Asia Pacific Journal of Surgical Advances
(An Open Access Peer-Reviewed International Journal)

eISSN: 3079-1618
Volume-1, Issue-1
DOI: https://doi.org/10.70818/apjsa.2024.v01i01.05

Case Report

Successful Surgical Creation and Management of an Arteriovenous Fistula: A Case Report

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Abstract: Arteriovenous fistula (AVF) are the preferred method for vascular access in hemodialysis patients due to their long-term patency and lower risk of complications. This case report details the successful creation and management of an AVF in a 34-year-old male with stage IV chronic kidney disease (CKD), poorly controlled diabetes mellitus (DM), and hypertension (HTN). The AVF was surgically created using the Brescia-Cimino technique at Rajshahi Diabetic Association General Hospital, Bangladesh. Despite the patient's comorbidities, the fistula matured successfully after 45 days, allowing for uneventful initiation of hemodialysis. Postoperative management included regular Doppler ultrasound assessments and patient education on fistula care. This case highlights the importance of multidisciplinary care, including careful preoperative planning and meticulous postoperative follow-up, to achieve successful AVF outcomes in patients with complex medical histories. It underscores the critical role of individualized care in managing vascular access for hemodialysis.

Keywords: Arteriovenous Fistula, Chronic Kidney Disease, Hemodialysis, Vascular Access, Diabetes Mellitus, Hypertension.

Significance: This case highlights the critical role of multidisciplinary care and patient involvement in successful arteriovenous fistula creation and management.

OPEN ACCESS

Citation:
Md. Anwarul Haque, Md. Imrul Islam, Hasibul Hasan, (2024). Successful Surgical Creation and Management of an Arteriovenous Fistula: A Case Report. *Asia Pac J Surg Adv*, 1(1), 34-38.

Received: 19/06/2024
Accepted: 23/07/2024
Published: 31/08/2024

INTRODUCTION

Chronic kidney disease (CKD) is a progressive condition characterized by a gradual loss of kidney function, ultimately leading to end-stage renal disease (ESRD) in many patients [1]. As CKD advances, the kidneys become unable to perform their essential functions, necessitating renal replacement therapies such as hemodialysis to sustain life. A critical component of effective hemodialysis is the establishment of reliable and durable vascular access, which allows for the efficient removal and return of blood during treatment. Among the various options for vascular access, arteriovenous fistulas (AVFs) are considered the gold standard due to their superior long-term patency, lower infection rates, and reduced need for interventions compared to central venous catheters or arteriovenous grafts [2].

Despite their advantages, the creation of an AVF can present significant challenges, particularly in patients with comorbidities such as diabetes mellitus (DM) and hypertension (HTN). These conditions are known to adversely affect vascular integrity, making it more difficult to establish and maintain a functional fistula. DM, in particular, is associated with endothelial dysfunction and vascular calcification, while HTN can contribute to increased venous pressure and vascular stiffness, both of which can complicate the maturation and long-term viability of the AVF [3].

This case report details the successful surgical creation and management of an AVF in a 34-year-old male with CKD stage IV, who also had a history of poorly controlled DM and HTN. The procedure was performed at Rajshahi Diabetic Association General Hospital in Rajshahi, Bangladesh. This case underscores the importance of a multidisciplinary approach, including thorough preoperative vascular evaluation and careful postoperative management, to achieve successful outcomes in patients with complex medical histories. The report further highlights the need for individualized patient care to overcome the challenges posed by comorbidities in AVF creation and maintenance [4].

CASE PRESENTATION

Abu Sayed, a 34-year-old male from Rajshahi, Bangladesh, presented with a complex medical history that significantly impacted his health. He was diagnosed with diabetes mellitus (DM) 10 years ago, but despite ongoing treatment, his glycemic control remained poor, exacerbating his condition over time. Additionally, he was diagnosed with hypertension (HTN) 8 years ago, requiring multiple antihypertensive medications to manage his blood pressure, although maintaining optimal control remained challenging. Two years ago, Abu Sayed's health further declined with the onset of chronic kidney disease (CKD) Stage IV, leading to a progressive deterioration in renal function. This combination of poorly controlled diabetes, hypertension, and advanced CKD placed him at high risk for complications, necessitating careful medical management and the planning of renal replacement therapy.

Clinical Presentation and Diagnosis

Mr. Abu Sayed initially presented with symptoms of fatigue, decreased urine output, and swelling in his lower extremities. Laboratory investigations revealed elevated serum creatinine and blood urea nitrogen (BUN) levels, consistent with stage IV CKD. His estimated glomerular filtration rate (eGFR) was calculated at 18 mL/min/1.73 m^2, indicating the need to plan for renal replacement therapy. Given his medical history of poorly controlled DM and HTN, and the progressive nature of his CKD, the nephrology team at Rajshahi Diabetic Association General Hospital recommended the creation of an AVF to establish reliable vascular access for future hemodialysis [5].

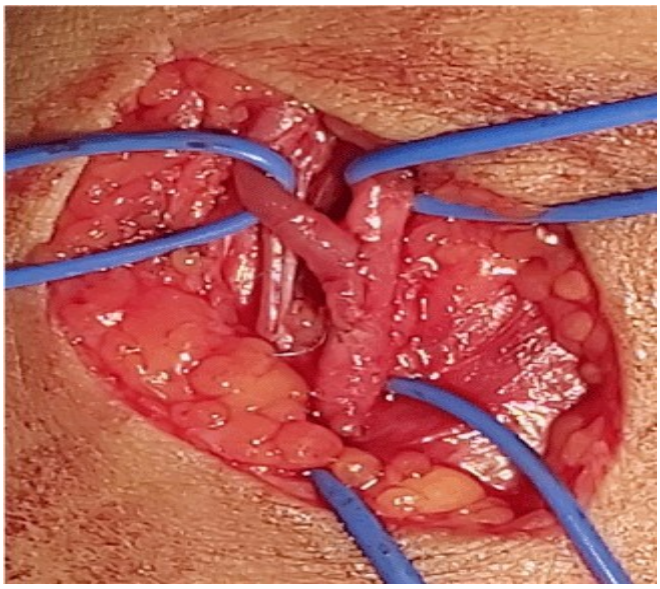

Figure 1: Intraoperative image showing the surgical creation of an arteriovenous fistula (AVF)

The radial artery and cephalic vein are identified and isolated using vascular loops to facilitate a side-to-end anastomosis. Meticulous care is taken to prevent vessel twisting and ensure adequate blood flow for future hemodialysis.

Preoperative Evaluation

A thorough preoperative evaluation was conducted to determine the suitability of Mr. Abu Sayed's vascular anatomy for the creation of an arteriovenous fistula (AVF). This assessment involved a Doppler ultrasound examination to measure the patency, diameter, and flow rates of the cephalic vein and radial artery in both arms. Based on the findings, the left arm was selected for AVF creation, as the radial artery had a diameter of 2.5 mm with a peak systolic velocity of 60 cm/s, indicating sufficient arterial flow. The cephalic vein also measured 3.0 mm in diameter, with no signs of stenosis or thrombosis, making it a suitable candidate for the procedure. To further reduce the risk of perioperative complications, Mr. Sayed's blood pressure and blood glucose levels were carefully managed in the weeks leading up to the surgery. His blood pressure was stabilized at 140/80 mmHg using a combination of ACE inhibitors and calcium channel blockers, while insulin therapy helped achieve a preoperative HbA1c level of 7.5%, optimizing his overall condition for the surgical procedure [6].

Surgical Procedure

The AVF creation was performed under local anesthesia with the patient in a supine position. The surgical approach chosen was the Brescia-Cimino technique, a widely accepted method for AVF creation due to its simplicity and effectiveness [7]. A transverse incision was made over the left wrist, and the cephalic vein was carefully dissected from surrounding tissues. The radial artery was then exposed and mobilized. A side-to-end anastomosis was performed between the cephalic vein and the radial artery using a continuous 7-0 polypropylene suture. Special care was taken to ensure a tension-free anastomosis and to avoid twisting of the vessels. Intraoperative Doppler ultrasound was used to confirm adequate blood flow through the newly created fistula, with a thrill palpated at the anastomosis site, indicating successful creation [8]. The incision was closed with absorbable sutures, and a sterile dressing was applied. The total duration of the procedure was approximately 60 minutes, and there were no intraoperative complications.

Postoperative Management

Postoperatively, Mr. Sayed was closely monitored for signs of fistula maturation, which is critical for successful long-term use. He was educated on the importance of hand exercises, such as squeezing a soft rubber ball, to promote vessel dilation and fistula maturation. Regular follow-up visits were scheduled to assess the maturation of the fistula and to monitor for potential complications, such as thrombosis, infection, or stenosis. During the first postoperative week, Doppler ultrasound was repeated to assess the flow through the fistula. The results indicated a flow rate of 350 mL/min, which is considered adequate for fistula maturation [9]. The patient was advised to avoid heavy lifting or any activity that could compromise the fistula during the early stages of healing.

Hemodialysis Initiation

Mr. Sayed's AVF was allowed to mature for 45 days, during which time the vessel diameter increased, and blood flow improved. After 45 days, the AVF was successfully cannulated for the first time, and hemodialysis was initiated. The dialysis sessions were uneventful, with no issues related to access flow or complications during the procedure. The AVF provided adequate blood flow rates necessary for effective hemodialysis, ensuring that Mr. Sayed could receive the required treatment without interruption [10].

Follow-up and Outcomes

Mr. Sayed was followed up regularly over the subsequent months, with the AVF showing excellent long-term patency. He reported no symptoms of venous hypertension, such as swelling or pain, and there were no signs of infection or other complications at the access site. Regular Doppler ultrasound evaluations confirmed that the AVF remained patent, with consistent blood flow rates conducive to effective hemodialysis. The patient's overall health remained stable, with improved management of his CKD and associated comorbidities through regular dialysis and medical therapy [11].

DISCUSSION

The creation of an AVF is a critical procedure for patients with CKD who are approaching the need for dialysis. The success of AVF creation and maturation depends on multiple factors, including the patient's vascular anatomy, the presence of comorbidities, and the surgical technique employed. In this case, Mr. Sayed's AVF creation was performed successfully despite the presence of significant comorbidities such as DM and HTN, which are known to increase the risk of AVF complications such as delayed maturation, thrombosis, and infection [12]. DM is associated with vascular complications, including medial arterial calcification and endothelial dysfunction, which can impair the success of AVF creation and maturation. Patients with DM are at increased risk of AVF failure due to the smaller caliber and reduced elasticity of their vessels. In this case, stringent control of Mr. Sayed's blood glucose levels was critical in promoting vessel health and supporting the maturation of the AVF.

Hypertension poses additional challenges in AVF management, as elevated venous pressure can lead to the development of venous hypertension, which can compromise fistula patency. In Mr. Sayed's case, careful management of his blood pressure before and after surgery helped prevent complications such as venous hypertension and facilitated the successful maturation of the fistula [13]. The timing of hemodialysis initiation is another critical factor in AVF management. Initiating dialysis too early can lead to AVF complications, while delaying it can result in inadequate renal replacement therapy. The 45-day maturation period allowed for sufficient vessel adaptation, reducing the risk of access-related complications during dialysis [14].

This case also underscores the importance of patient education and involvement in postoperative care. Mr. Sayed was actively engaged in his postoperative exercises and follow-up care, which contributed to the successful outcome of the AVF. Educating patients on the importance of hand exercises and adherence to follow-up visits is essential in promoting AVF maturation and long-term patency [15-17].

CONCLUSION

The successful creation and management of an AVF in Mr. Abu Sayed highlight the importance of a multidisciplinary approach, careful preoperative planning, and meticulous postoperative management. Despite the challenges posed by comorbid conditions such as DM and HTN, this case demonstrates that with appropriate management, excellent outcomes can be achieved. This case supports the continued use of AVF as the preferred vascular access for hemodialysis and underscores the need for ongoing research to optimize outcomes in patients with complex medical histories.

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