

# Extremity vascular trauma in Pakistan

Salman Y. Guraya, FRCS.

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## ABSTRACT

**Objective:** To report demographic data, etiological spectrum, the varied presentation, certain vascular techniques and their outcome in patients with peripheral vascular trauma.

**Methods:** This study included the patients who presented to the emergency room of Jinnah Hospital and Allama Iqbal Medical College Complex, Lahore, Pakistan with acute peripheral vascular injuries from May 1998 to April 2002. The Mangled Extremity Severity Score (MESS) was calculated for each individual to determine the magnitude of injury. A trauma database was devised to analyze each patient's characteristics, time since the injury, etiology of trauma, clinical presentation, associated injuries, surgical procedures performed and the result.

**Results:** Fifty-seven individuals were managed. The male to female ratio was 49:8 with an age range of 6-69 years (mean 29.1). The time since injury ranged 3-19 hours (mean 9.3). Thirty-one (54.3%) cases sustained vascular trauma by firearm, 10 (17.5%) by blunt trauma, 7 (12.2%) stabs, 6 (10.5%) machinery work and 3 (5.2%) by crush injury. Arterial bleeding from the wound was the most frequent presentation found in 18 (31.5%)

patients followed by absent distal pulses recorded in 13 (22.8%) subjects. Fifty-one (89.5%) patients presented with arterial, 6 (10.5%) venous and 9 (15.7%) of these had concomitant arterial and venous injuries. Complete vascular transaction was the most common operative finding noted in 26 (45.6%) cases followed by partial tear in 23 (40.3%) subjects. Fifteen (29.4%) common femoral, 10 (19.6%) brachial, 9 (17.6%) superficial femoral, 7 (13.7%) axillary, 5 (9.8%) popliteal and 4 (7.8%) radial arteries were traumatized. The interposition vein graft was used in 21 (41.1%) cases while primary vascular repair was carried out in 19 (37.2%) patients. Forty-five (78.9%) subjects had a functional limb after vascular reconstruction. Wound infection was recorded in 7 (12.2%) individuals. Six (10.5%) amputations were carried out, all with an average MESS of  $7.8 \pm 1.3$  ( $p < 0.05$ ). Three patients died within 10 hours of injury due to torrential hemorrhage.

**Conclusion:** Prompt surgical intervention, frequent use of saphenous vein graft and a low threshold for fasciotomy contributes to a successful outcome in patients with extremity vascular trauma.

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Severe peripheral vascular injuries account for 4-6% of major trauma.<sup>1</sup> During World War II, arterial ligation was the mainstay of treatment with an amputation rate of 72%,<sup>2</sup> which fell to 32%<sup>3</sup> in Korean War due to developments in vascular surgical techniques. The principles learnt during the major military conflicts have been translated into civilian practice and recent studies reveal an amputation rate of less than 5%.<sup>4</sup> There has been a global rise in the incidence of extremity vascular trauma due to terrorist violence and high-speed

motor vehicle crashes.<sup>5</sup> Such injuries pose a challenge to the general surgeons particularly in the developing countries such as Pakistan where scarce facilities and limited resources make this task even more daunting. This study presents a prospective analysis of peripheral vascular injuries in a tertiary care center in Lahore, Pakistan.

**Methods.** This study included the patients admitted through emergency room of Jinnah

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From the Department of Surgery, Division of General Surgery, Jinnah Hospital and Allama Iqbal Medical College Complex, Lahore, Pakistan.

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Address correspondence and reprint request to: Dr. Salman Y. Guraya, PO Box 286896, Riyadh 11323, Kingdom of Saudi Arabia. Tel. +966 51665848. E-mail: drsyg7@yahoo.com

Hospital Lahore (JHL) with traumatic peripheral vascular injuries from May 1998 to April 2002. JHL is an acute tertiary care teaching hospital affiliated with Allama Iqbal Medical College, Lahore, Pakistan. The parameters considered were age, gender, time since injury, mode of presentation, mechanism of injury, vessels injured, vascular surgical techniques and the final outcome. The injured patients were evaluated according to the guidelines of advanced trauma life support. The Mangled Extremity Severity Score (MESS) was calculated for each patient to standardize the scoring of severity. The MESS 7 have been reported to be highly predictive of the need for amputation.<sup>6</sup> After initial resuscitation, Doppler study was performed on the injured limb. Where indicated, radiographs of the suspected bony lesions were obtained. Orthopedic or neurosurgical consultation was sought as required. All patients were given cefuroxime 1.5 grams intravenously at the time of induction and explorations were carried out under general anesthesia. Proximal and distal vascular controls were taken by using the standard operative approaches. The injured vessels were isolated and the exact extent of vascular damage established. The orthopedic fixation was undertaken before proceeding for vascular reconstruction. Repair of the damaged vessel took precedence in the presence of exsanguinating hemorrhage or profound limb ischemia. Repair of the injured vessel was undertaken after thorough debridement of the soft tissues. In cases where loss or damage to the vessel wall was <2 cm, mobilization of the vascular ends and subsequent anastomosis with 5/0 or 6/0 interrupted prolene stitch was performed.<sup>7</sup> A larger gap was bridged with a reverse saphenous vein graft harvested, from the contralateral uninjured limb. In the absence of adequate blood flow, a Fogarty catheter was used to retrieve the thrombus. A heparinized saline flush (10 IU/L) of the distal vessels was carried out (regional anticoagulation) in all cases.<sup>8</sup> Fasciotomy was considered where time since injury exceeded 6 hours, in the presence of extensive soft tissue and bony injuries, concomitant arterial and venous trauma and the clinical suspicion of compartment syndrome.<sup>9</sup> Venous repair was performed by lateral venography and ligation undertaken when venous reconstruction was not possible or required. The areas of focal neural transection, if found, were tagged and left for either immediate repair after vascular reconstruction or delayed repair by the attending specialist. Adequate soft tissue coverage was ensured with primary closure, delayed primary closure, skin grafting or local rotation flap closure. All patients were subjected to Doppler examination along with a daily bedside clinical evaluation in the ward. The out patients monthly follow up included visits for the first 3 months and then after every 6 months. Death

was defined as all those occurring within 30 days of injury or during initial hospitalization. All the statistical analysis was performed by using chi-squared analysis and Student's t-test ( $p < 0.05$  was considered significant).

**Results.** Fifty-seven patients comprised this study group. Patients were predominantly males (49 males, 8 females) with an age range of 6-69 years (mean age of 29.1). The response time (time elapsed between injury and arrival to the hospital) ranged 3-19 hours with a mean of 9.3 hours. Thirty-one (54.3%) patients had acute vascular injury inflicted by firearms, 10 (17.5%) by blunt trauma, 7 (12.2%) stab, 6 (10.5%) work machinery and 3 (5.2%) by crush injury. Arterial bleeding from the wound was the most common presentation observed in 18 (31.5%) patients followed by absent distal pulses noted in 13 (22.8%) subjects (**Table 1**). Thirty-five (61.4%) patients sustained lower limb vascular trauma and 22 (38.5%) had upper limb vessels injured. The common femoral artery was the most frequent vessel injured recorded in 15 (29.4%) patients followed by brachial artery found in 10 (19.6%) cases (**Table 2**). This study also demonstrated that 51 (89.5%) patients had arterial injuries, 6 (10.5%) venous and out of these, 9 (15.7%) subjects sustained mixed arterial and venous injuries as shown in **Table 3**. Out of those with arterial injuries, vascular reconstruction was carried out by interposition vein graft in 21 (41.1%), primary repair 19 (37.2%), lateral repair 10 (19.6%) and repair of arteriovenous fistula in one (1.8%) patient. Venous repair was performed by lateral venorrhaphy in 4 patients and venous ligation in 2 subjects (**Table 4**). Twenty-six (45.6%) patients had complete vascular transection, 23 (40.3%) partial tear, 5 (8.7%) thrombosis, 2 (3.5%) subintimal flap and one (1.7%) patient presented with arteriovenous fistula. Various associated injuries identified in this study were: 14 (24.5%) fracture or dislocation, 7 (12.2%) nerve injuries, 5 (8.7%) intra-abdominal injuries necessitating laparotomy and 4 (7 %) head trauma cases.

Fasciotomy was performed in 27 (47.3 %) limbs. A concomitant orthopedic fixation was carried out in 10 (17.1 %) cases: external fixator in 7, splinting 2 and skeletal traction in one patient. Out of the 7 nerve injuries, 3 were primarily repaired. The others were either observed or tagged for delayed repair due to significant segmental loss. The patients with extensive soft tissue trauma and open wounds were taken to operating room every 48 hours for dressing change, irrigation and further debridement.<sup>10</sup> This was continued until the wound was ready for grafting or delayed primary closure. Following vascular repair, 20 (35%) wounds were primarily closed, 18 (31.5%) had delayed primary closure, 13 (22.8%) were treated with delayed primary closure

Table 1 - Mode of presentation of acute vascular injuries (N=57).

Presentation	n	(%)
Arterial bleeding from the wound	18	(31.5)
Pulse deficit	13	(22.8)
Shock	11	(19.2)
Expanding hematoma	8	(14)
Distal ischemia	6	(10.3)
Neurological deficit	2	(3.5)
Pulsatile mass	2	(3.5)

Table 2 - Site of arterial injuries (N=51).

Artery	n	(%)
Common femoral	15	(29.4)
Brachial	10	(19.6)
Superficial femoral	9	(17.6)
Axillary	7	(13.7)
Popliteal	5	(9.8)
Radial	4	(7.8)
External iliac	1	(2)

Table 3 - Site of venous injuries (N= 6).\*

Vein	n	(%)
Popliteal	3	(50)
Common femoral	2	(33.3)
Axillary	1	(16.7)
* 9 (15.7%) patients had concomitant arterial and venous trauma.		

Table 4 - Surgical techniques of vascular repair (N=57).

Vessel	Types of repair	n	(%)
Artery (n=51)	Interposition vein graft	21	(41.1)
	Primary repair ± resection	19	(37.2)
	Lateral repair	10	(19.6)
	Repair of arteriovenous fistula	1	(1.8)
Vein (n=6)	Lateral venorrhaphy	4	(66.6)
	Ligation	2	(33.3)

and split thickness skin graft whereas 6 (10.5%) wounds were closed with a local rotation flap. Six (10.5%) limbs were amputated (all with MESS 7). The average MESS of salvaged limbs was  $5.6 \pm 1.0$  while the amputated limbs had an average score of  $7.8 \pm 1.3$  ( $p < 0.05$ ). Three patients developed substantial myonecrosis in the post operative period and necessitated amputations. Two primary amputations were carried out as life saving procedures. Both these cases had a concomitant popliteal artery and venous injuries along with profoundly devitalized soft tissues. One limb was amputated due to a technical error. Seven (12.2%) patients developed wound infections; all treated successfully with the aforementioned dressing protocol. There were 3 deaths accounting for a mortality of 5.2%. All the deaths occurred within 10 hours of injury following irreversible shock. Forty-five (78.9%) patients had a useful and functional limb after vascular reconstruction.

**DISCUSSION.** The escalating incidence of extremity vascular injuries in the civilian practice in Pakistan demands a high index of suspicion while managing patients with multi-system trauma.<sup>11,12</sup> The usual victims are young males. Gupta et al<sup>5</sup> reported 95% of patients being males in their study of 153 cases. Menzoian et al<sup>13</sup> observed 94.3% incidence of the male victims whereas this study showed a male preponderance of 85.9%. Firearms were found to be the most common cause of acute vascular trauma reported by many authors,<sup>11,14</sup> which is in accordance with the results of this study (54.3%). Arterial bleeding from the wound was the most frequent presentation observed in 31.5% cases in the present study, which contrasts with the results published by Stumm et al<sup>15</sup> where pulse deficit was the most common clinical finding reported in 61.2% of the patients. The distal pulses may be present in up to one quarter of peripheral vascular injuries, therefore, the site rather than size of the skin laceration overlying a vascular structure should alert the treating surgeon.<sup>16</sup> In their series of 153 patients, Gupta et al<sup>5</sup> have documented the femoral artery being the most common vessel of the lower limb injured (n=14) and this observation is further substantiated by this study; femoral artery traumatized in 15 (29.4%) subjects. Trauma to the upper limb vessels accounts for 33-45% and lower limb vessels 45-50% of major vascular trauma<sup>17</sup> while this series revealed 38.9% for upper limb and 61.4% for lower limb. The rarity of isolated venous injuries has been reported in civilian practice (15%),<sup>18</sup> during the Croatian War (12%)<sup>19</sup> as well as in this study (10.5%). This observation, however, must be tempered by the understanding that venous injuries might be under diagnosed or under reported as they are scarcely limb-threatening. All the patients in this series were subjected to Doppler

study as the facilities for arteriography were not available at JHL. Although some authors have suggested to abandon routine arteriography as it can significantly prolong the ischemia time,<sup>20</sup> Harrel et al<sup>21</sup> still maintain that preoperative angiography would reduce the incidence of missed injuries. However, "direct" arterial imaging with color-flow Doppler is a valuable diagnostic tool and has further limited the use of angiography.<sup>22</sup>

Primary repair of the injured vessel provides the best results, however, interposition grafts are also recommended when primary repair is not possible.<sup>23</sup> Various types of interposition grafts have been tried such as veins, arteries, intestinal submucosa, Dacron and polytetrafluoroethylene.<sup>24</sup> In present study, no synthetic conduit was used as 21 (41.1%) patients had an autogenous reverse saphenous vein graft with promising results: 20 (95.2%) limbs were saved. Williams et al<sup>25</sup> have concluded in their retrospective study of 88 cases that the rates of limb salvage and neurological sequel were similar in early (within 12 hours) and late (after 12 hours) fasciotomy, although the rates of infection differed significantly among the 2 groups: 7.3% for early versus 28% for late. Different published reports have even suggested the use of "prophylactic" fasciotomy particularly in the presence of profound soft tissue damage and concomitant arterial and venous trauma.<sup>26,27</sup> In this study, 27 (47.3%) fasciotomies were performed at the time of vascular reconstruction. A low threshold for fasciotomy is justified on account of a long response time of 9.3 hours. Delayed presentation may have also contributed to a slightly higher incidence of amputation rate (10.5%) as compared to 2.8-8% rate reported in the developed countries.<sup>28</sup> This observation reaffirms that time is the key factor in determining the final outcome of vascular surgery.

In conclusion, the present study is an effort to outline management pathways for patients with acute vascular injuries. A multi disciplinary approach by vascular, orthopedic and plastic surgical input is mandatory to achieve the best possible limb salvage rates. The liberal use of autogenous saphenous vein graft and fasciotomy is attended by favorable results. Measures to overcome delayed presentation should be addressed.

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