

## CASE REPORT

# Limb Salvage after Delayed Brachial Artery Injury with Critical Limb Ischemia

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## Abstract

**Background:** Superficial location of the brachial artery makes it the most frequently injured artery in the upper extremity; its injury represents approximately 28% of all vascular injuries. The objective of this study is to highlight that prompt revascularization can save the limb even in cases of delayed brachial artery injury with severe vascular compromise.

**Patients and Methods:** It is a case study of 22-year male patient transferred to our hospital with critical limb ischemia following penetrating injury of his left elbow caused by glass during a fight. He presented to us 9 h

after the injury with hypotension, pallor, severe rest pain, cold and cyanosed extremity with absent distal pulses, and he had bleeding lacerated wound at the region of left elbow. Diagnosis of brachial artery injury was made with clinical examination with no need for farther diagnostic modalities, and after rapid patient resuscitation, he was taken immediately to the theater and we performed end-to-end anastomosis of the brachial artery and also repair of the associated nerve injuries.

**Conclusion:** Prompt surgical intervention with appropriate management is essential to save the limb in cases of delayed brachial artery injuries with critical limb ischemia.

**Key words:** *Delayed brachial artery injury; Penetrating injury; Critical limb ischemia; Nerve injuries; Fasciotomy; Duplex ultrasound; Compartment syndrome*

## Introduction

The superficial location of the brachial artery makes it the most frequently injured artery in the upper extremity; its injury represents approximately 28% of all vascular injuries [1]. The high incidence of the associated nerve injuries significantly affects the functional outcome of the limb even after successful vascular repair [2,3]. Intervention within the first 6 h after the injury, which is considered the golden time, decreases the degree of ischemia-reperfusion injury, and maximizes the chance of limb salvage [1].

## Patients and Methods

A 22-year male patient transferred to our hospital with extensive soft tissue injury of his left elbow caused by glass during a fight. He presented to us 9 h after the initial injury with hypotension, pallor, severe rest pain, cold and cyanosed extremity with absent distal pulses,



Figure 1: Severe soft tissue injury with muscles laceration.

and associated neurological deficits.

The wound examination showed active arterial bleeding together with severe muscles laceration and contamination (Figure 1).

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Diagnosis of brachial artery injury was evident with clinical examination with no need for farther diagnostic modalities. Due to presence of hard signs of penetrating vascular injury with critical limb ischemia, the patient was taken immediately to the theater after rapid resuscitation with intravenous fluids, broad spectrum antibiotics, full blood tests, and blood transfusion. First, we performed saline wound irrigation and thorough debridement of all necrotic nonviable tissues. Second we explored the brachial artery via a medial longitudinal extension and the artery was completely cut and we did proper mobilization of both cut ends proximally and distally by division of the unimportant collateral branches to make the anastomosis done without tension. Third we flushed both cut segments with heparinized saline 50 units/ml and we used Fogarty catheters routinely for thrombectomy, and dilatation of the cut segments that commonly have arterial spasm. Forth we gave systemic intravenous heparin 5000-10000



*Figure 2: Brachial artery and median nerve repaired.*

units before vascular clamping then we performed end-to-end anastomosis after freshens of the cut ends (Figure 2).

We performed primary repair of the associated nerve injuries and repair of the major venous injuries that needed reconstruction together with primary fasciotomy to decrease the incidence of compartmental syndrome.

Return of the distal pulses with good volume at the end of the operation was our indicator of successful vascular repair. The patient was given LMWH and continued the broad-spectrum antibiotic for 7 days postoperatively then shifted to 100 mg aspirin for 3 months. He had been followed at 1-month then at 3-month periods, the consistent arterial blood flow was assessed by clinical examination and duplex ultrasound; normally the average brachial-brachial pressure index is rarely less than 0.85.

## Results

In this case study, the age of the patient was 22 years and the mechanism of trauma was penetrating glass injury with extensive soft tissue lacerations. This patient presented to us 9 hours after the accident with hard signs of vascular injury in the form of pulsatile arterial bleeding and critical limb ischemia, but there were no associated bony fractures. The prompt vascular intervention done for him was end-to-end anastomosis of the brachial artery together with primary repair of the associated nerve injuries and the major venous injuries. Primary fasciotomy was a very essential step in our plan to manage such case of delayed brachial artery injury with critical limb ischemia.

The patient limb was saved with consistently good arterial blood flow that was assessed by physical examination and duplex ultrasound. He was followed postoperatively at 1-month then at 3-month periods for a follow up period of around 18 months. The patient developed postoperative complications in the form of wound infection with devitalization of the skin edges that needed farther thorough debridement and secondary sutures. He also had residual functional disability due to the concomitant nerve injuries and followed up by neurosurgeons with doing electromyography and nerve conduction studies to evaluate the neurological deficits with the help of rehabilitation clinics.

## Discussion

The rich collateral circulation around the elbow remain the hand and forearm well perfused after brachial artery injury especially if injury is distal to the origin of the profunda brachii which shares importantly in the anastomosis around the elbow joint [2]. In the recent years the limb salvage rate has increased nearly up to 100 % provided that appropriate management is done including prompt diagnosis, high surgical skills, attention to associated injuries and early management of complications [4-6].

We have what is so-called the hard signs and soft signs of vascular injury; the hard signs include active arterial (pulsatile) bleeding, pulseless/ischemia, expanding pulsatile hematoma and bruit or thrill whereas the soft signs include minor bleeding, injury in proximity to major vessels, small to moderate size hematoma and

associated nerve injury. This clinical classification has an important impact on the plan of management so in cases of brachial artery injury presenting with hard signs of penetrating vascular injury, like our case which moreover is complicated by the delayed presentation with critical limb ischemia, prompt surgical intervention without proceeding to farther diagnostic modalities even duplex ultrasound, is decided to save both the patient and the limb. However, in cases presenting with soft signs of vascular injury or blunt pattern injury we have time to investigate the patient [7].

Duplex ultrasound is a reliable, non-time consuming and cost-effective diagnostic tool of brachial artery injury whereas angiography, the more invasive technique, is spared for certain types of injuries or if the endovascular approach is used [8]. Normally the average brachial-brachial Doppler pressure index between the two upper extremities is approximately 0.95; it is rarely less than 0.85 and pressure measurements less than 0.5 are diagnostic of brachial artery injury [9,10]. The sensitivity and specificity of the duplex ultrasound is comparable to that of arteriography in diagnosing brachial artery injuries [8].

In our case study, we had to manage properly many challenging issues to save the limb of such young patient including his delayed presentation with critical limb ischemia as the patient was operated upon more than 9 hours after the injury whereas the first 6 h is considered to be the golden time for limb salvage after brachial artery injury [1]. The degree of ischemia-reperfusion injury depends on the severity and duration of striated muscle ischemia, however, because of the rich collateral circulation around the elbow all cases of brachial artery injury should be repaired regardless the time interval between the injury and vascular intervention [11]. Also, this type of penetrating injury with extensive soft tissue damage and severe muscle laceration with contamination added more risk of infection and bad healing so that thorough debridement was mandatory. The high possibility of compartment syndrome is one

of the morbidities of our case with more jeopardizing of the blood supply of the muscles and nerves with the risk of limb loss or Volkmann's ischemic contracture and we performed primary fasciotomy and repair of major venous injuries to decrease the incidence of such complications [12,13].

As regards the technique of vascular repair, we used the end-to-end anastomosis which is the best to be done provided that no tension at the suture line or damage to the major collateral vessels. Otherwise, the saphenous vein interposition graft is the second choice having better long term patency rates and more resistance to infection when compared to the synthetic graft (PTFE), which should be used only in cases where no adequate saphenous vein conduit is available [6]. Endovascular techniques have been indicated in certain types of upper extremity vascular trauma that are anatomically difficult to repair [14,15].

The close anatomical proximity of the brachial artery to the nerves of the upper limb makes the incidence of the associated nerve injuries is high and more than this anatomical consideration, ischemic injury of the nerves.

can occur especially in cases where the blood supply of the limb is much affected like in our case [16]. During the follow-up period the patient suffered from residual functional disability and this is coinciding with the results of the other studies that showed that the rate of functional disability after associated nerve injuries ranges from 27% to 44% [17].

## Conclusion

The morbidity and mortality of the brachial artery injuries depend on the type of injury, the degree and duration of ischemia, the associated injuries, and our experience in management plan. Prompt surgical intervention with appropriate management is essential to save the limb in cases of delayed brachial artery injuries with critical limb ischemia.

## References

1. Zellweger R, Hess F, Nicol A, et al. An analysis of 124 surgically managed brachial artery injuries. *Am J Surg.* 2003;188:240-5.
2. McCready RA. Upper-extremity vascular injuries. *Surg Clin North Am.* 1988;68:725-40.
3. Visser PA, Hermreck AS, Pierce GE, et al. Prognosis of nerve injuries incurred during acute trauma to peripheral arteries. *Am J Surg.* 1980;140:596-9.
4. Shanmugam V, Velu RB, Subramaniyan SR, et al. Management of upper limb arterial injury without angiography—Chennai experience. *Injury.* 2004;35:61-4.
5. Cihan HB, Gulcan O, Hazar A, et al. Peripheral vascular injuries. *Ulus Travma Derg.* 2001;7:113-6.
6. Yavuz S, Tiryakioglu O, Celkan A, et al. Emergency surgical procedures in the peripheral vascular injuries. *Turk J Vasc Surg.* 2000;1:15-20.
7. Magnus CW, Riddez L. Penetrating vascular trauma of the upper and lower limbs. *Current Trauma Reports* 2016;2:11-20.

8. Ergune K, Yillik L, Ozsoyler I, et al. Traumatic brachial artery injuries. *Tex Heart Inst J*. 2006;33:31-4.
9. Shalabi R, Amri YA, Khoujah E. Vascular injuries of the upper extremity. *J Vasc Brasil*. 2006;5:271-6.
10. Johnston KW. Upper extremity ischemia. In: Rutherford RB, (editor). *Vascular surgery*. (5th edn), WB Saunders company, Philadelphia. 2000;pp.1111-39.
11. Moini M, Hamedani K, Rasouli MR, et al. Outcome of delayed brachial artery repair in patients with traumatic brachial artery injury: prospective study. *Int J Surg*. 2008;6:20-2.
12. Velmahos GC, Theodorou D, Demetriades D, et al. Complications and nonclosure rates of fasciotomy for trauma and related risk factors. *World J Surg*. 1997;21:247-53.
13. Williams AB, Luchette FA, Papaconstantinou HT, et al. The effect of early versus late fasciotomy in the management of extremity trauma. *Surgery*. 1997;122:861-6.
14. Lonn L, Delle M, Karlstrom L, et al. Should blunt arterial trauma to the extremities be treated with endovascular techniques. *J Trauma*. 2005;59:1224-7.
15. Franz RW, Goodwin RB, Hartman JE, et al. Management of upper extremity arterial injuries at an urban level I trauma center. *Ann Vasc Surg*. 2008.
16. Ekim H, Tuncer M. Management of traumatic brachial artery injuries: A report on 49 patients. *Ann Saudi Med*. 2009;29:105-9.
17. Hardin WD, O'Connell RC, Adinolfi ME, et al. Traumatic arterial injuries of the upper extremity: determinants of disability. *Am J Surg*. 1985;150:266-70.