VASCULAR TRAUMA-EXPERIENCE AT LADY READING HOSPITAL PESHAWAR

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ABSTRACT

To evaluate vascular trauma management mainly on clinical assessment, at a less equipped set-up and compare the outcome in early and late arrivals. "A prospective study of vascular trauma patients at Lady Reading Hospital, Peshawar". The nature, site, early and late presentation and outcome of surgery in vascular injuries presenting to our depratment between Jan 1995 to Dec. 1998 were assessed. There were 354 vascular injuries in 344 patients (mean age 29, range 5-60). The study was divided into 2 groups, those presenting early (group A: 112 cases<8hours) were compared with those presenting late (group B: 232 cases<8hours). Out of these cases, only few stable neck injuries had pre-operative angiographies. The hospital mortality, complications, associated injuries and outcome were assessed.

Male accounted for 90% of patients. The majority of injuries (81.3%) were caused by bullets, followed by stab injuries (6.5%) blunt trauma (8.7%) and iatrogenic (3.4%). 61.3% were arterial, 10.2% were venous, (2.8%) were mixed, (4.8%) had intact vessels. Upper limb injuries were 31.6%, lower limb (60.2%), remaining were neck or abdominal injuries. Associated injuries included fractures (16.4%), nerve injuries (25.4%), chest injuries (5.9%), abdominal injuries (9%), and cervical spine or head injuries (1.4%). About 70% presented with haemorrhage and 80% with pulse deficit. Injuries treated with end-to-end anastomosis (44%), vein graft (21.5%), prosthetic graft (6.5%), lateral suture (16.7%), ligation (5.4%), thrombectomy (4.5%) and primary amputation (2.2%), Group "A" had higher mortality than group "B" (16%vs.5%) with amputation rate of (7.9 vs. 10.5%) and infection rate of (32% vs. 14.6%).

The higher mortality in those arriving within 8 hours of injury reflects, their more sever injuries. Early recognition and prompt referral to vascular surgery centre may save life and limbs in vascular trauma patients. PJCTS 2000; II: 2-9

INTRODUCTION

Most of the current knowledge of the principles and techniques of management of vascular trauma has developed just over the past 50 years[1]. In most of the hospitals in our country general or orthopaedic surgeons manage vascular trauma. Since the commencement of cardiovascular surgery in Peshawar, our department is working as a tertiary referral centre for cardiovascular surgical diseases in the North West Frontier Province (NWFP) of Pakistan and adjacent Afghanistan. Emergency vascular trauma cases are also dealt by our department. In the west vascular trauma mainly occurs in urban areas[2,3], but in Pakistan in general and in NWFP in particular due to easy availability of weapons, traditional family feuds and increasing violence, this unique entity of trauma comes from urban as well as from rural population. Bulk of vascular trauma comprises of penetrating injuries by bullets, which includes both high and low velocity missiles, so small skin wounds are often accompanied by large defect in deeper tissues or there may be injury along the track of the bullet. There is also increased incidence of infection as pieces of clothes and dirt are also dragged into such wounds. Mortality and limb salvage depends on adequate first aid and quick transportation to a proper vascular surgery centre[4]. Due to large catchments area some times patients are referred to us from far-flung areas and they take even days to reach us. Therefore most of the patients present to us late. This is in contrast to the situation in developed countries where the transportation time is minimal[5]. Our study

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is based on the comparison of early and late cases of vascular trauma presenting to us in a less equipped set-up. The out come of these cases was assessed regarding mortality, amputation rate in extremity injuries, acute renal failure, infection and re-exploration rates. Chi-square test was applied for analysis of the results.

MATERIAL AND METHODS

This is a prospective study of 344 patients with 354 vascular injuries, managed in the Department of Cardiovascular Surgery, Lady Reading Hospital Peshawar, Pakistan in 4 years period (Jan.1995 to Dec. 1998).

INCLUSION CRITERIA

Patients with history of penetrating or blunt injury to extremities, neck, abdomen, thorax or thoracic out let, irrespective of age, sex, and geographical distribution. Patients with acute sign of vascular injury i.e. pulse deficit, haemorrhage, expanding haematoma, temperature changes, impairment of sensations & movements in limbs, colour changes or late complications of vascular trauma i.e. arteriovenous fistulae or false aneurysms were included, in addition to:-

- Patients with penetrating, abdominal injuries, opened by general surgeons and vascular injury identified on operation table and our help was sought.
- Vascular injuries occurring during cardiac catheterisation and angiographies were included.
- Late referrals of vascular injuries, which occurred during different surgical procedures done in other hospitals of province.
- Patients with above-mentioned injuries in the extremities with established ischemia and presenting within 08 hours of injury.
- Patient with suspected vascular injuries and other associated injuries like fractures, nerve injury or soft tissue injuries.
- Patients with neck vascular injuries with or without associated neurological deficits.

EXCLUSION CRITERIA

- Severely crushed injuries of extremities e.g. degloving injuries with crushed muscles.
- Patients with penetrating or blunt injuries to extremities presenting after 08 hours of injury with established ischemia in extremities.
- Patients with chronic renal failure, having vascular injuries due to invasive procedures, presenting as aneurysmal dilation of arteriovenous fistula, leaking or infected arteriovenous fistula.
- Embolic episodes to the extremities or mesenteric vessels, managed surgically or conservatively.
- Electrocution injuries to the extremities.

Those included were divided into two groups on the basis of time presentaion to the hospital following injury. Cases reporting early i.e., within 08 hours of injuries were 112 (32.6%) and late cases were 232 (67.4%),due to non availability of facilities like arteriogram/doppler in Accident & Emergency, the patient in group A were explored with out these investigations. In late cases, for some of the neck injuries arteriogram was done to localize exact site and nature of injury, at a later date. And in few late cases of extremity injuries colour doppler was used to confirm diagnosis. All other cases were diagnosed clinically. Early cases were resuscitated and then shifted to operating room or if bleeding was uncontrollable then patients were shifted directly to operating room for immediate control of haemorrhage. Except two neck injuries, which were explored under local anaesthesia, all other operations were performed under general anaesthesia with endotracheal intubation. Operating time varies from 45 minutes to 6 hours. Average stay in hospital was 9 days (ranging from 02 days - 39 days). Blood transfusion during operation and post operatively ranged from 01-16 units with average of 4.5 units for each patient. Associated injuries with vascular trauma were managed by the colleagues of respective specialities. During operation systemic and local infiltration of heparin was used especially when there was sluggish or no back flow. Fogarty's catheter was used to clear distal or proximal segment of injured vessel. After which they were flushed with heparinized solution. Contaminated wounds were washed with hydrogen peroxide, povidone iodine and saline. After extensive debridement, some of these wounds were left opened, covering the vessels with muscle flap, later on closing them. Every graft interposition was put on heparin post operatively and later on was put on oral anticoagulants or antithrombotics. All the patients after

intervention were put on antibiotics.

RESULTS

Vascular injuries accounted for 3.4% of total trauma received at Accident and Emergency department of Lady Reading Hospital (LRH) Peshawar. And it is 7.6% of total fire arm injuries received at LRH.

Table I
Regional distribution of vascular trauma.

- Total No. of Vascular injuries	354	
- Total No. of Patients	344	
- Injuries of Lower extremity including External iliac vessel injuries	213	(60.2%)
- Injuries of upper extremity including Thoracic outlet.	112	(31.6%)
- Injuries of neck vessels	10	(2.9%)
- Injuries of inferior vena cava (IVC)	14	(4%)
- Injuries of Aorta	4	(1%)
- Injuries of common iliac vessels	1	(3%)

Total number of vascular injuries were 354 in 344 patients (Table 1). Ten patients had more than one vascular injuries. Mostly lower extremity was involved, followed by upper extremity, IVC, neck vessels and aorta. Number of IVC, Aorta and neck vessel injuries were less compared to extremity injuries. And there was no thoracic aorta or aortic arch injury, because all these injuries are mostly fatal instantaneously[6]. Age of the patients in this review ranged from 5-60 years, with a mean age of 29 years (Table II). Male patients were 312 (90.7%). 75% of patients were in age group of 15-39 years.

Table II
Age distribution of patients with vascular trauma.

Age Range	No. Of Patients.	
5-9 years	12	(3.5%)
10-14 years	23	(6.7%)
15-19 years	75	(21.8%)
20.29 years	112	(32.5%)
30.39 years	76	(22 %)
40.60 years	46	(13.4%)

Mechanism of injury (Table III) included 81.3% of firearm injuries. They were mainly bullet injuries. Only 7 of them were pellet injuries (Shot gun). Blunt injuries were 8.7% and stab injuries were 6.5%. There were 3.4% iatrogenic injuries. Iatrogenic injuries included 1 infrarenal aortic injury during excision of pheochromocytoma, 2 IVC injuries during right nephrectomy, 1 axillary artery and 1 subclavian vein injury during lymph node biopsy, 1 common iliac vein injury during hysterectomy, 5 femoral artery injuries out of which 2 during cardiac catheterisation and 3 during abscess drainage and 1 brachial artery injury during abscess drainage.

Table III
Mechanism of injury

- Firearm injuries (FAI)	288	(81.3%)
- Blunt injuries	31	(8.7%)
- Stab injuries	23	(6.5%)
- Iatrogenic injuries	12	(3.4%)

Table IV shows nature of vascular injuries. Arterial involvement was in 61.3%; venous involvement was in 10.2% and both artery and vein involved in 23.7% cases. There were 4.8% intact vessels. These negative explorations had injury in the proximity of vessel or a huge haematoma pressing on vessel resulting in pulse deficit distally.

Table IV
Nature of Vascular injury.

- Artery involved only	217	(61.3%)
- Vein involved only	36	(10.2%)
- Both artery and vein involved.	84	(23.7%)
- Intact vessels	17	(4.8%)

Associated injuries with vascular trauma shown in Table V. There were 16.4% associated fractures. As a principle bone should be fixed first followed by vascular repair[7]. Unfortunately this standard procedure was done in 11 cases only, as a result of which there were 6 cases of disruption of anastomosis due to un-fixed bone fragments. Associated nerve injuries were 25.4% of cases. Commonly involved nerves were median nerve, radial nerve, sciatic nerve, common peroneal nerve, cords and trunks of brachial plexuses.

Table V
Associated injuries with vascular trauma

Fractures	58	(16.4%)
Nerve injuries	90	(25.4%)
Chest injuries	21	(5.9%)
Abdominal injuries	32	(9%)
Cervical spine/head injuries	5	(1.4%)

Table VI
Bones fractured with vascular injuries

BONE	NO.
Femur	31
Tibia	7
Fibula	7
Clavicle	1
Humerus	9
Radius	1
Ulna	2

Some of the nerve injuries were repaired with vascular repair in the same sitting, if permitted by patient's condition, others were referred to neurosurgery later. Associated chest, abdominal and cervical spine / head injuries were dealt by colleagues of respective specialities.

Table VII
Clinical presentation of vascular injuries in the extremities.

	Upper Extremity 112/354 (31.6%)	Lower Extremity 213/354 (60.2%)
Pulse deficit	90 (80.3%)	176(82.6%)
Haemorrhage	72 (64.3%)	150(70.4%)
False aneurysum	15 (13.4%)	47(22%)
Temperature Changes	31 (27.7%)	51(23.9%)
Arteriovenous fistula	3 (2.7%)	36(16.9%)
Colour changes	7 (6.2%)	21(9.8%)
Established ischemia	2 (1.8%)	7(3.3%)
Expanding Haematoma	6 (5.3%)	19(8.9%)

Clinical presentation of extremity injuries is shown in Table VII. Most frequent sign was pulse deficit, which was present in more than 80% of both upper and lower extremity. In 14 case of upper extremity and 33 cases of lower extremity peripheral pulses were palpable in spite of arterial injuries. There were usually rent in artery, arteriovenous fistula or false aneurysm. Haemorrhage from the site of injury was the next common clinical presentation. False aneurysums and arteriovenous fistulae were more in the lower extremity as compared to upper extremity. Temperature changes and colour changes which had poor prospects regarding prognosis and out come in vascular trauma were more in lower extremity as compared to upper extremity[5]. Established ischemia, which resulted in primary amputation, were 2 in upper extremity and 7 in lower extremity. Aortic, IVC and common iliac injuries came to light on table while being operated by general surgeons and gynaecologist. Neck injuries presented with arteriovenous fistula, swelling in neck or expanding haematoma. Management of vascular trauma includes detailed history, careful physical examination including palpation of all the peripheral pulses, determination of hard and soft signs of vascular trauma[1], correction of hypovolemia, if there is any active bleeding in extremity injuries, then control of bleeding by pressure bandage and if bleeding is uncontrollable, shifting the patient to operating room. Extensive debridement is very important in limb salvage in extremity trauma[8]. Procedures done for repair or reconstruction of injured vessels listed in Table VIII. End to end anastomosis was done in 44.1% cases. Autologous vein graft interposition was done in 21.5% cases. Most of the time long saphenous vein was used. In few cases cephalic or basilic veins were also used. In 6.5% of cases synthetic graft was used. Most of the veins were repaired by lateral suture. Thrombectomy with vein patch repair was done in 4.5% of cases.

Table VIII
Procedure done in vascular trauma.

End to end anastomosis	150	(44.1%)
Autologous vein graft	76	(21.5%)
Synthetic graft	23	(6.5%)
Lateral suture	59	(16.7%)
Ligation of vessel	19	(5.4%)
Thrombectomy	16	(4.5%)
Primary Amputation	8	(2.2%)
Late Amputation	23	(6.5%)

Ligation of vessel was done as primary procedure in 5.4% cases. Vessels ligated include popliteal vein 1, common femoral artery 1, superficial femoral artery 2, brachial artery 1, below knee arteries 5, below elbow arteries 9,. These vessels were ligated because of severely infected wounds or to control life threatening haemorrhage. In case of below elbow or below knee injuries with one intact artery, the injured one was ligated.

Table IX
Out come of Vascular trauma

	Early cases	Late cases	
No. of cases	112(32.5%)	232(67.44%)	
Deaths	17(15.2%)	13(5.6%)	P<0.05
Amputations	7(7.9%)	24(10.5%)	P<0.05
Wound infection	36(32.1%)	34(14.6%)	P<0.05
Renal Failure	10(8.9%)	8(3.44%)	P<0.05
Re-exploration	4(3.6%)	13(5.6%)	P<0.05

Cases in this study were divided into two groups, those who presented to us within 8 hours of injury were early cases and those which reached to us after 8 hours of injury were late cases. Deaths were significantly more in early cases. There were 17 deaths in early cases. Out of which 12 were table deaths. They included 2 Aortic injuries, 8 IVC injuries and 2 groin injuries. Aortic injuries were bullet injuries, one IVC injury was iatrogenic during right nephrectomy and 7 IVC injuries were bullet injuries. All IVC injuries were supra renal or retrohepatic. Both the groin injuries were bullet injuries, received in shock. Both had shattered hip joint. There was 5 hospital deaths in early cases, these include 2 renal failures with septicaemia and 3 wound sepsis resulting in disruption of anastomosis and they bled to death. There were 13 deaths in late cases. They include 2 acute myocardial infarction, 3 acute renal failure, 3 associated abdominal injuries with septicaemia, 3 wounds sepsis with septicaemia and 2 wounds infection resulting in disruption of anastomosis and haemorrhage leading to death. More deaths in early cases reflect the severity of their injuries. Our total amputation rate was 9.5% with 26 amputation in lower extremities and 5 amputations in upper extremities. In early cases there were 7.9% amputations and in late cases there were 10.5% amputations. While primary amputations were 2.2% and late amputations were 6.5%. In upper extremity there were 2 primary amputations. One was bullet injury in axilla, received within 3 hours of injury[7] with discoloured contracted upper limb and the other was twisting injury at wrist. There were 3 late amputations in upper extremity. One blunt trauma with associated fracture humerus. Other two were bullet injuries received late. Trial by revascularization was given with out success. In lower extremities there were 26 amputations. 1 femoral and 5 popliteal injuries ended with primary amputations, they all presented with established ischemia. 20 cases ended up with late amputation. They include 7 popliteal and 13 femoral injuries. Amputation rate was significantly more in late cases. Wound infection was 32.1% in early and 14.5% in late cases. Most of these cases had superficial infection. Some cases with deep infection resulted in disruption of anastomsis or graft thrombosis. Over all infection rate was significantly more in early cases. Acute renal failure due to vascular trauma occurred in 18 patients. Nephrologist managed them by haemodialysis. Renal failure occurred in 8.9% of early cases. Among these 2 out of 10 (20%) died. While in late cases renal failure occurred in 3.4% of cases, out of which 3 out of 5 (37.5%) died. 3 patients with lower extremity injuries presented with established ischemia. After re-vascularization they developed acute renal failure, from which they recovered but ended up with two forefeet and one below knee amputations. Renal failure was significantly more in early cases. There was no significant difference in re-exploration rate, which was 3.6% (4 patients) in early cases and 5.6% (13 patients) in late cases. All re-explored early cases had un-fixed fracture femur, resulting in disruption of anastomosis in 3 cases and 1 graft thrombosis. On re-exploration bone fixation was also done. 13 patients were re-explored in late cases. They included two un-fixed fractures i.e. one fracture femur and other fracture humerus which resulted in disruption of anastomosis and repair was revised with bone fixation. There was one end-to-end anastomsis disruption and one non-patent end-to-end repair due to tension on vessel edges. Both of these were revised with graft interposition. There were 9 patients with infection in late cases. One patient with upper thigh injury was explored 3 times, due to severe sepsis. At the end common femoral artery was ligated and he ended up with above knee amputation. Other 8 cases had graft thrombosis detected by cold distal limb

post operatively. On re-exploration good back flow was found so both ends of vessel ligated (they all were superficial femoral arteries). After control of infection re-vascularization was done.

FOLLOW UP

Excluding deaths and amputations, 81.6% patients were followed for 3 months. 6 patients had absent pulses distal to repair. All of these were femoral artery injuries for which vein graft interposition was done. They had viable limb with out any symptoms. 3 patients with femoral artery injuries had claudication. Arteriography revealed two blocked grafts and one stenosis at anastomosis site. Patient with stenosis was managed conservatively and for blocked graft redo vein grafting done with satisfactory result.

DISCUSSION

Vascular trauma results in high mortality and more utilization of resources as compared to trauma patients without blood vessel injuries[11]. Vascular injuries are major contributor to the mortality and morbidity in trauma victims. As these patients need extra ordinary resuscitative measures, so prompt diagnosis and early intervention is key to success[1]. As a result of easy availability of automatic weapons in our society and increased violence cases of vascular injuries presenting to our department is ever increasing. At the same time working in a setup of a developing country, where limited facilities of emergency surgery is available, as well as lack of invasive and non-invasive diagnostic facilities results in vascular trauma assessment is mainly based on history and clinical examination[12]. Most of the time young population and predominantly, males are involved in violence. In our study maximum injuries were sustained by males and they were in young age group (Table II), and this is comparable with the studies in Pakistan[13] as well as abroad[10,14,15,16]. Like other violent societies the main mechanism of injuries are firearms[10,17,18,19] (Table III). We had only 4.8% negative exploration (Table IV), which showed that we could rely on clinical assessment to diagnose vascular injuries. Sophisticated investigation should be reserved for selective cases[20] and occult vascular injuries[32]. Clinical presentation in our study mostly comprised of the hard signs of vascular trauma[1] (Table VII). Regarding nature of injury, (Table IV) the arterial involvement was maximum followed by injury to both artery and vein and isolated venous injuries were minimal [21,22]. Vascular injuries to extremity are usually associated with nerve, bone or soft tissue injuries, which are contributors to the functional deficits in extremities[23]. Almost all subclavian and axillary injuries in our study had nerve deficit that was an important factor in functional recovery[24]. Most of the amputations were associated with blunt injuries and associated bone and soft tissue injuries[25]. We have obtained best results with end-to-end anastomosis [13,21,22,] (Table VIII), followed by autologous vein graft interposition, which are superior to synthetic grafts[26]. However synthetic grafts were better in compound contaminated wounds[26] and injuries of central vessels[27]. Venous repair is very important in limb salvage[28] and we have obtained good results with vein repair, which were most of the time repaired by lateral suture. Use of synthetic graft in venous repair carries poor prospects[27]. In our study we had 4 synthetic graft interpositions for popliteal venous injuries with good out come. We ligated few vessels as primary procedure. There was no limb loss when below elbow or blow knee one of the main branches of the artery were ligated[9], while the other artery was intact. Due to unavailability of blood that happens sometime in our set-up, to save life[13], we have ligated one brachial artery and one popliteal vein resulting in viable limbs later on. While ligation of a common femoral artery, resulted in above knee amputation. 2 superficial femoral arteries were ligated in severely infected wounds, with viable limb later on. In our series primary amputations were only 2.2%. This was because cases with established ischemia were dealt by general or orthopaedic surgeons (amputations) at local hospitals. Fasciotomy as an adjunct to vascular injuries to extremities is a limb saving

procedure[5]. We have a policy to do fasciotomy in all the popliteal injuries, and when indicated in other injuries. Time factor is very important in vascular injuries[12] (Table IX). It is evident from our study that mortality is mainly related to serverity of injuries[10] and due to complications e.g. renal failure, wound infection in early cases. Limb salvage mainly depends on early recognition, quick transportation i.e. scoop and run and timely intervention[29]. We are lacking early transportation. As most of the extremity injuries arrived late, so viability of limb depends on collateral, so amputation rate is significantly high in late arrivals. Most of the amputations were in lower extremity and popliteal artery injuries resulting in higher percentage of amputation[5,30]. In our study there is significant difference in renal failure in early cases (Table IX), which reflect severity of injuries and severe blood loss in these patients. They remain hypovolemic for longer periods affecting renal perfusion. Emphasis should be on the volume replacement in vascular trauma patients preferably by blood, and colloids if blood is not available. Our 3 patients went into renal shut down by re-vascularization of ischemic limb. So re-vascularization should not be done in limb with established ischemia to avoid rhabdomyolysis[7]. Wound infection is more in early cases (Table IX). This is due to prevailing situation in our accident and emergency department, where there is no facility for separate operating room for vascular surgical cases. Emergencies of all the surgical disciplines are operated in the same room resulting in this increased rate of wound infection. Situation can be improved by isolating vascular trauma operation room. There is no significant difference in re-exploration rate in early and late cases (Table IX). Most of the re-exploration were due to non-fixed bony injuries and wound infections. There were few incidences of technical errors during vascular repair. IVC and aortic injuries [10,16,29,31] have higher mortality rates and in our set-up most of the patients with these injuries died before reaching the hospital[12]. We have better survival rates in infrarenal IVC and aortic injuries, as compared to suprarenal injuries of IVC and aorta. We have used intraluminal shunts only in two cases of carotid injuries. These shunts may be used in extremity injuries to improve limb salvage[5].

In conclusion, dealing vascular trauma in a less equipped set-up is a challenging job, and out-come can be improved by better and effective first aid, early transportation of severely injured patients. High mortality in those arriving early reflects their more severe injuries. Early recognition and prompt referral to vascular surgical centre may save life and limbs in vascular trauma patients.

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