POPLİTEAL VE DİZALTI TRAVMATİK ARTERYEL YARALANMALAR (BULGULAR, RİSK FAKTÖRLERİ VE TEDAVİ)

Traumatic Popliteal and Infrapopliteal Arterial Injuries (Findings, Risk Factors and Treatment)

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ÖZET

Amaç: Popliteal ve infrapopliteal travmatik arteriyel yaralanmayı takiben uzuv kaybı, hastanın yaşamı ve işlevselliği üzerinde ciddi etkilere sahiptir. Bu çalışmanın amacı kliniğimizde retrospektif olarak tedavi edilen popliteal ve infrapopliteal arter yaralanmalarının sonuçlarını incelemektir.

Gereç ve Yöntemler: Ocak 2012 ve Kasım 2018 arasında; Travmatik popliteal ve infrapopliteal arter yaralanmaları nedeniyle acil cerrahi geçiren 30 hasta analiz edildi.

Bulgular: Hastaların 27'si (% 90) erkek ve 3'ü (% 10) kadın idi. Yaralanma şekli olguların% 43'ünde bıçak yaralanması (Grup 1),% 23,3'ünde (Grup 2) ateşli silah yaralanması ve % 33,3'ünde (Grup 3) künt travma vardı. Ortalama MESS skoru tüm olgularda 3.90 iken Grup 1'de 3.15 ± 1.57, Grup 2'de 4 ± 0.82 ve Grup 3'te 4.8 ± 1.32 idi. Amputasyona giden 3 vaka da künt travma nedeniyle oluşmuştu. Delici-kesici alet yaralanması olan hastalarda diğer yaralanma tiplerine göre daha kısa bir hastanede yatış süresi gözlendi (p <0.001). Uygulanan cerrahi teknikler; primer tamir 8 (% 20,5), ters safen ven interpozisyonu 20 (% 51,2), ligasyon 11 (% 28,2) idi. Grup 1'de bir hastada, Grup 2'de 4 hastada ve Grup 3'te 1 hastada kompartman sendromu gelişti. Amputasyon uygulanan 3 hasta grup 3'de idi.

Sonuç: Fizik muayene ve uygun görüntüleme yöntemleriyle doğru ve hızlı tanı koymak, uygun yöntemlerle revaskülarizasyon sağlamak, gerektiğinde fasiyotomi yapmak hastayı ve ekstremiteyi kurtarmak için önemlidir.

Anahtar Kelimeler: Travma; Arteryel yaralanma; Popliteal arter; Dizaltı arterler

ABSTRACT

Objective: Limb loss following popliteal and infrapopliteal traumatic arterial injury has serious implications on the patient's life and functionality. The objective of this study is to review popliteal and infrapopliteal arterial injuries treated in our clinic retrospectively.

Material and Methods: Between January 2012 and November 2018; 30 patients whom underwent emergency surgery due to traumatic popliteal and infrapopliteal arterial injuries were analyzed.

Results: There were 27 (90%) males and 3 (10%) females. The mechanism of injuries was stab wounds in 43% of the cases (Group 1), gunshot wounds in 23,3% (Group 2) and blunt trauma in 33.3% (Group 3). The mean MESS score was 3.90 in all cases, while it was 3.15±1.57 in Group 1, 4±0.82 in Group 2 and 4.8±1.32 in Group 3. All 3 cases of amputation were resulted from blunt trauma. A shorter length of hospitalization was observed in patients with stab wounds compared to other injury types (p<0.001). Primary repair was performed in 8 (20.5%), reverse saphenous vein interposition in 20 (51.2%), and ligation was in 11 cases (28.2%). Compartment syndrome was developed in one patient in Group 1, 4 patients in Group 2 and 1 in Group 3. Three patients were undergone in group 3.

Conclusion: It is important to provide accurate and rapid diagnosis by physical examination, appropriate imaging methods and providing revascularization with appropriate methods and performing fasciotomy, when necessary, in order to save the patient and related extremity.

Key words: *Trauma; Arterial injury; Popliteal artery; Infrapopliteal arteries.*

INTRODUCTION

Blunt popliteal and infrapopliteal crural artery injuries that following lower extremity trauma are often associated with loss of extensive tissue and extremities due to bone fractures. Penetrating arterial injuries have better prognosis as they are less traumatic. Although surgery is performed as the classical treatment method in the presence of distal ischemia, ligation of the injured vessel or conservative treatment can be applied in cases where there is no ischemia (1).

There are two main purposes in surgical intervention for popliteal and infrapopliteal arterial injuries. The first one is to save the patient's life and the second is the limb salvage. The limb salvage rate is over 95% in patients with uncomplicated penetrating arterial injuries. However, despite a successful surgical intervention, high amputation rates such as 70% can be seen in case of severe bone fractures and soft tissue injuries (2). Factors affecting the loss of extremity include wide tissue damage, duration of ischemia up to revascularization, venous injuries, popliteal artery injury, compartment syndrome, injury type and failed revascularization. Mengled Extremity Severity Scoring (MESS) system is helpful to give the decision of amputation therefore it is not 100% sensitive (3-5).

The aim of the study is to evaluate the popliteal and infrapopliteal arterial injuries which were treated in our clinic retrospectively in the light of literature.

MATERIAL AND METHOD

Between January 2012 and November 2018; 30 patients who underwent emergency surgery in our clinic due to traumatic popliteal and infrapopliteal arterial injuries were evaluated resrospectively. Age, gender, type of injury, clinical findings, comorbid injuries, presence of compartment syndrome, techniques of arterial repair, amputation rates and hospital stay time were evaluated.

The diagnosis of arterial injuries was made by physical examination, whereas in patients with stable hemodynamics and suspected arterial injury the diagnosis was made by lower extremity computed tomography angiography (CTA). In physical examination; active hemorrhage, poikilothermy, pallor, hematoma, reduced distal pulse amplitude compared to intact extremity and absent pulses, accompanying neurological deficits, soft tissue and bone injuries were evaluated. Bilateral lower extremity CTA was performed to determine the localization of arterial injury and to assess the distal vascular structure in stable patients. The severity of injury was classified according to the Mangled Extremity Severity Score (MESS) scoring system. The MESS was used to determine the injury severity in lower extremities by evaluating age, skeletal and muscle damage, shock, extremity ischemia and duration of ischemia (6). Ligation, end-to-end anastomosis, lateral repair, and reverse saphenous interposition were performed as surgical repair techniques. Saphenous vein in the opposite leg was prepared in patients that underwent saphenous vein graft interposition procedure.

Fasciotomy was performed in patients presenting with compartment syndrome and prolonged duration of ischemia. The lateral and medial compartments were decompressed.

The patients were discharged or referred to orthopedics or plastic surgery clinics, if necessary, after the vascular treatment process was completed.

Statistical Analysis:

Datas were expressed as mean±standard deviation or frequency and percent. Independent sample t test was used to compare the continuous normal data between/among groups. Chi-Square test was used to compare the categorical data between/among groups. Categorical variables were presented as a count and percentage. Pearson correlation coefficient test was used for correlation between variables. A p-value <0.05 was considered significant. Analyses were performed using SPSS 19 (IBM SPSS Statistics 19, SPSS inc., an IBM Co., Somers, NY).

RESULTS

Of the 30 patients operated, 27 (90%) were male and 3 (10%) were female. The mean age was 42.43±16.91. Thirteen (43%) of the cases had stab wounds (Group 1), 7 (23,3%) had gunshot wound (Group 2) and 10 (33.3%) had blunt trauma (Group 3). The distribution of the quantitative variables by type of injury is given in Table 1.

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Table 1: Distribution of Quantitative Variables According to Groups

	Type of Injury			
	Stab wounds (Group 1)	Gunshot wound (Group 2)	Blunt Trauma (Group 3)	p
	mean±sd	mean±sd	mean±sd	
Age	42,85±17,88(ab)	30,29±6,82(a)	50,4±16,67(b)	0,048
Syastolic Blood Pressure	126,92±9,47	117,14±18,9	114,3±25,5	0,244
Diastolic Blood Pressure	78,46±3,76	72,86±12,54	69,5±18,02	0,226
Hematocrit	39,49±5,52	34,64±6,38	33,83±6,79	0,079
MESS score	3,15±1,57(a)	4±0,82(ab)	4,8±1,32(b)	0,025
¬Hospitalization Time (day)	5,62±2,66(a)	12,14±4,41(b)	12,8±3,74(b)	<0,001

One-way variance analysis was used. The common letter in lines refers to statistical insignificance.
MESS: Mengled Extremity Severity Score

The mean MESS score was 3.90 in all cases, while it was 3.15±1.57 in Group 1, 4±0.82 in Group 2 and 4.8±1.32 in Group 3. In addition, it was observed that blunt traumas were significantly higher than stab wounds. (p=0.025) (Table 1). All 3 cases of amputation were resulted from blunt trauma. There was no significant difference in the duration of hospitalization after gunshot and blunt injuries, whereas a shorter length of hospitalization was observed in patients with stab wounds compared to the other injury types (p<0.001) (Table 1). Of 39 arterial injuries, primary repair (end to end anastomosis, lateral repair) was performed in 8 (20.5%), reverse saphenous vein interposition was performed in 20 (51.2%), and ligation was performed in 11 cases (28.2%) (Table 2). There were 8 venous and 5 nerve injuries associated with arterial injury. There were 6 bone fractures in Group 1, 5 in Group 2 and 9 in Group 3. There was no statistically significant difference between the groups. In Group 1, there was no accompanying nerve injury, whereas there were 3 in Group 2 and 2 in Group 3, and there was a statistically significant difference between group 1 and 2 (p=0.046). The evaluation of the groups by major tissue loss revealed that there was none in the Group 1 and 2 while 4 patients presented with tissue loss in Group 3, which was statistically significant (p=0.01). Compartment syndrome was developed in one patient in Group 1, 4 patients in Group 2 and 1 in Group 3. There was a statistically significant difference in Group 2 compared to the other two groups (p = 0.01). Poikilothermy were observed in 2 patients with stab wounds , 5 patients with gunshot injuries and 6 patients with blunt injuries. In addition, the distal pulse deficiency were in 4 patients in Group 1, 6 patients in Group 2 and 6 patients in Group 3. There was no statistically significant difference between the arterial repair techniques applied in the groups. There were no amputated patients in group 1 and 2, whereas 3 patients underwent amputation in group 3. There was no mortality in our patients, but functional impairment was observed in 1 patient in Group 2 and 2 patients in Group 3. (Table 2).

Table 2: Distribution of Qualitative Variables According to Groups

		Injury Types			
		Stab wounds (Group 1)	Gunshot wound (Group 2)	Blunt Trauma (Group 3)	p
		n(%)	n(%)	n(%)	
Gender	Male	12(92,3)	7(100)	8(80)	0,374
	Female	1(7,7)	0(0)	2(20)	
Popliteal artery	Absent	10(76,9)	5(71,4)	7(70)	0,925
	Present	3(23,1)	2(28,6)	3(30)	
1 artery	Absent	4(30,8)a	5(71,4)ab	8(80)b	0,041
	Present	9(69,2)a	2(28,6)ab	2(20)b	
2 arteries	Absent	11(84,6)	4(57,1)	5(50)	0,181
	Present	2(15,4)	3(42,9)	5(50)	
3 arteries	Absent	11(84,6)	6(85,7)	10(100)	0,433
	Present	2(15,4)	1(14,3)	0(0)	
Vein injury	Absent	12(92,3)	5(71,4)	5(50)	0,075
	Present	1(7,7)	2(28,6)	5(50)	
Nerve injury	Absent	13(100)a	4(57,1)b	8(80)ab	0,046
	Present	0(0)a	3(42,9)b	2(20)ab	
Bone fracture	Absent	7(53,8)	2(28,6)	1(10)	0,083
	Present	6(46,2)	5(71,4)	9(90)	
Major soft tissue disruption	Absent	13(100)a	7(100)ab	6(60)b	0,010
	Present	0(0)a	0(0)ab	4(40)b	
Compartment syndrome	Absent	12(92,3)a	3(42,9)b	9(90)ab	0,019
	Present	1(7,7)a	4(57,1)b	1(10)ab	
Distal Pulses	Absent	4(30,8)	6(85,7)	6(60)	0,055
	Present	9(69,2)	1(14,3)	4(40)	
Cold extremity	Absent	11(84,6)a	2(28,6)b	4(40)ab	0,023
	Present	2(15,4)a	5(71,4)b	6(60)ab	
End to end anastomosis	Absent	11(84,6)	7(100)	7(70)	0,260
	Present	2(15,4)	0(0)	3(30)	
Lateral repair	Absent	10(76,9)	7(100)	10(100)	0,113
	Present	3(23,1)	0(0)	0(0)	
Patchplasti	Absent	13(100)	7(100)	10(100)	-
	Present	0(0)	0(0)	0(0)	
Reverse saphenous vein interposition	Absent	7(53,8)	0(0)	3(30)	0,050
	Present	6(46,2)	7(100)	7(70)	
Ligation	Absent	8(61,5)	3(42,9)	8(80)	0,290
	Present	5(38,5)	4(57,1)	2(20)	
Amputation	Absent	13(100)a	7(100)a	7(70)b	0,036
	Present	0(0)a	0(0)a	3(30)b	
Mortality	Absent	13(100)	7(100)	10(100)	-
	Present	0(0)	0(0)	0(0)	
Functional disability	Absent	13(100)	6(85,7)	8(80)	0,259
	Present	0(0)	1(14,3)	2(20)	

Chi-square test was used. Common letters between column rates indicate statistical insignificance.

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DISCUSSION

Vascular injuries of the extremities are the major cause of limb losses when they are not treated immediately and appropriately (7). The risk of arterial injury in blunt and gunshot injuries is higher than sharp object injuries. Higher amputation rates were observed in injuries involving wider surrounding tissues due to their effect on collateral circulation (8-10). The MESS scoring system described by Johansen and co-authors can successfully identifies severe extremity injuries and determine the indications for amputation correctly. This scoring system includes severity of musculoskeletal injury, presence of ischemia, shock and the age of the patient. It was stated that the score of 7 and above would mostly indicate amputation (6). When Dirschl et al. evaluated various scoring systems, they determined that a single scoring system could not accurately predict limb salvage. They stated that the MESS could be an objective way to evaluate injured limbs although it could not predict the rate of amputation (11). In our study, the MESS score was significantly lower in Group 1 than Group 3 (p=0.02). There was no significant difference between group 2 and group 3. Two of the cases were amputated due to blunt trauma and one was due to gunshot injury.

Physical examination findings in arterial injury were distal pulse failure or not. If weaker pulses compared to the other extremity, arterial bleeding, increased hematoma, murmur or thrill at the site of injury and poikilothermy. Computed tomography angiography (CTA) is a diagnostic method that should be performed in patients with difficult surgical exploration or suspected vascular injuries. The fastest method to salvage and ensure the vitality of limbs, which are significantly compromised by ischemia, is arterial and venous exploration and repair according to the type of injury. Routine diagnostic methods should not be performed in hemodynamically unstable patients with active arterial haemorrhage; immediate surgical intervention should be performed instead. Extremity pulse deficiency may be associated with collateral circulation. When the patients with collateral circulation were compared to those who had ischemia, it was found that the amputation rates were higher in the group with ischemia (10). The physical examination of the patients who were treated in our clinic revealed that 13 (43%) patients had poikilothermy and 16 (53%) had absent distal pulses. The patients with stable hemodynamics and no signs of critical limb ischemia underwent lower extremity CTA to determine the status of the vascular injury.

Compartment syndrome is associated with insufficient blood supply, combined arterial and venous injuries, intraoperative blood loss, multiple arterial injuries and preoperative pulse failure (3). Early decompressive therapy may prevent neuromuscular damage. The data demonstrates that prophylactic fasciotomy is superior to early therapeutic decompression (12,13). On the other hand, in a study performed by Topal et al., prophylactic fasciotomy was performed in patients with ischemia duration of 6 hours or more. It was reported that the amputation rates were 2.5 times higher in patients with compartment syndrome despite undergoing fasciotomy, the rate of amputation was similar in all patient groups in the patients who underwent prophylactic fasciotomy, and amputation rates were increased in the patients who develop compartment syndrome, regardless of the protective effects of prophylactic fasciotomy (15). In our study, compartment syndrome was observed in 1 patient in Group 1, 4 patients in Group 2 and 1 patient in Group 3. In Group 2, there was a statistical significance compared to group 1. Postoperative lateral and medial fasciotomy were performed in all of these patients. Prophylactic fasciotomy was not performed in any patient. These patients did not develop compartment syndrome. Multiple arterial and venous injuries were present in patients with compartment syndrome. They had a prolonged ischemia times due to late delivery to our hospital.

The treatment of accompanying venous injuries is still controversy. While some studies reported that there was a correlation between venous injury and limb salvage (3), Timberlake et al. (15) noted in their study that venous ligation was performed in 70% of 322 venous injuries accompanied by arterial injuries, and none of them had permanent sequelae. In our study, the venous injuries that were accompanied by arterial injuries in lower limb traumas were ligated due

to the fact that the injured venous structures were not suitable for reconstruction. There was no postoperative complications associated with venous insufficiency.
Hafez et al. reported that (10) the amputation rates in the injuries of common and superficial femoral arteries were 12%, which increased to 21% in the popliteal and tibial arterial injuries. In the unilateral series that carried out by Moniz et al. (16), they determined a high rate of amputation as 36% in the below knee arterial injuries. Presence of multiple arterial injuries is associated with a higher rate of limb loss compared to a single crural arterial injury (9,10). In our study, two of the 3 cases undergoing amputation had 2 arterial injuries and one had a popliteal arterial injury.

It was stated that injured arteries can be safely ligated if there is no limb ischemia and there is a single-vessel injury in the tibial arteries (17). Topal et al. (14) demonstrated that the amputation rates were 75% in cases where two tibial arteries were ligated. Another study also reported that the amputation rates after ligation of a tibial artery were 14%, which then increased to 65% following the ligation of two arteries. The factors leading to limb loss in lower extremity injuries include multiple vascular injuries, as well as neuromuscular trauma and/or a very large, irreversible microvascular thrombosis. In our study, it was observed that only one of the cases with single-vessel ligation underwent amputation, in which was also accompanied by combined neuromuscular and venous injuries. In conclusion, the repair of at least two crural arteries is required for limb salvage.

Primary repair is rarely performed due to the small diameter of the arteries in below knee arterial injuries. The two most commonly used methods are the saphenous vein graft interposition or bypass (18).
Popliteal artery injuries are the most common injuries that threat limb viability (9,19). The popliteal artery has insufficient collateral supply. The popliteal vein is responsible for venous drainage of the lower extremities. Popliteal arterial injuries constitute 19% of all extremity injuries in the civilian population (20). An end-to-end anastomosis is the preferred method for popliteal arterial injuries, if applicable. It should be avoided from ligating and cutting the geniculate collateral because of its negative effect in lower limb circulation. Many surgeons recommend that the great saphenous vein graft interposition from the opposite leg as a method of popliteal artery repair (20,21) In our study, popliteal artery injuries were observed in 3 patients due to stab injuries, 2 patients due to gunshot injuries and 3 patients due to blunt injuries. Reverse saphenous vein interposition was performed in all of these cases. One case resulted with amputation.

CONCLUSION

In cases of popliteal and distal arterial injuries in the lower extremities, it is important to provide accurate and rapid diagnosis by physical examination and appropriate imaging methods. In addition, it is highly critical to provide revascularization by appropriate methods and to perform fasciotomy, when necessary, in order to save the patient and ensure the salvage of related extremity.

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