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Evaluation of peripheral vascular injuries treated with surgery: A retrospective cohort study

Cerrahi tedavi yapılan periferik vasküler yaralanmalarda değerlendirme: Retrospektif kohort çalışma

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Etik Kurul Onayı: Çalışmanın retrospektif doğası nedeniyle etik kurul onayı alınmadı. İnsan katılımcıların katıldığı çalışmalardaki tüm prosedürler, 1964 Helsinki Deklarasyonu ve daha sonra yapılan değişiklikler uyarınca gerçekleştirilmiştir.

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Abstract

Aim: Vascular injuries constitute 2-3% of the total injuries. Early diagnosis and emergent management of peripheral vascular injuries, which have high mortality and morbidity rates if inadequately managed, are particularly important. In this study, we aimed to evaluate the etiology and treatment results of patients who underwent surgical treatment due to peripheral vascular injury.

Methods: This research was designed as a retrospective cohort study. The etiologies, localizations, accompanying injuries, surgical methods, and results of 57 cases operated due to peripheral arterial injury in Yozgat State Hospital and Bozok University Research Hospital between 2012 and 2019 were evaluated.

Results: Fifty-two patients were male (91.23%) while 5 were female (8.77%). The mean age of all patients was 27.6 (10.5) years (range: 4 - 63 years). Among etiologies, injury due to sharp objects and firearms were significantly higher (n=34 (59.6%) and n=16 (28%), respectively). Traffic accidents were the cause in 5 (8.7%) cases and occupational accidents had occurred in 2 (3.5%) patients. Arterial injuries were detected in 33 (56.89%) upper extremities and 24 (41.87%) lower extremities. End-to-end anastomoses were performed in 29 cases, lateral arteriorrhaphy (primary repair) was performed in 24, autogenous saphenous vein interposition in 4 and ligation was performed in one patient. No cases required fasciotomy or amputation and one patient with a multi-trauma died. A secondary operation was needed for hematoma, thrombectomy, and anastomosis revision in seven, five and three cases, respectively.

Conclusion: In vascular injuries, after ensuring hemodynamic stability, the primary aim is providing the accurate operation approach in the shortest time to reduce morbidity and mortality.

Keywords: Vascular trauma, Vessel repair, Peripheral arterial injury

Öz

Amaç: Tüm travmaların %2 ila %3'ünü vasküler travmalar oluşturmaktadır. Etkin tedavi edilmediğinde mortalite ve morbidite oluşturan periferik damar yaralanmalarında erken tanı ve acil tedavinin önemi büyüktür. Bu çalışmada periferik vasküler yaralanmayla cerrahi tedavi uyguladığımız olguların etiyolojisi ve tedavi sonuçlarının değerlendirilmesini amaçladık.

Yöntemler: Bu çalışma retrospektif kohort çalışması olarak tasarlanmıştır. 2012 ve 2019 tarihleri arasında Yozgat Devlet Hastanesi ve Bozok Üniversitesi Araştırma Hastanesinde periferik arter yaralanması ile operasyona alınan 57 olgu etiyolojileri, lokalizasyonları, eşlik eden yaralanmalar, uygulanan cerrahi yöntemler ve sonuçları retrospektif olarak değerlendirildi.

Bulgular: Hastaların 52'si erkek (%91,23), 5'i kadın (%8,77), yaş ortalaması; 27,6 (10,5) (4-63 yaşları arasında) idi. Yaralanma etiyolojilerine bakıldığında kesici delici alet yaralanmalarında ve ateşli silah yaralanmalarında önemli bir artış izlendi. Kesici delici vakaların 34'ünde (%59,6) kesici delici alet, 16'sında (%28) ateşli silah yaralanmaları mevcuttu. Buna karşın, vakaların 5'inde (%8,7) vasküler yaralanmaya yol açan trafik kazası, 2'sinde (%3,5) iş kazası yaralanması gözlendi. Olguların, 33'ünde (%56,89) üst ekstremitede, 24'ünde (%41,37) ise alt ekstremitede arter yaralanması tespit edildi. 29 Vakada uç-uca anastomoz, 24'ünde lateral reperasyon (primer tamir), 4'ünde otojen safen ven interpozisyonu ve 1 hastada ligasyon uygulandı. Multi-travmalı olan bir hastada mortalite gözlendi. Hiçbir hastada fasiyotomi ihtiyacı olmadı ve ampütasyon yapılmadı. 7 vakada hematom, 5 vakada postoperatif trombektomi, 3 vakada anastomoz revizyonu gerekti.

Sonuç: Vasküler yaralanmalarda, hemodinamik stabilitenin sağlanarak en kısa sürede en doğru operasyon yaklaşımının sağlanması morbidite ve mortalitenin azaltılmasında esastır. Zaman tetkik ikileminde, vakaya göre karar verilmesi hastalık yoktur hasta vardır ilkesi doğrultusunda her vakaya özel yaklaşımı gerekli kılmaktadır.

Anahtar kelimeler: Vasküler travma, Damar onarımı, Periferik arter yaralaması

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Introduction

The main cause of death and disability under the age of 45 years is injury, which shows an increasing incidence due to global sociocultural corruption [1,2]. Vascular injuries constitute 2-3% of total injury cases [3]. Early diagnosis and emergent management of peripheral vascular injuries, which have high mortality and morbidity rates if inadequately managed, are particularly important [4,5].

Illegal individual armament and violence are rising problems all around the world. Injuries, even loss of lives caused by violence is increasing day by day. Owing to the recent improvements in vascular surgery, extremity loss has reasonably decreased. In cases which multiple tissues, such as muscle, tendon, bone, and nerve tissue, are at risk, a multidisciplinary management strategy is necessary.

This study was conducted to investigate the contemporary epidemiology and patient outcome of vascular injuries in Turkey.

Materials and methods

This retrospective cohort research, conducted in Yozgat State Hospital and Bozok University Research Hospital, complies with the standards of Declaration of Helsinki. The etiologies, localizations, accompanying injuries, surgical methods, and results of 57 cases operated due to peripheral arterial injury between 2012 and 2019 were retrospectively evaluated.

Colored Doppler Ultrasonography (CDUS) was performed in every patient in addition to anamnesis taking and physical examination for diagnosis. In seven cases, computerized tomographic angiography (CTA) was used. All patients underwent surgery after hemodynamic stabilization. After exploration of the traumatic zone, injured vessels were clamped proximally and distally. In case of suspected emboli, embolectomy was performed. Before clamping the injured vessels, 40-90 IU/Kg Heparin was administered intravenously. Each patient received tetanus prophylaxis along with antibiotic drug treatment for seven days starting from the preoperative period. The patients were prescribed wide spectrum antibiotics and 150 mg acetylsalicylic acid at discharge if there were no contraindications. All patients were re-evaluated on the 10^{th} postoperative day.

Statistical analysis

Statistical analysis was conducted using the SPSS for Windows software package (ver. 17; SPSS Inc., Chicago, IL, USA). All variables were evaluated using visual (histograms, probability plots) and analytical (Kolmogorov Smirnov test) methods to determine normality of distribution. Continuous variables were reported as mean (SD) for normally distributed, and median with interquartile ranges for non-normally distributed variables. Categorical variables were presented as numbers and percentages.

Results

Fifty-two patients were male (91.23%) while 5 were female (8.77%). The mean age of all patients was 27.6 (10.5) years (range: 4 - 63 years) (Table 1).

Among etiologies, injury due to sharp objects and firearms were significantly higher (n=34 (59.6%) and n=16 (28%), respectively). Traffic accidents were the cause in 5 (8.7%) cases and occupational accidents had occurred in 2 (3.5%) patients (Table 2).

Arterial injuries were detected in 33 (56.89%) upper extremities and 24 (41.87%) lower extremities (Table 3). A. ulnaris was the most frequently injured artery, as seen in 32% (n=16) of the cases. In lower extremities a. femoralis was the most frequently injured artery, as observed in 18.96% (n=16) of the cases. V. femoralis was the most frequently injured vein, as observed 3.44% (n=2) of the cases. Among 57 cases, 55 arterial and 3 venous injuries were observed.

End-to-end anastomoses were performed in 29 cases (50%), lateral arteriorrhaphy (primary repair) was performed in 24 (41.4%), autogenous saphenous vein interposition in 4 (6.9%) and ligation was performed in one (1.7%) patient (Table 4). No cases required fasciotomy or amputation and one patient with a multi-trauma died. A secondary operation was needed for hematoma, thrombectomy, and anastomosis revision in seven, five and three cases, respectively. One patient had a wound infection and was treated with antibiotics. Postoperative complications are listed in Table 5. Mean hospitalization time was 7.4 (1.8) days (range: 5-15 days).

Table 1: Distribution of gender

Gender	Number (n)	Percent (%)
Male	52	91.23
Female	5	8.77

Table 2: Etiology of vascular trauma

Type of injury	Number (n)	Percent (%)
Sharp object injury	34	59.6
Firearm injury	16	28.0
Traffic accident	5	8.7
Occupational accident	2	3.5
Total	57	100

Table 3: Injured vessels

Injured vessel	Number (n)	Percent (%)
Upper Extremity Arterial Injury	33	56.89
A. Axillaris	1	1.72
A. Brachialis	5	8.62
A. Ulnaris	19	32.75
A. Radialis	7	12.06
A.Radialis+ A.Ulnaris	1	1.72
Lower Extremity Arterial Injury	24	41.37
A. Femoralis	11	18.96
A. Poplitea	8	13.79
A. Tibialis Posterior	3	5.17
A. Tibialis Anterior	2	3.44
Venous Injury	3	5.17
V. Femoralis	2	3.44
V. Brachialis	1	1.72

Table 4: Operational techniques

Operational techniques	Number (n)	Percent (%)
End to end anastomosis	29	50.0
Lateral reparation	24	41.4
Saphenous vein interposition	4	69
Ligation	1	1.72
Total	58	100

Table 5: Peroperative complications

Complication	Number (n)	Percent (%)
Hematoma	7	12.1
Postoperative thrombosis	5	8.62
Revision of anastomosis	3	5.17
Wound infection	1	1.72
Mortality	1	1.72

Discussion

Peripheral vascular injuries remain a serious health problem despite the decreased mortality and morbidity rates compared to the past. Etiology of vascular injury differ with region. The most common causes of peripheral vascular injuries

are firearms in the US, blunt traumas and iatrogenic causes in European countries and sharp objects in Turkey [3, 8-10].

In our study, sharp object injuries were the most frequent, followed by firearm injuries, while occupational accidents and traffic accidents were the rarest. Traffic density and industrial structure of our region is less in comparison to other regions. These results show that economic structure and vascular traumas may be related. According to numerous studies, vascular traumas are mostly seen in the young male population [6,7,10], just as in our study.

The first step in a vascular trauma is to achieve hemodynamic stability. Airway should be kept open; volume should be replaced, and active bleeding should be stopped. A direct pressure on the bleeding area is more beneficial than a tourniquet to maintain collateral circulation. The external compression should be sustained until traumatic vascular tissues are surgically managed [4,6,7,9,11]. Decreased traffic density and relatively low population of our region are the main advantages in the transportation of patients with vascular injuries. According to the data derived from Yozgat Local Health Authorities, the mean time of an ambulance reaching a patient in the city center is 6 minutes, which is lower than the country average of 10 minutes.

In extremity traumas, vascular repair should be performed primarily. Otherwise, serious complications may be observed [3-6,11]. All patients were managed with multidisciplinary involvement in the emergency unit. Orthopedic and Neurosurgery Clinics were consulted in case of related tissue injuries. However, vascular management was prioritized.

In most of the cases diagnosis is based on physical examination [3,6,9,11-14]. Radiological imaging is a crucial step in localizing the traumatic tissues. Therefore, color Doppler ultrasonography (CDUS) was our first option due to the practicality and needlessness of contrast material use. However, in blunt traumas CDUS may remain incapable and angiographic imaging is more beneficial [6,7-12]. The time lapse between diagnosing imaging and surgical management maybe lifesaving and life threatening.

There are many revascularization techniques, such as autologous and artificial graft use. However, the first choice should always be arteriorrhaphy (primary repair). End to end anastomosis and lateral arteriorrhaphy are the most used techniques [3-6,8,11,13].

In our patients, we preferred end to end anastomosis and lateral arteriorrhaphy. For interposition, we used the saphenous vein. In one patient we ligated the artery. The first aim should be to maintain the viability of original tissue.

Parry et al. claim that patency rate following venous repair is 73% [16]. Although we did not observe any vascular complications after venous repair among our patients, we think that the number of our cases is not adequate to generalize our results.

Postoperative wound infections are one of the serious complications following surgery among these patients. Antibiotherapy administered peroperatively both for prophylaxis and according to the culture antibiogram is crucial. It is important to be alert about resistant infections, especially those resulting from firearm injuries.

Limitations

As a result of the retrospective nature of the study, certain variables specifically related to peripheral vascular injury are not available, including specific vascular imaging or diagnostic tests. Another limitation of our study is the lack of autopsy of sudden deaths following a multi-traumatic vascular injury, which were impossible to include. Further multi-center studies involving larger number of cases would provide more realistic and meaningful statistical results.

Conclusion

In vascular injuries, providing the most accurate operation approach in the shortest time after ensuring hemodynamic stability is essential in reducing morbidity and mortality. In case of dilemma, it must be kept in mind that the patient, rather than the disease, must be cured, and a different approach may be required for each case.

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