

Peripheral Arterial Injuries

PERİFERİK ARTER YARALANMALARI

Nehir SUCU*, Barlas Naim AYTAÇOĞLU*, İlhan MAVİOĞLU*, Ali GÜL**, Kerem KARACA**, Murat DİKMENGİL***

* Yrd.Doç.Dr., Dept. of Cardiovascular Surgery, Medical School of Mersin University,

** Arş.Gör.Dr., Dept. of Cardiovascular Surgery, Medical School of Mersin University,

***Prof.Dr., Dept. of Cardiovascular Surgery, Medical School of Mersin University, Mersin, TURKEY

Summary

Objective: This study was conducted to evaluate the effect of ischemic interval, localization of injury and accompanying pathologies on the outcome of arterial reconstructions in peripheral arterial injuries.

Institution: Mersin University Medical Faculty, Mersin State Hospital

Materials and Methods: One hundred and eighteen patients were treated between 1997 and 2001 for peripheral arterial injuries in Mersin State Hospital and Mersin University, School of Medicine. 89 patients (75.4%) had stab wounds, 18 patients (15.2%) had gunshot wounds and 11 patients (9.3%) had blunt trauma. The most affected sites were femoral arteries in 47 patients (39.8%), brachial arteries in 27 patients (22.8%) and popliteal arteries in 19 patients (16.1%). Resection and end-to-end anastomosis in 56 patients (47.4%), saphenous vein graft interposition in 21 patients (17.7%) and ligation in 13 patients (11.1%) were performed. Two of the cases died due to accompanying severe head and thoracic traumas.

Conclusion: Localisation of injury, ischemic interval and accompanying pathologies are the main factors affecting the outcome of patients.

Key Words: Peripheral arterial injury

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Özet

Amaç: Bu çalışmada periferik arter yaralanmalarında damar bütünlüğünün sağlanmasında; geçen iskemik sürenin travmanın lokalizasyonunun, eşlik eden yandaş patolojilerin etkisi araştırılmıştır.

Çalışmanın Yapıldığı Yer: Mersin Üniversitesi Tıp Fakültesi Mersin Devlet Hastahanesi

Materyal-metod: 1997-2001 yılları arasında Mersin Üniversitesi Tıp Fakültesi ve Mersin Devlet Hastahanesinde periferik damar yaralanması nedeniyle 118 hasta tedavi edilmiştir. 89 hastada (%75.4) delici ve kesici alet yaralanması, 18 hastada (%15.2) ateşli silah yaralanması ve 11 hastada (%9.3) künt travma saptanmıştır. En çok etkilenen damarlar 47 hastada (%39.8) femoral arter, 27 hastada (22.8) brakial arter, 19 hastada (%16.1) poplitea arterdi. 56 hastada (47.4) rezeksiyon ve uç uca anastomoz, 21 hastada (17.7) safen ven interpozisyonu ve 13 hastada (11.1) ligasyon uygulanmıştır. İki hasta eşlik eden kafa ve toraks travmaları nedeni ile kaybedilmiştir.

Sonuç: Travmanın lokalizasyonu, geçen iskemik süre ve eşlik eden yandaş patolojiler hastalardaki sonucu belirleyen temel faktörlerdir.

Anahtar Kelimeler: Periferik damar yaralanması

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Peripheral arterial injuries constitute a major problem in vascular surgery. Treatment should aim to control the hemorrhage and constitute arterial continuity. Interventions done in the early times were aiming solely to save the lives of the patients. By gaining experience in civil life and in wars and combination of this experience with the parallel advances in surgical techniques have pulled down the mortality and morbidity rates to acceptable limits with satisfactory results (1-7).

Materials and Methods

One hundred and eighteen patients were treated in Mersin University, School of Medicine, Department of Thoracic and Cardiovascular Surgery and Mersin State Hospital who admitted with peripheral arterial injuries between 1997 and 2001. 109 (92.3%) of the patients were male and 9 (7.6%) were female. Patients' ages ranged from 8 years to 64 years. 90 patients (76.2%) admitted to the hospital within the first 12 hours after injury

while other 28 (23.8%) came between 12-36 hours after the event took place.

Patients who were thought to have arterial injuries but could not be put forward with certainty were also evaluated with Doppler ultrasonography or by angiography when needed.

In surgical interventions, the primary goal was the simple reconstruction of the arterial continuity but when this did not seem possible, other techniques such as resection and end to end anastomosis, graft interposition or ligation were also performed. Vena Saphena Magna (VSM) was preferred for graft interpositions. The distal segments of the wounded arteries were routinely controlled by Fogarty catheters and irrigated with heparinised saline.

Venous continuity was also tried to be established in patients with concomitant vein injuries. When patients with bone fractures admitted within 6 hours from the injury and did not have significant ischemic findings in their extremities they were assigned to be examined by orthopedics department for external fixation to stabilize the extremity. Protective fasciotomy was performed in patients who admitted after six hours from the event with accompanying venous injury, fracture or large tissue defects.

Results

Most of the arterial injuries were stab wounds (Table 1). When the injured arterial sites reviewed, it is found out that the most commonly injured arterial site was the femoral arterial site followed by brachial and popliteal arterial sites (Table 2). The arterial lesions encountered in surgical explorations are outlined in Table 3.

Table 1. Etiology of the injuries.

Type of Injury	n	%
Sharp and Penetrating instruments	89	75,4
Gunshot	18	15,2
Blunt Trauma	11	9,3
Total	118	100

Table 2. Localisation and frequency of the injured vessels.

Localization	n	%
Axillary a.	2	1,6
Brachial a.	27	22,8
Radial + Ulnar a.	27	16,9
Femoral a.	47	39,8
Popliteal a.	19	16,1
Ant. and post. Tibial a.	3	2,5
Total	125	100,0

* Radial and ulnar arteries were both injured in 7 patients.

Venous injuries in 24 (20.3%) and bone fractures in 17 patients (14.4%) were accompanying the arterial problems. Venous ligation was performed in 7 patients (5.8%). External fixations were preferred in bone fractures. Resection and end-to-end anastomosis was the mostly applied technique in 56 (47.4%) of the patients (Table 4).

Five (4.2%) of the patients have undergone extremity amputation. Bleeding due to infection in 3 (2.5%) and compartment syndrome in the other 2 (1.7%) were the reasons for amputation. These cases also had accompanying venous injuries, large tissue defects and bone fractures. Among the amputation group popliteal arterial injuries were in the first place (Table 5).

Table 3. Distribution of the lesions.

Lesion	Penetrating	Blunt	n of patients	% of patients
Partial or total cut	97	6	96	81,3
A-V fistulae	7	0	7	5,9
False aneurysms	10	1	11	9,3
Others	0	4	4	3,3
Total*	114	11	118	100

* Contusion, compression, occlusion.

Table 4. Methods of surgical management.

Type of repair	n	%
Primary repair	11	9,3
Resection and end to end anastomosis	56	47,4
Vein interposition	21	17,7
Patch angioplasty	8	6,7
Ligation	13	11
A-V fistulae repair	9	7,6

* Radial and ulnar arteries were both evaluated in the same operation in 7 patients.

One hundred and one patients (85.5%) had a functional extremity after surgical treatment. Also, progressive recovery from the neurological sequels in 8 of the 17 (14.4%) patients who had preoperative neurological deficits was seen. The permanent neurological sequels were found out to be due to nerve injuries caused by the trauma for the remaining patients. The mortality rate in this series was 1.6% (2 patients). Head and thoracic trauma seem to be more responsible for the death rather than their arterial injuries.

Discussion

During first and second world wars ligation happened to be the first choice for the treatment of vascular injuries and arterial reconstructions were performed in only 3% of the wounded. As a result, amputation rates reached as high as 47-81% (8). During Korean and Vietnam wars, arterial and venous reconstructive methods were fancied resulting in decreased amputation rates as low as 8% (2). Nowadays, it is less than 5% due to experience gained in wars, lessened intervention time, use of wide spectrum antibiotics and use of vascular grafts (2,4,6,8-10).

Peripheral arterial injuries today are not encountered as often as in wars but we can still come

across due to terrorism, vandalism and accidents in industry or traffic (2,4,5,11,12). In literature gunshot wounds were at the first place but in our series, the mostly encountered injuries turned out to be stab wounds (1,2,4,5,13). Due to the character of the wounds, the lesion was complete or incomplete cut. Although the lesion remained mostly limited to arteries in stab wound injuries, bone fractures, vein injuries, nerve injuries and soft tissue injuries frequently accompanied blunt trauma or gunshot wounds (1,5,8,9,11,12).

Peripheral arterial injuries are seen more than the great arterial injuries (2, 4). Femoral artery is a long and superficial artery yet explaining the reason why it is injured more frequently than the others (6). Our series shows concordance with the literature but our radial and ulnar arterial injury rates (16.9%) differ from other civilian series (%5.6, %3.4) (2,3). This group consisted of drug abusers and alcoholics who had history of hitting to glass windows.

Patients who had clear findings of arterial injury (active bleeding, absence of pulse, pulsatile hematoma, thrill, bruit) were taken to surgery in emergency. In suspicious situations, the patients were taken to Doppler ultrasonography or to angiography. Some authors have pointed out that Doppler ultrasonography is as sensitive and specific as angiography. Pathologic flow patterns can be detected easily and a 10% reduction in ankle-brachial index is considered to be abnormal (11). Some authors believe that peripheral angiography is a must (2,5,12). There is still a debate in diagnostic methods (5,7,11). As noted in other studies resection and end-to-end anastomosis was the most applied method in our series, too (1-7,9,11,12). If there was a tension at the anastomosis site graft interposition was applied. We preferred VSM as

Table 5. Etiology and localisation of the arterial lesions in extremity amputated patients.

Type of injury	Popliteal a.	Femoral a.	Brachial a.	Total
Blunt trauma	2	1	1	4
Sharp and penetrating instruments	0	0	0	0
Gunshot	1	0	0	1
Total	3	1	1	5

the graft due to its resistance to infections and suitable caliber. Martin et al. expressed the rate of success with the PTFE grafts at the femoral and iliac sites to be as good as the VSM but also pointed out that VSM should be the first choice at the popliteal site (5). For the forearm and leg, we preferred ligation if one of the arteries were intact and there was no evidence of ischemia. In the presence of ischemia, the artery was reconstructed with separate sutures under magnifying loupes (2,3,5, 13).

The accompanying pathologies and the elapsed ischemic interval are the determining factors on the outcome of peripheral arterial injuries (1,2,4,6,7,9,11,12). Vascular continuity should be established in venous injuries. A corrupted venous circulation results in increased venous pressure and venous peripheral resistance that are the determinants in the deterioration of arterial circulation (2,6,7,9,10). There are reports forwarding that ligation at iliac or femoral or even at the popliteal vein are well tolerated and arterial circulation is not affected (1,7). Contrarily, many authors indicate the importance of venous circulation at the popliteal site for a healthy perfusion of the limb (2,5,7). It is very well known that venous insufficiency ensues very often in reconstructive interventions (2,12). We tried to keep the continuity of the venous system in our series. We used the VSM when needed. We found it obligatory to ligate the veins in 7 patients (5.9%).

We forwarded the patients to orthopedics department who presented within 6 hours from the event and did not have signs of ischemia at the extremity. The orthopedists used external fixates for fixation. External fixates are recommended for their easy application, low infection rate and low tissue damage rate (2,6,7). Reynolds et al reported that there is no difference in infection rates between the external and internal fixates (1).

Two important factors that affect the outcome postoperatively in complex injuries are increase in the pressure of the compartment and infection (3, 5,6). The timing and importance of fasciotomy is still a debate (12). Some authors prefer preoperative fasciotomy in late complex trauma whereas

others recommend to follow the progress and to decide accordingly (2,5,6,9). Although Abouezzi et al stood against fasciotomy, the rate reached to 62% in popliteal site injuries (12). We performed seven peroperative and six postoperative fasciotomies in our series. Direct amputation is suggested in the lower extremities when muscle infarct is diagnosed in more than two compartments (12). We performed extensive debridement in patients with accompanying soft tissue injuries aiming to stand against infection and tried to cover the vascular structures with regional muscles and soft tissue as much as possible. Unfortunately, three patients with bleeding due to infection and two patients due to compartment syndrome were referred to orthopedics for amputation. These patients were mostly the ones having occult trauma with complex popliteal artery injuries (Table 5). The results of the popliteal arterial injuries today are worse than the other sites. It seems that the reasons for this are the lack of collaterals at this site and anatomic weakness to save the popliteal artery (3-6,11,12).

Sfeir et al have put forward that according to their data obtained during the war in Lebanon, the hemodynamic state at the time of admittance, elapsed ischemic time and accompanying pathologies are more important than etiology, localization and existence of infection for amputations (7). The ischemic time in our five patients who underwent amputation was over 6 hours.

Conclusion

According to our knowledge and experience the outcome of peripheral arterial surgical interventions are strictly dependent on:

- Ischemic time elapsed.
- The etiology and localization of the trauma,
- Reconstruction of the accompanying pathologies

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Yazışma Adresi: Dr Nehir SUCU

Mersin Üniversitesi Tıp Fakültesi
Arastırma ve Uygulama Hastanesi
Kalp ve Damar Cerrahisi AD,
Zeytinlibahçe Caddesi,
33079, MERSİN
nehirsucu@superonline.com