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ORIGINAL ARTICLE

Frequency of Dysfunctional Arteriovenous Fistula among End Stage Renal Disease Patients on Thrice Weekly Maintenance Hemodialysis

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ABSTRACT

Background: Arteriovenous fistula (AVF) is the vascular access of choice for End-Stage Renal Disease (ESRD) patients on maintenance hemodialysis. Arteriovenous fistula is the vascular access of choice for adequate hemodialysis.AVF dysfunction is one of the most important causes of morbidity and mortality in these patients.
Aim: To access the frequency of dysfunctional AFVs using clinical examination among end-stage renal disease patients on thrice-weekly maintenance hemodialysis.
Study design: Cross-sectional study
Place and duration of study: Dialysis Unit, Nephrology Department, Sir Ganga Ram Hospital, Lahore from 21st January 2019, to 21st July 2019.
Methodology: 177 patients who had end-stage renal disease and were on maintenance hemodialysis were enrolled. Fistulas were examined clinically. The presence and types of dysfunctional AVF were recorded.
Results: Fifty three (29.9%) were females and 124 (70.1%) were females with mean age was 48±13.29 years. There were 44.1% diabetic, 91.0% hypertensive, and 44.1% both diabetic and hypertensive. The frequency of dysfunctional arteriovenous fistula was 30.5%. 123 (69.5%) patients had normal fistula, 13 (7.3%) had signs of outflow obstruction, 23 (13.0%) had aneurysm, 5 (2.8%) had signs of inflow obstruction, and 13 (7.3%) had a weak or absent thrill/bruit however no infection or steal syndrome was present.
Conclusion: The frequency of dysfunctional arteriovenous fistula among patients on thrice-weekly maintenance hemodialysis is 30.5% on physical examination. Periodic physical assessment of AVF can reduce fistula failure rates.
Key words: End-stage renal disease, Haemodialysis, Arteriovenous fistula

INTRODUCTION

Hemodialysis (HD) is the most well-known methodology of renal replacement therapy (RRT) in end-stage renal disease (ESRD) patients. The accomplishment of adequate hemodialysis relies upon the creation of vascular access. Decent vascular access ought to give an adequately high blood flow rate with sufficient inflow and outflow pressures, to take into consideration effective dialysis with negligible intricacies, in any case, under-dialysis prompts expanded morbidity and mortality[1]. Arteriovenous fistula (AVF) is the vascular access of choice for support hemodialysis (MHD), as it is connected with a lower rate of complexities and longer endurance than prosthetic grafts or double-lumen venous catheters.[2] Access blood flow of no less than 500 to 800 mL/min is important to permit adequate diffusion of uremic toxins from a patient. Stenosis of AVF generally leads to a decrease in fistula blood flow below the desired range. Diminished blood flow to <400 mL/min itself is related to an expanded danger of access stenosis and fistula failure, and a high flow rate of>1200mL/min, particularly >1500 mL/min, is related to high output cardiac failure[3].

Albeit altered hemodynamics in access fistulas are typically identified during hemodialysis, early identification of dysfunctional AVF before the need of medical and surgical intervention before deteriorating of the condition might assist with lessening the pace of complications and associated morbidity and mortality.[4] Previous research demonstrates 30% of hospitalizations in ESRD patients are brought about by the complications of vascular access[5]. There are several causes of dysfunctional AVF, most important are stenosis, aneurysmal dilation, Infection, thrombosis, and AVF access recirculation (AR)[6]. KDIGO guidelines for vascular access suggest routine evaluation and screening for AVF complications utilizing routine clinical examination and gadget-based observation like Doppler ultrasound (DU).[7] Physical examination (PE) has a reasonable efficacy for identifying complications in fistulas. Physical assessment is handily educated, effortlessly performed, immediately done, and cost-effective[8]. Doppler ultrasound is a straightforward, economical, and harmless strategy for the evaluation of blood flow in AVF. It has the additional advantage of early detection of complications and prompt treatment that helps in the longevity of AVF[9]. But this method requires a DU machine and experienced radiologist presence which is not readily available at many hemodialysis centers. In a review in Iran, 69 patients with asymptomatic well-working hemodialysis access were surveyed with Doppler ultrasound. There was a significant degree of anomalies, particularly high blood flow rates in clinically well-working mature AVFs[10]. Many studies have proved the superiority of DU as compared to clinical examination for the detection of access complications, but clinical examination remains a preferred and mandatory part of AVF complications assessment. In a cohort study one dialysis unit assessed AVF complications using DU while another unit assessed AVFs clinically, 100 patients from every unit were selected. The outcomes showed that a coordinated clinical evaluationis equivalent to DU estimations as a screening strategy to forestall hemodialysis access dysfunctions[9].

This study was structured to access the frequency of dysfunctional AVFs using clinical examination among end-stage renal disease patients on thrice-weekly maintenance hemodialysis.

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MATERIALS AND METHODS

The cross-sectional study was conducted at Dialysis Unit, Nephrology Department, Sir Ganga Ram Hospital, Lahore, from 21st January 2019, to 21st July 2019. Using a non-probability consecutive sampling technique, the sample size of 177 was calculated with a 95% confidence interval and a 4% margin of error. ESRD patients of both gender, ages ranging from 18 to 70 years who were on HD for>3months were included in the study. Patients having AV grafts or double-lumen catheters were excluded from the study. After approval from the ethical board, data were collected by taking informed consent from each patient. The demographic information (name, age, gender, registration number) was taken. Effect modifiers like co-morbidities, duration of dialysis via the AVF, duration of dialysis via central venous

catheters before the formation of AVF, number of previously failed fistulas were also recorded. All patients were physically examined by a single senior nephrology doctor. AVFs were divided into normal categories having no abnormality and dysfunctional categories with the presence of one or more complications. Complications of AVF were classified into Inflow stenosis, outflow stenosis, aneurysm, thrombosis, infection, and steal syndrome.[11] The collected data were entered and analyzed in SPSS-23. Data were stratified for age, gender, duration of dialysis via the AVF, to deal with the effect modifiers. Post-stratification, the Chi-square test was used. A p-value ≤0.05 was considered significant.

RESULTS

There were 124 (70.1%) male patients and 53 (29.9%) female patients. Among these patients 4% were from the age group 18 to 29 years, 34.5% were from the 30-45 years age group, 44.6% were from the age group 46 to 60 years, and 16.9% were more than 60 years of age. The mean age was 48±13.29 years. Among these patients 44.1% were diabetic, 91.0% were hypertensive, and 44.1% were both diabetic and hypertensive. The youngest age group subjects were hypertensive only, while those above 46 years mostly had both diabetes and hypertension (60.8%). 27.2% of patients had right-sided AV fistula, and 72.9% had left-sided. Most 44.1% had a left brachiocephalic AVF. On clinical examination, 123 (69.5%) patients had normal fistula, 13(7.3%) had signs of outflow obstruction, 23(13%) had aneurysm, 5 (2.8%) had signs of inflow obstruction, and 13(7.3%) had a weak or absent thrill/bruit however no infection or steal syndrome was present. When data were stratified for gender, out of 124 male patients 71.8% had a normal functioning AVF, 5.6% had outflow obstruction, 5.6% had a weak thrill, 16.9% had an aneurysm on clinical examination. Out of 53 females, 64.2% had normal fistula, 11.3% had outflow obstruction, 9.4% had inflow obstruction, 11.3% had a weak thrill, and 3.8% had signs of the aneurysm on clinical examination. When data was stratified with respect to age, 42.9% of those aged 18-29 years had normal AVF on clinical examination (p=0.118); for those aged 30-45 years, 86.9% (p<0.001); for those aged 46- 60 years, 57% (p=0.001), and for those aged >60 years, 73.3% had normal AVF (p=0.616).On stratification for diabetes and hypertension, out of 16 patients that were neither diabetic nor hypertensive all had a normal fistula (p=0.022). Patients who were both diabetic and hypertensive had a higher percentage 43.6% (p=0.001) of dysfunctional AVF than those who were hypertensive alone (24.1%, p=0.028). On stratification of clinical examination for the duration of dialysis through the current AVF, all the 3 patients using their fistulas for dialysis for the last 6-12 months had a normal functioning fistula (p=0.247). It was observed that as the fistula age increases, the percentage of dysfunctional AVF increases. 27.1% of patients using their fistula for 1-3years (p=0.432), and 33.7% (p=0.278) of those with a duration of more than 3 years had dysfunctional AVF. On stratification of clinical examination concerning the site of AVF, fistulas on the left and right arm had a roughly same percentage of dysfunctional AVF. Right brachiocephalic had highest i.e., 50% of dysfunctional AVF (p=0.026), followed by 33.3% of left brachiocephalic (p=0.469), 25.5% of left radiocephalic (p=0.356) and 12.5% of right radiocephalic (p=0.039) [Table 1].

Table 1: Comparison of AVF according to gender, age, site of AVF and HD duration via AVF

Variable	No. (%)	AVF		P value
		Normal	Dysfunctional	
Gender				
Male	124 (70.1%)	89 (71.8%)	35 (28.2%)	0.313
Female	53 (29.9%)	34 (64.2%)	19 (35.8%)	0.313
Age (years)				
18-29	7 (4%)	3 (42.9%)	4 (57.1%)	0.118
30-45	61 (34.5%)	53 (86.9%)	8 (13.1%)	<0.001
45-60	79 (44.6%)	45 (57%)	34 (43%)	0.001
>60	30 (16.95)	22 (73.3%)	8 (26.7%)	0.616
Site of AVF				
(R) Brachiocephalic	24 (13.6%)	21 (87.5%)	3 (12.5%)	0.039
(R) Radiocephalic	24 (13.6%)	12 (50%)	12 (50%)	0.026
(L) Brachiocephalic	78 (44.1%)	38 (74.5%)	13 (25.5%)	0.356
(L) Radiocephalic	51 (28.8%)	52 (66.7%)	26 (33.35)	0.469
HD duration via AVF				
6-12 months	3 (1.7%)	3 (100%)	-	0.247
1-3 years	70 (39.5%)	51 (72.9%)	19 (27.1%)	0.432
>3 years	104 (58.8%)	69 (66.3%)	35 (33.7%)	0.278

DISCUSSION

The purpose of monitoring AVF is to extend its life as it is considered as the lifeline of ESRD patients on HD. worldwide all vascular access guidelines recommend periodic monitoring of AVF to screen dysfunctions at an early stage to prevent AVF failure.[12] Physical examination is considered an easy and effective way of AVF monitoring. In addition to physical examination, Doppler ultrasound detects and localizes AVF abnormalities with reliability and confirms findings of physical examination.[13]In this study a total of 177 patients fulfilling the inclusion criteria, with the age range of 25 and 67 years, were enrolled to calculate the frequency of dysfunctional arteriovenous fistulas among patients of end-stage renal disease on thrice-weekly maintenance hemodialysis. It was found that the number of male patients exceeded females, representing 70 and 30% of all patients respectively. This gender bias/inequality is not only prevalent in Pakistan but observed worldwide with minor differences.[14] However local cultural and economic factors that vary from region to region creates a big impact resulting in the fewer female population getting optimal treatment of CKD and dialysis, despite the high prevalence of CKD in women globally[15]. An American study, reported a greater risk of late initiation of dialysis among women[16]. Another study confirmed the inclination of the trend towards males having an early start of dialysis as compared to females.[17] Fewer older age women were enrolled for dialysis in our center, probably because elderly women seem to be more inclined towards conservative treatment instead of dialysis.

The radiocephalic fistula at the wrist is viewed as the first best option for HD access.[18] In our study, left brachiocephalic was the most frequent site for AVF (44.1%) followed by left radiocephalic AVF. Choice of the site for AVF formation mainly depends upon adequate vessels status, damage of veins by repeated venipunctures, and surgeon preference. It is recommended that venous mapping should be performed before AVF formation but this method relies on radiologist expertise and results differ on interobserver variability[19].

In our study overall 30.4%of patients had dysfunctional fistula, this result is comparable to US data exhibiting 20-50% dysfunctional AVFs.[20] Although the male population on HD is high

as compared to females, AVF dysfunction is the same in both genders without any statistically significant difference. The presence of Diabetes and hypertension is associated with an increased risk of dysfunctional fistula.[21,22] Microvascular complications, poor glycemic control, uncontrolled hypertension, and dyslipidemias are strong predictors of early AVF complications and failure[23]. Of our patients who had both diabetes and hypertension showed more AVF dysfunction than those with hypertension alone.

It was seen that as the fistula age increases the probability of the fistula being dysfunctional increments[24]. A study conducted at a tertiary care hospital in Pakistan, showed one-third of radiocephalic fistulas failures within two years of construction.[21] In our study complications in AVF are high after 3 years of construction but statistically, no significant difference is found in different fistulas age groups as well as the site of AVFs. AVF stenosis especially outflow stenosis is considered a major cause of AVF failure secondary to previous double-lumen catheterization and repeated needle pricks for dialysis[25]. Outflow stenosis contribute 70-80% of all stenotic lesion among AVF failures[26]. Our study demonstrated outflow stenosis in 13% of patients and inflow stenosis in 7.3% of individuals. Aneurysmal dilatation of AVF is a potential threat for rupture and AVF failure with serious life-threatening consequences[27]. we have found aneurysms in 2.8% AVFs. This complication is relatively uncommon, but prompt diagnosis and management can save AVF as well as reduce associated morbidity and mortality.

CONCLUSION

The frequency of dysfunctional arteriovenous fistula among patients on thrice-weekly MHD is 30.5% on physical examination. Periodic physical assessment of AVF can reduce fistula failure rates.

Conflict of interest: Nil

REFERENCES

1. Qian J, McAdams-DeMarco M, Ng D, Lau B. Selecting important predictors for arteriovenous fistula maturation in older hemodialysis patients by using random survival forests. Semin Dial 2020;33(2):148–55.
2. Brown RS. Is an arteriovenous fistula or graft the better access in older adults who have initiated hemodialysis with a catheter? Kidney Med 2021;3(2):171–2.
3. MacRae JM, Oliver M, Clark E, Dipchand C, Hiremath S, Kappel J, et al. Arteriovenous vascular access selection and evaluation. Can J Kidney Health Dis 2016;3: 2054358116669125.
4. Lok CE, Foley R. Vascular Access Morbidity and Mortality: Trends of the Last Decade. CJASN 2013;8(7):1213–9.
5. Suri RS, Larive B, Sherer S, Eggers P, Gassman J, James SH, et al. Risk of vascular access complications with frequent hemodialysis. J Am Soc Nephrol 2013;24(3): 498–505.
6. Aljuaid MM, Alzahrani NN, Alshehri AA, Alkhaldi LH, Alosaimi FS, Aljuaid NW, et al. Complications of arteriovenous fistula in dialysis patients: Incidence and risk factors in Taif city, KSA. J Family Med Prim Care 2020;9(1):407–11.
7. Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, et al. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis 2020;75(4 Suppl 2):S1–164.
8. Pirozzi N, Mancianti N, Scrivano J, Fazzari L, Pirozzi R, Tozzi M. Monitoring the patient following radio-cephalic arteriovenous fistula creation: current perspectives. Vasc Health Risk Manag 2021;17:111-21.
9. Zamboli P, Fiorini F, D'Amelio A, Fatuzzo P, Granata A. Color Doppler ultrasound and arteriovenous fistulas for hemodialysis. J Ultrasound 2014;17(4):253–63.
10. Fonseca Junior JH, Pitta GB, Miranda Júnior F. Accuracy of Doppler ultrasonography in the evaluation of hemodialysis arteriovenous fistula maturity. Revista do ColégioBrasileiro de Cirurgiões 2015;42(3):138-42.
11. Bodington R, Greenley S, Bhandari S. Getting the basics right: the monitoring of arteriovenous fistulae, a review of the evidence. Curr Opin Nephrol Hypertens 2020;29(6):564–71.
12. Mat Said N, Musa KI, Mohamed Daud MA, Haron J. The combination of sonography and physical examination improves the patency and suitability of hemodialysis arteriovenous fistula in vascular access. Malays J Med Sci 2016;23(4):26–32.
13. Tong A, Evangelidis N, Kurnikowski A, Lewandowski M, Bretschneider P, Oberbauer R, et al. Nephrologists' perspectives on gender disparities in CKD and dialysis. Kidney Int Reports 2021.
14. Carrero JJ, Hecking M, Chesnaye NC, Jager KJ. Sex and gender disparities in the epidemiology and outcomes of chronic kidney disease. Nat Rev Nephrol 2018;14(3):151–64.
15. Streja E, Nicholas SB, Norris KC. Controversies in timing of dialysis initiation and the role of race and demographics. Semin Dial 2013;26(6):658–66.
16. Sparke C, Moon L, Green F, Mathew T, Cass A, Chadban S, et al. Estimating the total incidence of kidney failure in Australia including individuals who are not treated by dialysis or transplantation. Am J Kidney Dis 20131;61(3): 413–9.
17. Farrington C, Lee TC. The New age of vascular access: choosing the right access for the right reason in older hemodialysis patients. Am J Kidney Dis 2020;76(4):457–9.
18. Distefano G, Zanoli L, Basile A, Fatuzzo P, Granata A. Arteriovenous fistula and pre-surgery mapping: Potential role of physical exercise on endothelial function. J Vasc Access 2019;20(6):652–8.
19. Rajabi-Jaghargh E, Banerjee RK. Combined functional and anatomical diagnostic endpoints for assessing arteriovenous fistula dysfunction. World J Nephrol 2015;4(1):6–18.
20. Nawaz S, Ali S, Shahzad I, Baloch MU. Arterio venous fistula experience at a tertiary care hospital in Pakistan. Pak J Med Sci 2013;29(1):161–5.
21. Yan Y, Ye D, Yang L, Ye W, Zhan D, Zhang L, et al. A meta-analysis of the association between diabetic patients and AVF failure in dialysis. Ren Fail 2018;40(1):379–83.
22. Cui T, Zhang R, Liu F, Tang W, Fu P, Zhou L, et al. Association of diabetes and early failure of arteriovenous fistula in the end stage of renal diseases. Sichuan Da Xue Xue Bao Yi Xue Ban 2012 May;43(3):438–41.
23. Fokou M, Teyang A, Ashuntantang G, Kaze F, Eyenga VC, Chichom Mefire A, et al. Complications of arteriovenous fistula for hemodialysis: an 8-year study. Ann Vasc Surg 2012;26(5):680–4.
24. Campos RP, Do Nascimento MM, Chula DC, Do Nascimento DE, Riella MC. Stenosis in hemodialysis arteriovenous fistula: evaluation and treatment. Hemodial Int 2006;10(2):152–61.
25. MacRae JM, Dipchand C, Oliver M, Moist L, Lok C, Clark E, et al. Arteriovenous access failure, stenosis, and thrombosis. Can J Kidney Health Dis 2016; 3:2054358116669126.
26. Pasklinsky G, Meisner RJ, Labropoulos N, Leon L, Gasparis AP, Landau D, et al. Management of true aneurysms of hemodialysis access fistulas. J Vasc Surg 2011; 53(5):1291–7.