

Evaluation and Management of Blunt Solid Organ Trauma



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Trauma is a leading cause of death in patients under the age of 45 and generally associated with a high kinetic energy event such as a motor vehicle accident or fall from extreme elevations. Blunt trauma can affect every organ system and major vascular structure with potentially devastating effect. When we consider abdominal solid organ injury from blunt trauma, we usually think of the liver, spleen, and kidneys. However, all of the abdominal organs, including the pancreas and adrenal glands, may be involved. Blunt hepatic trauma is more commonly associated with venous bleeding rather than arterial injury. Stable venous injury is often managed conservatively; when the patient is hemodynamically unstable from venous hepatic injury, operative management should be first-line therapy. When the injury is arterial, endovascular therapy should be initiated. Blunt trauma to the spleen is the most common cause of traumatic injury to the spleen. Management is controversial. In our institution unstable patients are taken to the operating room, and stable patients with Grades IV-V injuries and patients with active arterial injury are taken for endovascular treatment. Renal injuries are less common, and evidence of arterial injury such as active extravasation or pseudoaneurysm is warranted before endovascular therapy. Pancreatic trauma is uncommon and usually secondary to steering wheel/handlebar mechanism injuries. Adrenal injuries are rare in the absence of megatrauma or underlying adrenal abnormality.

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Statistics and Epidemiology, the Role of the Interventionist

Traumatic injury is a major cause of mortality worldwide, with over 5 million fatalities per year. Most of the preventable deaths in the trauma setting are a result of unrecognized, and therefore, untreated hemorrhage.¹⁻³ Uncontrolled bleeding results in 30%-40% of trauma-related early mortality.⁴ In trying to prevent morbid outcomes, blunt solid organ trauma is approached on an organ-by-organ basis.

The spleen is the second most commonly injured organ, however it is the most common source of massive bleeding in blunt abdominal trauma. The role

of interventional radiology in splenic trauma is hotly contested, but the ideal goal is to reduce splenic perfusion pressure and promote hemostasis while preserving long-term splenic function. Some institutions take an aggressive endovascular approach, with embolization as preferred first-line therapy in any patients with Grades III-V injuries,⁵ while reserving surgery for those patients who are hemodynamically unstable or with clinical signs of peritonitis.⁶ Other institutions are on the other end of the spectrum, with surgical or medical intervention as the predominant therapy, and endovascular management reserved only for patients with active extravasation. Some data suggest that prophylactic splenic embolization should be strongly considered in patients >50 years old.⁷ Although controversial, literature supports practice paradigms with aggressive IR intervention in Grades IV-V injuries, and injuries with evidence of active arterial injury.^{8,9} With increasing early management, improved outcomes have been seen, leading many hospitals to adopt this approach.

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The most common organ injured in blunt force trauma is the liver. Multiple trials have investigated the role of interventions in blunt force liver trauma and have resulted in our current management paradigm. At our institution, patients with evidence of arterial injury are managed endovascularly. Hemodynamically stable patients without evidence of arterial injury are managed conservatively. Hemodynamically unstable patients without definite evidence of arterial injury are taken to the operating room with concomitant activation of the interventional radiology team in case there is intraoperative evidence of an arterial injury, or, in the setting of complete surgical treatment without hemodynamic stabilization. Statistically, greater than 70% of traumatic liver injuries are managed conservatively.¹⁰

For additional organs, including the kidneys, pancreas, and adrenal glands, we rely upon imaging evidence of active extravasation before endovascular intervention.

Clinical Evaluation of the Patient

When approaching blunt abdominal trauma, initial triage and evaluation begins before the patient's arrival to the hospital. At our institution, a Level I trauma center, the emergency physician and trauma surgeon work in tandem to coordinate the appropriate level of care. The patient is evaluated first by physical exam and radiographs of the chest and pelvis. A focused assessment with sonography in trauma (FAST) is performed. Patients who are hemodynamically stable undergo a single phase, split bolus CTA of the chest, abdomen, and pelvis. The split bolus allows for parenchymal evaluation with half the contrast in portal venous phase, as well as simultaneous arterial evaluation.

Hemodynamically unstable patients are taken to the operating room, sometimes before acquisition of the split bolus CTA. If clinically indicated, a femoral access sheath is placed by the trauma team under ultrasound before going to surgery, through which a REBOA balloon catheter (ER-REBOA, Prytime Medical, Boerne, TX) is placed. Subsequently, a commercial or sheet pelvic binder is placed. If an abdominal source of hemorrhage is suspected, the REBOA is stationed above the celiac artery (Zone 1, measured externally to the xiphoid). If only a pelvic source of hemorrhage is suspected, the REBOA is stationed just above the aortic bifurcation (Zone 3, measured externally to just above the umbilicus). When we are consulted on a patient who is too unstable to undergo a CTA, we perform emergent angiography (and possible embolization) in the hybrid operating room without the guidance of cross-sectional imaging. Depending on clinical status, the REBOA access sheath can be used for our endovascular intervention or contralateral femoral access may be obtained.

In any scenario, initial management of a trauma patient should entail securing intravenous (IV) access and initiating fluid resuscitation with crystalloids and blood products

as necessary. At our institution, a massive transfusion protocol is initiated. Any underlying coagulopathy or thrombocytopenia should be corrected. Airway protection is a priority, and should be supported by anesthesia and respiratory therapy when appropriate.

When evaluating the split bolus CTA for the purpose of blunt abdominal trauma, our focus is directed toward the spleen, the liver, and the kidneys. Significant injuries to the pancreas and adrenal glands are less common.

Blunt hepatic trauma is more commonly associated with venous rather than arterial injury.¹¹ Stable venous injury is often managed conservatively. When the patient is hemodynamically unstable from venous hepatic injury, operative management should be first-line therapy. When the injury is arterial, including active extravasation, pseudoaneurysm formation, or significant arterioportal fistula, endovascular therapy should be initiated, and the manner of repair can be either through permanent embolization (eg, coils) if focal, or with temporary embolization (eg, gelfoam) if diffuse. Additional points to consider with hepatic injury are injuries to the biliary system and the complication of hepatic necrosis after embolization.

The approach to the patient with splenic trauma can be controversial. If hemodynamically unstable or exhibits signs of peritonitis, the patient is taken to the operating room. On the other hand, if a patient is hemodynamically stable and there are no CT signs of injury, the patient may be managed nonoperatively. While CT is highly accurate in general, it is felt to be less sensitive in splenic injury, and for this reason follow-up CT at 48 hours may be performed if the initial imaging is normal.^{12,13} When active contrast extravasation is present, the patient is taken to the endovascular suite. If active contrast extravasation is not present, the grading of the splenic injury becomes very important. Grades I-II injuries are managed medically. Grades IV-V injuries are taken for endovascular therapy. Grade III injuries are debatable and management can depend on discussion with the trauma surgeon, although generally these are managed medically.

In renal trauma, the most frequent presenting clinical sign is hematuria, although in high-grade injuries (eg, renal pedicle injuries), hematuria may be absent. CT is the most sensitive examination for renal injury. If there is active extravasation or pseudoaneurysm, distal embolization of the source will be attempted. If the kidney is completely devascularized, attempts at revascularization can be made if attempted shortly after the initial injury. The kidney usually maintains collateral flow and for this reason surgical revascularization, with the ability to directly visualize the kidney and determine if it is viable or necrotic, can be attempted more remotely from the initial insult. Patients who undergo revascularization should always be monitored for the development of hypertension.¹⁴

If active extravasation is seen in an adrenal gland or in the pancreas in the setting of polytrauma, superselective

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