Distal ischemia induced by vascular access for hemodialysis - a case report

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Abstract

Arteriovenous fistulas for hemodialysis may cause significant local and general changes in the bloodstream. Vascular access-induced ischemia is a rare but very serious complication which, if not treated in time, can lead to tissue necrosis. We describe a 66 year-old man with symptoms of distal limb ischemia caused by an arteriovenous fistula for hemodialysis.

Key words: arteriovenous fistula, hemodialysis, distal ischemia, steal syndrome

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CASE REPORT

Introduction

As a form of vascular access for hemodialysis arteriovenous fistula is the gold standard in treating patients with terminal renal insufficiency, which, in most cases, does not compromise perfusion of the hand. However, in 1.6-8% of patients unilateral ischemia develops, recently named distal ischemia caused by vascular access. The acute form of this ischemia occurs a few hours after surgery and is characterized by complete loss of function of the hand. Chronic hand ischemia is often mild, but severe long-term hypoperfusion leads to tissue necrosis requiring amputation of fingers and/or forearm of 1% of patients. In order to prevent permanent loss of limbs rapid diagnosis is of paramount importance. The low vascular resistance in fistula veins decreases arterial flow in the distal part of the vascular bed, while arterial stenosis in proximal parts of the access encourages hand ischemia. Ischemic syndrome caused by vascular access develops in four clinical stages.

1. In phase I asymptomatic retrograde blood flow in the vascular access during diastole is a common finding and does not require any intervention.
2. Phase II is characterized by a feeling of pain in the hand during hemodialysis, which requires continuous attention until further deterioration is revealed.
3. Phase III is manifested by pain at rest and out of dialysis.
4. Phase IV is characterized by tissue necrosis.

Case report

A 66 year-old patient, was hospitalized at the Centre for Nephrology and Dialysis, Clinical Center Kragujevac, Serbia, because of pain, chills, numbness, redness and swelling on the left forearm, which was fitted with an arteriovenous fistula for hemodialysis in the cubital area. After an initial nonfunctional termino-terminal anastomosis in the distal area of the left forearm, this arteriovenous fistula was successfully created in the elbow area two months before the start of chronic dialysis. During the previous 5 months the patient had been included in a chronic hemodialysis program, due to hypertensive nephropathy. He had a personal history of chronic obstructive pulmonary disease, umbilical hernia and discopathy. On admission local redness of the left hand was recorded (Figure 1). There were no established trophic changes. The radial artery pulse in the fistulated arm was less palpable. Anemia and uremia-electrolyte status corresponded to the fifth degree of renal insufficiency. The patient had a right jugular vein catheter placed for safe hemodialysis treatment.

During the hospital stay color Doppler of vascular access was performed: Directly above the anastomosis we observed an aneurysmal expansion of diameter 2.8 x 1.4 cm, with no signs of parietal thrombus. Proximal to the aneurysmatic extension we visualized venous drainage of internal diameter 0.74 cm and blood flow Qav ~ 2000 ml/min.

Echocardiographic findings: The left atrium was easily dilated. The left ventricle wall was hypertrophic, dilated at systole and diastole, with weakened global systolic function. The left ventricular ejection fraction was 43%. The septum was hypertrophic and less contractile in the basal segment area. The right cavities appeared normal. The pericardium was stratified 3-4 mm behind the rear wall.

Selective digital subtraction angiography of the left hand: Due to the wide AV fistula in the cubital region we could not visualize the blood vessels of the forearm (Figure 2).
After consultation with a vascular surgeon we attempted reconstruction of the fistula vein, under local anesthesia, with longitudinal single sutures for a length of 10 cm. After completion of the corrective intervention, to narrow the fistula vein (Figure 3), we registered flow in the distal forearm by continuous pulse Doppler (Figure 4). Immediately after surgical intervention a flow of about 1166 ml/min was determined by Doppler ultrasound examination (Figure 5).

**Discussion**

Although the term arterial blood theft often used to describe one of the most serious complications in patients with arteriovenous fistulas, this is not an appropriate term to denote hand ischemia. There is evidence that a large number of arteriovenous accesses show blood steal, but only a small number of patients reported clinical symptoms of ischemia. Pathophysiological mechanisms of vascular access-induced distal ischemia are complex and little known. Symptoms of arterial blood theft are more common in patients with diabetes mellitus and smokers. Cold hands, numbness and pain during or outside the di-
alysis process are most commonly encountered. Progression of these symptoms can lead to trophic changes, a prerequisite for the occurrence of ischemic changes and dry gangrene. Vascular access-induced hand ischemia is a common clinical symptom, may be 1 in 500 cases, most likely due to the rich collateral vascular network and small muscle mass. Data in the literature suggest that symptomatic ischemia develops in 10-25% of patients with brachiophleic and brachiobasilic vascular access, 4-6% at the level of the forearm and 1-2% at the radiocephalic level. Due to the increasing age of patients on hemodialysis, as well as a rising number of comorbidities, the incidence of hand ischemia is significantly increasing. In general, for the occurrence of ischemia in the hand with a fistula certain conditions are required, primarily reduced blood flow through the arterial system, due to arterial occlusive disease, proximal or distal from the arteriovenous anastomosis. Steal syndrome may arise from excessive blood flow through a dilated blood vessel together with insufficient vascular adaptation and reduced collateral perfusion. It is assumed that in the future, the frequency of these ischemias will rise due to popularization of vascular access in the proximal region of the elbow, as well as the growing number of elderly people on hemodialysis. However, in these relations, there are several dilemmas. Thus, it is not clear whether the type of arteriovenous fistula determines the time of appearance of ischemia and there is no simple practical classification of blood stealing syndrome. Treatment of this condition is difficult and the risk of amputation of fingers and the forearm is great. Therefore, attention must be focused on prevention, which includes adequate preoperative assessment, use of Doppler ultrasound, and a precise surgical technique that involves arteriotomy no greater than 7 mm, and a 90-180° angle of anastomosis, which leads to increased resistance and reduced blood flow. So far, there are five known therapeutic options for the treatment of distal arm ischemia caused by vascular access. In milder cases, we monitor the development of symptoms and a radical approach is not required. Percutaneous transluminal angioplasty with possible stent implantation, in the case of a stenotic lesion, is carried out as a part of diagnostic arteriography and may be a therapeutic option for a third of cases. There are three different corrective surgical procedures. However, the strategic application of a treatment depends on the severity of symptoms, comorbidities and the skill of the surgical team.

In summary, in our case we did not apply the protocol for corrective surgical procedure recommended in such cases, due to the lack of experience of the team for vascular surgery concerning the solution of this type of vascular access complication. However, after the diagnosis of distal ischemia was confirmed by clinical and radiological examination, the vascular surgery team performed longitudinal narrowing of the fistula vein lumen, reducing arteriovenous fistula flow, thus improving circulation to the distal part of the forearm. As an epilogue to the operative treatment we achieved disappearance of subjective feeling and numbness of the hands and reduced volume load of the right heart.

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References