The Decade in Vascular Trauma

The developments and data that have shaped modern vascular trauma care and what the next decade may hold.

BY JOHN FRITZ ANGLE, MD, AND JAMES FORREST CALLAND, MD

For years, the literature surrounding trauma embolization was limited to technical notes and case series; however, in the last decade, the role of trauma embolization has come into much better focus. This is not surprising, given the ongoing difficulties in conducting clinical research in patients with limited capacity.[1] There is, fortunately, an increase of high-quality clinical evidence and more sophisticated multispecialty consensus documents that are clarifying the indications, potential complications, and expected outcomes of embolization in blunt and penetrating trauma.[2] The lack of high-quality data still limits the widespread use of some procedures, such as arterial embolization for pelvic fractures in which rigorous comparisons to surgical alternatives are lacking and late neurovascular complications, which are only potentially related to embolization, are pointed to as a cause of patient disability.[3]

It is worth reviewing the progress made in the endovascular management of trauma, focusing on the most frequent sites of trauma-related endovascular therapy. In this article, we also attempt to identify future trends in trauma diagnosis and endovascular management.

SPLENIC EMBOLIZATION

Nowhere in the field of trauma embolization has the role of embolization increased more or been studied as carefully as with splenic embolization. Splenic embolization for trauma was first reported more than 40 years ago.[4] For years, splenic embolization was the procedure trauma centers had to provide, but rarely considered first-line therapy. Improvements in embolization technology and the increasing evidence that proximal embolization is efficacious, have made this procedure well accepted (Figure 1). Many centers now have clear indications for splenic embolization based on CT and clinical presentation.[5] Previous concerns about late hemorrhage and splenic abscess have largely been disproven.[6,7]

PELVIC EMBOLIZATION

The role of angiography and embolization in pelvic fractures remains in flux. There are unstable pelvic fractures in which embolization provides the only viable method to control arterial hemorrhage. Therefore, pelvic angiography with embolization will remain an essential tool in the management of pelvic trauma. At the same time, there are no

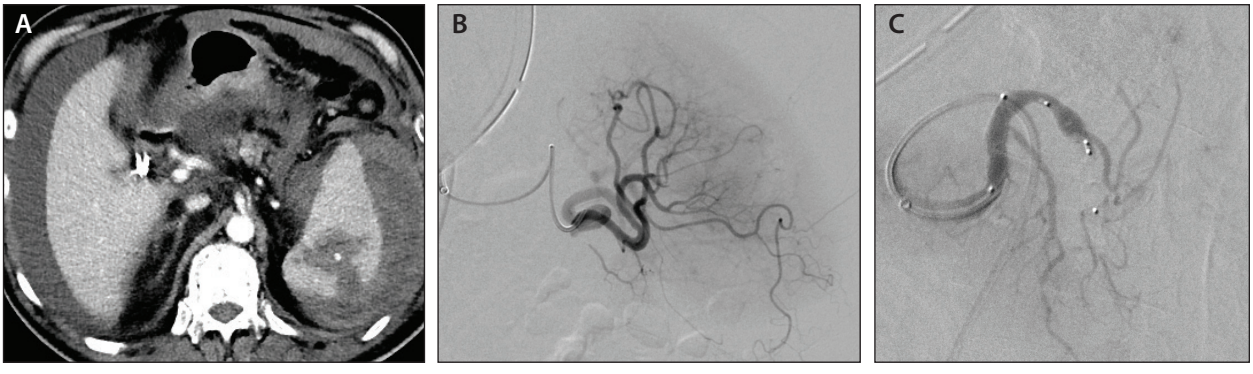

Figure 1. CT demonstrates a grade IV splenic laceration with pseudoaneurysm (A). Selective splenic angiogram (B). After deployment of Amplatzer plugs (St. Jude Medical, Inc.), the splenic artery is occluded, but flow to the gastric and pancreatic branches from the mid-splenic artery are noted (C).

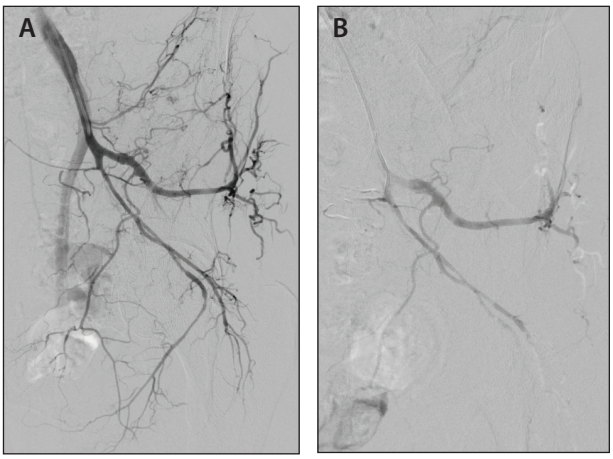

Figure 2. Open-book fracture caused by a falling tree. Selective left internal iliac angiogram shows several potential sites of arterial injury, but findings are nonspecific (A). No active extravasation is seen, making treatment planning difficult. Gelfoam slurry embolization was performed (B).

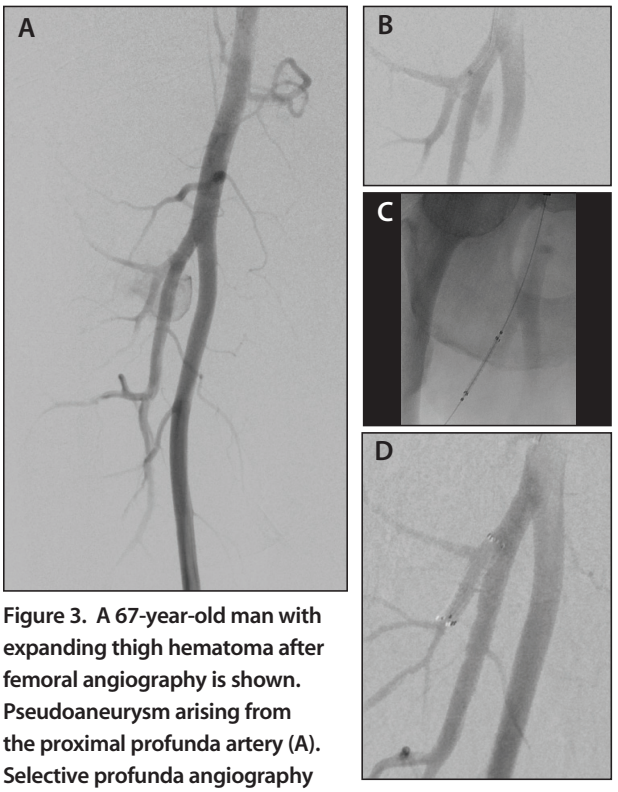

Figure 3. A 67-year-old man with expanding thigh hematoma after femoral angiography is shown. Pseudoaneurysm arising from the proximal profunda artery (A). Selective profunda angiography demonstrates the pseudoaneurysm arises from a very proximal profunda branch (B). Coil embolization of this branch might fail to provide proximal control or lead to coils falling into the main profunda branch. A 5-mm X 2.5-cm self-expanding covered stent is positioned in the injured branch (C). There is no filling of the pseudoaneurysm after stent deployment, and there is flow to the distal profunda branches (D). Even if the branch ultimately occludes, the parent vessel would be protected.

Courtesy of Saher Sabri, MD.

adequate studies comparing embolization to fixation or pelvic packing, both of which may be more effective in controlling venous bleeding. An ongoing challenge in pelvic trauma embolization is the broad spectrum of vascular findings on angiography.[8] Indirect signs of arterial injury on angiography are common, potentially leading to nonselective or broad-area embolization (Figure 2); however, this practice may be associated with more complications, including claudication.[9] There is a trend toward more microcatheter superselective embolization. Embolization in which only active extravasation is treated using superselective embolization may lead to fewer complications with improved control of bleeding.

The biggest change in practice, which is just now being defined, is the role of CT angiography (CTA) in pelvic trauma. It seems likely that CTA may be the best tool to determine not only who should have endovascular arterial intervention, but also to define the appropriate vessels to embolize.[10] The other important trend in pelvic arterial injury embolization is that it is more widely available with shorter response times. Improved training of an enlarging group of specialists is making the procedure available to more patients.

EXTREMITY EMBOLIZATION

In our practice, we are seeing less open repair than we did 10 years ago because of advances in covered stents and embolization. Nationally, the trend in extremity arterial injury management has been toward endovascular therapies, particularly in blunt trauma and in patients with high injury severity scores.[11]

The introduction of low-profile, self-expanding covered stents has made it technically possible to rapidly seal many ruptured femoropopliteal and subclavian arteries. Peripheral embolization is still essential for management of small muscular branches and other noncritical branches. A series of improvements in microcatheters and embolization coils has led to better outcomes and shorter procedure times.[12]

FUTURE DIRECTIONS

Obtaining a CTA is now a near-essential step on the way to the angiography suite or operating room.[8,13] Time to definitive (often multispecialty) treatment is very important.[14] Hybrid (angiography-enabled) operating rooms, increasingly popular in the last several years for the treatment of peripheral vascular disease, speed the time to treatment in trauma,[15,16] and the ability to perform peripheral embolization and orthopedic fixation or pelvic packing in the same room is in increasing demand.[17] The time to embolization is still limited by the time required for CTA and patient transfers.

In the next few years, the first change we hope to see is hybrid rooms that have CTA capability, enabling us to make a diagnosis and deliver complex therapies in the shortest possible amount of time. The second change we

(Continued on page 55)

(Continued from page 49)

should see in the next few years is the increasing use of covered stents to preserve medium and even small arteries.[18] For example, it is entirely feasible that the use of covered stents could become routine in the treatment of superior gluteal or profunda artery pseudoaneurysms (Figure 3). The third, and most important change we hope to see, is data-driven algorithms that define when and how embolization or covered stents should be used in specific types and sites of vascular injury.[19] The time is right for endovascular procedures to become part of almost every trauma center's protocol manual, with care delivered in a setting of rapid CT diagnosis and cutting-edge multispecialty care. ■

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