

Preoperative Factors Predicting the Outcomes of Brachiocephalic Arteriovenous Fistula Surgery

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Abstract- The aim of our study was to determine the preoperative factors predicting the outcome of arteriovenous fistulas (AVF) in chronic kidney disease (CKD) patients.

Methods: A single-center prospective observational research was conducted on CKD patients necessitating vascular access surgery. Informed consent was taken from the patients. Factors such as patient's demographics, flow across vein, and anastomosis were Recorded during the data collection. The patient's vessel status recorded preoperatively by a Doppler ultrasound. The data was evaluated to determine the risk variables that influence AVF outcomes.

Results: Evaluation of 35 patients of BC AVF was included in the study. The study results demonstrated that the Mean age of the patients was 51 ± 10.2 . Male predominance (60%) was observed during the study. Influence of artery and vein diameter and flow rate across anastomosis and flow rate across vein on success rate were determined and evaluated for the factors predicting their outcome.

Conclusion: The output vein diameter, artery diameter, and flow rate in the vein and across the anastomosis were shown to be the most important factors in the success of the proximal and distal arm fistulas in this investigation. These findings might aid in the identification of a vulnerable group that would benefit from closer monitoring and perhaps early intervention in order to ensure AVF maturity or the establishment of an AVG as main access.

Index Terms- Brachiocephalic arterio-venous fistula; vein diameters; End-stage renal disease ; Preoperative Factors

I. INTRODUCTION

The arteriovenous fistula (AVF) is proven to be the primary hemodialysis approach (HD) in patients with end-stage renal disease (ESRD) due to their long-term patency and minimal likelihood of complications. [1] Brescia cimino fistulas are now considered the finest vascular access for HD patients. Aside from the parameters described in the text, there are other more factors that influence fistula success or failure. Size/type of anastomosis, preoperative blood pressure, thrill immediately after fistula development, AVF design, capacity of vein to dilate, venous intimal hyperplasia or calcification, and serum creatinine are some of the factors to consider. [2,3] The following are some of the advantages of arteriovenous fistulas over other types of chronic access: When compared to arteriovenous grafts and central venous catheters, arteriovenous fistulas are linked with lower morbidity and mortality in hemodialysis patients.

A brachiocephalic fistula placed directly between the brachial artery and the cephalic vein in the cubital fossa had an 80 percent patency rate after 4.5 years. When compared to the usage of interposition graft materials, the rate of problems is rather low. When compared to arteriovenous grafts, the total number of interventions over the life of the access is significantly fewer with arteriovenous fistulas. [4 -6] The objective of this study is to figure out what factors influence the outcome of AVFs in ESRD patients.

II. MATERIALS AND METHODS:

This is a prospective observational research which examined on patients with end-stage renal disease (ESRD) on HD who had primary AV fistula surgery at this hospital between January 2020 and October 2021.

The aim of this study is to identify the factors predicting the outcome of AVFs in ESRD patients. In this study, a total of 35 patients were enrolled. The local institutional ethical committee reviewed and approved the current study. A prospectively managed database was used to gather data from all patients who underwent surgical intervention. Physicians participating in direct patient care were in charge of data input.

Inclusion Criteria:

Patients who were diagnosed with CKD stage 5 needs surgical intervention of brachiocephalic fistula. Patients of both the gender and all age group patients are included in the study.

Exclusion Criteria:

1. Patients of AVFs who needed autologous grafts and synthetic grafts
2. Patients undergoing redo-surgery for failed fistulas at the same site
3. Patients who had a second fistula during the study period were not enrolled in the study to eliminate bias.
4. Patients who require surgical intervention other than brachiocephalic fistula are excluded from the study.

Methodology:

Subjects satisfying the above inclusion and exclusion criteria are included in the study. A thorough history was taken of each patient. The natural AV fistula was created after a thorough clinical assessment. Patients who met the inclusion criteria were told about the study and the need to be followed up on a regular basis until the trial was completed. We acquired informed consent.

Several factors impacting vascular access patency in an AV fistula were investigated. Age, gender, place, laterality, vascular diameter, type of anastomosis, and flow across vein and anastomosis were among the demographic and clinical characteristics taken into account. A Doppler ultrasound was used to assess the patient's vascular status prior to surgery to detect any stenosis or thrombus. Doppler ultrasonography was used to palpate the thrill, bruit, and presence of flow across vein and across anastomosis in the postoperative period. A successful fistula is one that is mature, appropriate for cannulation, and capable of delivering

the prescribed blood flow throughout the dialysis process. The loss of patency prior to cannulation is referred to as primary failure.

III. STATISTICAL ANALYSIS

SPSS software version 16.0 was used to conduct statistical analysis. Statistical analysis was used to examine the results of AV fistula once all of the data was gathered. Mann–Whitney U test or independent t-test was used for analysis depending on distribution of variables. For comparing categorical variables, Fisher's exact test will be employed. A statistically significant value of $P < 0.05$ was evaluated.

IV. RESULTS

The study cohort consisted of 35 patients underwent procedures for AVF creation during the delta wave. The patients' mean age was 62 ± 16.8 years (mean \pm SD), 21 patients were male (60%), and 14 patients were female (88.1%). Hypertension (74.2%) was the most common comorbidity followed by Diabetes. The ultrasound-determined vessel diameters used for AVF creation were 3.2 ± 1.2 and 2.5 ± 1.3 mm for artery and vein, respectively. The patient demographic characteristics are depicted in Table 1.

Demographics	n (%)
Age years	51 \pm 10.2
Gender	
Male	21(60)
Female	14(40)
Body mass index, kg/m ² (mean \pm SD)	29.8 \pm 7.5
Systolic blood pressure (mean \pm SD)	162.0 \pm 23.7
Diastolic blood pressure (mean \pm SD)	91.7 \pm 13.2
Comorbidity	
Diabetes	16(45.7)
Hypertension	26(74.2)
Peripheral Arterial Disease	12(34.2)
Cardiovascular	5(14.28)
Cerebrovascular	3(8.5)
Medication	
Antiplatelet drugs	15(42.8)
ACE inhibitor	21(60)
Statins	13(37.1)

Table 1: Distribution of subjects based on Demographics

Of the 21 male patients, 17 (80.95%) had effective fistulae, whereas four had failed (19.04 %). In females, 10 out of 14 cases (71.42%) had a positive result, whereas 4 instances had failed fistulae (28.5%). The male to female ratio was 1.5:1. The overall success rate was 77.1%. Table 1 illustrates the Patients demographic characteristics.

Parameters	BC AVF			
	Total	Success	Failure	P
Male	21	17	4	1.05
Female	14	10	4	
Total	35	27	8	
HTN	26	20	6	.958
Non-HTN	9	7	2	
Total	35	27	8	
DM	16	9	7	.006
Non-DM	19	18	1	
Total	35	27	8	

Table 2: Distribution of patients according to demographic parameters with success and failure

Distribution of patients according to demographic parameters with success and failure rates are illustrated in Table-2. The study results indicates that there is no significant difference in the success rates in gender ($p = 1.05$) and patients with hypertension and patients without hypertension ($p = 0.95$). Also, there was no significant difference found in patients with DM and without DM ($p = 0.006$).

Parameters	BC AVF			
	Total	Success	Failure	<i>p</i>
Arterial diameter				0.29
<2	NA	NA	NA	
2.1-3	17	13	4	
3.1-4	12	9	3	
4.1-5	4	4	0	
>5	2	1	1	
Total	35	27	8	
Venous diameter				0.0396*
<2	26	21	5	
>2	9	6	3	
Total	35	27	8	

Table 3: Distribution of patients according to artery and vein diameter with success and failure Rates.

Table 3 illustrates the results analysis of Distribution of patients according to artery and vein diameter with success and failure Rates. It was found that on 35 patients with BC AVF patient's failure was more in patients with cephalic vein diameter <2mm. During the study it was noticed that there is no significant association found between patient's arterial diameter and venous diameter ($P = 0.29$). The statistical analysis demonstrated that there is significant difference in the success rates in patients presents with the venous diameter of <2mm ($P = 0.0396$).

The Results of Distribution of patients according to flow rate across anastomosis and flow rate across vein on post-operative day 1 with success and failure in arteriovenous fistula are demonstrated in Table-4. It was found that the success rate was more seen in patients with flow across vein < 300 ml/min.

V. Discussion;

The primary factors that determine the resistance to blood flow within a single vessel include vessel diameter (or radius), vessel length, and viscosity of the blood. Of these three factors, the most important quantitatively and physiologically is vessel diameter. [7] Vessel resistance (R) is inversely related to radius to the fourth power, according to Poiseuille's Equation (r^4). Demographic characteristics, comorbidities, arterial and venous diameters, and flow rate were all examined in this study.

This study evaluated the factors predicting the outcome of AVFs in ESRD patients. The study results demonstrated that Age and gender had no effect on the outcome of an AV fistula in our investigation. Which is similar to study conducted by Pegula VR.et.,[8] Men and women's arterial and venous diameters did not differ appreciably, according to Caplin et al.[9] The study analysis demonstrated that there is no significant association between patients demographics and the risk of AVF failure, the similar results were also demonstrated by Monroy-Cuadros et al. [10] in AVF patients even after adjusting for age, history of peripheral vascular disease, presence of diabetes mellitus, hypertension and type of procedure.

Parameters	BC AVF			
	Total	Success	Failure	<i>p</i>
Flow at anastomosis				
No flow	NA	NA	NA	0.91
100-200	3	2	1	
201-300	7	6	1	
301-400	16	12	4	
>400	9	7	2	
Total	35	27	8	
Flow at vein				
No flow	NA	NA	NA	0.5
100-200	5	4	1	
201-300	16	14	2	
301-400	8	5	3	
>400	6	4	2	
Total	35	27	8	

Table 4 : Distribution of patients according to flow rate across anastomosis and flow rate across vein on post operative day 1 with success and failure in arteriovenous fistula.

Diabetes had a substantial impact on all types of AV fistula outcomes in this study (P 0.006). Compared to non-diabetics, who required several fistula constructions, these patients had multiple failures. In contrast to this, study by Fernström et al.[11] illustrated that Diabetes did not affect the failure rate, but it did dramatically shorten the mean patency time. Diabetes was found to be a major predictor of AVF patency by Smith et al. [12]

Because the number of non-hypertensive individuals in our research was too small to compare with the hypertensive patients, the significance of hypertension could not be established. Whereas the previous study results of Patel et al.,[13] and Manne et al. [14] , demonstrated significant correlation of Hypertension to vascular patency.

With cephalic vein diameter < 2mm as compared to >2mm had a successful outcome. It was found during the study that there is a significant role on outcome in our investigation (P = 0.039). In contrast to this Mendes RR.et al.,[14] depicted in his study that venous diameter of >2.0 mm had higher successful rate.

Although an exact minimum vein diameter for effective fistulas has yet to be determined. According to Silva et al., most clinical trials utilize a cutoff value of 2.5 mm for AVF and 4.0 mm for synthetic grafts. [15]

In our study, the data results illustrated that the patients presenting with the brachial artery diameter of < 3mm had more failure rates. The impact of arterial diameter and vascular quality on fistula success rate is seldom documented. Patients with unsuccessful forearm fistulas had considerably lower mean preoperative radial artery diameters than those with successful fistulas, according to Lemson et al (1.9 vs. 2.8 mm). [16]

Our study data shows that the blood flow at >200ml/min in cephalic vein and flow across anastomosis >300ml/min had more successful outcome. Which is similar to study conducted by Johnson et al.[17] However, most of these veins recovered completely the next day, and in the vast majority of instances, the flow rose significantly compared to intraoperative levels.

The present study has several limitations. These results were gained from a single dialysis Centre. A power test was also executed, although a larger sample size investigation will be required in the future. Further research into the association between a particular component and AVF dysfunction is also required.

VI. CONCLUSION:

HD need vascular access, and autologous fistulas have been shown to be superior than central catheters. The cephalic vein diameter, artery diameter, and flow rate through the vein and anastomosis were shown to be the most important factors in the success of the proximal and distal arm fistulas in our investigation. The use of a preoperative Doppler study aids in the proper placement of the fistula. More research and long-term follow-up are needed to validate the impact of these variables on vascular access patency. Branch divisions can be spotted using ultrasonography prior to surgery and may be ligated at the time of fistula construction

VII. REFERENCES:

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