ISSN (Print): 2663-9491 ISSN (Online): 2789-6897

Original Article

A Study on Emergency Peripheral Vascular Reconstruction for Traumatic Vascular Injury

DOI: dx.doi.org

Mohammad Khalilur Rahman[1]

Received: 01 OCT 2022
Accepted: 10 OCT 2022
Published: 14 NOV 2022

Published by:
Sheikh Sayera Khatun Medical College, Gopalganj, Bangladesh

ABSTRACT

Introduction: *Explosions and projectiles can produce traumatic vascular damage, which can impact the arteries and veins of the limbs and cause bleeding and ischemia. The increased employment of high-energy weaponry in modern warfare has been linked to serious vascular damage. The peripheral arteries and veins of the extremities are among the most commonly injured vessels in both civilian and military vascular trauma. Vascular injuries are classified as contusion, intimal disruption, puncture, lateral disruption, transections with hemorrhage or occlusion, arteriovenous fistula and spasm, and pseudoaneurysms. Any type of bleeding, whether internal or external, is an indication of vascular trauma. Bleeding, swelling and/or discomfort, bruising, and a lump beneath the skin are all symptoms of vascular trauma. The therapy of vascular damage is evolving in tandem with the passage of time. Patients with vascular damage can now benefit from sophisticated medical devices. Meanwhile, conventional therapies continue to be effective. If vascular trauma is not treated promptly, it can result in impairment or even death, especially in cases of limb vascular damage. Physical examination and basic bedside pulse pressure examinations are critical in the early detection of injuries. Vascular reconstruction with blood flow restoration is a significant surgical intervention among several procedures. The study aimed to analyze the role of emergency peripheral vascular reconstruction for a traumatic vascular injury.* ***Methods:*** *This retrospective study was carried out among fifty cases who attended at the National Institute of Cardiovascular Disease (NICVD, Sher-e-Bangla Nagar, Dhaka and casualty department of Dhaka Medical College Hospital, with vascular injury from January 2008 to January 2009.* ***Result:*** *A total of 50 cases were studied. These included 41 male and 9 female patients. Various types of repairments were done to arteries and veins. Primary suturing was needed in 10 arteries and 16 veins. The primary anastomosis was done in 15 arteries and in 3 veins, 17 arteries needed saphenous vein grafting, 4 arteries required prosthetic grafts, and ligation was needed for 2 arteries and 9 veins. These results*

1. *Department of vascular surgery, National Institute of Cardiovascular Disease (NICVD), Sher-e-Bangla Nagar, Dhaka & casualty department of Dhaka Medical College Hospital, Dhaka*

indicated that primary suture was the mostly done procedure. Concerning the mechanism of injury, bullet injuries were the most found type of injury which occurred in 25 (50%) patients, followed by shrapnel injuries in 15 (30%) patients, and the least cases were of blunt injuries (20%) Regarding regional distribution radial artery was the most affected site including 12 (24%) patients. An equal number of patients (7,14%) came with ulnar and brachial artery injuries. Both radial and ulnar artery injuries occurred in 10 (20%) patients. Popliteal artery injury was sustained in 8 (16%) patients followed by femoral artery with inferior vena cava (IVC) injury in 3 (6%) patients. Axillary and carotid artery injury was seen in 2 (4%) and 1 (2%) patients respectively. ***Conclusion:*** *This study observed immediate vascular reconstruction followed by delayed tissue coverage provides a high limb salvage rate after combat trauma. Patients should be surgically intervened even after the golden period has passed. A few complications may arise following reconstruction if a patient is brought to the hospital after several hours after injury. To get robust data multicenter studies are in great need to analyze the salvage rate of limbs.*

Keywords: *Reconstruction, Trauma, Peripheral vessel, Extremity.*

(The Insight 2022; 5(1): 164-171)

INTRODUCTION

The extremity peripheral arteries and veins are among the most often damaged vessels in both civilian and military vascular trauma. Except during armed confrontations and in certain geographic locations, blunt causes are more common than penetrating causes. Physical examination and basic bedside pulse pressure examinations are critical in the early detection of injuries. In stable patients computed tomography angiograms (CTA) and magnetic resonance angiograms (MRA) have become the mainstay of screening and diagnosis. Early detection and treatment of compartment syndrome remain essential in the recovery of patients with significant peripheral vascular injuries.[1]. However, detecting vascular damage is difficult if the primary cause of external bleeding cannot be identified. A physical examination can identify whether there is a blood vessel damage and, if so, whether surgery is required. Doppler indices should be an integral part of the physical examination and can screen patients with proximal injuries for further studies such as duplex sonography or arteriography.[2] The fundamental aims of vascular trauma therapy are immediate bleeding control and quick restoration of blood flow. Vascular sutures or ligation, vascular wall repair, and vascular reconstruction using blood vessel prosthesis or vascular grafts are among surgical therapeutic options for vascular injuries. The most common endovascular procedures are embolization, balloon dilation, and covered stent placement. Surgical operation is still the primary treatment for vascular injuries. Endovascular treatment is a promising alternative, proved to be effective, and preferred selection for patients. It is very important to determine vascular injury

in the lower extremities. The fundamental aims of vascular trauma therapy are immediate bleeding control and quick restoration of blood flow. Vascular sutures or ligation, vascular wall repair, and vascular reconstruction using blood vessel prosthesis or vascular grafts are among surgical therapeutic options for vascular injuries. The most common endovascular procedures are embolization, balloon dilation, and covered stent placement. The objectives of the treatment are relief of symptoms, lower infection, and prevention of limb loss. In the lower extremity, the goal is to maintain a bipedal gait.[6] The graft is the optimum treatment for vascular injuries. Autogenous veins and artificial vessels are examples of vascular grafts. A temporary intravascular shunt (TIVS) can be utilized for temporary vascular repair in addition to vascular grafts. TIVS methods advanced substantially in the twentieth century. [3] The safety of nonoperative therapy, the introduction of temporary intraluminal shunts, and improved diagnosis of posterior compartment syndromes have all had a substantial influence on vascular injury care. [7] If not treated properly, peripheral arterial injuries have a significant amputation rate. Explosives are the most likely to result in amputations, whereas knife injuries are the least probable. The most significant independent risk factor for limb loss was failed revascularization.[8] Vascular reconstruction plays a significant role in peripheral vascular injuries.2–4 % of vascular injuries need operative reconstruction. In polytraumatized patients, the rate is even 10 %. Arterial vascular repair should precede venous reconstruction and orthopedic stabilization due to limb-threatening ischemia [9] Moreover, in case of multiple trauma, a multidisciplinary approach is suggested to provide the best medical care to the victims.[10] The study aimed to analyze the role of peripheral vascular reconstruction in traumatic vascular injury.

OBJECTIVE

General Objective

- To analyze the impact of early recognition of vascular injury and immediate revascularization.

Specific Objectives

- To determine the scope of surgical intervention.
- To determine several types of diagnostic tools.

METHODS

This was a retrospective study and was carried out at the National Institute of Cardiovascular Disease (NICVD) and casualty department of Dhaka Medical College Hospital, with peripheral vascular injury. The study duration was from January 2008 to January 2009. A total of fifty cases were selected for this study who attended the casualty block of the hospital. The patients were divided into 2 groups such as patients coming within 6 hours of injury and patients coming after 6 hours to 24 hours of injury. Data sheets were prepared considering variables such as age, sex, clinical presentation, radiological and duplex study. The data

were collected and recorded on a broadsheet. Detail history and examination were done on all patients to exclude any associated injury. The main variables included sensitivity of clinical impression, ultrasound, and radiological investigations, time lapsed between the onset of injury and revascularization, the efficacy and benefits of revascularization, morbidity, and mortality. All these data were analyzed by SPSS 10 version. All information was kept with strict confidentiality.

Inclusion Criteria

- Patients with a vascular injury who came within 24 hours of trauma.
- Patients who had given consent to participate in the study.

Exclusion Criteria

- Patients with a vascular injury who came after 24 hours of trauma.
- Patients with vascular injury associated with ischemic change.

RESULTS

A total of 50 cases were studied. These included 41 male and 9 female patients. Various types of repairments were done to arteries and veins. Primary suturing was needed in 10 arteries and 16 veins. The primary anastomosis was done in 15 arteries and in 3 veins, 17 arteries needed saphenous vein grafting, 4 arteries required prosthetic grafts, and ligation was needed for 2 arteries and 9 veins. These results indicated that primary suture was the mostly done procedure. [**Table 1]** Concerning the mechanism of injury bullet injuries was the most found type of injury which occurred in 25 (50%) patients, followed by shrapnel injuries in 15 (30%) patients, and the least cases were of blunt injuries (20%) [**Table 2]** Regarding regional distribution radial artery was the most affected site including 12 (24%) patients. An equal number of patients (7,14%) came with ulnar and brachial artery injuries. Both radial and ulnar artery injuries occurred in 10 (20%) patients. Popliteal artery injury was sustained in 8 (16%) patients followed by femoral artery with inferior vena cava (IVC) injury in 3 (6%) patients. Axillary and carotid artery injury was seen in 2 (4%) and 1 (2%) patient respectively. [**Table 3**]

Table 1: Operative procedures in patients (N=50)

Type of repairment	Number of arteries	Number of veins
Primary suturing	10	16
Primary anastomosis	15	03
Saphenous vein grafting	17	-
Prosthetic grafts	04	-
Ligation of vessels	02	09

Table 2: Mechanism of vascular injury (N=50)

Cause of injury	Number of patients	%
Bullet injuries	25	50
Shrapnel injuries	15	30
Blunt injuries	10	20

Table-3: Regional distribution (N=50)

Artery	Number of patients	%
Radial artery	12	24
Ulnar artery	7	14
Both radial and ulnar	10	20
Brachial artery	7	14
Axillary artery	2	4
Carotid artery	1	2
Femoral artery and IVC	3	6
Popliteal arteries.	8	16

DISCUSSION

Trauma is a major health problem worldwide. Vascular trauma is an important component of this critical scenario. The incidence of vascular trauma is on the rise.[11] Vascular injuries are life-threatening circumstances that necessitate fast judgments by the treating surgeon. In these critical situations, most surgeons rely on clinical evaluation, such as external hemorrhage, pulsatile hematoma, absent peripheral pulses, the sign of ischemia, and hemodynamic instability. This study has also relied on clinical parameters mentioned above. A few arteriograms had been done and they also confirmed the clinical impression. Pre-operative angiography, CT-Scan, Helical angiography, Magnetic resonant angiogram (MRA), and MRI are modern but time-consuming studies that are not necessary in the great majority of patients and should be reserved solely for dubious circumstances. 2–4 % of vascular injuries need operative reconstruction. In polytraumatized patients, the rate is even 10 %. Arterial vascular repair should precede venous reconstruction and orthopedic stabilization [9] Modern concept of trauma management consists of immediate resuscitation followed by quick evacuation in a well-equipped hospital with modern facilities for trauma management including vascular repair and available skilled staff. Prompt vascular repair and attention to associated injuries resulted in minimum morbidity and zero mortality. The same scenario was also seen in this study. Increasing domestic violence and war situations have resulted in major advancements in the field of emergency revascularization. Vascular trauma care consists mostly of three steps: vessel compression and cautery, vessel ligation, and vascular repair. In this study, ligation was carried out on 2 vessels because of delay in presentation and the possibility of severe reperfusion injury. The complication rate in emergency revascularization has been reported in different studies to be between 10 to 18%. In this study, 10%

of patients developed complications that are compatible with other studies.[14][15][16][17][18] among all the arteries of the lower extremity, popliteal artery injury was the commonest one which was quite relatable to this present study.[19] Concerning the mode of injury, there was a high proportion of blunt vascular injuries (84%) in a study whereas this study showed the highest percentage of bullet injuries (50%).[20] In another study, blunt trauma to the lower leg was linked to a 28 to 46 percent increase in popliteal artery damage. [21] There is increasing evidence that several factors are associated with motor and sensory recovery after peripheral nerve injuries. For example, repair of nerve compression injuries has better outcomes than repair of nerve rupture injuries. The age of the patient, mechanism of injury, nerve injured, injury location, defect length, repair time, repair method, operation technique, and repair materials are currently thought to be associated with outcomes after the repair of peripheral nerve injuries.[22] However, delay in diagnosis of major arterial injuries represents a significant contributor to high amputation rates, despite increasingly sophisticated orthopedic and vascular surgical technique.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

Rapid clinical diagnosis and resuscitation, as well as treatment of hypovolaemic shock, saved numerous lives and limbs. A sophisticated diagnostic instrument was not required for the pre-operative workup. Following the fundamental principles of vascular repair and rapid intervention aimed at revascularization significantly lowered mortality and morbidity. Surgical procedures, including the use of autologous vein grafts and artificial vascular grafts, have saved numerous limbs that would have been lost if not managed appropriately and promptly. Most of these injuries were potentially fatal to the patient if not treated promptly.

RECOMMENDATION

One of the most prevalent emergency illnesses is traumatic vascular damage. It is critical to recognize vascular damage indications quickly and execute temporary bleeding control measures. Surgical methods might be chosen based on the anatomical affected location. The primary goal is to restore limb perfusion through primary repair or damage control approaches. Major vascular procedures can be handled post-operatively in the critical care unit, allowing for physiological reorganization and the detection of patients developing compartmental syndrome. Early detection and management are critical for preserving extremities function and perfusion.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. *Kobayashi L, Coimbra R, Goes Jr AM, Reva V, Santorelli J, Moore EE, Galante J, Abu-Zidan F, Peitzman AB, Ordonez C, Maier RV. American Association for the Surgery of Trauma–World Society of Emergency Surgery guidelines on diagnosis and management of peripheral vascular injuries. Journal of Trauma and Acute Care Surgery. 2020 Dec 1;89(6):1183-96.).*
2. *Nassoura ZE, Ivatury RR, Simon RJ, Jabbour N, Vinzons A, Stahl W. A reassessment of Doppler pressure indices in the detection of arterial lesions in proximity penetrating injuries of extremities: a prospective study. The American journal of emergency medicine. 1996 Mar 1;14(2):151-6.*
3. *Liu JL, Li JY, Jiang P, Jia W, Tian X, Cheng ZY, Zhang YX. Literature review of peripheral vascular trauma: Is the era of intervention coming? Chinese Journal of Traumatology. 2020 Feb 1;23(01):5-9.*
4. *Frykberg ER, Dennis JW, Bishop KI, Laneve LI, Alexander RH. The reliability of physical examination in the evaluation of penetrating extremity trauma for vascular injury: results at one year. The Journal of trauma. 1991 Apr 1;31(4):502-11*
5. *Espinosa GA, Chiu JC, Samett EJ. Clinical assessment and arteriography for patients with penetrating extremity injuries: a review of 500 cases from the Veterans Affairs West Side Medical Center. Military medicine. 1997 Jan 1;162(1):19-23.*
6. *Ratnayake A, Samarasinghe B, Halpage K, Bala M. Penetrating peripheral vascular injury management in a Sri Lankan military hospital. European Journal of Trauma and Emergency Surgery. 2013 Apr;39(2):123-9.*
7. *Feliciano DV. Management of peripheral arterial injury. Current Opinion in Critical Care. 2010 Dec 1;16(6):602-8.*
8. *Davidovic LB, Cinara IS, Ille T, Kostic DM, Dragas MV, Markovic DM. Civil and war peripheral arterial trauma: a review of risk factors associated with limb loss. Vascular. 2005 May 1;13(3):141-7.*
9. *Markgraf E, Böhm B, Bartel M, Dorow C, Rimpler H, Friedel R. Traumatic peripheral vascular injuries. Der Unfallchirurg. 1998 Jul;101(7):508-19.*
10. *D'Alessio I, Domanin M, Bissacco D, Romagnoli S, Rimoldi P, Sammartano F, Chiara O. Operative treatment and clinical outcomes in peripheral vascular trauma: the combined experience of two centers in the endovascular era. Annals of Vascular Surgery. 2020 Jan 1; 62:342-8.*
11. *Jan WA, Samad A, Anwar R. Mortality and morbidity of abdominal inferior vena-caval injuries. Journal of the College of Physicians and Surgeons--pakistan: JCPSP. 2004 Oct 1;14(10):622-5.*
12. *Starnes 13W, 13ruce .1M. Pop!kcal artery trauma in a forward, deployed Mobil Army surgical hospital. Lessons learned from the war in Kosovo. J Trauma 2000; 48:1144-9*
13. *Davidovic L, Lotina S. Kostic D. Popliteal artery war injuries. Cardiovasc Surg 1997; 5:133-7*
14. *Meimner M, Paun M, Johansen K: Duplex scanning for arterial trauma. Am J Surg 1991; 161:552-5.*
15. *Cuschieri A, Steele RJC, Moossa AR. Essential surgical practice by Butterworth. 4th ed Rome, Heinemann, Italy, fourth edition 2000*
16. *Hood DB, Weaver FA, Yellin AE: Changing perspectives in the diagnosis of peripheral vascular trauma. Semin Vasc Surg 1998;11(4):255-60*
17. *Kundson MM, Lewis FR, K. The role of duplex ultrasound arterial imaging in patients, with penetrating extremity trauma. Arch surg 1993; 128(9):1033-7*
18. *Nassotira ZE Ivatury RR, Somon RJ A reassessment of Doppler pressure indices in the detection of arterial lesions. in proximity penetrating, injuries of extremities: a prospective study. Am. J Emerg, Med 1996*
19. *Lim LT, Michuda MS, Flanigan DP, Pankovich A. Popliteal artery trauma: 31 consecutive cases without amputation. Archives of Surgery. 1980 Nov 1;115(11):1307-13.*
20. *Menakuru SR, Behera A, Jindal R, Kaman L, Doley R, Venkatesan R. Extremity vascular trauma in civilian population: a seven-year*

review from North India. Injury. 2005 Mar 1;36(3):400-6.

21. *Abou-Sayed H, Berger DL. Blunt lower-extremity trauma and popliteal artery injuries: revisiting the case for selective arteriography. Archives of Surgery. 2002 May 1;137(5):585-9.*
22. *He B, Zhu Z, Zhu Q, Zhou X, Zheng C, Li P, Zhu S, Liu X, Zhu J. Factors predicting sensory and motor recovery after the repair of upper limb peripheral nerve injuries. Neural regeneration research. 2014 Mar 3;9(6):661.*