The Role of Interventional Radiology in Trauma

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ABSTRACT: **Trauma is a leading and preventable cause of death in many age groups. Emergency care of trauma patients is complex and requires a team approach, which includes nurses and physicians. Interventional radiology (IR) plays a significant part in the management of some trauma patients with solid organ or pelvic injuries. This article reviews the role of IR and aspects of radiology nursing in this patient population. (J Radiol Nurs 2014;33:181-187.)**

KEYWORDS: **Interventional radiology; Angiography; Trauma radiology; Radiology nursing.**

INTRODUCTION

In the United States, unintentional injury is a leading cause of death after the first year of life up to the age of 44 and is the fourth leading cause of death overall (Feliciano, Mattox, & Moore, 2008). Blunt trauma from motor vehicle collisions and falls as well as penetrating trauma from firearms account for many of these deaths. Successful management of adults with blunt or penetrating trauma is quite complex and requires a multidisciplinary team approach. Nursing care is critical particularly with regard to management during interventional radiology (IR) procedures.

The goal of this article is to review the role of IR in the management of adult trauma patients, with perspectives on IR nursing.

PELVIC TRAUMA

Background

Pelvic fractures occur in less than 10% of blunt trauma patients, with motorcycle and pedestrian accidents accounting for the greatest percentage of pelvic fractures. Mortality in trauma patients who have pelvic fractures is around 14% but can be up to 40% to 60% in those who present with hemodynamic instability (Demetriades et al., 2002; Suzuki, Smith, & Moore, 2009). However, most deaths are not the direct result of the pelvic fractures but rather other associated injuries (Demetriades et al., 2002; Karadimas et al., 2011). Accordingly, angiography is needed in a small percentage of pelvic trauma patients, but in these patients, arterial embolization (AE) to treat bleeding may be essential (Demetriades et al., 2002).

In blunt trauma, major pelvic bleeding is often associated with pelvic fractures. Bleeding can arise not only from the fractured bones themselves but also from arteries and veins that are lacerated by the jagged bone edges. Some pelvic fractures cause disruption of the pelvic ring, which encloses the relatively contained space of the pelvis. Thus, pelvic ring injuries can lead to increased pelvic volume and a decreased tamponade effect. Therefore pelvic "sheeting" is used to treat some pelvic fractures. This involves binding of the pelvis with a folded sheet that is wrapped around the pelvis and clamped, which may help to decrease pelvic volume and venous bleeding (Grimm, Vrahas, & Thomas, 1998; Suzuki et al., 2009).

Some investigators have sought to create prediction rules to identify which patients may have major pelvic bleeding associated with pelvic fractures. Among the factors suggesting higher probability include initial hematocrit ≤ 30, pulse ≥ 130 beats/min, and displaced pubic symphysis or obturator ring fracture (Blackmore et al., 2006). When three or four factors are present, the probability of major hemorrhage is 66%. Other criteria such as fracture pattern have been less fruitful at predicting hemorrhage.

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1546-0843/$36.00

http://dx.doi.org/10.1016/j.jradnu.2014.09.003

Unstable blunt trauma patients with pelvic fractures and without gross hemoperitoneum identified on computed tomography (CT), ultrasound, or diagnostic peritoneal lavage should undergo pelvic arteriography. Occasionally, hemodynamically stable patients will also undergo angiography if major bleeding or injury is identified on CT. Trauma patients treated in IR are frequently hemodynamically unstable and often need high-level nursing care to provide hemodynamic support, blood products, and sedation. Nursing staff is a critical part of the care team for safe patient transport and continuing the trauma resuscitation.

Technique

Pelvic arteriography generally starts with contrast injection in the distal aorta to image the pelvic arteries (Figure 1). Both the internal and external iliac arteries are typically selectively catheterized for more detailed imaging. In general, the closer the catheter is positioned to the source of bleeding during contrast injection, the more likely the bleeding will be seen (Figure 1) (Roy-Choudhury et al., 2007). If selective angiography is omitted, injuries could be missed (Johnson et al., 2013). The interventional radiologist scrutinizes the arteriogram for signs of arterial injuries. These may manifest as leakage of contrast material beyond the expected confines of the vessel, either as extravasation (uncontained bleeding, Figure 2) or a confined collection representing a pseudoaneurysm (a contained arterial rupture, Figure 1). Other findings of acute arterial injury include occluded vessels, filling defects within the vessel, vessels that have been abnormally stretched, or arteriovenous fistulae (an abnormal communication between an artery and a vein). Most pelvic arterial injuries can be treated with AE. Although a number of different agents are available, the most common embolic agents used are gelatin sponge (Gelfoam, Upjohn, Kalamazoo, MI) slurry and metal coils.

Gelatin sponge is a material that has been used topically in surgery since the 1940s (Jenkins, Janda, & Clarke, 1946). Its endovascular use in pelvic trauma began in the early 1970s (Ring, Waltman, Athanasoulis, Smith, & Baum, 1974). It is supplied as a sheet in various sizes. Gelatin sponge slurry is prepared by either cutting the material into small pieces with scissors (Figure 3) or by shearing apart large pieces suspended in contrast material by using two syringes connected by a three-way stopcock valve. The particles are then injected into the target artery once the catheter has been positioned appropriately. This leads to a mechanical obstruction of the injured vessel. One potential benefit of gelatin slurry use in trauma is the temporary nature of the occlusion. Generally, occlusion lasts weeks to months as the material is absorbed and the artery recanalizes (Cho, Reuter, & Schmidt, 1976). By the time the artery recanalizes, the injury has also healed. Metal coils are another material that may be used to embolize injured arteries (Figure 1). In this case, the occlusion is intended to be permanent.

There are no prospective randomized trials investigating the efficacy of pelvic AE in trauma; however, a number of retrospective studies show very good efficacy in the range of 85% to 100% (Agolini et al., 1997). Adverse effects of pelvic AE are remarkably infrequent. Skin sloughing or parasthesias are rare, and gluteal necrosis occurs infrequently. Male sexual dysfunction occurs at similar rates in those embolized compared with matched controls with pelvic trauma, suggesting that the cause is the trauma itself (Travis et al., 2008).

At the conclusion of angiography, the catheter is removed. The arterial sheath can be sutured to the skin and left in place. This may be done because of risk of puncture site bleeding in a coagulopathic

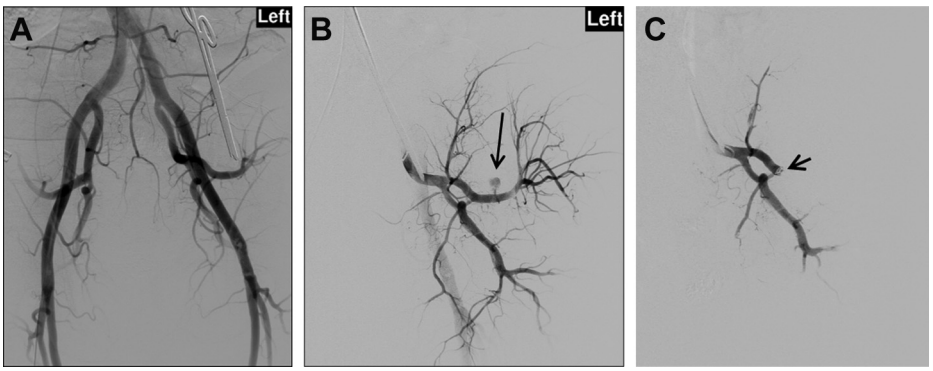

Figure 1. A 65-year-old man sustained pelvic fractures after falling and was brought to interventional radiology. (A) A frontal pelvic digital subtraction arteriogram was obtained. (B) Selective left internal iliac arteriogram demonstrates a pseudoaneurysm (long arrow) or contained rupture of the superior gluteal artery. This was not evident on the nonselective arteriogram. The arterial injury was treated with metallic coil embolization. (C) After this, arteriography shows expected occlusion of the vessel (short arrow).