World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Hybrid approach in the management of arteriovenous fistula complications

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World Journal of Advanced Research and Reviews, 2025, 28(01), 2214-2218

Publication history: Received on 10 September 2025; revised on 20 October 2025; accepted on 22 October 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.28.1.3592

Abstract

The arteriovenous fistula (AVF) remains the vascular access of choice for hemodialysis due to its durability and low risk of infection. Nevertheless, it can present various complications, such as stenosis, thrombosis, aneurysm, or steal syndrome. Conventional management relies on either surgical or endovascular techniques. Recently, a hybrid approach combining both modalities has emerged as an effective strategy, particularly for complex cases.

This article reviews the indications, techniques, and benefits of hybrid management for AVF complications.

Keywords: Arteriovenous fistula; Hybrid surgery; Endovascular techniques; Vascular access; Complications

1. Introduction

The native AVF represents the best option for chronic hemodialysis. However, up to 60% of patients develop complications requiring intervention {14}. Optimal management of these complications is essential to maintain a functional access, reduce morbidity, and avoid the need for central venous catheters.

Endovascular techniques (angioplasty, thrombolysis, stenting) and surgical procedures (aneurysmorrhaphy, transposition, suture repair, reimplantation) each have advantages and limitations. Hybrid management, combining both approaches in a single operative session, has emerged as a promising alternative, particularly in complex cases or after failure of standard treatment.

2. Materials and Methods

This retrospective analytical study was conducted in the Vascular Surgery Department of CHU Hassan II, Fez, over a three-year period (January 2021–December 2023). It included 36 patients who underwent hybrid procedures for the management of AVF complications.

2.1. Study population

-Inclusion criteria: all patients who underwent hybrid management for AVF complications during the study period.

-Exclusion criteria: patients who had surgical and endovascular treatments performed separately in two sessions, and incomplete medical records.

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3. Results

The study included 36 patients, with a male predominance: 21 men (58%) and 15 women (42%), corresponding to a sex ratio of 1.38.

The mean age was 55 years (range 24–80 years). The most frequent age group was 56–72 years, representing 44.44% (16 patients).

3.1. Clinical profile of patients:

- -Etiologies of renal failure: In 47.23% of cases, the cause of renal failure was identified, while 52.77% had an undetermined nephropathy. Diabetes was the leading cause (27.78%; 10 cases), followed by hypertension (16.67%; 6 cases).
- -Duration of hemodialysis: Data were available for 26 patients. The mean duration was 5 years (range 2 months–15 years).
- -Previous dialysis modalities: All patients had data on prior dialysis methods. Most (24 patients) received an AVF directly, while 12 were previously dialyzed via catheter (7 temporary, 5 tunneled).
- -Site of the AVF: All 36 AVFs were located in the upper limbs; none were performed in the lower limbs.

3.2. Therapeutic management

Preoperative anticoagulation with unfractionated heparin was administered in 58.3% of patients presenting with AVF thrombosis. Aspirin was prescribed in 11.1% of cases with residual stenosis or atheromatous lesions. All patients received postoperative antibiotic therapy adjusted to renal clearance and systematic analgesia.

Figure 1 Correction of a venous kinkin by exclusion and end-to-end anastomotic repair associated with stenosis of the cephalic vein arch.

Most interventions (91.7%) were performed under regional anesthesia.

Fogarty catheter thrombectomy combined with transluminal angioplasty (PTA) was performed in 52.8% of patients. Other procedures included aneurysmorrhaphy with PTA (16.7%), resection of kinked segments (5.5%), and skin plasty (22.2%).

The mean hospital stay was 2.33 nights. Primary success (palpable thrill and residual stenosis <30%) was achieved in 94.4% of cases. Two primary failures (5.6%) were reported. No major intraoperative events occurred. Two minor postoperative hematomas were noted, with no functional impact. One case of late AVF rupture was reported.

4. Discussion

Our study demonstrated a slight male predominance (sex ratio M/F: 1.38), consistent with several previous studies. Conversely, other studies report a female predominance, possibly related to smaller arterial diameters in women {1}.

The etiologies of renal failure vary among studies. In our series, diabetic nephropathy was the leading cause (27.78%), followed by hypertensive nephropathy. This aligns with the study by Boughalem, while other studies, such as those by Campos and Bensalem, found hypertension as the main cause. The high prevalence of diabetes in our series highlights its major impact as a public health problem in Morocco. Hypertension, although frequent, may be both a cause and a consequence of renal failure, complicating its etiologic role {1.2}.

In our series, 66.67% of patients received an AVF as their initial dialysis access, whereas 33.33% were initially dialyzed via catheter (temporary or tunneled). These findings reflect an improvement compared to earlier Moroccan studies, such as those of Medkouri and Boughalem, where temporary accesses predominated (86.3% and 58.63%, respectively). This evolution suggests better coordination between nephrologists and vascular surgeons, enabling earlier preparation for hemodialysis {1.3}.

Since its introduction in 1966 by Brescia and Cimino, the native AVF remains the gold standard vascular access for hemodialysis, despite high maturation failure rates (50–60%) and often limited primary patency (~50%), largely depending on practitioner expertise. Studies by Weale et al. and the Dialysis Access Consortium show variable outcomes according to AVF site, age, and dialysis history {4}.

Recent percutaneous techniques offer promising results, with technical success rates of 95–99% and secondary patency up to 96% at one year, while reducing classical complications. However, long-term follow-up remains limited {5}.

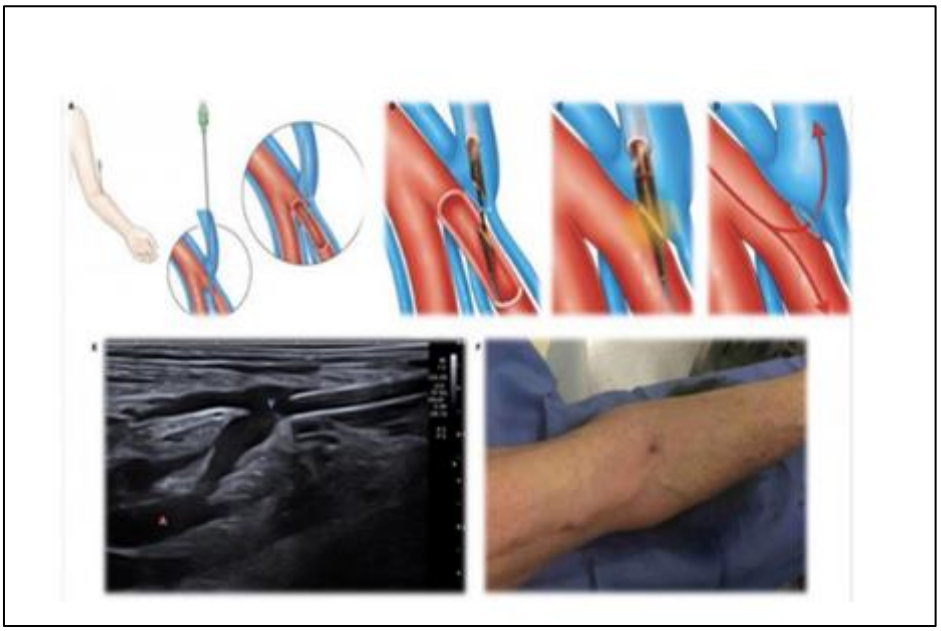

Figure 2 Puncture of the median cephalic vein followed by direct puncture of the proximal radial artery through the perforating vein of the elbow (A). The Ellipsys system, in its open position, is then advanced until it abuts the arterial wall during traction (B)

In our series, 61% of patients had proximal AVFs, nearly half with a history of distal fistula, reflecting frequent re-creation of AVF after failure or dysfunction of the first access {6}.

The AVF remains the preferred vascular access for chronic hemodialysis due to its hemodynamic efficiency and low complication rate. Regular clinical surveillance allows early diagnosis of complications, particularly stenoses and thromboses. Several studies (Dhamija, Chen, Migliaacci, Asif) confirm the high sensitivity and specificity of clinical examination for detecting stenoses, comparable to Doppler ultrasound {7}.

According to KDOQI recommendations, clinical warning signs include absence of thrill, weak distal pulse, edema, or a pulsatile AVF. In our series, the main presenting symptoms were silent AVF (58.3%), skin necrosis (22.22%), aneurysmal dilation (16.66%), palpable venous cord (11.11%), and distal ischemic signs (2.7%). Most of these complications were secondary to undiagnosed stenoses {8}.

Hybrid treatment of AVF complications, combining surgical and endovascular techniques, has shown notable efficacy in managing stenoses, preventing thrombosis, and improving blood flow. This approach reduces postoperative complications and the need for reintervention, although long-term follow-up may still reveal recurrence {9}.

Studies by Lambert and Catherine Go confirm the superiority of hybrid management over conventional surgery regarding assisted primary patency, especially in thrombosis cases. Similar findings were observed for venous aneurysms, where two-step hybrid procedures (surgical and endovascular) proved less invasive and more versatile for managing complex or multiple lesions {10}.

Hybrid treatment of AVF complications has yielded promising results in terms of efficacy and vascular access preservation. It significantly improves blood flow, corrects stenoses, prevents thromboses, and reduces postoperative complications. Studies by Lambert and Catherine Go have demonstrated the superiority of this approach compared with open surgery, particularly for thrombosis, although reinterventions may still be required {11}.

Hybrid procedures have also proven useful in the management of venous aneurysms, enabling targeted interventions on multiple vascular segments with a minimally invasive character {12}.

Primary patency, defined as the time from access creation to the first reintervention, remains a key performance indicator. Reported rates in the literature range from 60% to 90% at one year, depending on study and geographic context. In our series, primary patency was 85% at 6 months, 76% at one year, and 60% at two years, showing improvement compared with historical data {13}.

These results reflect progress in both AVF creation and surveillance, highlighting the importance of regular follow-up to detect early abnormalities, optimize access longevity, and ensure effective, durable hemodialysis.

5. Conclusion

Hybrid treatments for arteriovenous fistula (AVF) complications represent an innovative and effective approach to managing these complex clinical situations, offering encouraging outcomes in terms of treatment success and reduction of postoperative complications. Larger prospective studies are needed to confirm these findings and better define optimal indications for hybrid management in this patient population.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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