

Evaluation of Vascular Injuries Caused by Trauma, Surgery and Complications

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Abstract

Background: Treatment of traumatic vascular lesions requires accurate and rapid diagnosis. Improper treatment and loss of time may lead to loss of limbs, or lives due to ischemia. This study aimed to evaluate various surgical methods used to treat vascular injuries.

Methods: This Cross-sectional study included all trauma patients referred to Shohada-e-Ashayer hospital, Khorramabad, Iran, and Shaheed Chamran hospital, Boroujerd, Iran, with vascular injury from 2015 to 2019. Demographic characteristics, duration of surgery, complications of the vascular injury, mechanism of vascular injury, type of vascular injury, location, clinical symptoms, comorbidities, and vital signs were assessed.

Results: Overall, 233 patients with a mean age of 29.15 ± 11.8 years (maximum 78 years and a minimum two years) and a male to female ratio of 20: 1 were included. Six patients (25.8%) were treated via venous graft and 11 cases (4.7%) by arterial ligation. Six cases (2.6%) with minor arterial injury were treated without surgical intervention. The artery was completely removed in 135 patients (9.57%) and partially in 83 cases (6.35%). Arterial thrombosis were seen in 70 cases (30%), intimal flap in 14 cases (6%), vascular spasm in 4 cases (7.1%), crush injury in 4 cases (7.1%), arterial fistula in 1 patient (4.0%), and deep vein thrombosis were seen in 3 cases (1/3 %).

Conclusion: Vascular injury following penetrating trauma occurs more commonly in young ages. However, the rate of vascular damage was higher in the arteries than in veins. The type of surgical treatment and side effects of treating vascular injuries vary depending on the type, site, severity, and other parameters (age, gender, etc.) associated with the trauma.

Keywords: Trauma, Vascular Injury, Vascular Treatment, Vascular Surgery.

Introduction

Vascular trauma involves acute force injuries to normal and healthy vessels, with typically short time intervals to identify and intervene ¹. Although the anatomy, exposure, and management principles are similar to elective vascular surgery, there is often not the luxury of time to perform a detailed and complete preparation for treatment ². The vascular trauma surgeon must proceed rapidly and definitively in the face of ten incomplete and imperfect information, with the patient's life and limb often at stake. This challenging condition is fertile ground for potential

complications that follow vascular trauma and surgery ³.

There are two primary measures of success in peripheral arterial injury management: limb salvage and limb function ⁴. Historically, outcomes of arterial repair have focused on primary patency and limb salvage or amputation rates for peripheral vessels ⁵. Certainly, the salvage of a viable extremity is the first goal of arterial injury management. But, it does not represent longer-term outcome ⁶. The viability of the affected limb is the most critical factor in determining salvage. Although, limb function is a reflection of multiple factors, including the vascular, neurologic,

muscular, skeletal, and integumentary systems. The motor and sensory functions of the affected limb are the primary determinants of the degree of any short- or long-term disability after injury ⁷. Additional critical factors include the final cosmesis and the presence of any prolonged pain syndromes or other chronic conditions associated with the salvaged limb ⁸. These factors should be considered in the often-difficult decision regarding aggressive attempts at limb salvage versus primary amputation ⁹. Therefore, relevant outcome measures for peripheral arterial reconstruction must further simple actions such as, graft patency or limb salvage.

Therefore, this study aimed to evaluate various surgical methods and complications of vascular injuries.

Method

This study was registered in the ethics committee in biomedical research of Lorestan University of Medical Sciences with the code IR. LUMS.REC.1399.072; all trauma patients referred to Shohada-e-Ashayer hospital, Khorramabad, Iran, and Shaheed Chamran nomadic hospital, Boroujerd, Iran, with the possibility of vascular injury from 2015 to 2019 were included in the study. However, patients for whom vascular injury were clinically and Para clinical R/O were excluded from the study. Surgical procedures in arterial injury were treated by primary vascular repair (including primary and lateral anchorage), venous graft (graft interposition or bypass graft), and arterial ligation. However, minor arterial injury was treated without surgery.

Demographic characteristics, duration of surgery, complications of vascular injury, mechanism of vascular injury, type of vascular injury, location of vascular injury, clinical symptoms, comorbidities, and vital signs upon entry were extracted and recorded in the checklist. The collected data were described using SPSS 23 software. Mean, standard deviation, frequency, tables, and graphs were used to describe the data. Chi-square and t-test were used for statistical analysis. $P < 0.05$ was considered a significant level.

Result

In total, 233 eligible patients were studied in Shohada-e-Ashayer and Shahid Chamran hospitals. The mean

age of patients was 29.15 ± 11.8 years (the maximum and minimum age were 78 and 2 years). According to Table 1, vascular trauma was more common in 154 people (66.1%) under the age of 30 years. The 222 patients (95.3%) were male, and 11 cases (4.7%) were female. The male to female ratio was 20.1, 193 patients (82.8%) had penetrating trauma and 40 patients (17.2%) had blunt trauma. 226 (97%) patients had arterial injury, and 89 patients (38.2%) had venous injury, of which 86 (36.9%) patients had simultaneous arterial and venous injury.

Frequency distribution of anatomical location of trauma in the study population shows that the upper limb with 180 (77.3%) cases is the most common location and the lower limb with 36 cases (5.15%), thorax 7 cases (3%), abdomen and pelvis 6 cases (2.5%), neck of 4 cases (1.7%) were in the next rank (Table,2).

In 156 patients (66.9%) with arterial injury by primary vascular repair (including primary anastomosis and lateral suture) were treated. Sixty patients (25.8%) by venous graft (graft or bypass graft) and 11 patients (4.7%) via Arterial ligation procedures were treated. Six cases (2.6%) of arterial minor injury, was treated without surgical intervention (Table, 2).

62 patients had side effects during or after surgery, among which, Compartment syndrome was observed in 28 cases (12%), which had the highest prevalence. On the other hand, muscle necrosis (9.9%), rhabdomyolysis (7.7%), and infection (7.3%) are the other complications that had the highest incidence.

Based on the results in table 2, amputation was performed in three (1.3%) patients. There were three cases (1.3%) of deaths before 24 hours due to axial artery damage such as the aorta or massive bleeding, and one case (0.4%) died 24 hours after the accident following blunt trauma. Due to the mechanism of the accident, vehicles with carotid and jugular vascular injuries died after 24 hours due to extensive stroke, despite initial anastomotic treatment.

Regarding the types of arterial injuries after arterial exploration in 135 cases (57.9%) the artery was completely cut, 83 cases (35.6%) partial amputation, 70 cases (30%) arterial thrombosis, 14 cases (6%) Intimal flap in 4 cases (7.1%) vascular spasm and in 4 cases (7.1%) crush injury, and venous arterial fistula in 1 case (4.0%) and deep vein thrombosis in 3 cases (1/3 %) was seen (Fig, 1).

Table 1: Frequency distribution of gender, age, and underlying disease of study participants

Indexes		N	Present	cumulative percentage
Age	<30	154	66.1	66.1
	>30	79	33.9	100
gender	Male	222	95.3	95.3
	Female	11	4.7	100
Type of trauma	Penetrating trauma	193	82.8	82.8
	Blunt trauma	40	17.2	100
Type of damaged vessels	Arteries	226	97	97
	Veins	89	38.2	96
	Arteries & Veins	86	36.9	100

Table 2: Frequency distribution of various types of arterial injury treatments, distribution of treatment outcomes, Anatomical location of trauma and Frequency of complications due to vascular injuries following trauma in the studied patients

		N (%)	cumulative percentage
Frequency distribution of various types of arterial injury treatments in the studied patients	Primary vascular repair	156 (66.9%)	66.9
	Intravenous graft	60 (25.8%)	92.7
	Arterial ligation	11 (4.7%)	97.4
	Lack of arterial treatment	6 (2.6%)	100
Frequency distribution of treatment outcomes in patients with vascular injury	Improved	121 (52%)	52
	Maim	105 (45%)	97
	Amputation	3 (1.3%)	98.3
	Mortality before 24 hours	3 (1.3%)	99.6
	Mortality after 24 hours	1 (0.4%)	100
Anatomical location of trauma in the study population	Upper limb	180 (77.3%)	73.5
	Lower limb	36 (15.5%)	51.6
	Thorax	7 (3.0%)	83.4
	Abdomen and Pelvic	6 (2.5%)	100
	Neck	4 (1.7%)	91.8
Frequency of complications due to vascular injuries following trauma	Compartment syndrome	28 (12%)	87.2
	Muscle necrosis	23 (9.9%)	84.6
	Rhabdomyolysis	18 (7.7%)	93.9
	Infection	17 (7.3%)	57.7
	Acute kidney injury	14 (6.0%)	97.0
	Thrombosis	11 (4.7%)	56.1
	Ischemia	9 (3.4%)	76.8
	Hematoma	7 (3.0%)	100

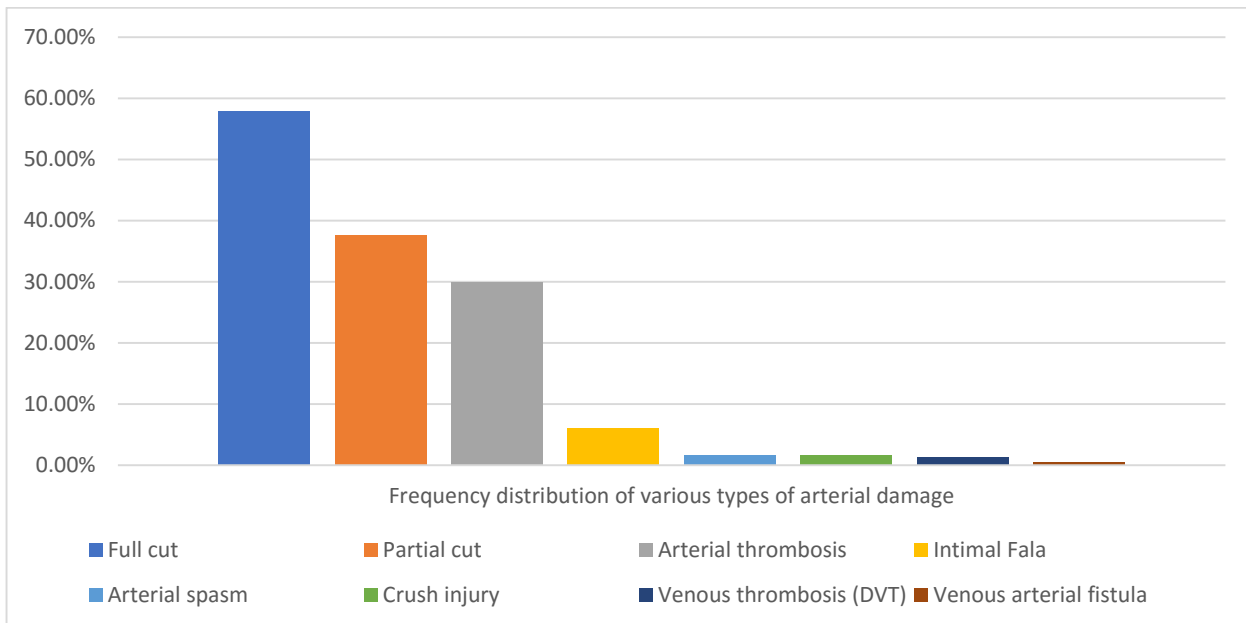


Figure 1: Frequency distribution of various types of arterial damage.

Discussion

According to the results of the present study, the mean age of patients with vascular trauma was 29.15 years, of which the minimum age was two, and the maximum age for the patient was 78 years. This result is similar to other studies on patients with vascular trauma⁹. According to studies, ages between 18 and 40 years are associated with the highest prevalence of trauma¹⁰. However, in most of the reports presented, the mean age for patients is higher than what we have reached in the present study. This discrepancy can be related to the fact that the general population of Iran is younger than other countries, especially European countries.

The results show that approximately 95.3% (222 people) of the patients participating are men, and 4.7% (11 people) are women. This can be due to the employment of men in high-risk environments and more significant greater activity in street fights, etc. Previous studies have reported that men are at greater risk for trauma¹¹. Grace et al.¹² demonstrated that 80.3% of trauma patients are men with a mean age of 33.2 years. Qoddusi et al.¹³ Reported an average age of 28.5 years for their patients, while according to mention study, men with trauma were seven times more than women. After examining the patients, 193 cases (82.8%) had penetrating trauma, and 40 patients (17.2%) had blunt trauma. However, 226 (97%) patients with trauma suffered arterial injuries, including arteries. Radial and ulnar in 147 reported cases (63.1%) were the most

damaged arteries in patients.

In the present study, after exploring the site of injury, 135 (57.9%) arterial cases were completely cut and 83 patients (35.6%) partial amputation. Also, 70 cases (30.0%) arterial thrombosis, vascular spasm and crush injury 4 cases (each 1.7%), venous thrombosis (DVT) 3 cases (1.3%) and venous arterial fistula 1 case (0.4%) were observed. Previously, in another study¹⁴ of 157 cases of arterial injury, 22 cases (14%) of healthy arteries, 59 cases (37.6%) complete amputation, 20 cases (12.7%) partial amputation, 31 cases (19.8%) False aneurysm, 6 cases (3.8%) of AVF and 17 cases (10.8%) of arterial thrombosis were reported. This type of discrepancy can be attributed to differences in the type of trauma created, the mechanism and severity of the trauma, and the referral of patients from other centers.

According to the present results, the most common treatment for arterial lesions was primary vascular repair (66.9%), while the use of venous graft (25.8%), arterial ligation (6.0%) and artificial graft (1.3%). In a previous study by Paul W. Humphrey et al., The most common methods of vascular repair were lateral suture (51%), ligation (19%), venous graft (16%) and artificial graft (6%), respectively¹⁵. However, according to Mohd Lateef Wani's research, most patients underwent surgery with the saphenous vein graft method following the initial anastomosis. However, there is no specific source to accurately recommend the type of surgery for

a vein or artery injury. An appropriate decision is made based on the type of injury to the vein or artery, blood flow from other arteries to the injured limb, and the accompanying injuries during the operation.

According to the findings, 52% of the patients in this study had complete recovery after treatment and repair of arteries. Also, in 45% of them, despite the presence of complications such as deformity or lack of use of the injured limb, complications of vascular injury were not reported. However, some studies have previously reported 4-7% of complications from vascular injury in such patients. However, a comparison of mortality in this study (1.7%) with other studies has shown significant success in implementing our procedures. Thus, according to similar studies, the death rate was 6-18%.

Conclusion

Vascular injury following penetrating trauma occurs typically at young ages. However, the rate of vascular damage in the arteries was much higher than in the veins. The type of surgical treatment and side effects of treating vascular injuries vary depending on the type, severity, and other parameters associated with the trauma.

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Authors' contributions

All authors contributed in this study equally.

Conflict of interest

None.

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Ethical consideration

This study was registered in the ethics committee in biomedical research of Lorestan University of Medical Sciences with the code IR. LUMS.REC.1399.072

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