PERIPHERAL VASCULAR TRAUMA- A LIMB MAY BE SAVED

Hemlata Verma[1], Ram Swaroop Sain[2], Deepak Sethi[3], Anjali Sethi[4]

[1]Assistant Professor, Department of Cardiothoracic and Vascular Surgery, Sawai Man Singh Medical College, Jaipur, Rajasthan.
[2]Assistant Professor, Department of Cardiothoracic and Vascular Surgery, Sawai Man Singh Medical College, Jaipur, Rajasthan.
[3]Consultant Surgeon and Senior Specialist, Department of Surgery, Rabindranath Tagore Medical College, Udaipur, Rajasthan.
[4]Associate Professor, Department of Surgery, Ananta Institute of Medical Sciences, Kaliwas, Rajsamand, Rajasthan.

ABSTRACT

BACKGROUND

The incidence of vascular trauma has increased considerably during the past 40 years. Although, they represent less than 3% of all injuries, they deserve special attention because of complications and limb loss.

MATERIALS AND METHODS

This was a descriptive study. Over a period of one year, 98 patients were operated for peripheral vascular injuries. Physical examination was used for diagnosis with the use of duplex ultrasonography/ CT angiography where needed. Vascular repair was carried out in terms of primary repair or interposition vein graft and fasciotomy was considered as and when required. Patients with non-salvageable extremity requiring primary amputation were excluded from the study.

RESULTS

Most of the patients were male. Most common cause was road traffic accidents. Occurrence of concomitant orthopaedic injuries was very high in this study. The commonly injured artery was popliteal artery (38.7%) and brachial artery (27.5%). Surgical procedures performed were interposition vein grafts in 54% cases, whereas end-to-end repair in 20.4% cases. The limb salvage rate was 76.53%.

CONCLUSION

Early diagnosis and treatment of vascular injury is important for limb salvage. Patients should be surgically intervened even after golden period has passed, because with limb or without limb matters a lot.

KEYWORDS

Vascular Trauma, Interposition Vein Graft, Limb Salvage, Vascular Repair, Road Traffic Accidents.

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BACKGROUND

Vascular trauma is a fast growing emergency for vascular surgeons. The incidence of vascular trauma has increased considerably during the past 40 years. Vascular injuries comprise of 3% of all civilian traumas and continue to have significant associated morbidity and mortality in the 21st century.[1] Although, they represent only 3% of all injuries, they deserve special attention because of complications and limb loss.

Various common mechanism of injury seems to differ in different parts of the world[2,3] and include blunt and penetrating trauma, stab wound, gunshot wound and RTA with later being the most common cause in majority of cases.[4] In view of urgent need of intervention, usually physical examination is used for diagnosis with the use of duplex ultrasonography/ CT angiography where critically indicated. CTA provides accurate and timely diagnosis of peripheral vascular injuries and challenges the gold standard of arteriogram.[5]

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Corresponding Author:
Dr. Ram Swaroop Sain,
#109, J-Block, Sector-14, Hiran Magri,
Udaipur-313002, Rajasthan, India.
E-mail: dr.rssain68@gmail.com
Deepanjali.d1972@gmail.com
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In the past attempts to control arterial bleeding were by means of cauterisation method, manual compression and pouring boiling liquid materials on the wounds. Ambroise Pare initially used the ligation method during XVI century.[4] While first and second world wars gave knowledge of diagnosis and treatment of vascular injuries, vascular reconstructive methods were mainly introduced during the Korean and Vietnamese wars with a tremendous progress[3,4] and a dramatic decrease in amputation rate.[2,3,6,7] Successful treatment of major arterial injuries is life-saving and allows limb salvage with restoration of function[6]; however, return of function also depends on concomitant nerve injury.[7]

Vascular trauma is associated with major morbidity and mortality, but little is known about its incidence or nature in our region. This study was done in 98 patients who underwent operative intervention for vascular trauma. This report presents the different mechanisms of vascular trauma, arteries involved, associated bone or nerve injuries and types of vascular intervention done and specially limb salvage rate at our centre. Injury to major peripheral artery causes limb ischaemia and if not repaired at proper time then can lead to loss of limb. That is why vascular trauma should be dealt within 6 hrs. of injury, which is called as golden period. But at our centre most of the patients present after passing of these golden hours because of delay in diagnosis or transportation. Still we moved on to repair these limb-threatening arterial injuries and got good limb saving results. We excluded crushed injuries, badly infected wound, limb with gangrenous changes and injuries presented after 100 hrs.

Objectives

The objective of this study was to find out salvageability of limb in case of vascular injury to limb; particularly when patients present late. This study was done to analyse the outcome of peripheral vascular injuries in the form of limb salvage after surgical intervention.

MATERIALS AND METHODS

This was a descriptive study. In this study, 98 patients were included who presented with peripheral vascular injuries over a period of one year in CTVS Department of SMS Medical College, Jaipur, Rajasthan, India. All patients underwent physical examination and immediate management according to the principles of the Advanced Trauma and Life Support (ATLS) guidelines of trauma management. The patients were assessed in casualty and were referred to CTVS Department after finding absent pulsations in one or more limbs. In view of urgent need of intervention, physical examination was used for diagnosis with the use of duplex ultrasonography/CT angiography where critically indicated. Pre-operative duplex ultrasonography/CT angiography was done in patients with multiple fracture sites.

Patients with non-salvageable extremity requiring primary amputation or those who presented after 100 hours of injury were excluded from the study.

Patients were taken immediately to the operating room for vascular, orthopaedic and plastic surgery management. In patients with associated bony injuries, orthopaedic intervention was done first. Thorough debridement of wound with removal of foreign bodies and copious irrigation with isotonic saline was done in all patients. Management of vascular injuries was done in the operating room under general anaesthesia or spinal/epidural anaesthesia using standard vascular techniques. Vascular repair was carried out in terms of primary repair or interposition vein graft. Repaired vessels were covered with muscles and soft tissues to prevent desiccation and disruption. If needed suitable covers for the defect were given by Plastic Surgeons with split skin grafting (SSG) techniques. Fasciotomy was considered as and when required.

Successful repair was assessed by the return of distal pulses at the end of operation. Associated nerve injuries were repaired at the time of vascular repair and injury to major veins were also repaired to minimise postoperative oedema and compartment syndrome. Antibiotics were given for five to seven days unless prolonged use was dictated by presence of contamination or infection. All patients also received intravenous heparin for a period of 3 days postoperatively and oral anticoagulants were started after patient started to take orally. Patients were discharged on oral anticoagulants and anti-platelets.

Statistical Analysis

Data was analysed using SPSS Version 16.0. The qualitative data were expressed as numbers and percentages.

RESULTS

A total of 98 patients were operated for vascular injury over a period of one year. Road traffic accident (RTA) was the commonest cause of peripheral vascular injury (60.20%). Other forms of trauma were penetrating injury (16.32%), fall from height (9.18%), industrial or machinery like electric saw or hand drilling machines (2.04%), gunshot (2.04%) and stab injuries. One interesting mode of vascular injury was camel bite, which accounted for 6% cases. Males were the main victims accounting for 93% cases and females were 7% with male-to-female ratio of 19: 1.

Vascular trauma was more common in lower limb (60.20%) in comparison to upper limb (39.79%). Most commonly injured arteries were popliteal (37.75%), brachial (26.53%) and femoral (18) with radial, ulnar, posterior tibial and axillary artery in 7, 4, 4, 2 cases respectively (Table 1).

Successful outcome in vascular trauma depends on early diagnosis and intervention. In our set-up, majority of the patients presented beyond the duration that is considered as the "Golden Period."

Patients usually presented after 6 hrs. Only 19% patients presented within 6 hrs. With 46% patients in 7 to 12 hrs., 5 patients after 72 hrs., 2 after 81 hrs. and 3 patients presented after 4 days (Table 2). The time interval between beginning of the trauma and arrival to our centre was a mean of 24 hours. The causes of delayed presentation were delayed recognition of vascular injury and delay in transport. Presence of open arterial bleeding, presence of an increased intended or pulsated haematoma, presence of six 'P' signs (Pulselessness, Poikilothermia, Pallor, Pain, Paraesthesia, Paralysis) of the related extremities formed the basis of diagnosis with Computed Tomographic angiography done only in 9 cases (9.1%) with multiple fracture sites.

Orthopaedic injuries were seen in 65% cases with nerve and vein injuries seen in 12 and 19 cases respectively. Contusion was the most common pattern of arterial injury (49%) cases followed by complete transection (29%). Spasm, partial transection and multiple site injury were seen in 10%, 7% and 3% cases respectively. Only one case of traumatic AV fistula was seen (Table 3). No intervention was done in 2 cases, because after exposing the artery pulsations were present with no visible vascular injury. Reversed saphenous vein interposition graft was used most commonly to repair the artery (53%) with end-to-end repair was done in 20% cases and PTFE graft was used in 3% cases. Ligation was done in 6 cases (Table 4). A balloon embolectomy catheter was used to remove thrombus and confirm patency proximally and distally.

Repair of major venous injuries was performed in 18 patients with primary repair in 3, end-to-end repair in 8, interposition vein graft in 6 and patch repair in 1 case and ligation of vein in one. Nerve repair was done in 7 cases.

In spite of presentation after 6 hours, the results of repair were extremely good. 18 out of 19 patients who presented within 6 hrs. achieved warm limb with palpable distal pulse. One case was sent for amputation, because of multiple injury of artery due to bomb blast. In 64 cases of delayed presentation, we were able to give warm limb with palpable pulses in 45 cases. In 14 cases of vascular repair limb remained cold, mainly in patients who presented after 24 hrs. (Table 5).

Postoperative complications in the form of infection was seen in 10 cases, secondary haemorrhage resulted in 3 patients (3%) and 2 patients (2.04%) died due to septicaemia (Table 6). 23 cases underwent amputation. 14 cases did not improve with surgery and had cold limb postoperatively (Table 7). 9 cases with warm limb were amputated due to secondary haemorrhage (3), blast injury (1), myonecrosis (3)

due to delayed presentation and infection (1), while 1 case underwent toes amputation. Overall limb salvage rate was 76.53%.

Artery	No. of Cases	Percentage
Axillary	2	2.08
Brachial	26	26.53
Radial	7	7.14
Ulnar	4	4.08
Femoral	18	18.36
Popliteal	37	37.75
Posterior tibial	4	4.08
Total	**98**	**100**

Table 1. Artery Involved

Time (Hours.)	No. of Cases	Percentage
0 – 6	19	19.38
7 – 12	40	40.82
13 – 19	5	5.10
20 – 25	10	10.20
26 – 30	4	4.09
31 – 40	1	1.02
41 – 50	7	7.15
51 – 60	2	2.04
61 – 70	0	0
71 – 80	5	5.10
81 – 90	2	2.04
91 – 100	3	3.06
Total	**98**	**100**

Table 2. Time of Presentation

Injury	No. of Cases	Percentage
Contusion	48	48.97
Spasm	10	10.20
Partial transection	7	7.14
Complete transection	29	29.59
Multiple sites	3	3.06
AV fistula	1	1.02
Total	**98**	**100**

Table 3. Arterial Injury

Repair	No. of Cases	Percentage
No intervention	2	2.04
Embolectomy	10	10.20
Lateral sutures	4	4.08
End-to-end repair	20	20.40
Vein graft	53	54.08
PTFE graft	3	3.06
Ligation	6	6.12
Total	**98**	**100**

Table 4. Arterial Repair

Result	No. of Cases	Percentage
Warm limb	84	85.71
Pulse present	63	64.28
Pulse absent	21	21.42
Cold limb	14	14.28
Total	**98**	**100**

Table 5. Result of Vascular Repair

Complication	No. of Cases	Percentage
Bleeding	3	3.06
Infection	10	10.20
Amputation	23	23.46
Death	2	2.04

Table 6. Complication

Limb Condition	No. of Cases	Percentage
Cold limb	14	14.28
Warm limb	9	9.18
Total Amputation	**23**	**23.46**

Table 7. Amputation

DISCUSSION

Despite modern surgical interventions, vascular injuries can still cause extremity loss and even death. According to some authors, amputation rates can even reach 78%.[8] In our study amputation rate was 23%, while it was 6%,[9,10] 7.7%,[11] 14.6%[7] and 17.24%[12] in other studies. The extremity salvage in our study was 76.53%, while it was 84%,[7,9,11] 94%[10] and 95%[13] in others. Cause of less percentage of limb salvage may be due to delayed presentation.

Successful outcome in vascular trauma depends on early diagnosis and intervention. In our set-up, majority of the patients presented beyond what is considered as the "Golden Period."

In this study Road traffic injury was the commonest cause (60%), mainly in male patients. This may be due to population and road discrepancy. Also women usually do not prefer driving in our region. Vascular injuries are frequent among young male population,[7,9,10,14] and in this study male patients composed of 93% of the cases with lower limb involvement (60.20%), more common than upper limb (39.79%).

Vessels, nerves and bones may be injured together due to their close relation anatomically.[15,16]

In our study, popliteal artery was the most commonly injured artery (37.75%) followed by brachial artery (26.53%).

Bone fractures and nerve lesions in this study involved 65% and 12% of cases respectively. The patients with bone fracture, nerve injury and severe soft tissue injuries were assessed by related disciplines and appropriate intervention was done. In our patients with fractures external fixation was more preferred because of easier application and low infection risk.

Peripheral angiography in vascular injuries is controversial. Some authors are suggesting angiography to every pre-operative patient.[8,17,18,19] Many clinicians report their successful vascular injury results without angiography.[7,14,20,21] We followed only clinical diagnostic method for early intervention and peripheral angiography was only done in cases with multilevel vascular and orthopaedic injuries. In all the patients with associated orthopaedic injuries, the orthopaedic surgeon performed reduction and fixation of fracture and/ or dislocation prior to the vascular repair. In one study, end-to-end repair was done in 26.75%, vein graft in 21%, PTFE graft in 1.9% and ligation in 8.9% cases.[7]

Reversed saphenous vein interposition graft in this study was used most commonly to repair the artery (53%) with end-to-end repair done in 20% cases and PTFE graft was used in 3% cases, while in another study primary repair in 55.5% cases and vein graft 35.2% cases.[10] Ligation was done in 6 cases.

In repairing damaged blood vessels, lifesaving measures take precedence over limb-saving procedures; at exploration, proximal and distal arterial control must be established before repair is attempted; vascular reconstruction is preferable to ligation; and the best evidence of good repair is restoration of the distal pulses. These principles are based on experience with 125 peripheral vascular injuries in Vietnam.[22]

Endovascular interventions (EVIs) are an important adjunct to open surgical management of peripheral vascular injuries. In appropriate situations EVIs decrease operative time, estimated blood loss and iatrogenic complications when compared with similar surgical cohorts by limiting surgical dissection in traumatised operative fields.[23]

A well-stabilised skeleton is essential before definitive arterial and soft tissue repair can be performed.[24] However, Hunt et al suggested that arterial revascularisation should be followed by skeleton stabilisation and nerve and tendon repair.[25] In this study, skeleton fixation was done prior to vascular repair. In arterial injuries successful results were obtained in arterial reconstruction procedures, which were held 6 - 8 hours after the event.[18,26] Almost, all of the amputation performed in our study were late cases that were revascularised after 8 hours of injury. Infection is also a major factor, which increases amputation rate after a successful vascular surgery. For this reason, vigorous and appropriate tissue debridement is important before and after the revascularisation procedure.[27] In our study 10 patients developed infection, but amputation was done in only one case.

Abbreviations

CTA: Computed Tomographic Angiography.
RTA: Road Traffic Accident.
ATLS: Advanced Trauma and Life Support.
CTVS: Cardiothoracic and Vascular Surgery.
SSG: Split Skin Grafting.
EVI: Endovascular Intervention.

CONCLUSION

Early diagnosis and treatment of vascular injury is important for limb salvage. Patients should be surgically intervened even after golden period has passed, because with limb or without limb matters a lot.

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