AAST Acute Care Surgery Didactic Curriculum

Genitouinary Injury Renal Trauma

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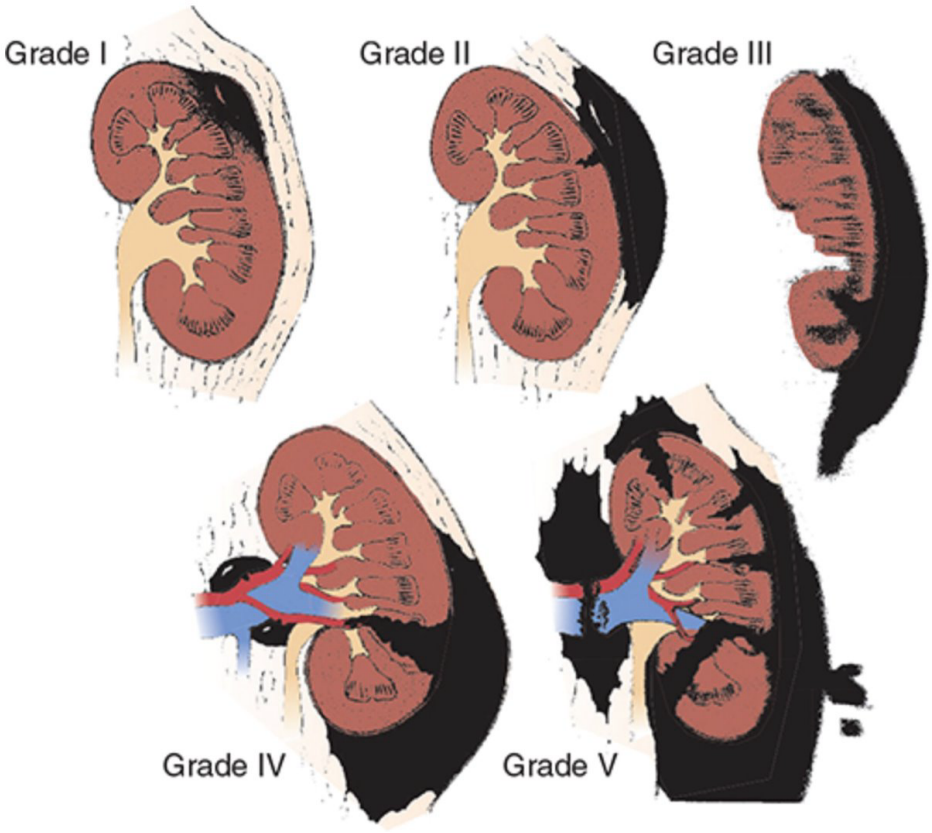
Overview:

Renal injuries occur predominantly in young male, the incidence in the literature ranges 1.2% to 3.2% in all trauma patients. [12] Blunt mechanism accounts for the majority, (71% to 85%) and penetrating trauma is lower, 16% -19% but accounts for a higher percentage of those needing operative management. Nephrectomy rates vary between 11% to 47% for patients undergoing renal exploration, the most common indication is hemodynamic instability and injury grade.

The management of renal trauma has evolved over time, as in other abdominal injuries the use of non-operative management (NOM) has significantly increased up to 80% in some series.[3] The global impact of new resuscitation strategies, damage control resuscitation, using blood products in ratios (1:1:1 or 1:1:2) of plasma to platelets to packed red blood cells [PRBCs] cannot be overstated. It should be emphasized that there are no randomized studies to guide proper management.

Grading

The American Association for the Surgery of Trauma Organ Injury Scaling Committee developed the most widely used renal injury grading system. First published in 1989 as an atomical description of the injury mainly based on findings at laparotomy before there was widespread use CT. [4] The revised AAST 2018 update is still an anatomic description, but with increased incorporation of contrast-enhanced spiral CT enabling diagnosis of vascular injury, pseudoaneurysm or arteriovenous fistula, and collecting system injuries.[5] [6] the improved accuracy has enabled incorporation of minimally invasive interventions. [7] It is important to note that despite the increased anatomic detail, it did not outperform the 1989 AAST grading in predicting bleeding and need for intervention.



AAST Grade	AIS Severity	Imaging Criteria (CT Findings)	Operative Goals	Pathologic Criteria
I	2	– Subcapsular hematoma and/or parenchymal contusion without laceration	– Nonexpanding subcapsular hematoma – Parenchymal contusion without laceration	– Subcapsular hematoma or parenchymal contusion without parenchymal laceration
II	2	– Perirenal hematoma confined to Gerota fascia	– Nonexpanding perirenal hematoma confined to Gerota fascia	– Perirenal hematoma confined to Gerota fascia
		– Renal parenchymal laceration ≤1 cm depth without urinary extravasation	– Renal parenchymal laceration ≤1 cm depth without urinary extravasation	– Renal parenchymal laceration ≤1 cm depth without urinary extravasation
III	3	– Renal parenchymal laceration >1 cm depth without collecting system rupture or urinary extravasation	– Renal parenchymal laceration >1 cm depth without collecting system rupture or urinary extravasation	– Renal parenchymal laceration >1 cm depth without collecting system rupture or urinary extravasation
		– Any injury in the presence of a kidney vascular injury or active bleeding contained within Gerota fascia	–	
IV	4	– Parenchymal laceration extending into urinary collecting system with urinary extravasation	– Parenchymal laceration extending into urinary collecting system with urinary extravasation	– Parenchymal laceration extending into urinary collecting system
		– Renal pelvis laceration and/or complete ureteropelvic disruption – Segmental renal vein or artery injury – Active bleeding beyond Gerota fascia into the retroperitoneum or peritoneum	– Renal pelvis laceration and/or complete ureteropelvic disruption – Segmental renal vein or artery injury – Segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding	– Renal pelvis laceration and/or complete ureteropelvic disruption – Segmental renal vein or artery injury – Segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding
		– Segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding		
V	5	– Main renal artery or vein laceration or avulsion of hilum – Devascularized kidney with active bleeding – Shattered kidney with loss of identifiable parenchymal renal anatomy	– Main renal artery or vein laceration or avulsion of hilum – Devascularized kidney with active bleeding – Shattered kidney with loss of identifiable parenchymal renal anatomy	– Main renal artery or vein laceration or avulsion of hilum – Devascularized kidney – Shattered kidney with loss of identifiable parenchymal renal anatomy

Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging. Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.
Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen.
More than one grade of kidney injury may be present and should be classified by the higher grade of injury.
Advance one grade for bilateral injuries up to Grade III.

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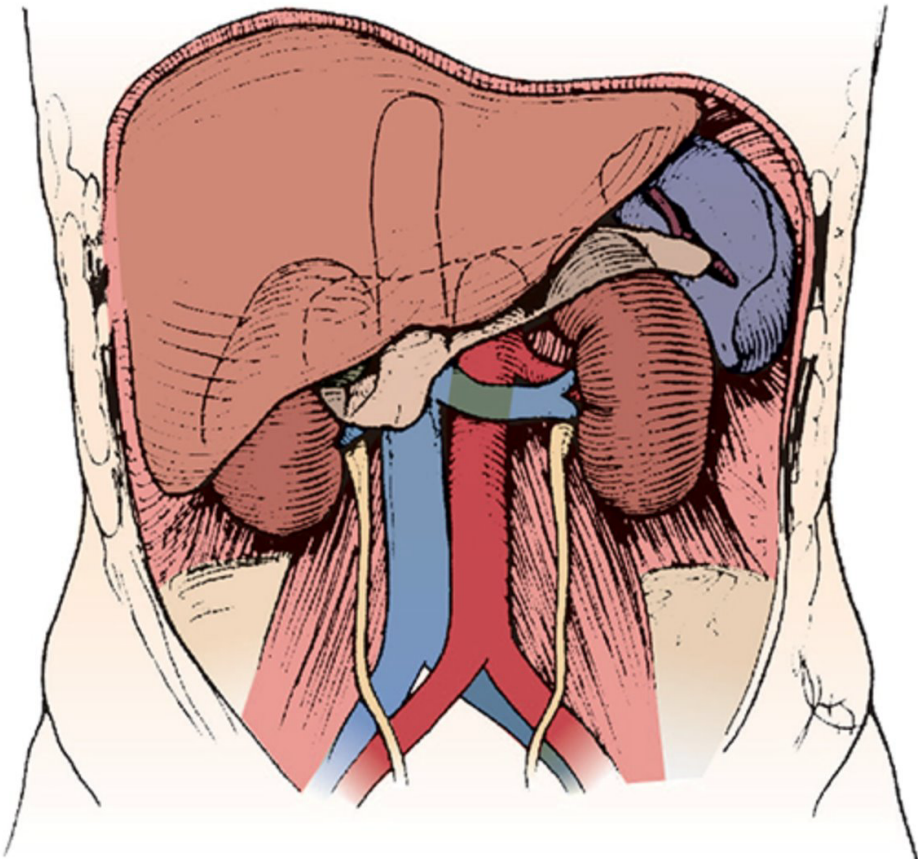
Wright et all in their review of National Trauma Data Bank found renal and extra-renal predictors of nephrectomy. [8]

Pertinent Anatomy



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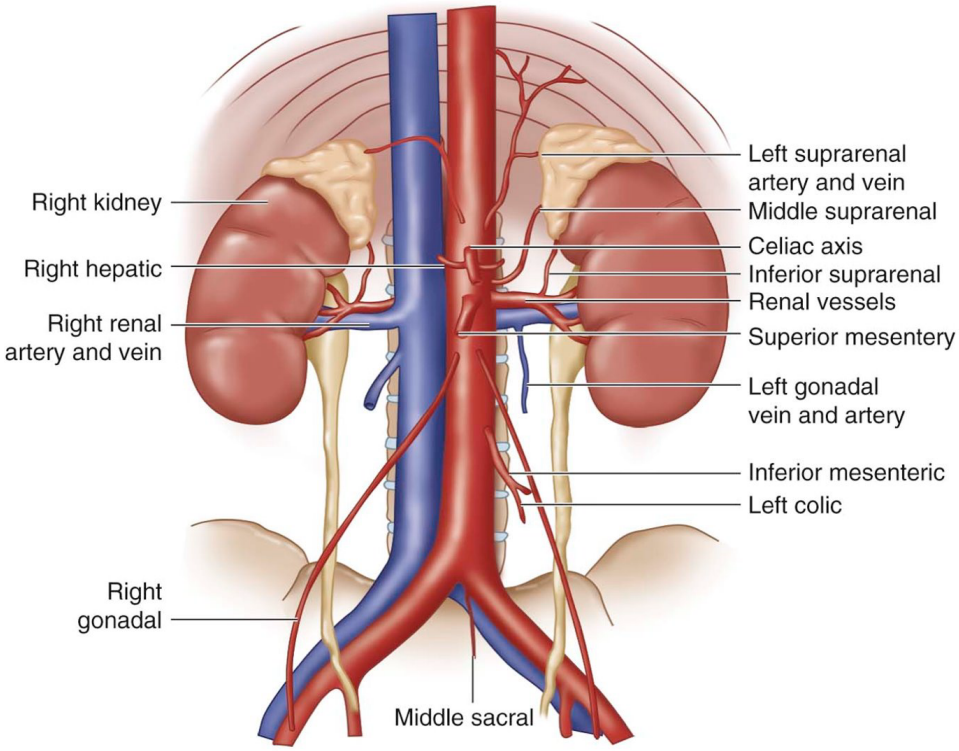
The kidneys are paired retroperitoneal organs, laying on the posterior abdominal wall, at the level between the transverse processes of T12 and L3. The right kidney is usually slightly more inferior in position than the left kidney. They are invested in a fibro-fatty layer of tissue, Gerota's facia, on top of each kidney are the suprarenal glands (adrenal glands). The superior 3rd (upper pole) of the kidney rests on the diaphragm, the 12th rib passes posterior to it. The kidneys overly the medial aspect of the psoas muscle and the lateral aspect of the quadratus lumborum. Penetrating trauma can result in brisk bleeding from these and the other deeper muscles of the back and may be misinterpreted as bleeding from the kidney.

The right kidney is posterior to the ascending colon, the second part of the duodenum medially, and the liver, separated by the hepatorenal recess. The left kidney is posterior to the descending colon, its renal hilum lateral to the tail of the pancreas, superomedial aspect adjacent to the greater curvature of the stomach and left upper pole next to the spleen and connected by splenorenal ligaments.

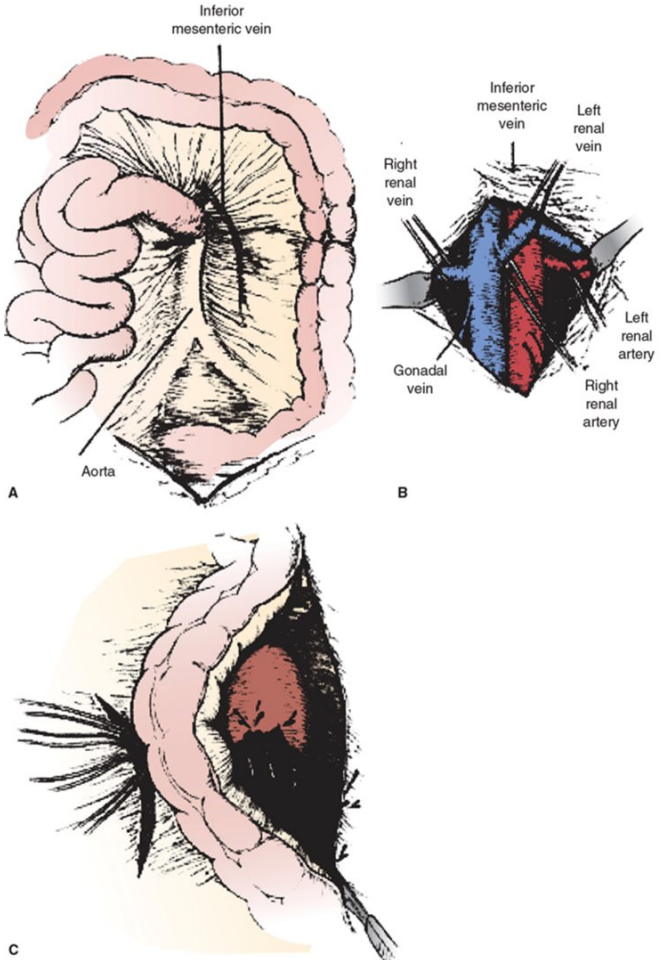
At the medial margin of each kidney lies the renal hilum, where the renal artery enters, and the renal pelvis and vein leave the renal sinus. The renal artery originates from the aorta between L1 and L2, just inferior to the origin of the superior mesenteric artery (SMA). The left renal artery arises

at a higher level than the right renal artery. The right renal artery is longer and passes posterior to the vena cava. As each renal artery approaches the hilum, it divides into anterior and posterior segmental arteries. The renal vein is found anterior to the renal artery, which is anterior to the renal pelvis.



From: Evers, W.C.C.T.J.A.B. (2014). Atlas of Trauma/Emergency Surgical Techniques - Electronic. Elsevier - OHCE.

Pertinent anatomy to be attentive to during exploration, the left renal vein passes anteriorly to the aorta and receives drainage from the left gonadal vein, the left inferior adrenal vein, and a lumbar vein. The presence of these collateral branches of the renal veins can allow safe ligation of the left renal vein near the vena in 85% of cases. On the right side such collaterals do not exist, the gonadal vein arises directly from the vena cava, a lumbar vein, often arises from the posterior aspect of the right renal vein near the connection with the inferior vena cava. Ligation of the right renal vein close to the IVC will most likely result in thrombosis and a nonviable kidney.



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Managment

The gold standard for evaluating renal injuries is a contrast-enhanced CT scan with delayed images.[6] Immediate surgical exploration is indicated in the presence of hemodynamic instability. The surgeon may also forego preop imaging in stable patients in the presence of peritonitis or in penetrating trauma. In those situations, the surgeon must prioritize the injuries encountered. Isolated renal injuries are rare, Toutouzas et al. of the 37 patients in their series of 37 patients with blunt, only 10 (27%) had isolated injuries.[3] Another study of 185 patients with penetrating trauma, there were no isolated renal injuries.[9] The liver, spleen, duodenum, vena cava, aorta, ureter and bowel injuries were concomitant injuries found with penetrating trauma.

Once in the abdomen a quick evaluation to ensure that the concomitant injuries are not the cause of hemodynamic instability. The only absolute indication for immediate renal exploration is evidence of brisk bleeding such as expanding perirenal hematoma in the presence of hemodynamic instability. When renal exploration is chosen, assessment of presence of the contralateral kidney should be done by palpation, or more accurately with an intraoperative on-table, “one-shot”, IVP. Intravenous administration of 1 to 2 mL/kg of iodinated contrast followed by an excretion abdominal x-ray in about 10 minutes.[10] This needs to be thought of early so that other general surgical tasks are being carried out to avoid wasting time. While an intraoperative IVP provides some added reassurance that a functional contralateral kidney is present when exploring

an injured kidney, trauma surgeons generally proceed with exploration of the injured kidney based on contralateral renal palpation alone. This practice is controversial practice and is not based on randomized controlled studies. A survey of members of the Society of Genitourinary Reconstructive Surgeons (GRUS) and AAST members was presented at AAST Annual Meeting in 2010 and revealed differing "community standards of practice" of renal trauma.[11] Urologists are proponents of the on-table IVP use.

Urologists also tend to try a period of observation of collecting system injuries initially then reimage either in 48 to 72 hours in and place ureteral stents after the injury or only if the clinical scenario (i.e., unexplained fever or flank pain) warrants it. The literature supports a trial of observation with bladder drainage and broad-spectrum antibiotics for patients with urinary extravasation as a result of blunt or penetrating RT, as these injuries spontaneously resolve in 81% to 91% of cases. [1213]

There is also controversy whether to obtain early proximal renal vascular control prior to renal exploration. In this same survey, the urologists tend to obtain proximal renal vascular control with vessel loops before renal exploration compared to trauma surgeons (71.4% vs. 20.7%; $p < 0.0001$). The renal vessels are exposed by reflecting peritoneum at the ligament of Treitz medial to the inferior mesenteric vein and individually dissecting the renal vessels and placing vessel loops. Trauma surgeons favor medial visceral rotation, reflecting the descending colon medially exposing the perinephric hematoma contending that preliminary control of the renal vessels is not necessary in trauma. The best renal salvage rates are reported when vascular access or control is obtained. Damage control scenarios pose the most challenge to the surgeon who risks leaving the OR only to return a few hours because of hypotension and continued bleeding. As a result, potentially salvageable low-grade injured kidneys are sacrificed as a package to control severe bleeding. The surgeon must pose and assess whether firm indications to explore the kidney exist.

Grade IV and V injuries involve segmental renal artery or renal vein injury or hilar avulsion and require revascularization to salvage. The results after renal revascularization in these situations have been poor, impaired renal function, delayed development of hypertension or progressive renal failure are possible complications. Knudson et al have observed that these patients may be best served by immediate nephrectomy, if there is a functioning contralateral kidney.[14]

Institutional factors, know your institution well, availability of skilled interventional radiologists or urologists who are familiar with partial nephrectomy is important and might influence your decision.

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