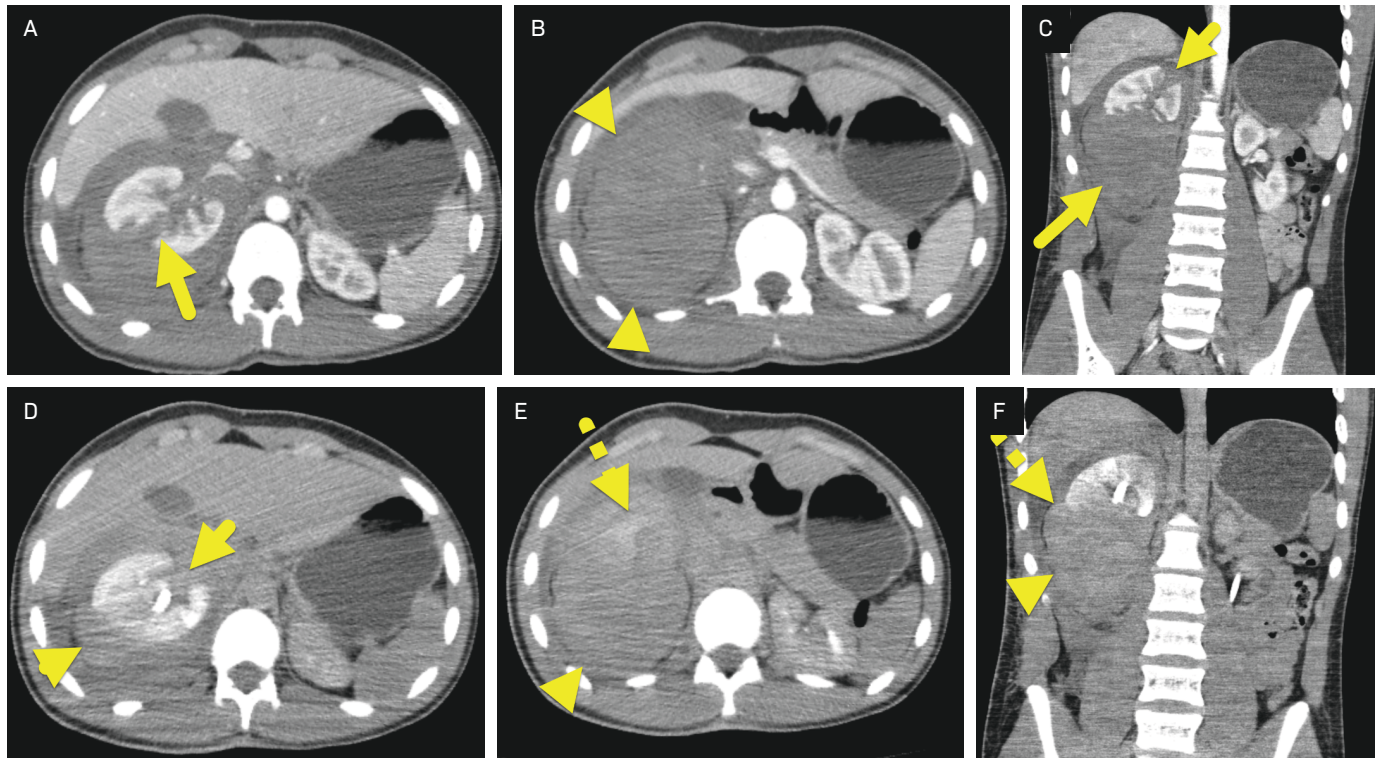


Figure 2. Selective right renal artery angiogram showing vascularization of the upper pole and absent perfusion within the lower pole.



to determine if a renal injury is present. If a renal injury is present and perinephric fluid is visible, delayed images are obtained to assess for a urine leak. Some organizations prefer to perform trauma imaging using a split contrast bolus. With this technique, contrast is administered at 2 timepoints before imaging is initiated. This allows vessels and renal collecting systems to be assessed at the same time, avoiding the excess radiation dose and longer imaging times associated with delayed images. However, a potential limitation of this approach is difficulty distinguishing a vascular injury from an injury to the collecting system.

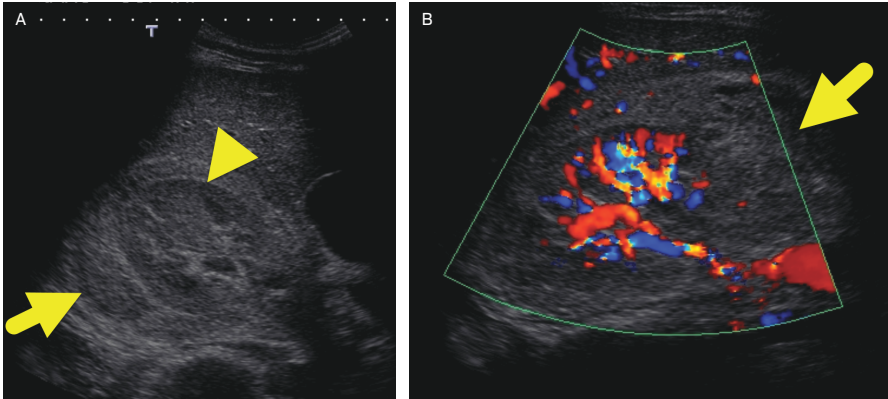
US can be used to evaluate hemodynamically unstable patients who cannot undergo CT imaging.⁶ However, this approach is uncommon as children who are too unstable for CT are often taken immediately to the operating room for exploratory laparotomy. When performed, US may miss renal and

collecting system injuries due to the kidney's retroperitoneal location. Prior studies have shown that FAST US exhibits a high specificity (95%) but low sensitivity (33-89%) for detecting a renal injury.⁶ Thus, US should not be the sole imaging modality in the evaluation of pediatric blunt abdominal trauma.⁶

The American Association for the Surgery of Trauma (AAST) has developed a grading scale based on CT findings (Table 1).⁷ This grading system ranges from 1 to 5, with higher grade injuries being more severe. The AAST grading system should be used to describe all renal trauma as current management depends upon the severity of injury. Minor injuries are usually observed and treated expectantly, while embolization, open surgical repair, or nephrectomy is indicated for severe injuries.⁸

Outcomes depend upon the injury grade and associated injuries. In general, children with grade 1-3 renal injuries have

Figure 3. (A) Transverse US of the right kidney showing a hematoma (arrow) surrounding the upper pole parenchyma (arrowhead). (B) Longitudinal color Doppler image showing vascular flow within the upper pole and absent flow within the lower pole hematoma (arrow).



may lose renal tissue, and have long-term complications of renal malfunction and loss of function.

Conclusion

Renal trauma most commonly occurs because of blunt force trauma in the pediatric population. When renal trauma is suspected, CT should be performed. The AAST grading system is used to describe renal injuries and guide management. Treatment of renal injuries ranges from observation to hemodynamic stability. Outcomes depend upon the injury grade and associated injuries. Patients with grade 4 and 5 injuries have a longer hospital stay and a higher risk of complications.

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Table 1. The American Association for the Surgery of Trauma Kidney Injury Scale

American Association for the Surgery of Trauma Grade	Abbreviated Injury Scale	Imaging Criteria (CT Findings)
1	2	Subcapsular hematoma and/or parenchymal contusion without laceration
2	2	Perirenal hematoma confined to Gerota fascia OR renal parenchymal laceration ≤ 1 cm depth without urinary extravasation
3	3	Renal parenchymal laceration > 1 cm depth without collecting system rupture or urinary extravasation OR any injury in the presence of a kidney vascular injury or active bleeding contained within Gerota fascia
4	4	Parenchymal laceration extending into urinary collecting system with urinary extravasation OR renal pelvis laceration and/or complete ureteropelvic disruption OR segmental renal vein or artery injury OR active bleeding beyond Gerota fascia into the retroperitoneum or peritoneum OR segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding
5	5	Main renal artery or vein laceration or avulsion of hilum OR devascularized kidney with active bleeding OR shattered kidney with loss of identifiable parenchymal renal anatomy

good outcomes, high success rates, and normal to near-normal renal function. Patients with grade 4 and 5 injuries have a longer hospital stay and a higher risk of complications. These

patients often require transfusions, sepsis, urinomas, and a higher risk of post-traumatic hypertension. This subgroup has a greater likelihood of requiring surgical and image-guided interventions,