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Our clinical experiences in vascular injuries due to intravenous drug abuse

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ABSTRACT

Objectives: The aim of this study was to present our clinical experiences in vascular injuries due to intravenous drug abuse.

Patients and methods: This retrospective study included a total of 36 patients (26 males, 10 females; mean age 31.2 years; range, 24 to 52 years) who were admitted to our clinic with vascular injury as a result of drug abuse between October 2016 and October 2019. All patients were followed for three months after treatment and relevant data of the patients were evaluated.

Results: Vascular injuries were present in the lower limbs in 19 (52.7%) patients and in the upper limbs in 17 (47.2%) patients. In two (5.5%) patients with arterial injury in the lower limb, arterial ischemic findings developed and one of these injuries resulted in foot amputation and the other one below knee amputation. All lower limb pseudoaneurysms were located only in the femoral region. Three of them were superficial femoral artery pseudoaneurysms and four were pseudoaneurysms of the common femoral artery. Deep venous thrombosis was seen in the lower limbs of five (13.8%) patients.

Conclusion: Vascular injuries secondary to intravenous drug abuse are remarkable problems. Patients usually postpone admission to the hospital as much as they can, even if some symptom occurs, since drug abuse is not legal. Pathologies become even more irreversible over time. A prompt intervention can reduce possible mortality and morbidity in these patients.

Keywords: Drug abuse, intravenous, vascular injury.

Intravenous (IV) drug use is an important socioeconomic problem which has been increasing day by day worldwide. Understanding the epidemiology is more difficulty, since the patient is likely to be discreet. Currently, IV drugs which are abused can be prescribed, over the counter, or can be illegal. These drugs have many local and systemic side effects, due to their chemical ingredients. These side effects may also lead to fatal consequences. Intravenous drug abuse constitutes 4% of all vascular injuries and 20% of these vascular injuries causes death.[1]

Most of the patients with IV drug abuse apply to hospital late, due to the illegal nature of abuse. Therefore, vascular pathologies are overlooked, since most patients experience more fatal problems such as systemic problems and organ failure.[2] In this study, we present our clinical approach and experience in vascular injuries due to IV drug abuse.

PATIENTS AND METHODS

This descriptive, single-center, retrospective study included a total of 41 patients who were admitted to Bakirköy Dr. Sadi Konuk Training and Research Hospital with vascular injury secondary to IV drug abuse between October 2016 and October 2019. Five patients discontinued treatment. Finally, a total of 36 patients (26 males, 10 females; mean age 31.2 years; range, 24 to 52 years) were included in our study. Inclusion criteria were as follows: age >18 years; having vascular injuries, and the use of IV drugs. Patients with systemic disease were excluded. A written informed consent was obtained from each patient.

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The study protocol was approved by the Bakırköy Dr. Sadi Konuk Training and Research Hospital Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Duplex ultrasound (DUS) was used for the diagnosis in all arterial and venous pathologies. In all vascular pathologies, except for deep and superficial vein thrombosis, computed tomography angiography (CTA) was used as an advanced examination for diagnosis and treatment planning after DUS.

Primary repair was preferred in the first-line setting in patients with vascular injury requiring repair. In cases where primary repair was not possible, the saphenous vein, an allogenic vascular graft, was preferred. Primary vascular repair was performed in the operation of all pseudoaneurysm cases. After sampling for the culture, the wound was thoroughly cleaned, and the wound was properly closed by washing with saline and rifampin. The vacuum-assisted wound closure system was used in patients with severe wound infection. All patients received IV antibiotherapy postoperatively. Low-molecular-weight heparin (LMWH) and steroids were used for non-dominant radial artery thrombosis in the upper limb.

Treatment with unfractionated heparin (UFH) was initiated in hospitalized patients with deep venous thrombosis (DVT), which is one of the venous complications. In the outpatient group, treatment with LMWH was started and continued with warfarin in patients who were unable to adhere to the treatment. The new generation oral anticoagulant treatment was continued in patients who were unable to adhere to treatment. The patients who developed superficial vein thrombosis continued using LMWH for one month, followed by acetylsalicylic acid (ASA) 150 mg.

Demographic and clinical characteristics of the patients and follow-up data were recorded. The primary outcome measures were technical success and patency rates. Secondary outcome measures were amputation and mortality rates.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 21.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed in mean ± standard deviation (SD) or median (min-max), while categorical variables were expressed in number and percentage.

RESULTS

Baseline demographic and clinical data of the patients are shown in Table 1. In two patients with arterial injury in the lower limb, ischemia developed and one of them had foot and the other one below knee amputation. All these patients applied to our clinic after the motor functions were already lost. One of two patients with a sign of arterial ischemia in the upper limb used brachial artery for abuse. This patient applied to our clinic with total obstruction in the brachial artery due to the substance he injected. Cellulitis and necrosis were the main findings and the limb was amputated upon the diagnosis of severe osteomyelitis. In the other patient who used upper limb for abuse, cellulitis, edema, pallor and coldness were the main examination findings. Obstruction in the radial artery was detected; however, the patient's symptoms regressed after the third day due to dominance of the ulnar artery.

All lower limb pseudoaneurysms were located only in the femoral region. Three of them were superficial femoral artery pseudoaneurysms and four were pseudoaneurysms of the common femoral artery (Figure 1). Three patients suffered from serious soft tissue infection as a result of multiple injections. Since vascular tissue was rigid and infective in these patients, graft interposition with the saphenous vein

Table 1. Baseline demographic and clinical characteristics of patients

	n	%	Mean	Min-Max
Age (year)			31.2	24-52
Sex				
Male	26	72.2		
Female	10	27.7		
Injury of extremity				
Lower limbs	19	52.7		
Upper limbs	17	47.2		
Complications				
Arterial ischemia	4	11.1		
Lower limbs	2	5.5		
Upper limbs	2	5.5		
Arterial pseudoaneurysm	10	27.7		
Lower limbs	7	19.4		
Upper limbs	3	8.3		
Deep venous thrombosis	6	16.6		
Lower limbs	5	13.8		
Upper limbs	1	2.7		
Superficial vein thrombosis	12	33.3		
Lower limbs	2	5.5		
Upper limbs	10	27.7		
Venous pseudoaneurysm	4	11.1		
Lower limbs	3	8.3		
Upper limbs	1	2.7		

Min: Minimum; Max: Maximum.

Figure 1. A digital substraction angiography image of an intravenous drug abuse-induced common femoral artery pseudoaneurysm.

was performed. In all seven cases, wound areas were carefully resected and the culture specimens were obtained from tissues. The wounds were closed anatomically after washing with saline and rifampin.

In addition, DVT was seen in the lower limbs of five patients. In one of these patients, thrombus was extending from the iliac vein to the popliteal vein and, in the other two patients, from the common femoral to the popliteal vein. In two patients, thrombus was seen only in the common femoral vein. Hospitalized patients were treated with UFH, while the outpatients received treatment with LMWH and continued with warfarin with patients who could adhere to treatment. In patients who were considered not to adhere, treatment was continued with new generation oral anticoagulant agents.

There was also superficial vein thrombosis. Two of them were located in the vena saphena magna. Eight of the patients had cephalic vein thrombosis and two of them had basilic vein thrombosis. These patients were treated with LMWH for one month, followed by ASA 150 mg.

Four patients suffered from venous pseudoaneurysm. One pseudoaneurysm was detected in the basilic vein and three in the common femoral vein. All three patients with a pseudoaneurysm in the lower limbs had an infected, running, and necrotic tissue. The wounds were cleaned, and the femoral vein repair was done by primary suturing. The vacuum-assisted wound closure was used in one patient.

During three-month follow-up, all patients with a pseudoaneurysm completely recovered. No pseudoaneurysm sac was seen later. In one patient with DVT in the lower limb, DUS showed a decreased thrombus burden (less than 50% thrombus). There was no increase or decrease in the thrombus burden of other patients. All three patients who applied with ischemia underwent amputation due to the delay in hospital admission, as well as irreversible ischemia, necrosis, and motor function loss.

None of the patients required intensive care. The mean hospital stay was 3.4 (range, 1 to 8) days. The mean amount of blood transfusion was 1.2 (range 0 to 8) U.

DISCUSSION

Patients usually use already accessible superficial veins and, when these superficial veins become unsuitable after a while, patients lean to abuse their larger vascular structures in their lower limbs. Vascular injury may occur after any IV injection; however, repetitive use of the same vascular region significantly increases the risk of vascular injuries.[3] Continuous injections in the same vascular area may lead to phlebitis and thrombosis, both increasing the risk of vascular injury.[3]

Vascular injury after IV drug abuse is usually the result of the injection procedure itself, rather than the chemical component of the drug.[3] Arthritis may also develop due to the chemical substance after the IV injection.[3] Chemical components may also cause endothelial damage and thrombosis in the vessels. Chemical endarteritis and endothelial cytotoxic effects are the other mechanisms of injury after intra-arterial drug injection which usually cause direct endothelial damage within the first 24 h.[4] Initially, due to the injection of the drug into the arterial system, drug affects the arterioles and, then, it passes through the venous system and affects all vascular structures. If the drug is given directly to the venous system, it can directly slow the flow and cause venous thrombosis.[4]

Intra-arterial injections of abused drugs may result in acute, severe limb ischemia and gangrene.[3] Etiological factors include vasospasm, chemical endarteritis, vessel obstruction by inert

particles or drug crystals, platelet aggregation, hemolysis, and venous thrombosis. Most of these factors lead to arterial thrombosis.[5]

Arterial complications related to the IV drug use include limb ischemia, infected or uninfected pseudoaneurysms, while venous complications include DVT, venous pseudoaneurysm, and chronic venous insufficiency. Local complications include cellulitis, access area infections and osteomyelitis and systemic complications include sepsis and disseminated intermittent coagulation.[5]

Among IV drug users, ischemia occurs after accidental arterial injection or when the user intentionally uses the arterial medication due to a widespread venous scar or a desire for a special arterial stroke. While cocaine has long been associated with vasospasm-mediated ischemic complications, there are other causative agents and recommended mechanisms of injury.[2] The list of offensive drugs includes barbiturates, opiates, benzodiazepines, and amphetamines.[3] In addition to vasoconstriction, pathogenesis, chemical endarteritis, platelet aggregation, distal embolization of injected particles and subsequent embolic events can be associated with intimal damage leading to thrombus formation.[2]

Arterial complications are usually more common in the upper limb than the lower limb; however, having better collateral circulation in the upper limb reduces the incidence of ischemia and amputation in these patients.[6] Clinical findings of injections are intense burning, pain, gangrene, pregangrenous findings, and neuromuscular deficit. The most useful test and the first choice in diagnosis is DUS which can detect thrombi, pseudoaneurysms, infected hematomas, or abscesses. Patients who are unable to be diagnosed with DUS can be diagnosed with computed tomography. The main goal of the treatment is to protect tissue perfusion and prevent thrombosis. The fundamentals of the treatment are limb elevation, vasodilators, and heparin. Steroids and heparin are included in treatment to prevent chemical related arteritis.[5] Arterial pseudoaneurysms are serious complications after drug use and are often located in the femoral region. They start as a pulsatile mass with cellulite tissue formed around it. If there is a pseudoaneurysm occurring in the brachial and axillary region, neurological deficits should come to mind due to the anatomy of these regions. Treatment includes adequate and appropriate antibiotherapy in addition to usual surgical pseudoaneurysm treatment.[3]

The most common venous complication is DVT. It can occur both in the upper and lower limb. It may also cause thrombosis in the superficial venous system. The gold standard for diagnosis is DUS.[7] The UFH, LMWH, warfarin, and new generation oral anticoagulant agents can be used for treatment.[7] Treatment with UFH or LMWH is continued, until the desired international normalized ratio value is reached after warfarin administration in DVT treatment.[7] Another complication is an infected venous aneurysm which usually involves the femoral vein. After many punctures in the same area, an infected venous aneurysm sac is formed together with the venous structure itself and the surrounding hematoma. The DUS usually yields accurate results in diagnosis.[7] Treatment is resection of all infected tissues and initiation of appropriate antibiotherapy after repairing of the aneurysmatic structure. While the most common agents are *Staphylococcus aureus* and *Escherichia coli, Streptococcus spp.* have been also reported in some cases.[3] Antibiotherapy should be continued for two weeks and treatment should be planned according to the positivity of blood cultures.[4] Another venous complication is chronic venous insufficiency. It was reported in 40% of patients who received IV injection repeatedly.[8]

Early admission is important to prevent limb loss in patients with vascular injuries. As mentioned in our study, late admission is the main factor in all three limb losses. Our patients were mostly young men, consistent with previous studies.[9-11] It is known that IV drug abuse has significant effects on hemostasis. Therefore, in our study, both at the access site and distal or proximal to the accessed vessel thrombosis is an expected result.

In a study, Benitez and Newell[11] evaluated with 172 occurrences of vascular injuries secondary to intravascular or perivascular drug injections. A venous pseudoaneurysm was seen in 10 patients and an arterial pseudoaneurysm was seen in 132 patients. In our study, three of 36 patients had a venous and 10 had an arterial pseudoaneurysm, indicating lower rates of pseudoaneurysm than the Benitez and Newell study.[11] Additionally, Yeager et al.[12] found that 13 of 32 patients developed arterial and 19 had complications in the venous structures. Two of these patients suffered from digital gangrene. In our study, 14 of 36 patients had arterial and 22 of them had venous complications. In two of them, irreversible stenosis occurred in the large arterial structures, resulting in amputation. Similarly, Silverman and Turner[5] observed arterial structures after the IV substance and confirmed vasospasm. The authors observed recovery after streptokinase and

heparin administration. In our study, symptomatic improvement was observed after the administration of UFH to one patient who arrived hospital early. The UFH has been shown to provide symptomatic relief as a result of giving vasodilator drugs together with heparin and basically resolves vasospasm caused by IV substances in patients who are symptomatic in the early period.[5] Therefore, vasodilator drugs should be considered in the clinical practice.

Once the arterial flow returns to normal level after prolonged vasospasm, compartment syndrome may develop, particularly in the forearm. The reason for this is extravasated fluid, vasculitis, precapillary leakage due to blood flow, and venous thrombosis.[5] Therefore, fasciotomy is indicated for the prevention of compartment syndrome, particularly in the early period.[13] In our study, none of the patients developed compartment syndrome.

In a study by Johnson et al.,[14] graft revascularization was applied to the common femoral artery in four patients. In 25 patients, vascular injury was detected on bifurcation and treated with primary repair. While 53% of these patients had ischemic findings, 21% of them underwent amputation. In our patient group, 11% had ischemic findings, and 8.3% underwent amputation. The main reason was considered late admission to the hospital. In the study of Johnson et al.,[14] after the use of artificial grafts, the grafts were removed in two patients due to infection, whereas during our three-month follow-up, there was no thrombosis or infection in the autologous saphenous graft. Based on these findings, it may be preferable to use autologous saphenous grafts in such cases. Furthermore, in the Reddy et al.'s[15] study, 11% of 54 infected femoral pseudoaneurysms underwent amputation, although there was no mortality. Autogenous saphenous grafts were used in six patients, while synthetic grafts were used in three patients. In all patients with the synthetic graft, all had to be resected secondary to infections. In our study, three patients had saphenous grafts. The IV drug is considered a high-risk factor for infections causing late recovery of the surrounding tissue of the region which develops pseudoaneurysms. Therefore, using autografts can yield more favorable outcomes, where applicable.

Nonetheless, there are several limitations to this study. As a retrospective analysis, the study is inherently subject to confounding and bias. Also, this study is a single-center study with a relatively small sample size and short follow-up. In addition, patients with more fatal symptoms (i.e., organ failure or sepsis) were unable to be included in the study, since this group of patients are admitted to our clinic very rarely.

In conclusion, vascular injury is a significant problem in IV drug users. In particular, the increasing use of IV drugs in the society and the accessibility to these substances easily, although prohibited, make this problem even more important. Patients usually choose to postpone admission to the hospital as much as possible, since it is not legal to abuse drugs. Therefore, pathologies become even more irreversible. The fastest intervention for these patients reduces possible mortality and morbidity. All systemic organs should be examined thoroughly, and appropriate antibiotherapy should be initiated to prevent infections. In arterial injuries, autogenous grafts should be preferred, whenever possible. Vascular injuries should be always treated as quickly as possible and patients should be evaluated for all systems.

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