

# Arteriovenous Fistula Creation by Nephrologist: A Single Centre Experience

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## ABSTRACT

**Introduction:** Arteriovenous Fistula (AVF) is the preferred vascular access with the least rate of complications and morbidities. Across the globe except European countries AVF is created predominantly by surgeons. There are very few experiences shared by Nephrologists from Indian subcontinent in creating AV fistulas and their follow up. The aim of this study was to assess preoperative factors affecting the outcome of AVF creation and the follow up of successfully created fistulas.

**Material and Methods:** A prospective observational study was carried at our hospital over a period of six months from 01 October 2018 to 31 March 2019. All patients undergoing AVF creation by nephrologist from 01 October 2018 to 15 Feb 2019 were included in the study and each patient was followed for six weeks. Besides baseline parameter, history of Diabetes, hypertension and coronary and peripheral vascular disease were noted. All the perioperative findings like vascular calcification and Blood pressure were noted. All successful AVF were followed for six weeks with serial USG and Doppler at postoperative day 1, 2 week and 6 weeks.

**Results:** A total of 20 (77%) out of 26 AVF were successfully created, The average age was 54.6±15.4 years, Among baseline parameters gender had statistical significance (p=0.03). During surgery more arterial diameter and hypertension were associated with successful outcome. During follow-up, both arterial and venous diameter as well as blood flow in artery and AVF had significant correlation between postoperative 1<sup>st</sup>, 2<sup>nd</sup> and 6<sup>th</sup> week (p<0.01). More than 35% and 80% of patients at 2 and 6 weeks respectively achieved criteria for successful maturation as per NKF- KDOQI criteria and it was > 90% and 100% as per UAB criteria.

**Conclusion:** Our experience suggest good outcome of AVF creation by nephrologist, even with those with risk factors for failure and non maturation. Also we suggest early cannulation of AVF at four weeks or earlier.

**Keywords:** Arteriovenous Fistula, Dialysis, Nephrologist, Ultrasound and Doppler evaluation

20% nephrologists respectively in online survey. AVF is the first vascular access as reported by only 1% of nephrologists and 57% had nontunnelled catheter as long term vascular access at their centre whereas KDOQI guidelines suggest use of AVF access in 50% or greater of incident and 65% in prevalent patients.<sup>7,8</sup> We share our experience of AV Fistulas created by a nephrologist at a single centre and their follow up for six weeks.

## MATERIAL AND METHODS

A prospective observational study was carried at our hospital over a period of six months from 01 October 2018 to 31 March 2019. All patients undergoing AVF creation from 01 September 2018 to 15 Feb 2019 were included in the study and each patient was followed for six weeks. Informed consent was obtained from all patients for being included in the study.

The indications for AV Fistula creation were: Individuals already initiated on HD through temporary access and those in whom RRT is required in near future as per NKF- KDOQI guidelines. All the fistulas were created in non dominant forearm and only distal radiocephalic fistulas were created. History included age, sex, and duration of Diabetes, Hypertension, coronary artery disease, and chronic kidney disease. Besides general physical examination, specific arterial (Peripheral vessels, Allen test, blood pressure) and venous system examination including vein mapping on USG was done.

Preoperative evaluation also included Doppler ultrasound (Duplex) to look for patency and size of vessels used (Radial artery and cephalic vein) at distal forearm in all patients. The minimum diameter for radial artery and cephalic vein to be

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## INTRODUCTION

Arteriovenous Fistula (AVF) is the preferred vascular access after its first introduction in 1966 by Brescia and Cimino.<sup>1</sup> AVF creation by nephrologists is not as common in India and US as in European countries.<sup>2</sup> There have been numerous studies by Nephrologists on AVF creation and outcome from developed countries particularly European but there are only a few studies from developing countries i.e. Brazil<sup>3</sup>, and it has only been abstracts from India.<sup>4,5</sup> As per a study by Bansal et al.<sup>6</sup> AVF was the vascular access in more than 75% and less than 50% of patients as reported by 41% and

used were 1.4 and 2 mm respectively. Also calcification was noted both on ultrasound and perioperatively. Immediate patency was noted by thrill in postoperative period. All patients were admitted a day prior to surgery and the waiting period was 1-3 days. Patients were discharged within 48 hours of postoperative period after the first USG examination of AV Fistula.

During this period, radiocephalic fistula was created in 26 patients and 20 patients were followed for six weeks with colour Doppler ultrasound at postoperative day 1 (1-2), day 14 (13-15), day 42 (41-43). The arterial and AVF diameters were measured using GE logic P5 duplex scanner high resolution linear assay probe using high frequencies in the range of 10-12 MHz for B mode evaluations and frequencies in the range of 5 – 6.7 MHz for blood flow. On the arterial side of fistula the feeding artery which was radial artery was evaluated 2 cm proximal to the fistula site, inner diameter (intima-intima) in longitudinal plane, and total blood flow was measured. On the venous side the draining vein (cephalic vein) was evaluated approximately 8 -10 cms proximal to the fistula site, venous diameter and total blood flow was measured in the region using relatively straight segment of vein, while assessing the venous side care was taken to apply minimal pressure and copious amount of ultrasound gel.

Primary failure is defined as failed AVF function either immediately after construction or in the first 24 hours. A total of six patients had primary failure. Out of 20 patients with successful AVF creation, 17 were already on RRT and were cannulated at four weeks. Postoperatively all of them had sufficient blood flow on USG as well as adequate pump speed on HD machine i.e. at least 300 ml/min.

Surgical technique: All patients were admitted on the day of surgery. All surgeries were done by nephrologists under 5-7 ml LA using 2% lignocaine. Magnifying loupe was not used. A 5 cm long skin incision was given. Only distal radial artery and cephalic vein were used and only end vein to side artery anastomosis was performed. Arteriotomy size in all the cases was 6-8 mm. No perioperative diameter was measured. We

dilated the distal vein using cannula (20G) and passed 5-0/6-0 feeding tube till elbow for ruling out any thrombus and for assistance during anastomosis. Anastomosis was done by taking continuous running suture using 6-0 polypropylene/PTFE. Skin was closed using either mersilk or metallic staples.

We didn't use any heparin or antiplatelets in postoperative period and no intervention was performed in cases where thrill was absent as we don't have the facilities of interventional nephrology/ radiology at our centre. All the patients received verbal and written instructions about care of AVF, underwent alternate day dressing and removal of skin staples after 2 weeks.

### STATISTICAL ANALYSIS

All patients were divided into two groups; Group A -successful AVF creation and Group B- primary failure. We analyzed the effect of individual parameters on the result of AVF creation and the progression of blood flow and vessel diameter in artery and AVF over six weeks of follow up. Also correlation of blood flow between followup visits was determined. Continuous variables, reported as mean  $\pm$ SD, were compared using Student's t-test, and categorical variables were analyzed using chi-square test. Pearson's correlation coefficient was used to evaluate the relation between dependent and independent variables, and Spearman's correlation coefficient was used for nonparametric results. p value less than 0.05 is considered statistically significant. All calculations were performed using SPSS software 21.

### RESULTS

A total of 26 patients underwent AVF creation, of these 17 (65%) had already been initiated on HD, 20 had successful outcome (Group A) and 6 had primary failure (Group B). The average age of participants was 54.6 $\pm$ 15.4 years (Range: 25-76 years). Out of 26 subjects, eight (30.8%) were females, nine (34.6%) had Diabetes mellitus, twelve (46.2%) had hypertension, four (15.6%) had CAD/PVD. Of these only

		Group A	Group B	P value
1.	Age	54.7 $\pm$ 14.8	54.3 $\pm$ 18.9	0.95
2.	Sex			0.03
	Female	4 (20%)	4 (66.6%)	
	Male	16(80%)	2 (33.4%)	
3.	DM 2			0.29
	Yes	8(40%)	1(16.7%)	
	No	12(60%)	5(83.3%)	
4.	HTN			0.47
	>140/90 or on antihypertensive medications	10(50%)	2(33.4)	
	< 140/90	10(50%)	4(66.6%)	
5.	Duration of CKD (in months)	14.1 $\pm$ 13.5	25.1 $\pm$ 33.6	0.23
6.	eGFR	10.5 $\pm$ 3.6	13.5 $\pm$ 5.6	0.12
7.	PVD/CAD			0.92
	Yes	3	1	
	No	17	5	

Table-1: Base line parameters

		Group A	Group B	P value
1.	BP < 120 mmHg			0.02
	Yes	2	3	
	No	18	3	
2.	Atherosclerosis/calcified			0.29
	Present	8	1	
	Absent	12	5	
3.	Artery Diameter (in mm)	2.1±0.3	1.7±0.2	0.02

Table-2: Perioperative factors

		Pre op	POD - 1 d	POD -2 w	POD - 6 w	P value
1.	Mean arterial diameter (in mm)	2.1±0.3	2.6±0.4	3.4±0.4	4.3±0.6	0.01
2.	Venous/AVF diameter (in mm)	2.9±0.4	3.8±0.6	5.2±0.9	6.5±0.7	0.01
3.	Arterial blood flow (ml/min)	-	261± 75	402± 92	634±161	0.01
4.	AVF blood flow (ml/min)		298±75	528±101	722±120	0.01

Table-3: Followup USG findings

		2weeks		6 weeks	
		Yes	No	Yes	No
1.	Diameter				
	> 4 mm	19 (95%)	1(5%)	20(100%)	0
	> 6 mm	7(35%)	13(65%)	16(80%)	4(20%)
2.	AVF Flow				
	>500 ml/min	18(90%)	2(10%)	20(100%)	0
	>600 ml/min	7(35%)	13(65%)	17(85%)	3(15%)

Table-4: Followup USG findings at 2 and six weeks

gender had statistical significance ( $p = 0.03$ ) (Table 1).

During Surgery, systolic BP < 120 mm Hg was associated with significant failure rates ( $p = 0.02$ ), atherosclerosis was present in nine patients. The mean arterial diameter was  $2.0 \text{ mm} \pm 0.4 \text{ mm}$  (Range 1.4- 3 mm), internal arterial diameter was significantly more in Group A ( $p=0.02$ ). (Table 2).

Follow up: All 20 patients were followed up with serial Doppler study of AVF; six patients who had primary failure were referred to vascular surgeon for more proximal AVF creation and were not followed with imaging. The mean arterial and AVF diameter and blood flow at the postoperative visits was as given in Table 3. There was significant correlation in blood flow and diameter of both radial artery and AVF at different visits (between POD -1 and POD-2 w, POD 1 and POD -6 w and POD 2w and POD -6w)

Out of 20 patients, we quantified the patients as having AVF diameter more than 4 and 6 mm respectively and AVF flow more than 500 and 600 ml/min respectively at 2 and 6 weeks (Table 4).

## DISCUSSION

Our study is one of the few studies by nephrologists about their experience in AVF creation outside Europe and American continent. Though our study is a prospective study but being from a single centre and its small size its generalisation is limited. In India where untunneled catheter is used as permanent vascular access in significant patients and initiation of haemodialysis with AVF is in minimal patients<sup>6</sup>, this experience as well as the results are encouraging.

The baseline parameters like age, gender, diabetes and hypertension were similar to other studies.<sup>3,9,10</sup> The primary

patency rates was 77% in our experience which was similar to other Indian experience published by plastic surgeon<sup>11</sup> as well as other international studies by nephrologists.<sup>9,12-14</sup> All of 17 patients already on HD could be switched to AVF from nontunneled catheter at 4-5 weeks with adequate pump speed (300 ml/min). We followed them only for two weeks after first cannulation, no one had secondary failure/complications in this period.

In comparative studies between Nephrologists and Surgeons result of successful AVF creation have been similar.<sup>4,15</sup> Four out of eight females had primary failure but it may be due to smaller arterial size in females, as many studies have proven that gender doesn't affect the outcome.<sup>3,16</sup>

We found normotension (systolic < 120 mmHg) to be strongly associated with AVF failure as low blood flow is predisposing factor for AVF failure as in HEMO study.<sup>17</sup> As expected similar to other studies failure was significantly associated with lesser arterial diameter<sup>9,10,12,13,18</sup>, the minimum diameter on which AVF was successfully created was 1.5 mm, we didn't attempt AVF creation if cephalic vein diameter after proximal compression of arm was less than 2 mm. Different studies have suggested a good correlation between arterial measurement by USG and direct measurement perioperatively<sup>9,12,13,19</sup>; we didn't measure the arterial diameter during surgery. We had successfully created AVF in 3 of 4 calcified radial arteries.

During follow up, the mean arterial and AVF diameter and blood flow had shown progressive increase. Adequate blood flow was achieved in >90% and > 35% patients at two weeks as per UAB criteria<sup>20</sup> and KDOQI criteria<sup>7</sup> respectively for AVF maturation. In a recent study by T Lee et al<sup>21</sup>, UAB

criteria has more sensitivity in assessing maturation for distal AVF, we suggest early cannulation should be attempted as some authors have been cannulating as early as 10 days after AVF creation.<sup>22</sup>

The strength of our study is experience of nephrologist from Indian subcontinent in AVF creation, the prospective follow up with ultrasound, encouraging results even in elderly, calcified and narrow arteries and very short waiting period. The drawback of our study is small size of patients and short duration of follow up and AVF creation limited to distal forearm only.

## CONCLUSION

To conclude, more nephrologists should be participating in AVF creation thus improving patient care as access creation is not a priority for surgeons.

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