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Case Study

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ISCHEMIC DIGITAL NECROSIS ON A RIGHT BRACHIOCEPHALIC FISTULA TREATED BY RADIAL ANGIOPLASTY AND AMPUTATION: A CASE REPORT

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ABSTRACT

Introduction: Distal ischemic steal syndrome (DISS) is a rare but serious complication of brachiocephalic arteriovenous fistulas (AVFs) used in chronic hemodialysis. It results from a diversion of blood flow through the AVF at the expense of distal arterial perfusion, potentially leading to digital ischemia and necrosis. Prompt diagnosis and a balanced therapeutic approach are essential to avoid limb-threatening outcomes while preserving vascular access. **Case report:** We present the case of a 70-year-old male undergoing chronic hemodialysis, who developed ischemic necrosis of the right fourth finger in the context of a functioning right brachiocephalic AVF. Clinical evaluation and Doppler ultrasound revealed absent radial and ulnar pulses and reversed radial artery flow due to long-segment radial artery stenosis. Given that the AVF was the patient's last viable access site, a conservative strategy was adopted. Endovascular percutaneous angioplasty of the radial artery successfully restored antegrade flow, and surgical amputation of the necrotic finger was performed in the same operative session. Postoperative follow-up showed favorable healing and preserved AVF function without recurrence of ischemic symptoms. **Discussion:** This case illustrates the importance of individualized, vessel-sparing strategies in managing DISS, particularly in patients with limited vascular access options. Percutaneous angioplasty of forearm arteries represents a safe, effective, and minimally invasive alternative to traditional revascularization procedures in selected cases. Timely intervention can prevent further ischemic damage and avoid the need for major amputation or fistula sacrifice. **Conclusion:** Early recognition and targeted treatment of AVF-related ischemic complications are crucial to prevent irreversible damage. In patients with limited vascular access, percutaneous revascularization combined with limited surgical intervention may achieve symptom resolution while preserving hemodialysis viability.

KEYWORDS: Hemodialysis, Arteriovenous fistula, Ischemic steal syndrome, Digital necrosis, Radial angioplasty, Vascular access preservation, Amputation.

INTRODUCTION

Distal ischemic steal syndrome (DISS) is a rare but serious complication of arteriovenous fistulas (AVFs) used for hemodialysis, occurring in 1 to 8% of cases, particularly in brachiocephalic fistulas.[1,2] It results from arterial blood flow diversion toward the AVF, compromising distal perfusion. Clinical manifestations range from mild paresthesia to digital necrosis.

Risk factors include advanced age, diabetes, atherosclerosis, and proximal arterial stenosis. In cases of critical ischemia, prompt intervention is essential to preserve limb function and maintain vascular access. We report the case of a 70-year-old chronic hemodialysis patient with a right brachiocephalic AVF complicated by necrosis of the right middle finger due to long-segment radial artery stenosis. He was successfully treated with percutaneous angioplasty and digital amputation, with a favorable outcome and preservation of the fistula.

CASE REPORT

A 70 year old male with end-stage renal disease secondary to diabetic nephropathy, on chronic hemodialysis for 22 years, presented with progressive right-hand ischemia. The clinical picture was dominated by dry gangrene of the distal phalanx of the right fourth finger and cyanosis of the remaining fingertips [Fig 1], associated with persistent pain. The patient reported no fever, trauma, or recent cannulation-related complications. His right upper limb was his last viable vascular access site after the failure of three previous fistulas: radiocephalic, brachiocephalic, and brachiobasilic AVFs on the left arm.

Fig. 1: Necrosis du fourth finger.

The patient had a functioning right brachiocephalic arteriovenous fistula (AVF), created nine years earlier and used exclusively for dialysis. On physical examination, the AVF was patent, with a strong palpable thrill. The brachial pulse was present, but both the radial and ulnar pulses were absent on the right side. There was localized necrosis of the distal phalanx of the fourth finger, which was dry, blackened, and demarcated, with surrounding cyanosis affecting all digits. Capillary refill was delayed, and hand temperature was decreased distally, raising concern for critical digital ischemia. No motor or sensory deficits were noted at that stage.

Given the vascular findings and presence of a functional high-flow fistula, distal ischemic steal syndrome (DISS) was suspected. A duplex ultrasound was performed, revealing retrograde flow in the radial artery and long-segment high-grade stenosis. The ulnar artery demonstrated a weak but antegrade flow. The digital arteries were not visualized, likely due to poor perfusion and vessel caliber below the resolution threshold. These findings confirmed compromised distal perfusion secondary to AVF-induced hemodynamic imbalance, worsened by pre-existing arterial disease.

Given the critical nature of the ischemia, and in an effort to preserve the only remaining functional AVF, a combined interventional approach was decided. Under local anesthesia, the patient underwent diagnostic fistulography and selective arteriography of the right upper limb. These confirmed retrograde flow in the radial artery due to long-segment stenosis and poor distal runoff [Fig 2]. Percutaneous transluminal balloon angioplasty (PTA) of the radial artery was performed with technical success, restoring antegrade flow toward the hand [Fig 3].

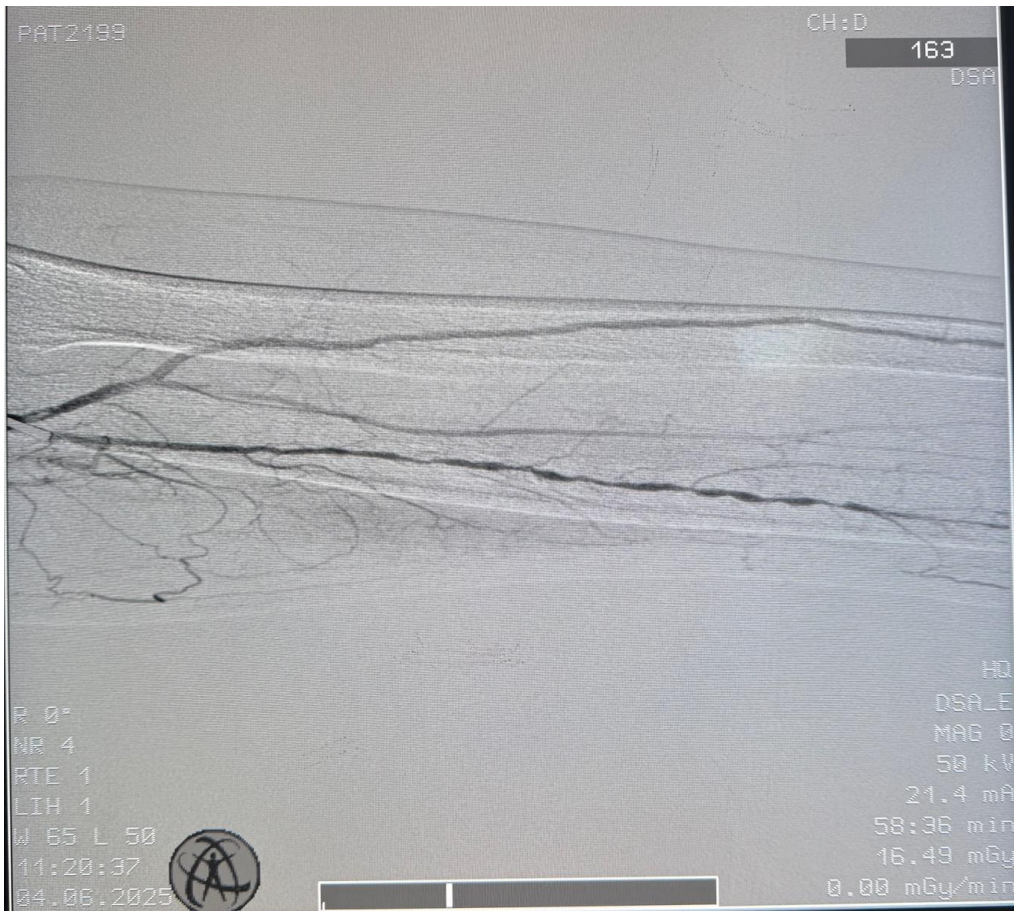

Fig. 2: Angiographic view demonstrating multiple discrete, segmental stenosis along the entire course of the radial artery.

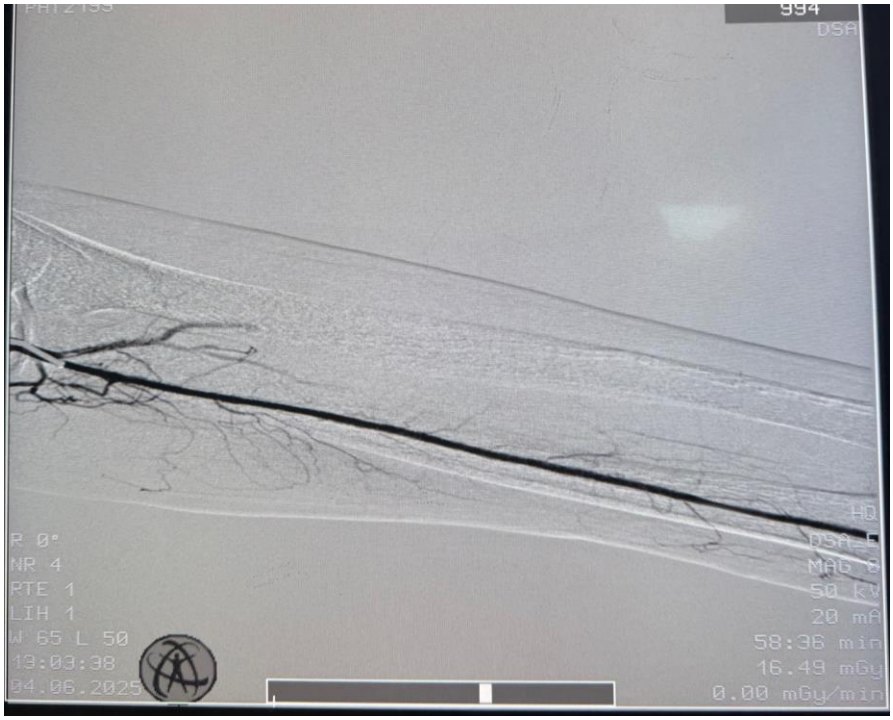

Fig. 3: Post angioplasty control showing successful dilatation of the radial artery.

Immediately following endovascular intervention, a conservative surgical amputation of the necrotic middle finger was performed. Intraoperative findings confirmed dry necrosis limited to the distal phalanx. The amputation stump showed adequate bleeding and perfusion [Fig 4], indicating effective revascularization. The procedure was well tolerated, and no intraoperative complications occurred.

Postoperatively, the patient was monitored for vascular patency and wound healing. On day 7, clinical examination demonstrated a warm hand with preserved AVF function, satisfactory capillary refill, and no new areas of cyanosis or ischemia. Duplex ultrasound confirmed continued patency of the angioplastied radial artery and a functioning AVF. The amputation site showed favorable healing without infection.

Fig. 4: Amputation of the fourth finger following digital ischemic necrosis.

At the 1-month follow-up, the patient remained asymptomatic, and there was no recurrence of ischemic symptoms. Hemodialysis continued successfully via the same AVF. This case underscores the value of early diagnosis and targeted intervention in patients with DISS, particularly when vascular access options are limited.

DISCUSSION

DISS is a severe but uncommon vascular complication observed after AVF creation. It occurs when a substantial volume of blood is diverted through the fistula at the expense of distal arterial perfusion, leading to digital ischemia ranging from cold sensitivity to tissue necrosis.[1] It is more common with proximal AVFs such as brachiocephalic or brachiobasilic fistulas due to higher flow volumes and wider perfusion territories.[2]

Well-known risk factors include diabetes, atherosclerosis, advanced age, female sex, and underlying proximal arterial stenosis or occlusive disease.[2,4] The Schanzer classification stratifies clinical severity from stage I (mild symptoms) to stage IV (necrosis).[5] In severe cases, such as this one, intervention is necessary to avoid major limb loss.

Diagnosis relies on clinical assessment and imaging. Duplex ultrasound is especially useful in demonstrating retrograde flow in the radial or ulnar artery and identifying underlying stenosis.[6] In this case, multiple long-segment stenoses of the radial artery were observed, explaining the digital ischemia.

Therapeutic options depend on the severity and anatomical findings of DISS

- Flow reduction techniques, such as banding or the MILLER procedure, are indicated in moderate cases.[7]
- Distal revascularization procedures, such as DRIL (Distal Revascularization with Interval Ligation) or RUDI (Revision Using Distal Inflow), are preferred in severe cases with compromised perfusion.[8,9]
- Radial artery embolization may be used in cases of steal syndrome caused by radiocephalic AVFs with radial flow reversal.[10]
- Percutaneous angioplasty of forearm arteries is a more recent and less invasive option that restores distal flow in cases of localized or diffuse stenosis.[11,12]

In our case, percutaneous angioplasty of the right radial artery restored sufficient antegrade flow. Digital amputation was necessary due to irreversible necrosis. This surgical gesture prevented infectious complications and promoted rapid healing.

Several studies confirm the efficacy of angioplasty in improving ischemic symptoms, particularly in localized or diffuse stenosis.[13,14] This endovascular approach is especially suitable for fragile patients or those with limited vascular access, as in our patient whose AVF was the last available access.

Thus, the chosen strategy achieved distal revascularization, controlled the necrosis, and preserved AVF patency—crucial objectives in chronic dialysis patients.

CONCLUSION

This case highlights the importance of early diagnosis of DISS and an individualized therapeutic approach. Radial artery angioplasty is a simple, effective, and conservative option. When combined with targeted digital amputation, it can resolve severe ischemic complications while preserving vital vascular access in chronic hemodialysis patients.

Consent

A consent was obtained from the patient to publish this case report and accompanying images.

Ethical approval

This case report is exempt from ethical approval in our institute, Ibn Sina University Hospital Center.

Conflict of interest statement

The authors declare that they have no competing interests relevant to the content of this article.

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