

case report

Injury of the axillary artery: duplex ultrasound detects postoperative occlusion of the artery with the establishment of the collateral network

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Background. Injury of the axillary artery is a life-threatening condition. The injury requires immediate, on-place treatment (compression) and a number of patients require prompt explorative surgery. Whenever a vascular injury is suspected, radiological follow-up (angiography), intra-operative or post-operative, should be performed.

Case report. We report a case of axillary artery injury in 28-year-old woman. Though postoperative duplex ultrasound gave an accurate finding, i.e. pre-stenotic, high resistant Doppler wave spectrum proximal to and post-stenotic, monophasic distal to the injury, angiography was performed. It showed extensive collateral network in the axilla and the blocked perfusion in the axillary artery. The patient underwent re-operation. Thrombectomy in the axillary artery was performed, with a subsequent radical improvement of the arm perfusion.

Conclusions. In these particular circumstances, duplex ultrasound displayed a characteristic pattern and the angiography might even be avoided.

Key words: axillary artery-injuries-ultrasonography-surgery; thrombosis; thrombectomy

Introduction

Injury of the axillary artery is a life threatening condition. Seventy-five percent of the patients die before being deported to the hospital.

Received 19 May 2004

Accepted 20 June 2004

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tal.¹ Out of the rest, 82% are deported to the hospital within 24 hours, and others between 24 and 48 hours or more.¹ The injury requires immediate, on-place treatment (compression) and many patients (38%) require prompt explorative surgery.¹ In reports, some 85% of axillary artery traumas are caused by penetrating (stab) injuries and 15% by blunt injuries.²

Some 40-50% of the patients suffer from brachial plexus trauma: 2/3 from direct injury (partial or complete resection), 1/3 from compression due to enlarging haematoma.^{2,3} Unlike in cases of compression due to

haematoma, in cases in which a direct injury of the brachial plexus occur, most patients do not have subsequent neurological improvement.^{2,3}

Arterial repair is usually successful.⁴ However, even if it fails, a severe ischemia is a rarity and the amputation rate is low.^{4,5} In cases of ischemia of the upper extremity, the patients usually undergo saphenous vein interposition grafting that generally yields good results.⁴

The most frequently recurring symptoms are motor and sensitive deficiencies and distal ischemia, which, in some cases, may not occur, owing to an extensive collateral network.³

However, whenever vascular injury is suspected, radiological follow-up (angiography), intra-operative or post-operative, should be performed.^{1,3,6} Our case reports a very synchronous cooperation between surgeons and radiologists, which led to a high-quality evaluation of the patient.

Case report

A 28-year-old woman fell through a glass door in a nightclub. An hour later, she was deported to the hospital in shock due to profuse bleeding in the left axillary fossa. Her peripheral pulses were not palpable, and her pupils were dilated. The breathing was very shallow, barely registered.

She underwent an immediate explorative surgery of the axilla. The axillary artery, vein and the brachial plexus were resected and the surgeons performed the reconstruction with an end-to-end anastomoses of the vein and artery and tried to repair the brachial plexus.

However, after the operation, the pulsations of the arteries of the left arm were not palpable, although the arm was not pale, but warm and blushing.

The surgeons decided to refer the patient for radiological evaluation. First, she underwent duplex ultrasound scanning. The examiner found a pre-stenotic high resistant spec-

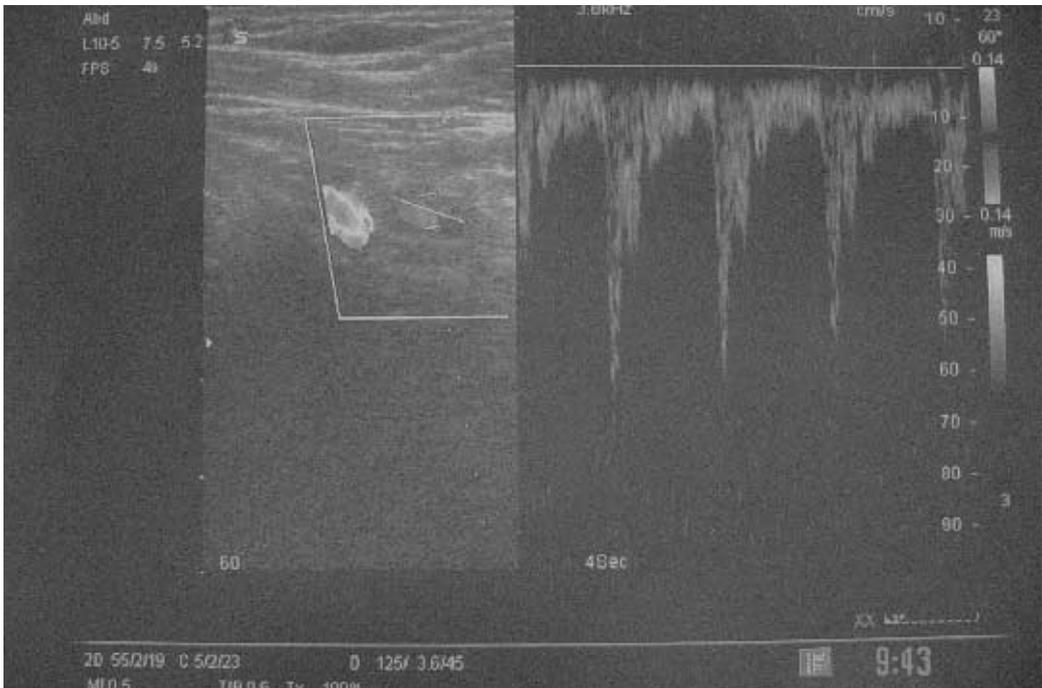


Figure 1a. Duplex ultrasound: high resistant, pre-stenotic attenuated spectra in the subclavian artery.

trum in the subclavian artery and a post-stenotic, monophasic spectra in all left arm arteries (brachial, ulnar, radial), (Figures 1a, 1b). The axillary artery was not examined because the patient complained of heavy pain and the arm could not be elevated. The venous circulation, however, was satisfactory. The next day, she underwent selective angiography. Using Seldinger technique, the subclavian artery was reached with the catheter and the contrast was injected. The subclavian and the proximal portion of the axillary artery were opacified, but the other two portions of the axillary artery were not. The brachial artery was filled with a delay, through the network of collateral vessels. The distal arteries of the left arm were later also opacified (Figure 2). These findings confirmed the Doppler findings that there was an obstruction in the axillary artery.

The patient was planned to undergo saphenous vein grafting, but during the second operation, exploration with the Fogarty catheter

through the incision in the brachial artery was performed and thrombi were found proximal to the incision, and so, she was successfully thrombectomised. Immediately afterwards, the reperfusion was established: the previously thin artery, very poorly filled with

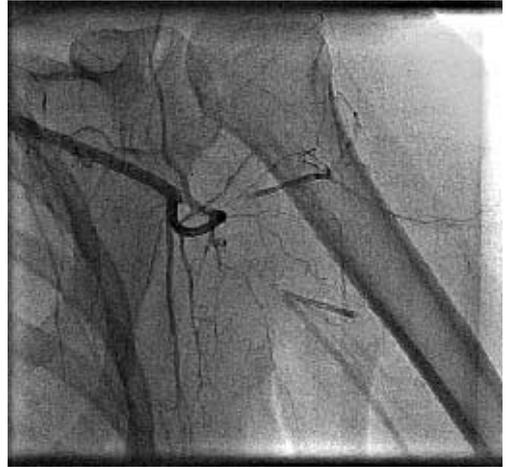


Figure 2. Angiography: occlusion of the axillary artery and the collateral network establishment.

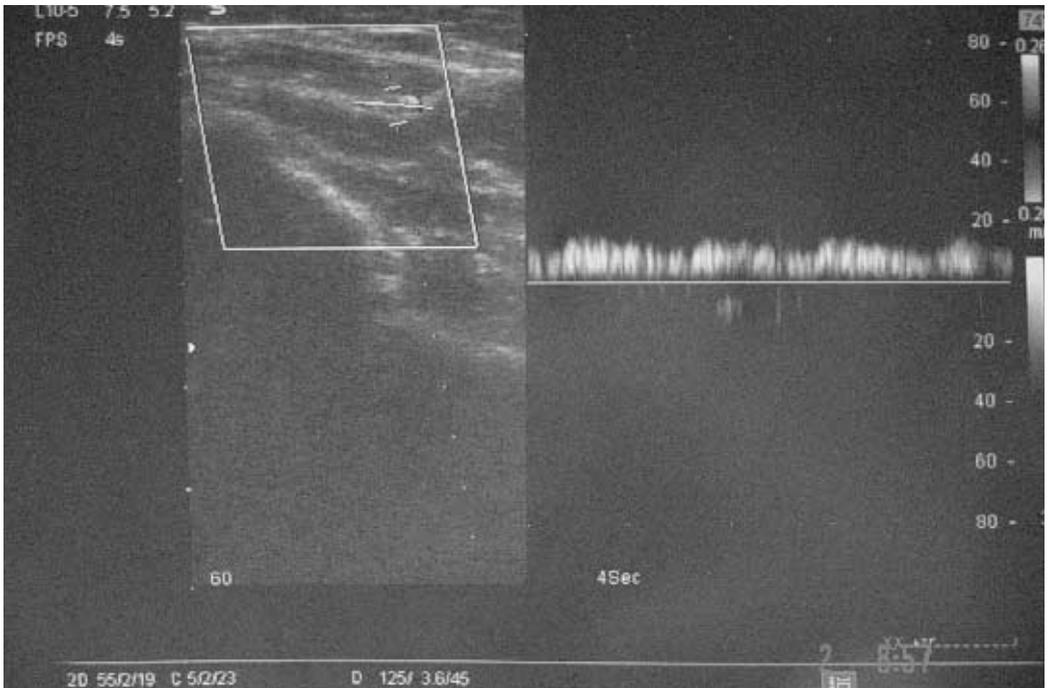


Figure 1b. Duplex ultrasound: low resistant, post-stenotic monophasic spectrum in the ulnar artery.

blood and initially very hard to find, started to inject blood through the hole of the incision and became obviously much better filled after the arterial wall was sewed. Congruently, its diameter was considerably increased afterwards.

The follow-up after this, second, operation proved almost normal (lightly attenuated) Doppler spectra in left arm arteries, almost symmetric to the contra-lateral one and the surgeons did not indicate the second angiography (they did not find it necessary any more).

Discussion

Due to the trauma of the axillary fossa and postoperative thromboembolism of the axillary artery in our patient, the blood perfusion through the axillary artery was blocked and collateral perfusion network was established. Duplex ultrasound showed a characteristic pattern, pre-stenotic, high resistant spectra in the subclavian artery, and post-stenotic, »parvus-tardus« spectra in the left arm arteries. These findings seemed to be almost pathognomonic. Despite the very convincing duplex ultrasound findings, angiography was performed to confirm the findings.

Angiography is highly invasive; some patients often refuse it. It has a 1-2-percent risk for complications and may be expensive.^{1,7,8} However, in circumstances when angiography is not possible or not preferable for various reasons, the duplex scanning, as it seems, might be sufficient to set up the diagnosis.^{9,10} Some data report the overall accuracy of 98% of Doppler ultrasonography in the detection of vascular trauma.⁵ Besides, duplex scanning equipment is portable, the test is non-invasive and relatively easy to perform and no contrast is required.⁸

When the examinations are correctly performed, there should be, as in this case, high concordance between clinical presentation,

radiological findings and surgical, intra operative findings.⁶ With such concordance, the duplex ultrasound may be a gold standard for the evaluation of this kind of patients.

On the other hand, according to some reports, in case of axillary artery trauma the sensitivity of duplex ultrasound examination is usually low and therefore, the examiner has to be very cautious.⁸ We thereby recommend the examiner to compare the findings of the subclavian and arm arteries of the injured body side to the contra-lateral to make sure the Doppler wave spectra differ highly in its morphology and resistance index.

When postoperative thromboembolism of the axillary artery develops, collateral axillary network might be established,^{3,4} although it may provide, as is shown here, only attenuated, temporary sufficient arterial perfusion of the arm. In such cases, re-operation is required in order to establish normal, fully functional perfusion. As seen here, exploration with the Fogarty catheter and thrombectomy may be sufficient, and the saphenous vein interposition grafting may not be needed.

In this very case, though the surgeons tried to repair the resected brachial plexus, the left arm is still under palsy (»flail limb«).¹ Although reperfusion initially worsened the nerve function and aggravated the fibre degeneration, it allowed the fibre regeneration to occur in the longer time frame.¹¹ Though the necessary condition for a possible recovery of the nervous function, i.e. normal blood supply, was fulfilled, the patient still had to undergo a long-term rehabilitation with neurological follow-up (electromyography) and with uncertain and probably only partial improvement of the nervous function.³ Further duplex ultrasound follow-up was also necessary.

Since the injuries of the subclavian-axillary arteries have taken many lives,¹ and, as shown here, can happen in relatively benign, peaceful circumstances, we highlight the im-

portance of prompt reaction on-place, as well as prompt hospital admittance and surgical exploration whenever the vascular and/or nervous injury is suspected.¹ This way, many lives could be saved and disabilities prevented.^{1,5} We assume that the experience from the war in Croatia (1991-1995) of the surgeon on duty was probably beneficial in this situation, since these kinds of injuries are uncommon and most surgeons lack familiarity with their management and few are able to gain significant experience (operative mortality rate ranges between 5 and 30%).¹

The importance of radiology in such cases is high.^{1,3,6} It is applicable for possible intraoperative and is necessary for postoperative evaluation and follow-up.^{1,3,6} Although the angiography is considered to be a »gold standard«,^{3,6-8} a correctly performed duplex ultrasound should give sufficient information and can even exclude the need for angiography.^{5,8-10} We offer our duplex ultrasound findings as an example of that.

In these, particular circumstances (postoperative thromboembolism in the axillary artery and establishment of the axillary collateral perfusion network), duplex ultrasound gave a highly typical and recognizable pattern (Figure 1). It is also the method we recommend for postoperative follow-up.

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