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Case Report

Loop arteriovenous graft of the chest wall as a viable option for dialysis☆

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ABSTRACT

The search for a reliable, complication-free vascular access is crucial among dialysis patients. The creation of a long-term access site for hemodialysis is dependent on several factors that mandate forming a life-plan for dialysis access, with upper extremity vascular access being the preferred route. However, complications including poor maturation, venous anastomosis lesions, and thrombosis are all associated with poor survival of these accesses. As a result, numerous patients within the dialysis population have exhausted access sites in the upper and lower extremities, requiring the search for other access options including chest wall arteriovenous graft (AVG). However, limited data is available about the outcomes of these chest wall grafts. Here, we describe two 62-year-old female dialysis patients who exhausted other dialysis access sites and subsequently underwent arteriovenous loop graft of the chest wall that connected the axillary artery with the ipsilateral axillary vein. These AVGs remained functional during the follow up period. This report highlights the viability of chest wall AVG access in the unique subset of hemodialysis patients who exhausted all other access sites.

Introduction

Hemodialysis longevity is largely dependent on the presence of functional vascular access. As a result, the search for reliable, complication-free access is crucial in dialysis patients. The creation of a long-term access site for hemodialysis is dependent on several factors, such as the patient's age, sex, vascular anatomy, and comorbidities that mandate formulating a long-term plan for dialysis access [1,2]. Due to the relatively

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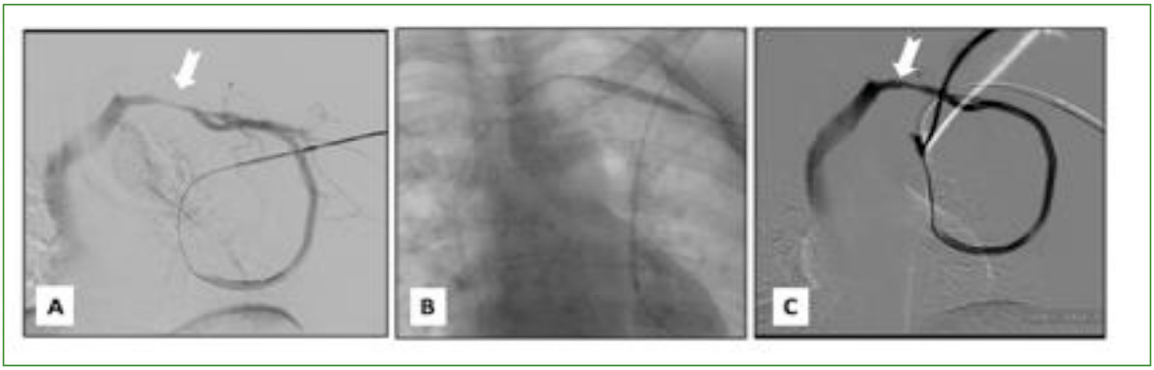

Fig. 1 – Left axillary-axillary loop graft. A. venous anastomosis stenosis (arrow). B. Balloon angioplasty of the lesion. C. Post angioplasty angiogram with good angiographic outcomes.

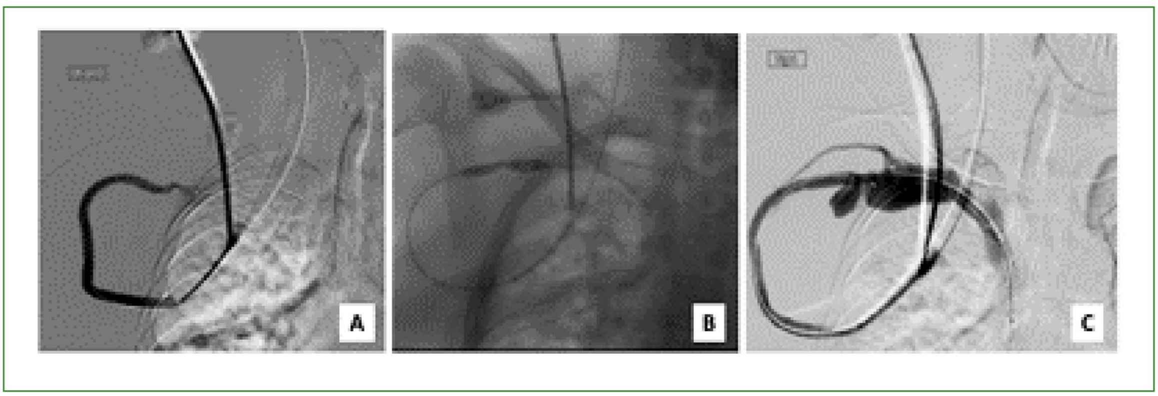

Fig. 2 – Right axillary-axillary loop graft. (A) Angiogram is showing stenosis at the venous anastomosis (B) that underwent angioplasty (C) with good response to angioplasty.

low complication rate once matured, the creation of native arteriovenous fistulas (AVFs) in the upper extremity is the preferred access [3]. Unfortunately, AVFs are plagued with poor maturation that usually requires the construction of AVGs in the upper extremities. However, it is well known that AVGs also face complications, such as poor survival, due to venous anastomosis lesions and subsequent thrombosis that compromises the access survival [4].

With the survival improvement seen in the dialysis population, many of these patients exhaust the access sites in the upper extremities and require other access options. To overcome these challenges, the chest wall AVGs were developed. Accumulating evidence suggests that these alternative access sites have reasonable patency rates [5]. In this article, we present 2 dialysis patients who exhausted all upper extremity access sites and underwent chest loop AVG placement with promising clinical outcomes.

Case study 1

A 62-year-old female with end stage kidney disease (ESKD) due to hypertension and diabetes mellitus started dialysis in August of 2019 via a tunneled venous catheter. The patient was not a candidate for AVF creation and underwent left upper extremity AVG creation. Unfortunately, the AVG was complicated with severe steal syndrome requiring access ligation. As a catheter sparing alternative, a left chest wall loop graft was constructed in November of 2019. This chest wall AVG remains functional as of the writing of this paper, only requiring two interventions at the venous anastomosis (Fig. 1).

Case study 2

A 62-year-old female with a history of ESRD due to hypertension started dialysis in 2006 using a tunneled venous catheter. Past medical history was remarkable for lupus, systolic congestive heart failure, and hypertension. An attempt was also made to create an AVF in both arms but failed due to clinical reasons. Subsequently, she received dialysis via left upper arm AVG for 3 years before failing due to recurrent thrombosis. She was not a candidate for thigh AVG or peritoneal dialysis. As a result, she received a right axillary-axillary chest loop graft in August 2020 that continues to be functional as of the writing of this paper, requiring 3 interventions during that time (Fig. 2).

Discussion

Vascular access is considered the lifeline for dialysis patients. However, these access sites are often complicated with circuit stenotic lesions and subsequent thrombosis leading to poor access survival, dialysis therapy interruptions, and increased use of the dialysis catheters. On the other hand, the advancement in the dialysis therapy has resulted in marked improvement of survival of the dialysis population [3,6]. Hence, most patients outlive their dialysis access, and consequently, it necessitates the exploration of other sites to construct an access site including femoral AVGs and hemodialysis reliable outflow devices. While these sites are reasonable options to deliver dialysis, they have been associated with a significant risk of infection, steal syndrome, and access failure [6,7]. Taking into consideration these risks and complications, the creation of chest wall dialysis access as a catheter sparing modality has become an attractive choice among patients who have exhausted other options.

Chest wall AVGs are created using the axillary artery with the ipsilateral axillary vein, contralateral axillary vein, or the ipsilateral jugular vein [5]. These grafts have several advantages over other graft sites. First, anterior chest wall AVGs are less likely to be associated with steal syndrome as compared to the brachio-axillary AVGs. In fact, mathematical modeling showed that an axillary–axillary loop access increased distal flow and relieved symptoms of steal syndrome more effectively as compared to a brachio-axillary AVG [6]. Second, anterior chest wall AVGs are associated with reduced cannulation pain and lower infection rates [6]. Third, in the absence of crossing any joints, the chest wall AVGs may have lower incidence of kinking and possible stenosis than grafts in other sites. Lastly, chest wall AVGs also frees all four extremities during dialysis, a finding that potentially improves the quality of life in this ill population [6]. It is important to note that the chest wall lends the possibility of cardiac compromise and congestive heart failure; however, this possibility can be mitigated by the use of smaller caliber grafts like 6 mm grafts or tapered 4-7mm grafts. In our patients, the chest wall AVG was created by connecting the axillary artery to the ipsilateral axillary vein using tapered 4-7 mm grafts. Further, no signs of steal syndrome or cardiac compromise were encountered in our patients.

The axillo-axillary loop AVGs have a good cumulative patency rate as well. In a series of 27 patients who underwent chest wall AVG, the cumulative patency rate was 80% at 2 years [5]. Another study described 9 patients who underwent axillary vein-based AVG and reported a patency rate of 78% at the 18-month follow-up. Out of the 9 patients, 7 continued to have functional grafts at the follow-up with 2 patients requiring additional secondary interventions [2]. In comparison to femoral AVG access, the patency rates of chest AVGs are comparable [8]. However, chest wall AVGs may be associated with lower rates of post-operational infections and steal syndrome as compared to femoral AVGs [8,9].

In summary, chest wall AVGs are a viable option for ESKD patients who have exhausted the vascular access. Moreover, these AVGs may be preferred over the femoral AVGs and long-term catheter use due to their lower infectious and ischemic complications. These findings are crucial to the potential longevity of access sites for dialysis patients and their overall quality of life.

Author contributions

all authors contributed equally to this article. all authors read and approved the final manuscript.

Ethics approval

Our institution does not require ethical approval for reporting individual cases or case series.

Patient Consent

Written informed consent was obtained from the patient for all procedures and publication of this case and accompanying images.

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