

Triumphantly Orchestrating the Rescue: Masterful Handling of Three Life-threatening Dialysis Fistula Ruptures

Midhun Ramesh¹, Anand Kumar², Shabeen Kumar T¹, Ameesha Ravoran Veetil¹, Faris K.V.P¹

Departments of ¹Nephrology and ²Vascular Access Surgery, Baby Memorial Hospital, Kannur, Kerala, India.

Corresponding Author:

Dr Midhun Ramesh
Email: dr.midhunramesh@gmail.com

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Abstract

Background: Dialysis arteriovenous (AV) fistula ruptures are rare but serious complications in end-stage renal disease (ESRD) management. They can result from various factors like high arterial pressures, repeated needle punctures, aneurysm formation, or vascular disease. Symptoms include pain, swelling, bruising, and bleeding. We hereby present a case series on the management of AV fistula ruptures. **Case Series:** Three cases illustrate different management approaches. Our first case was a 55-year-old woman with multiple co-morbidities underwent surgical resection of an aneurysm in her AV fistula, followed by the creation of an autologous AV fistula. Second case involved a 52-year-old woman presenting with a ruptured AV fistula aneurysm. She underwent surgical excision of the aneurysm and placement of a prosthetic graft, leading to a successful outcome. Third case was an 85-year-old man with multiple medical issues developed compartment syndrome following AV fistula rupture. Surgical intervention involved hematoma evacuation and vein repair, with subsequent improvement and preservation of vascular access. **Conclusion:** These cases emphasize the importance of prompt recognition and collaborative multidisciplinary intervention in managing AV fistula ruptures.

Keywords: Aneurysm, Arteriovenous Fistula, Compartment Syndrome, Dialysis, Infection.

Introduction

Dialysis arteriovenous (AV) fistula rupture represents a rare yet potentially life-threatening complication in the management of end-stage renal disease (ESRD). While arteriovenous fistulas (AVF) are considered the gold standard for dialysis access due to their durability and lower risk of infection compared to other access methods, they are not without complications. A frequent issue with such a fistula involves the development of either an aneurysm or a pseudoaneurysm, which can pose a significant danger of potential rupture [1,2].

Rupture of an AVF occurs when there is a breach in the integrity of the vessel wall, leading to uncontrolled bleeding into the surrounding

tissues. This can be precipitated by a variety of factors, including prolonged exposure to high arterial pressures during dialysis, repeated needle punctures at the same site, aneurysm formation, vessel calcification, or underlying vascular disease. Patients may present with symptoms such as sudden severe pain, swelling, bruising, and torrential bleeding with or without thrill loss at the site of the AVF. The consequences of AVF rupture can be dire, potentially resulting in hemorrhagic shock, compromised dialysis adequacy, and the need for emergent interventions such as surgical repair or endovascular procedures. It may even necessitate the creation of new accesses or resorting to less desirable access modalities with higher complication rates.

We present three cases of dialysis arteriovenous fistula (AVF) ruptures encountered at our centre, each requiring urgent intervention and subsequent successful management. Despite the severity of their initial presentations, all patients were discharged with functional AVFs, ensuring continued access to hemodialysis.

Case Series

Case 1: Autologous venous graft AVF

A pleasant 55-year-old woman, previously diagnosed with pulmonary hypertension, hypothyroidism, end-stage renal disease necessitating thrice-weekly hemodialysis, stage-4 breast carcinoma managed with Trastuzumab, and an atrial septal defect, sought medical attention due to an impending rupture of an aneurysm in her AVF. A Doppler evaluation of the left brachial cephalic AV dialysis fistula uncovered an aneurysmal dilation at the venous end, measuring 0.8×1.6×1.7 cm. with an average blood flow velocity of 185 cm/s, and flow volume of more than 1000 ml/minute.

The patient underwent pre-operative optimization of biochemical and hematological parameters, utilizing hemodialysis through a right internal jugular catheter. The subsequent surgical intervention involved resecting the venous aneurysmal segment under a supraclavicular anesthetic block. A venous segment from the left forearm was harvested, and an autologous venous AV fistula was crafted at the exercised site [Fig.1]. Post-operatively, the patient was stabilized in the surgical intensive care unit (ICU), necessitating support with blood components. A drain, strategically placed at the surgical site, was eventually removed once the drainage became negligible. Gradual improvement in her overall condition allowed a discharge with central line dialysis after a week. Over thirty days, the AV fistula matured, leading to a triumphant return to AVF dialysis.

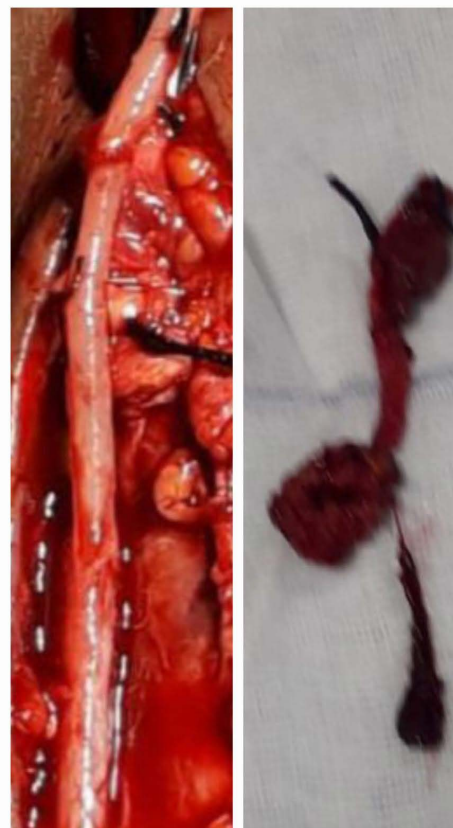


Fig.1: Newly created autologous venous AV fistula and exercised aneurysmal segment.

Case 2: Ruptured aneurysm excision and placement of a prosthetic graft- a hybrid AVF

A 52-year-old woman arrived at the emergency department after being referred due to bleeding from her right AV fistula for several hours. An emergency Doppler scan revealed a 3×3.5 cm aneurysm in the AV fistula with a thrombosed cephalic vein segment of 3.4 cm proximally. She was in hypovolemic shock with a hemoglobin level of 5.8 g/dL, necessitating admission to the ICU for resuscitation with blood transfusions and pre-operative optimization through hemodialysis via an internal jugular dialysis catheter. The surgery involved removing the ruptured aneurysm with the thrombosed venous segment and connecting the brachial artery to the arterialized cephalic vein segment of old AVF using a prosthetic graft under regional anesthesia. A post-operative Doppler

scan on day six revealed a patent brachiocephalic anastomotic graft. She was discharged after a week in the hospital with a functional prosthetic AV fistula graft.

Case 3: Compartment syndrome in a patient on hemodialysis following arteriovenous fistula rupture

An 85-year-old gentleman with a history of systemic hypertension, coronary artery disease, and polycythemia rubra vera was referred to our center due to left upper limb swelling, discoloration, and pain persisting for 5 days. He had undergone dialysis via an AVF on the left upper limb at a peripheral center a week prior, experiencing active bleeding from the puncture site post-dialysis. Subsequently, he developed worsening pain, swelling, and discoloration in the left upper limb, exhibiting signs of compartment syndrome, distal ischemia, pre-gangrene changes in the left upper limb, and cellulitis over the AVF site. Multiple serous fluid blebs were formed in the upper arm near the fistula site. Given the worsening sepsis and ischemia in the left upper limb, there was a suggestion of limb amputation at the peripheral center. Upon admission to our hospital, the patient presented with elevated inflammatory markers, an elevated total leukocyte count, severe anemia, and septic shock. An AV fistula Doppler revealed a narrow-neck cephalic vein pseudo-aneurysm at the mid-arm level proximal to the fistula, accompanied by a large hematoma in the mid and proximal arm in the subcutaneous plane, indicating an AV fistula rupture. Moderate peri-fistulous inflammation and extensive skin and subcutaneous tissue edema were also observed.

In response to developing compartment symptoms, the patient underwent hematoma evacuation and cephalic vein repair under left supraclavicular and interscalene anesthesia. Nearly 1000 ml clot was removed and two corrugated drains were also placed. The post-operative period in the ICU was challenging, requiring

multiple blood component supports and broad-spectrum antibiotic coverage. The surgical drain was removed once drainage became minimal, and he was discharged, continuing thrice-weekly hemodialysis via a central line, with the AV fistula remaining functional. The plan is to initiate AVF dialysis once the surgical wound is well healed.

Discussion

Renal transplantation stands out as the optimal therapy for individuals grappling with chronic renal failure; nevertheless, hemodialysis remains the prevailing treatment. To facilitate vascular access, patients often undergo the establishment of an AVF, commonly at the distal wrist (known as the Brescia-Cimino fistula) or at the elbow (known as the brachiocephalic fistula) [3]. Yet, these fistulas come with their set of complications, such as the development of aneurysms or pseudoaneurysms. The repetitive puncturing of AVF for hemodialysis vascular access, especially with buttonhole technique [4]; can result in the thinning of aneurysm walls, potentially leading to their rupture. Such ruptured aneurysms necessitate immediate surgical intervention as they constitute surgical emergencies and surgical AVF takedown was considered as the safest option in these settings [5].

Karabay *et al.* [6] detailed a procedure involving the removal of the aneurysm and the connecting veins, aiming to restore arterial flow. On the other hand, Moini *et al.* [7] introduced a novel technique, but both approaches resulted in the patient's loss of a functional fistula. A conservative approach was attempted by Hong-Yee *et al.* in unruptured AVF aneurysm cases [8]. But the literature is deficient in case reports detailing management strategies for maintaining functionality in ruptured hemodialysis AVFs.

At our centre, we have not only excised the ruptured venous aneurysms but maintained a functional AVF post-procedure, preserving the lifeline of our patients. These cases

emphasize the importance of prompt recognition, multidisciplinary collaboration, and timely intervention in managing AVF ruptures. Early recognition and management of AVF ruptures are important in preventing catastrophic outcomes and preserving vascular access for continued dialysis therapy.

Conclusion

Through coordinated efforts involving nephrologists, vascular surgeons, radiologists, anaesthesiologists, intensivists, and dialysis staff, we successfully salvaged vascular access in these patients, ensuring the continued provision of life-sustaining hemodialysis. Such experiences reinforce the critical role of specialized centres in optimizing outcomes for ESRD patients facing complex dialysis fistula complications.

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