Türk Göğüs Kalp Damar Cerrahisi Dergisi 2017;25(1):74-81
http://dx.doi.org/doi: 10.5606/tgkdc.dergisi.2017.13203

Original Article / Özgün Makale

Emergency vascular injuries: patient profile, management strategies and risk factors for mortality

Acil vasküler yaralanmalar: Hasta profili, yönetim stratejileri ve mortalite risk faktörleri

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ABSTRACT

Background: This study aims to evaluate the mechanisms and localizations of injury, diagnosis, patient profile, treatment modalities, and risk factors for mortality, and to offer a guide for vascular surgeons for the management of emergency vascular injuries.

Methods: Between September 2009 and June 2013, a total of 161 patients (156 males, 5 females; mean age 30.3±11.8 years; range 8 to 80 years) were surgically treated for vascular injuries in our clinic. All patients were taken to the operation emergently after clinical assessment or after diagnostic imaging using Doppler ultrasound, computed tomography angiography or magnetic resonance angiography.

Results: Penetrating injuries (89.4%) were more common and most injuries involved the upper extremity (49.1%), followed by the lower extremity (41%), abdomen (5.6%), neck (2.5%), and thorax (1.9%). Simple ligation technique (14.3%) was used for small vessel injuries, whereas end-to-end anastomosis (49.7%) and repair with a saphenous vein (32.3%) or prosthetic graft (4.3%) was used for more complex cases. Mortality was seen in 10 patients (6.2%). Major risk factors for mortality were abdominal localization of injury ($p<0.001$), hemodynamic instability on admission ($p<0.001$) and low hematocrit levels before the operation (33.4±5.6 vs 18.1±9.1; $p<0.001$).

Conclusion: Vascular injuries should be diagnosed and treated promptly. The clinical status at the time of presentation, localization of injury, diversity of diagnostic and treatment options and concomitant injuries are important considerations. Only clinical assessment may be enough in many emergency cases. Patients with hemodynamic instability and major blood loss before the surgery should be managed with surgery and medical resuscitation simultaneously to prevent patient loss.

Keywords: Mortality; risk factors; surgical treatment; vascular trauma.

ÖZ

Amaç: Bu çalışmada yaralanmanın mekanizmaları ve yerleri, tanı, hasta profili, tedavi yöntemleri ve mortalite risk faktörleri değerlendirildi ve acil vasküler yaralanmaların tedavisine yönelik damar cerrahları için bir rehber sunuldu.

Çalışma planı: Eylül 2009 - Haziran 2013 tarihleri arasında toplam 161 hasta (156 erkek, 5 kadın; ort. yaş: 30.3±11.8 yıl; dağılım 8-80 yıl) vasküler yaralanma nedeniyle cerrahi olarak kliniğimizde tedavi edildi. Hastaların tümü klinik değerlendirme sonrası acil olarak veya Doppler ultrason, bilgisayarlı tomografi anjiyografi veya manyetik rezonans anjiyografi gibi tanısal görüntüleme sonrası ameliyata alındı.

Bulgular: Delici yaralanmalar (%89.4) daha sık olup, yaralanmaların büyük bir çoğunluğu üst ekstremite (%49.1) takiben alt ekstremiteyi (%41), batını (%5.6), boynu (%2.5) ve toraksı (%1.9) içermekteydi. Küçük damar yaralanmalarında basit bağlama tekniği kullanılırken (%14.3), daha karmaşık durumlarda uç uca anastomoz (%49.7) ve safen ven (%32.3) veya protez greft (%4.3) ile onarım yapıldı. On hastada (%6.2) mortalite gözlendi. Mortalite için majör risk faktörleri; yaralanmanın batını içermesi ($p<0.001$), başvuru sırasında hemodinamik instabilite ($p<0.001$) ve ameliyat öncesi düşük hematokrit değerleri (18.1±9.1'e kıyasla 33.4±5.6; $p<0.001$) idi.

Sonuç: Vasküler yaralanmalarda hızla tanı konulmalı ve tedavi başlanmalıdır. Başvuru sırasındaki klinik durum, yaralanmanın yeri, tanı ve tedavi seçeneklerinin farklılığı ve eşlik eden yaralanmalar dikkate alınması gereken önemli sorunlardır. Pek çok acil durumda yalnızca klinik değerlendirme yeterli olabilir. Hemodinamik instabilite ve ciddi kan kaybı olan hastalarda, hasta kaybını önlemek için, eş zamanlı cerrahi tedavi ve tıbbi resüsitasyon birlikte uygulanmalıdır.

Anahtar sözcükler: Mortalite; risk faktörleri; cerrahi tedavi; vasküler travma.

Available online at
www.tgkdc.dergisi.org
doi: 10.5606/tgkdc.dergisi.2017.13203
QR (Quick Response) Code

Received: February 28, 2016 *Accepted:* June 10, 2016

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Vascular injuries constitute about 2 to 3% of all trauma cases[1] and associated mortality, and risk for extremity loss require prompt diagnosis and treatment. The etiology of vascular injury can be a penetrating or blunt trauma or a gunshot wound with variable frequencies depending on multiple factors, such as the socioeconomic status and geographic region.[1] Although there has been improvement in the management of these patients in parallel to the recent developments in imaging modalities and endovascular treatments, significant risks of mortality and functional loss still deem these patients challenging for surgeons.

In this study, we present our patients with vascular injuries and define risk factors for mortality. This study does not address to one region of the body such as abdomen, thorax or extremities, but includes all vascular emergency cases in a vascular clinic within a multidisciplinary hospital. Therefore, we aimed to evaluate the mechanisms and localizations of injury, diagnosis, patient profile, treatment modalities, and risk factors for mortality, and to offer a guide for vascular surgeons for the management of emergency vascular injuries.

PATIENTS AND METHODS

This retrospective study includes a total of 161 patients who underwent surgical treatment for emergency vascular injuries between September 2009 and June 2013. Patient data including age, gender, mechanism of the injury, concomitant injuries (i.e., tendon, orthopedic, or nerve), anatomical location, clinical presentation, laboratory test results and vital signs, and diagnostic investigations and management were retrospectively collected and analyzed. Patients with cardiac injuries and trauma patients who did not underwent a vascular intervention were excluded. The study protocol was approved by the Bağcılar Training and Research Hospital Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

The clinical presentation and hemodynamic status of the patients were the main determinants of the diagnostic work-up before the operation. The patients underwent diagnostic studies to locate the site of vascular injury, if they had no active bleeding or hemodynamic instability. In case of active external bleeding and hemodynamic instability with a probability of internal bleeding, the patients were transferred to the operating room immediately after the initial assessment. Active bleedings localized in the extremities were controlled with pressure or tourniquet in the emergency room, if already not under control. Simultaneous fluid resuscitation was initiated to prevent hemorrhagic shock. The preferred method of the diagnostic modality was computed tomography angiography (CTA) for suspected arterial injuries. Doppler ultrasound (USG) and magnetic resonance (MR) angiography were also used for the initial assessment of those with a suspicion of concomitant venous and soft tissue injuries and renal impairment.

Intra-abdominal vascular injuries presented with hemorrhagic shock and aggressive fluid, and blood resuscitation was necessary immediately before and during the operation. A long midline incision was used to enter the abdominal cavity rapidly, and the localization and control of bleeding was attempted after the evacuation of blood clots. Thoracic injuries of the descending aorta in three patients were approached through a left thoracotomy or treated with endovascular technique in stable patients. Longitudinal incisions were used for extremity injuries and localization of the incision was identified according to the site of injury, as confirmed by physical examination or imaging studies. In case of active bleeding, incision was extended accordingly to provide proximal and distal vascular control, while the tourniquet was still in place. We preferred autologous vein as the vascular conduit and mostly used the contralateral leg for harvesting. An expanded polytetrafluoroethylene (PTFE) graft was used in selected cases with no available vein graft and non-contaminated blunt injuries. In case of a suspicion of thrombosis distal or proximal to the injury, embolectomy was performed. In stable patients with concomitant bony fractures and soft tissue damage, the ischemic status of the limb was the determinant of the intervention. If vigorous manipulation was anticipated, arterial repair was delayed, until the bony stabilization was completed. Lower extremity injuries with double bone fractures, large tissue defects, and high risk for infection required distal bypass to the posterior tibial artery. Fasciotomy was performed, when indicated, by edema and tenseness of the affected compartment, and the threshold for fasciotomy was low in those with associated venous injuries, bony skeletal injuries, and in those with a blunt crushing trauma. Endovascular intervention was used for those with a difficult vascular access to the site of injury in hemodynamically stable patients.

Statistical analysis

Statistical analysis was performed using SPSS version 16.0 for Windows (SPSS Inc., Chicago, IL, USA). Continuous variables were presented in mean ± standard deviation and categorical variables were presented in frequencies (n, %). The Fisher exact

Table 1. Patient profile

Variable	n	%	Mean±SD	Range
Age (years)			30.3±11.8	8-80
Gender				
Male	156	96.9		
Female	5	3.1		
Mechanism of vascular injury				
Penetrating	127	74.7		
Blunt	17	10.6		
Gunshot	22	13.7		
Localization of injury				
Upper extremity	79	49.1		
Lower extremity	66	41.0		
Abdomen	9	5.6		
Neck	4	2.5		
Thorax	3	1.9		
Type of vascular injury				
Arterial	97	60.2		
Venous	14	8.7		
Arterial and venous	50	31.1		

SD: Standard deviation.

and Pearson chi-square tests were used to analyze the categorical variables. Binary logistic regression analysis was performed to determine the predictors of mortality and to obtain the risk ratios (odds ratios; OR). A p value of <0.05 was considered statistically significant.

RESULTS

The study population was mainly composed of young male patients (96.9%) with penetrating injuries (89.4%) involving the upper (49.1%) and lower extremity (41%) (Table 1). The mean age was 30.3±11.8 (range, 8 to 80) years. Most patients were taken to the operation immediately after the initial clinical assessment (68.9%) without performing any imaging study (Table 2). In stable patients, CTA (22.4%), Doppler USG (3.1%), or MR angiography (4.3%) were performed to detect vascular pathologies (Figures 1 and 2).

Table 2. Clinical presentation of patients

Clinical presentation	n	%
Active bleeding	120	74.5
Internal bleeding	9	5.5
Extremity ischemia	32	19.9
Arteriovenous fistula	2	1.2
Hemorrhagic shock	16	9.9

Radial and ulnar arteries together were the most common sites of injury in the upper extremity, whereas superficial femoral and popliteal arteries were most common arteries involved in the lower extremity (Table 3). Abdominal injuries mostly inflicted damage to the aorta and vena cava, a fact contributing to critical clinical presentation of these patients. Simultaneous

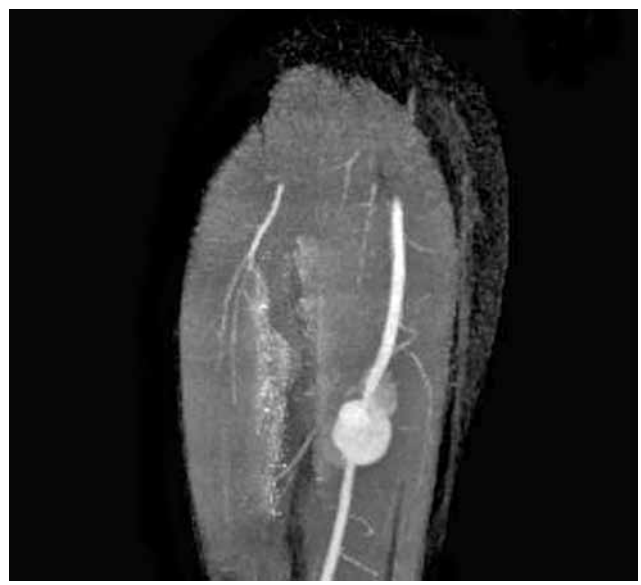

Figure 1. A pseudoaneurysm of femoral artery after penetrating injury in a 28-year-old male patient which was repaired with saphenous vein graft interposition.

Figure 2. An image of a 49-year-old male patient presenting with axillary artery thrombosis due to blunt injury in a traffic accident.

Table 3. Vascular injuries according to localization

Affected vessel	n	%
Upper extremity		
Radial artery	30	18.6
Ulnar artery	28	17.4
Brachial artery	16	9.9
Axillary artery	3	1.8
Only vein	2	1.2
Lower extremity		
Superficial femoral artery	23	14.3
Popliteal artery	21	13.0
Posterior tibial artery	9	5.6
Anterior tibial artery	6	3.7
Common femoral artery	4	2.5
Profunda femoral artery	3	1.8
Dorsalis pedis	2	1.2
Only vein	4	2.5
Abdomen		
Abdominal aorta	3	1.8
Vena cava	1	0.6
External iliac artery	2	1.2
Mesenteric vessels	1	0.6
Aorta and cava	2	1.2
Thorax		
Descending aorta	2	1.2
Vena cava + Descending aorta	1	0.6
Neck		
ECA	2	2.5
ECA+EJV	1	1.2
EJV	1	1.2

ECA: External carotid artery; EJV: External jugular vein.

arterial and venous injuries were more common in the extremities (p=0.001) (Table 4). It should be noted in tables that some patients had both arterial and venous injuries, but only arterial injuries of the extremities are listed in Table 3. Concomitant tendon and nerve injuries were confined only to the upper (26.7% and 23.6%, respectively) and lower extremities (7.5% and 5.6%, respectively), and were seen significantly more frequently in the upper extremity (p<0.001). Bony skeletal injuries were encountered only in the lower extremity in eight patients (4.9%).

Stab injuries of the arteries and veins were repaired with simple stitches in 62 vessels (38.5%) and repair with a saphenous vein conduit or a PTFE graft was necessary in 58 vessels (36.0%) with a large defect (Table 5). In five of these patients (3.1%) with lower extremity injuries with double bone fractures, large and extensive tissue defects and with a high anticipation of infection, bypass grafting of the distal arteries with a vein graft was required. It was possible to resect the injured segment and make an end-to-end anastomosis in 46 patients (28.6%), and simple ligation was used for small vessel injuries in 17 (10.6%) usually in addition to the repair of other vessels. Simultaneous embolectomy was performed in 61 patients (37.9%), whereas fasciotomy was necessary in 28 patients (17.3%) with lower extremity injuries.

Table 4. Type of vascular injury according to localization

	Localization										*Total*	
	Lower extremity		Upper extremity		Neck		Abdomen		Thorax			
	n	%	n	%	n	%	n	%	n	%	n	%
Arterial injury	36	22.4	54	33.5	2	1.2	5	3.1	2	1.2	99	61.5
Venous injury	4	2.4	2	1.2	1	1.9	1	0.6	0	0	8	4.9
Concomitant arterial and venous injury	26	16.1	23	14.2	1	0.6	3	1.9	1	0.6	54	33.6
Total	66	41.0	79	49.1	4	2.5	9	5.6	3	1.9	161	100.0

Table 5. Surgical techniques of vascular repair and concomitant procedures

Technique	n	%
Simple ligation	17	10,6
Primary repair	62	38,5
End-to-end anastomosis	46	28,6
Short vein graft interposition	47	29,1
Vein graft bypass to distal tibial arteries	5	3,1
Polytetrafluoroethylene graft interposition	5	3.1
Polytetrafluoroethylene graft patch	1	0.6
Endograft occlusion	1	0.6
TEVAR	1	0.6
Concomitant embolectomy	61	37.9
Fasciotomy	28	17.3

TEVAR: Thoracic endovascular aortic repair.

The mean length of postoperative intensive care unit and hospital stay was 1.7±1.6 (range, 1 to 12) and 6.1±14.3 (range, 1 to 123) days, respectively. Re-exploration was necessary in 19 patients (11.8%); for wound complications in 10, bleeding in three, graft occlusion in two, and orthopedic reasons in four patients. Re-operations for fasciotomies were not included. None of the patients had a limb loss.

Mortality was seen in 10 patients (6.2%). The main reason of death was blood loss in seven patients, followed by crush syndrome-related complications in two and cerebrovascular accident in one. Statistical analysis showed that the type of injury being arterial, venous or mixed did not affect mortality (p=0.3), whereas the abdominal localization (4/9, 44.4%; p=0.001) and gunshot mechanism of the injury (4/22, 18.1%; p=0.04) were the risk factors for death. Other risk factors were hemodynamic instability on admission (p<0.001) and low hematocrit levels before the operation (33.4±5.6 vs 18.1±9.1; p<0.001). Binary logistic regression analysis showed that the mechanism of injury (p=0.01; OR 3.9), hemodynamic shock at clinical presentation (p=0.005; OR 15), and low preoperative hematocrit levels (p=0.005; OR 0.7) were the main predictors of mortality.

DISCUSSION

Vascular injuries may manifest mainly by bleeding or ischemia or both, and may result in mortality or limb loss according to the severity of injury. Initial assessment and diagnostic techniques to be utilized primarily depend on the clinical status of the patient at presentation. Bleeding, the presenting symptom in almost 80% of cases in the current series, may be either external or internal, and may lead to hypovolemic shock.[2] Even in cases without hypovolemic shock, bleeding dominates the clinical presentation, and the surgeon's primary goal becomes the prevention of exsanguination and death which should be followed by the establishment of vascular supply to save the extremity.[2] If present, bleeding should be controlled by pressure or application of tourniquet in the emergency room, and patients should be transferred to the operating room immediately without performing any imaging study (68.9% in our series). In our experience, the absence of imaging usually does not pose a challenge for detecting the site of the vessel injury. After the initial control of bleeding in the operating room, exploration of the site of injury usually reveals the affected vessel. When the localization of the damage is not in the immediate vicinity of the entry site, extension of the incision proximally or distally, and exploration of the vessel are often enough to detect and repair the damage. The main reason that we preferred longitudinal incisions for the extremity injuries the feasibility of extension of the incision proximally or distally. In case of abdominal injuries, our patients presented with internal bleeding and shock in whom bleeding control was not possible in the emergency room. These patients were, therefore, transferred to the operating room immediately with aggressive fluid resuscitation. Of note, thoracic injuries may present with active bleeding requiring an immediate intervention, as well as a contained rupture which may allow the diagnostic studies and endovascular repair.

When the primary symptom is ischemia, it is usually possible to perform diagnostic studies to identify the exact localization of the vascular damage. On the other hand, this duration should be as short as possible to minimize ischemic time and thus prevent the extremity loss. It has been suggested that the Ankle-Brachial Pressure Index measurement should be the first-line diagnostic choice to exclude an arterial injury.[3] However, in the present study, this index was not consistently utilized to diagnose vascular injuries in all patients due to personal preferences of the surgeons for diagnostic studies. Doppler USG is also cost-effective and easily available; however, it is operator-dependent, and sometimes technically impossible to perform in patients with open wounds and pain.[4] Angiography is often time-consuming due to the requirement of the patient transfer to the catheter laboratory. The use of pre-procedural angiography in the operating room has been suggested to decrease time to start the intervention and, therefore, reduce the likelihood of amputation.[5] We mostly used CTA for preoperative diagnosis, as it is easily available

and makes it possible to localize the site of injury and guide treatment strategies. Currently, CTA, the first-line assessment of a vascular injury in trauma patients, offers a rapid, accurate, non-invasive method of detecting vascular injuries.[6,7] We also used this imaging modality postoperatively for the diagnosis of any graft failure or incomplete repair in patients with recurrent or persistent ischemia.

The diagnosis of concomitant venous injuries is more difficult, particularly in those with an extensive tissue damage which preclude the use of Doppler USG. In the current study, most venous injuries were detected during surgery in the adjacent venous vessels. It was often easy to diagnose venous injuries causing bleeding during surgery, which might actually make the exploration considerably difficult. On the other hand, crush injuries of the veins may avoid detection, and we suggest that the adjacent major veins should be explored to reveal localized obstructing lesions during arterial repair particularly in patients with swelling of the leg. Ustunsoy et al.[8] and Tunerir et al.[9] also emphasized the importance of concomitant venous repair during the repair of peripheral arterial injuries for graft patency and salvation of the extremity.

The surgical techniques for the repair of arterial injuries are simple repair, resection of the affected segment, and end-to-end anastomosis and bypass grafting. It has been showed that the ligation of the injured vessels have a high risk for amputation, and is not used nowadays.[10] We used the ligation technique only for injuries of side branches or small-size veins usually along with the repair of a major vessel. The simple repair is possible, when there is partial laceration of the vessel, and lateral repair gives satisfactory results, when the lumen of the repaired artery is no less than 50% of the original vessel diameter.[1] If simple repair is not possible, the resection of the affected segment and end-to-end anastomosis of the remaining healthy vessel ends are the preferred techniques. It is also important to mobilize arteries adequately to prevent stretching at the site of anastomosis particularly during the extension of the extremity in limb injuries. If a conduit is required, we prefer an autologous vein as the vascular conduit for extremity injuries, and we mostly use the contralateral leg for harvesting to prevent venous stasis of the affected extremity. The main advantages of venous grafts include resistance to infection, which is particularly critical for contaminated wounds of trauma patients, easy availability, and superior patency rates. In addition, expanded PTFE grafts may be used in selected cases with no available vein grafts and non-contaminated blunt injuries. In the presence of large tissue defects, multiple bone fractures and high risk for infection bypass grafting of the distal arteries may be required particularly in the lower extremity. Although distal bypass graft patency rates are not very high, popliteal-to-distal tibial artery (anterior or posterior) bypass grafting with a vein graft may save the limb in these patients. To protect the bypassed graft, it may be passed through a tunnel not included in the affected area. In case of a suspicion of thrombosis distal or proximal to the injury, embolectomy should be performed before the completion of repair. Abdominal and thoracic arterial and venous injuries may be repaired by simple sutures or may require graft interposition.

Furthermore, the management of vascular injuries with endovascular techniques has become an important treatment option during the last decade.[11] Patients with injuries in an anatomic region where surgical exposure is difficult and with an increased risk for iatrogenic injuries during the exposure are ideal candidates for endovascular interventions.[11] Endovascular interventions have been suggested to reduce operating room time, estimated blood loss, and iatrogenic injury in trauma cases, while increasing operating costs, compared to open surgery.[12,13] The major uses of endovascular techniques for trauma are bleeding control interventions such as balloon occlusion, embolization, and deployment of a covered stent, exclusion of pseudoaneurysms and arteriovenous fistulas by either covered stents or coil embolization, and deployment of bare metal stents or covered stents for dissection.[11,14-16] In our daily practice, we have been using endovascular interventions increasingly for our elective cases; however, due to the lack of endovascular capabilities in the operating room, the number of emergency cases treated with this modality still remains low. In the present study, only one patient was treated with an endograft for ruptured subclavian artery, and one other patient underwent thoracic endovascular graft implantation,[17] although our number has been increasing since that time. Uncontrolled bleeding and hemodynamic instability were also important factors precluding endovascular interventions; however, hybrid operating rooms with endovascular capabilities may permit more liberal use of endovascular techniques. Temizkan et al.[18] suggested that early angiography in hybrid rooms during other procedures facilitated early diagnosis and treatment of vascular injuries yielding improved outcomes.

An important consideration in trauma patients is the sequence of intervention in patients with multiple

injuries. Active bleeding is the most important indication for emergency vascular surgery and becomes the number one priority, particularly in hemodynamically unstable patients. In patients with shock who has concomitant double-bone fractures and more than two arterial injuries below the knee, our approach depends on the clinical status of the patient and the presence of nerve injuries. If the patient is stable after bleeding control and there is no nerve injury, an attempt to repair is usually tried. In the presence of nerve injuries and hemodynamic stability, amputation may be a prudent decision. In stable patients with concomitant bony fractures and soft tissue damage, the ischemic status of the limb is the determinant of the intervention. In case of severe ischemia of the limb, complete absence of vascular supply distal to the injury site and long anticipated duration for repair of injuries of other sites such as muscle, tendon and nerves, we prefer vascular repair initially. This approach decreases ischemic duration; however, there is a risk for recurrent injury during vigorous manipulation. In such cases, the arterial repair should be delayed, until the bony stabilization is completed.

Another consideration is the inability to use heparin in multisystem trauma patients with associated intrathoracic or intra-abdominal injuries and with possible closed head injuries. If these injuries are present, the use of minimal dose of heparin with immediate reversal after repair may help to minimize bleeding complications. Simple repair of arterial injuries with side clamping may also help to avoid heparin use. If the risk for bleeding is high, we sometimes complete the repair without the use of heparin and at the time of removal of vascular clamps, we perform proximal and distal embolectomy through a small opening of the anastomosis. After allowing some bleeding, we complete the anastomosis. This technique may help to avoid heparin use and also avoid thrombosis or distal embolization after repair. Finally, in the absence of active bleeding and limb threatening ischemia, vascular repair may be delayed, until other injuries are stabilized with close observation for the development of limb ischemia. Delayed revascularization has been shown to produce good results in vascular trauma patients with good distal perfusion and no evidence of ischemic neurological deficit,[19] although our preference is the early correction of vascular pathology, if possible.

In patients with extremity injuries, fasciotomy may be necessary to relieve compartment pressure. The diagnosis is in our clinic is mostly based on clinical criteria, although direct compartment pressure measurements have been used to confirm the diagnosis by others.[20] Although fasciotomy was suggested to be performed prophylactically in lower extremity vascular injuries, there is controversy about the timing of fasciotomy and the role of intra-compartmental pressure.[20] We perform fasciotomy, when there is edema and tenseness of the affected compartment, paraesthesia and pain out of proportion with inadequate perfusion distal to the site of injury. It is important to perform fasciotomy before the development of motor deficits, and the threshold for fasciotomy should be low in those with associated venous injuries, bony skeletal injuries, long ischemic duration, and in those with a blunt crushing trauma.

In the current series, there was no extremity loss. This can be due to our strategy of early revascularization with close observation and performing a timely fasciotomy, when indicated. On the other hand, the rate of penetrating injuries was quite high in this series which may actually have a role in the absence of extremity loss. Moreover, patients undergoing primary amputation were not included in the study, while those with only any kind of vascular intervention or surgical vascular exploration were included. In patients with extensive tissue damage of the extremity with long vessel segments crushed, multiple bone fractures and particularly with severed sciatic or posterior tibial nerves, the decision for amputation is given together with orthopedicians.

The mortality rate in the current series was 6.2% and hemodynamic instability on admission, gunshot mechanism of the injury, and low preoperative hematocrit levels were the main risk factors for death. This suggests that the preoperative blood loss is an important predictor of mortality. Factors which may affect that are the severity and mechanism of the injury, localization of the vascular damage, and time to admission. The localization of the injury was not a predictor of mortality in logistic regression analysis; however, it was a risk factor for death in the univariate analysis. We believe that localization such as abdominal, thoracic or subclavian vessels may preclude bleeding control by pressure, and may allow free bleeding into a body cavity. These patients require aggressive fluid and medical resuscitation with immediate transfer to the operating room. Similarly, definitive correction of the extremity vascular injuries presenting with active bleeding should not be delayed for lengthy diagnostic studies. The mortality of patients without active bleeding is usually related to the extensive tissue injury or injuries of other sites, as presented in our study.

In conclusion, traumatic vascular injuries in a large-scale state hospital consist of a vast variety of vascular pathologies and are challenging for vascular surgeons. The clinical status at the time of presentation, localization of the injury, diversity of diagnostic and treatment options, and concomitant injuries are important considerations during management. Therefore, a meticulous clinical assessment is of utmost importance for prompt diagnosis and treatment. In addition, patients with hemodynamic instability and major blood loss should be managed with surgery and medical resuscitation simultaneously to prevent the patient loss.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

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