

A two-year experience of treating vascular trauma in the extremities in a military hospital

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Abstract

Objective: To assess the presentation, diagnostic evaluation, various techniques of vascular repair and their outcomes.

Methods: The prospective descriptive study was conducted at the Combined Military Hospital, Rawalpindi, from October 2008 to December 2010. It involved 54 patients with vascular injuries in the extremities who underwent various vascular surgical interventions. Those who presented with irreversible ischaemia or had primary amputation and presented late with missed vascular injuries were excluded. The cases were evaluated for mechanism of injury, site and type of injury, associated injuries, type of repair performed and its outcome. Mean with standard deviation and frequency and percentage was calculated wherever relevant.

Results: The mean age of 54 patients was 26.8 ± 9.2 years (range: 9- 67 years), and the male-to-female ratio was 17:1. Penetrating trauma was the most common cause (n=34; 62.9%). Lower extremities were affected more commonly (n=33; 61.1%) and superficial femoral artery was the most frequently involved vessel (n=14; 25.9%). Besides, 16 (29.6%) patients had associated fractures, while concomitant venous injuries were present in 12 (22.2%). Interposition autogenous saphenous vein graft was the most common type of repair performed (n=42; 77.7%). Prosthetic graft was used only in 3 (5.5%) patients. Wound infection was the common complication (n=6; 11.1%). Three (5.5%) patients had secondary amputation and 2 (3.7%) died due to associated injuries. Vascular reconstruction was successful in 49 (90.7%) cases.

Conclusion: Early recognition and re-vascularisation by a vascular surgeon hold the key to saving more than 90% limbs with vascular injuries.

Keywords: Extremity vascular injury, Re-vascularisation, Amputation. (JPMA 63: 327; 2013)

Introduction

Vascular injuries in the extremities can result in loss of limb, serious life-long functional disability and even death in young adult males. These unfortunate outcomes occur due to delayed or failed recognition or incomplete assessment of the extent or severity of vascular injuries.¹ In the recent past, extremity vascular injuries have increased manifold in our country due to increase in terrorist activities and high-speed motor vehicle accidents.^{2,3} Much of our knowledge of vascular injuries is based on the experience gained during previous military conflicts. During World War II, vascular injuries were managed by ligation of injured vessels, but resulted in amputation in over 50% of the cases.⁴ Formal repair of peripheral vascular injuries started during the Korean War and with further refinement in arterial repair in the Vietnam War, the amputation rate for peripheral vascular injuries reduced to 15%.^{5,6} With improvement in vascular

surgical techniques and suture materials, early evacuation of patients to tertiary care hospital and awareness among general practitioners about vascular injuries, the amputation rate has gone down to less than 10%.⁷ High index of suspicion, detailed history, including mechanism of injury and clinical assessment with use of hand-held Doppler and pulse oximetry, and early exploration can save more than 90% of limbs.⁸ The objective of this study was to determine the outcome of various techniques of vascular repair employed, related complications and the rate of limb salvage.

Patients and methods

The descriptive study was carried out at the Combined Military Hospital (CMH), Rawalpindi from October 2008 to December 2010. Approval of the study was taken from the ethics review committee of the hospital. All cases of vascular trauma involving the upper or lower extremity and which were directly reported or referred from peripheral hospitals and evacuated from operational area were included in the study. Patients who sustained vascular injuries in the neck, thorax, abdomen and those who presented late with missed vascular injuries like arteriovenous fistula and pseudoaneurysm were

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excluded. A total of 64 cases of extremity vascular trauma were reported during the study period. Ten (15.6%) cases had already developed irreversible ischaemic changes equivalent to Rutherford grade III. Rutherford has classified acute limb ischaemia in three grades. Grade I, viable limb and not immediately threatened; Grade II, viable but threatened requiring immediate intervention; and Grade III, non-viable limb due to irreversible ischaemia.⁹ Primary amputation was advised in these patients and they were excluded from the study. All the cases were assessed by the surgeon on duty in the trauma centre and vascular surgeon on call. Patients were resuscitated according to the guidelines of Advanced Trauma Life Support protocol. Informed consent was taken and patients' particulars like age, gender, time between the onset of injury and arrival at hospital, mechanism of injury (penetrating, blunt or iatrogenic), site and associated injuries were recorded. Diagnosis was made on the basis of history and clinical examination, including hard and soft signs of vascular injuries, measurement of ankle-brachial index (ABI) and pulse oximetry of the affected limbs. Doppler study was done in only 5 (9.2%) cases with equivocal clinical findings. Pre-operative arteriogram was not done in any patient to avoid unnecessary delay in exploration. Blood complete picture, blood grouping and cross-match, blood sugar, serum urea and creatinine and X-rays of the affected region were advised before shifting the patients to the operation theatre, where 41 (75.9%) were operated upon under general anaesthesia, while 13 (24.0%) were managed under regional block (epidural/ spinal). Broad-spectrum antibiotics (inj cefuroxime 1.5g and inj amakacin 500mg) was started before the surgery and continued for 4 to 5 days after the surgery. Both lower limbs in case of lower extremity injury, and whole injured upper limb and one lower limb was prepared and draped. Associated fractures were fixed by the orthopaedic surgeon before vascular repair. Temporary shunt was passed in 3 (5.5%) cases of severed popliteal artery before the fixation of fracture. All injuries were explored through a longitudinal incision extending both proximally and distally to the affected site. Proximal and distal control was achieved before exploring the injury site. Associated injuries (nerves, veins, muscles and tendons) and extent and type of arterial injury was assessed. Debridement of surrounding soft tissue and affected vessel was done and the injured nerves were tagged with 2-0 prolene. Before the repair of arterial injury both the proximal and distal vessels were cleared from any residual thrombus with Fogarty catheter and flushed with heparinised saline (10 units/ml). All the arterial injuries were repaired with 6/0 prolene. Type of repair depended upon the extent and

type of injury. Reverse autogenous saphenous vein graft was the commonest type of repair performed in our study. Post-operatively, the patency of repair was assessed by palpation of distal pulses, capillary refill and with intraoperative probe of hand-held Doppler. Repaired vessels were covered with muscles/soft tissue, and the wound was washed with normal saline. Suction drain was placed in selective cases for 24 to 48 hours. Prophylactic fasciotomies were performed in 23 cases, where ischaemia time exceeded more than 8 hours, had both arterial and venous injury and extensive musculoskeletal injuries. Post-operatively all the patients were closely monitored regarding the state of circulation of distal limb (presence of distal pulses, capillary refill and the temperature), compartment syndrome, signs of secondary haemorrhage and reperfusion injury. Patients were discharged after satisfactory healing of wounds and secondary closure of fasciotomy wounds. At the time of discharge they were advised to follow-up in vascular outpatient department after two weeks. On follow-up, the vascularity of the limb was assessed both clinically and by Doppler examination. Any neurological deficits and other wound-related complications were recorded and the patients were advised to continue follow-up initially after one month and then after every three months.

Results

The age of patients ranged from 9 to 67 years with a mean of 26.8 ± 9.2 years. Male-to-female ratio was 17:1. Hospital stay ranged from 5 to 29 days. Penetrating trauma was the most common cause of injury (n=34; 62.9%), followed by blunt trauma (n=18; 33.3%), while the rest had iatrogenic injury. Time interval between injury and presentation in our hospital ranged from 2 to 21 hours, with most cases getting reported between 6 and 12 hours. Lower limb was more commonly affected (n=33; 61.1%) and superficial femoral artery was the most frequently involved artery (n=14; 25.9%) (Table-1). Besides, 16 (29.6%) patients had associated fractures and 9 (16.6%) had nerve injuries.

Table-1: Site of vascular injury.

Anatomical site of injured vessel	No. of cases	Percentage
Superficial femoral artery	14	25.9%
Popliteal artery	11	20.3%
Common femoral artery	3	5.5%
Anterior tibial artery	3	5.5%
Posterior tibial artery	2	3.7%
Brachial artery	10	18.5%
Axillary artery	5	9.3%
Subclavian artery	3	5.5%
Radial artery	2	3.7%
Ulnar artery	1	1.8%

Table-2: Type of vascular injuries.

Type of injury	No of cases	Percentage
Complete transection	19	35.1%
Transection and thrombosis	14	25.9%
Contusion and thrombosis	11	20.3%
Laceration	8	14.8%
Dissection	2	3.7%

Table-3: Technique of vascular repair.

Type of repair	No of cases	Percentage
Reverse autogenous vein graft	42	77.7%
End-to-end anastomosis	5	9.2%
Patch plasty	3	5.5%
Lateral suturing	1	1.8%
PTFE graft	3	5.5%

PTFE: Polytetrafluoroethylene.

Concomitant venous injury was present in 12 (22.2%). Complete transection was the commonest type of vascular injury (n=19; 35.1%) (Table-2). Interposition reverse autogenous saphenous vein graft was the most common type of repair (n=42; 77.7%) (Table-3). Fasciotomies were performed in 23 (42.5%) patients. Wound infection was the most common complication (n=6; 11.1%), managed with wound debridement, dressing and secondary suturing. Swelling of distal limb developed in 5 (9.2%) who had associated venous injury. They were managed by elevation, compression stocking and anticoagulant therapy. Three (5.5%) patients developed secondary haemorrhage due to anastomotic blow-out. One (1.8%) patient was managed by extra-anatomical autogenous vein graft, while another had two vessels ligated as life-saving measure; both patients ultimately ended up with below-knee amputations. Graft thrombosis occurred in 3 (5.5%) cases who underwent re-exploration. Embolectomy and re-vascularisation was performed in 2 (3.7%) patients while ligation in 1 (1.8%) patient with popliteal artery injury who finally had an amputation. Two (3.7%) patients died due to associated abdominal and head injuries.

Discussion

The increasing terrorist activities and operations in war against terrorism in the northwestern parts of the country have led to an increase in the incidence of vascular injuries. The increasing use of body armour (bullet-proof jackets and helmets) has reduced the incidence of major thoracic and abdominal vascular injuries, but the limbs are now more exposed. Majority of our patients were victims of blast (penetrating) injury and were young adult

males as reported in other series worldwide.⁷⁻¹² Incidence of vascular injuries are more in military conflict than in civil disasters; 192 major vascular injuries were treated at the Balad Air Force Theater Hospital in Operation Iraqi Freedom over two years.¹¹ During Soviet-Afghan war, 224 extremity vascular injuries were reported in 18 months.¹³ Presence of hard signs of vascular injury (pulsatile bleeding or increasing haematoma, presence of thrill or bruit and distal ischaemia) is the indication of immediate exploration without any diagnostic investigation, which should be reserved for selective cases. In our study, 49 (90.7%) cases were explored on the basis of clinical assessment. Literature suggests accurate physical examination has been found to be highly sensitive and specific.¹⁴ Spencer review of 269 arterial injuries, pulsatile bleeding or the combination of absent pulses and signs of distal ischaemia accurately indicated arterial injury in all patients.¹⁵ Pulse oximetry is a cost-effective, non-invasive and safe bedside diagnostic modality to assess vascular injury. We used a pulse oximeter in all patients to measure the oxygen saturation of the limb. More than 92% oxygen saturation in the affected extremity after resuscitation excludes major vascular injury.¹⁶ Meissner et al have recommended a combination of physical examination, Doppler arterial pressure measurement and Duplex ultrasonography as an optimum screening method for potential vascular injury.¹⁷ In stable patients with equivocal clinical finding, computed tomography angiography is an effective alternative to conventional arteriography in assessing extremity vascular trauma.¹⁸ Time interval between the onset of injury and repair has significant effect on the outcome of the patient in terms of limb salvage and avoidance of complications.¹⁹ Late referral and inadequate assessment at peripheral hospital resulted in irreversible ischaemic changes and amputation. Technique of vascular injury repair depends upon the mechanism of injury, type and extent of injury and associated injuries. Temporary intraluminal arterial shunt is advised for complex injuries, which requires fracture fixation and extensive wound debridement. It may reduce ischaemia time, amputation and hospitalisation.^{20,21} Reverse autogenous vein graft is the commonest conduit used for extremity vessel repair, which was the most commonly used technique in other series.^{7,22} Polytetrafluoroethylene (PTFE) graft can be used where autogenous vein graft is not available, but it has poor patency.²³ Patch angioplasty or lateral suture repair is possible in only small clean laceration of vessels. Primary end-to-end anastomosis should be done only when the gap between the proximal and distal end is less than 2cm after debridement of the vessel wall. Management of venous injury is controversial. Repair is

preferred by an experienced vascular surgeon in stable patients; it improves the outcome of arterial repair and minimises potential long-term complications.²⁴ Ligation of veins has been advised in unstable patients and with extensive venous injury, which requires a long interposition vein graft. A large number of venous repairs will thrombose in the post-operative period, especially if an interposition vein graft has been used.²⁵ Adequate fasciotomies have been considered a useful adjunct to repair the extremity vascular injuries, especially with prolonged ischaemia time and associated injuries to prevent compartment syndrome.²⁶ Wound infection was the most common complication. Aggressive debridement of the soft tissue and vessel wall reduces the incidence of wound infection, secondary haemorrhage and subsequent amputation rate. In our study the amputation rate was 5.5%. It was due to the exclusion of patients who had already developed ischaemic changes and through debridement and meticulous arterial repair.

Conclusion

Incidence of vascular trauma, especially extremity vascular injuries, has increased due to terrorist activities and high-speed road accidents. Penetrating trauma due to bomb blast and gunshot injury was the most common cause, and young males were the most common victims both in military and civil populations. Early recognition and re-vascularisation by a vascular surgeon can save more than 90% limbs and can have a good functional outcome.

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