

Distal revascularization and interval ligation for the treatment of steal syndrome secondary to hemodialysis arteriovenous fistula in the lower limb

Rafael Demarchi Malgor^I; Ricardo de Alvarenga Yoshida^{II}; Marcone Lima Sobreira^{III}; Mariângela Giannini^{IV}; Winston Bonetti Yoshida^V; Hamilton Almeida Rollo^{VI}

^IFellow, Vascular Surgery Service, Faculdade de Medicina de Botucatu (FMB), Universidade Estadual Paulista (UNESP), Botucatu, SP, Brazil.

^{II}Graduate physician, Vascular Surgery, FMB, UNESP, Botucatu, SP, Brazil.

^{III}Hired physician, Vascular Surgery, FMB, UNESP, Botucatu, SP, Brazil.

^{IV}Assistant professor, Vascular Surgery, FMB, UNESP, Botucatu, SP, Brazil.

^VAssistant professor, Vascular Surgery, FMB, UNESP, Botucatu, SP, Brazil.

^{VI}Assistant professor, Vascular Surgery, FMB, UNESP, Botucatu, SP, Brazil.

Correspondence

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ABSTRACT

Arteriovenous fistula with adequate blood flow is extremely important for patients with chronic renal insufficiency undergoing hemodialysis. Steal syndrome is a complication of arteriovenous fistula, but it is rare and its treatment is directly indicated when there are associated symptoms. Although many treatments have been proposed for its repair in the upper limbs, distal revascularization and interval ligation is currently the treatment of choice. This original case report describes the treatment of steal syndrome secondary to arteriovenous fistula in the lower limb, which was successfully treated using the same procedure described for the upper limbs.

Keywords: Arteriovenous fistula, hemodialysis, steal syndrome, therapeutic approach.

RESUMO

A fistula arteriovenosa com bom fluxo sanguíneo é de fundamental importância para os pacientes portadores de insuficiência renal crônica em tratamento hemodialítico. Uma das complicações da fistula arteriovenosa é a síndrome do roubo, mas esta é de ocorrência incomum, e o seu

tratamento está diretamente indicado quando há sintomas manifestos. Vários métodos foram propostos para sua correção nos membros superiores, sendo considerada a revascularização distal com ligadura arterial o procedimento de escolha. Neste relato de caso inédito, descreve-se o tratamento da síndrome do roubo de uma fístula arteriovenosa realizada em membro inferior, tratada com sucesso por meio da mesma técnica indicada para os membros superiores.

Palavras-chave: Fístula arteriovenosa, hemodiálise, síndrome do roubo, terapêutica.

Introduction

Chronic renal failure (CRF) is a disease that has a strong socioeconomic impact on health care of patients who depend on the public and/or private health system in Brazil. It is estimated that approximately 60,000 patients with CRF are treated by dialytic methods and, of these, 89.6% by hemodialysis.¹ Hemodialysis accesses defined as definitive are surgical procedures characterized by communication of a vein with an artery, called arteriovenous fistulas (AVF). Most of them are performed in the upper limbs and, exceptionally, in the lower limbs. In this context, AVF of choice is performed by direct anastomosis between the cephalic vein and the radial artery and, less frequently, by vascular grafts.²

According to current consensus reports, it is believed that construction of AVF between the radial artery and the distal cephalic vein (Brescia-Cimino AVF) should be used as the first technical option, due to their higher long-term patency, leaving synthetic grafts for a secondary alternative.^{2,3}

Steal syndrome associated with AVF is a relatively rare, but potentially severe clinical entity, whose etiopathogeny is due to lower distal blood supply, resulting from deviation of arterial blood that is directed to AVF and usually manifested by limb cooling, pain, pallor, muscle fatigue and reduction or absence of distal pulses.⁴ Its diagnosis is eminently clinical, but can be confirmed by noninvasive vascular methods, such as pressure index, digital photoplethysmography and/or *duplex* scan, as well as by arteriography. Its prevalence is estimated in around 1-8% in upper limbs;^{5,6} however, we found no prevalence in lower limbs in the databases.⁵

Among the varied types of surgical treatment for steal syndrome secondary to AVF, distal revascularization and interval ligation (DRIL) offers good outcomes in upper limbs.⁷ However, we did not find any published report on repair of steal syndrome using this technique in lower limbs in surveyed sources (MEDLINE, LILACS, SciELO, EMBASE) from 1996 to 2007, using the terms arteriovenous fistula, dialysis access, hemodialysis, steal syndrome, lower limbs.

Case report

A 56-year-old female patient, hypertensive, with hypothyroidism and CRF undergoing hemodialysis and a straight and synthetic AVF in the right lower limb between the superficial femoral artery and the arch of the great saphenous vein constructed using a wired expanded polytetrafluoroethylene (PTFE)[®] vascular graft measuring 8 mm in diameter.

Since the immediate postoperative period, the patient manifested a status compatible with steal

syndrome, characterized by reduction in limb temperature and perfusion, pain on palpation of calf muscle, disappearance of popliteal and tibial pulses, besides reduction in ankle-brachial index (ABI) at rest from 1.0 to 0.3. The patient was submitted to a treadmill test (Gardner protocol), with presence of claudication for more than 500 m; we then chose to perform conservative treatment based on physical exercises (walking) and clinical follow-up.⁶

However, symptoms were intensified after the first hemodialysis session, performed 25 days after the surgery, manifested by pain at rest, worsening of pallor and limb cooling, compatible with critical ischemia. Despite not having any change in ABI at rest, arterial screening was performed using *duplex scan*, which showed: patent common, superficial and deep femoral arteries and with preserved hemodynamic patterns; patent popliteal, fibular, anterior and posterior tibial arteries, but with two-phase arterial curves and major degeneration of hemodynamic patterns of arterial curves from the distal third of the thigh, characterized by one-phase, low-speed arterial curves (Figure 1).

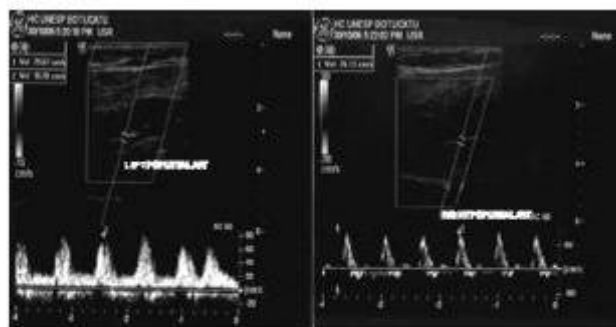


Figure 1 - Photographs regarding arterial *duplex scan*, which shows two-phase arterial curve in the right popliteal artery (right) compared to three-phase arterial curve in the contralateral popliteal artery (left)

The patient was then submitted to surgical treatment using distal revascularization and interval ligation, internationally known as DRIL⁷ which had probably not been described for the treatment of this syndrome in lower limbs so far.

To do so, a bypass was performed between the proximal artery (superficial femoral artery, approximately 5 cm above the AVF) and the femoropopliteal transition (approximately 5 cm below the AVF) using wired a 6-mm PTFE[®]. Next, we performed arterial ligation between the AVF and the distal anastomosis of the graft (Figures 2 and 3).

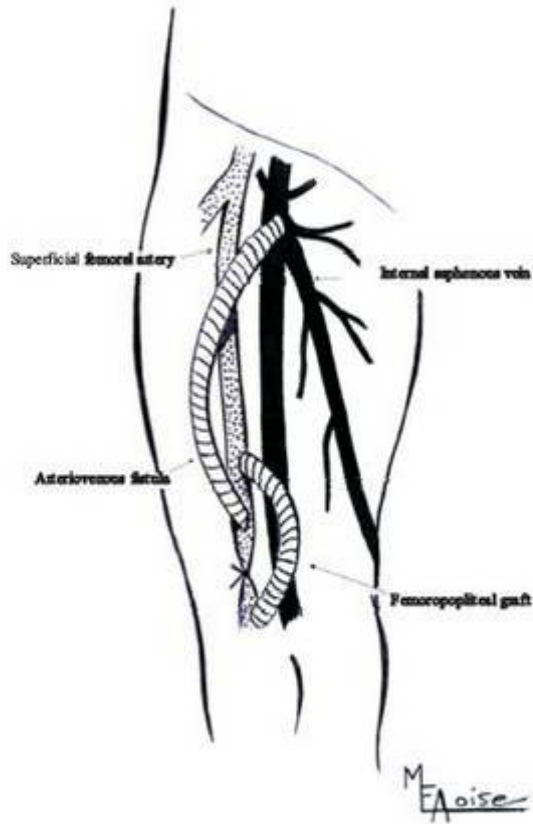
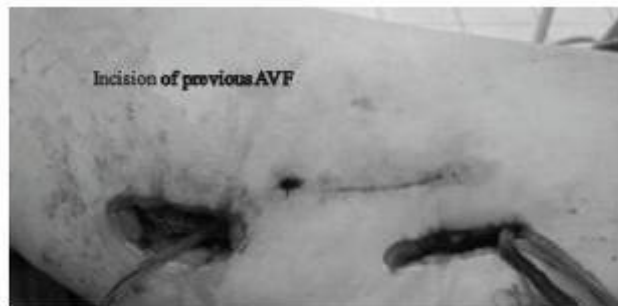


Figure 2 - Drawing showing the technique of distal revascularization and interval ligation



AVF = arteriovenous fistula.

Figure 3 - Photograph in which the surgical incisions performed to construct the suprapatellar femoropopliteal graft can be seen

After flow release, there was improvement in perfusion, appearance of anterior and posterior tibial pulses, complete remission of symptoms, ABI return to 1.0 and normalization of hemodynamic patterns assessed by *duplex scan* in leg arteries during early and middle postoperative period. In the 30-day postoperative control, the patient was asymptomatic and, in hemodialysis sessions, the

AVF presented good pattern (mean pressure of 156 mmHg and mean flow of 300 mL/second).

Discussion

The first description of the steal syndrome associated with vascular accesses for dialysis was performed by Storey et al. in 1969, secondary to an AVF between the radial artery and the distal cephalic vein (Brescia-Cimino).⁸ Although rare, steal syndrome causes discomfort and important symptoms, able to restrict the patient's activities. According to Schanzer & Skladany, severe ischemia related to steal syndrome occurs in about 1% of cases, especially when the AVF is constructed between the brachial artery and the antecubital vein, and in 2.7-4.3% of patients with bypass AVF.⁴

Berman et al. showed that only 0.3% of their patients submitted to AVF of the upper limbs, with preoperative assessment altered by segmental Doppler or preoperative digital Doppler, developed steal syndrome, concluding that there was no need of performing complementary routine examinations.⁹ Its diagnosis is performed by the association of manifestations compatible with low arterial supply to the AVF, such as limb cooling, sensitive loss, pallor and pain at rest,⁷ associated with complementary examinations, usually noninvasive, such as pressure index, photoplethysmography or pneumoplethysmography,^{5,10} *duplex scan*^{11,12} and, occasionally by arteriography.¹³

So far there are no means to exactly predict when the steal syndrome will occur,^{9,14} but several techniques used for its correction are described, which can be summarized in three types:

-AVF ligation with resolution of steal syndrome, but with loss of access.

-Access cerclage using banding interposition, but with the inconvenience of increasing distal resistance, which causes reduction in blood flow and increase in chance of thrombosis in the AVF.¹⁵ To minimize blood flow reduction in this technique, Aschwanden et al.¹⁶ proposed perioperative assessment using *duplex scan* during cerclage, recommending that distal arterial pressure and digital-brachial index should be higher than 60 mmHg and 0.5, respectively, at the end of the procedure.

-Distal revascularization and interval ligation (DRIL), proposed by Schanzer et al.¹⁷ Good long-term patency outcomes and patient's clinical improvement¹⁸⁻²⁰ were exclusively reported in the upper limbs.^{7,9,17}

As previously stated, construction of AVF in the lower limb is not frequent, being an exception choice, performed in cases in which there was exhaustion of accesses in the upper limbs.²¹ In our institution, less than 5% of patients have AVF in the lower limbs, and in this report, we noticed that steal syndrome, similarly to what occurs in the upper limbs, can potentially occur in the lower limbs, despite absence of any description in the surveyed literature.

In preoperative assessment, the patient did not report any complaint of intermittent claudication and had anterior and posterior popliteal and tibial pulses, which suggests she did not have peripheral arterial disease (PAD), even having CRF. However, performing a treadmill test with ABI before constructing the AVF could have assessed more precisely presence or not of PAD.

According to Berman et al., there is no indication for preoperative assessment with noninvasive examinations for construction of AVF in the upper limbs. However, due to the characteristics of

higher prevalence of PAD in the lower limbs associated with risk factors prevalent in this population, we believe that further studies are necessary to construct AVF in the lower limbs.

Conclusions

Based on this report, we can infer that:

-Steal syndrome secondary to an AVF can also occur in the lower limbs;

-The DRIL technique, despite being described for the treatment of steal syndrome secondary to an AVF only in the upper limbs, proved to be a good therapeutic option for the same problem in the lower limb.

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 Correspondence:

Rafael Demarchi Malgor
Departamento de Cirurgia e Ortopedia
Universidade Estadual Paulista
Rua Rubião Júnior, s/nº
CEP 18618-000 – Botucatu, SP, Brazil
Email: rafaeldemarchi@yahoo.com.br

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