

An Experience of Surgical Management of Peripheral Vascular Injuries at Pakistan Institute of Medical Sciences, Islamabad

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ABSTRACT

Background: Peripheral vascular trauma is fairly common and its repercussions demand urgent management and multidisciplinary approach. We hereby evaluated the presentation, management and outcomes of peripheral vascular injuries presenting in a tertiary care hospital in Islamabad, Pakistan.

Material and Methods: This was a prospective clinical study conducted in the Department of General Surgery, Pakistan Institute of Medical Sciences (PIMS) Hospital, Islamabad Pakistan from January 2016 to June 2018. A total of 60 patients with peripheral vascular extremity trauma were included in the study. Initial assessment and resuscitation was done and patients with vascular injury were directly shifted to operating room for primary vascular repair (if defect size < 2 cm) or vein graft (great saphenous). Fractures and nerve injuries were also treated. Fasciotomies were performed where indicated. Post-operative monitoring of limb was done for palpable pulses, temperature and color changes. Collected data included age, gender, duration of injury, nature of injury, operative findings, other associated injuries, type of definitive repair, involvement of artery, complications including amputations, infections, re-exploration, ligation or death. Statistical Package for Social Sciences (SPSS) version 23 was used to analyze data.

Results: Out of total 60 patients, 53 (88.3%) were males and 7 (11.7%) were females, with a mean age of 27.8±14.1 years. Most of the patients presented after 6 hours of trauma (n=36; 60%). Blunt trauma accounted for 37 (61.7%) while penetrating trauma was seen in 23 (38.3%) patients. Per operatively, 33 (55%) patients had intimal injury, 7 (11.7%) had partial tear and 20 (33.3%) had complete transection of artery. Primary repair was performed in 9 (15%) patients and reverse vein graft in 51 (85%) patients. Most commonly injured arteries were femoral (n=21; 35%), brachial (n=18; 30%) and popliteal (n=12; 20%) arteries, respectively. Amputations were significantly related to presentation of patients later than 6 hours ($P=0.035$).

Conclusions: Patients who present with vascular trauma need an early diagnosis, referral and timely management in order to save both limb and life of patients with special concern for good quality of life and cost-effective management.

Key words: Blunt trauma, Penetrating trauma, Peripheral vascular injury, Vascular trauma

Authors' Contribution:

¹Conception; Literature research; manuscript design and drafting; ^{2,3} Critical analysis and manuscript review; ⁴Data analysis; Manuscript Editing.

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Introduction

Overall, vascular trauma constitutes 3% of all traumatic injuries while in urban trauma centers, peripheral vascular injuries account for approximately 5% of all the major traumas.^{1,2} The surgical management of extremity vascular injuries has evolved over time. In the civilian population, blunt trauma in road side accidents is more prevalent when compared with penetrating trauma, which is mostly related to warfare injuries.³ However, recently, due to an increase in urban violence, the patterns of vascular injuries are changing.^{4,5} Major blunt trauma is associated with the transmission of force to the lower extremity that can lead to vascular, nerve, soft tissue and bone injury. Neurovascular examination including ankle-brachial index should be assessed before and after reduction of fractures. Major orthopedic injuries secondary to blunt trauma are associated with traction-type injuries, avulsions, or transections of the popliteal artery from the adjacent bone fragments.^{4,6} Unfortunately, traumatic extremity vascular injury associated with concomitant fractures and major soft tissue loss results in a relatively high morbidity in terms of prolonged hospital stays and high amputation rates.^{4,7,8} Popliteal artery injuries are potentially devastating injuries with a relatively high morbidity, but are uncommon, accounting for 0.2% of all traumas.¹ Injury to the popliteal artery can occur in the form of transection, occlusion, intimal injury, pseudoaneurysm, or fistula formation.^{9,10} Initial evaluation requires a thorough vascular and neuromuscular assessment.¹⁰ Early recognition of lower limb vascular injuries can improve overall patient outcomes. Immediate engagement of the trauma team is essential for early resuscitation and prevention of existing exsanguination. Hard signs of vascular injury, including hemorrhage, expanding hematomas, pulsatile bleeding, presence of bruits or thrills, absent pulses and signs of distal ischemia

require immediate surgical intervention.^{1,4,11} Diagnostic procedures are frequently unnecessary and lead to delay in definitive care although information may be obtained through doppler, duplex ultrasound, or angiography as necessary. Evidence of cyanosis, neurological deficit, and temperature change are reliable findings predictive of vascular compromise.^{1,11} To date, there are no well-defined guidelines for the management of extremity vascular trauma and optimum strategies are variable depending upon the local setup and expertise available.⁵ Despite major efforts in establishing protocols and guidelines in the management of vascular trauma, optimal strategies of traumatic peripheral arterial injuries are still under investigation.¹² An organized approach is of paramount importance in the expedited delivery of care by the trauma team leader, the nursing staff and subspecialties, such as interventional radiology, orthopedics, anesthesiology, emergency department personnel, and vascular surgeons.¹³ A stepwise multidisciplinary approach to manage traumatic injuries is associated with improved morbidity and decreased in-hospital mortality.¹⁴⁻¹⁶ This study was conducted to evaluate the presentations, management and outcomes of peripheral vascular injuries presenting in a tertiary care center of a developing country.

Material and Methods

This was a prospective clinical study, conducted in the Department of General Surgery, PIMS Hospital, Islamabad Pakistan over a period of two and a half years i.e. from January 2016 to June 2018. A total of 60 patients were included in the study. All patients with vascular extremity trauma presenting in the emergency were included in the study. Initial assessment and resuscitation were done by casualty medical officer followed by referral to the general

surgical team. In cases presenting with fractures and dislocations, orthopedic department was involved. In patients less than 12 years of age, pediatric surgical team was contacted. Patients having established gangrene, crush injuries with unsalvageable limb, extensive trauma leading to auto amputation, those who had amputations performed in periphery as lifesaving treatment or those presenting with severe visceral or brain injury were excluded from the study. Ethical approval was taken from the Pakistan Institute of Medical Sciences (Ref No: F51/2018 PG/GS).

After initial resuscitation, patients with hard signs of vascular injury were directly shifted to operating room while those with soft signs were investigated further using one or more of the following: color Doppler scan, x-rays for associated bone injuries and computerized tomographic angiograms. Definitive vascular repair, either primary for defect size less than 2cm or vein graft (great saphenous) was used to restore circulation to the affected limb. After repair, flow was confirmed by using hand held Doppler. Associated fractures were reduced and immobilized with external fixator by the orthopedics team before definitive vascular repair. A nerve injury, if found, was either repaired after vascular injury or two ends were brought together and a marker was applied. Fasciotomies were performed in all patients presenting more than 6 hours after injury or where clinically indicated. Postoperatively patient was started on heparin infusion six hours after surgery if there were no contraindications and patient's limb was monitored for palpable pulses, temperature and color changes. Amputation was decided when there were no signs of perfusion and gangrene developed and patient became septic. Relevant data was collected using a Proforma which included age, gender, duration of injury, nature of injury, operative findings, other associated injuries, type of definitive repair, involvement of artery and postoperative complications. These postoperative complications/outcomes included amputations,

wound/graft infections, re-explorations, ligation or death. Statistical Package for Social Sciences (SPSS) version 23 was used to analyze data.

Results

Total 60 patients were included in the study, with 53 (88.3%) males and 7 (11.7%) females and a mean age of 27.8 ± 14.1 years. Table I shows the characteristics of patients presenting with vascular trauma. Only 24 (40%) patients presented within 6 hours of trauma and 36 (60%) presented after 6 hours. Of the latter, 23 (38.3%) patients presented between 6 to 12 hours of trauma and 13 (21.7%) patients presented after 12 hours of trauma.

Characteristics	Results
Age in years	
Mean \pm SD	27.8 \pm 14.1
Range	5 to 72
Gender	
n (%)	
Male	53 (88.3)
Female	7 (11.7)
Duration of injury	
n (%)	
Less than six hours	24 (40)
More than six hours	36 (60)
Type of injury	
n (%)	
Blunt Injury	37 (61.7)
Penetrating Injury	23 (38.3)

Table II shows the details of operative findings of the patients. Intimal injury was the commonest type of arterial injury (n=33; 55%). Primary repair was done in 9 (15%) patients and reverse vein graft was done in 51 (85%) patients. Most commonly injured arteries were femoral (n=21; 35%) and brachial arteries (n=18; 30%). Fasciotomy was performed in 51 (85%) patients.

Table III shows the postoperative outcomes of patients who underwent vascular repair. Post-operative wound infection occurred more commonly in patients presenting after 6 hours than

those presenting within 6 hours ($P=0.056$). Amputation was required post operatively in 6 (10%) patients and all of them presented after 6 hours ($P=0.035$). Re-exploration was done with re-anastomosis and ligation only in cases presenting after 6 hours. Death occurred in 2 (3.3%) of the patients. None of the other factors like graft infection, graft thrombosis, hemorrhage and death were significantly related with time of presentation ($P>0.05$).

Operative findings	Frequency n (%)
Type of Arterial Injury	
Intimal Injury	33 (55)
Partial Tear	7 (11.7)
Complete transection	20 (33.3)
Type of Repair	
Primary Repair	9 (15)
Venous Graft Repair	51 (85)
Artery Involved	
Femoral	21 (35)
Brachial	18 (30)
Popliteal	12 (20)
Radial	5 (8.3)
Ulnar	2 (3.3)
Axillary	2 (3.3)
Associated Injuries to limbs	
Venous Injury	14 (23.3)
Nerve Injury	2 (3.3)
Fractures	35 (58.3)

Outcomes	Presentation < 6hrs (n=24)	Presentation > 6hrs (n=36)	Total (n=60)
Wound Infection	2 (8.3)	8 (22.2)	10 (16.7)
Graft Infection	1 (4.16)	4 (11.1)	5 (8.3)
Graft Thrombosis	1 (4.16)	3 (8.3)	4 (6.67)
Hemorrhage	0 (0)	1 (2.7)	1 (1.67)
Re-exploration	0 (0)	3 (8.3)	3 (5)
Amputation	0 (0)	6 (16.67)	6 (10)
Death	1 (4.16)	1 (2.7)	2 (3.3)

Discussion

A high index of suspicion should be kept for peripheral vascular injuries in patients with blunt and penetrating limb trauma. Patient with hard signs of vascular injury should be immediately explored to prevent morbidity and mortality. In our study there was a male predominance (88.3%) which is also reported in other studies.¹⁷⁻¹⁹ Mean age in our study was 27.8 ± 14.1 years which is comparable to another study (28.6 ± 14.5 years) conducted in level-1 trauma centers in Pakistan. This is probably because in our society males suffer more road traffic accidents as mostly automobiles are driven by them. Penetrating vascular trauma patients are mainly involved in violence associated with poverty and lack of knowledge. Blunt trauma is mostly associated with road traffic accidents and domestic assault cases. Blunt trauma was present in 61.7% of the cases while 38.3% cases had penetrating trauma. Similar incidence was reported in another study (65.4% blunt trauma and 34.6% penetrating trauma).¹⁷ The time of presentation since injury varied from less than 6 hours to more than 24 hours. This variation is probably because some patients are brought directly to the hospital, while others are brought from remote areas, referred from other setups for specialized care with missed injuries associated with blunt trauma. Majority of the vascular injuries can be easily diagnosed clinically and presence of hard signs of vascular injury should be addressed with immediate exploration.¹⁶ Patients with soft signs of vascular injury can be evaluated using Doppler and computerized tomography before intervention if or as required. Arterial intimal injury was present in 55% of the cases followed by complete transection (33.3%) and partial tears (11.7%). Intimal injury was usually associated with blunt trauma while tear and complete transection was associated with penetrating injury. Primary repair was done in 15% patients which was also reported in another study, while reverse vein graft was done in a higher percentage of our patients

(85% versus 60.5%).¹⁷ Higher incidence of vein graft in our study is due to the fact that no prosthetic grafts were used at the time of repair as these grafts are associated with increased morbidity due to infection, graft thrombosis, long term patency and amputations. Fasciotomy was done (in n=51; 85% patients) to prevent risk of compartment syndrome occurring after reperfusion injury. Complications like postoperative wound infection, graft infection and rejection, re-explorations and amputations were all more common in patients presenting after six hours of injury. Amputations were significantly associated with late presentations ($P=0.035$). Two deaths occurred in our study, one in each group as patient went into multi organ failure due to sepsis. Peripheral vascular trauma is a condition which if not properly addressed can lead to high morbidity and mortality. A multidisciplinary approach should be opted when dealing with polytrauma cases. Training of surgeons working in remote areas regarding management of peripheral vascular traumas with a high index of suspicion must be initiated.

Recommendations

This study was conducted in a single tertiary care hospital of Islamabad. A study with a larger sample size taking into account the management protocols of other tertiary care hospitals at national level is required to come up with uniform local guidelines for vascular injuries in our hospitals. There is a need to compare them with international guidelines to further improve patient outcomes in the local context.

Conclusion

Amputation rates in peripheral vascular injury increase significantly in patients presenting after six hours of injury. In a developing country with limited resources, an early diagnosis, referral and timely

management of patient having a peripheral vascular trauma can save both limb and life of patient.

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References

1. Sciarretta JD, Perez-Alonso AJ, Ebler DJ, Mazzini FN, Petrone P, Asensio-Gonzalez JA. Popliteal vessel injuries: complex anatomy, difficult problems and surgical challenges. *Eur J Trauma Emerg Surg.* 2012; 38(4): 373–391. Doi: 10.1007/s00068-012-0217-7
2. Feliciano DV, Rasmussen TE. Evaluation and treatment of vascular injuries. In: Browner BD, Jupiter JB, Krettek C, eds. *Skeletal Trauma. Basic Science, Management and Reconstruction.* Philadelphia: Elsevier Saunders, 2015: 423-35. Doi: 10.3400/avd.oa.18-00068
3. Rozycki GS, Tremblay LN, Feliciano DV, McClelland WB. Blunt vascular trauma in the extremity: diagnosis, management, and outcome. *J Trauma.* 2003; 55(5): 814-24. Doi: 10.1097/01.TA.0000087807.44105.AE
4. Sciarretta JD, Macedo FI, Otero CA, Figueroa JN, Pizano LR, Namias N, et al. Management of traumatic popliteal vascular injuries in a level 1 trauma centre: a 6-year experience. *Int J Surg.* 2015; 18: 136-141. Doi: 10.1016/j.ijvs.2015.04.056
5. Feliciano DV, Moore EE, West MA, Moore FA, Davis JW, Cocanour CS, et al. Western Trauma Association Critical Decisions in Trauma: Evaluation and management of peripheral vascular injury, Part II. *J Trauma Acute Care Surg.* 2013;75(3):391-397 Doi: 10.1097/TA.0b013e3182994b48
6. Trieman GS, Yellin AE, Weaver FA, S Wang, N Ghalambor, W Barlow, et al. Examination of the patient with knee dislocation. The case for selective arteriography. *Arch Surg.* 1992; 127(9): 1056–1062. Doi: 10.1001/archsurg.1992.01420090060009
7. Hafez HM, Woolgar J, Robbs JV. Lower extremity arterial injury: results of 550 cases and review of risk factors associated with limb loss. *J Vasc Surg.* 2001;33(6): 1212-19. Doi: 10.1067/mva.2001.113982
8. Kauvar DS, Sarfati MR, Kraiss LW. National Trauma Databank analysis of mortality and limb loss in isolated lower extremity vascular trauma. *J Vasc Surg.* 2011; 53(6): 1598-603. Doi: 10.1016/j.jvs.2011.01.056

9. Abou-Sayed H, Berger DL. Blunt lower-extremity trauma and popliteal artery injuries. *Arch Surg.* 2002; 137(5): 585–89. Doi:10.1001/archsurg.137.5.585
10. Teixeira PGR, DuBose J. Surgical management of vascular trauma. *Surg Clin North Am.* 2017; 97(5): 1133-55. Doi: 10.1016/j.suc.2017.05.001
11. Feliciano DV. For the patient: evolution in the management of vascular trauma. *J Trauma Acute Care Surg.* 2017; 83(6): 1205-12. Doi: 10.1097/TA.0000000000001689
12. Fox N, Rajani RR, Bokhari F, Chiu WC, Kerwin A, Seamon MJ, et al. Evaluation and management of penetrating lower extremity arterial trauma: An Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma Acute Care Surg.* 2012; 73(5): S315-320. Doi: 10.1097/TA.0b013e31827018e4
13. D'Amours SK, Rstogi P, Ball CG. Utility of simultaneous interventional radiology and operative surgery in a dedicated suite for seriously injured patients. *Curr Opin Crit Care.* 2013; 19(6): 587-593. Doi: 10.1097/MCC.0000000000000031
14. Tubb CC, Oh JS, Do NV, Tai NR, Meissel MP, Place ML. Trauma care at a multinational United Kingdom-led Role 3 combat hospital: resuscitation outcomes from a multidisciplinary approach. *Mil Med.* 2014; 179(11): 1258-62. Doi: 10.7205/MILMED-D-14-00042
15. Bach JA, Leskovan JJ, Scharschmidt T, Boulger C, Papadimos TJ, Russell Set al. The right team at the right time: multidisciplinary approach to multi-trauma patient with orthopedic injuries. *OPUS 12 Scientist.* 2012; 6(1): 6-10. Doi: 10.4103/IJCIIS.IJCIIS_5_17
16. Georgiou A, Lockey DJ. The performance and assessment of hospital trauma teams. *Scan J Trauma Resusc Emerg Med.* 2010; 18(1): 66. Doi: 10.1186/1757-7241-18-66
17. Usman R, Jamil M, Anwer MF. Evaluation, Surgical Management and Outcome of Traumatic Extremity, Vascular Injuries: A 5-year Level-1 Trauma Centres Experience. *Ann Vasc Dis.* 2018; 11(3): 312-17. Doi: 10.3400/avd.oa.18-00068
18. Khan MA, Jamal S, Khaliq T. A critical appraisal of management of extremity vascular trauma in civilian population: a PIMS experience. *Rawal Med J.* 2011; 36(3): 190-4.
19. Nasim A, Nisar M, Bashir A. The Outcome of Surgery for Vascular Injuries in Major Limb Trauma. *J Fatima Jinnah Med Univ.* 2016; 10(4): 41-48