

## Correction of carotid-jugular traumatic fistula using a bovine pericardial patch

### *Correção de fístula traumática carotídeo-jugular com pericárdio bovino*

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#### Abstract

Carotid-jugular fistulae are rare, but habitually cause morbidity and mortality. They are often linked with penetrating trauma, primarily caused by gunshots. This report describes the case of a patient who was the victim of a gunshot wound to the left cervical area, provoking a carotid-jugular arteriovenous fistula and occlusion of the common carotid artery. The fistula was corrected by ligation of the internal jugular vein and arteriorrhaphy of the left common carotid artery with a bovine pericardium patch.

**Keywords:** firearms; arteriovenous fistula; neck injuries; jugular veins; carotid artery.

#### Resumo

A fístula carotídeo-jugular é de ocorrência rara, porém habitualmente causa morbimortalidade. Está associada frequentemente a trauma penetrante, principalmente em razão de lesão por projétil de arma de fogo. Relata-se o caso de um paciente vítima de lesão por projétil de arma de fogo na região cervical esquerda, o que provocou fístula arteriovenosa carotídeo-jugular com oclusão da artéria carótida comum. Foi realizada correção da fístula com ligadura da veia jugular interna e arteriorrafia com remendo de pericárdio bovino na artéria carótida comum esquerda.

**Palavras-chave:** armas de fogo; fístula arteriovenosa; lesões do pescoço; veias jugulares; artéria carótida.

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## INTRODUCTION

Traumatic penetrating injuries in the cervical region are generally complex conditions, especially when there is vascular injury.<sup>1</sup> They can be caused by medium and high-velocity firearm projectiles, or by knives.<sup>2</sup> In many cases immediate surgery is imperative, when there is unquestionable evidence of vascular injury, manifest as severe external bleeding, with risk of hypovolemic shock or upper airway compression. In general, these events are associated with high rates of morbidity and mortality.<sup>3</sup> Traumatic vascular injuries can manifest as pseudoaneurysms, arteriovenous fistulae, dissections, occlusions, compressive hematomas and direct bleeding.<sup>4</sup> In general, early treatment is of benefit since delay in diagnosis and treatment can increase the potential for morbidity and mortality.<sup>1</sup> Traumatic carotid-jugular fistulae present clinically with thrill on palpation and murmur on auscultation, which may or may not be accompanied by motor function deficit, which can vary from hemiparesis to hemiplegia.<sup>5</sup> Definitive diagnosis is not generally a challenge, using color Doppler ultrasonography, angiogram, magnetic resonance angiography or even arteriography.<sup>6,7</sup> Patients with traumatic cervical contusions who are at risk of traumatic cerebrovascular injury should undergo cerebral and cervical angiogram. When necessary, digital arteriography can be used to provide a clearer picture of the extent of arterial injury.<sup>8</sup>

Treatment can be administered via percutaneous access, by embolization or by placement of a covered stent.<sup>9-11</sup> Conventional techniques for vascular repair include identification of the orifice allowing communication between artery and vein – of which there is generally only one – followed by a number of possibilities, including lateral suture, end-to-end anastomosis, interposition of a vein graft, repair using patches and ligation.<sup>7,12</sup> When the common carotid is occluded, with refilling of the internal carotid, one possible solution may be to create a subclavian-carotid graft.<sup>13</sup>

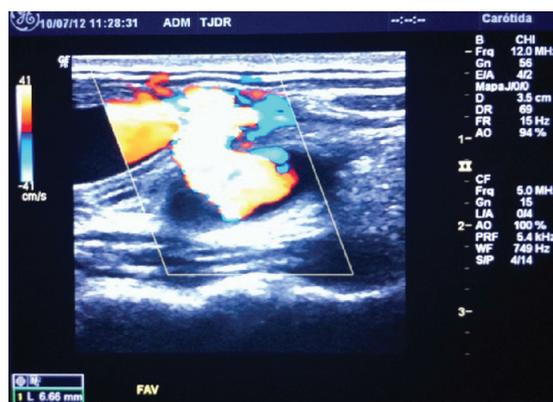
## CASE REPORT

The patient was a 40-year-old male who had been victim of penetrating traumas caused by firearm projectiles in the left cervical-thoracic region and the right thigh. On initial assessment the patient had patent airways, showed signs of left-side pneumothorax, was hemodynamically unstable with major bleeding from the right thigh and was in a

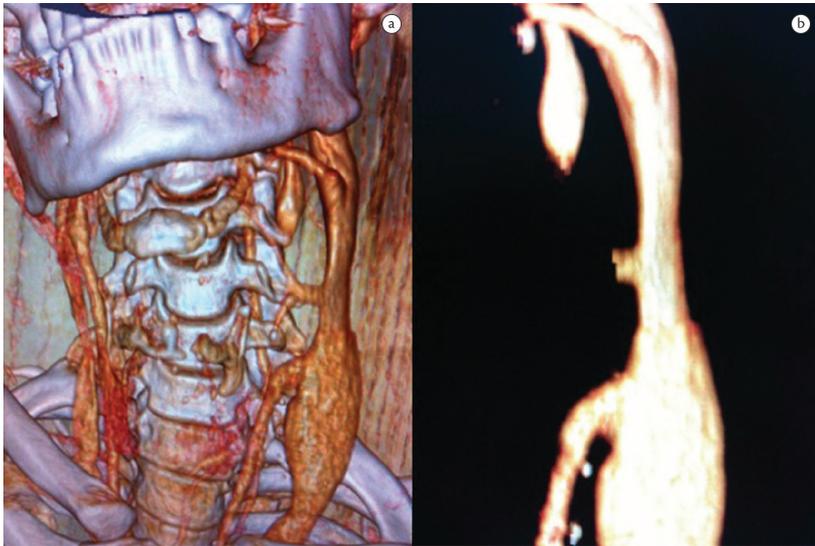
coma (Glasgow Coma Scale 6). The patient had two gunshot wounds caused by firearm projectiles: one to the left cervical region (Zone II) and the other in the right thigh. After oral endotracheal intubation, drainage of the left thorax, manual compression of the wound to the right thigh and volume resuscitation, the patient was sent to the operating theatre for vascular exploration of the wound to the thigh, with repair of the injury to the right femoral vein by venorrhaphy.

The patient was kept in the intensive care unit during the immediate postoperative period and no hematoma in the cervical region, active bleeding or thrill were detected during his clinical course, so the decision was taken to opt for hemodynamic stabilization, leaving the cervical surgery for a later date. When the patient was clinically stable and had been taken off sedation, physical examination revealed right-side hemiplegia and a thrill in the left cervical region. An arteriovenous fistula was suspected and confirmed by vascular echography with Doppler (Figure 1). Angiotomography confirmed the findings and showed occlusion of the left common carotid, with refilling of the internal carotid in the cervical region (Figure 2). The patient was then transferred to the Vascular and Endovascular Referral Service, where he underwent a left cervicotomy with correction of the arteriovenous fistula, with arteriorrhaphy of the common carotid with bovine pericardium and ligation of the internal jugular vein, and vacuum drainage (Figure 3).

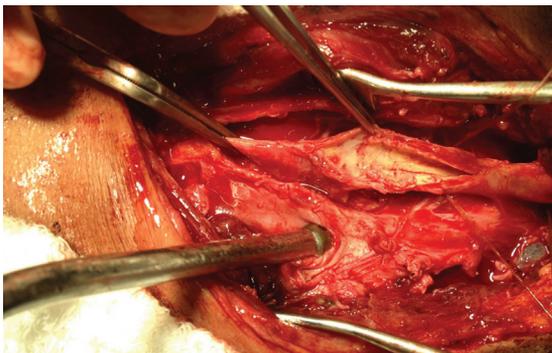
During the operation, an intense inflammatory cicatricial reaction was observed, making it difficult to dissect vascular and neural structures. This meant that it was not possible to reconstruct the internal jugular vein and the decision was taken to ligate it.



**Figure 1.** Color Doppler ultrasound showing an arteriovenous fistula between the common carotid artery and the left internal jugular vein.



**Figure 2.** Angiotomography with reconstruction (A) demonstrating arteriovenous fistula between left common carotid artery and left internal jugular vein, distal arterial occlusion and refilling of the internal carotid by retrograde flow. (B) Bone subtraction.



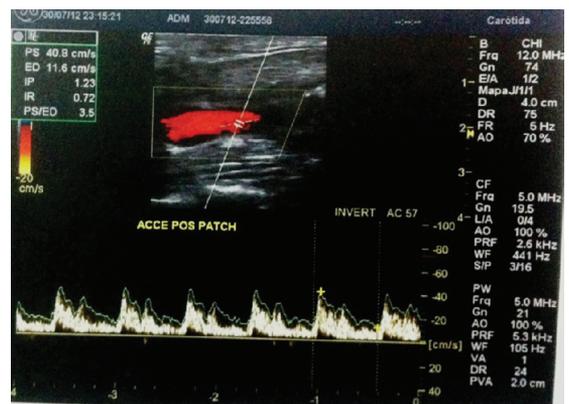
**Figure 3.** Intraoperative view: left common carotid repaired and orifice into internal jugular vein identified.



**Figure 4.** Final results of surgery: pericardial patch to left common carotid artery.

During repair of the carotid injury, after debridement of the artery edges, it became clear that primary suture would not be possible and that it would be necessary to employ a bovine pericardium patch, 30 mm long by 6 mm wide, which procedure was performed successfully (Figure 4).

The patient progressed satisfactorily, was discharged from hospital on the third day after surgery, in good general condition, with neurological status preserved, free from facial edema, but with hemiplegia unchanged. At a 20-day follow-up appointment, color Doppler ultrasound of the carotids showed the reconstructed artery functioning, free from stenosis, and with normal flow waves in the common and left internal carotid arteries (Figure 5).



**Figure 5.** Postoperative outpatient follow-up Doppler ultrasound showing normal flow inside the left common carotid.

## ■ DISCUSSION

Penetrating traumas in the cervical region with arteriovenous injury are a challenge for vascular surgeons.<sup>1,4</sup> Treatment is complex and if identification is delayed, patients' clinical progress can be compromised, due to their unfavorable course.<sup>2</sup> The major complications caused by this condition are thrombosis and embolization, with hemispheric cerebral ischemia, infection and cardiovascular overload causing congestive heart failure.<sup>7,14</sup>

In the case described here, the patient first received care at a different facility, where the vascular injury was not diagnosed immediately, probably due to the absence of evidence of an injury combined with the poor clinical conditions for conducting examinations. Had there been an obvious injury and hemodynamic instability, immediate surgical intervention could have been indicated. In stable patients, imaging studies could be used to plan treatment.<sup>15</sup> Possible options include vascular echography, angiotomography, magnetic resonance angiography or arteriography, and all of them could be used to plan conventional or endovascular surgery.<sup>6</sup> The importance of angiotomography for managing these cases should not be underestimated, since it is a less invasive method than arteriography and offers satisfactory accuracy.

Repair of the carotid-jugular fistula can be performed with conventional open surgery and the construction of bypasses, anastomosis, patches, sutures or ligatures, or with percutaneous methods, with access via the femoral artery, intraoperative arteriographic monitoring to confirm prior arteriographic findings and embolization of the lesion or placement of a covered stent to exclude the lesion.<sup>11,12</sup> In this case, conventional treatment was chosen because of the complex anatomy, with occlusion combined with fistula and refilling at the carotid bifurcation.

Despite the severe and potentially irreversible neurological deficit that had already set in, the decision was taken to conduct surgery to eliminate the emboligenic site, which could cause hemispheric cerebral ischemia and worsen neurological status, with risk of death. The great saphenous vein could have been used to conduct the repair, with low rates of thrombosis and infection, but at the cost of increased time in theater and the need for additional incisions in the lower limb. Another option for venous patching is a segment of the ipsilateral internal jugular vein after ligation, which was not available in this case,

because of the intense cicatricial reaction. The bovine pericardium carotid patch offers the following advantages: reduced surgery time, without the need for additional incisions; easy handling; good fit to the suture line, and low rupture rates, although it is less resistant to infection.<sup>16</sup> A subclavian-carotid bypass was ruled out because the occlusion of the common carotid artery was not extensive.<sup>13</sup>

A carotid-jugular FAV is an event that demands a complex hospital structure for treatment and is linked with significant morbidity and mortality. When combined with occlusion of the common carotid, treatment can be safely achieved through ligation of the jugular vein and arteriorrhaphy of the common carotid with a bovine pericardium patch, with low postoperative morbidity.

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