

Peripheral vascular injury-related deaths

Periferik damar yaralanmalarına bağlı ölümler

Sadık BİLGİN,¹ Nursel TÜRKMEN,² Bülent EREN,² Recep FEDAKAR²

BACKGROUND

Peripheral vascular injuries are frequently encountered in lethal and nonlethal trauma. Although significant improvements in treatment have been achieved, such injuries are still important causes of mortality.

METHODS

In this study, the records of 6769 autopsies performed between 1996 and 2006 at the Council of Forensic Medicine Bursa Group Chairmanship Morgue Department were evaluated retrospectively.

RESULTS

The 63 cases (0.9%) who were determined to have died due to vascular injury were included in this study. Fifty-seven cases (90.5%) were men (mean age: 36 years); 58.7% of the injuries were due to stab wounds. The femoral artery and vein were the most frequently injured vessels. The origin was a homicide in 85.7% of the cases. In 25% of the cases, blood alcohol levels were between 44 and 256 mg/dL.

CONCLUSION

The availability of experienced surgical teams and effective prehospital emergency care are vital for decreasing the mortality due to extremity vascular injuries. In the autopsy of a patient who died primarily due to extremity vascular injury, the injured vessel, numbers of injuries and of lethal injuries, and locations and sides of the injuries shed light on the possible presence of intention.

Key Words: Autopsy; extremity; trauma; vascular injuries.

AMAÇ

Periferik damar yaralanmaları sıklıkla ölümcül ve ölümcül olmayan travmalarda saptanmaktadır. Tedavide önemli ilerlemeler kaydedilmesine karşın, bunlar hala önemli ölüm nedenleri olarak kalmaktadır.

GEREÇ VE YÖNTEM

Bu çalışmada, 1996 ile 2006 yılları arasında Adli Tıp Kurumu Bursa Grup Başkanlığı Morgu'nda yapılan 6796 otopsiye ait raporlar retrospektif olarak incelendi.

BULGULAR

Çalışmaya, damar yaralanmasına bağlı hayatını kaybettiği saptanan 63 (%0,9) olgu dahil edildi. Olguların 57'si (%90,5) erkek olup, yaş ortalaması 36 bulundu; yaralanmaların %58,7'si kesici delici alet yaralanmasına bağlı idi. Olguların %85,7'sinde orijinin cinayet olduğu belirlendi; %25'inde kan alkol seviyesi 44 ile 256 mg/dL arasında saptandı.

SONUÇ

Ekstremitte damar yaralanmalarında, mortaliteyi azaltmak açısından tecrübeli cerrahi ekibin bulunması, bunun yanında efektif hastane öncesi acil girişim yapılması hayati önem taşımaktadır. Primer ekstremitte damar yaralanmasına bağlı ölen kişilerin otopsilerinde; yaralanan damar, yaralanma sayısı ve ölümcül yaralanma sayısı, yaralanma yerleşimi ve tarafı özellikle üzerinde durulması gereken konulardır.

Anahtar Sözcükler: Otopsi; ekstremitte; damar yaralanmaları; travma

Peripheral vascular injuries are frequently encountered in lethal and nonlethal trauma; although significant improvements in treatment have been achieved, such injuries are still important causes of mortality. In the absence of a potentially lethal injury

at some other location, death caused by extremity injury is possible due to major vascular injury or development of complications. Demonstration of the injured vessel, determination of whether the vascular injury is lethal by itself and determination of the

Departments of ¹Orthopedics and Traumatology, ²Forensic Medicine, Uludağ University Faculty of Medicine, Bursa, Turkey.

Uludağ Üniversitesi Tıp Fakültesi, ¹Ortopedi ve Travmatoloji Anabilim Dalı, ²Adli Tıp Anabilim Dalı, Bursa.

Correspondence (İletişim): Nursel Türkmen, M.D. Uludağ Üniversitesi Tıp Fakültesi, Adli Tıp Anabilim Dalı, Görükle-Nilüfer, 16059 Bursa, Turkey. Tel: +90 - 224 - 222 03 47 e-mail (e-posta): nursel_turkmen@yahoo.com

number, locations and sides of the injuries are important for assessment of the possible intention to kill or to inflict injury.^[1,2]

In this study, the frequency and characteristics of deaths due to peripheral vascular injury among the forensic autopsies performed at the Council of Forensic Medicine Bursa Group Chairmanship Morgue Department were determined.

MATERIALS AND METHODS

In this study, the records of 6769 autopsies performed between 1996 and 2006 at the Council of Forensic Medicine Bursa Group Chairmanship Morgue Department were evaluated retrospectively. The 63 cases (0.9%) who were determined to have died due to vascular injury were included in this study. Cases with a potentially lethal injury at some other location were not included.

The major cause of death in all cases was the vascular injury; all other death causes were excluded after performing autopsy, toxicologic analysis and pathologic investigation. Only those cases with isolated vascular injuries were included in this study.

Age, gender, type of the incident, injury locations and the injured vessels, cause of death, blood alcohol levels, extremity fracture, and duration of hospital treatment were considered.

Statistical analysis was performed using SPSS 11.0 version for Windows (SPSS Inc., Chicago, IL, USA). Continuous variables are presented as mean ± standard deviation. Categorical variables are presented as frequencies (n, %). One sample chi-square test was used. A p value of less than 0.05 was regarded as a statistically significant difference.

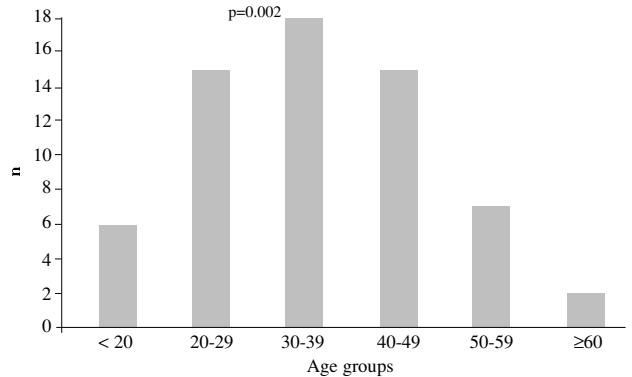


Fig. 1. The age distributions of the cases.

RESULTS

Of the 6769 forensic autopsies, the primary cause of death was determined to be peripheral vascular injury in 63 cases (0.9%). Fifty-seven cases (90.5%) were men and six (9.5%) were women (p<0.001). Mean age was 35.6±12.3 (range: 16-66 years). The age group with the highest number of cases was 30-39 (n=18, 28.6%) (p=0.002) (Fig. 1). Stab wound was the most frequent type of injury (n=37, 58.7%), followed by shotgun wounds (n=14, 22%) (p<0.001). The most frequent origin was a homicide (n=54, 85.7%) (p<0.001). Of the homicides, 68.5% (n=37) were due to stab wounds and 20.4% (n=11) were due to shotgun wounds. Three of the suicides were due to stab wounds (Table 1). Of the homicides, 27.8% (n=15) were in the 30-39 age group (p=0.006).

No significant difference was detected among month and/or year distribution of the cases (p>0.05).

Of the lethal vascular injuries, 54 (85.7%) were in the lower extremity (Fig. 2) and 9 (14.3%) were in

Table 1. The origins and types of the injuries

Type of injury	Origin of the injury							
	Murder		Suicide		Accident		Total	
	n	%	n	%	n	%	n	%
Stab wound	37	100	0	–	0	–	37	58.7
Shotgun injury	11	78.6	3	21.4	0	–	14	22.2
Gunshot injury	6	100	0	–	0	–	6	9.5
Cut	0	–	3	100	0	–	3	4.8
Traffic accident	0	–	0	–	1	100	1	1.6
Work machine-related accident	0	–	0	–	1	100	1	1.6
Explosion	0	–	0	–	1	100	1	1.6
Total*	54	85.7	6	9.5	3	4.8	63	100

* Percentages of the row were calculated.



Fig. 2. Lethal vascular injury in the lower extremity (A. femoralis, V. femoralis stab injury).

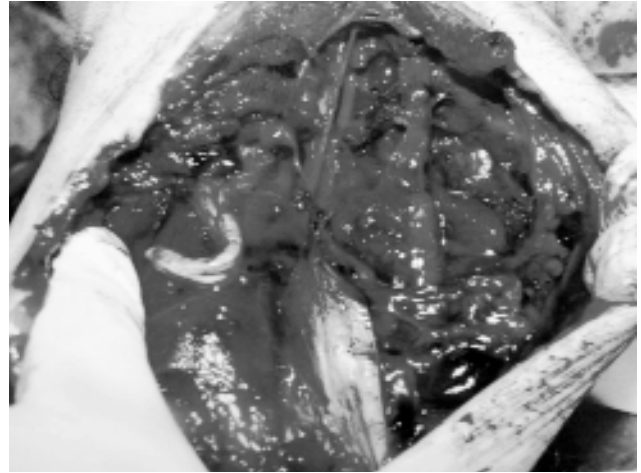


Fig. 3. Lethal vascular injury in the upper extremity (A. brachialis, V. brachialis shotgun injury).

the upper extremity (Fig. 3); 40 (63.5%) were in the left lower extremity, 13 (20.6%) in the right lower extremity and 1 (1.6%) in both lower extremities. The majority of the stab wounds [33 (89.2%)] were in the lower extremity (Table 2).

The femoral artery was the most frequently injured vessel (n=47, 74.6%); in 35 of these cases, the accompanying vein was injured concomitantly. Another frequently injured vessel was the brachial artery (n=4, 6.3%) (Table 3).

The number of wounds on a cadaver varied between 1 and 8; 32 cases (50.8%) had one wound, 12 (19.1%) had two wounds, 8 (12.7%) had three wounds, 4 (6.3%) had five wounds, 2 (3.2%) had four wounds, 2 (3.2%) had six wounds, and 1 (1.6%) had eight wounds. Two cases had been hospitalized, and the initial examination findings had not been recorded properly; subsequent healing and therapeutic interventions compromised determination of the number of wounds.

According to the autopsy reports, the cause of death was hypovolemia in 61 cases (96.8%) and various complications in 2 (3.2%). Twenty-three cases (36.5%) had been hospitalized: 17 (73.9%) died on the day of admission, 2 (8.2%) on the 1st day, 2 (8.7%) on the 2nd, 1 (4.3 %) on the 16th and 1 (4.3%) on the 20th. Six cases (9.5%) were already dead on admission. In 12 cases (19%), an extremity fracture along with a vasculature injury was detected. Sixteen of the hospitalized patients (25.4%) had undergone surgery. Amputation was applied to three of the cases.

Ethanol at levels between 44 mg/dL and 256

mg/dL (mean: 153±63 mg/mL, median: 148 mg/dL) were detected in the blood of 18 male cases (28.6%) and 1 female case (1.6%). Eighteen of these (92%) were homicides and one (5.3%) was suicide. The distribution of the ethanol levels is presented in Figure 4.

Table 2. The injured extremities in all injuries and stab wounds

Extremity	All cases n (%)	Stab wounds n (%)
Right lower	13 (20.6)	10 (27)
Left lower	40 (63.5)	23 (62.2)
Right upper	4 (6.3)	2 (5.4)
Left upper	4 (6.3)	2 (5.4)
Left and right lower	1 (1.6)	– (0)
Left and right upper	1 (1.6)	– (0)
Total	63 (100)	37 (100)

Table 3. The injured vessels

	Injured vessel	n	%*
Lower extremity	A. femoralis	47	74.6
	V. femoralis	35	55.6
	A. poplitea	2	3.2
	V. poplitea	1	1.6
	A. tibialis	1	1.6
Upper extremity	A. brachialis	4	6.3
	V. brachialis	4	6.3
	A. ulnaris	3	4.8
	V. ulnaris	1	1.6
	A. axillaris	2	3.2
	V. axillaris	2	3.2

* The percentages were calculated on the total of 150 patients.

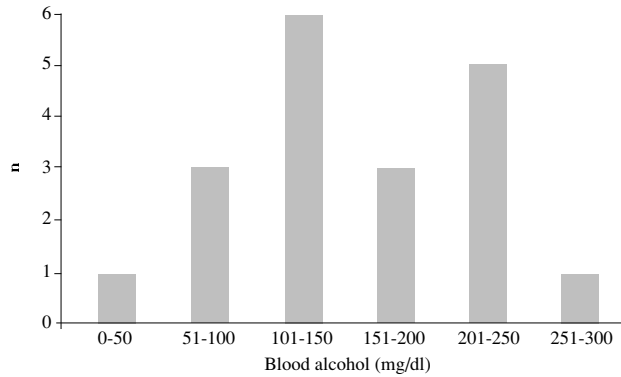


Fig. 4. The distribution of the blood alcohol content.

According to the District Attorney (DA) archives, the crime scene was documented as outdoors in 26 cases (41.3%), an office in 3 (4.8%) and a hotel in 2 (3.2%). In 23 cases (36.5%), the crime scene was not mentioned in the DA's reports.

DISCUSSION

Developments in vascular surgery and improved general awareness in first aid have contributed to the increasing treatment success and decreased mortality in extremity vascular injuries.^[1-6] In the present study on autopsies performed between 1996 and 2006 in Bursa the frequency of deaths due to extremity vascular injury was 0.9%. Although this figure may seem low, in such injuries, first aid in the form of direct compression or proximal occlusion followed by expert surgical intervention at the hospital provide the highest chance of success.

There is a marked male dominance in peripheral vascular injuries in both hospitalizations as well as autopsy cases.^[1,4-9] In the present study, 90.5% of cases (n=57) were men. This may be due to the fact that men are more active socially and they are more frequent participants in events that set the stage for injury.

In the literature, extremity vascular injury patients are generally young adults.^[5,9-11] In the present study, mean age was 36 and the majority of the cases (n=18, 29.6%) were in the 30-39 age group.

Studies on hospitalized patients as well as autopsy series in our country showed that the most frequent mechanism of injury was a stab wound followed by gunshot wounds.^[1,3,7,10,12] In Georgia,^[13] 87% of the cases were due to penetrating trauma and 13% were due to blunt trauma. In Pakistan,^[9] 54% were due to gunshot wounds, 18% due to blunt trauma and 12% due to stab wounds. In England,^[14] 46% of the

lower extremity vascular injury cases were due to gunshots, 19% due to blunt trauma and 12% due to stab wounds. In the present study, stab wounds were most frequent (n=37, 58.7%). This may be due to the fact that sharp objects can be carried easily and these are implicated in other deaths as well.^[15] Violence with sharp objects is the most common cause of homicidal deaths in Sweden,^[14,15] and in many other countries in Europe,^[16-18] Africa^[19] and Asia.^[20]

As in similar studies,^[1,5] the left lower extremity was the most frequently injured extremity in the present series (n=40, 63.5%). It has been argued that the higher frequency of the left lower extremity may be explained by stab assaults usually being perpetrated by a right-handed individual.^[1] Accordingly, in the present study, the left lower extremity was more frequently affected in stab wounds (n=23).

In this study, the femoral artery and its branches (n=45, 71.4%) were the most frequently injured vessels. Similar results were obtained in other studies.^[1,3-6,9-11,13,14]

In this series, 36.5% of the patients died during hospital treatment and an operation could be performed in 25.4%. In hospitalized patients, autopsy is important for the assessment of the wound, characteristics of the medical treatment and the complications. Two cases had been hospitalized, and the initial examination findings had not been recorded properly; subsequent healing and therapeutic interventions compromised the determination of the number of wounds.

Extremity fracture along with a vasculature injury was detected in 40% of the cases in one study,^[21] and high mortality rate has been reported with a 10-40% amputation risk in these cases.^[22] In our study, extremity fracture along with a vasculature injury was detected in 12 cases, and amputation was applied to three of the cases.

In accordance with previous studies,^[1] 30.2% of the cases had detectable levels of alcohol in the blood. We think alcohol contributes to the mortality of extremity vascular injury. Alcohol consumption may compromise the capacity for self protection as well as escape from the scene of injury.^[15] Furthermore, the vasodilator effect of alcohol may cause increased bleeding and accelerate death.

In conclusion, the availability of experienced surgical teams and effective prehospital emergency care are vital for decreasing the mortality due to isolated

vascular injuries. Since most wounds are due to stabbing, the reason the involved sharp object was in the possession of the potential assailant should be questioned in detail. Demonstration of the injured vessel, determination of whether it is lethal by itself and determination of the number, locations and side of the injuries are important for the assessment of the intention to kill or to injure. Autopsy is vital in the evaluation of lethal peripheral vascular injuries.

REFERENCES

1. Cetin G, Yavuz MF, Azmak D, Birincioglu I. Deaths related to vessel injuries in extremities. I. Forensic Sciences Congres 12-15 April 1994; Adana: Poster Presentation Book; p. 259-61.
2. Durak D. Femoral artery injury in autopsy cases. PAUTF Journal 1999;5:65-7.
3. Erturk S, Ege B, Karali H. Retrospective evaluation of 94 vascular injury autopsy cases. Journal of Forensic Medicine 1990;6:181-6.
4. Sayin A, Ozer M, Karaozbek Y, Erdag A, Aktan K, Tuzun H. Vascular injuries: evaluation of 208 case. Journal of Forensic Medicine 1987;3:34-44.
5. Goren S, Tirasci Y. Retrospective evaluation of extremity vascular injuries. The Bulletin of Legal Medicine 2000;5:112-3.
6. Cargile JS 3rd, Hunt JL, Purdue GF. Acute trauma of the femoral artery and vein. J Trauma 1992;32:364-71.
7. Dokgoz H, Yanik A, Yilmaz R, Ozturk O. Forensic evaluation of traumatic vascular injuries. 10. National Forensic Medicine Days-2003; 8-12 November 2003 Antalya: Poster Book; p. 230-3.
8. Kanko M, Oztop C. Traumatic vascular injuries. Ulusal Travma Derg 1999;5:106-10.
9. Guraya SY. Extremity vascular trauma in Pakistan. Saudi Med J 2004;25:498-501.
10. Ozokeli M, Gunay R, Kayacioglu I, Sarikaya S, Yazar M, Akcar M. Peripheral Vascular Injuries. Turkish Journal of Thoracic and Cardiovascular Surgery 1998;249-53.
11. Cihan HB, Gülcan O, Hazar A, Türköz R. Peripheral vascular injuries. [Article in Turkish] Ulus Travma Derg 2001;7:113-6.
12. Durak D, Durak K, Çoltu A. Damar yaralanmasına bağlı ölüm olgularının değerlendirilmesi. Göztepe Tıp Derg 1995;12:178-9.
13. Razmadze A. Vascular injuries of the limbs: a fifteen-year Georgian experience. Eur J Vasc Endovasc Surg 1999;18:235-9.
14. Hafez HM, Woolgar J, Robbs JV. Lower extremity arterial injury: results of 550 cases and review of risk factors associated with limb loss. J Vasc Surg 2001;33:1212-9.
15. Karlsson T. Sharp force homicides in the Stockholm area, 1983-1992. Forensic Sci Int 1998;94:129-39.
16. Ormstad K, Karlsson T, Enkler L, Law B, Rajs J. Patterns in sharp force fatalities-a comprehensive forensic medical study. J Forensic Sci 1986;31:529-42.
17. Hunt AC, Cowling RJ. Murder by stabbing. Forensic Sci Int 1991;52:107-12.
18. Rouse DA. Patterns of stab wounds: a six year study. Med Sci Law 1994;34:67-71.
19. Ogungbemi K, Ahmed MH. Psychosocial aspects of murder in Nigeria. Forensic Sci Int 1993;59:157-62.
20. Nagamori H, Mukai T, Uchima E, Tamaki N, Ohshiro T, Une Y. Statistical observations on the cases of unnatural deaths examined at our department during the past 10 years. Nihon Hoigaku Zasshi 1993;47:72-9.
21. Andrikopoulos V, Antoniou I, Panoussis P. Arterial injuries associated with lower-extremity fractures. Cardiovasc Surg 1995;3:15-8.
22. al-Salman MM, al-Khawashki H, Sindigki A, Rabee H, al-Saif A, al-Salman Fachartz F. Vascular injuries associated with limb fractures. Injury 1997;28:103-7.