ORIGINAL ARTICLE

OUTCOME OF ARTERIOVENOUS FISTULAE IN PATIENTS WITH END STAGE RENAL DISEASE

Dastgeer Waheed, Muhammad Zarin, Ikramullah Khan, Arshad Ali, Shahzad Akbar, Haider Kamran

Department of Surgery Gomal Medical College, D.I.Khan and Khyber Teaching Hospital, Peshawar, Pakistan

ABSTRACT

Background: Vascular access has been the corner stone for renal replacement therapy. This study was conducted to assess the outcome of arteriovenous fistulae in patients with end stage renal disease in terms of stomal diameter and blood flow rate.

Methodology: It was a descriptive study carried out in Surgical C Unit of Khyber Teaching Hospital, Peshawar from March 2004 to July 2006. All the study participants underwent arteriovenous fistula construction surgery as advised by nephrologist. Patients irrespective of the site of anastomosis were examined by color doppler ultrasound for stomal opening size and flow rate measurements. All patients were followed for 6 months. The data was analysed using SPSS version 12.0.

Results: A total of 92 patients with end stage renal disease were included in the study. The mean age was 42.9±13.1 years and majority were men (63%). 42.39% of the patients were hypertensive and an equal percentage was diabetic. The patients having the ESRD history of six or more months were 57.6%. During the course of study, 15.2% of the constructed AVF failed. The blood flow rate across each of AVF recorded by doppler ranged from 160-820 ml/min (Mean 527.5±177.8). All of the AVF with flow rate of less than 300 ml/min failed. The stomal diameter ranged from 2.3-9.8 mm (Mean 4.3±1.7). Most (77.7%) of the AVF having less than 3.5 mm of stomal diameter failed. Overall, majority of the failed AVF belonged to the age group of 20-39 years (57.1%), married status (71.4%) and male gender (71.4%). 50% of the failed group of AVF patients were hypertensive while 64.2% were diabetics. 86% of proximal fistulae in comparison to 83.7% of distal fistulae were found to be patent and successful at the end of the study.

Conclusion: The blood flow rate of less than 300ml/min and stomal diameter of less than 3.5 mm is critical for the future failed outcome of AVF within six months of construction surgery.

KEYWORDS: Arteriovenous fistula, End stage renal disease, Blood flow rate, Stomal diameter.

INTRODUCTION

Since Quinton, Scribner, and Dillard described the first permanent access for chronic hemodialysis in I960,[1] vascular access has been the corner stone for this form of renal replacement therapy. Without a vascular access that can offer an adequate and reliable source of blood flow through the hemodialyzer, hemodialysis is not conceivable. The ideal access should be simple to place, immediately usable, inexpensive, and resistant to infection and thrombosis,[2] but in reality, no such access exists. Arteriovenous fistulae (AVF) introduced in 1966[3] remain the hemodialysis access modality that most closely resemble the ideal form.[4,5] Cuffed tunneled internal jugular catheters and synthetic arteriovenous grafts are some of the new additions to angio access armamentarium, but the AVF still remains the life time solution for chronic hemodialysis patients.[6]

AVF have the lowest infection and thrombosis rates, have the longest patency rates, and are associated with the best morbidity and mortality outcomes of any access modality. Patients with persistent AVF use have reported greater physical activity and energy, better emotional and social well-being, fewer symptoms, and better sleep compared with patients with persistent central venous line use.[7]

Maintenance of patent, functional AVF is a major problem for adequate care of end stage renal disease (ESRD). An ideal access should deliver an adequate flow rate, remains usable for long period of time, and has a low complication rate.[8] Complications like thrombosis of hemodialysis vascular access have emerged as a major cause of patient morbidity in patients with ESRD.

A considerable number of AVF (28-53%) never mature to support dialysis.[9] Two factors are nec-

essary for an AVF to be usable as dialysis access. It must have adequate blood flow, and it must have a size that will allow cannulation.[10] Generally a blood flow of 500 ml/min and a diameter of at least 4 mm are required for an AVF to be adequate to support dialysis therapy. These parameters are met within 4 to 6 weeks in most successful fistulae. Most important, commonly encountered problems (stenosis and accessory veins) that result in early AVF failure can be diagnosed easily with skillful examination.[9]

The repetitive measurement of hemodialysis access flow rate using different techniques was found to be a sensitive and specific indicator of venous outflow stenosis.[11-14] Early prediction of an impending failure of AVF is important. It is suggested that doppler ultrasound assessment of the blood flow rate and diameter can help in prevision of AVF failure.

This study described the outcomes of AVF in patients with ESRD in terms of stomal diameter and blood flow rate.

MATERIAL AND METHODS

This single-center, prospective observational study was carried out at Surgical C Unit of Khyber Teaching Hospital, Peshawar from March 2004 to July 2006. Patients with ESRD who were proposed a permanent vascular access for haemodialysis by nephrologist were recruited. Inclusion criteria were as follows: age >18 years and those who opted for the study. The exclusion criteria included patients who could not make the follow up visits and those unfit for the AVF construction surgery. Written informed consent was obtained from all patients. The study protocol was approved by the hospital ethical committee.

Study participants underwent AVF construction. Surgeries were performed by the same surgeon using similar technique. As an end-to-side anastomosis is considered to be the recommended type of anastomosis,[l5] each of the patients underwent this type of AVF anastomosis. All patients irrespective of the site of anastomosis were examined by color doppler ultrasound for stomal opening size and flow rate measurements during the first week of AVF construction. Two measurements were recorded at each time point. If the second measurement varied by 10%, then a third measurement was performed and the two closest measurements were recorded. The average was then obtained and used in the analysis. The findings were entered into a proforma and patients were enrolled for regular follow up visits.

Patients were followed for 4-6 weekly intervals for a maximum period of 6 months. During these visits, patients were looked for failure of the native AVF. Those patients who were noted to have failed AVF, the follow up was discontinued. The AVF was labeled as failed when the flow could not be detected by clinical examination (absent bruit and/or thrill) and was confirmed by doppler study. The data was analysed using SPSS version 12.0.

RESULTS

The sample included a total of 92 patients. The mean age was 42.9+13.1 years and majority of them 58 (63.1%) were males. The demographic profile of the sample is outlined in the Table 1.

Table 1: Demographic profile of the sample (n=92)

Parameter	Frequency (%)
Gender	
Males	58 (63.1)
Females	34 (36.9)
Age in years	
20-39	39 (42.4)
40-59	38 (41.3)
60 and above	15 (16.3)
Mean age in years +SD	42. 9 ±13.1
Marital Status	
Single	13 (14.1)
Married	69 (75.0)
Widow/ Divorced	10 (10.9)
Occupation	
Manual worker	16 (17.4)
Office worker	30 (32.6)
House wife	32 (34.8)
Student	6 (6.5)
Other	8 (8.7)

Co-morbidities of the patients were recorded and 42.39% of the sample was found to be hypertensive and diabetic each, 8.7% with connective tissue disease and 2.2% with malignancy.

Fifty-three (57.6%) of the patients were having the ESRD history for six or more months. (Table 2)

Out of all the AVF constructed, 49 (53.3%) were proximal (brachiocephalic) and 43 (46.7%) were distal (Radiocephalic) fistulae.

Table 2: End stage renal disease history of the sample (n=92).

History of ESRD (in months)	Frequency (%)
<3	15 (16.3)
3-5	24 (26.1)
6-11	28 (30.4)
12+	25 (27.2)

During the course of the study, 14 (15.2%) of the AVF failed while 78 (84.8%) remained patent and functional.

The blood flow rate across each of the AVF recorded through doppler study was ranging from 160-820 ml/min (Mean 527.5±177.8). The blood flow rate across the AVF was categorized into three categories i.e. less than 300 ml/min, 300-599 and >600. Majority (88.8%) of the AVF constructed were having the flow rate of 300 ml/min and above.

Out of the 12 failed fistulae having blood flow rate of less than 300 ml/min, 58.3% were found to be proximal AVF. The outcome of AVF cross tabulated with the blood flow rate is given in Table 3.

Table 3: Outcome in relation to the blood flow rate in AVF.

Blood Flow Rate Categories (in ml/min)	Outcome *n* (%)	
	Failed (n=14)	Patent (n=78)
<300	12/12 (100)	0 (0)
300-599	2/43 (4.6)	41/43 (95.4)
600+	0 (0)	37/37 (100)

The stomal diameter of the newly constructed AVF was ranged from 2.3-9.8 mm (Median 4.3±1.7). Only 9.8% of the sample was having a stomal diameter of less than 3.5 mm, most (77.7%) of which failed. All of the AVF having a recorded stomal diameter of 6 mm and more were found to be successful and patent at the end of the study. Out of the 7 failed fistulae having stomal diameter of less than 3.5 mm, 57.1% were found to be proximal AVF. The categorized stomal diameter of AVF is tabulated across the outcome in Table 4.

Majority of the tailed AVF belonged to the age group of 20-39 years (57.1%), married status (71.4%) and male gender (71.4%). 50% of the failed group of AVF patients were hypertensive while 64.2% were diabetics. 86% of proximal fistulae in comparison to 83.7% of distal fistulae were found to be patent and successful at the end of the study.

Table 4: Outcome in relation to the stomal diameter of AVF.

Stomal Diameter Categories (mm)	Outcome *n* (%)	
	Failed	Patent
<3.5	7/9 (77.7)	2/9 (22.3)
3.5-5.9	7/57 (12.3)	50/57 (87.7)
6.0+	0 (0)	26/26 (100)

DISCUSSION

The concept of prospective monitoring with elective intervention to maintain patency of AV access has been substantiated in multiple clinical trails.[16] Our prospective, observational study extended the role of access flow monitoring in an overall haemodialysis access maintenance program, and suggested that monitoring with access flow rate and stomal size has benefits beyond using dynamic venous pressure as a monitoring tool in AVF.[17]

Doppler depiction of flow rate through the vascular access is an excellent device but other methods have been also used by certain researcher like use of indicator dilution technique to measure the vascular access flow rate.[18] Our study preferred the doppler study as it was easily available and the proper expertise was at hand.

The role of AVF flow rate as a predictor of early failure of native AVF has been mentioned in other similar studies but the stomal size as a predictor is mentioned in only few studies.[19] Our study outlined the 300 ml/min of blood flow rate as a critical value in relation to the future failure of a particular AVF. Another study identified a higher value of blood flow rate i.e. 425 ml/min for distinguishing successful outcome from failure.[20] The difference may be due to the variation in method used for the selection of patients and their general health status. According to our study the stomal diameter of less than 3.5 mm across the AVF was found to be a significant value in relation to the future failed outcome. Although as suggested by others,[2l] the absolute value of arterial diameter may not be a crucial factor for success. In certain univariate analysis, artery diameter measured during preoperative evaluation was found to be smaller in patients with failing fistulas in Compared to those with patient fistula. This observation was also supported by other studies.[22] However in multi-

variate analysis, the significance of the association between artery diameter and AVF failure attenuated.

According to the current study, AVF failure was found to be more common in male gender. This was in contradiction to some studies where increased risk of AVF failure was found to be related to female gender. [23] The number of female patients included in our study was smaller in addition to the small size of the study population.

Diabetes is proposed as a major risk factor for AVF failure. Many[24] but not all[25] studies have noted lower patency rates in AVF, constructed in diabetic patients. Endothelial dysfunction, arteriolopathy, and pre-existing intimal hyperplasia of radial artery were proposed as pathogenetic factors to explain this poor prognosis.[26] We did observe a slight difference in patency rates between the patients with and without diabetes. But a lack of significant difference between diabetic and non-diabetic patients may be due to our small number of diabetic patients. Some studies also indicate a worse fistula patency in older patients,[27,28] and others do not find a difference,[29] according to our results, fistulae patency rates were not different in patients older than 60 years of age when compared with those of patients younger than 60 years of age.

Our study was aimed to assess only the outcome of AVF, but there are certain studies in which the factors have been determined and solutions for failure group have been sorted out like percutaneous transluminal angioplasty.[30] Most of these studies recommend the minimally invasive procedures and patients are referred for revision surgery as this procedure fails. But these interventions were beyond the scope of this study.

In our study proximal fistulae were found to be slightly superior to distal fistulae. The results are similar to certain studies[23] but contrary to others where although fistula patency percentage after one year of AVF construction was high in case of proximal fistulae but statistically no significant difference was found between the proximal fistulae and the distal fistulae.[31] We presume that a wider vessel lumen, higher flow rate, and easier surgical approach to fistula creation were the most important advantages of the proximal over the distal forearm AVF.

CONCLUSION

The blood flow rate of less than 300 ml/min and stomal diameter of less than 3.5 mm is critical for the future failed outcome of the AVF within six months of construction surgery.

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Corresponding author:

Dr. Dastgeer

Department of Surgery

Gomal Medical College

D.I.Khan, Pakistan

E-mail: wdastgee@gmail.com