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Surgical Approach of an Infected Saphenofemoral Looped PTFE Graft Arteriovenous Fistula and Arterial Reconstruction with Cryopreserved Allograft

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Abstract **Case Report**

Introduction: Autologous arteriovenous fistula is still the most popular vascular access for hemodialysis [1]. There have been few reports of saphenofemoral arteriovenous fistulas over the last 10 to 20 years because of suggestions of high morbidity, poor patencies and needling difficulties [2]. Some disadvantages of using this access are the necessity for a more extensive and deeper dissection using larger vessels and greater susceptibility to infection and steal syndrome [3, 4]. Attention should be paid to the patient's vasculature before surgery, through the "maturation" phase and chronic use [5]. ***Case report:*** A 72-year-old female with a history of arterial hypertension, diabetes mellitus and chronic renal failure requiring three-weekly hemodialysis, with a 4-day history of a painful and hot mass in the right thigh, fever, and hemoglobin decline. Physical examination: hematoma at the right inguinal region, presence of a tourniquet, femoral pulse 2/2 and not assessable distal pulses due to edema; coldness, and increased capillary refill. Aortoiliac and lower limb angiotomography showed: ruptured pseudoaneurysm of the right common femoral artery, ipsilateral superficial femoral artery injury and prosthetic femoral arteriovenous fistula infection. Open emergency approach through an infra-inguinal longitudinal incision was performed, draining a large hematoma and pus, finding an infected prosthetic PTFE graft from a saphenofemoral loop fistula with injury of the right superficial femoral artery and active bleeding at the site, plus dehiscence of saphenous anastomosis. Thrombectomy of the superficial and common femoral artery, en bloc arteriotomy of the right superficial femoral artery and arterial reconstruction with a cryopreserved arterial allograft with end-to-end anastomosis was performed. A Vacuum Assisted Therapy (VAC®) system was created to cover the surgical site. Patient deceased from hypovolemic shock. ***Conclusions*** Unusual site AVFs (i.e., saphenofemoral loop graft AVFs) should be carefully followed-up to reduce the risk of complications and raise the awareness to diminish associated morbidity and mortality. An arterial cryopreserved allograft may be used for arterial reconstruction in the setting of an infected wound. The goal must be to spread more knowledge in this critical area of medicine that is importantly affecting medical costs of renal replacement therapies and patients' quality of life and survival rates.

Keywords: Allografts, Arteriovenous Fistula, Pseudoaneurysm, Chronic Renal Failure, Continuous Renal Replacement Therapy.

INTRODUCTION

Vascular access is the lifeline for hemodialysis (HD) patients, its establishment remains a challenge for vascular surgery. Due to the improvement of chronic renal failure (CRF) treatment and consequently, increased survival, maintenance of vascular access and long-term treatment of its complications, it has become an important cause of hospitalization, morbidity, and patient costs [2].

Autologous arteriovenous fistula (AVF) is still the most popular vascular access for HD, being the access of choice a primary access in the upper limb, between the radial artery and the cephalic vein [1]. There have been few reports of saphenofemoral AVF (SFAVF) over the last 10 to 20 years because of previous suggestions of high morbidity, poor patencies and needling difficulties [2]. Some disadvantages of using this AVF are the necessity for a more extensive and deeper dissection that uses larger vessels and makes it more susceptible to infection and steal syndrome [3, 4].

However, compared to central venous catheters, AVF is characterized by a lower risk of infection and lower number of hospitalizations, a better quality of life, higher dialysis efficiency, and more prolonged life expectancy for patients. Despite, attention should be paid to the patient's vasculature before surgery, through the "maturation" phase and chronic use. The crucial role is played by the patient itself in cooperation with devoted clinical staff involving skilled nurses, nephrologists, surgeons, radiologists, and sonographers [5].

CASE REPORT

A 72-year-old female with a history of arterial hypertension, diabetes mellitus and CRF, requiring three-weekly hemodialysis, referred from a public health care unit to Luis Vernaza Hospital (Guayaquil-Ecuador) with a 4-day history of a painful and hot mass in the right thigh, fever, and hemoglobin decline, in the context of an infected saphenofemoral fistula, assessed initially with Doppler ultrasound showing a pseudoaneurysm of the common femoral artery.

Physical examination revealed hematoma in the right inguinal region, presence of a tourniquet, erythema, femoral pulse 2/2 and not assessable distal pulses due to large edema, also coldness, pallor, and increased capillary refill.

An aortoiliac and lower limb angiotomography was performed, finding a ruptured pseudoaneurysm of the right common femoral artery, ipsilateral superficial femoral artery injury and prosthetic femoral arteriovenous fistula infection (Image 1, 2 and 3).

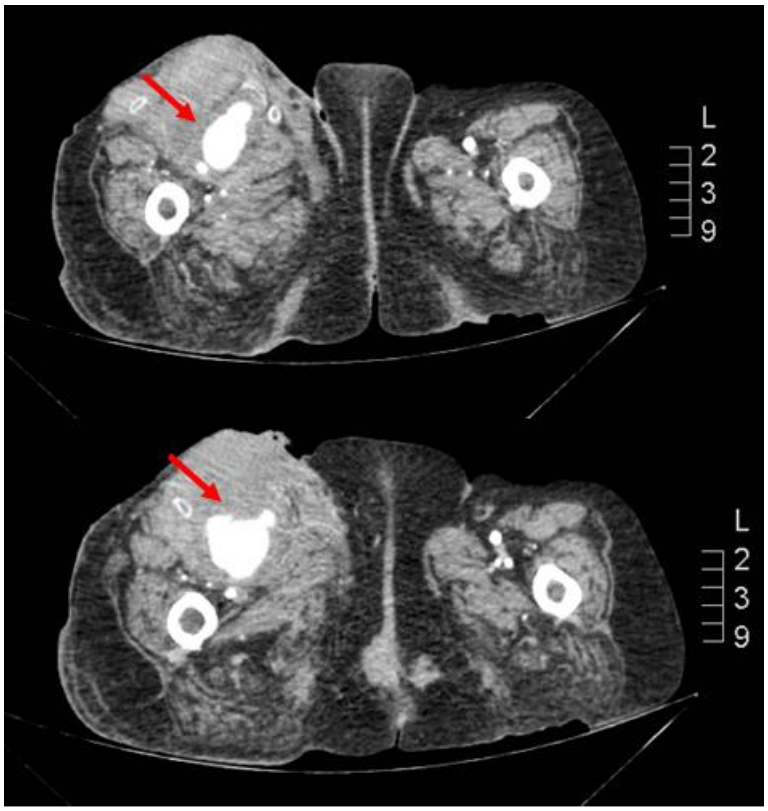

Image 1: Aortoiliac and lower limb angiotomography showing a saphenofemoral arteriovenous fistula with ruptured femoral pseudoaneurysm, hematoma and peripheral soft tissue infection

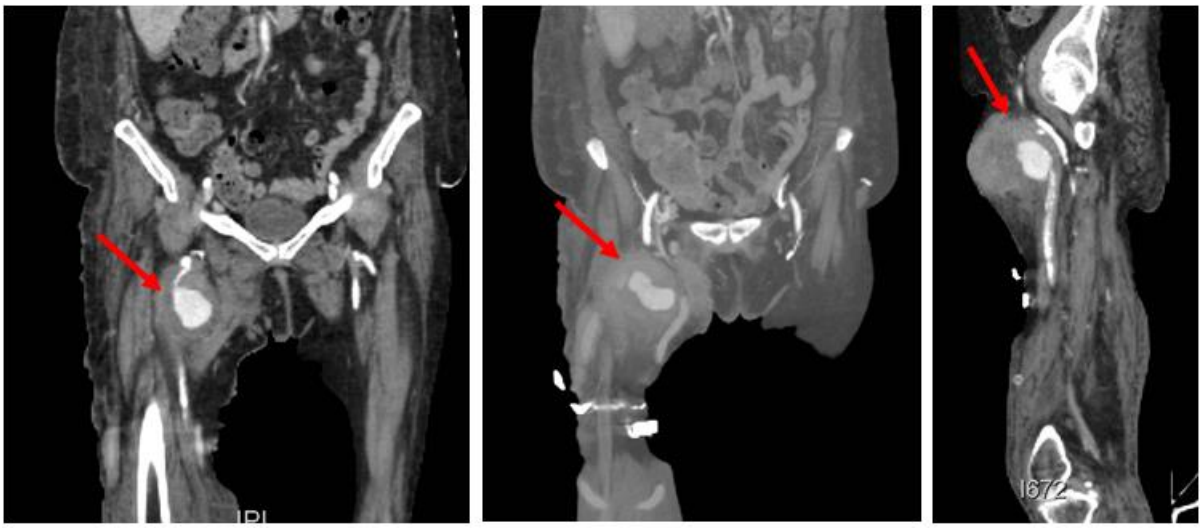

Image 2: Aortoiliac and lower limb angiotomography showing a pseudoaneurysm at the right common femoral artery. (A, B: coronal plane. C: sagittal plane)

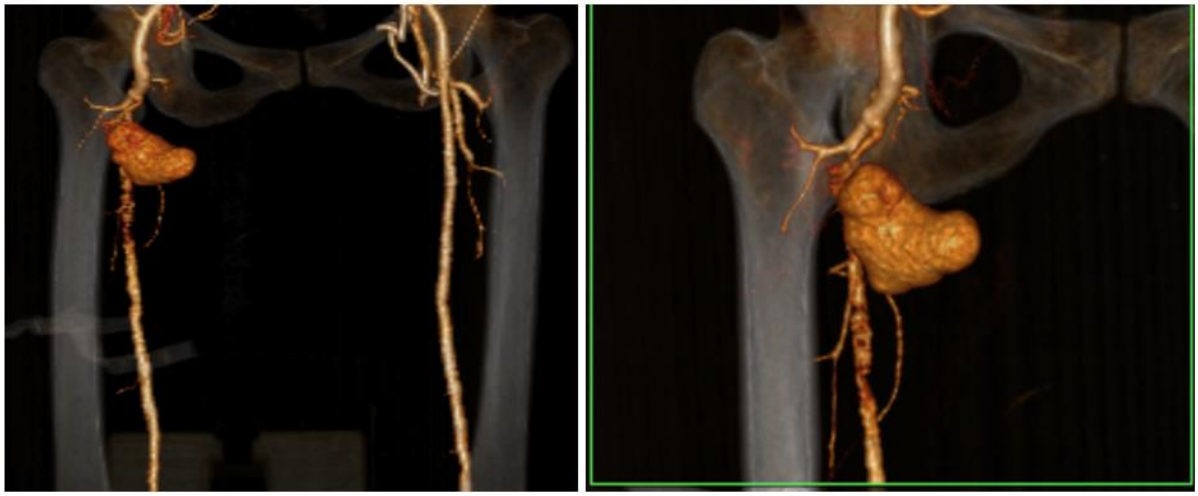

Image 3: Aorto-iliac and lower limb angiography (3D) showing a pseudoaneurysm at the right common femoral artery

Emergency surgical management was decided due to the patient's unstable condition, with a high probability of limb loss, thrombosis, compartment syndrome and death.

An open approach was performed through an infra-inguinal longitudinal incision, draining a large hematoma and pus; then, difficult dissection of surrounding tissues achieving atraumatic vascular proximal and distal control with vessel loops of the right superficial, deep, and common femoral artery. Infected prosthetic PTFE graft was identified leading to recognize a saphenofemoral loop fistula with injury of the right superficial femoral artery and active bleeding at the site, and dehiscence of saphenous anastomosis. The graft was then removed and a thrombectomy of the superficial and common femoral artery was performed with Fogarty 3 Fr, to continue with en bloc arteriotomy of the right superficial femoral artery and arterial reconstruction with a cryopreserved allograft (iliac artery – length: 11cm) performing end-to-end anastomosis between the allograft and the proximal and distal ends of the superficial femoral artery with running sutures using polypropylene 6/0 (Image 4). It was covered with 4ml Coseal® surgical sealant and 5ml Floseal® hemostatic matrix to assure hemostasis. A Vacuum Assisted Therapy (VAC®) system was created to cover the surgical site, using whitefoam® to protect the vascular structures.

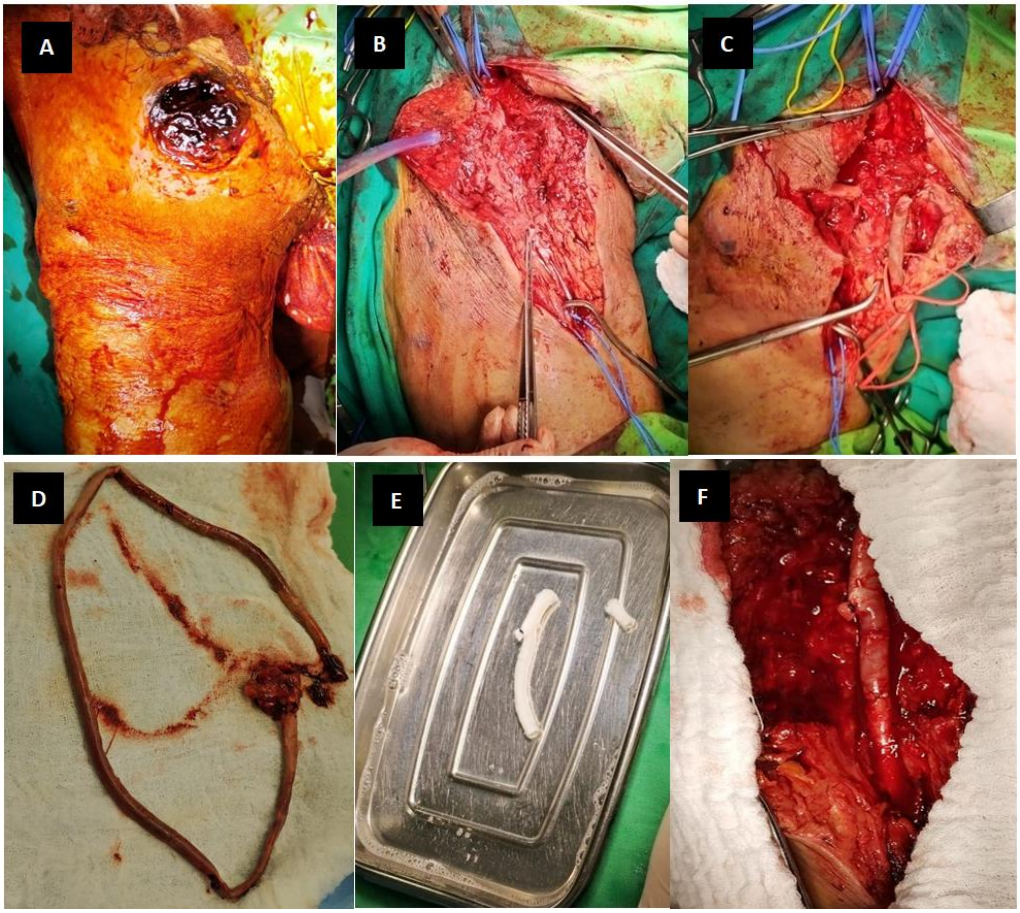

Image 4: Intraoperative course. A. Right inguinal infected ulcerated mass. B. Infrainguinal right incision exposing infected and friable soft tissue, proximal and distal vascular control of superficial, deep, and common femoral artery with vessel loops. C. Identification of infected PTFE graft and proximal injury of the superficial femoral artery. D. Removal of infected PTFE graft. E. Preparation of cryopreserved iliac artery allograft. F. Femoro-femoral bypass: end-to-end anastomosis of the allograft for superficial femoral artery reconstruction

Initially, the patient's post-surgical recovery was favorable, receiving a multi discipline management in the intensive care unit (ICU) including Nephrology, Vascular Surgery and Infectiology continuous evaluation and follow-up. Remained conscious, hemodynamically stable, and her general clinical condition improved, although renal function was severely deteriorated. Three days after first surgical procedure, the patient was reoperated to perform a surgical debridement and cleaning of the surgical site and to evaluate closure possibility, observing an intact arterial allograft anastomosis, preserving patency and right lower extremity irrigation, however, the patient then presented bleeding from the surrounding tissues and had to be reoperated twice in the following 24 hours, resulting in a rapid torpid evolution, thus provoking her decease because of hypovolemic shock and multiple organ failure.

DISCUSSION

CRF presents a high morbidity and mortality, requiring an adequate HD access, which can be done by temporal or permanent catheter placement, creation of autogenous or prosthetic graft AVFs and others, for example, use of peritoneal catheter.

Research has shown that severe infection (aHR, 9.6; 95% CI, 8.86-10.36; $p < .001$) and mortality (aHR, 1.29; 95% CI, 1.27-1.31; $p < .001$) are higher for prosthetic grafts compared with autogenous fistulas, however, temporizing with a catheter comprises a 51% increase in mortality (aHR, 1.51; 95% CI, 1.48-1.53; $p < .001$), 69% decrease in primary patency (aHR, 0.31; 95% CI, 0.31-0.32; $p < .001$), and 130% increase in severe infection (aHR, 2.3; 95% CI, 2.2-2.5; $P < .001$) compared to initiation with autogenous fistulas or prosthetic grafts [6].

Less frequently, in the mature AVF, complications are acquired 'de novo'. They derive either from incorrect management of vascular access (haematoma, pseudoaneurysm, prosthesis infection) or wall pathologies (aneurysm, kinking, coiling or abnormal dilation from defects of elastic structures). In an emergency setting, ultrasonography high-resolution transducers (10-20 MHz) allow the characterization of the wall damage, haemodynamic dysfunctions, early and late complications even if phlebography remains

the gold standard for the diagnosis for its sensitivity and specificity [7]. Other image methods may be used, such as angiotomography, which can contribute to surgical planning.

Exhaustion of all upper body outflow veins is not uncommon, owing to previous central catheter insertions, making fistulas constructed at the femoral region inevitable for patients who do not have a chance for a transplant or when peritoneal dialysis is not an option. In this context, femoral loop grafts have been used as a lifesaving measure for this purpose, although their risks of infectious complications and steal are well known [8]. This AVF grafts, and especially femoral loop graft AVFs show an unacceptable high rate of septic and steal related morbidity and even mortality: septic complications reach 20%, amputation rates 22%, and mortality rates 20% [9, 10]. To date there have been only two reports about FVT favoring the procedure [11, 12].

Also, it is important to note that diabetes mellitus has been associated with a decrease in patient survival, access maturation, and primary fistula patency; reaching a 19% increase in patient mortality for diabetic relative to nondiabetic autogenous AVF recipients (aHR, 1.19; 95% CI, 1.17-1.20; $p < .001$) and 12% increase for prosthetic graft recipients (aHR, 1.12; 95% CI, 1.10-1.15; $p < .001$) [13]; but, no significant difference has been shown in severe prosthetic graft infection warranting excision between diabetic and nondiabetic patients (aHR, 0.99; 95% CI, 0.92-1.08; $p = .90$).

In the elderly, literature has reported a decrease in severe prosthetic graft infection requiring graft excision (aHR, 0.99; 95% CI, 0.99-0.99; $p < .001$) and increase in mortality (aHR, 1.03; 95% CI, 1.03-1.03; $p < .001$) compared with younger patients [14]. In contrast with the previously reported case, where the patient presented, both, severe graft infection which led to her decease.

In this case, HD access was assured with previous placement of right jugular temporal hemodialysis catheter, and due to patients' unstable clinical condition, it was decided to remove the infected prosthetic PTFE graft and perform arterial reconstruction of superficial femoral artery with a cryopreserved arterial allograft to reduce intraoperative time and attempt limb salvage.

The durability of cryopreserved allograft has been previously demonstrated in the setting of infection, providing an excellent conduit for angioaccess when autogenous tissue is not available in patients with current or past conduit infection; and allowing immediate reconstruction through areas of infection, reducing the need for staged procedures, and permitting early use for dialysis. A study of 82 patients (18%) in whom the cryopreserved allograft was placed in the same location as the excised infected prosthetic graft, 13 had infection of the allograft during the study period (early: n = 4; late: n = 9), with no significant difference in infection rate ($p = .312$) compared with the remainder of the study population [15].

Finally, HD vascular access creation and function is a vast and interdisciplinary scenario, thus adequate access management must be based on knowledge of the state of the art and on future perspectives. Recent developments to improve arteriovenous fistula creation and patency, the blood compatibility of arteriovenous shunt, needs to avoid infections, and potential development of tissue engineering applications in HD vascular access must be acknowledged [16].

CONCLUSIONS

Unusual site AVFs (i.e., saphenofemoral loop graft AVFs) should be carefully followed-up by physicians to reduce the risk of complications and raise the awareness of them to diminish associated morbidity and mortality.

An HD access must be always warranted for the patient in case of current access complication or disability.

Surgical approach of complications such as reported in this case continues to be challenging for vascular surgeons, thus the need to a prompt recognition and prevention.

An arterial cryopreserved allograft may be used for arterial reconstruction in the setting of an infected wound.

The goal must be to spread more knowledge in this critical area of medicine that is importantly affecting medical costs of renal replacement therapies and patients' quality of life and survival rates.

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