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Femoral Artery Injuries Due to Gunshot Injury in Somalia Civil War Continues

İç Savaşın Devam Ettiği Somali'de Ateşli Silah Yaralanmasına Bağlı Femoral Arter Yaralanmaları

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ABSTRACT Objective: Surgical interventions and results of femoral arterial injuries due to gunshot injuries were evaluated and presented in Somalia, where civil war continued. Patients and **Material and Methods:** 18 patients who were operated due to femoral artery injury between November 2015-May 2016 were evaluated retrospectively.14 of the patients were male (77.7%). All patients were evaluated respectively for the age, gender, hospital admission time, femoral artery injury locations, revascularization techniques and graft selection, accompanying injuries, additional surgery procedures, infection rates, amputation and mortality. **Results:** The mean age was 27,83±8,39 (16-52). Additional injuries were as; 14 patients (77.8%) had venous injury, 8 patients (44.4%) had venous injury and nerve damage, 6 patients had bone fracture (33.3%), 2 patients (11.1%) intraabdominal injury and 3 patients (16.6%) had extensive soft tissue defects. The admission time to the hospital was quite delayed and the mean appealing time was 69.55±44.81 (6-144) hours. For revascularization; primary repair was performed in 1 patient (5.5%), end to end vascular repair in 3 patients (16.6%), saphenous vein graft in 10 patients (55.6%) and PTFE graft in 4 patients (22.2%). Fasciotomy was performed in 6 patients (33.3%) who were suspected or had compartment syndrome and amputation was performed in 2 patients (11,1%). Mortality causes were intrabdominal injury and hypotensive shock in one patient and sepsis in two patients. Mortality rate was 16.6%. The mean discharge interval was 12.9±5.11 (6-24) days. **Conclusion:** Surgical success and mortality of vascular injuries in the war zone is related with the duration of intervention, accompanying injuries, infection and motor loss. Particularly for the infection suspected cases, the usage of saphenous vein grafting is recommended and if the hemodynamic instability is present, bypassing by the PTFE graft may be a useful alternative to shorten the surgical time.

Keywords: Femoral artery; wounds, gunshot

ÖZET Amaç: İç savaşın sürdüğü Somali'de ateşli silah ve şarapnel yaralanmasına bağlı femoral arter yaralanmalarına yapılan cerrahi operasyonlar ve sonuçları değerlendirilerek sunuldu. **Gereç ve Yöntemler:** Kasım 2015-Mayıs 2016 arasında femoral arter yaralanması sebebiyle opere edilen 18 hasta retrospektif olarak değerlendirildi. Hastaların 14'ü erkek (%77,7) idi. Tüm hastaların yaş, cinsiyet, hastaneye başvuru süreleri, femoral arter yaralanma lokasyonları, revaskülarizasyon teknikleri ve greft seçimleri, eşlik eden yaralanmalar ve ek cerrahiler, enfeksiyon oranları, amputasyon ve mortalite sayıları değerlendirildi. **Bulgular:** Yaş ortalaması 27,83±8,39 (16-52) yıl idi. Hastalarda arteryel yaralanmaya ek olarak; 14 hastada (%77,8) ven yaralanması, 8 hastada (%44,4) ven yaralanması ve sinir hasarı, 6 hastada kemik fraktürü (%33,3), 2 hastada (%11,1) batın içi yaralanma ve 3 hastada (%16,6) geniş doku defekti mevcuttu. Hastaneye başvuru süreleri oldukça gecikmiş olup ortalama 69,55±44,81 (6-144) saat idi. Revaskülarizasyon için; 1 hastada (%5,5) primer onarım, 3 hastada (%16,6) uç uca tamir, 10 hastada (%55,6) safen greft ile ve 4 hastada (%22,2) PTFE greft ile bypass yapıldı. Kompartman sendromu düşünülen 6 hastaya (%33,3) fasyotomi açıldı, 2 hastaya (%11,1) amputasyon yapıldı. Batın içi yaralanmaları olan ve hipotansif şoktaki bir hasta ve sepsis gelişen 2 hastada mortalite görüldü, toplam mortalite 3 hasta (%16,6) idi. Taburculuk süreleri ortalama 12,9±5,11 (6-24) gün idi. **Sonuç:** İç savaşın sürdüğü bölgelerde vasküler yaralanmaların operasyon başarısı ve mortalite; müdahale süresi, eşlik eden yaralanmalar, enfeksiyon ve motor kayıp varlığına bağlıdır. Özellikle enfeksiyon şüphesi olan durumlarda safen greft kullanılması önerilirken hemodinamik instabilite olması durumunda operasyon süresini kısaltmak amacıyla PTFE greft ile bypass yapılması bir alternatif olarak kullanılabilir.

Anahtar Kelimeler: Femoral arter; yaralar, ateşli silah

Today, one of the most important causes of mortality and morbidity is trauma. Vascular injuries constitute 2-3% of all traumas and carry significant mortality-morbidity risks.[1]

There are many life-threatening injuries for both military personnel and civilians in regions where civil war continues, such as Somalia. Difficulties in access to health services, the poor physical conditions in field hospitals lead to dramatic consequences especially in patients with vascular injuries.

MATERIAL AND METHODS

A total of 18 patients who underwent surgery for femoral artery injury due to firearm or sham injury between November 2015 and May 2016 at the Somalia Turkey Mogadishu Recep Tayyip Training and Research Hospital were retrospectively evaluated.

RESULTS

Of the 18 patients, 14 were male (77.7%) and 4 were female (22.2%). The mean age was 27.83 (16-52) years. All cases were administered tetanus vaccination and triple antibiotic therapy was started just after the admission. The diagnosis of vascular injury was performed by clinical evaluation and Doppler ultrasonography (USG). The admission time to the hospital was evaluated and it was determined that the average admission time of the patients was 69.55 ± 44.81 (6-144) hours due to the ongoing civil war and was quite delayed. The reason for delayed application periods; all patients were referred to our hospital for further intervention because of the lack of vascular surgeon and ligation to stop bleeding in the nearest field or regional hospital before admission to our hospital. At the time of admission, 4 patients (22.2%) were hypotensive.

There were 8 patients (44,4%) in the superficial femoral artery (SFA) and 4 patients (22,2%) in the common femoral artery (CFA) in 6 patients (33.4%) had proximal femoral artery (PFA) injuries (Table 1).

Of the 18 patients, one patient was repaired by primarily (5,6%), 3 patients were undergone end-to-end anastomosis (16,6%), 10 patients were repaired by using saphenous graft (55,6%) and 4 patients were repaired by PTFE graft (22,2%) (Table 2). We performed femoropopliteal bypass with proximal and distal ligation at the injury site in 3 patients with SFA injury in Hunter's canal.

TABLE 1: Injury sites of femoral artery.

CFA	6 patients (33,4%)
SFA(Entrance of the Hunter canal)	5 patients (27,8%)
SFA (Inside of the Hunter canal)	3 patients (16,7%)
PFA	4 patients (22,2%)
Total	18 patients

CFA: Common femoral artery, SFA: Superficial femoral artery, PFA: Profunda femoral artery.

In addition to arterial injuries; two patients (11.1%) were operated by general surgeon after vascular surgical procedures due to intraabdominal injury. 14 patients (77.8%) had venous injury. Nine patients with deep venous system injuries were treated with saphen vein graft in order to reduce venous pressure. In 5 patients, venous repair was not required and vascular ligation was performed. Six patients with bone fractures (33%) were primarily operated by orthopedist. Eight patients (44.4%) who presented motor loss on initial evaluation. Surgical exploration revealed peripheral nerve damage additional to arterial and venous injury and any peripheral nerve surgery was not performed for these patients. There were 2 patients with arterial, venous, nervous damage had additional bone fractures, and 3 patients with extensive shrapnel injury of the thigh (Table 3). By after the fixation of the fractures and revascularization of the arterial and venous supply the patients were followed by plastic surgeon. The skin and soft tissue defects were reconstructed by split thickness skin graft after adequate granulation tissue development.

Ten patients (55.5%) had open and contaminated injuries with infection. In the postoperative period, clinical infection were detected in 12 patients (66.7%) and appropriate antibiotherapy was started according to culture antibiogram result. 2

TABLE 2: Surgical intervention types.

Primariy suture	1 patient (5,6%)
End-to-end anostomosis	3 patients (16,6%)
Otogenous v.saphena magna interposition	10 patients (55,6%)
Synthftic graft insertion	4 patients (22,2%)
Total	18 patients

TABLE 3: Coinjuries with the femoral artery Injury.

Venous injury	14 patients (77,8%)
Peripheral nerve damage+ venous injury	8 patients (44,4%)
Bone fractures	6 patients (33,4%)
Intraabdominal injury	2 patients (11,1%)
Extensive soft tissue defects	3 patients (16,6%)

patients (11.1%) had sepsis. The patient, who had hypotensive occlusion and was repaired with PTFE graft, died at the postoperative 1st hour. Mortality was seen in 3 patients (16.6%).

Six patients (33.3%) who were considered to have compartment syndrome were consultated to plastic surgeon and fasciotomy was performed according to clinical signs of suspected compartment syndrome. The anterior and posterior compartments were opened with a longitudinal incision between the lateral trochanter major and the lateral condyle of the thigh, and a second incision was opened for the medial compartment, as needed. The mean fasciotomy incision length was 20.3 ± 2.6 cm. On average, fasciotomies were closed at 13,16 ± 4,07 days.

Amputation was performed due to progressive tissue necrosis in 2 patients (11,1%) to whom underwent fasciotomy. The amputations were performed as to trying to protect the optimal extremity length for usage of prothesis. Patients were discharged in a mean of 13.86 ± 5.08 days. Physiotherapy was started to all the patients after discharge.

DISCUSSION

The treatment of war-related vascular injuries is usually based on military experience.[2] Sepsis is the most important issue due to delayed access to health facilities for traumas (especially vascular trauma) for the civilians in the regions of civil war, such as Somalia.[3] The most common cause of vascular trauma in these areas is firearm and shrapnel injury.[4]

The first intervention for these patients is very important to reduce blood loss and stabilize vital functions. Especially for the extremity vascular injuries, bleeding should be controlled by compression and the tourniquet apply should be avoided for the whole extremity circulation compromise.[5] If the vascular surgery is not possible, especially in field hospitals, ligation of the vessel for life saving is frequently used. All patients referred to our hospital were the patients who had vascular ligation in the field or regional hospitals.

Although hemorrhagic stabilization and life-saving intervention have been performed for bleeding with arterial injuries, vascular surgical intervention is urgently needed for revascularization. If there is no timely revascularization for these patients, serious complications such as sepsis and amputation are inevitable.[6]

In order to provide rapid circulation, arterial repair and venous ligation are used to shorten the operation time in distressed patients and some studies have indicated that venous flow is important as much as arterial flow for limb salvage.[7-10] Habson et al. have reported that femoral artery blood flow decreases within 72 hours of femoral ven ligation.[11] We performed venous anastomosis in patients when the repair was feasible.

The ischemia that develops after trauma causes hypoxia. Another possible intervention to prevent hypoxia-induced oedema, loss of function and tissue necrosis is fasciotomy and should be performed within 6-8 hours after the compartment syndrome signs are developed.[12,13]

According to the literature the compartment pressure releaving procedures were applied for the cases who suffered of pain with passive stretching and had paraesthesia. In delayed cases, fasciotomy for the intra-compartmental necrotic tissue and anaerobic infection in the closed environment is

controversial, but we think that it was a precise decision to perform fasciotomy for our patients.[13-15]

Fixation procedure should be done before vascular repair because it may damage the anastomosis in patients with bone fractures. Transient arterial shunts can be used as an alternative method before bone stabilization.[16,17] We did not use arterial shunting in any of our patients.

Amputation rates in vascular injuries were 80% in the World War I, 15% in the Korean and Vietnam wars and quite decreased in recent years, depending on surgical techniques and increased surgical experience (1.5%).[18,19] The reason for the higher rates of amputation in our study compared with the literature depends on the lower number of cases, the delayed arrival of the patients with bone defects particularly associated with vascular injuries and the insufficient initial intervention

In the literature mortality rates of lower extremity vascular injuries ranges between 1.5-20%.[20,21] In our patients the mortality was 3 patients. The delayed admission to the hospital, the accompanying injuries and the sepsis can be considered as the main mortality reasons.

If the primary repair is not possible, grafting is the first choice. For both of the arterial and venous grafting the vein grafts are the first choise that they have a high rate of blood flow and infectious resistance.[22] In 10 patients (55.6%) who had no chance of primary repair and end-to-end anastomosis, we used saphenous vein grafting. For the 4 patients (22.2%) who had hypotensive shock , the revascularization with PTFE graft was performed in order to shorten the operation time. We performed femoropopliteal bypass with proximal and distal ligation at the wound site of 3 patients with SFA injury within the Hunter's canal.

As a result; In areas where the civil war, such as Somalia, continues, higher mortality and amputation rates depends on to the lower-extremity vascular injuries, insufficient initial intervention, difficulty in vascular surgery, higher infection rates. Revascularization should be provided as soon as possible after ligation to achieve hemostasis, especially in the field hospitals. Although an autogenous graft is recommended for the risk of infection, PTFE grafts should be considered as an alternative method in order to shorten the operation time and provide revascularization as soon as possible in hypotensive shock patients.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Oğuz Uğur, Ali Özgür Karakaş ;* ***Design:*** *Oğuz Uğur, Ali Özgür Karakaş;* ***Control/Supervision:*** *Oğuz Uğur, Ali Özgür Karakaş;* ***Data Collection and/or Processing:*** *Oğuz Uğur, Ali Özgür Karakaş;* ***Analysıs and/or Interpretation:*** *Oğuz Uğur, Ali Özgür Karakaş;* ***Literature Review:*** *Oğuz Uğur;* ***Writing the Article:*** *Oğuz Uğur;* ***Critical Review:*** *Ali Özgür Karakaş.*

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