



Gradually increasing predominance of self-mutilation in upper extremity arterial injuries: less morbidity but with high threat to society

Üst ekstremitte arter yaralanmalarında self-mutilasyonun gittikçe artan predominansı: Düşük morbiditesi olsa da toplum için büyük tehdit

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BACKGROUND

Although vascular trauma of the upper extremity is increasingly more common, mortality and morbidity rates remain low, at between 0-8%. Self-mutilation has become evident in recent years. We planned this study to compare the results of self-mutilation with other penetrating trauma in upper extremity vascular injuries and also to emphasize the dangers of self-mutilation for society.

METHODS

Data of 249 patients with penetrating vascular injury of the upper extremity were retrospectively analyzed. There were 214 male (86%) and 35 female (14%) patients, with a mean age of 24.76 ± 11.28 years (range: 2-69 years). Of these, 129 (52%) were self-mutilators.

RESULTS

The ulnar artery was the most frequently affected ($n=140$, 56%). There was no mortality or limb loss. However, eight (3.21%) patients, who had penetrating trauma, had restriction in finger motions. Male predominance, substance abuse and associated nerve injury were significantly more common among self-mutilators (p values <0.001 , <0.001 and 0.005 , respectively), whereas brachial artery injury, vein graft interposition and fasciotomy rates were higher among the penetrating trauma group ($p<0.001$ for all).

CONCLUSION

The form of and reason for injuries and presence of substance abuse in case of self-mutilation must be investigated cautiously, and the immediate commencement of psychiatric treatment must be provided to the self-mutilators.

Key Words: Penetrating injury; self-mutilation; upper extremity.

AMAÇ

Üst ekstremitte vasküler yaralanma sıklığı giderek artmakla beraber, mortalite ve morbidite oranları %0-%8 arasında kalmaktadır. Son yıllarda self-mutilasyon olguları belirgin olarak karşımıza çıkmaktadır. Üst ekstremitte vasküler yaralanmalarında self-mutilasyon ve diğer penetran travma sonuçlarını karşılaştırmak ve self-mutilasyonun toplum için oluşturduğu tehditi ortaya koymak amacıyla bu çalışmayı planladık.

GEREÇ VE YÖNTEM

Üst ekstremitte penetran vasküler yaralanması tanısıyla ameliyat edilen 249 hastanın verileri retrospektif olarak değerlendirildi. Hastaların 214'ü (%86) erkek, 35'i kadındı (%14). Ortalama yaş $24,76 \pm 11,28$ idi (dağılım, 2-69 yaş). Hastaların 129'u (%52) self-mutilatördü.

BULGULAR

En sık yaralanan arter ulnar arterdi ($n=140$, %56). Ölüm ve uzuv kaybı yaşanmadı. Ancak, penetran travmalı 8 hastada parmak hareket kısıtlılığı ortaya çıktı. Erkek baskınlığı, madde bağımlılığı ve eşlik eden sinir yaralanması varlığı self-mutilatör grupta anlamlı olarak daha yaygındı (sırasıyla p değerleri $<0,001$, $<0,001$ ve $0,005$). Buna karşılık brakial arter yaralanma sıklığı, ven greft interpozisyon kullanımı ve fasyotomi oranları penetran travma grubunda daha yüksekti (p değerleri $<0,001$).

SONUÇ

Üst ekstremitte penetran travmalarında, yaralanma şekli ve sebebi dikkatlice sorgulanmalı, self-mutilasyon varlığında madde bağımlılığı araştırılmalı ve self-mutilatör hastalara hemen psikiyatrik destek başlanması sağlanmalıdır.

Anahtar Sözcükler: Penetran yaralanma; self-mutilasyon; üst ekstremitte.

Vascular injuries of the upper extremity represent approximately 30% to 50% of all peripheral vascular injuries, and are major complications of military and civilian trauma, more than 60 to 90% of which are from penetrating trauma.^[1,2] Nowadays, the overall amputation rate has been lowered to 0-8% compared with 49% in World War II.^[1,3-5] The mortality rate is primarily related to other associated severe injuries; however, morbidity is also frequently related to associated upper extremity injuries, with nerve injury being the most important.^[1-3,5-8] The mechanism of injury seems to differ in different parts of the world.^[9,10] Blunt injuries account for 6-10% of upper extremity vascular trauma and are often associated with musculoskeletal injuries and neural injuries.^[2,5]

Self-mutilation is defined as any intentional injury to one's own body. Cutting one's skin with razors or knives is the most common pattern of self-mutilation. The behavior is not limited by education, age, sexual orientation, socioeconomic status, or religion.^[11]

The aim of this study was to indicate the increased rate of self-mutilation among the penetrating arterial injuries of the upper extremity and to call surgeons' attention to the importance of self-mutilation.

MATERIALS AND METHODS

A retrospective chart review of 249 patients with penetrating vascular injuries of the upper extremity, who underwent revascularization at our reference center between September 2002 and January 2008, was performed. Criteria for inclusion into this study were penetrating injuries with a visible wound of the vascular structure, confirmed by operative findings. Data regarding age, sex, mechanism of injury, anatomic injury location, associated nerve and/or tendon injury, arterial repair techniques, fasciotomy procedure, and substance abuse were gathered. According to the mechanism of injury, the patients were divided into two groups as self-mutilation (Group 1) or other penetrating injury (Group 2). In addition to blunt trauma, axillary artery injuries were excluded as well, to maintain the similarity of the two groups, because there was no patient with axillary artery injury in the self-mutilation group.

The diagnosis of an upper extremity vascular injury is initially made by physical examination as part of the full trauma assessment. The classic five P's - pain, pulselessness, pallor, paresthesias, and paralysis - may be partially present or may be absent in many patients. Some patients with proximal brachial artery injuries may have palpable pulses at the wrist. Depending on the mode of presentation, most patients were taken immediately to the operating room for vascular or orthopedic/vascular management. In others with soft signs or doubtful vascular injury and when patients were

stable, preoperative duplex ultrasonography or rarely angiography was performed.

Patients with more severe soft tissue and muscle injuries were treated with complete debridement of all grossly nonviable tissue, with removal of foreign bodies and irrigation with isotonic saline.

Management of vascular injuries was performed in the operating room under local anesthesia or general anesthesia if combined with nerve and tendon injury. Endoluminal shunts were not used in any patient. Repaired vessels, especially at the anastomotic suture lines and graft location, were completely covered with muscles and soft tissue to prevent desiccation and disruption.

Because the injury mechanism was knife or glass in most patients, the injured edges of nerves and tendons were sharp and smooth. Therefore, associated tendon and nerve injuries were repaired immediately at the same time, with primary repair in a few hours. Tendons were repaired primarily by using modified Kessler technique, and injured nerves were treated with the group fascicular nerve repair technique, mostly with the aid of microscope. In the case of unsuccessful primary nerve repair, sural nerve was preferred for nerve graft.

Major associated venous injuries were repaired whenever possible, in an attempt to prevent postoperative venous hypertension and to minimize development of compartment syndrome. Depending on the condition of the limb after revascularization, open full fasciotomy was carried out liberally to either relieve existing compression or to avoid one from occurring in the postoperative period. Fasciotomy wounds were usually covered later by a delayed primary, split-thickness skin graft. The patients with associated orthopedic injury underwent reduction of joint dislocation or bone fracture and immobilization by internal or external fixation.

All patients also received intravenous heparin for a period of 3-5 days postoperatively and were discharged home on oral aspirin 150 mg tablet/day and pentoxifylline 800 mg/day for a period of 12 weeks.

Mean and standard deviation (SD) were calculated for continuous variables. The normality of the variables was analyzed by Kolmogorov-Smirnov test. The means of independent groups were analyzed by Student's t test. Fisher exact and Pearson chi-square tests were used to analyze the categorical variables. P values were considered statistically significant at $p < 0.05$.

RESULTS

Of the 249 patients with penetrating arterial injury of the upper extremity, there were 214 male (85.94%)

and 35 female (14.06%) patients, with a mean age of 24.76±11.28 years (range: 2-69 years). The cause of trauma was self-mutilation in 129 (51.81%). The other penetrating injuries were gunshot wounds in 18 patients and stab or glass wounds in 102 patients. Although age distribution among self-mutilators and patients with other penetrating traumas was not different, male predominance in self-mutilators was significant (p<0.001).

Most patients had only one arterial injury; however, 30 patients had both ulnar and radial arterial injuries. The ulnar artery was the most frequently affected (140 patients, 50.18%), followed by the radial artery (107 patients, 38.35%) and brachial artery (32 patients, 11.47%). Brachial artery involvement was found 10-fold more in Group 2, whereas ulnar artery injury was 1.5-times more common in the self-mutilation group. Overall, 171 nerve injuries accompanied arterial injuries in 148 (59.44%) patients, and of these, 93 were self-mutilators. The most frequently injured nerve was the ulnar nerve (108 patients, 63.16%), followed by median nerve (53 patients, 30.99%) and radial nerve (10 patients, 5.85%). In 23 patients, there were two nerve injuries (ulnar and median nerves in 22 patients, radial and median nerves in 1 patient). Radial nerve injury was very seldom among self-mutilators. Bone fractures were seen in only eight (3.21%) patients (one ulna, one metacarpal and six humerus fractures), all of whom were in Group 2. The distribution of arterial and associated nerve injuries differed significantly between groups as seen in Table 1 (p<0.001 and p=0.005, respectively).

Totally, 279 interventions were performed in 249 patients. Arterial repair performed by end-to-end anastomosis (189 times, 67.74%) was the most frequently used single technique of arterial repair. Other techniques were interposition vein graft (19.71%), primary lateral repair (7.89%), ligation (4.3%), and synthetic graft (0.36%, in only one patient to repair the brachial arterial injury near the axillary junction, which was still patent at the second-year follow-up). In the self-mutilation group, end-to-end anastomosis was carried out mostly; however, in Group 2, primary repair was usually not likely and vein graft interposition was performed more than other techniques since arterial defects were too large to bring the edges of the arteries closer (p<0.001).

Concomitant venous injuries were mostly ligated. However, in four patients, end-to-end anastomosis, in three patients vein graft interposition and in two patients primary lateral repair were performed. Tendon injuries were determined in 157 patients (63.05%), and all were repaired by orthopedic surgeons. In 148 patients, 171 primary nerve repairs were performed by orthopedic surgeons or neurosurgeons primarily. However, in two patients, “good regeneration findings” were not obtained by electromyography at the third month follow-up, so sural nerve graft was positioned in those patients at the fourth month of trauma. Nerve injury was encountered in 64.63% of patients, more commonly among self-mutilators (72.09% versus 45.83%, p=0.005). Fasciotomy was performed in 16 patients (6.43%), only two with self-mutilation. Need for fasciotomy was more common in Group 2 (p=0.001).

Table 1. Characteristics of patients and differences between self-mutilation and penetrating injuries

Variables	Self-mutilation (n=129)	Penetrating trauma (n=120)	p
Age (/years)	24.41±5.94	25.15 ± 11.31	0.874
Male	127 (98.45%)	87 (72.5%)	<0.001
Injured artery	146	133	<0.001
Radial artery	58 (39.73%)	49 (36.84%)	
Ulnar artery	85 (58.22%)	55 (41.35%)	
Brachial injury	3 (2.05%)	29 (21.81%)	
Associated nerve injury	101 (in 93 patients)	70 (in 55 patients)	0.005
Radial nerve	1 (0.99%)	9 (12.86%)	
Ulnar nerve	68 (67.33%)	40 (57.14%)	
Median nerve	32 (31.68%)	21 (30%)	
Arterial repair techniques	146	133	<0.001
End-to-end anastomosis	129 (88.36%)	60 (45.11%)	
Primary lateral repair	6 (4.11%)	16 (12.03%)	
Vein graft interposition	10 (6.85%)	45 (33.84%)	
Ligation	1 (0.68%)	11 (8.27%)	
PTFE	–	1 (0.75%)	
Fasciotomy	2 (1.55%)	14 (11.67%)	0.001
Substance abuse	41 (31.78%)	6 (5%)	<0.001

PTFE: Polytetrafluoroethylene.

No patient underwent amputation and none died as a consequence of upper limb vascular injury. A limb salvage rate of 100% was therefore achieved. However, eight (3.21%) patients in Group 2 had restriction in finger motions.

Substance abuse was present in 47 patients, and of these, 41 were self-mutilators (31.78% in self-mutilation group versus 5% in Group 2, $p < 0.001$).

DISCUSSION

Vascular injuries of the upper extremities are not rare, accounting for approximately 50% of all peripheral vascular injuries. The mechanism of injury differs according to social, cultural and economical status; however, penetrating traumas are more common.^[1,2,5,12-14] In the past, mortality and morbidity rates, especially amputation, were high, but nowadays amputation is seen very rarely (0-8%) and mortality is near zero.^[1] Timely restoration of blood flow is essential to optimize outcome. Revascularization should be completed within the critical ischemic time: 4 hours for proximal injuries and 12 hours for distal injuries.^[2] While successful treatment of major arterial injuries may be life-saving and also allow limb salvage and restoration of function, return of function is often related to the presence of concomitant injury to peripheral nerves.^[1-3,5-8]

The management and outcomes of upper extremity arterial injuries are nearly the same worldwide. The difference between this study and other series is related to the reasons for and the form of the injury because in the existing publications, penetrating injuries occurred either accidentally or were caused consciously by other persons. However, half of the injuries considered in this study were self-inflicted, referred to as self-mutilation, as a result of a moment's anger, and such injuries usually occurred in the form of severance of vessels as a result of punching through glass.

Upper extremity vascular injuries are mostly seen in young males;^[5,12,14] however, in this study, we determined that the male dominance in self-mutilators was more visible. Although in many series regarding penetrating injuries, the brachial artery was the most frequently involved,^[1,2,5,6,12,15,16] in this series, we observed mostly radial and ulnar artery injuries, and the reason for this was that only 7% of the victims suffered firearm injuries, and brachial injuries were near zero in the self-mutilation group. However, the nerve injury frequency was greater compared to other series.^[5,12] This situation may be explained by the frequent involvement of ulnar artery injuries and the presence of anatomic adjacency between the ulnar nerve and ulnar artery.

In the self-mutilation group, we also saw that the vascular damage did not occupy large segments, pri-

mary repair was possible in most of the cases, and the need to use grafts was minimal. Fasciotomy is mostly used in lower extremity vascular injuries, yet in some brachial artery injuries, compartment syndrome develops and urgent fasciotomy may be required.^[16,17] In this series, we performed fasciotomy in 16 patients, who had developed or were at risk of compartment syndrome, and only two of the patients were self-mutilators; this was another data supporting that the injuries in the self-mutilation group were less complicated. The positive effects of lack of broad vascular, nerve or tissue defects on morbidity have been reflected in better results, yet we do not believe that the injuries, which occurred as a result of self-mutilation, are more innocent. In fact, the increase in the frequency of such injuries is more worrisome.

A common belief regarding self-mutilation is that it is a way to express things that can not be put into words such as displaying anger, shocking others or seeking support and help; however, in most cases, this is inaccurate. It usually occurs when people face what seems like overwhelming or distressing feelings such as loss of a relative or an argument with their partner or friend. Self-mutilators might feel that self-mutilation is a way of temporarily relieving intense feelings, pressure or anxiety. Self-mutilation can be a symptom of psychiatric illness including personality disorders (particularly borderline personality disorder), bipolar disorder, major depression, anxiety disorders (particularly obsessive-compulsive disorder), and schizophrenia.^[18-20] Even though there is the possibility that a self-inflicted injury might result in life-threatening damage, self-mutilation is not considered to be suicidal behavior.^[19] However, becoming a habitual self-injurer is a progressive process, and self-injury is strongly linked to a poor sense of self-worth. Over time, that depressed feeling can spiral into a suicidal attempt.^[20,21] In addition, it is known that self-mutilators show a tendency to crime and even murder in the following process and therefore these persons also constitute a threat to society as well as themselves.

There are some common factors among people who engage in self-injury, like co-existing problems of substance abuse, lacking skills to express their emotions and lacking a good social support network.^[22] When we questioned patients regarding substance abuse, we observed a high rate of 31.78% among self-mutilators. However, this rate was only 4.55% in other patients with penetrating injuries. There is a close correlation between substance addiction and antisocial personality and also commitment.^[23-26] Substance abuse is associated with an increased risk of violent crime.^[27] A Canadian center on substance abuse reported that 40-50% of the crimes can be attributed to at least one psychoactive substance like alcohol or an illicit drug.

When substance abuse is added to the crime potential in self-mutilators, it is certain that we face very dangerous individuals.

Despite an underestimation because the majority of acts of self-mutilation go unreported, the numbers of self-mutilators are staggering. It is known that about two million people in the United States and considerably higher numbers in other parts of the world are self-injurers. Considering that the self-mutilation rates in the patients with upper extremity vascular injuries is on the increase and that such patients constitute a threat to both themselves and society, the form of and reason for injuries and presence of substance abuse in the case of self-mutilation must be investigated cautiously, and the self-mutilators must be directed to psychiatric treatment. The responsibility of vascular surgeons is not only to establish revascularization of an injured artery but also to contribute to the immediate commencement of psychiatric treatment of self-mutilators, thus ensuring the security of both self-mutilators and society at large.

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