

Brachial artery injury in a referral center in central Mexico

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Summary

Introduction: Brachial artery lesions are rare, even in high concentration trauma centers and despite having good technical success, they can have significant functional limitations due to being associated with nerve lesions, that is why we decided to describe our experience in the management of lesions of brachial artery. **Material and methods:** Review of clinical records of patients with brachial artery injury treated by the vascular surgery service at the General Hospital of Mexico from January 1, 2013 to May 30, 2022 was performed. Characteristics of the lesions, time elapsed from lesion to revascularization, type of surgical treatment, and postoperative results. **Results:** 16 lesions were treated. 100% with late referral (more than 6 hours after the injury). There were 9 (56.25%) complete sections, 4 (25%) partial section, 2 (12.5%) thrombosis, and 1 (6.25%) pseudoaneurysm. 100% of the lesions were distal to the deep brachial branch. 8 (50%) had associated venous injury, 6 (37.5%) nerve injury (median nerve in 100%). The treatment was 3 (18.75%) simple closure by partial section, 3 (18.75%) end-to-end anastomosis, 8 (50%) autologous bypass (5 with reverse vein of the ipsilateral arm and 3 with great saphenous vein) and 2 (12.5%) thrombectomy. Technical success in 100% and 0% amputation. **Conclusion:** Due to the important collaterality of the brachial artery, the percentage of amputation is very low and, despite late care, revascularization should be offered to improve the functional prognosis of the limb.

Keywords: Brachial artery injury. Brachial trauma. Late revascularization.

Introduction

Brachial artery injuries are rare even in high concentration trauma centers. They occur in 25 to 33% of all vascular lesions. It is the second most injured artery and the most frequent in the upper extremity^{1,2}. It occurs in males with a 9:1 ratio in the 3rd and 4th decade of life. Penetrating wounds are the most common mechanism of injury (90%), with a sharp object wound being the main one, followed by a gunshot wound^{2,3}.

The deep brachial artery offers an important collateral network towards the forearm together with ulnar

collateral branches, so the risk of limb loss increases twice when the lesion is prior to the exit of the deep brachial artery¹.

Despite progressing with adequate technical success after repair, vascular trauma to this artery can have a significant impact on the functional outcome of the limb due to the high incidence of associated nerve lesions, mainly to the median nerve².

Although the literature on this topic is scarce and there are very few series describing brachial artery injuries that have reported any statistical analysis or outcome

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predictors, the management of brachial injuries has developed significant experience in recent decades^{1,2}.

Rationale

In our country there are no recent series on the management of brachial artery injury. For this reason we decided to describe our experience in the management of brachial artery lesions in a reference center of the country.

Materials and methods

A review of the clinical records of patients admitted with a diagnosis of brachial artery injury treated by the vascular surgery service at the General Hospital of Mexico from January 1, 2013 to May 30, 2022 was carried out.

Demographic data of the patients, time elapsed from the lesion to revascularization, type of trauma, characteristics of the lesions, their association with other injured structures, type of surgical treatment, and post-operative results were described.

Results

Sixteen brachial artery lesions were treated, 15 (93.75%) male and 1 (6.25%) female. (Table 1.) The mean age was 29.4 years. Two (12.5%) were due to blunt trauma, 14 (87.5%) were due to penetrating trauma, 12 (75%) due to a sharp object injury, and 2 (12.5%) due to a firearm projectile injury. All patients attended with a late referral to the hospital (more than 6 hours after the injury) for which late revascularization was offered. All patients presented at least 1 hard sign of vascular lesion and were therefore taken to the operating room for vascular exploration. The most common type of lesion was complete section in 9 (56.25%), 4 (25%) partial section, 2 (12.5%) thrombosis, and 1 (6.25%) pseudoaneurysm. All lesions were distal to the exit of the profunda brachial artery. Among other associated injured structures, there were 3 (18.75%) lesions of another artery (1 radial artery and 2 combined radial and ulnar artery), 8 (50%) had associated venous injury (5 basilic vein, 4 brachial veins and 1 cephalic vein), 5 (31.25%) had a nerve lesion (median nerve lesion in 100%). All patients in whom nerve injury was suspected were assessed for plastic surgery at the same surgical time, immediately after revascularization. In those who presented a median nerve lesion, a simple repair was performed with adequate technical success. At discharge, they were sent to rehabilitation for assessment. The surgical treatment performed was 3 (18.75%) simple closure by partial section, 3 (18.7%)

Table 1. Characteristics of patients, injury and treatment

	n (%)
Gender	
Male	15 (93.75)
Female	1 (6.25)
Age (year)	Mean 29.4
Mechanism of injury	
SOI	12 (75)
GW	2 (12.5)
Bruised	2 (12.5)
Time>6 hours	16 (100)
Type of arterial injury	
Full section	9 (56.25)
Partial section	4 (25)
Thrombosis	2 (12.5)
Pseudoaneurysm	1 (6.25)
Location with respect to the deep brachial artery.	
Distal	16 (100)
Associated injuries	
Arterial	3 (18.75)
Radial Artery	1 (33.33)
Radial artery and ulnar	2 (66.66)
Venous	8 (50)
Basilic vein	5 (62.5)
Brachial veins	4 (50)
Cephalic vein	1 (8)
Nervous	6 (37.5)
Median nerve	6 (100)
Procedures	3 (18.75)
Simple closure	3 (18.75)
T-T anastomosis	2 (12.5)
Thrombectomy	8 (50)
Autologous bypass	3 (37.5)
Basilic vein	2 (25)
Cephalic vein	3 (37.5)
Great saphenous vein	

SOI: sharp object injury; GW: Gunshot wound. T-T: term-terminal.

end-to-end anastomosis, 8 (50%) autologous bypass with vein (3 with ipsilateral basilic vein, 1 with ipsilateral cephalic vein and 3 with a great saphenous vein) and 2 (12.5%) thrombectomy due to secondary thrombosis of the shock wave due to a gunshot wound. In the group that underwent bypass, 1 was simple brachyulnar, another was brachyulnar with reimplantation of the radial artery in the vein graft for reconstruction of the brachial bifurcation. (Fig. 1). The other 5 bypasses with vein grafts were brachio-brachial. One hundred percent of the patients recovered pulses at the end of the surgery until their discharge, having no amputations.

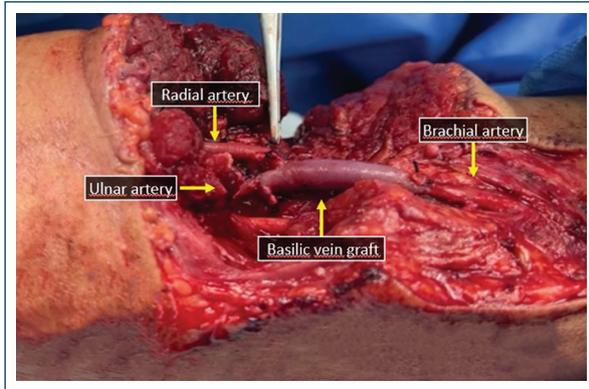


Figure 1. Brachyulnar bypass with reimplantation of the radial artery to a basilic vein graft for reconstruction of the brachial bifurcation.

Discussion

The incidence of brachial artery injuries ranges from 25-33% of all peripheral vascular injuries.¹ Penetrating trauma is the most frequent mechanism of injury, the rest are caused by iatrogenic or blunt trauma^{1,4}.

Currently, an upper extremity amputation rate due to brachial artery injury of 1 to 4% is reported, when it ranged from 10 to 40% and a survival rate of 95 to 100%.¹

In our review, no amputation occurred, with survival similar to those reported. Our data coincide with the demographic data regarding sex, age, and the most frequent mechanism of injury reported in the literature⁵.

The mainstay of diagnosis is clinical evaluation and manual Doppler examination. From 5% to 15% of patients with vascular injury may present a normal pulse^{2,4,6}.

In the presence of hard signs of arterial injury such as pulsatile hematoma, expanding hematoma, active bleeding, audible bruit, thrill, and signs of arterial occlusion (absence of pulses, pallor, paresthesia, pain, paralysis, and poikilothermia), urgent surgical intervention is required^{7,8}. The evaluation should be complemented with a brachio-brachial index, so a difference > 10 mmHg could suggest vascular injury^{2,7,8}. Doppler ultrasound of the upper extremity has a sensitivity of 99% and a specificity of 98%. It has the advantages of being more accessible, non-invasive, and does not use a contrast medium, despite being operator-dependent^{2,9}. Angiography for a long time was the gold standard in peripheral vascular lesions. However, its value is currently controversial when clinical signs are unequivocal^{2,4}. Preoperative arteriography is required when there are multiple sites of injury or if clinical evaluation is inconclusive¹⁰.

Computed tomography angiography has a sensitivity and specificity close to 100% and is useful when physical examination alone cannot definitively diagnose or rule out vascular injury or when there are multiple lesions^{4,7}.

The brachial artery has a wide collaterality at the level of the elbow given mainly by the profunda brachial artery. This is a branch that arises from the proximal third of the brachial artery and reaches the radial artery. It communicates with the collateral circulation of the forearm through collateral and recurrent ulnar arteries. Due to this, there is a low percentage of limb loss despite the delay in treatment, since the degree of ischemia depends on whether the lesion is proximal or distal to the profunda brachial artery¹¹⁻¹⁴. This explains why none of the patients we reported, who, despite having more than 6 hours of evolution, did not present any irreversible ischemia requiring amputation and revascularization was successful in all cases.

The association of nerve injuries causes long-term disability in 27 to 44%^{1,2}. Degiannis concluded that “the long-term outcome of an upper limb injury does not depend on the vascular injury that can be successfully treated, but on the recognition, treatment, and outcome of the associated nerve injuries”^{15,16}. Primary nerve repair is recommended at the same surgical time as revascularization, mainly in the context of penetrating trauma from a sharp object, since the functional deficit of the peripheral nerves associated with brachial artery injury is directly related to the repair time^{2,17,18}. All of our patients who had suspected nerve injury were evaluated for plastic surgery after revascularization with immediate nerve repair in the event of such an injury.

Venous injury repair is not described, most describe ligation of said injuries^{1,2,9,19}. In our series, all the venous lesions were ligated, presenting an adequate evolution and without significant edema.

The goal of treatment is the prevention of prolonged tissue ischemia and the salvage of the limb preserving the best functionality. Ideally, vascular repair should be performed within the first hour of injury presentation, however, most of these patients are referred after this time, so regardless of time, most patients benefit from delayed arterial revascularization to improve treatment functional prognosis of the limb²⁰.

There is a variety of surgical techniques for arterial injury repair such as simple repair in partial lesions and end-to-end anastomosis when there is no tension and in those arterial tissue losses < 2 cm. This technique is possible in approximately one third of patients with brachial artery injury^{2,6,15}.

Bypass grafting is recommended for lesions larger than 2 cm with extensive tissue loss or multiple lesions. Autologous, saphenous vein, or upper extremity grafts are preferably recommended because they present better patency rates and lower risk of infection compared to synthetic grafts^{2,6}. Repair using an ipsilateral upper extremity vein graft or close to the area of injury is safe and effective as long as the surrounding tissue is not severely injured, and the donor vein is in good condition^{21,22}.

Conclusion

Brachial artery lesion is a rare pathology even in highly concentrated trauma centers. Our center, despite being a referral center, is not a referral hospital for patients in the context of trauma; however, adequate results have been obtained in the management of brachial injuries.

Demographic characteristics and mechanisms of injury were similar to those of other reported series. Due to the important collaterality of the brachial artery, the percentage of amputation is very low and despite the fact that most patients present late, with more than 6 hours of evolution, revascularization should be offered to improve the functional prognosis of the limb. The results are encouraging, having a 100% technical success with 0% amputation percentage. Long-term follow-up is necessary to assess the functionality of the lesion in the context of associated nerve injury. Revascularization with a vein graft of the upper extremity is an appropriate treatment option due to the proximity of the lesion, similar diameters to the artery, shorter surgical time, and complications. This opens a wide field of study in the management of upper extremity trauma in Mexico.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of people and animals. The authors declare that no experiments were carried out on humans or animals for this research.

Data confidentiality. The authors declare that no patient data appears in this article.

Rights to privacy and informed consent. The authors declare that no patient data appears in this article.

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