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Diagnosis and treatment of posttraumatic arteriovenous fistula in the lower leg – a case report

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Abstract

External injuries are one of the common reasons for reporting to hospital emergency departments. Peripheral vascular injuries occur in up to about 25% of upper and lower extremity injury cases. Arteriovenous fistula is a type of arterial injury. Doppler ultrasound is currently the primary diagnostic method for vascular injuries as it allows for the implementation of appropriately targeted treatment, indicating the potential need for extended diagnosis or patient qualification for endovascular or classical surgery. Endovascular procedures are currently an acknowledged treatment method in peripheral vascular injuries. We present a case of endovascular treatment in a patient with posttraumatic arteriovenous fistula in the lower leg. Patient qualification and treatment efficacy assessment were performed using Doppler ultrasound.

Introduction

External injuries are one of the common reasons for reporting to hospital emergency departments. It is estimated that peripheral vascular injuries occur in up to about 25% of upper and lower extremity injury cases, with the predominance of arterial damage. Disruption of arterial continuity is the most common type of injury, followed by slightly less common arterial dissection, pseudoaneurysm or arteriovenous fistula (ATV). All these conditions can lead to limb ischemia progressing peripherally from the site of injury⁽¹⁾. Other symptoms of arteriovenous fistula or pseudoaneurysm include pain at the site of injury, pulsation of the area above the fistula/aneurysm and often edema of the affected limb due to increased venous blood flow or venous compression. Diagnosis is often possible already during physical examination if a pulsating mass is palpated or characteristic machinery murmur is detected on auscultation^(2,3).

Doppler ultrasound, as a non-invasive, easily available, as well as inexpensive examination that can be performed

at patient's bedside, is currently the primary diagnostic method for vascular injuries. Compared to CT angiography or arteriography, Doppler US allows saving time, which is of particular importance in traumatic patients and involves no risk of complications associated with iodine contrast agent administration. Doppler ultrasound allows for the implementation of appropriately targeted treatment, indicating the potential need for extended diagnosis or patient qualification for endovascular or classical surgery. Due to the good anatomical access to the arteries of the lower and upper limbs, the need for more advanced imaging is extremely rare.

If the patient is qualified for endovascular surgery, arteriography is performed first, but always with simultaneous treatment in mind. Therefore, appropriately equipped radiological intervention room, i.e. allowing for immediate use of different types of endovascular equipment, is essential. Standard stents, but also covered stents (stentgrafts) as well as a wide range of embolization materials (coils, vascular occluders, emboli-

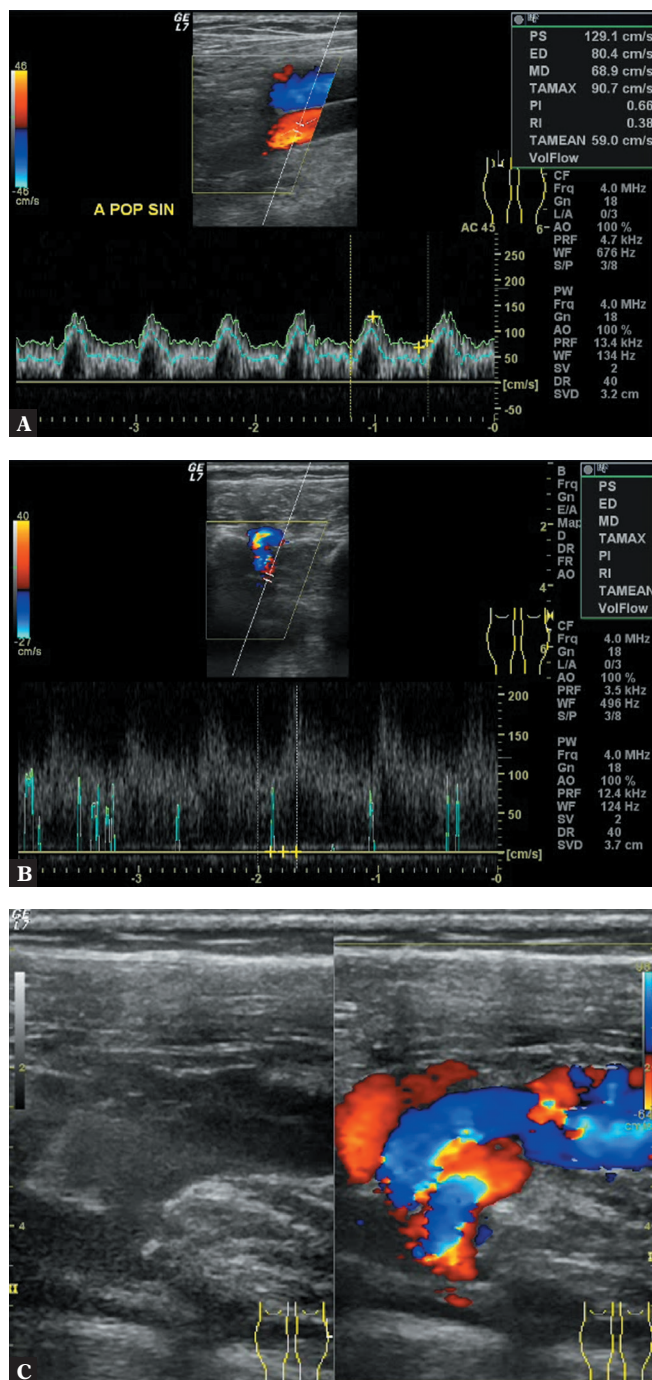


Fig. 1. Baseline US using a linear Doppler 6–12 MHz transducer. **A.** Low-resistance, single-phase blood flow spectrum in the popliteal artery, indicating blood supply to a high-flow fistula. **B.** Arteriovenous fistula in the anterior tibial vessels. **C.** Fistula and dilated efferent vein in both B-mode and Doppler ultrasound

zation particles and fluid embolization materials) are needed⁽⁴⁾.

We present a case of endovascular treatment in a patient with traumatic arteriovenous fistula in the lower leg.

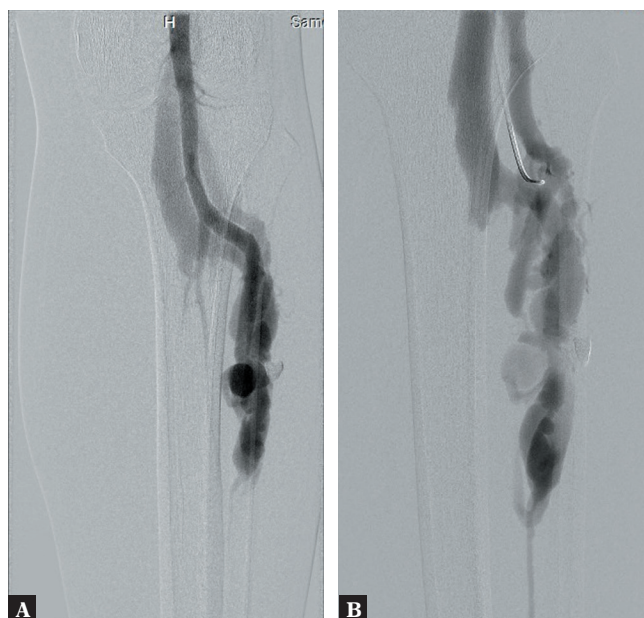


Fig. 2. Arteriography showing an arteriovenous fistula in the lower leg. **A.** Preliminary arteriography confirming the presence of posttraumatic arteriovenous fistula and a piece of metal responsible for arterial damage near the anterior tibial artery. **B.** Rapid venous blood outflow from the fistula, evident dilation of the efferent AVF veins

Patient qualification and treatment efficacy assessment were performed using Doppler ultrasound.

Case report

A 25-year-old male was referred to the Department of Interventional Radiology and Neuroradiology of the Medical University of Lublin in 2011 for consultation and Doppler US scanning. A month earlier, while metalworking, the patient experienced lower leg injury, which was probably caused by a piece of metal. Although the wound healed within a few days, a pulsating bump causing mild periodic pain occurred after several weeks. On the day of consultation, the skin was healed, but slight pulsation around the bump was palpable. Doppler ultrasound of femoral and popliteal arteries on the side of the injury revealed low-resistance, single-phase blood flow spectrum and dilated popliteal vein (Figs. 1 A and B). An arteriovenous fistula at the site of anterior tibial artery damage and a dilated efferent vein of the AVF were identified in the region of lower leg injury (Fig. 1 C). The patient was qualified for arteriography with simultaneous endovascular fistula closure. Preliminary arteriography revealed an arteriovenous fistula, while fluoroscopic images of this region showed a piece of metal responsible for vascular damage (Fig. 2). After selective fistula catheterization, Amplatzer vascular occluder was introduced at the site of disrupted anterior tibial artery. The artery was closed at the site of fistula, however, a follow-up arteriography showed minor, yet evident, blood flow into the fistula from the peripheral arterial segment

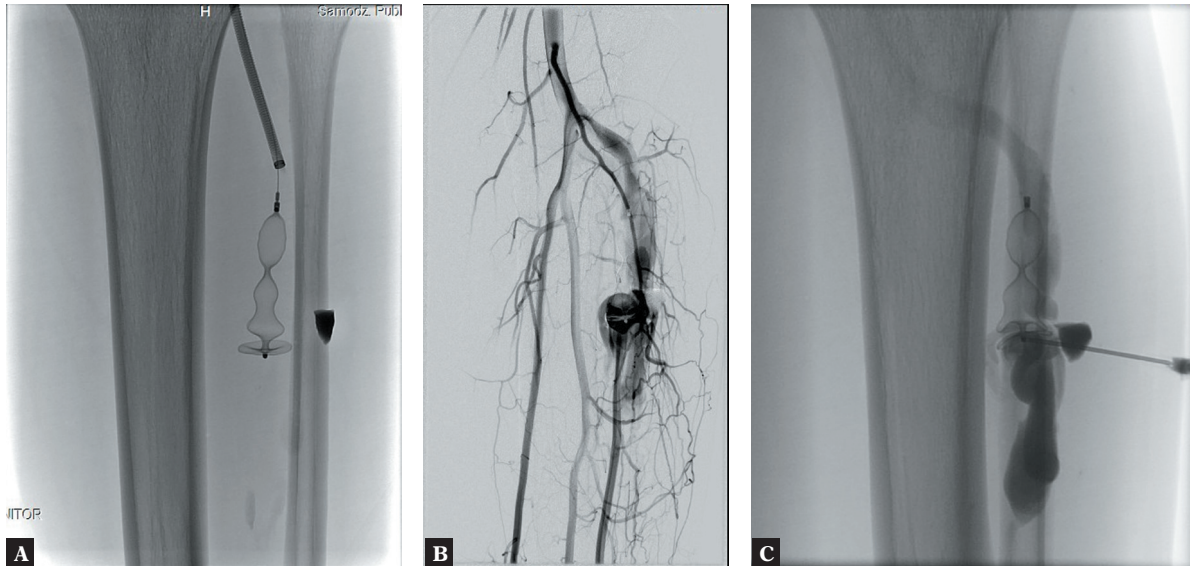


Fig. 3. Embolization of arteriovenous fistula of the lower leg. **A.** Implantation of Amplatzer vascular occluder in the fistula. A visible piece of metal responsible for anterior tibial artery damage. **B.** Blood supply to the fistula through collateral circulation from peripheral arterial segment. **C.** Injection of Glubran 50% mixture through a direct puncture

through collateral circulation (Figs. 3 A and B). In the next stage of treatment, a mixture of cyanoacrylate glue and Lipiodol (Glubran 50%) was injected through a direct puncture during efferent vein compression, which led to complete fistula closure (Fig. 3 C). Another angiography was performed and demonstrated collateral

circulation from the posterior tibial and fibular arteries to the distal segments of the anterior tibial artery below the injury; no limb ischemia was observed.

Treatment outcomes were monitored using Doppler ultrasound on the second day after the procedure and after

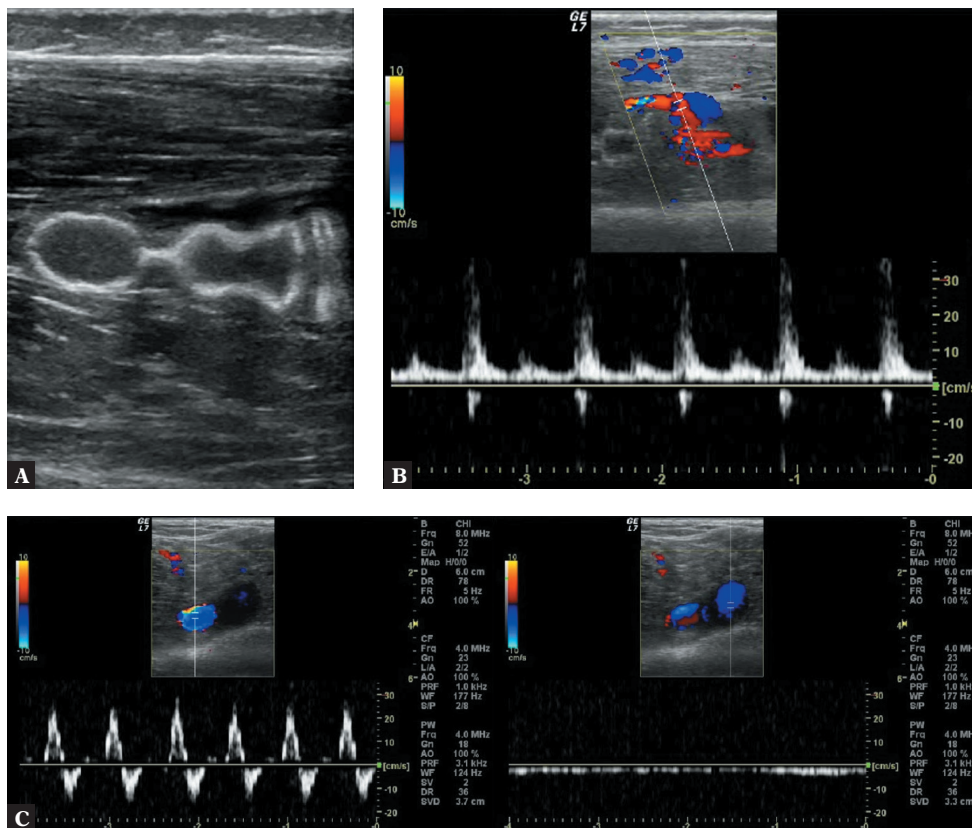


Fig. 4. Ultrasound assessment of endovascular treatment efficacy. **A.** Amplatzer vascular occluder implanted into the arteriovenous fistula in B-mode presentation. **B.** Closure of the arteriovenous fistula in the lower limb. **C.** Normal blood flow in the popliteal artery and vein

3 months. Complete closure of fistula as well as normal blood flow in the popliteal artery and vein were confirmed (Fig. 4).

Discussion

Endovascular procedures are currently an acknowledged treatment method for peripheral vascular injuries⁽⁵⁾. Compared to classical surgery, endovascular procedures are characterized by similar efficacy, but a significantly lower risk of complications, such as blood loss and only a minimal risk of infection⁽⁶⁾.

Good endovascular treatment outcomes depend on a number of factors. Accurate diagnosis is of primary importance. CT angiography is the first-choice diagnostic imaging to assess vascular damage in patients with multiorgan injury, while Doppler US is usually performed in stable patients with limited injuries. A number of literature reports confirm the high efficacy of ultrasonography in the diagnosis of vascular damage due to lower limb injuries⁽⁷⁾. Knudson *et al.* demonstrated 100% sensitivity and specificity, while Pezeshki Rad *et al.* showed 95% sensitivity and 98% specificity^(8,9). Bynoe *et al.*, who assessed vascular damage due to limb and neck injuries,

also pointed to high sensitivity and specificity of 95% and 99%, respectively⁽¹⁰⁾.

Disadvantages of ultrasonography for the assessment of vascular damage may include its limited usefulness in massive open injuries and high dependence on the equipment used and operator's experience⁽⁷⁾.

Conclusions

Doppler ultrasonography is an effective, accurate and safe diagnostic tool for the assessment of patients with post-traumatic tibial arteriovenous fistula, which can be used for patient diagnosis and qualification for the treatment as well as therapeutic efficacy evaluation. Endovascular treatment is a safe and effective method in patients with isolated posttraumatic arterial fistulas in the lower limbs.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organizations, which might negatively affect the content of this publication and/or claim authorship rights to this publication.

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