VASCULAR INJURIES IN TEHRAN: A REVIEW OF 123 CASES

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Abstract- Studies of the epidemiology of civilian vascular trauma in developing countries are rather few. This is a prospective study of our experience with vascular trauma in a referral university hospital in Tehran, Iran. The aim was to study the etiology, pattern of injuries and the mortality and morbidity rates due to vascular trauma in our population. In this cross-sectional study, all trauma patients suspicious of having vascular injuries who were admitted to Sina Hospital between March 2002 and May 2003 were included. Among 123 studied cases, there were 109 males and 14 females. Blunt injuries were more common than penetrating ones (56.1% vs. 43.9%). The most common anatomical site of vascular injuries had been knee and lower leg. In fact, cases with lower extremities vascular trauma were twice as common as those with vascular trauma in upper limbs (59.1% vs. 27.3%). The commonest injured vessels were popliteal artery followed by femoral artery. Arterial repair with graft interposition was done in 23 cases and bypass graft in 13 cases. Procedures on veins were performed in 24 cases. Five patients (4.06%) died and in 3 cases the patients died because of non-vascular reasons. The present study allows an understanding of the epidemiology of vascular trauma in the one of the major trauma centers in the metropolitan city of Tehran. The majority of our cases were young males sustaining vascular injuries due to road traffic accidents or being stabbed with knives. It also has important implications for vascular injury prevention in our community.

Acta Medica Iranica, 44 (5): 333-340; 2006

Key words: Vascular injury, arterial bypass, amputation, popliteal artery, femoral artery, blunt injuries

INTRODUCTION

Vascular injury epidemiology has been studied in three different settings (1): military conflicts (2-7), large urban centers (8-12) and in rural areas (13-15). Most of these studies demonstrate the pattern of vascular injuries in developed countries (2-6, 8-15); but, studies of the epidemiology of civilian vascular trauma in developing countries are rather few (7,16-19). In fact vascular injuries are common in civilian trauma and prompt diagnosis and management of these injuries is the mainstay of a successful outcome (17). Our study aims to depict the pattern of civilian vascular injuries in a referral university hospital in Tehran, Iran.

Received: 9 Nov. 2005, Revised: 8 Jan. 2006, Accepted: 18 Feb. 2006

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MATERIALS AND METHODS

In this cross-sectional study, all trauma patients suspicious of having sustained vascular injuries who were admitted to and had stayed for more than 24 hours in Sina hospital, Tehran, Iran between March

2002 and May 2003 were included. Sina hospital is one of the three referral university hospitals in the metropolitan city of Tehran, admitting patients from Tehran and also the neighboring cities. During this 14-month study, 123 cases entered into the study. Our cases do not include those dying at the scene of trauma or along the way to the hospital. The criteria for inclusion of cases into the study were clinical evidence of vascular injuries (hard signs, soft signs or both).

Patients with soft signs (without definite evidence of vascular injuries) were also included in the study; because vascular injuries had to be ruled out in these patients using diagnostic techniques (e.g. angiography). For our patients, a questionnaire was filled in round-the-clock by the vascular surgery fellow of the center and a general practitioner under the supervision of vascular surgery staff. Data regarding demographics, time, place and mechanism of trauma, details of vascular injuries and surgical procedures, Injury Severity Score (ISS) and the outcome of patients were recorded through questionnaires. Type of injuries and the vessels involved were coded according to ICD-10. SPSS version 11.5 was used for statistical analysis and $\alpha = 0.05$ was considered as the level of statistical significance.

RESULTS

Among 123 studied cases, there were 109 male (88.6%) and 14 female (11.4%). Mean age of our patients was 26.8 with a median and mode of 23 (0.95 CI for mean = 24.50-29.17).

Manual workers and students comprised a considerable proportion of our cases (each 14.3%). About 63.8 percent of our patients had passed 9 years or less at school and 11.4 percent were illiterate. The commonest places of trauma were streets (60%), followed by homes (17.5 %). Among the patients, 16 (13%) were injured while busy working (occupational injuries).

Victims of blunt injuries (n = 44) outnumbered those suffering from penetrating injuries (n = 54); but the difference was not statistically significant.

Of 54 cases with penetrating injuries, 23 patients (42.6%) had been injured through stabbing with knife. Road traffic accidents were responsible for injuries in 62 cases (50.4%), followed by wounds by sharp objects 34 (27.6%). Of road traffic accidents, 35 had been in motorcyclists, followed by 18 pedestrians and 3 car occupants.

Falls were responsible for trauma in 7 cases (5.7%) which in 4 of them, the patient had fallen from a height more than 4 meters (from buildings). Gunshots were responsible for injuries in 12 cases (9.7%). Iatrogenic injury was observed in one case (0.8%). Considering the intentionality of injuries, 85 (69%) were non-intentional (accidental), 35 (28.5%) assault and 2 (2.5%) were self-inflicted. The commonest assault mechanism had been stabbing with knife (n = 23).

About 28 percent of our patients had been injured between 4 to 8 PM, followed by 25% between 12 MD and 4 PM. Only 6 percent of cases had been injured from 12 MN to 4 PM ($P < 0.001$). The highest frequencies of our patients were admitted at 4 PM (mode).

A considerable percent of our cases had been referred from other centers (69.1%). Of these 85 referred cases, 31 had been referred from another city (25.2%).

The delay between time of accident and arrival to the hospital had been 7.9 ± 12.85 hours (median 2 hours). This delay had been significantly higher in those referred from other centers (9.02 ± 12.68 hrs., median = 4 hours and 15 minutes) than those admitted directly (7.9 ± 12.85hrs., median = 45 minutes) ($P = 0.001$). The median delay in those referred from other cities was 9 hours (12.46±15.45 hrs).

Only 21 patients (17.1%) were transported to hospital by the National Emergency Service. A considerable proportion of our cases (69%) had been referred from other centers. Mean ISS of our patients was 7.1. 47 cases (49%) had low ISS (ISS < 7), 40 (32.5%) moderate ISS and 9 (7.3%) had a high severe ISS (ISS >15).

The frequency distribution of soft and hard signs of vascular injuries is demonstrated in figure 1. 35 patients (28.5%) had only soft signs, 3 (2.4%) had only hard signs and 85 (69.1%) had both.

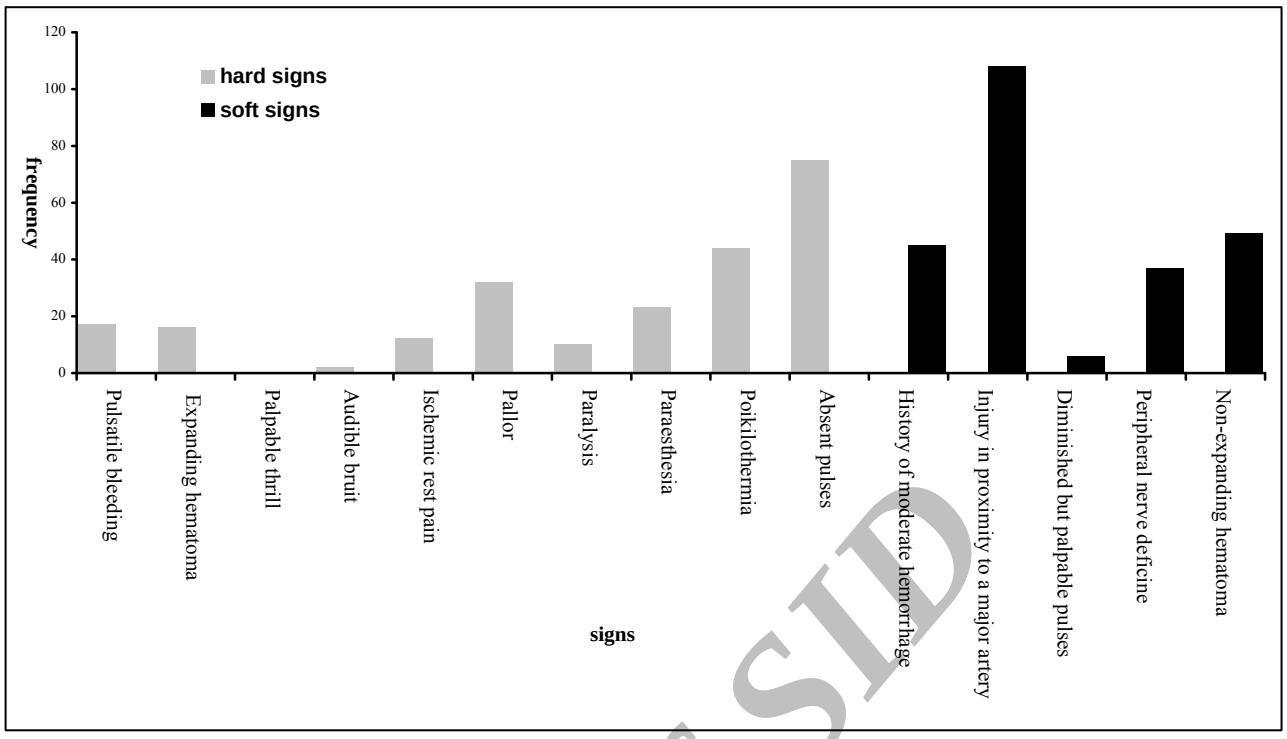

Fig1. Frequency distribution of soft signs and hard signs.

Of 88 cases having a sort of hard signs, 24 underwent angiography which was abnormal in 20 cases (cut off in 17 cases, AV fistula+ extravasation in 1, AV fistula plus pseudoaneurysm in 1, extravasation plus pseudoaneurysm in 1). Surgery was performed in 14 of these 20 cases with abnormal findings in angiography. In addition, 3 of them underwent amputation (1 urgent and 2 delayed). Death occurred in 2 of these cases.

From those cases with hard signs in whom angiography was not performed (n=64), 42 underwent surgery and amputation was performed in 11 of them (4 urgent and 7 delayed).Of 35 cases with only soft signs, angiography was performed in 14 cases which proved abnormal in 4 (all cut-off). Surgical procedures were performed just in one case in this subgroup (ligature of deep femoral artery). No cases of death or amputation were observed among this group.

The vessels injured in each anatomical site are shown in table 1. As is evident in this table, vascular injuries were proved in 100 of our cases (81.3%). In fact, a total of 110 vascular injuries were observed in these 100 cases. 30 of these injuries were in upper extremities (27.3%) and 65 in lower extremities (59.1%). Of these 110 vascular injuries, 79 were arterial (71.8%), 23 in veins (20.9%) and 8 not discriminated in this regard (7.3%). A significant relationship was observed between mechanism of injury and extremity trauma: Most of the injuries to upper limbs were due to penetrating trauma (68.8%) while in lower extremity injuries blunt trauma was predominant (69.1%) ($P = 0.001$). Injuries to popliteal arteries were the commonest (n = 26).

Among the cases with popliteal injuries, blunt injuries were the predominant mechanisms of trauma (24 out of 26) ($P < 0.001$). Road traffic accidents were also very common among these cases (88.5%) ($P < 0.001$).

Table 2 demonstrates the different types of vascular injuries in our patients. All patients had at least one type of associated injures. The frequency and types of these associated injuries according to mechanism of trauma are summarized in table 3. There was a significant statistical relationship between type of associated injuries ($P < 0.001$). In 14 cases, amputation was performed (11.4%) (in 4 cases, urgent amputation; in 9 delayed amputations and in 1 both).The mechanism of injury in 11 out of these 14 cases (78.6%) was blunt compared with the other 3 (21.4%) with penetrating injuries ($P = 0.07$). All of these 14 cases with amputation had bone

fractures as the accompanying injuries (with or without other accompanying injuries in muscles and nerves). Mean duration of hospitalization of patients was 8.56 days (0.95 CI=6.92-10.2). 8.1% of patients (n=10) were admitted to ICU. Unfortunately five patients died (4.06%). The vascular injuries in these fatal cases had been to 1) abdominal aorta, 2&3) femoral artery, and 4) popliteal artery and 5) popliteal artery and saphenous vein avulsion.

Table 1. The injured vessels according to anatomical sites in patients with vascular injuries, Tehran, 2002-2003.

Sites	Vessels (number)	Total
Head and Neck		5
	External juglar vein (1)	
	Internal juglar vein (2)	
	Carotid artery(1)	
	Other (1)	
Thorax		3
	Innominate or subclavian vein (2)	
	Innominate or subclavian artery (1)	
Abdomen and Pelvis		7
	Abdominal aorta (1)	
	Inferior vena cava (1)	
	Iliac blood vessels (2)	
	Renal blood vessels (1)	
	Other blood vessels (2)	
Shoulder and upper arm		24
	Axillary artery (6)	
	Brachial artery (15)	
	Axillary or brachial vein (1)	
	Others (2)	
Forearm		5
	Ulnar artery (1)	
	Radial artery (2)	
	Vein injuries (2)	
Wrist and hand		1
	Radial artery (1)	
Hip and thigh		26
	Femoral artery (16)	
	Femoral vein (10)	
Lower leg		39
	Popliteal artery (26)	
	Ant. Post. Tibia artery (6)	
	Peroneal artery (3)	
	Popliteal vein (4)	
Total		110

Table 2. Frequency distribution of types of vascular injuries (in descending order of frequency) in patients with vascular injuries, Tehran, 2002- 2003.

Type of Vascular injuries	Number	Percent
Transection	22	17.9
Thrombosis	17	13.8
Laceration	10	8.1
Spasm	10	8.1
Contusion	7	5.7
Entrapment	6	4.9
Transection and Thrombosis	12	9.8
Thrombosis and Contusion	9	7.6
others	7	5.7
none	23	18.7
Total	123	100

The mechanism of injury was iatrogenic in the first and road traffic accidents in the others. All these 5 cases had been referred from other centers (the third one from another city); but none of them had been operated in those centers. All of them had both soft and hard signs. Their ISS were 16, 4, 18, 20 and 9. In 3 cases, the patients died because of non-vascular reasons (GI bleeding in case number 1, crush injury in case 3 and ARDS in case 5). During follow-up (until discharge) vascular complications were observed in one case that needed secondary vascular repair due to graft thrombosis. Non-vascular complications were observed as follow: ARDS (n=3), fat emboli and ARDS (n=2), renal failure (n=4), wound infection (n=16), wound hematoma (n=3), sepsis (n=5) and compartment syndrome (n=1). 5 patients had permanent disabilities at discharge, 5 were discharged against the physician's advice, 87 suffered temporary disabilities and 13 were discharged with complete recovery.

Eight patients had a vascular operation before referral to our center. Totally, vascular operations were performed for 76 cases (61.8); for 22 of them in the first 6 hours after trauma and in 54, after these early 6 hours and in one case, at both of these times. Arterial repair was performed in 50 cases (bypass graft in 13, interposition graft in 23, ligature in 6, end to end anastomosis in 5, lateral repair in 2 and patch angioplasty in 1). Procedures on veins were performed in 24 cases (ligation in 15, venorrhaphy in 6, venoplasty in 2 and end to end anastomosis in 1).

Table 3. The frequency distribution of associated injuries according to the injury mechanism in the studied patients, Tehran, 2002-2003.

Type	Mechanism		Total
	Blunt	Penetrating	N (%)
Nerve injuries	1	2	3 (2.4)
Muscle injuries	13	35	48 (39)
Bone injuries	29	1	30(24.4)
Visceral injuries	0	2	2 (1.6)
Nerve & muscle injuries	1	8	9 (7.3)
Nerve & bone injuries	6	1	7 (5.7)
Muscle & bone injuries	11	2	13 (10.6)
Bone & visceral injuries	1	0	1 (0.8)
Nerve, muscle & bone injuries	7	3	10 (8.1)
Total	69	54	123 (100)

DISCUSSION

Of 123 cases suspicious of sustaining vascular trauma, 110 proved to have at least one vascular injury. In fact, a total of 112 vascular injuries were documented in the study subjects. No other studies had previously reported this number of vascular trauma victims in this time frame (14 months). For instance, 248 cases in 20 years from rural areas in Missouri-Columbia (14), 155 cases are reported from Kuwait in an 8 year study (17), 153 cases from Western Australia during 5 years (8), 80 cases from Houston, Texas in a 4 year period (20) and 57 cases from Pakistan during 4 years (19).

Age and sex

The preponderance of young males in vascular trauma has been cited elsewhere (17,18, 21,22).

Blunt vs. penetrating trauma

Although blunt injuries were more common in our series than penetrating trauma (56.1% vs. 43.9%), the difference did not prove to be significant. In addition, road traffic accidents (especially while motorcycling) were the commonest mechanism of injury in our study followed by sharp objects, especially stab wounds. This is similar to a report from Australia in which motor vehicle accidents comprised 43.2% of injuries and the blunt injuries were more common than penetrating (58% vs. 42%) (21). Similarly, in a study from a British teaching hospital, road traffic injuries were the most common (the mechanism in 45% of all cases) followed by accidents and stabbing; nevertheless, most injuries were penetrating (12).

Equal frequencies of blunt and penetrating vascular injuries has been observed in a study from a suburban trauma center in the USA (23). In fact, the majority of upper extremity injuries were penetrating and the majority of injuries in lower extremities were blunt in that study.

In European countries, blunt injuries have been reported to comprise 19 to 40% of vascular injury patients. In European countries where penetrating trauma exceeded blunt trauma as the cause of vascular injuries (such as Turkey or Finland), stab wounds were more common than gunshot wounds (24). In Australia (8) and Kuwait (17) stabbing had been the most common etiology of vascular injuries followed by motor vehicle accidents. In other reports like those from Pakistan (7, 19) and Latin America (11) gunshot wounds have been reported as the most common etiology of vascular trauma. In a study of civilian vascular trauma in India, 41 out of 54 cases were injured due to blunt trauma (16).

Clinical findings: hard signs, soft signs

Absent pulses and cold extremities were the most common hard signs. Regarding soft signs, injury in proximity of a major artery was the most common. This is similar to the report by Hussain (7).

Anatomical site

The most common anatomical site of vascular injuries had been knee and lower leg. In fact, cases with lower extremities vascular trauma were twice as common of those with vascular trauma in upper limbs (59.1% vs. 27.3%). In the Pakistan and also Malaysia's experience, vascular trauma in lower extremities were observed about twice as that in upper limbs (7, 18). In Germany, the relative frequency of lower and upper extremity arterial injuries had been 53.8% and 46.2% in a series of extremity vascular trauma, respectively (25). In European studies these relative frequencies were 45% and 33% of all vascular trauma, respectively (A). Rural vascular trauma in the United States have also documented this pattern (14).

Similar to Diamond's report, most of the injuries to upper extremities were penetrating and in lower extremities blunt trauma as in our study (23).

Injured vessels

The most common injured vessels was popliteal artery (in 28 cases), followed by femoral and brachial arteries (each in 17). This is similar to the report from Malaysia (18) and Germany (25). In our study, the majority of popliteal injuries were blunt and due to road traffic accidents. This is similar to reports from Australia (8) and Europe (26). In the United Stated (27) and South Africa (28) gunshot wounds were more predominant as the cause of popliteal injuries. In rural setting in the USA, popliteal artery injury had been again the result of blunt mechanisms of injury (29).

In the report from Tbilisi, Georgia (30) and the one from Britain (12), femoral and brachial arteries have been the most common. In the American experience, injuries to femoral arteries comprised 70 % of cases of extremity vascular trauma and popliteal artery injuries were observed in 20% with a higher percentage being blunt injuries. In (19) and Australia (8) femoral artery had been the commonest injured vessel.

Type of injuries and surgical procedures

The most common type of vascular injuries had been transection followed by thrombosis. The most common surgical procedures for arterial repair in our study had been interposition graft followed by bypass graft. This is similar to the reports from Pakistan (19), the University of Istanbul, Turkey, (31), Athens (24), Latin America (11) Germany (25) Georgia (30) and from Kuwait (17).

Accompanying injuries

Accompanying injuries were observed in essentially all of our cases, the most prevalent being muscle injuries followed by fractures. In a report from the Latin America the most common associated injuries had been fractures and dislocations, followed by neurological and soft tissue injuries (11). The lower incidence of soft tissue injuries in the aforementioned study might be attributed to predominance of gunshot injuries (63% of all cases).

Limb loss

Primary amputation was performed in 4 cases in our study. In addition, in 9 patients, delayed amputations and in 1 both (urgent and delayed) were performed. This makes the amputating rate to be 11.4%. In the United states, extremity vascular injuries are currently associated with limb loss in 1 to 10 percent of cases (used to be 10-30% in the Vietnam war, and 35-75% in World War I and II) (23).

The rather high rate in our center might be due to the fact that majority of our cases were referral from other centers. In some studies from Turkey, amputation rate was between 3 to 56%, the latter in a series of lower extremities vascular trauma (24). In study of civilian trauma in India and Malaysia, amputation rate were 24% and 15.5%, respectively (16).

The response time

The median duration of time elapsed between injury and arrival to the hospital was 2 hours overall (4:15 in those referred and 45 minutes in those admitted directly). The mean response time had been 9.3 hours in Pakistan's report (19).

Hospital length of stay

Mean duration of hospitalization of patients was 8.56 days and 8.1% of patients were admitted to ICU. Hospital length of staying the report from Australia had been 14.6±24.7 days with 44.4% of cases being admitted to ICU (21).

Mortality rate

The mortality rate in our study was 4.06%. This is comparable to those reported by Guraya from Pakistan (5% mortality) and from Kuwait (3%). In Finland, the overall mortality of vascular injuries had been 2.8%. In different studies from Turkey, the mortality rate ranged from 1.9% to 25 % (24). The mortality rate in Australian experience was as high as 26%; despite the most common injury mechanism being motor vehicle accidents. In conclusion the present study allows an understanding of the epidemiology of vascular trauma in the one of the major trauma centers in the metropolitan city of Tehran. The majority of our cases were young males

sustaining vascular injuries due to road traffic accidents or being stabbed with knives especially in streets. The patterns depicted here will hopefully lead to improved diagnostic pathways for patients sustaining vascular injury in the similar settings. It also has important implications for vascular injury prevention in our community.

Conflict of interests

The authors declare that they have no competing interests.

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