

## Original Research Article

# Our experience of arteriovenous fistula creation as vascular access for hemodialysis

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## ABSTRACT

**Background:** End stage renal disease (ESRD) patients depend on lifelong renal replacement therapy. The arteriovenous fistula (AVF) is the preferred hemodialysis access. Cimino fistulas are currently accepted as the best mode of vascular access for hemodialysis (HD). The present study was planned to study for presence of on table bruit and thrill and to know postoperative outcome and patency.

**Methods:** This single center, prospective study was carried out in department of Urology at SNMC, Jodhpur from November 2018 to May 2019. Dominance of hand was examined, and preference was given to non-dominant hand. Physical examination of the arterial system along with physical examination of the venous system was done. Preoperative color Doppler of upper limb veins and arteries was done in selected patients. End to side anastomosis was done between cephalic vein and radial artery.

**Results:** In this study of 70 cases of AVFs, there were 53 (75.71%) successful cases and 17 (24.2%) were failures. End (vein) to side (artery) anastomosis was done in 70 (100%) cases. On table bruit was present in 63 (90%) and thrill in 58 (82.8%) cases. All patients with failed post-operative fistula were not doing ball exercise.

**Conclusions:** Presence of on table thrill and bruit are indicators of successful AVF. Post-operative ball exercise should be done for better results.

**Keywords:** Arteriovenous fistula, End stage renal disease, Hemodialysis

## INTRODUCTION

Advanced states of kidney disease patients require either lifelong dialysis (hemodialysis or peritoneal dialysis) or kidney transplantation to stay alive. This state of disease is called end stage renal disease (ESRD) in which gradual loss of kidney function occurs. The use of chronic haemodialysis (HD) as renal replacement therapy (RRT) in patients with end stage renal disease (ESRD) is a prevalent practice worldwide.<sup>1</sup>

Vascular access is required for hemodialysis. Central venous catheters (CVC), arteriovenous grafts (AVG), and

autologous arteriovenous fistulae (AVF) are the three mode of vascular access used in chronic haemodialysis patients. In 1966, Cimino and Brescia described the creation of subcutaneous AV between the radial artery and an adjacent vein in the arm and it is used commonly for vascular access for haemodialysis (HD).<sup>2</sup> Although AVF had been recommended since 1997; in 2003, the National Kidney Foundation (NKF) set forth the Fistula First Breakthrough Initiative (FFBI), recommending fistula rates of  $\geq 50\%$  for incident (first placed access), and  $\geq 40\%$  for prevalent (patient had previous surgically created accesses) patients undergoing HD.

In USA, only 16.9% of patients initiate dialysis with an AVF and after 1 year post-HD initiation, 65% of patients dialyzed exclusively using an AVF.<sup>1</sup> The NKF recommends that AVF be placed at least 6 months prior to initiation of HD treatment to allow sufficient time for access creation and evaluation, vein maturation, and if necessary, maturation enhancing interventions prior to cannulation. Therefore, it is recommended in patients with CKD in the fourth or fifth stages should be educated on vascular access modalities to allow sufficient time for access placement.<sup>3</sup>

It is common for patients to progress to ESRD and initiate HD before the fistula has either been created or matured. In such cases a central catheter is commonly placed to be used for vascular access, placing patients at high risk of complications and resulting in increased patient costs and burden, and resulting in a mentality of both “fistula first” and “catheter last”.<sup>4,5</sup> The use of AVFs as vascular accesses for haemodialysis has independent risks. Not all patients are candidates for AVF and studies that highlighted the advantages of autologous access did not acknowledge the unacceptable rate of early failure and fistula non-maturation.<sup>6</sup>

The FFBI inadvertently exposed the disadvantages of autologous access and the related cascade of unintended consequences from early AVF failure or prolonged catheter exposure because of the need for several maturation enhancing procedures. The resulting undesired situation is the result of high levels of primary fistula failure, either non-maturation caused by early thrombosis or insufficient dilation to support repetitive cannulation. Fistula non-maturation rates ranging from 20% to 60% have been reported.<sup>6,7</sup>

Vascular access failure is a major contributor to the hospitalization of CKD patients and their overall morbidity and mortality.<sup>8-10</sup> Vascular access dysfunction also imposes a substantial financial burden, accruing more than one billion dollars per year in healthcare costs.<sup>11</sup> Approximately 50% of AVFs are never usable for hemodialysis, and AVFs that function, upto 25% will fail after 2 years; outcomes for other accesses are also poor with patency rates of 67% and 58% for central venous catheters and AV grafts at 6 months.<sup>12-15</sup> AVF, exhibits failure rates that are among the highest for any elective surgical procedure.

The consequences of AVF failure are substantial. First, such failure denies patients a functional access and also reduces the number of sites. Second, other interventional procedures are done to salvage failing AVFs and also subjecting patients to these procedures in addition to AVF creation. Third, AVF placement is not risk-free, exposing patients to complications, including permanent ones, which may aggravate the frustration and setback in patient management incurred by AVF failure. There is thus a substantial need to identify patients at risk for AVF failure and to define the complications that may ensue

after AVF placement. This study was planned to study for presence of on table bruit and thrill and to know postoperative outcome and patency of arteriovenous fistula (AVF) as vascular access for hemodialysis (HD).

## METHODS

This single center, prospective study was carried out in department of Urology at SNMC, Jodhpur from November 2018 to May 2019. All the cases who were candidates for AVF surgery during this period were included in study. Patients undergoing radio-cephalic surgery for failed fistulas at the same site and patients who had a second fistula during the study period were not enrolled in the study to eliminate bias. All patients were assessed clinically in out-patient department. Patients with good veins were taken up for surgery. Patients with thin veins were advised ball exercise for 10-14 days and were reassessed and taken up for surgery.

History of diabetes mellitus, on anticoagulant therapy, history of cardiovascular disease, heart valve disease or prosthesis, previous dialysis access, previous central venous or peripheral catheter were noted. Physical exam of the arterial system (peripheral pulses, Allen test, bilateral upper extremity blood pressure) was performed along with physical exam of the venous system (edema, arm size comparability, collateral veins, tourniquet venous palpation with vein mapping, examination for previous central or peripheral venous catheters, evidence of arm, neck, or chest surgery/trauma). Dominance of hand was examined and preference was given to non-dominant hand for vascular access creation.

Preoperative color Doppler of upper limb veins and arteries was done in selected patients like in cases with obesity, absent or feeble pulses and history suggestive of thrombophlebitis. End to side anastomosis was done between cephalic vein and radial artery.

## Operative technique

After ensuring that vein and artery are good enough to support a fistula, the day care surgery was planned to create AV fistula. Patients were called on the day of surgery and admission was done. Local anaesthesia (10 cc 2% Lignocaine) was given at the site of AVF creation. Approximately 2.5-3 cm long transverse incision was used in all the patients. After that vein and artery were mobilized adequately. 7-8 mm size arteriotomy was done in all the patients. Anastomosis was done by taking continuous running suture using 6-0 or 7-0 polypropylene depending upon vessel wall thickness. For distal and mid forearm fistula, end of cephalic vein to side of radial artery anastomosis was performed. Skin closure was done with 3-0 ethilon in single layer. Non-compressive dressing was given. Bruit was heard and thrill was felt on operation table at the end of dressing. In cases where bruit was absent but there was good venous filling, anticoagulation with low molecular weight heparin

subcutaneously, (doses according to creatinine clearance), and tablet Clopidogrel 75 mg was given once a day for 3-5 days. Patient was discharged on same day or next day. Relevant instructions about care of operated side arm were given to the patients and their relatives. They were told to avoid AVF arm vein blood collection, avoid blood pressure cuffs, not to use tight clothing or jewellery, and avoid prolong pressure on operated arm. Written instructions about how to feel for thrill were given and patients were asked to report any coldness, numbness, ulcers, discoloration at fingertips. Hand ball exercises were taught to patients before discharge. Fistula maturation and its cannulation for use of dialysis were decided by nephrologist based on visible enlarged vein and well felt thrill which required 4-6 weeks after construction. All the patients were followed up for a period of at least 3 months.

All data was expressed in mean or percentage. Data was analyzed using Microsoft excel.

## RESULTS

Total 70 cases of AVFs were analyzed and patients were followed-up for at least 12 weeks. The patients' mean age was  $55 \pm 15$  years and ranged between 22 and 85 years. 56 (80%) patients were male and 14 (20%) patients were female. Diabetic nephropathy (45.71%) was the most common kidney disease (Table 1). There were 53 (75.71%) successful cases and 17 (24.2%) failures. End (vein) to side (artery) radio cephalic anastomosis was done in 70 (100%) cases. On table bruit was present in 63 (90%) and thrill in 58 (82.8%) cases (Table 2).

**Table 1: Demographic details of the patients who underwent AVF.**

Characteristics	N (%)
Age (years)	55±15
Male	56 (80)
Female	14 (20)
Cause of ESRD	
Diabetic nephropathy	32 (45.71)
Hypertension	17 (24.28)
Glomerulonephritis	10 (14.28)
Others	11 (15.71)

**Table 2: Results of AVF.**

Characteristics	N (%)
Total Number of AVF made	70 (100)
Successful (thrill present)	53 (75.71)
Early failure (bruit absent)	07 (10)
Thrill absent ( on follow up)	10 (14.29)
Total failure	17 (24.29)

The possible causes of early failures (on table failure) in 7 (10%) cases were atherosclerotic calcified artery (in 2 patients), technical errors (in 3 patients) and unknown

reasons (in 2 patients). Not performing postoperative ball exercise and not following post-operative instruction properly were found to be the possible cause for failure (during follow up) in 10 (14.29%) patients.

## DISCUSSION

As the life expectancy of hemodialysis patients have improved over years, many patients require multiple vascular access procedures over their lifetime. It is prudent to preserve as many vessels possible and start using the distal vessel.

In present study, average age of presentation was found 55 years and 45% patients had diabetes as a cause of ESRD. Due to general population aging, median age at onset of ESRD has been progressively increased over last few decades. More than 20% of people have diabetes as a cause of ESRD and average age is 58.8 years.<sup>16</sup> Similar results were found in present study.

Successful HD depends on creation and maintenance of adequate vascular access. Patients who receive dialysis across a functional AVF have lower complication rates and longer duration of event-free patency than patients with catheter access and arteriovenous grafts (AVGs).<sup>17-20</sup> Thus construction of a native AVF on arm or forearm is considered a good practice over prosthetic grafts and central venous catheters. There were no AVGs created in the present study. However, central venous catheters is primary method of choice for temporary access in which there is urgent need for HD and no other vascular access is available or has failed.<sup>19</sup> However, these devices suffer from several complicating factors as infection, thrombosis, venous stenosis, and damage to proximal vessels. In present study AVF was performed in all CKD patients as first choice of vascular access.

The most common operative procedure was the creation of the distal radio cephalic fistula, initially described by Brescia et al in 1966.<sup>1</sup> This operation is still considered to be the gold standard for vascular access for HD.<sup>21</sup> In present study also; all patients underwent distal radio cephalic fistula.

Most large-volume centers report 15-30% primary failure rates for distal radio cephalic AVF.<sup>22,23</sup> The reported incidence of primary failure in the medical literature varies from 9% to 40% and these results were comparable with 24.29% primary failures of present study.<sup>24,25</sup> These failures may be due to lack of exercise, either prior to surgery or after fistula creation, because these may play a role in promoting fistula maturation.

AVF creation in all patients with ESRD in present study far exceeds the target goals of 50% set forward by the NKF/DOQI and the CMS (Centres for Medicare and Medicaid Services) Fistula First Breakthrough Initiative. This was being achieved with acceptable rates with no operative mortality and good primary patency (75.71%).

## CONCLUSION

Presence of on table thrill and bruit are indicators of successful AVF. Post-operative ball exercise should be done for better patency rates and to avoid failure. Primary failure as an index of quality should not be used as it would discourage attempts at AVF construction.

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