Analysis of Vascular Trauma in Terror-Related Civilian Attacks Within South-Eastern Turkey

Güneydoğu Türkiye'de Terör Saldırılarında Sivillerdeki Vasküler Yaralanmaların Analizi

Iyad FANSA,[a]
Mehmet ATAY,[b]
Levent ALTINAY,[a]
Onur SAYDAM,[b]
Celalettin KARATEPE,[a]
Mehmet ACIPAYAM,[a]
Cem LALE[a]

[a]Department of Cardiovascular Surgery, Mustafa Kemal University Faculty of Medicine, Hatay
[b]Department Cardiovascular Surgery, Karaman State Hospital, Karaman

Geliş Tarihi/*Received:* 30.05.2017
Kabul Tarihi/*Accepted:* 10.10.2017

Yazışma Adresi/*Correspondence:*
Iyad FANSA
Mustafa Kemal University
Faculty of Medicine,
Department of Cardiovascular Surgery,
Hatay,
TURKEY/TÜRKİYE
iyadfansa@yahoo.com

ABSTRACT Objective: To evaluate the results of terror related vascular injuries and predictors of mortality caused by these injuries in South-Eastern Turkey. **Material and Methods:** Eighty-eight patients (82 men, 24.4 ± 8.1 years) who had vasculary trauma in terrorist attacks between January 2012-August 2015 in South-Eastern Turkey included in this retrospective study. Patients with traumatic amputations, extensive tissue losses, amputations after severe nerve damage and head injuries were excluded. Study patients were analyzed according to the mechanism and severity of injury, location of trauma, and surgical treatment options. **Results:** Forty-six (52.3%) patients had lower limb, 19 (21.6%) patients had upper limb, 13 (14.8%) patients had both upper and lower limb vascular injuries. Other vascular injuries involved neck (n=3; 3.4%), thorax (n=2; 2.3%), abdomino-pelvic (n=5; 5.7%) locations. Twenty-three (26.1%) of them were caused by bullets, 54 (61.4%) by shrapnel and 11 (12.5%) by bombs and explosions. Thirty-eight (43.2%) of these patients were in hypovolemic shock at admittance. Forty patients (45.5%) had isolated arterial, 42 (47.7%) patients had both artery and vein, 6 (6.8%) patients had isolated vein injuries. Autogenous grafts were used in 28 (31.8%) patients, and synthetic grafts were used in 10 (11.4%) patients. Vascular ligations were performed in 18 (20.5%) patients. Seven (8%) patients had acute renal injury and 28 (31.8%) patients had wound infections postoperatively. Overall in-hospital mortality rate was 18.2% (16 patients). Hypovolemic shock ($p<0.0001$), acute renal failure ($p=0.002$) and massive blood transfusion ($p=0.007$) were the main predictors of mortality. **Conclusion:** Vascular injuries in terror-related trauma victims require multidisiplinary urgent treatment of hypovolemic shock, preventive measures to avoid acute renal failure and immediate complex vascular surgery.

Keywords: Gunshot wounds; vascular system injuries; vascular grafting; limb salvage.

ÖZET Amaç: Türkiye'nin Güneydoğusu'nda meydana gelen teröre bağlı vasküler yaralanmalar ve mortalite göstergelerini incelemek. **Gereç ve Yöntemler:** Ocak 2012-Ağustos 2015 arasında teröre bağlı vasküler yaralanması olan 88 hasta (82 erkek, yaş 24.4±8.1) bu retrospektif çalışmaya alındı. Travmatik amputasyon, yaygın doku kaybı, ciddi sinir hasarına bağlı amputasyon ve baş yaralanması olan hastalar çalışmaya alınmadı. Hastalar yaralanmanın ciddiyeti ve mekanizması, travma lokalizasyonu ve cerrahi tedavi şekillerine göre değerlendirildi. **Bulgular:** Kırkaltı (%52.3) hastada alt ekstremite, 19 (%21.6) hastada üst ekstremite, 13 (%14.8) hastada alt ve üst ekstremitede vasküler yaralanma vardı. Ayrıca boyun (n=3; %3.4), toraks (n=2; %2.3), abdomino-pelvik (n=5; %5.7) yaralanmalar da vardı. Yaralanmaların 23'ü (%26.1) mermi, 54'ü (%61.4) şarapnel, 11'i (%12.5) patlama sebebiyle meydana gelmişti. Hataların 38'i (%43.2) hastaneye geldiklerinde hipovolemik şoktaydı. Kırk (%45.5) hastada izole arter, 42 (%47.7) hastada arter ve ven, 6 (%6.8) hastada sadece ven yaralanması vardı. Yirmisekiz (%31.8) hastada otojen greft, 10 (%11.4) hastada sentetik greft kullanıldı. Onsekiz (%20.5) hastada vasküler ligasyon yapıldı. Yedi (%8) hastada postoepratif akut böbrek hasarı gelişti. Yirmisekiz (%31.8) hastada yara enfeksiyonu gelişti. Çalışmamızda erken dönem mortalite oranı %18.2 (16 hasta)'dir. Hipovolemik şok ($p<0.0001$), akut böbrek yetmezliği ($p=0.002$) ve masif kan transfüzyonu ($p=0.007$) mortalite prediktörleridir. **Sonuç:** Teröre bağlı bağlı vasküler yaralanmalarda multi-disipliner yaklaşımla hipovolemik şok tedavi edilmeli, akut renal yetmezlik engellenmeli ve acil kompleks vasküler cerrahi girişimler planlanmalıdır.

Anahtar Kelimeler: Ateşli silah yaralanmaları; vasküler sistem yaralanması; vasküler greft; ekstremite kurtarma

doi: 10.9739/uvcd.2017-56705

Damar Cer Derg 2016;25(3):101-9

Nowadays the attack of terrorism to civilian targets is a global problem. It is defined as an instrumental use of violence to achieve political, economic and social goals.[1] Explosive weapons, firearms and bombs are the most commonly used tools in these attacks. Explosive weapons are designed to create multiple penetrating wounds in the body.[2] None of the trauma in civilian life is similar to the multi-trauma caused by multiple shrapnels, traumatic amputation of anti-personnel mines and high kinetic energy military rifle bullets' injuries. Furthermore, these attacks cause significant emotional and psychological trauma.[3] Explosive weapons and firearms may cause penetrating vascular injuries accompanied by a major organ, massive bone and soft tissue injuries.[4] As a result, if an emergent surgery is not performed, those injuries may be responsible for high morbidity and mortality.

In this study, we aimed to investigate the vascular injuries in the victims of terrorism attacks, mechanism of the injury and the predictors of mortality. This study was carried out in our center approximately 100 kilometers far away from the war region in the neighboring countries in South-Eastern Turkey.

MATERIAL AND METHODS

Between January 2012 and August 2015, 3714 victims of terrorism attacks were admitted to our center. First aid to injured victims was carried out in the field by health professionals and/or civilians. Eighty-eight patients (2.4%) were operated for vascular injuries and followed up in our department. Initially, the patients were admitted to the emergency department and then were consulted by our trauma team and vascular surgeons. All operations were performed under general anesthesia. Sine qua non of our therapeutic approach was multidisiplinary treatment involving emergency physicians, general surgery, cardiovascular surgery, orthopedics, neurosurgery, neurology, anesthesia and infectious diseases specialists. All patients received intravenous antibiotic therapy (cefazolin, ornidazole, gentamicin) and tetanus prophylaxis prior to surgery. Open contaminated wounds were irrigated and cleaned with saline. The operations were carried out in compliance with normovolemic volume status, and the principles of antisepsis. In patients with a long duration of ischemia, vascular repair was carried out at first and followed by orthopedic fixation, nerve repair, debridement of necrotic and infected tissues. Fasciotomy was performed if necessary to prevent development of compartment syndrome. Negative pressure wound therapy was applied to the patients with extensive surgical wounds. Patients were assessed with handheld Doppler ultrasound (HUNTLEIGH Dopplex® D900) and followed up by examinations in every 3 hours in the postoperative period. Vascular assessments were carried out daily until the patients were discharged home or transfered to another center.

After institutional review board approval, data were retrospectively analyzed. In-hospital stay, amount of blood transfusions, treatment modalities, amputation and mortality rates were evaluated in the study. Patients with traumatic amputations, extensive soft tissue losses, amputations after nerve damage and head injuries were not included in this study.

STATISTICAL ANALYSIS

Statistical analyzes were performed with SPSS for Windows version 16 (Pearson, San Antonio, TX, USA). Chi-square test was used for comparison of categorical variables and t- test was used to calculate the relationship between independent groups for continuous variables. P value <0.05 was accepted as statistically significant.

RESULTS

Patients' demographics, clinical characteristics are shown in (Table 1). Distribution of vascular injuries after terrorism attacks is presented in (Table 2). Thirty-eight (43.2%) patients were in hypovolemic shock on admission. Forty six (52.3%) patients had lower limb, 19 (21.6%) patients had upper limb, 13 (14.8%) patients had both upper and lower limb, 3 (3.4%) patients had neck, 2 (2.3%) patients had thoracal, 5 (5.7%) patients had abdomino-pelvic

TABLE 1: Demographic data of the patients.

Gender N (%)	Male	82 (93.2)
	Female	6 (6.8)
Age (mean ± SD)	Male	24.43±8.09
	Female	35.66±22.03
Injury site N (%)	Trunk	10 (11.4%)
	Extremity	78 (88.6 %)
Type of injury N (%)	Penetrating (bullet. shrapnel)	77 (87.5)
	Other (blast effect) bombs and explosions	11 (12.5)
Co-existing pathology with vasculary trauma N (%)	Bone fracture	56 (63.6)
	Nerve damage	62 (70.5)
	Tissue loss	61 (69.3)
	Exterior intervention	36 (40.9)
	Shock	38 (43.2)
Blood type N (%)	0 Rh+	24 (27.3)
	Rh-	1 (1.1)
	A Rh+	32 (36.4)
	Rh-	2 (2.3)
	B Rh+	20 (22.7)
	Rh-	-
	AB Rh+	3 (3.4)
	Rh-	1 (1.1)
Transfusion (units) (mean ± SD)	Blood	6.97±7.22
	Fresh frozen plasma	2.84±5.45
Complications N (%)	Infection	28 (31.8)
	Fasciotomy	8 (9.1)
	Acute renal failure	7 (8.0)
	Amputation	15 (17.0)
Mortality N (%)		16 (18.2)
In-hospital stay (days)(mean ± SD)	Intensive care unit	5.68±8.42
	General care	11.36±20.65

vascular injuries. Forty (45.5%) patients had isolated arterial, 42 (47.7%) patients had both arterial and venous, 6 (6.8%) patients had isolated venous injuries. Distribution of arterial and venous injuries and surgical procedures are shown in (Table 3). Autogenous grafts were used in 28 (31.8%) patients, and synthetic grafts were used in 10 (11.4%) patients. Eighteen (64.3%) of these autogenous grafts were used for arterial injuries, one (3.5%) was used for a venous injury and 9 (32.1%) were used for both arteriel and venous injuries. Seven (70%) of the synthetic grafts were used for arteriel injuries and 3 (30%) of them were used for both arteriel and venous injuries. Fifty-five (62.5%) patients were suitable for primary vascular repair. Primary vascular repair was performed using 6.0 polipropolene sutures. In 18 (20.5%) patients, vascular injuries were not suitable for repair or vascular grafts. In these patients 4 (22.2%) artery, 1 (5.5%) vein and 13 (72.2%) both artery and vein ligations were performed. Mean hospitalization time was 17.1 ± 21.4 days, mean blood transfusion amount was 6.9 ± 7.2 units and mean fresh frozen plasma transfusion amount was 2.8 ± 5.5 units. Eighteen (20.5%) patients required massive blood transfusions (>10 Units). Seven patients (7.9%) developed acute renal injury (ARI) and 5 (71.4%) deaths occured in this group. Twenty-eight (31.8%) patients had wound

TABLE 2: Location of vascular injury and concomitant pathologies.

		Lower extremity	Upper extremity	Both Extremities	Neck	Chest	Abdomen and pelvis	Total
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Type of injury	Bullet	16 (18.2)	5 (5.7)	-	-	1 (1.1)	1 (1.1)	23 (26.1)
	Shrapnel	24 (27.3)	10 (11.4)	12 (13.6)	3 (3.4)	1 (1.1)	4 (4.5)	54 (61.4)
	Other	6 (6.8)	4 (4.5)	1 (1.1)	-		-	11 (12.5)
Concomitant bone fracture		24 (27.3)	15 (17.0)	13 (14.8)	2 (2.3)	1 (1.1)	1 (1.1)	56 (63.6)
Nerve injury		31 (35.2)	15 (17.0)	13 (14.8)	2 (2.3)	1 (1.1)	-	62 (70.5)
Tissue loss		30 (34.1)	15 (17.0)	13 (14.8)	2 (2.3)	1 (1.1)	-	61 (69.3)
External interventions		21 (23.9)	5 (5.7)	4 (4.5)	2 (2.3)	-	4 (4.5)	36 (40.9)
Shock		23 (26.1)	3 (3.4)	6 (6.8)	-	1 (1.1)	5 (5.7)	38 (43.2)
Arterial injury		16 (18.2)	14 (15.9)	5 (5.7)	2 (2.3)	1 (1.1)	2 (2.3)	40 (45.5)
Venous injury		1 (1.1)	1 (1.1)	-	1 (1.1)	1 (1.1)	1 (1.1)	5 (5.7)
Arterial and venous injury		29 (32.9)	3 (3.4)	8 (9.1)	-	-	2 (2.3)	42 (47.7)
Neck		3 (3.4)	-	-	3 (3.4)	1 (1.1)	-	7 (8)
Chest		1 (1.1)	3 (3.4)	-	1 (1.1)	2 (2.3)	2 (2.3)	9 (10.2)
Abdomen and pelvis		4 (4.5)	4 (4.5)	-	1 (1.1)	-	5 (5.7)	14 (15.9)

TABLE 3: Location of vascular injuries and surgical approaches.

		Autogenous graft (%)	Synthetic graft (%)	Primary repair (%)	Ligation (%)	Total
Left jugular Vein (%)				1 (0.69)		1 (0.69)
ECA (%)					1 (0.69)	1 (0.69)
ICA (%)				2 (1.38)		2 (1.38)
Subclavian V (%)				1 (0.69)		1 (0.69)
Axillary vein (%)				1 (0.69)		1 (0.69)
Brachial (%)	A	5 (3.47)	2 (1.38)	2 (1.38)	-	9 (6.25)
	V			1 (0.69)		1 (0.69)
Radial A (%)		1 (0.69)		2 (1.38)	1 (0.69)	4 (2.77)
Ulnar (%)	A			5 (3.47)	2 (1.38)	7 (4.86)
	V				1 (0.69)	1 (0.69)
Others (upper extremity) (%)	A			1 (0.69)	1 (0.69)	2 (1.38)
	V				1 (0.69)	1 (0.69)
Thoracic A (%)				2 (1.38)		2 (1.38)
Abdominal A (%)				2 (1.38)		2 (1.38)
VCI (%)				3 (2.08)		3 (2.08)
SMA (%)				1 (0.69)		1 (0.69)
IMA (%)		1 (0.69)				1 (0.69)
Iliac (%)	A				1 (0.69)	1 (0.69)
	V			1 (0.69)	1 (0.69)	2 (1.38)
Femoral (%)	A	15 (10.41)	5 (3.47)	11 (7.63)	5 (3.47)	36 (25.0)
	V	8 (5.55)	3 (2.08)	6 (4.16)	5 (3.47)	22 (15.27)
Popliteal (%)	A	5 (3.47)	3 (2.08)	7 (4.86)	3 (2.08)	18 (12.5)
	V	2 (1.38)	-	8 (5.55)	3 (2.08)	13 (9.02)
Others (lower extremity) (%)	A			4 (2.77)	3 (2.08)	7 (4.86)
	V			2 (1.38)	3 (2.08)	5 (3.47)
Total		37 (25.69)	13 (9.02)	63 (43.75)	31 (21.52)	144

Surgical treatment type **A:** arterial, **V:** venous, B total

ECA: External carotid artery; **ICA:** Internal carotid artery; **SMA:** Superior mesenteric artery; **IMA:** Inferior mesenteric artery.

infections. Cultures were obtained and appropriate antibiotic therapy was administered. Sixty-one (69.3%) patients had tissue loss, 62 (70.5%) patients had nerve damage and 56 (63.6%) patients had bone fractures. Eight (9.1%) patients underwent fasciotomy procedure. Primary amputations was performed in 6 (6.8%) patients and secondary amputations were performed in 9 (10.2%) patients. Bone fracture, tissue loss and nerve damage was present in all of them and 4 (26.7%) patients died in the postoperative period as a result of acute renal failure in this group.

A total of 16 (18.2%) patients died in hospital. One of these patients was female and others were males. All of them were emergency operations and the patients were in hypovolemic shock condition when they were admitted into the emergency room. Nine (56.2%) of these patients had previous interventions before being transfered to our center. Ten (62.5%) of them had cardiac arrest and transfered to the operation room under cardiopulmonary resuscitation (CPR). Eleven (68.7%) of them had impaired renal and liver functions.

In our study we found that gender and age, wound site and type, bone fracture, nerve damage, tissue loss accompanying the vascular injury and the type of treatment (graft interpositioning, ligation, etc.), postoperative infections and amputations, intensive care unit times did not effect the mortality rates. The hypovolemic shock state of the patients ($p<0.001$) and acute renal failure ($p=0.002$), massive blood transfusion ($p=0.007$), fresh frozen plasma transfusion amount ($p=0.029$), abdominal and pelvic injuries ($p=0.009$) and general care hospitalization time ($p<0.001$) were the main predictors of mortality (Table 4).

DISCUSSION

Terrorism attacks destroy the cultural and economic wealth of the countries, also leading to significant morbidity and mortality among victims. In about 4000 years of written history of humanity, it is difficult to find a time of peace longer than 100 years. Terrorism attacks to civilian targets aim social trauma. The general condition of the patients who had vascular injuries in terrorism attacks is usually unstable and highly critical.

Extremity wounds constitute 75% of all of the war wounds.[5] In our study, the incidance of extremity vascular injuries were 88.6%. The rate of injuries in the neck, thorax and abdomino-pelvic regions was 11.4%. It is known that abdomino-pelvic vascular injury is rarely seen in military conflicts. The rate of this was around 2% in Second World War and Corean War.[6-8] It was 2.9% in Vietnam War.[6] The abdomino-pelvic vascular injury rate in all of the vascular injuries of the civilians is around 30%.[9] Military personel usually wears a body armor thus it reduces the abdomino-pelvic injury risk. The rate of abdomino-pelvic injury in our study was 5.7% which is higher than the literature rates. We think that this was because of the extension of terrorism attacks into civilian habitats.

Non-compressible hemorrhagia is considered to be the most common cause of mortality in war surgery.[10] Patients with severe traumatic injuries often present with coagulopathy and require massive blood transfusion. The rate of mortality because of hemorrhagic shock increases in this population. Massive blood transfusion is defined as the transfusion of 10 or more red blood cell (RBC) units in the first 24-hours after trauma.[11,12] Massive blood transfusion incidence may vary from 1% to 3% in civilian trauma centers and it may rise up to 15% in terrorism attack victims.[13] The mortality rate after massive blood transfusion is reported between 20-50%.[11,14] In our study 18 (20.5%) patients had massive blood transfusions and 7 (8%) died despite every effort ($p=0.007$).

Interventions in trauma patients must be primarily directed to save the patient's life. After hemodynamic stability is achieved, the goal of the treatment should be the limb salvage.[15] First, the bleeding must be stopped and fluid replacement should be carried out to preserve the hemodynamic stability. Bleeding control can be done by pressing finger or hand on the bleeding area or it may also be achieved by applying a tourniquet.[16]

TABLE 4: Predictors of mortality.

		Survived		Exitus		p
Age (years)(mean ± SD)		24.31±8.00		29.18±15.47		0.238
Intensive care unit time (days)(mean ± SD)		4.80±6.23		9.62±14.39		0.208
General care time(days)(mean ± SD)		13.86±22.08		0.12±0.50		**<0.001**
Blood transfusion (units) (mean ± SD)		6.22±7.16		10.37±6.72		**0.037**
Fresh frozen plasma transfusion (units)(mean ± SD)		1.81±3.57		7.43±9.20		**0.029**
		Survived		**Exitus**		
		n	%	n	%	
Type of injury	Bullet	22	25.0	1	1.1	
	Shrapnel	41	46.6	13	14.8	0.149
	Others	9	9.2	2	2.3	
Additional pathologies	Bone fracture	45	51.1	11	12.5	0.434
	Nerve injury	52	59.1	10	11.4	0.313
	Tissue loss	49	55.7	12	13.6	0.767
	Neck injury	6	6.8	1	1.1	1.0
	Chest injury	6	6.8	3	3.4	0.355
	Abdomen and pelvis injury	8	9.1	6	6.8	**0.009**
	Exterior interventions	27	30.7	9	10.2	0.168
	Shock	22	25.0	16	18.2	**<0.001**
Massive Blood Transfusion (>10 U)		11	12.5	7	8	**0.007**
Results	Infection	24	27.3	4	4.5	0.767
	Fasciotomy	7	8.0	1	1.1	1.0
	AcuteRenalInjury	2	2.3	5	5.7	**0.002**
	Amputation					
	Primer	4	4.5	2	2.3	0.479
	Secondary	7	8.0	2	2.3	0.521

When chosing the vascular repair technique the surgeon should consider the physiological reserve of the patient as well as the physical conditions he/she is in, such as the operating room conditions, the personnel, the materials needed in the surgery, etc. Prolonged surgeries, massive blood transfusions, hypothermia and acidosis may cause coagulopathies and eventually lead to deaths in severely wounded patients. In this situation palliative measures may be undertaken and the patient may be protected from the hazard of the prolonged and complex surgery. When the general condition of the patients recovered, the main surgical intervention can be planned. In a life-threatening situation an extremity or organ may be sacrificed.[17]

The distal pulse assessment alone is not a proper method in extremity injuries. Even though the patient had major arterial injury, distal pulse could still be palpable.[18,19] We had received nearly half of the patients (38 patients, 43.2%) in hemodynamic shock state. It was difficult to evaluate the distal pulses in these patients. Also because of the critical conditions, most of these patients were directly taken to the operation room after brief physical examination.

In our experience, use of color Doppler ultrasound (CDU) is extremely useful for the diagnosis of vascular injuries after complete physical examination.[20] Palpation of the distal pulses should not exclude the presence of any vascular injury following terrorism attacks. Immediate complete evaluation and rapid surgical desicion might save lives. Close follow up and re-evaluations are also mandatory. In lateral vascular wall injuries or in the presence of collateral circulation, distal vascular pulses may be palpable. Existence of trill or

murmur in the wound site may point to a pseudoaneurysm or arteriovenous fistula. When the general condition of the patient is stabilised other diagnostic methods such as angiography can be performed.[21]

A total of 144 vascular operations were performed. Among these operations, 126 (87.5%) of them were performed for extremity vascular wounds, 18 (12.5%) of them were performed for cervical, thoracal, abdominal and pelvic vascular injuries. Femoral region was the most frequently wounded site in our study as a total of 58 (40.27%) operations were done involving femoral arteries and veins. Thirty-six (25%) operations were done for femoral artery injuries and 22 (15.2%) operations were done for femoral vein injuries.

In some patients, both lower extremities were operated due to vascular injuries. Initially end to end anastomosis and primary vascular repair was preferred in 55 (62.5%) patients. If the primary repair was not achievable, vascular repair was performed with autogenous saphenous vein grafts (28 patients, 31.8%). Synthetic grafts were preferred as the last choice (10 patients, 11.6%). Autogenous grafts are more resistant to infection and have higher patency rates than any other grafts. Although saphenous vein was preferred mostly, also cephalic vein could be used successfully as an autogenous graft.[22] In our study, our results were similar to the literature.

The venous repair was contraversial for a long time in the complex vasculary injuries involving both arteries and veins. When compared to the arterial repair, the results of venous repair may not be as pleasant. If venous circulation could not be established properly, this would lead to venous hypertension, oedema, arterial circulation disorders and extremity loss in the end. Quan et al emphasized the importance of venous repair to preserve circulation.[23] We think more studies should be done on this issue and this will contribute to the reduction of morbidity rates. In our study, we performed venous repair in 24 (27.3%) patients. Primary repair was performed in 11 (45.8%) patients. Autogenous saphenous vein grafts were used in 10 (41.6%) patients. Synthetic grafts were used in 3 (12.5%) patients. Fourteen (15.9%) patients underwent vein ligation.

There are publications suggesting fasciotomy after vascular repair when vascular tissue pressure exceeds 30 mmHg. In a study consisted of 368 patients, fasciotomy applied in 6.79% of patients.[24] In our study fasciotomy was applied to 9.1% of the patients.

New advancements and methods are developed in the vasculary surgery field after the II. World War, Corean War and Vietnam War. DeBakey and Simeone reported the rate of extremity amputation after arterial ligation as 40.4% in the II.World War. They defended arterial reconstruction since then. Rich et al reported the rate of extremity amputations in the Vietnam War as 12.7% in their research consisted of 1000 vascular injury patients. A decrease in the amputation rate was seen as a result of surgical experience and rapid response.[25] In our study, a total of 15 (17%) amputations (6 primary, 9 secondary) were performed in accordance with the current literature. Considering the patients lost after the operation, nerve injury observed in 62.5% of patients, 75.0% of patients had tissue loss secondary to trauma and in 68.8% of patients concurrently underwent orthopedic surgery due to bone fractures. Hip disarticulation was done in one patient. Bertani et al conducted a study in children trauma due to war, shrapnel explosions have been found responsible for 78.9% of all injuries and amputation rate for these patients was found around 18%. Furthermore, if bone injuries observed with vascular and nerve injuries, this may create higher mortality and morbidity risk for the patients.

Postoperative renal insufficiency is one of the worst complications in the vasculary surgery field. It is usually seen in patients presented with hemorrhagical shock, patients with advanced comorbidities, hypovolemic or hypotensive patients, patients with borderline renal functions or after surgical interventions that may cause renal ischemia. The surgeon and the anesthesiologist should balance the body fluid properly and prevent

acute tubulary necrosis.[26] The mortality rate of postoperative renal insufficiency is quite high. These patients usually need hemodialysis in postoperative period and the mortality rate of them usually depends on the type of surgery, creatinine levels before hemodialysis and the time between the diagnosis of renal insufficency and the onset of routine hemodialysis programme. Age of the patient, blood transfusion amount, insuffiency of the heart or other internal organs may also effect the mortality rate.[27] Seven (8%) patients had acute renal failure in our study and 5 (71.4%) of them died. The mortality rate was statistically significant (p=0.002).

CONCLUSION

We believe that increase in the quality and rapidness of emergency response, will decrease the morbidity and mortality rates of civilian victims of terrorism attacks. More studies should be conducted on the causes and treatment methods of the acute renal failure after vascular injury which is one of the major risk factors of mortality.

LIMITATIONS OF THE STUDY

1) In most patients ischemia time was not exactly known until they were admitted into our hospital. After the first intervention, detailed physical examination and occasionally color Doppler ultrasonography was performed in patients with stable hemodynamic status. Conventional angiography or computerized tomography angiography (CTA) was done only in a few patients because of the unstable hemodynamic status of these patients.

2) Patients could not be followed up properly after their discharge or transfer to another center. During the periods of intense conflict, after the first intervention, the patients who require long-term care and rehabilitation had been transferred to other centers. There were no acute vascular problems during their transfers. Transferred or discharged patients did not or could not come for regular visits to our center.

Conflict of Interest

Authors declared no conflict of interest or financial support.

Authors Contributions

Mehmet Atay: *Participated in data collection and drafting the manuscript;* ***Levent Altınay:*** *Participated in drafting the manuscript and helped in statystical analyses of the data;* ***Onur Saydam:*** *Participated in data collection and drafting the manuscript;* ***Celalettin Karatepe:*** *Participated in data collection and interpretation of the data;* ***Mehmet Acıpayam:*** *Helped in interpretation of the data;* ***Cem Lale:*** *Participated in data collection, authors contributed.*

REFERENCES

1. Jawas A, Abbas AK, Nazzal M, Albader M, Abu-Zidan FM. Management of war-related vascular injuries: experience from the second gulf war.World J Emerg Surg 2013;8(1):22.
2. Champion HR, Holcomb JB, Young LA. Injuries from explosions: Physics, biophysics, pathology, and required research focus. J Trauma 2009;66:1468-77.
3. Heldenberg E, Givon A, Simon D, Bass A, Almogy G, Peleg K. Terror attacks increase the risk of vascular injuries. Front Public Health 2014;2:47.
4. Khan MS, Waheed S, Ali A, Mumtaz N, Feroze A, Noordin S. Terrorist attacks in the largest metropolitan city of Pakistan. Profile of soft tissue and skeletal injuries from a single trauma center. World J Emerg Med 2015; 6(3):217-20.
5. Dougherty AL, Mohrle CR, Galarneau MR, Woodruff SI, Dye JL, Quinn KH. Battlefield extremity injuries in operation Iraqi Freedom. Injury 2009;40(7):772-7.
6. Rich NM, Baugh JH, Hughes CW. Acute Arterial Injuries in Vietnam 1000 Cases. J Trauma 1970;10:359.
7. DeBakey ME, Simeone FA. Battle injuries of the arteries in World War II: An analysis of 2,471 cases. Ann Surg 1946;123(4):534-79.
8. Hughes CW. Arterial repair during the Korean War. Ann Surg 1958;147(4):555-61.
9. Mattox KL, Feliciano DV, Burch J, Beall AC Jr, Jordan GL Jr, De Bakey ME. Five thousand seven hundred sixty cardiovascular injuries in 4459 patients. Epidemiologic evo lution 1958 to 1987. Ann Surg 1989;209(6): 698-705.
10. White JM, Stannard A, Burkhardt GE, Eastridge BJ, Blackbourne LH, Rasmussen TE. The epidemiology of vascular ınjury in the wars in Iraq and Afghanistan. Ann Surg 2011; 253(6):1184-9.
11. Malone DL, Hess JR, Fingerhut A. Massive transfusion practices around the globe and a suggestion for a common massive transfusion protocol. J Trauma 2006;60:91-6.

12. Wudel JH, Morris JA Jr, Yates K, Wilson A, Bass SM. Massive transfusion: outcome in blunt trauma patients. J Trauma 1991;31(1):1-7.
13. Huber-Wagner S, Qvick M, Mussack T, Euler E, Kay MV, Mutschler W, et al. Massive blood transfusion and outcome in 1062 polytrauma patients: a prospective study based on the Trauma Registry of the German Trauma Society. Vox Sang 2007;92(1):69-78.
14. Sauaia A, Moore FA, Moore EE, Moser KS, Brennan R, Read RA, et al. Epidemiology of trauma deaths: a reassessment. J Trauma 1995;38(2):185-93.
15. Topal AE, Eren MN, Celik Y. Lower extremity arterial injuries over a six year period: outcomes, risk factors, and management. Vasc Health Risk Manag 2010;6:1103-10.
16. Ode G, Studnek J, Seymour R, Bosse MJ, Hsu JR. Emergency tourniquets for civilians: Can military lessons in extremity hemorrhage be translated? J Trauma Acute Care Surg 2015;79(4):586-91.
17. Luna GK1, Maier RV, Pavlin EG, Anardi D, Copass MK, Oreskovich MR, et al. Incidence and effect of hypothermia in seriously injured patients. J Trauma 1987;27(9):1014-8.
18. Van Waes OJ, Van Lieshout EM, Hogendoorn W, Halm JA, Vermeulen J. Treatment of penetrating trauma of the extremities: ten years'experience at a dutch level 1 trauma center. Scand J Trauma Resusc Emerg Med 2013;21:2.
19. Dua A, Patel B, Desai SS, Holcomb JB, Wade CE,Coogan S, et al. Comparison of military and civilian popliteal artery trauma outcomes. J Vasc Surg 2014;59(6):1628-32.
20. Knudson MM, Lewis FR, Atkinson K, Neuhaus A. The role of duplex ultrasound arterial imaging in patients with penetrating extremity trauma. Arch Surg 1993;128(9):1033-7.
21. Conrad MF, Patton JH Jr, Parikshak M, Kralovich KA. Evaluation of vascular injury in penetrating extremity trauma: angiographers stay home. Am Surg 2002;68(3):269-74.
22. Bertani A, Mathieu L, Dahan JL, Launay F, Rongiéras F, Rigal S. War-related extremity injuries in children: 89 cases managed in a combat support hospital in Afghanistan. Orthop Traumatol Surg Res 2015;101(3):365-8.
23. Quan RW, Gillespie DL, Stuart RP, Chang AS, Whittaker DR, Fox CJ. The effect of vein repair on the risk of venous thromboembolic events: a review of more than 100 traumatic military venus injuries. J Vasc Surg 2008;47(3):571-7.
24. Menzoian JO, Doyle JE, Cantelmo NL, LoGerfo FW, Hirsch E. A comprehensive approach to extremity vascular trauma. Arch Surg 1985;120(7):801-5.
25. Rich NM. Vascular trauma historical notes. Perspect Vasc Surg Endovasc Ther 2011; 23(1):7-12.
26. Williams GM. Complications of vascular surgery. Surg Clin North Am 1993;73(2):323-35.
27. Cioffi WG, Ashikaga T, Gamelli RL. Probability of surviving postoperative acute renal failure: development of a prognostic index. Ann Surg 1984;200(2):205-11.