

Complications of Arterio-Venous Fistula in Patients Undergoing Haemodialysis

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ABSTRACT

Background: Vascular access is required for hemodialysis and arterio-venous fistula is the preferred access. Various guidelines have recommended monitoring and surveillance of arterio-venous fistula as the standard of care. This study looked into usefulness of clinical examination to detect complications of arterio-venous fistula.

Methods: The study was conducted in the from February 2022 till September 2022 under Nephrology unit, Departement of Internal Medicine at Universal College of Medical Sciences. Ethical clearance was taken. Patients undergoing hemodialysis were enrolled in the study. After informed and written consent, clinical examination of arterio-venous fistula was done by look, listen and feel method. Data was collected as per the approved performa. Statistical analysis was done using Statistical Package for the Social Sciences software version 17.

Results: Total enrolled study population was 73. Mean age of the study population was 47.45 years \pm 14.60 years with a Male: Female ratio of 1.3:1. Complications were seen in a total of 33 patients with an overall rate of 45.2%. The mean duration of AVF creation was 32.68 \pm 24.56 months. Most common complication of arterio-venous fistula was overall stenosis 18 (24.7%).

Conclusions: There is a higher rate of complications of arterio-venous fistula. Monitoring and surveillance of arterio-venous fistula should be performed as a standard of care in every hemodialysis centre.

Keywords: Arterio-venous fistula; complication; hemodialysis

INTRODUCTION

Hemodialysis (HD) is an established and preferred modality of RRT throughout the world. In Nepal, the number of patients on HD has increased significantly since government has been providing free HD to its citizens.¹ Functioning vascular access is fundamental for effective delivery of HD. The vascular access can be made temporarily through a non-cuffed or cuffed tunnelled central venous catheter and permanently by creating an arterio-venous fistula (AVF) or an arterio-venous graft (AVG).² It is imperative that vascular access created is stable and causes least access related morbidity. Temporary central venous catheter is more prone to problems like low dialysis blood flow, loss of patency, thrombus formation and catheter-related bacteremia.³ In Nepal, there is paucity of data focusing on routine monitoring of AVF. Thus, this study aims to fill lacunae in prevalent knowledge and gap in practice regarding complications of AVF in patients undergoing hemodialysis.

METHODS

This prospective observational study included 73 consecutive patients who had AVF as their vascular access for hemodialysis. The study was conducted from February 2022 till September 2022 under the aegis of Nephrology unit, Department of Internal Medicine at Universal College of Medical Sciences (UCMS). Ethical clearance was taken from IRC, UCMS. After taken informed and written consent patient data was collected in the prescribed Performa. Taking the prevalence of end stage renal disease (ESRD) as 5% based on previous studies^{4,5} and at 95% (Z=1.96) confidence interval using the Fisher's formula below for estimating sample size, the sample size was calculated as 73 at 5% error. All the patients underwent clinical examination which included Inspection, Palpation, Auscultation, Arm elevation test and Pulse augmentation test based on Look, Listen and Feel method for examination of AVF. Patients' vitals were monitored pre and post HD along with interdialytic weight gain. Continuous variables having normal distribution were reported as Mean \pm SD and independent t-test

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was used to test the difference between groups with complications and without complications. For comparing discrete variables, Chi-Square test was used. "p" value of <0.05 was considered statistically significant.

RESULTS

Total of 73 patients were included in the final analysis. Mean age of the study population was 47.45 years \pm 14.60 years with a Male: Female ratio of 1.3:1. Majority of the patients, 43 (58.9%) were receiving twice a week maintenance hemodialysis. The most common site of AVF was Left Radio-cephalic, 43 (58.9%). The mean duration of AVF creation was 32.68 \pm 24.56 months. About 11 (15.1%) of the study population had a history of primary failure of AVF leading to creation of second AVF. On inspection of the AVF, 38 (52.1%) were normal. The most common symptom patient complained was swelling of limb with AVF (Table 1).

Table 1. Symptoms associated with complications of AV fistula (n=73).

Symptoms	Categories No. of patients (%)	
	Present	Absent
Pain	4 (5.5)	69 (94.5)
Swelling	23 (31.5)	50 (68.5)
Redness	0 (0)	73 (100.0)
Bears Weight	2 (2.7)	71 (97.3)
Checks thrill	44 (60.3)	29 (39.7)

Complications were seen in a total of 33 patients with an overall rate of 45.2%. Some patients had more than one complication. The different complications observed were stenosis 18 (24.7%), pseudoaneurysm 10 (13.7%), thrombus formation 11 (15.1%), extra vascular hematoma five (6.8%), mega-fistula three (4.1%) and infection one (1.4%). Among the stenosis, venous outflow stenosis was seen in 10 (13.7%), juxta anastomotic stenosis was seen in five (6.8%) and central vein stenosis was seen in 3 (4.1%) of the study subjects. The clinical examination findings of AVF are given in Table 2. Secondary failure was seen in 9 (12.3%).

Presence of strong palpable pulsations on clinical examination of AVF was statistically significant parameter which identified complications of AVF (Table 3).

Table 2. Clinical examination findings of arterio-venous fistula (n=73).

Examination Parameters	Categories No. of patients (%)	
	Present	Absent
Collapsibility on arm elevation	52 (71.2)	21 (28.8)
Palpable pulse	24 (32.9)	49 (67.1)
Palpable thrill	68 (93.2)	5 (6.8)
Bruit	68 (93.2)	5 (6.8)
Pulse augmentation	4 (5.5)	69 (94.5)

Table 3. Comparing risk factors with complications of AVF on clinical examination (n=73).

Characteristics	Categories	Without Complications (n=40)	With Complications (n=33)	p value
Sex	Male	29	13	<0.01
	Female	11	20	
Diabetes Mellitus	No	27	27	0.13
	Yes	13	6	
Hypertension	No	14	11	0.54
	Yes	26	22	
Tuberculosis	No	32	17	0.01
	Yes	8	16	
Primary failure	No	37	25	0.04
	Yes	3	8	
Presence of palpable pulse	No	40	9	<0.01
	Yes	0	24	
Secondary failure	No	39	25	<0.01
	Yes	1	8	

Table 4. Comparing study parameters with complications of AVF on clinical examination (n=73).

Characteristics	Without Complications (n=40)	With Complications (n=33)	p value
Mean age in years \pm SD	46.85 \pm 14.22	48.18 \pm 15.23	0.79
AV fistula creation since (months)	30.07 \pm 23.54	36.36 \pm 25.69	0.58
Dialysis duration (months)	29.20 \pm 22.09	37.21 \pm 24.21	0.56
Ultra-filtration per week (Litres)	7.76 \pm 2.78	7.77 \pm 2.11	0.16
Venous pressure (mmHg)	100.75 \pm 26.34	119.12 \pm 38.47	<0.01
Blood flow rate (ml/min)	238.50 \pm 18.19	238.78 \pm 21.32	0.57
Inter-dialytic weight gain (Kg)	2.98 \pm 1.44	2.78 \pm 1.29	0.64
Pre dialysis systolic blood pressure (mmHg)	135.25 \pm 21.83	147.87 \pm 21.75	<0.01
Pre dialysis diastolic blood pressure (mmHg)	83.25 \pm 10.47	89.09 \pm 11.28	0.02
Post dialysis systolic blood pressure (mmHg)	144.00 \pm 23.18	146.93 \pm 20.95	0.57
Post dialysis diastolic blood pressure (mmHg)	85.25 \pm 10.37	85.75 \pm 11.46	0.84
Body Mass Index (Kg/m ²)	21.91 \pm 4.26	20.70 \pm 3.62	0.5

Female sex, high venous pressure, history of primary failure of AVF, Tuberculosis, higher pre dialysis systolic and diastolic blood pressure and secondary AVF failure were statistically significant for complications associated with AVF (Table 4).

DISCUSSION

The study looked into usefulness of simple clinical examination to identify complications and has re-emphasized its utility into day-to-day clinical practice. The different types of AVF observed in our study were radio-cephalic (RCAVF), brachio-cephalic (BCAVF) and transposition of basilic vein. The commonest AVF was left RCAVF followed by left BCAVF and this was as per the standard practice irrespective of age and gender worldwide.^{6,7} The overall complication rate was 45.2% in the current study which is similar to a study by Ngatchou et al. conducted in Belgium where they found an overall complication rate of 44%. Their study also showed Hypertension as the most common co-morbidity followed by Diabetes Mellitus which is in accordance to our study.⁸ In our study, wrist AVF i.e RCAVF was the most common AVF seen in nearly 60% of the population. In a similar study Qing et al. from China, the wrist AVF was observed in 93% of their study population. Thrombus followed by Aneurysm was common complication which is similar to our findings.⁹ 350 of them had wrist NAVFs (wrist group) In a study by Schwab et al. it was found that high venous pressure above 150 mmHg was associated with increased chances of complications of AVF which was similar to our study where the mean venous pressure in the group with complications was 120mmHg and was statistically significant. The difference of the venous pressure is due to the low blood flow rate in our dialysis unit (Mean 238 ml/min) and it was similar in both the groups.¹⁰ In the

present study, the presence of pulsatility along with thrill on clinical examination of AVF was statistically significant for identifying complications (p=0.001) and the similar finding was also observed in a study by Maldonado-Cárceles et al. where presence of pulsatility was statistically significant in detecting stenosis when compared with colour doppler examination (p=0.001).¹¹ In our study, BMI (20.70 \pm 3.62kg/m²) was associated with presence of complications. This was similar to study done by Galiardi et al.¹² Similarly in a review by Mafra et al. it was pointed that BMI of <19kg/m² is associated with adverse outcomes in CKD patients in relation to survival.¹³ The cut-off of BMI in South Asian is different to other population¹⁴ and low BMI is related to obesity paradox and increased inflammation which may be a cause for complication of AVF.¹⁵ Thus, the current study highlighted the importance of monitoring and surveillance of AVF in patients undergoing HD which is not the current practice though recommended by different guidelines.

Surgeon dependent factors could not be taken into consideration as most of the AVF were created by different surgeons at different sites. There were no pre operative vascular mapping records available to correlate with complications of AVF identified in the study.

CONCLUSIONS

Arterio-venous fistula is the most common vascular access in our setting with RCAVF being the most common anastomosis created on the non-dominant arm. Complications are common and more than one complication can be present. Monitoring and surveillance of AVF should be the standard of practice in every

hemodialysis unit.

CONFLICT OF INTEREST

The authors declare no conflict of interest

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