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Rate of Arteriovenous Fistula Stenosis and Access Recirculation among Individuals Receiving Maintenance Hemodialysis

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ABSTRACT

Background: Arteriovenous fistula stenosis and access recirculation in hemodialysis represent critical challenges, influencing the efficiency of vascular access and dialysis treatment outcomes. **Objective:** The objective is to assess the prevalence of arteriovenous fistula (the AVF) stenosis as well as access recirculation (AR) in patients of hemodialysis. **Study Design:** Cross sectional study. **Settings:** Department of Nephrology, Bolan Medical Complex Hospital, Quetta. **Duration:** From 1st April 2022 to 1st September, 2022. **Methods:** Adult patients having age 18 years to 80 years receiving maintenance hemodialysis 3 times in a week were included in this study. Patients who were willing to provide informed consent participated in the study. Patients with active infections or sepsis, with a history of vascular access interventions within the last three months, pregnant or lactating women as well as patients with cognitive impairment were excluded from study. Outcome variables will be incidence of AVF Stenosis which was determined by regular ultrasound assessments and monitoring of clinical symptoms. Statistical analyses were performed using SPS version 22. **Results:** The study comprised 150 maintenance hemodialysis patients with a mean age of 55±10. Age distribution showed that 20% were between 18-40 years, 53.3% between 41-60 years, 23.3% between 61-80 years, and 3.3% were older than 80 years. Sixty percent (60%) of the participants were male, while 40% were female. The mean duration of AV fistula use was 3.21± 2.65 years, with 14.66% having duration of 6-12 months, 41.33% between 1-3 years, and 44% using AV fistulas for more than 3 years. Seventy-five point three percent (75.3%) of patients had hypertension, 40.0% had diabetes mellitus, and 28.0% had cardiovascular disease. Additionally, 16.7% of patients presented with other comorbidities. Out of total 25 (16.7%) patients were affected by arteriovenous fistula (AVF) stenosis, while access recirculation was observed in 20 patients (13.3%). **Conclusion:** In conclusion, our study reveals a notable incidence of arteriovenous fistula (AVF) stenosis and access recirculation among maintenance hemodialysis patients. The observed associations with age and AVF duration underscore the complexity of vascular access complications.

Keywords: *Access Recirculation, Arteriovenous fistula, Dialysis Outcomes, Maintenance hemodialysis stenosis, Vascular access challenges.*

INTRODUCTION

Chronic Kidney Disease (CKD) has emerged as a global health concern, with a rising prevalence that significantly impacts public health systems worldwide. CKD is characterized by the gradual loss of kidney function over an extended period, often leading to irreversible damage. The prevalence of CKD has reached epidemic proportions, affecting millions of individuals across the globe.[1] Contributing factors include aging populations, the upsurge in non-communicable diseases, and lifestyle changes that predispose individuals to kidney-related complications. Hemodialysis, a crucial therapeutic intervention for advanced CKD, serves as a lifeline for patients whose kidneys can no longer effectively filter waste and excess fluids from the blood.

Globally, the demand for hemodialysis is escalating, reflecting the increasing burden of CKD. The prevalence of CKD and the utilization of hemodialysis vary across regions, influenced by socioeconomic factors, healthcare infrastructure, and cultural practices.[2,3]

The prevalence of Chronic Kidney Disease (CKD) in Pakistan ranges between 16 to 25%. The Pakistan Kidney Foundation's 2014 report states that there are 891 hemodialysis machines in the country, and 5935 people are now undergoing dialysis treatment.[4] Patients with stage 5 of chronic kidney disease are often advised to have thrice-weekly maintenance hemodialysis. However, in our country, 67% of patients receive dialysis just twice per week due to economic and social challenges.[5]

Arteriovenous fistula (AVF) stenosis and access recirculation represent critical challenges in the maintenance hemodialysis of end-stage renal disease (ESRD) patients. AVF, a surgically created connection between an artery and a vein, serves as the preferred vascular access for hemodialysis due to its long-term patency and lower complication rates. However, stenosis, the narrowing of the AVF lumen, is a common complication that compromises blood flow and efficacy of hemodialysis.[6,7] Access recirculation, on the other hand, occurs when the dialyzed blood returns to the systemic circulation without proper filtration, diminishing the effectiveness of hemodialysis. Both AVF stenosis and access recirculation contribute to inadequate dialysis and can lead to complications such as inadequate solute clearance and compromised fluid removal, adversely affecting patient outcomes.[8,9] Understanding the mechanisms, risk factors, and consequences of AVF stenosis and access recirculation is pivotal for optimizing the management of maintenance hemodialysis patients. These challenges not only impact the efficiency of the dialysis process but also pose potential threats to patient health.[10]

Understanding the incidence of arteriovenous fistula (AVF) stenosis and access recirculation among maintenance hemodialysis patients is crucial for optimizing patient care. These complications significantly impact the efficacy of hemodialysis and patient outcomes. Our study aims to contribute valuable insights by exploring the prevalence, risk factors, and mechanisms involved in AVF stenosis and access recirculation. Through this research, we seek to enhance the existing literature and provide a foundation for the development of targeted preventive and management strategies in the context of maintenance hemodialysis.

METHODS

It was a cross-section study which was conducted in Department of Nephrology, Bolan Medical Complex Hospital, Quetta From 1st April 2022 to 1st September, 2022. The sample size for this study was calculated based on 11.9% frequency of access re-circulation keeping 95% significance of study and 5 % margin of error.[14] Adult patients (18 years to 80 years) receiving maintenance hemodialysis 3 times in a week were included in this study. Patients who were willing to provide informed consent participated in the study. Patients with active infections or sepsis, with a history of vascular access interventions within the last three months, pregnant or lactating women as well as patients with cognitive impairment were excluded from study. Outcome variables will be incidence of AVF Stenosis which was determined by regular ultrasound assessments and monitoring of clinical symptoms. Access recirculation assessed through blood flow measurements and urea reduction ratio calculations during hemodialysis sessions. Demographic and clinical characteristics of the study population, including age, gender and comorbidities were summarized using descriptive statistics such as mean, median, standard deviation, and frequency distributions. The incidence of AVF stenosis and access recirculation was calculated as the number of new cases divided by the total person-time at risk. This allowed for the determination of event rates per patient-year of follow-up.

Statistical analyses were performed using SPS version 22. Subgroup analyses were conducted to explore variations in incidence among different patient subgroups, such as age categories, gender and duration of AVF. Chi-square test was applied and p-value less than 0.05 was considered statistically significant.

RESULTS

The study comprised 150 maintenance hemodialysis patients with a mean age of 55 years (SD ± 10). Age distribution showed that 20% were between 18-40 years, 53.3% between 41-60 years, 23.3% between 61-80 years, and 3.3% were older than 80 years. Sixty percent (60%) of the participants were male, while 40% were female. The mean duration of AV fistula use was 3.21 years (SD ± 2.65), with 14.66% having a duration of 6-12 months, 41.33% between 1-3 years, and 44% using AV fistulas for more than 3 years as shown in table 1.

Among the 150 maintenance hemodialysis patients, comorbidities were prevalent. Seventy-five point three percent (75.3%) of patients had hypertension, 40.0% had diabetes mellitus, and 28.0% had cardiovascular disease. Additionally, 16.7% of patients presented with other comorbidities as shown in table 2. Out of total 25 (16.7%) patients were affected by arteriovenous fistula (AVF) stenosis, while access recirculation was observed in 20 patients (13.3%). These frequencies underscore the

occurrence of vascular access complications in the examined patient population as shown in table 3.

Table 1: Demographic data age, gender and duration of AVF of studies patients

Characteristics	Category	Frequency
Age	Mean ± SD	55 ± 10 years
	18-40 years	30 (20%)
	41-60 years	80 (53.3%)
	61-80 years	35 (23.3%)
	>80 years	5 (3.3%)
Gender	Male	90 (60%)
	Female	60 (40%)
Duration of AV fistula	Mean ± SD	3.21 ± 2.65
	6-12 months	22 (14.66%)
	1-3 years	62 (41.33%)
	> 3 years	66 (44.0%)

Table 2: Participants' Comorbidities and disease-related characteristics

Comorbidity	Number of Patients	Percentage
Hypertension	113	75.3%
Diabetes Mellitus	60	40.0%
Cardiovascular Disease	42	28.0%
Other	25	16.7%

Table 3: Frequency of arteriovenous fistula (AVF) and Access Recirculation among studies patients

Variables	Frequency	Percentage
AVF Stenosis	25	16.7%
Access Recirculation	20	13.3%

Among male participants (60%), 11.11% experienced AVF stenosis, while 88.88% did not, with no statistically significant difference (p = 0.395). In the female group (40%), 13.33% had AVF stenosis, and 86.66% did not. Regarding age distribution, individuals aged 41-60 years (53.3%) had the highest incidence of AVF stenosis (16.25%), while those aged 61-80 years (23.3%) and >80 years (3.3%) experienced lower incidences (8.57% and 20.0%, respectively). Examining AV fistula duration, a statistically significant association was observed (p = 0.001*). Patients with a duration of 6-12 months (14.66%) had a higher incidence of AVF stenosis (13.63%) compared to those with 1-3 years (40.32%) and >3 years (40.90%). These results provide insights into the varying frequencies of AVF stenosis across gender, age groups, and AV fistula duration among the studied hemodialysis patients as shown in table 4.

Table 4: Stratification of age, gender and duration of AV fistula across incidence of AVF stenosis

Variables	Characteristics	AVF Stenosis	No AVF Stenosis	P-value
Male	90 (60%)	10 (11.11%)	80 (88.88%)	0.395
Female	60 (40%)	08 (13.33%)	52 (86.66%)	
18-40 years	30 (20%)	4 (13.33%)	26 (86.66%)	0.003*
41-60 years	80 (53.3%)	13 (16.25%)	67 (83.75%)	
61-80 years	35 (23.3%)	03 (8.57%)	32 (91.42%)	
>80 years	5 (3.3%)	01 (20.0%)	04 (80.0%)	
6-12 months AV fistula	22 (14.66%)	03 (13.63%)	19 (86.36%)	0.001*
1-3 years AV fistula	62 (41.33%)	25 (40.32%)	37 (59.67%)	
> 3 years AV fistula	66 (44.0%)	27 (40.90%)	39 (59.09%)	

DISCUSSION

In In the realm of maintenance hemodialysis, understanding the incidence of arteriovenous fistula (AVF) stenosis and access recirculation is paramount. These complications can compromise the efficacy of hemodialysis, impacting patient outcomes.[11,12]

In our study encompassing 150 maintenance hemodialysis patients, demographic characteristics revealed a mean age of 55 years, with 60% being male and 40% female. Comparing these results with those of Kafayat *et al.* (2022), our gender distribution aligns closely, although our age distribution leans towards an older population, with a higher mean age of 55 years compared to their mean age of 48 years.[13] Similarly, Anwar *et al.* (2022) reported a higher proportion of male patients (71.4%), resembling our study's gender distribution.[14]

In our study of 150 maintenance hemodialysis patients, the mean duration of AV fistula use was 3.21 years, exhibiting a diverse distribution across different duration categories. Comparing this with Anwar *et al.* (2022), while they did not provide specific details on AV fistula duration, they highlighted a significant prevalence of hypertension (77.4%), aligning with our study's observation of 75.3% hypertensive patients. Moreover, our findings indicated a substantial diabetic population (40%), with 44.1% of Anwar *et al.*'s patients being diabetic. Notably, the co-occurrence of diabetes and hypertension in our study (44.1%) echoes their reported comorbidity patterns. These shared trends emphasize the consistent prevalence of key comorbidities in the maintenance

hemodialysis patient population across different studies.[14]

In our study, 13.3% of maintenance hemodialysis patients were affected by access recirculation. Comparing these results with Anwar *et al*. (2022), our findings align with their reported prevalence of AV fistula stenosis (8.3%) and access recirculation (11.9%). Additionally, the consistency of our results with international studies, such as T Buur's study (13.5%) and Javad Salimi's study (8.75%).[15,16] Interestingly, our study and Anwar *et al*.'s findings demonstrate a lower prevalence compared to studies from Egypt (55%) and Bangladesh (82.2%), emphasizing regional variations in the occurrence of AVF-related complications among hemodialysis patients.[17,18]

In our study, we observed that 16.7% of maintenance hemodialysis patients experienced arteriovenous fistula (AVF) stenosis. Comparing this with a Romanian study that conducted doppler USG on 97 patients, our findings demonstrate a significantly lower prevalence, with the Romanian study reporting the highest incidence of AVF stenosis at 54.6%.[19]

CONCLUSION

In conclusion, our study reveals a notable incidence of arteriovenous fistula (AVF) stenosis and access recirculation among maintenance hemodialysis patients. The observed associations with age and AVF duration underscore the complexity of vascular access complications.

LIMITATIONS

One limitation of this study is the lack of long-term follow-up, which may limit our ability to assess the sustained impact of arteriovenous fistula (AVF) stenosis and access recirculation over an extended period.

SUGGESTIONS / RECOMMENDATIONS

The significance of future research on this topic should be acknowledged.

CONFLICT OF INTEREST / DISCLOSURE

None.

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