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

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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 major traumas. 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. However, recently, due to an increase in urban violence, the patterns of vascular injuries are changing. 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. 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. Popliteal artery injuries are potentially devastating injuries with a relatively high morbidity, but are uncommon, accounting for 0.2% of all traumas. Injury to the popliteal artery can occur in the form of transection, occlusion, intimal injury, pseudoaneurysm, or fistula formation. Initial evaluation requires a thorough vascular and neuromuscular assessment. 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. 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. 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. 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. 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. A stepwise multidisciplinary approach to manage traumatic injuries is associated with improved morbidity and decreased in-hospital mortality. 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.

Table I: Presenting characteristics of patients with vascular trauma

| Characteristics          | Results          |
|-------------------------|------------------|
| Age in years            | 27.8±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. Postoperative 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 ($P=0.035$). 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 ($P>0.05$).

**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. 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). 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. 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.

| Table II: Operative findings of patients with vascular trauma |
|---------------------------------------------------------------|
| **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) |

| Table III: Postoperative outcomes of vascular repair |
|--------------------------------------------------------|
| **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) |
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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