

Study of Repair of Lower Extremity Arteries with Late Presentation after Blunt and Penetrating Trauma

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ABSTRACT

Objective: To evaluate the surgical outcomes of delayed presented lower extremities injuries following blunt and penetrating trauma.

Study Design: A prospective study

Place and Duration of Study: This study was conducted at the vascular surgical unit of Doctor Hospital and Medical center Lahore for 1 year from Oct 2020 to Oct 2021.

Materials and Methods: The study included confirmed cases of arterial injuries of lower limbs following blunt and penetrating trauma presented to us after 24hours. Whereas, patients with non-salvageable limbs were excluded from the study. Surgical revascularization was carried out in all the cases in an attempt to repair lower limb arteries. The patients were assessed for amputation rate, mortality rate. Patients were followed for at least 3 months, postoperatively to evaluate complications (if any).

Results: A total of 22 patients were included in the study. External iliac artery injury (EIA) and common femoral artery injury (CFA) were presented in 9% patients, superficial femoral artery injury (SFA) was affected in 31.8%, and popliteal artery injury (PA) in 59%. The average hospital presentation time was 28.3 hrs. There was no mortality. Amputation was done in 9% patients with popliteal artery injury because of muscle necrosis, increasing infection. The secondary amputation rate was significantly higher in the PA group than in the other two groups. Soft tissue infection and tissue necrosis are the most reported complications in all three groups.

Conclusion: Though amputation or limb complications may develop over time because of limited revascularization time of vessels, the rate of such complications is limited. Moreover, popliteal artery injury leads to most complications among other lower vascular injuries.

Key Words: Blunt trauma, penetrating trauma, lower limb arterial injury, revascularization, surgical repair, vascular injuries.

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INTRODUCTION

Pakistan, the fourth-most populous state across the world, suffers massively from non-communicable diseases such as injury. These injuries and associated trauma particularly related to limbs are also becoming a significant cause of morbidity and mortality. Around 40 to 75% of injuries are inflicted on peripheral vessels⁽¹⁾ and deemed as most challenging since the amputation risk increases if the injury is not addressed on time.

The optimum golden period of revascularization of a limb with arterial injury is less than 6 hours, due to completely disrupted blood supply⁽⁷⁾. However, since limbs with injured arterial vasculature have intact

collateral circulation, the golden period, in this case, is slightly extended. However, even in these cases, ischemia of more than 6 hrs. in the injured leg increases the amputation risk by 4 times⁽⁸⁾. Therefore, the efficiency of revascularization after 6 hours of arterial injury in the lower limb is still a debated subject. Some of the studies have found that revascularization even after 24 hrs or in some cases after 1 week, can save the leg⁽⁹⁾, but the underlying mechanisms that allowed successful salvage even after prolonged ischemia couldn't be understood.

The rate of salvage of lower limbs after an injury to arteries is dependent upon the various factors including the amount of soft tissue damage, associated damage to the venous system, involvement of nervous system and bony injury, the occurrence of compartment syndrome, and extent of ischemic damage before revascularization^(1,2). Trauma or damage to the arterial system is believed to be a major risk for limb survival⁽³⁾. However, proper management strategies such as the immediate provision of treatment, appropriate fasciotomy, and restoration of arterial injury can significantly help in the survival of limbs⁽⁴⁾. Some reports have also suggested that reduction in ischemic time can also decrease the extent

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of morbidity^(5,6). Generally, blunt trauma, associated venous, musculoskeletal injuries, and prolonged ischemia are the factors that are related to the high rate of lower limb amputations⁽²⁾.

Due to lack of awareness and poor health care facilities, many patients with lower limb arterial injury in Pakistan present late or are treated after the golden time (within 6hrs after the injury). This study aims to evaluate the outcomes of surgical repair of late-presented lower limb arterial injuries with blunt and penetrating trauma.

MATERIALS AND METHODS

A prospective study was conducted at the vascular surgical unit of Doctors hospital, Lahore from 5th October 2020 to 5th October 2021. The study included patients who were presented at least after 24 hrs of blunt and penetrating trauma but had viable limbs on examination and those whose CT angiography revealed the vascular injury. Whereas, the patients with dead limbs, characterized as complete paralysis with mottling, were excluded from the study. The participants were informed of the study objective and their consent was sought. Similarly, an ethical review of the study was conducted by the ethical review committee of the hospital. Soon after the hospital admission, all participants were evaluated by the surgeon. The confirmed cases of arterial injury were referred for immediate surgical repair. X-ray was taken for detecting lower-extremity fractures. At baseline, extents of sensory and motor deficits were also assessed. CT angiography was done to evaluate the arterial system. All patients underwent surgical intervention for repair. During surgical intervention, electrical stimulations were given to gastrocnemius muscles and their response was monitored to define the viability of muscles. Femoropopliteal bypass was conducted in patients through the use of contralateral saphenous veins. Following revascularization, all patients underwent Doppler ultrasound analysis again to evaluate the effect of distal perfusion. Fasciotomy was performed in all patients. Amputation was carried out primarily if the limb was found to be non-salvageable intraoperatively or following the surgery. It was also performed secondarily in the following conditions: the local or systematic spread of infection; toxin absorption, or irreversible damage to bone or soft tissue following debridement.

A self-designed questionnaire was completed by the surgeons to identify baseline and surgical characteristics of all patients. The surgical complications were assessed soon after the surgery and were followed for at least 3 months in all patients.

Statistical Analysis: SPSS (version 21) was used for statistical analysis. The data were presented as numbers and frequency. Fisher's exact test was used to assess the outcomes of surgery in self-categorized participants of

the study. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 22 patients were enrolled in the study. Out of the 19 were male and 3 were female. The average age of enrolled patients was 32.5± 5.6 years. All cases were confirmed of lower-extremity arterial injury and took at least 24 hrs. Before getting treated while the average hospital presentation time was 28.3 hrs. Among the participants, 2 (9.09%) had common femoral artery injury (CFA) and external iliac artery injury (EIA), 7 (31.03%) had superficial femoral artery injury (SFA), and 13 (59%) had popliteal artery injury (PA). Out of a total of 22 patients, 18 (81.8%) had concomitant venous or nerve injuries and fractures. In 72.7% (16) cases pulselessness was reported at the time of admission. 22.7% (5) patients and 18.1% (4) patients had complete sensory and motor loss, respectively (Table I).

No mortality was reported intra or post-operatively in any of the arterial injuries. Similarly, no patient in the three groups was found to have non-viable feet intraoperatively or soon after the surgery. Therefore, no primary amputation was reported in any group. On the other hand, secondary amputation was carried out in 2 patients in the PA group due to progressive infection and muscle necrosis. The secondary amputation rate was significantly higher in the PA group than in the other two groups. Soft tissue infection and tissue necrosis are the most reported complications in all three groups (Table II).

Table No.1: Clinical presentation of the study population (N=22)

Sign	N (%)
Cyanosis	1 (4.54%)
Weak pulse	3 (13.6%)
Pulselessness	16 (72.7%)
Partial sensory loss	12 (54.5%)
Complete sensory loss	5 (22.7%)
Partial motor loss	14 (63.6%)
Complete motor loss	4 (18.1%)
Shock	1 (4.54%)
Prolonged capillary filling time (CFT)	9 (40.9%)

Table No.2: Outcomes of surgical repair among study groups (N=22)

Outcomes	EIA or CFA (n=2)	SFA (n=7)	PA (n=13)	P-value
Amputation				
Primary amputation	0	0	0	-
Secondary amputation	0	0	2 (15.3%)	0.04
Mortality	0	0	0	
Complication				

Soft tissue infection	0	2 (28.5%)	1 (7.6%)	0.006
Muscle necrosis	1 (50%)	2 (28.5%)	4 (30.7%)	
Osteomyelitis	0	0	2 (15.3%)	
Non-union	0	1 (14.2%)	1 (7.6%)	

EIA= External iliac artery injury; CFA= Common femoral artery injury; PA= Popliteal artery injury

DISCUSSION

Our study has categorized the patients according to the anatomic site of vascular injury that presented after at least 24 hrs and investigated the surgical outcomes in them. Accordingly, patients were categorized into EIA/CFA, SFA, and PA groups, and a low amputation rate was found, as by earlier studies ^(11,12).

Perkins et al. conducted a meta-analysis to identify the factors that determine the success of surgical repair of the lower limb after vascular injury and he found the anatomic site of the injury as a strong determinant ⁽¹⁰⁾. Taupe et al. explored the function of collateral arteries and found an excess of such arteries in the superficial femoral artery which plays a protective role during limb ischemia. Therefore, in our study, too, all the patients (100%) with SFA had effective revascularization. Contrastingly, due to the absence of corresponding collateral blood supply to the external iliac artery and proximal femoral artery, the amputation rate increases in the cases with these arterial injuries. Therefore, in such vascular injury ischemic period should be kept as limited as possible. Among all lower extremity injuries, damage to the popliteal artery is considered most significant in the loss of limbs ⁽¹³⁾. We have classified popliteal artery injury into proximal and distal based on anatomic positions between the gastrocnemius and popliteal artery. The popliteal artery in the proximal region, just before entering into gastrocnemius, has fewer branches. Therefore, injury in this region presents more severe ischemic effects in a relatively shorter duration. Apart from frequent incidence of tissue swellings and knee dislocation in these patients, the higher performance rate of fasciotomy in these injuries increases the prospects of embolization of vessels. The higher secondary amputation rate in patients (1 case) with the proximal portion of the popliteal artery in our study is associated with the above-described complications. In contrast, all patients with an injured distal portion of the popliteal artery had successful revascularization as this segment is abundantly supplied with collateral circulation.

Moini et al. investigated the outcomes of late vascular repair in terms of sensory and motor defects and muscle viability. The authors found that successful limb salvage is directly dependent on the viability of gastrocnemius muscle ⁽⁹⁾. Similarly, Jagdish et al. also

found the success of delayed revascularization following popliteal injury and improvement in sensory and motor functions was related to gastrocnemius vitality ⁽¹⁴⁾. These results are also confirmed by several other studies based on the exploration of factors responsible for successful revascularization after vascular injury ⁽¹⁵⁾.

The study is limited in terms of smaller study sizes and shorter follow-up periods. Therefore, patients should be followed for a long to evaluate outcomes of delayed surgical repair with progressing time.

CONCLUSION

Though amputation or limb complications may develop over time because of limited revascularization time of vessels, the rate of such complications is limited. Moreover, popliteal artery injury leads to most complications among other lower vascular injuries.

Author's Contribution:

Concept & Design of Study: Ilyas Sadiq
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Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Alarhayem AQ, Cohn SM, Cantu-Nunez O, Eastridge BJ, Rasmussen TE. Impact of time to repair on outcomes in patients with lower extremity arterial injuries. *J Vasc Surg* 2019;69(5):1519-23.
2. Asensio JA, Dabestani PJ, Miljkovic SS, Kotaru TR, Kessler JJ, Kalamchi LD, et al. Popliteal artery injuries. Less ischemic time may lead to improved outcomes. *Injury* 2020;51(11):2524-31.
3. Futchko J, Parsikia A, Berezin N, Shah A, Stone Jr ME, McNelis J, et al. A propensity-matched analysis of contemporary outcomes of blunt popliteal artery injury. *J Vasc Surg* 2020; 72(1):189-97.
4. Asmar S, Bible L, Chehab M, Obaid O, Castanon L, Yaghi M, et al. Traumatic Femoral Artery Injuries and Predictors of Compartment Syndrome: A Nationwide Analysis. *J Surg Res* 2021;265: 159-67.
5. Ratnayake A, Ranatunga PE, Worlton TJ. Letter Regarding: A Nationwide Analysis of Popliteal Vascular Injuries and Outcomes by Hospital Teaching Status. *J Surg Res* 2021;259:569 -71.
6. Ramdass MJ, Muddeen A, Harnarayan P, Spence R, Milne D. Risk factors associated with

- amputation in civilian popliteal artery trauma. *Injury* 2018;49(6):1188-92.
7. Yu L, Deng L, Zhu S, Deng K, Yu G, Zhu C, et al. Limb-Salvage Outcomes of Arterial Repair Beyond Time Limit at Different Lower-Extremity Injury Sites. *Medical Science Monitor. Int J Clin Exp Med* 2021;27: e927652-1.
 8. Baghi I, Herfatkar MR, Shokrgozar L, Poor-Rasuli Z, Aghajani F. Assessment of vascular injuries and reconstruction. *Trauma Mon* 2015;20(4).
 9. Moini M, Hamedani K, Rasouli MR, Nouri M. Outcome of delayed brachial artery repair in patients with traumatic brachial artery injury: prospective study. *IJS* 2008;6(1):20-2.
 10. Perkins Z, Yet B, Glasgow S, Cole E, Marsh W, Brohi K, et al. Meta-analysis of prognostic factors for amputation following surgical repair of lower extremity vascular trauma. *Br J Surg* 2015;102(5):436-50.
 11. Stanley B, Teague B, Raptis S, Taylor DJ, Berce M. Efficacy of balloon angioplasty of the superficial femoral artery and popliteal artery in the relief of leg ischemia. *J Vasc Surg* 1996;23(4): 679-85.
 12. Jawas A, Abbas AK, Nazzal M, Albader M, Abu-Zidan FM. Management of war-related vascular injuries: experience from the second gulf war. *World J Emerg Surg* 2013;8(1):1-5.
 13. Choi BH, Chang LS, Park SO, Kim YH. Microsurgical Reconstruction of Lower Limb Using Thoracodorsal Artery Perforator Chimeric Free Flap after Popliteal Artery Revascularization: A Case Report. *Arch Hand Microsurg* 2021; 26(4):303-8.
 14. Jagdish K, Paiman M, Nawfar A, Yusof M, Zulmi W, Azman W, et al. The outcomes of salvage surgery for vascular injury in the extremities: special consideration for delayed revascularization. *Malays Orthop J* 2014;8(1):14.
 15. Mullenix PS, Steele SR, Andersen CA, Starnes BW, Salim A, Martin MJ. Limb salvage and outcomes among patients with traumatic popliteal vascular injury: an analysis of the National Trauma Data Bank. *J Vasc Surg* 2006;44(1):94-100.