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Original Article

Delays in Arterio-Venous Fistula Formation Among Patients With Chronic Kidney Disease; A Comparative Analysis Between Patient and Healthcare Related Factors

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ABSTRACT

Objective: To evaluate the factors associated with delay in arterio-venous fistula formation among the patients with chronic kidney disease on hemodialysis.
Study Design: Comparative cross-sectional study.
Place and Duration of Study: Combined Military Hospital, Lahore Pakistan, from Jan to Dec 2020.
Methodology: All patients above 18 years of age with chronic kidney disease on maintenance hemodialysis (end stage renal disease) were inducted in the study. Patients requiring hemodialysis for acute kidney injury were excluded from the study. Patients were interviewed face-to-face about their socio-demographic variables, cause of delay and mean delay time from diagnosis to Arterio-venous fistula formation.
Results: Out of 292 patients, 228 patients (76%) had a delay in arterio-venous fistula and first dialysis through double lumen catheter. The mean age of these patients was 59.05 years with 78.1% males. The mean delay of these patients was 60.63+26.832 days. Patient unwillingness and lack of awareness of deteriorating renal disease were the commonest factors (35%) in patient related factors and delayed surgical appointment being commonest (49.1%) in health care associated factors. The longest delay time was 69.04±25.759 months which was associated with delayed surgical appointment (p<0.001). Monthly income, gender and age had significant impact on different factors included in this study.
Conclusion: The study identified that differences in Arterio-venous fistula maturation with respect to age, gender and socio-demographic factors were significant. Timely formation of Arterio-venous fistula in patients with chronic kidney disease is the most favourable approach to establish vascular access for hemodialysis and improves outcome.

Keywords: Arterio-venous fistula, Chronic kidney disease, Hemodialysis.

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INTRODUCTION

The burden of chronic kidney disease (CKD) is on the rise throughout the world, with Pakistan facing a large number of cases of end stage renal disease (ESRD).[1] Despite of being a global concern, CKD disproportionately affects the people from developing countries. A systematic review, conducted in 2015 reported that, 109.9 million people from high-income countries had CKD (men-48.3 million, women-61.7 million) whereas the burden was 387.5 million in lower-middle income countries (men-177.4 million, women- 210.1 million).[2] Hemodialysis is the commonest modality of treatment for patients of ESRD throughout the world, but data has shown that survival on long term hemodialysis is generally poor.[3] The reduction of morbidity and mortality in patients of ESRD is a major challenge encountered by nephrologists today and vascular access is one the major contributing factor in this.

An arterio-venous fistula (AVF) is the vascular access of choice in patients undergoing hemodialysis, due to a lower chance of infection and long term patency.[4-5] Thus, the creation of an AVF in patients with CKD is preferred and recommended by KDOQI guidelines.[6] Reports have shown that there is a worldwide increasing trend in AVF formation for hemodialysis.[7] Owing to insufficient resources, most of the healthcare institutions in Pakistan are unable to provide patients with adequate dialysis at par with the recommended guidelines, this leads to increased morbidity and mortality among patients with CKD.[8-9] Majority of patients in Pakistan have a delayed AVF formation and almost 81% in one study get their first haemodialysis session through a double lumen.10 Our study aims to identify the patient and health care dependent parameters associated with delay in AVF

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formation in patients with CKD to improve the quality of these patients and prognosis.

METHODOLOGY

The comparative cross sectional study was conducted at Combined Military Hospital, Lahore, Pakistan from January to December 2020 (ERC). Keeping the prevalence of CKD to be 21.2%, the sample size was estimated.[11]

Inclusion Criteria: All patients of CKD more than 18 years of age and undergoing regular sessions of maintenance haemodialysis were included in the study.

Exclusion Criteria: Patients requiring haemodialysis for acute kidney injury were excluded from the study.

A non-probability convenience sampling technique was used to enrol participants. Common causes of nephropathy were diabetes mellitus, hypertension, obstructive nephropathy, and glomerular disorders. Patients were interviewed face-to-face about their sociodemographic variables, cause of delay, and mean delay time from diagnosis to AVF formation. AVF was considered delayed if first haemodialysis was performed through temporary vascular access mostly a non-tunnelled haemodialysis catheter (double lumen catheter).All data was recorded in a predefined proformas. Data analysis was performed using Statistical Package for Social Sciences (SPSS version 26). Mean with standard deviation were computed for all continuous variables whereas all categorical variables were presented as frequency and percentages. The chi-square test was applied to find out the factors causing delay in formation of AV fistula. The *p*-value of ≤ 0.05 was set as the cut off value for statistical significance.

RESULTS

A total of 292 patients were recruited in the study, out of which 64(21.9%) patients had their first session of haemodialysis through AVF and the rest 228(78.1%) patients needed a temporary double-lumen catheter placed to establish a central venous access for haemodialysis and AVF was formed later as shown in Figure-1.

These 228 patients were included in the analysis; the mean age was 59.05±9.8 years with the majority belonging to the age group between 51 and 60 years. Almost three-fourth of the study population was male (78.1%). The mean delay time of patients was 60.63±26.832 days. Patient related factors were responsible for the delay in 49.1% cases with patient unwillingness and lack of awareness of deteriorating renal functions being the commonest cause of delay (14%) due to late referral to nephrologist. Health care related factors caused the delay in 50.9% cases in which major factor was delayed surgical appointment (49.1%) and in 1.8% cases it was due to delay in advice for AVF formation (Figure 2 and 3).

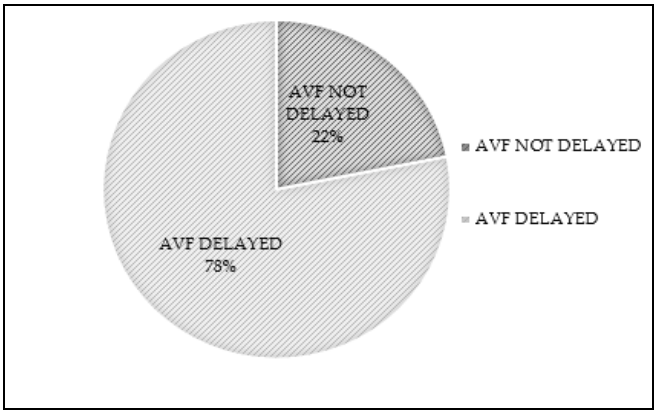

Figure-1: Vascular Access At the Initiation of Hemodialysis (N=292)

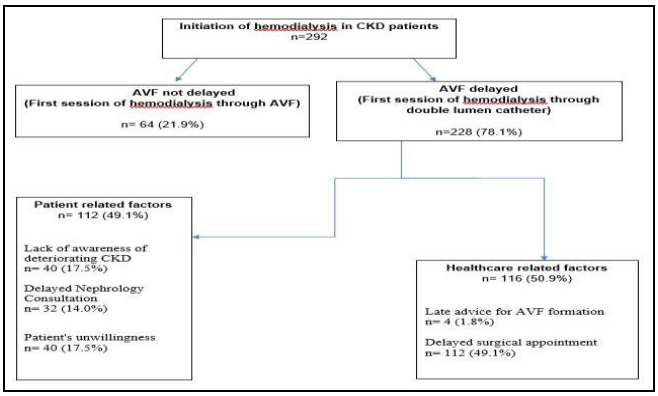

Figure-2: Distribution of Av Fistula Formation and Temporary Double Lumen At Initiation of Hemodialysis in CKD Patients (N=292)

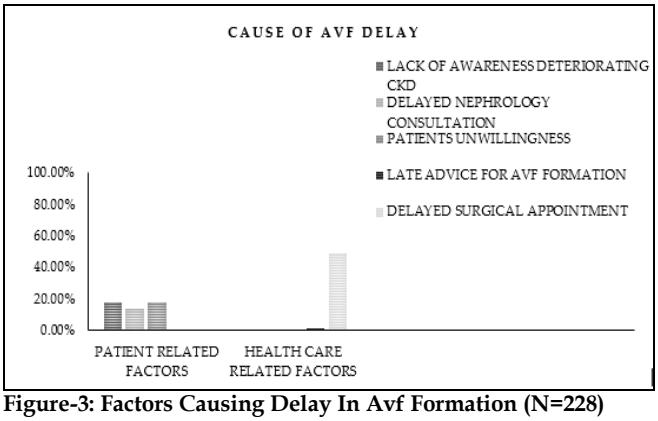

Figure-3: Factors Causing Delay In Avf Formation (N=228)

Patients were analysed involving different demographic factors including monthly income, gender and age as shown in Table.

analysis. The factors causing delay in AVF formation including lack of awareness of deteriorating CKD and delayed surgical appointment were significantly

Table: Patient-related Parameters and its Association with Factors causing Delay in Arteriovenous Fistula Formation (n=228)

	Monthly Income				***p*-value**
	<60,000		>60,000		
Cause of Arteriovenous Fistula Delay					
Health Care Related Factors as Cause of Delay (n=116)					
Delayed surgical appointment	76(57.60%)		36(37.50%)		<0.001
Late advice for Arteriovenous Fistula formation	0(0.00%)		4(4.20%)		
Patient Related Factors as Cause of Delay (n=112)					
Lack of awareness of deteriorating condition	32(24.20%)		8(8.30%)		
Delayed Nephrology Consultation	16(12.10%)		16(16.70%)		
Patient's unwillingness	8(6.10%)		32(33.30%)		
Gender					*p*-value
	Female		Male		
Cause of Arteriovenous Fistula Delay					
Health Care Related Factors as Cause of Delay (n=116)					
Delayed surgical appointment	24(48.00%)		88(49.40%)		0.002
Late advice for Arteriovenous Fistula formation	1 (2.00%)		3(1.70%)		
Patient Related Factors as Cause of Delay (n=112)					
Lack of awareness of deteriorating condition	1(2.00%)		39(21.90%)		
Delayed Nephrology Consultation	8(16.00%)		24(13.50%)		
Patient's unwillingness	16(32.00%)		24(13.50%)		
Cause of AVF Delay	Delay time (±SD)				
Health Care Related Factors as Cause of Delay (n=116)					
Delayed surgical appointment	69.04±25.759				<0.001
Late advice for Arteriovenous Fistula formation	48.75±14.361				
Patient Related Factors as Cause of Delay (n=112)					
Lack of awareness of deteriorating condition	54.5±21.055				
Delayed Nephrology Consultation	51.25±27.911				
Patient's unwillingness	51.9±28.589				
Age Groups					*p*-value
	>50	51-60	61-70	>70	
Cause of Arteriovenous Fistula Delay					
Health Care Related Factors as Cause of Delay (n=116)					
Delayed surgical appointment	24(54.5%)	40(45.5%)	36(52.9%)	12(45.9%)	0.003
Late advice for Arteriovenous Fistula formation	0(0.0%)	0(0.0%)	4(5.9%)	0(0.0%)	
Patient Related Factors as Cause of Delay (n=112)					
Lack of awareness of deteriorating condition	4(9.1%)	20(22.7%)	8(11.8%)	8(28.6%)	
Delayed Nephrology Consultation	8(18.2%)	8(9.1%)	8(11.8%)	8(28.%)	
Patient's unwillingness	8(18.2%)	20(22.7%)	12(17.6%)	0(0.0%)	

Dividing these patients in two income groups at the level of PKR 60,000/month gave an interesting

correlated with monthly income below PKR 60,000 while patients with income higher than PKR

60,000/month were more frequently unwilling to give consent for AVF for haemodialysis (p <0.001). Comparing the patients on gender basis revealed that male gender (13.5%) was more frequently associated with delayed nephrology consultation compared to female (16%). Patients' unwillingness was more common in females than males (p=0.002). Patients aged above 70 years of age claimed more frequently that delayed nephrology consultation and lack of awareness of their deteriorating CKD were factors associated with AV fistula formation (p<0.003). The longest delay time was 69.04±25.759 days which was associated with delayed surgical appointment, followed by lack of awareness of deteriorating renal functions (54.5+21.055) and patient willingness (51.9+28.589) (p<0.001).

DISCUSSION

Only 21.9% patients had AVF formed before the start of haemodialysis in this study, this is almost similar to the study conducted by Baig *et al* in Pakistan in 2010 in which 23.5% patients had permanent access created before the start of hemodialysis.[10] Our study population was older than the earlier study but males outnumbered females in both. An interesting aspect noted in that study was that even in late access creation group 36% of patients had an early nephrology consultation, but fistula was formed late in them. In our study the most common patient related factors were lack of awareness of deteriorating CKD and patient unwilling to consent for AVF. A similar study depicted most important patient related factors of denial of kidney disease or the need of AVF (76.4%) and patient refusal (73.3%).[11] In contrast to our study the most important physician and hospital related factor were insufficient conduction of predialysis care and education (63.7%) and late referral to nephrologist (56.6%) while in our study delayed surgical appointment was the main factor. The main difference between the two studies is in the methodology as our study was conducted with patient face-to-face interviews giving patients perspective of the problem while Saudi study was conducted on nephrologists using a questionnaire.[12] There is a significant difference in annual GDP, GDP per capita and government health expenditure between the two countries so the factors responsible for health care related delay are different.[13]

The study reported that the income groups had a significant impact on factors causing delay in AVF formation. Lack of awareness of deteriorating CKD and delayed surgical appointment were significantly correlated with monthly income below PKR 60,000 and unwilling to give consent for AVF for haemodialysis in patients with higher income group (p<0.001). This indicates that financial stability and education status may be to some extent contributing to the delayed AVF formation in CKD patients. A study revealed that patients with low income were less likely to appear for a follow up for post AVF creation procedures.[14] These findings are consistent with our study, which also indicates an association with low income and AVF delay. This implicates that the expenses and cost of follow up procedures are difficult to bear for the mentioned population, which results in AVF formation and maturation delay.

A strong association between female gender and delay in AVF has been found in multiple studies. A prolonged maturation time was found in women, before the fistula could be used effectively for hemodialysis.[15] Certain conditions, such as hormonal differences, vessel reactivity and platelet aggregation are causative of the gender disparity in AVF maturation failure.[16] Our study indicated that the male population had significant delay in AVF owing to a delay in nephrologist consultation. Our findings were supported by a research conducted by Avorn *et al*., which reported that a delay in nephrologist consultation is associated with an inadequate development and maturation of AVF for patients of ESRD requiring hemodialysis.[17] This implies that a timely nephrologist consultation is an essential factor for the maintenance of patency of the AVF. We also reported in our study that delay in AVF was commonly seen in the elderly patients. This was associated with a delay in consultation and the lack of health awareness. Research conducted reported that a delay in AVF maturation was frequently observed in the elderly. The study found a connection between increasing age, AVF maturation delay and the width of intima media.[18] A greater intima-media width is causative of reduction in the elasticity of vascular lumen and its resultant narrowing.[19] This finding was also supported by Woodside *et al*., which also reported an association between AVF delay and increasing age. The study implicated that a cause of delay in the elderly was commonly due to an increased need of assistance and a lack of awareness.[20]

Our study identified multiple associations between the AVF delay and the patient factor associated with the delay. Differences in AVF

maturation with respect to age, gender and socio-demographic factors were significant.

CONCLUSION

Timely formation of AVF in patients with CKD is considered to be the most favourable approach to establish vascular access for hemodialysis and improves outcome. A patient centred approach of good predialysis clinic with patient education and counselling regarding importance of AVF and its benefits over other vascular access my help improve patient related factors. An early referral to nephrologists and vascular surgeon can be a key in preventing delay in AVF formation. A combined nephrology and vascular surgery clinic can help reduce the barrier between the two specialities in the better interest of the predialysis CKD patients. Prioritizing of high-risk groups like low-income CKD patients, elderly and female gender can further enhance outcome in these cases.

Conflict of Interest: None.

Authors Contribution:

Following authors have made substantial contributions to the manuscript as under:

MAJ & ZFB: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

IA & UT: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MAJ & MS & AH: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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