REVIEW ARTICLE

VASCULAR TRAUMA EXPERIENCE AT HOSPITAL DURAND

ABSTRACT

A brief review of the guidelines for diagnosing and treating vascular trauma in civil society presents the experience with 38 patients over 3 years and 8 months in a public hospital in the City of Buenos Aires.

Keywords: *vascular injuries, differential diagnosis, image diagnosis, vascular surgical procedures*

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INTRODUCTION

Vascular trauma is considered to account for approximately 3% of all trauma worldwide in the context of emergency department admissions; vascular injuries are relatively low, representing only 0.67% of all patients.

In the past, the main source of vascular trauma came from military conflicts, where the greatest experience was gained and where knowledge was established. Nowadays, vascular emergencies come mostly from the civilian sector. For example, in the United States of America, 3% of all cases of major trauma are associated with vascular injury or are exclusively vascular[1,2], so blunt trauma and iatrogenic injuries are becoming increasingly important. The exponential increase in iatrogenic vascular injuries is related to the increase in intravascular procedures and, to a lesser degree, to laparoscopic procedures. At the same time, blunt trauma with vascular lesions is mainly attributed to traffic accidents[3].

ANATOMICAL DISTRIBUTION OF TRAUMA

Experience in civilian vascular trauma since the 1960s documents a relative increase in cervical, thoracic, and abdominal vascular trauma caused by the less deleterious effect of civilian firearms and increased stab wounds, which produce less vascular damage. The above, added to the rapid transport of injured patients, allows more patients to arrive alive to emergency services.

Most of the vascular injuries are due to penetrating trauma. Only 1% of vascular injuries in wartime are from blunt trauma, which is slightly higher in civilian trauma, between 10% and 15%.

A 400% increase in cardiovascular trauma was documented in the civilian population in Houston between 1958 and 1988, 50% of which occurred in the last 10 years. Part of this increase corresponds to iatrogenic injuries, the procedures responsible for these being mainly cardiac catheterization, angiography, and surgical procedures, the femoral and brachial arteries being the most injured[2].

MECHANISMS OF VASCULAR INJURY

The consequences and magnitude of vascular injury depend on the mechanism of injury; therefore, it is essential to identify the agent, which helps to use appropriate diagnostic resources and institute proper treatment. Different mechanisms can cause vascular injuries; these can be penetrating, the most common being those produced by firearms; in this case, the severity depends on the projectile's velocity. In the case of those produced by long-range weapons, in addition to the direct destruction of tissue, injuries secondary to the cavitational effect are observed; bone fragments can produce penetrating injuries of the vessels. Within these lesions, laceration (tear or partial rupture of a vessel and transection), which corresponds to the complete loss of continuity of a vessel, is the most frequent, with bleeding being greater in partial than in complete transections, since in this case there is retraction of both ends and vasoconstriction due to vascular spasm[2,3].

Closed lesions, the least frequent mechanism, have a more serious prognosis, given that the lesion is by crushing and diagnosis tends to be delayed. In this case, lateral disruption of the entire wall or intimal disruption (flap) occurs, leading to thrombosis or dissection and subsequent rupture. In the case of thrombosis, there is the possibility of distal embolization with deleterious effects for the patient. If the lesion is in a contained compartment, there will be a pulsatile hematoma, constituting a pseudoaneurysm. In this case, distal flow is preserved, which initially makes clinical diagnosis difficult and, in turn, changes over time with the appearance of a pulsatile mass. The great danger is rupture away from the initial trauma. The formation of an AVF occurs when trauma of the vein adjacent to the arterial vessel is associated, manifesting itself far from the trauma through cardiovascular alterations and/or rupture[3].

DIAGNOSIS

The diagnosis of vascular lesions is made by exhaustive physical examinations that reveal two types of signs: hard signs or vascular lesions and soft signs. The former includes active arterial bleeding, hematoma that increases in size rapidly, and signs of ischemia with an absence of pulses, phlegm, or murmur; the existence of any of them has surgical or exploratory indications in the operating room. The so-called soft signs of vascular injury include a history of bleeding at the scene of the accident or place of the event, small stable non-pulsatile hematoma, a neurological deficit of a nerve related to a vascular bundle, and wounds with a trajectory neighboring a vascular bundle of importance[2,4]. The presence of hard signs is associated with a high suspicion of vascular trauma (100%) with a false negative rate of 0.7%; these signs are an indication for surgical exploration. Soft signs are indicative of vascular injury but do not indicate immediate surgical exploration; these patients will be submitted to complementary studies[5]; their presence is associated with a 63% incidence of vascular

injury. Echo-Doppler may indicate the possibility of vascular injury. However, angiotomography is the gold standard for visualizing vascular lesions because, in addition to seeing the lesion itself, it allows the evaluation of the associated lesions and planning surgery more accurately.

Traumatized patients should be given first aid, airway control, and management; however, the management priorities in patients with this type of injury are to stop bleeding, restore normal circulation and avoid, as far as possible, tissue distress.

TREATMENT

Once surgical exploration of the patient with vascular trauma has been decided, good visualization of the involved vessel is paramount, so the incision should be generous. Proximal and distal vascular control is the first principle of vascular repair. Then the use of heparin in the general or systemic form must be considered if there are no associated severe lesions. However, a heparinized solution is common for the lavage of vascular ends[6].

Fogarty catheter embolectomy of both ends is essential to ensure a thrombus-free sector; intraoperative arteriographic verification indicates whether the distal sector is free of thrombus.

The distal sector is free of thrombus. For vascular shunt, fasciotomies should be used (open or semi-closed of the compartments in the limb) to avoid compartment syndrome, which occurs when ischemia is greater than 6 hours, or in closed trauma, or venous ligation or reconstruction is performed.

Regarding the type of conduit to be used, the autologous vein remains the gold standard, especially the internal saphenous vein, ideally from the leg contralateral to the trauma in the case of limb involvement. For this reason, the extremities should always be prepared to resort to the vein[7].

In case of impossibility to obtain the saphenous vein, either for technical reasons or due to urgent situations, as occurred in a patient of our statistics, it is advisable to use a PTFE prosthesis, although with a higher risk of infections (since these are emergencies) and better long-term patency.

METHODS

The present study is retrospective, performed in the hospital ward from January 2019 to September 2022; patients who presented possible vascular trauma with data available for reporting were included. Demographic data, mechanisms of injury, site of injury, vascular soft and hard signs, imaging, injured vessel, complications, and mortality were recorded.

RESULTS

Thirty-eight patients with possible vascular injury presenting with hard or soft signs were analyzed. The mean age was 29 years (18-64); sex, male, 37 cases (90.2%). We found 25 vascular lesions in 22 patients (3 had combined lesions, and vein and popliteal artery).

Of the 38 patients, 33 (86.8%) were due to penetrating trauma, and 5 (13.2%) cases were due to blunt trauma (*Figure 1*). Of the total possible injuries, 20 patients (52.6%) presented hard signs, which were intervened, and a vascular lesion was found in 19 (95%); only one patient presented hard signs, but no vascular lesion was found. The remaining 18 (47.4%) patients had soft signs, arterial Doppler ultrasound and angiotomography (*Figure 2*) were performed, and vascular lesion was found in 3 patients (16.6%). Among the 25 vascular lesions, the following were found: popliteal lesion in 8 cases (32%), 5 arterial and 3 venous, 3 patients with combined lesions (*Figures 3, 4, and 5*), superficial femoral in 4 cases (16%) (*Figure 6*), 2 common femoral (8%), 1 tibioperoneal trunk (4%) (*Figure 7*) and 1 posterior tibial (4%). In the upper limb, it was found in 8 cases (32%), 3 humeral (*Figure 8*), 4 radial and 1 ulnar, and 1 case of the right subclavian artery (*Figure 9*). The surgical techniques used were primary suture of the vessel in 4 cases (16%), ligation of the vessel in 2 (8%) (popliteal veins), closure with vein patch in 1 case (*Figure 5*), venous bypass in 17 (68%) and bypass with prosthesis in 1 case (4%), the patient was admitted in cardiorespiratory arrest in resuscitation.

Fasciotomy was performed in 4 patients (18%) (*Figure 10*), 3 due to combined popliteal injury, and 1 due to humeral injury. Amputation was required in 3 cases (13.6%). One patient died (4.5%). Follow-up is low since postoperative consultation is very rare.

CONCLUSION

Vascular lesions are challenging pathologies where rapid intervention is essential for prognosis. Generally, they are young patients with few comorbidities, where the main issue is hemorrhage control and rapid resuscitation, which explains the low mortality. The relevant data obtained are from hospitalization. After discharge, patients do not return to the office, so follow-up is challenging.

Declarations
The authors declare no conflict of interest.

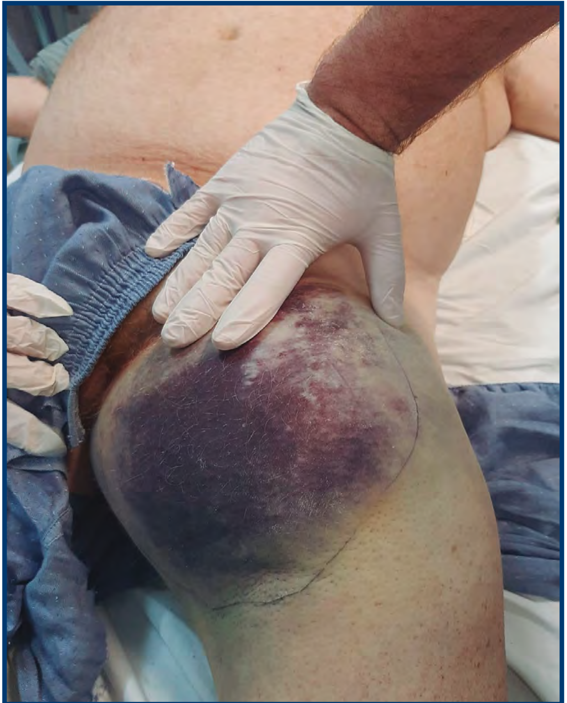

FIGURE 1. Closed vascular trauma of the inguinal region.

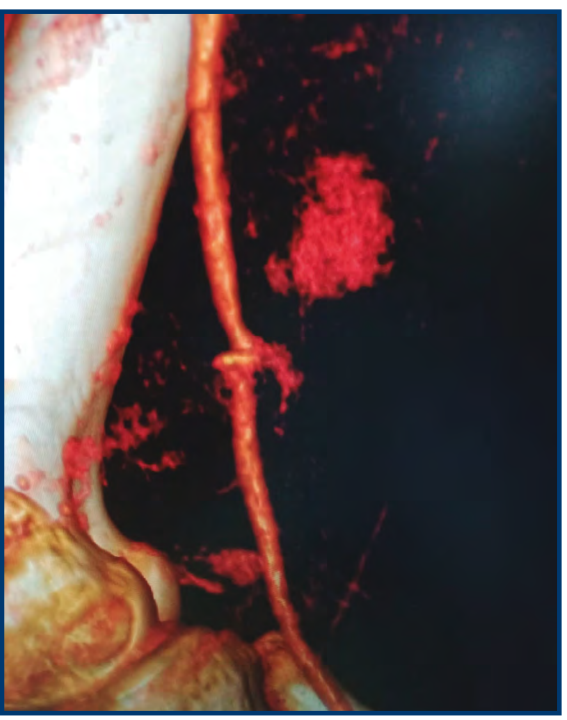

FIGURE 2. Angiotomography with a superficial femoral lesion.

FIGURE 3. Combined vein and artery popliteal injury, posterior approach.

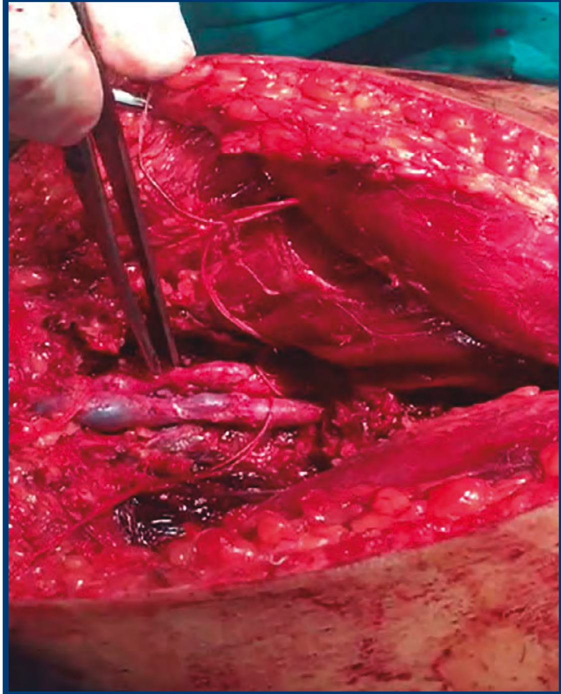

FIGURE 4. The popliteal fossa can be seen with a posterior approach; the calf muscles are towards the right of the figure -surgical repair of figure 5-, popliteal artery venous bypass, and popliteal vein venous patch.

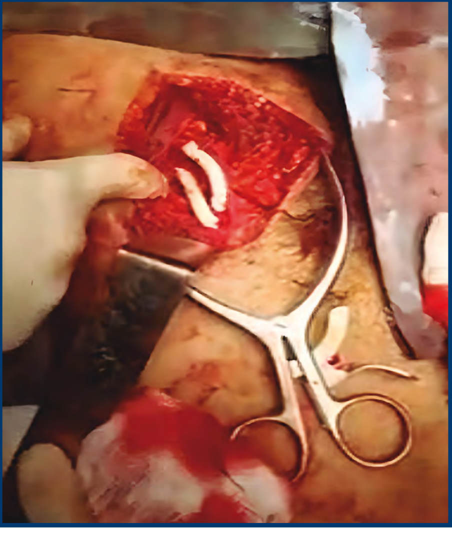

FIGURE 6. Repair with prosthesis separately, femoral chamber gunshot injury with common, superficial, and deep femoral involvement.

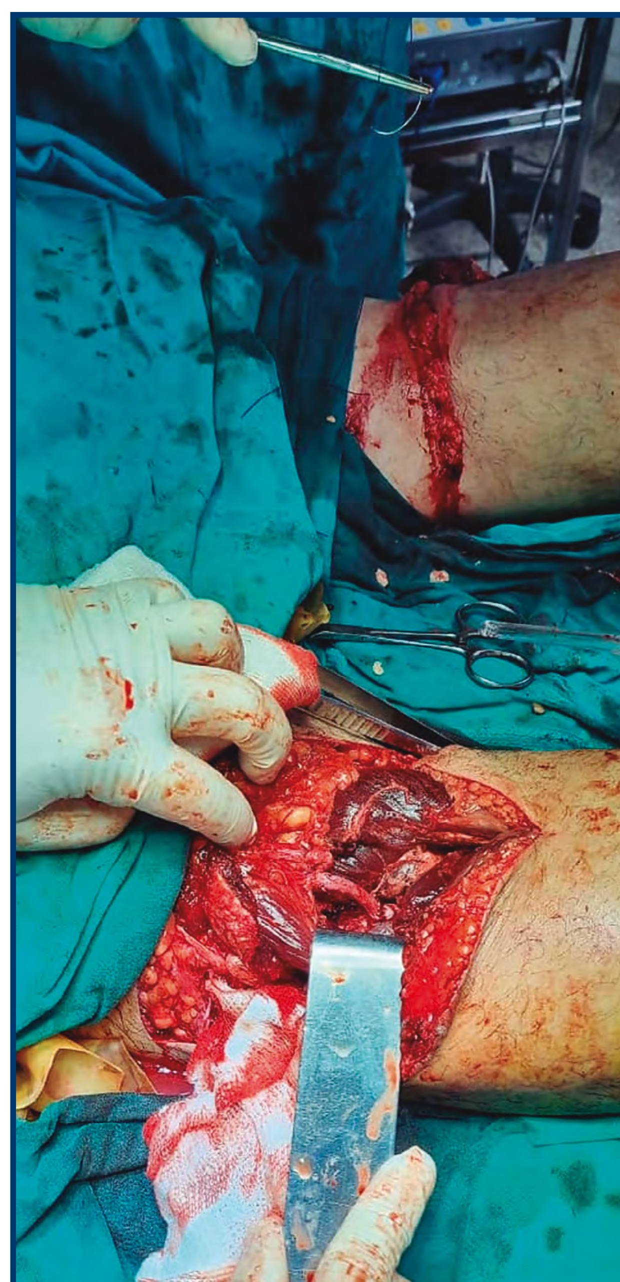

FIGURE 5. Popliteal injury with posterior approach and venous bypass.

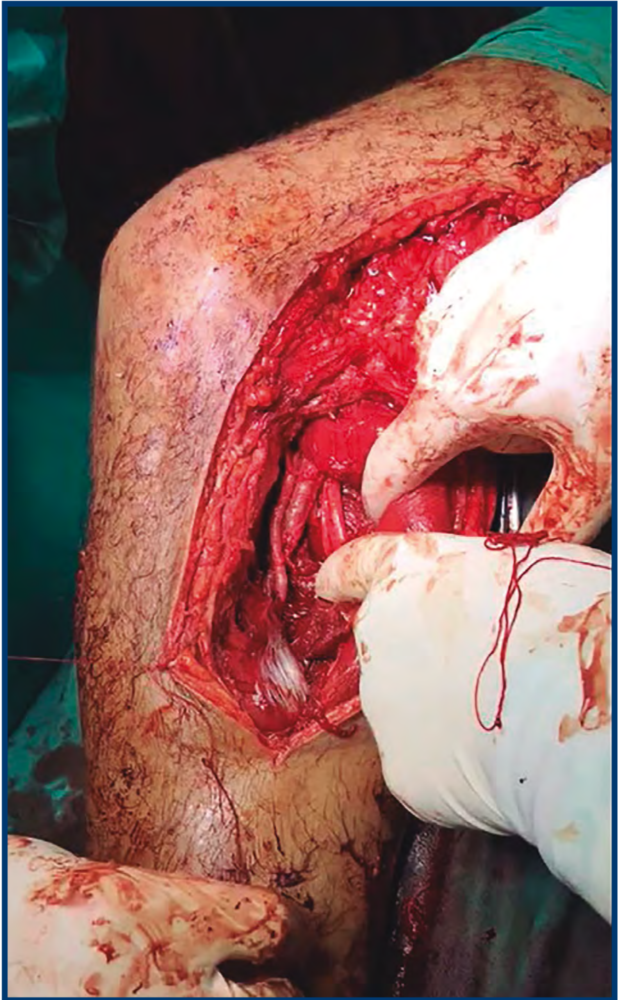

FIGURE 7. Medial approach of right leg. Proximal control was performed in the popliteal artery. The internal geniculate muscle is removed to visualize the venous bypass of the tibioperoneal trunk.

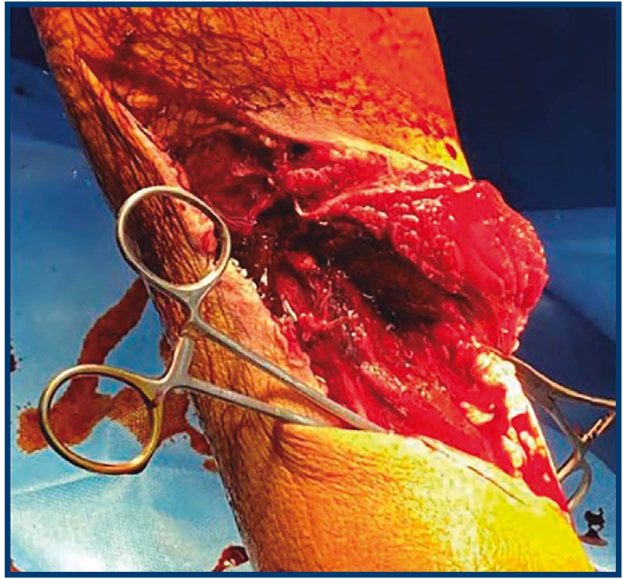

FIGURE 8. Penetrating injury in elbow crease. The biceps was completely sectioned, and the humeral artery lesion was clamped.

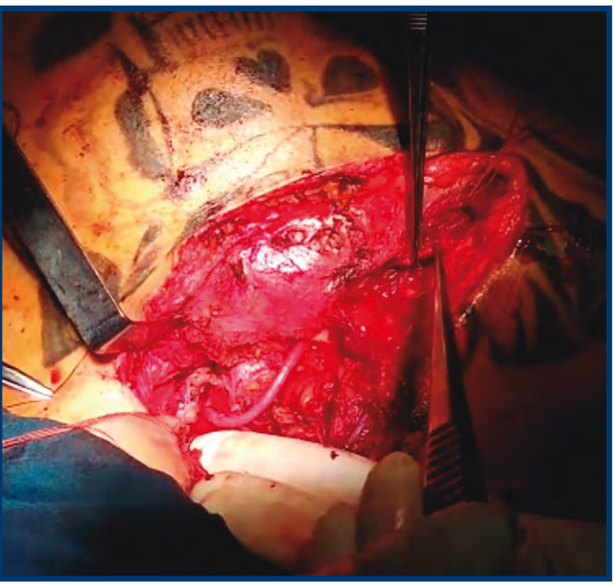

FIGURE 9. Subclavian injury. Bypass is observed coming out of the subclavian and passing under the clavicle.

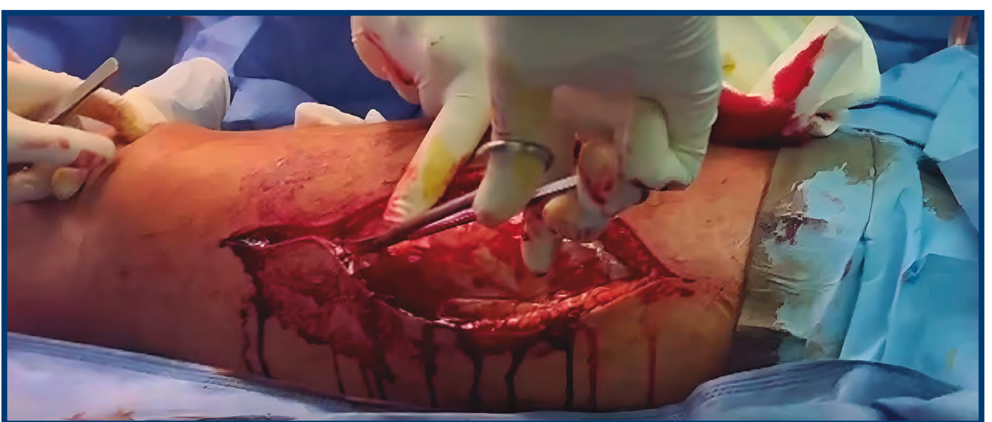

FIGURE 10. Fasciotomy due to compartment syndrome. The tension is observed where the opening of the fascia is missing.

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