Journal of Radiology Nursing xxx (2017) 1–6

Contents lists available at ScienceDirect

Journal of Radiology Nursing

journal homepage: www.radiologynursing.org

Clinical Approach to the Trauma Patient

Shiraz Rahim, MD *, Jon Davidson, MD

Department of Radiology, University Hospitals Cleveland Medical Center, Case Western Reserve University, Cleveland, OH

Keywords:
Trauma
Imaging
Patient care
Radiology nursing

A B S T R A C T

This review article is designed as an introductory reference to the clinical management of trauma patients by interventional radiologists. The article is geared toward the radiology nurse participating in the care of these patients alongside the interventionalist to provide a framework to understand the process of working up, treating, and managing trauma patients using minimally invasive techniques. Special emphasis is placed on the preoperative and postprocedural care issues that are relevant specifically to nursing staff as they relate interventional radiology. A sample case is provided at the end to further emphasize key points discussed in the article.

Clinical approach to the trauma patient

Interventional radiology (IR) plays a strong role in the management of patients with solid organ injuries, and an understanding of the presentation, imaging features, and management of patients is vital to administer appropriate care by both interventional physicians and nursing staff. Identifying and treating solid organ trauma requires a multidisciplinary approach as well as rapid evaluation and treatment to avoid potential patient decompensation. Vigilance and readiness are key to patient care.

Workup of the Trauma Patient

Although the initial triage of patients is often performed by a dedicated trauma and emergency room (ER) team, an understanding of the clinical presentation of trauma patients is vital for radiology health care providers as well. Patients presenting with hepatic or splenic injury often present with localized pain over the organ, over the right upper quadrant for the liver, and over the left upper quadrant for the spleen. Bleeding around the organs can cause irritation of the adjacent diaphragm, which causes referred symptoms to the shoulders; therefore, lack of localized pain and presentation with shoulder pain can be the only presenting symptom. Additional findings can include hypotension caused by blood loss with compensatory tachycardia and drops in the blood hemoglobin levels. Elevation of liver function tests with an increase in transaminase levels can also suggest evidence of hepatic injury. Post-traumatic sequelae can also develop, such as fistulas between the gallbladder and bile ducts with the surrounding gastrointestinal (GI) tract as well as pseudoaneurysms of the adjacent vasculature. Both these have specific presentations that must be considered as they can present with delayed symptoms from the initial time of trauma.

The initial workup of the trauma patient usually involves a clinical history, physical examination, and laboratory work, although in certain situations of high-speed trauma or decompensating clinical status, patients may be rushed straight to imaging to identify urgent pathologies. Imaging often begins with a chest X-ray to identify major complications of chest trauma such as pneumothorax and a contrast-enhanced computed tomography (CT) to identify injury to the solid organs and bleeding. Ultrasound is occasionally used in the emergent setting to identify fluid in the abdomen as a suggestion of underlying organ injury; however, this modality requires a significant amount of time and is often reserved for stable patients. Magnetic resonance imaging is also a time-consuming modality best reserved for cases of suspected spinal injury who are otherwise stable and able to undergo imaging. It is important for nurses to be aware of the standard approach to the workup of a trauma patient as the history of receiving intravenous contrast may affect the renal function in the short term and can affect patient's blood pressures and ability to excrete certain types of medications such as sedating medications and cause prolonged effects of the medications in the patient's bloodstream. Contrast media can also affect excretion and renal function in patients who already have underlying pre-existing kidney disease.

Conflicts of interest and source of funding: The contributing authors have no financial disclosures to report. There was no funding for this research project or article preparation. There are no conflicts of interest to report.

* Corresponding author: Shiraz Rahim, Department of Radiology, University Hospitals Cleveland Medical Center, 11100 Euclid Avenue, Cleveland, OH 44106.
E-mail address: Shiraz.rahim@uhhospitals.org (S. Rahim).

https://doi.org/10.1016/j.jradnu.2017.09.002
1546-0843/$36.00/Copyright © 2017 by the Association for Radiologic & Imaging Nursing.

Indications for the Treatment of Trauma Patients by IR

Injuries to solid organs, particularly the spleen and liver, are treated according to the patient's clinical status. Although there are no dedicated treatment protocols currently established in the literature, the American Association for the Surgery of Trauma (AAST) has outlined categories to classify different types of solid organ injury based on their appearance on imaging, and these can often be used by an institution to guide management (Moore, 1994). In general, active arterial extravasation from an organ seen on CT is considered an indication to attempt imaging-guided embolization of the artery because of the lower operative morbidity of interventional techniques compared with open surgical repair of a bleeding artery. Patients who undergo open surgical treatment for hemostasis who subsequently develop rebleeding during their course are also often selected for treatment by IR. Delayed complications of trauma such as pseudoaneurysms are also generally treated prophylactically by IR to avoid bleeding later.

Contraindications to the Treatment and Notes for the IR Nurse

The major contraindication to the treatment of patients by IR is hemodynamic instability, largely driven by the prolonged time it can take to cannulate and embolize a bleeding artery. In these cases, patients undergo open surgical treatment for control of bleeding. Other relative contraindications can include complete transections of major arteries or more complex traumatic injuries; in these cases, patients often must undergo surgery for treatment of additional findings, and it becomes easier to control bleeding during the planned surgery rather than subject the patient to two procedures. An additional contraindication is severe allergic reactions to contrast material, particles, or medications administered periprocedurally during angiography (Dondelinger, 2014).

When treating trauma patients in the IR suite, a multidisciplinary approach is required to facilitate smooth and effective patient care. Nurses should be aware of the preceding injury and the organs involved that are intended to be treated by the IR physician. They should also be aware of the expected preceding care and workup before a patient presenting in the IR operating suites. Most patients are given narcotics or other pain medications in cases of severe trauma; this can drastically affect options for intraprocedural sedation and require extra vigilance in monitoring patients for their cardiopulmonary status with even smaller doses of additional sedation. Patients also undergo rapid evaluation with contrast-enhanced CT imaging, which, in the short term, can significantly decrease renal function. Intravascular resuscitation with fluids can therefore cause significant overload issues such as heart failure and pulmonary edema if the patient's renal function is not able to handle the additional fluid loads. The effects of certain medications are also prolonged when the kidneys are unable to excrete byproducts. Knowledge of the patient's laboratory work and comorbidities is essential; as patients are often treated emergently in cases of active arterial extravasation, patients who have coagulopathies or are on anticoagulant medications are at increased risk of bleeding complications from the primary injury and arterial puncture access site after the procedure. Finally, an understanding of the procedure being performed, which will be outlined later, can help nurses anticipate intraprocedural and postprocedural complications based on the organ being treated and the embolization technique used.

Techniques and Equipment

Most embolization procedures begin with arterial access acquired through the femoral artery. Although radial access can be used for arterial cases, the size of the catheters required and the general ease and speed of performing femoral access make this the most likely route of entry. This fact is important for nurses to remember as it will impact postprocedural management and predispose the patient to different complications compared with radial access (see later). After access using a micropuncture set, wires and catheters are threaded into the aorta, and different types of curved catheters are used to access the main artery supplying the injured organ, usually the celiac artery in the case of hepatic or splenic injury. After entry into the main artery branch, an angiographic run is performed to identify the site of active arterial extravasation, which is identified as a blush of contrast on imaging. Once the culprit vessel is identified, the catheter is advanced as close to the site of extravasation as possible to avoid blocking major blood vessels where embolization could cause infarction of the organ. An additional run is often performed to confirm that the bleeding vessel is catheterized. After confirmation, coils are deployed to block the vessel, with subsequent additional runs performed to confirm that no further contrast leaks out of the damaged vessel. In certain situations, such as pseudoaneurysms or arterial dissections, stents may also be used to help block or support vessels, and small embolic particles can be used to block smaller vessels distally, with the exact embolization equipment decided on a case-by-case organ-by-organ basis. After appropriate embolization of the vessel(s) involved, all wires and catheters are removed, and pressure is placed on the femoral artery puncture site to provide hemostasis. Depending on the institution, arterial closure devices may be used to plug the hole in the artery created during the procedure to minimize the time spent to compress the artery for hemostasis. The decision to use a closure device will impact the postprocedural management that the nurse should expect (see Postoperative Management section later).

Specifics About Liver

The liver is supplied by two major blood supplies—the portal vein and the hepatic artery. This allows physicians to choose more conservative techniques to manage bleeding rather than require the patient to undergo surgery. Because removal of the liver cannot be performed, surgeons often opt for conservative management with IR involvement before attempting more radical resections and open hemostasis.

The technique for treating the liver involves selective catheterization of the bleeding branch vessels in the liver, which are identified during the initial angiographic runs. Coils are then placed as close to the site of bleeding as possible to avoid infarction of large parts of the tissue that can predispose the patients to bile necrosis and infection. The vascular supply of the liver also provides blood to the gallbladder, and therefore IR physicians are careful to avoid embolization of vessels that would damage this structure.

These techniques have been proven to be effective in controlling a bleeding liver. In a study of patients treated with active arterial extravasation from the liver after blunt trauma, embolization controlled bleeding in 100% of patients; these patients presented with grade 3 and 4 injuries as defined by the AAST (Hagiwara et al., 1997). In 30 patients who were unstable because of liver injury, 16 patients underwent embolization for hemostasis with all patients showing stabilization and no major complications after the procedure (Murakami et al., 1993). These studies, as well as multiple others, have been used to show the growing role of IRs in the treatment of trauma and the increasing evidence showing embolization efficacy in cases of liver injury, both in the stable and unstable patients (Ciraulo et al., 1998; Schwartz, Teitelbaum, Katz, Pentecost, 1993).