Case Report

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Bedside Duplex Ultrasonography Identifies Multiple Pseudoaneurysms in a Penetrating Extremity Trauma

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Abstract

A 14-year-old boy sustained an accidental self-inflected stab wound to the calf injuring both the posterior and anterior tibial arteries. On physical examination, pedal pulses were palpable and no obvious sign of arterial injury was identified. It was only after noninvasive duplex ultrasonography that multiple pseudoaneurysms were identified. The patient was taken to the operating room where reversed saphenous vein interposition grafts were used to repair both injuries. Therefore, use of bedside vascular duplex ultrasonography has the ability to expedite patient care.

Keywords

vascular extremity trauma, traumatic pseudoaneurysm, vascular ultrasound, bedside vascular duplex, duplex in trauma patient

Introduction

Arterial pseudoaneurysm (PA), or false aneurysm, formation results from a discontinuity of the blood vessel wall. Typically, this is not a complete vessel transection but more of a tangential laceration. This disruption allows bleeding into the surrounding soft tissue creating a blood-filled cavity confined by the neighboring tissues. If this extravascular collection of blood clots, then by definition, a hematoma is formed. Failure of clot formation and continued flow within the cavity constitutes a PA. If left untreated, the natural history of a traumatic PA is unpredictable but could include thrombosis, embolization, or ongoing enlargement. When continued growth occurs, the surrounding tissue and accompanying neurovascular bundle are subjected to increasing pressure transmission. This increasing pressure to the neighboring neurovascular bundle translates to increasing pain experienced by the patient. In addition, as the size of the PA increases, the complexity of the repair increases as well. In our case presentation, we demonstrate how bedside noninvasive duplex ultrasonography can rapidly identify traumatic lower extremity PAs. This can allow a more rapid diagnosis helping expedite patient care.

Case Study

A 14-year-old boy presented to the emergency room with an accidental self-inflected stab wound to the right medial calf. By the parents' report, there was significant blood loss at the scene, but on arrival, the bleeding had stopped. Initial vital signs were stable with a heart rate of 98 and a blood pressure of 124/91. On physical examination, a 2-cm puncture wound was identified on the medial right calf and pedal pulses were noted to be weak but intact. During the time in the emergency room, no further bleeding occurred so the wound was cleaned and closed with interrupted nylon sutures. Prior to discharge, noninvasive vascular studies were ordered. An ankle:brachial index (ABI) was found to be 0.7 on the right and 1.0 on the left (Figure 1). While performing the ABI examination, the vascular technologist noticed a bulging protrusion on the anterior lateral right calf with an associated palpable thrill. This prompted a bedside duplex ultrasound, which discovered PAs that appeared to originate from both the mid anterior tibial artery and the mid posterior tibial artery (Figure 2). The PA of the anterior tibial artery measured 1.7 cm × 1.9 cm, whereas the posterior tibial artery PA measured 1.6 cm × 3.6 cm (Figure 3). Vascular surgery was consulted and the patient was taken to the hybrid suite for conventional angiography and definitive treatment of the right lower extremity. In the operating room, the angiogram verified PAs originating from both the anterior tibial and posterior tibial arteries (Figure 4). At this point, the extremity was exsanguinated and a sterile tourniquet inflated across the upper thigh. Explorations of the posterior and anterior compartments were performed through a medial and lateral incision, respectively. Injuries in each compartment were identified and both appeared to be almost complete transections of

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RESTING

	Right				Left	
mmHg	Index	Waveform		mmHg	Index	Waveform
110			Arm	118		
80	0.68	Mildly Abnormal	Ankle DP	130	1.1	Normal
84	0.71	Mildly Abnormal	Ankle PT	134	1.14	Normal
65	0.55	Mildly Abnormal	Toe	108	0.92	Normal

Figure 1. Resting ankle: Brachial index.
Note. DP = dorsalis pedis; PT = posterior tibial.

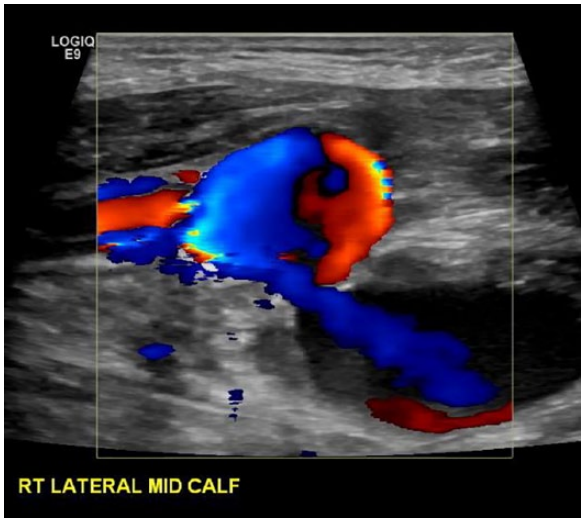

Figure 2. Pseudoaneurysms anterior and posterior tibial arteries.

Figure 3. Pseudoaneurysm measurements.

the involved artery. To repair the injuries, a short segment of greater saphenous vein was harvested from the medial exposure site. The segment of vein was reversed and used as 2 separate interposition graphs repairing each arterial injury. The

Figure 4. Right lower extremity angiogram.

patient tolerated the procedure well and was discharged the following morning. On the 1-month follow-up visit, all incisions were healed and both the posterior tibial and dorsalis pedis pulses were easily palpable. A duplex ultrasound examination showed patent interposition grafts having flow velocities within normal limits. The ABIs were normal as well.

Discussion

Arterial injury after penetrating extremity trauma can rapidly be diagnosed when hard signs of active hemorrhage, expanding or pulsatile hematoma, thrill, bruit, or pulse deficit are identified on the initial physical examination. Historically, these individuals have been taken either directly to an operating room for exploration and repair or to an angiography suite for definitive evaluation and/or endovascular intervention. In these critical patients, it is well documented that outcome is very dependent on how rapid a diagnosis is made and vascular repair is performed. Delays in diagnosis and/or treatment of an arterial injury can arise when there is a nonischemic injury

(such as a PA) or lack of ongoing hemorrhage. In this situation, the treating clinician must have a high index of suspicion; otherwise, subtle injuries can frequently be missed. In these situations, when an occult arterial injury is of concern or suspected, conventional angiography has long been considered the gold standard diagnostic tool of choice. Pitfalls of angiography include its invasiveness, cost, administration of iodinated contrast, requirement of a special suite, as well as the time delays associated with the lack of specialized in-house personnel after hours. In addition, exclusion angiography frequently has a relatively low yield.[1,2]

Advances in computed tomography imaging, specifically computed tomography angiography (CTA), have recently led some to use this as a first line diagnostic tool in the absence of hard signs or in the presence of a proximity injury. Similar to conventional angiography, it has a high sensitivity and specificity but is a noninvasive modality. In addition, it has the added advantage of being readily available in most emergency room departments with quicker turn-around times and does not require a specialized health care team to perform.[3] In a multitrauma patient, it has the added advantage of being used for a multisystem assessment helping expedite care of a critical patient. A major pitfall of CTA is streak artifact. When either a prosthetic joint or metallic deposit is in close proximity to the vessel of question, accurate diagnosis of a vessel injury can be problematic. This can certainly diminish the value of this modality when using it for a proximity injury. Similar to angiography, it does require the use of intravenous iodinated contrast.

Utilization of bedside vascular ultrasound is common in most large institutions. Vascular surgeons have customarily relied on noninvasive screening modalities for diagnosis and/or treatment of aneurysms as well as cerebrovascular and peripheral occlusive disease. Facilities with active cardiac catheterization laboratories use vascular diagnostic ultrasound imaging daily. In fact, the tool of choice for both evaluation and treatment of PA formation after cardiac catheterization is ultrasound-guided compression or guided thrombin injection. This holds true for both upper (brachial) and lower (femoral) extremity access sites. Certain hospitals servicing moderate to large volume urban trauma patients have also adapted emergency room use of bedside diagnostic ultrasonography. These individuals use bedside sonography as a diagnostic tool in parallel with the initial evaluation and resuscitation of the trauma patient (FAST examination: focused assessment with sonography for trauma).[4] Others even advocate addition of an extremity and respiratory component calling it a FASTER examination.[5] Rad and colleagues[6] promote screening color duplex in patients with suspicious vascular injury on the basis of the following characteristics: high sensitivity, acceptable specificity, noninvasiveness, and ready availability.

All of these above-mentioned uses of bedside vascular duplex ultrasonography provide examples of its clinical usefulness. Particularly with proliferation of cardiac angiography and the inherent accompanying access site PA formation, ultrasonographers have become accustomed to identification and treatment of extremity PAs. This in parallel with increasing ultrasound utilization in the trauma patient population and has offered the opportunity for rapid bedside identification of arterial PA in the patients with a penetrating extremity trauma.

Conclusions

Advancements in ultrasound technology in conjunction with physician familiarity have led to more frequent use of bedside sonography when diagnosing a variety of conditions. One of the more common examples is identification and treatment of iatrogenic PA formation after common femoral or brachial artery cannulation following a cardiac catheterization procedure. In our case presentation, we demonstrated how utilization of this same noninvasive technology, with a good understanding of patient anatomy, can allow a rapid bedside diagnosis of a PA following penetrating extremity trauma. As time is of the essence, this can play a vital role in expediting the delivery of patient care.

Declaration of Conflicting Interests

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