Ulus Travma Acil Cerrahi Derg 2010;16 (4):308-312
Klinik Çalışma

# Traumatic vascular injuries of the lower extremity: report of the Iranian National Trauma Project

## Alt ekstremitenin travmatik vasküler yaralanmaları: İran Ulusal Travma Projesi raporu

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***BACKGROUND***
This study aimed to determine the pattern of traumatic lower extremity vascular injuries in Iran.

***METHODS***
Patients with vascular injury of the lower extremity were selected from the Iranian National Trauma Project. This project was conducted in eight major cities during 2000-2004 and consisted of more than 17000 patients.

***RESULTS***
Sixty-three subjects (54 men) with a total of 92 vascular injuries of the lower extremity were identified. Mean age of the patients was 25.87±13.37 years. Blunt trauma was more frequent than penetrating (62% vs. 38%). In 36 cases (57%), road traffic crash (RTC) was the cause of injury. In 21% of the patients (n=24), vascular injury resulted from occupational trauma. Workers (n=23, 20%) were the most frequently affected group. Three patients (5%) died due to severity of the associated injuries.

***CONCLUSION***
Our results revealed that RTC is the most frequent cause of lower extremity vascular injuries in Iran. Our findings also showed that occupational injuries have considerable prevalence. Establishment of preventive strategies to reduce the frequency of these injuries is recommended.

***Key Words:*** Iran; lower extremity; vascular injury.

***AMAÇ***
Bu çalışma, İran'daki travmatik alt ekstremite vasküler yaralanmalarının özelliklerini belirlemeyi amaçlamıştır.

***GEREÇ VE YÖNTEM***
Alt ekstremite vasküler yaralanması bulunan hastalar, İran Ulusal Travma Projesinden seçildi. Bu proje, 2000-2004 yılları arasında sekiz büyük kentte yürütüldü ve 17000'den daha fazla sayıda hastayı içerdi.

***BULGULAR***
Toplam 92 vasküler alt ekstremite yaralanması bulunan 63 olgu (54 erkek) belirlendi. Hastaların ortalama yaşı, 25,87±13,37 yıl idi. Künt travma, penetran yaralanmaya göre daha yüksekti (%38'e karşı %62). Olguların 36'sında (%57), yaralanma nedeni, karayolu trafik kazası (KTK) idi. Hastaların %21'inde (n=24), vasküler yaralanma mesleki travmadan kaynaklanmıştır. İşçiler (n=23, %20) en çok etkilenen grup olmuştur. Üç hasta (%5) eşlik eden yaralanmaların şiddeti nedeniyle ölmüştür.

***SONUÇ***
Bizim bulgularımız, KTK'nın İran'daki en sık alt ekstremite vasküler yaralanma nedeni olduğunu göstermiştir. Aynı zamanda bizim bulgularımız, mesleki yaralanmaların da kayda değer bir prevalansa sahip olduğunu göstermiştir. Bu yaralanmaların sıklığını azaltmaya yönelik önleyici stratejilerin oluşturulmasını önermekteyiz.

***Anahtar Sözcükler:*** İran; alt ekstremite; vasküler yaralanma.

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Acute traumatic arterial injury to the lower extremity is uncommon but remains a challenging problem,[1] and in spite of improvement in the management of these injuries, they are still associated with significant rates of limb loss and functional deficits.[2]

In Iran, due to the limited numbers of level 1 and 2 trauma centers, the majority of patients are managed initially by ligation of the injured vessels. Although it can be life-saving, it increases the probability of limb loss.[3] Moreover, a considerable number of patients are referred late for treatment in Iran.[4] These factors make management of these lesions more difficult. On the other hand, the mechanisms of these injuries vary in different regions. In some countries such as the United States (US) and South Africa, gunshot injuries are more frequent than in other countries, while in other regions stabbings are more frequent.[5,6] Thus, the epidemiology of these injuries should be determined in each country separately.

There are only a few studies about traumatic vascular injuries of the extremities in Iran,[4,7] and the pattern of these injuries in this country is not well-defined. Therefore, in this study, we aimed to evaluate these injuries in Iran using the registry system of the Iranian National Trauma Project (INTP).

## MATERIALS AND METHODS

During a four-year period (2000 to 2004), a cross-sectional study was performed as a part of the NTP in eight major cities. The study was set up in accordance with the American College of Surgeons National Trauma Registry System (TRACS) and the National Trauma Data Bank (NTDB) using a validated questionnaire. A group of physicians were trained for the process of data collection during several sessions. During the study period, the trained physicians visited traumatic patients during their first 24-hour admission to the emergency rooms and wards and completed the questionnaires.[8]

Patients with traumatic vascular injuries of the lower extremity were identified amongst a total of 17753 patients referred to the trauma centers of the study cities and hospitalized for more than 24 hours. Required data including demographics, duration of transportation to the hospital, mechanism of trauma, details of injured vessels and nerves (coded according to International Statistical Classification of Diseases and Related Health Problems [ICD-10]), associated injuries, Injury Severity Score (ISS), preoperative investigations, surgical intervention, duration of hospital stay, and outcome (amputation or death) were obtained. In the present study, we divided the ISS into three ranks of <16, 16-25, and >25.[9] The arterial injuries were diagnosed by physical examination (soft/hard signs), Doppler ultrasound and arteriography, if necessary.

The collected data were analyzed using SPSS software (Statistical Package for the Social Sciences, version 13.0, SPSS Inc, Chicago, IL, USA), and a p value <0.05 was considered statistically significant.

## RESULTS

During this time period, 63 patients (54 men, 86%) with a total of 92 traumatic vascular injuries of the lower extremity presented to the studied hospitals. The mean age of the patients was 25.9±13.3 (mean± SD) years old (range 2 to 71).

Median duration of transportation to hospital was 2.05 hours (h) (range 15 min to 44.30 h). Fifteen patients (24%) presented to the centers after 6 h. In 21% of the patients (n=24), vascular injury had resulted from occupational trauma. Workers (n=23, 20%) were the most frequently affected groups. Blunt and penetrating traumas were responsible for the vascular injuries in 39 (62%) and 24 (38%) cases, respectively (Fig. 1). ISS ranks one, two and three were determined in 19 (30%), 29 (46%) and 8 (13) cases; ISS rank was not available for 7 cases (11%).

The diagnosis of vascular injuries had been established by physical examination (soft/hard signs) and Doppler ultrasound. When they were not diagnostic, arteriography was performed. Arteriography was performed in 2 cases (3%). Femoral and popliteal artery was injured in 19 (30%) and 18 (28%) cases, respectively. Table 1 shows the details of the injured vessels. Peripheral nerve injuries were seen in 8 cases (13%). Peroneal and tibial nerves near the end of the leg had been injured in 4 and 3 cases, respectively. There was also one sural nerve injury. All associated nerve and tendon injuries had been repaired primarily. Fig. 2 demonstrates details of other associated injuries.

Femoral artery injuries were treated with end-to-end anastomosis or interposition of the saphenous graft (n=18, 95%). One patient had been referred to another center. Popliteal artery lesions had been managed by ligation (n=2, 11%), repair with end-to–end anastomosis or saphenous vein interposition (n=11, 61%), and

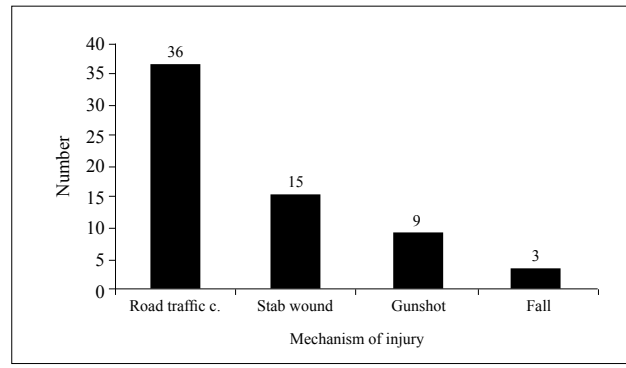


**Fig. 1.** Mechanisms of trauma are shown.

**Table 1.** Details of the injured vessels

| Injured vessels | Number | Percent |
|---|---|---|
| Femoral artery | 19 | 21 |
| Popliteal artery | 18 | 20 |
| Tibial artery (anterior and posterior) | 15 | 16 |
| Peroneal artery | 4 | 4 |
| Dorsalis pedis artery | 3 | 3 |
| Femoral vein | 7 | 8 |
| Popliteal vein | 3 | 3 |
| Others | 23 | 25 |

Multiple injuries were divided into subgroups. In 19 and 5 cases, respectively, 2 and 3 vessels were injured.

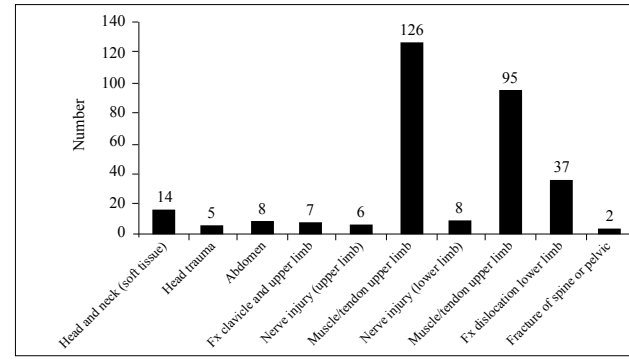


**Fig. 2.** The frequencies of associated injuries (multiple injuries are divided into subgroups).

femorotibialis bypass with saphenous vein graft (n=5, 28%). Fasciotomy and amputation was performed in 5 cases (28%) and 1 case (5.5%) successfully. Intraluminal shunt was not used in any patient. All tibial (n=15) and peroneal (n=4) artery injuries were ligated, as were distal arterial and concomitant venous injuries.

Median hospital stay was 7 days, and 3 patients (5%) died due to severity of the associated injuries. Table 2 demonstrates the details of the exitus cases.

## DISCUSSION

This study, in addition to providing an epidemiologic profile of lower extremity vascular injuries in Iran, provides data regarding management of these lesions in centers that are not equipped with a vascular surgery team. Some of these patients may be managed by ligation of the injured vessels in other centers, which may increase the risk of amputation. These patients may then be referred to the equipped centers or may present to these centers due to resulting complications. As a result, a considerable number of these patients receive appropriate treatments late.[4,7,10]

Regarding age and sex of the patients, our results were similar to other reports showing that young males are affected more than other groups.[1,4,5] In this study, 86% of the victims were male, and the mean age of the subjects was approximately 26 years.

Most of the vascular injuries in our study (62%) had resulted from blunt trauma. Although it is compatible with our previous report,[4] the mechanism of trauma in these injuries varies in different parts of the world.[1,3,5,11] In some countries such as South Africa and the US, penetrating injuries are more prevalent than in Iran.[5,6] Our findings also revealed that road traffic crash (RTC) is the most common cause of lower extremity vascular injuries in Iran.

Arteriography as a preoperative assessment had been performed in only 2 patients (3%), showing that most of these injuries can be diagnosed on physical examination with signs such as significant hemorrhage from a penetrating wound, lack of distal pulses, or both;[5,12] however, we do not know the exact success rate of Doppler ultrasound in the diagnosis of vascular injuries in our study. On the other hand, some researchers suggest that angiography is unnecessary in the routine evaluation of a patient with blunt lower extremity trauma who has a normal neurovascular examination. It can be used selectively for patients with diminished pulses with associated indications for mandatory operative exploration.[12] Ankle brachial index (ABI) has been suggested as a rapid and reliable tool for diagnosing blunt vascular injuries of the lower extremity including vascular injuries resulting from knee dislocation.[13,14] However, in the present study, ABI was not utilized to diagnose vascular injuries resulting from blunt traumas.

There are several options for treatment of arterial injuries, including simple repair, end-to-end anasto-

**Table 2.** Details of exitus patients

| No. | Sex | Age (years) | Mechanism of trauma | Injured vessel | ISS Rank | GCS | Associated Injuries |
|---|---|---|---|---|---|---|---|
| 1 | Male | 27 | RTC | Femoral artery | 3 | 7 | Fx. Femur, tibia, acetabulum and base of skull; traumatic subdural hemorrhage |
| 2 | Male | 28 | RTC | Femoral artery | 3 | 9 | Fx. Tibia, femur, radius, ulna, vault of skull, lumbar spine and clavicle |
| 3 | Male | 40 | RTC | Femoral artery | 2 | 14 | Multiple fx. of upper limb and femur |

Fx: Fracture; GCS: Glasgow Coma Scale; ISS: Injury Severity Score; RTC: Road traffic crash.

mosis and bypass grafting.[1,15] Ligation of the injured vessels is associated with high risk of amputation and is not used today.[16] Our study showed that ligation of great vessels such as the popliteal artery is still used frequently in Iran, which may increase the risk of amputation. It is a result of the limited number of trauma centers equipped with vascular surgery teams. However, the amputation rate was not actually high in our series and just one amputation was recorded, which was not related to ligation. Except for two cases of popliteal artery injury who were managed by ligation of the injured artery, other ligations were limited to tibial and peroneal arteries. It is likely that these injuries were located at the distal parts of these arteries and ligation was performed distally, which resulted in less severe ischemia. Another reason may be related to the short-term follow-up of the subjects in this study; it is possible that some of these patients underwent amputation later. In the present study, all simultaneous venous injuries were ligated. Ligation of injured veins can be associated with several postoperative and late complications such as deep vein thrombosis (DVT) and venous insufficiency. In a study by Kurtoglu et al.,[17] outcome of 63 patients with serious venous injuries of the lower extremity managed by ligation was assessed. DVT developed in 49 patients in the postoperative and late follow-up. Postoperative edema and wound infection developed in 56 and 19 cases, respectively. In the mentioned study, no significant sequelae of chronic venous insufficiency were seen, and they suggested that venous ligation has no detrimental effect on associated arterial repair. However, in the present study, we did not have long-term follow-up results of the cases who underwent venous ligation and can not judge about ligation-related complications in this group.

Although fasciotomy is performed prophylactically in lower extremity vascular injuries, there is controversy about the timing of fasciotomy and the role of intracompartmental pressure.[16] According to other studies, the location of the arterial injury is the main determinant of fasciotomy in patients with lower extremity vascular injury.[18,19] In our study, fasciotomy was performed in five patients (28%) with injured popliteal artery. This percent is higher than our previous report in which fasciotomy was performed in only 3% of the patients with traumatic popliteal artery injury and prolonged ischemia.[4] Our previous reports about traumatic vascular injuries[4,7,10] showed lower rates of fasciotomy compared to other studies[20-22] because in Iran prophylactic fasciotomy is not performed routinely and is reserved for those patients who have overt compartment syndrome based on measured compartment pressure and/or clinical assessment.

This study has several limitations that should be kept in mind. In fact, the present study is a small part of the INTP, which had been designed to provide epidemiologic aspects of all types of trauma in Iran. Thus, some details such as exact frequency of soft/hard signs of vascular injuries and Mangled Extremity Severity Score were not considered in the INTP.

In conclusion, peripheral vascular injuries can result in limb loss, and injuries of the major vessels including the popliteal artery should be repaired as soon as possible. In some countries such as Iran, ligation of great arteries is performed frequently because in some centers there is no on-call vascular or trauma surgeon. This shortage may increase the rate of amputation. Our results revealed that RTC is the most frequent cause of lower extremity vascular injuries in Iran. The study also showed that occupational injuries have considerable prevalence. Establishment of preventive strategies to reduce the frequency of these lesions is recommended.

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