

Hemodialysis Access Outcome in Elderly Population and its Association with Mortality

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ABSTRACT

Objective: to determine the outcome of arteriovenous fistula in the elderly compared to the younger age group and its association with mortality so that the best approach to hemodialysis access can be defined.

Study Design: Prospective longitudinal study

Place and Duration of Study: Department of Vascular Surgery, CMH, Lahore Pakistan, from Jan 2020 to Aug 2021.

Methodology: All the Patients who presented to access the Surgical Clinic were categorized into three groups according to their age. Outcome variables like fistula maturation, complications and mortality were compared according to age groups.

Result: A total of 184 patients were recruited. We found that in the age group >70 years, there was male predominance (12, 54.5%), three-quarters of them were on hemodialysis at the time of access surgery, only half of them were functional at one year of follow-up, and 6 (27.3%) were not alive at the time of contact. In addition, the pseudo aneurysm was the most common complication in this group, which was the most dreadful of all access-related complications and further put the already frail at risk.

Conclusion: No single optimal approach can be expected to meet the needs of all, and an extensive patient-centred case-based discussion is required for each patient in the hope that optimal dialysis access can be created. Age cannot be defined as an independent risk factor for access creation.

Keywords: Access, Arteriovenous fistula elderly, Hemodialysis, Old age, Pakistan, Vascular access.

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INTRODUCTION

Pakistan has many geriatric populations facing end-organ damage resulting from long-standing diabetes and hypertension.^{1,2} According to a recent study, the mean age of the population undergoing hemodialysis in Pakistan is 46.3 years (range 20 to 83 years).³ However lack of a central data registry makes it difficult to comment on epidemiology.

Elderly patients presenting with end-stage renal disease have multiple comorbidities.⁴ According to Lok *et al.* the risk of arteriovenous fistula (AFV) failure is doubled in patients aged more than 65 years.⁵ Therefore, some access surgeons prefer to use arteriovenous grafts in such patients, which is not without its disadvantages.⁴ Additionally, the elderly population have thick and calcified vessels (usually with diabetes and peripheral arterial disease), which makes them prone to access related steal syndrome with a dreadful possibility of limb loss.^{4,6} On the other hand, some surgeons prefer a central venous catheter, the least invasive, as the only access for a patient with limited life expectancy. The evidence of this practice is controversial because of the high infection, thrombosis and mortality

rate.⁶ According to Kidney disease outcomes quality initiatives (KDOQI) updated in 2019, the elderly patient is a risk of fistula failure. They have added different decision-making algorithms for patients over 85 years or with a life expectancy of fewer than two years. They have emphasized that an access surgeon has to identify the suitable candidate in an elderly age group according to its frailty, peripheral vascular disease, diabetes, suboptimal ejection fraction, and life expectancy.⁷ A recent survey on the Italian population showed no difference in fistula outcome in old age with primary patency of 73 %,⁸ contrary to Richardson *et al.*, reported, who reported primary patency of 35 % at one year.⁹

The currently available literature concludes that every centre has variable outcomes and optimum hemodialysis access for the elderly population is yet to be defined.¹⁰ Therefore, the present study aimed to determine the outcome of arteriovenous-fistula in our elderly population as per the latest KDOQI guidelines and compares it with younger age groups so that the best approach to hemodialysis access can be defined.

METHODOLOGY

This prospective longitudinal study was conducted at the Department of Vascular Surgery, CMH

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Lahore Pakistan, after ethical approval from the Institutional Review Board (ERB # 256/2020) from December 2019 to July 2021.

Inclusion Criteria: All the patients who underwent primary access surgery for AV Fistula were included in the study.

Exclusion Criteria: Patients undergoing basilic vein transposition and secondary access procedures (e.g., arteriovenous grafts) were excluded from the study.

The non-probability consecutive sampling technique was used. The sample size of 160 was calculated with a 95% confidence interval and 5% margin of error, and a population proportion of 50 % using a WHO calculator.¹⁰ All surgeries were done by a single vascular surgeon, and a similar end-to-side anastomotic technique was utilized in all cases. After taking the consent, initial data was entered on a proforma, and the follow-up data were collected on the follow-up visits or via telephone calls to inquire about the status of their AV fistula. Data collected included demographics and access procedure(s) like a site of AV fistula, previous history of AV fistula construction, if there was any dialysis line before AV fistula creation, if it was working correctly and the probable reason behind AV fistula failure. Mortality, if any, was also recorded. Patients were then categorized into three groups according to their age. Group-A: age less than 60 years, Group-B: age 60 to 65 years, and Group-C: more than 66 years.

Statistical package of social sciences (SPSS) version 20 was used to calculate the mean and SD for qualitative variables and the frequency and percentage of a quantitative variable. The *p*-value was calculated with the chi-square test, and less than or equal to 0.05 was considered statistically significant.

RESULTS

A total of 274 access procedures were carried out over this period. Of them, 184 were included in the study, and the rest were lost to follow. There was male predominance (136, 73.9%). The mean age was 55.14 ± 13.14 , with the majority in the age range less than 54 years.

Diabetes mellitus was the most common comorbidity. It was present in 80 (43.5%) of the participants, 105 (57.1%) had CKD for 1 to 5 years, and 159 (86.4%) had their dialysis already initiated at the time of AV creation. All the study participants were categorized according to their age group. Demographic variables according to age groups were shown in Table-I.

Outcomes of AV Fistula according to the age group were shown in Table-II. Complications according to Age Group were shown in Table-III.

Table-I: Socio-Demographic Factors (n=184)

	Age Less Than 65 Years (n=137) n (%)	Age 66 to 70 Years (n=25) n (%)	Age More than 71 Years (n=22) n (%)	<i>p</i> - value
Gender				
Male	107 (78.1)	17 (68.0)	12 (54.5)	
Female	30 (21.9)	8 (32.0)	10 (45.5)	0.05
On Hemodialysis at the Time of Access Surgery				
Yes	121 (88.3)	20 (80.0)	18 (81.8)	
No	16 (11.7)	5 (20.0)	4 (18.2)	0.42
Frequency of Dialysis				
Once weekly	1 (0.7)	1 (4.0)	1 (4.5)	<0.001
Twice weekly	93 (67.9)	8 (32.0)	2 (9.1)	
Thrice weekly	31 (22.6)	11 (44.0)	16 (72.7)	

Table-II: Outcome of Arteriovenous Fistula (n=184)

	Age Less than 65 Years (n=137) n (%)	Age 66 to 70 Years (n=25) n (%)	Age More than 71 Years (n=22) n (%)	<i>p</i> - value
Type of Arteriovenous fistula				
Brachiocephalic	97 (70.8)	19 (76.0)	17 (77.3)	
Radiocephalic	40 (29.2)	6 (24.0)	5 (22.7)	0.742
Current Status of Arteriovenous Fistula				
Working	119 (86.9)	10 (40.0)	12 (54.5)	
Not Working	16 (11.7)	11 (44.0)	9 (40.9)	
Died before fistula worked	2 (1.5)	4 (16.0)	1 (4.5)	<0.001
Previous Dialysis Line				
Yes	124 (90.5)	23 (92.0)	20 (90.9)	
No	13 (9.5)	2 (8.0)	2 (9.1)	0.97
Patient Mortality				
Alive	104 (75.9)	14 (56.0)	16 (72.7)	
Dead	33 (24.1)	11 (44.0)	6 (27.3)	0.120

Table-III: Causes of Arteriovenous Fistula (AVF) Failure (n=22)

	Age Less than 65 Years n (%)	Age 66 to 70 Years n (%)	Age More than 71 Years n (%)	<i>p</i> - value
Thrombosis	11 (50)	1 (4.5)	0(0)	<0.001
Infection	1 (4.5)	0(0)	0(0)	
Pseudoaneurysm	1 (4.5)	0(0)	6 (27)	
Steal syndrome	0(0)	2 (9)	0(0)	

Figure-1 showed the relationship between age group and mortality. It reveals that the number of non-functional fistulae (8 out of 15) increased in the elderly age groups (more than 65 years) when compared with the younger age groups (less than 65 years, 6 out of 33). Figure -2 showed the final appearance of AVF after

surgery, showing a good calibre radial artery and cephalic vein with end-to-side anastomosis in an 80 years old gentleman.

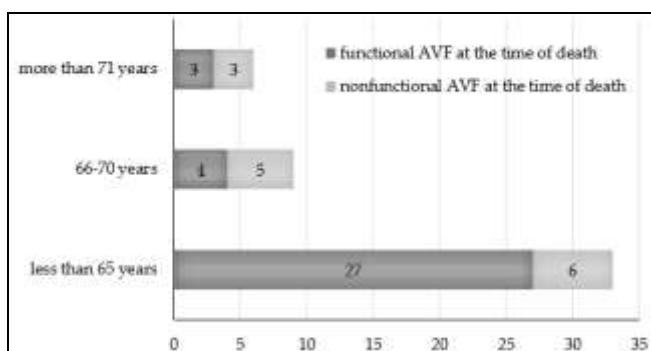


Figure-1: Relationship between Age Group and Mortality (n=48)



Figure-2: The Final Creation on Distal RCAVF End to Side Anastomosis In a 80 Years Old Gentleman . Patient had a Good on Table Thrill. Successful Hemodialysis were Started After 6 Weeks

DISCUSSION

The mean age of our study population was 55.14 ± 13.14 years, which was contrary to 64.1 ± 0.05 years as described by Hicks *et al.* in a retrospective study via the United States Renal Data System (USRDS) database in 2015.¹¹ In a GOLD study conducted in Netherland in 2017, mean age was 75 ± 7.12 years. Our country's relatively early age group presenting with end-stage renal disease is worrisome and multifactorial.

The updated National Kidney Foundation (NFKDOQI) guidelines in 2020 have introduced the life plan of all patients presenting to access surgeons for renal replacement therapy, which emphasizes individualizing the plan for dialysis access. They have recommended that vascular access surgery should not be offered to patients with a life expectancy of fewer than two years. AVG or permanent dialysis line should be considered. Age of more than 85 years is an

important component of a life plan.¹² This brings us to an open question of how to effectively choose the patients from another age group considered elderly in our population to have the maximum benefit of autogenous AV access.

We found that at the time of contact with the patients, the age group between 61 to 70 years had the worst outcome with 11 (44%) were not functional ($p<0.001$), although in 8 (32%) patients, no cause could be determined ($p<0.001$) and 55% were not functional at the time of death of patients. On further assessment, it was found that this age group had fallen into the hands of a central dialysis catheter more frequently than any other age group ($n=23$, 92% $p=0.97$). This has further strengthened the fact that the dialysis line is only responsible for a failed AVF but also leads to an overall increase in mortality.^{13,14,15}

The age group over 71 years calls for special attention as they are the patients with the most comorbidities and fragility. We found that in terms of patient survival, mortality was the same for ages less than 65 and more than 71 after the creation of AVF at 24 % and 23%, respectively and was the highest in the age group between 66 to 70 years which was 44 %. This is comparable to a previous study Hicks *et al.* in 2014, where he stated that for all age groups, patient mortality after AVF is far superior to any other hemodialysis access. So choosing patients according to age and life expectancy as stated in the latest NF KDOQI guidelines is not proven suitable in the present study.¹¹

Age over 64 is determined as a reason for fistula failure to maturation in previous literature.¹¹ In terms of access survival, we found that 11 (0.59%) failed to mature, most commonly in the age group between 65 to 70 and none in age less than 65. Hemanchander also concluded similar results, but in his study, 25% of fistulas failed to mature in all patients more than 60 years.¹⁴ Other studies concluded that the primary patency of an AVF is 40% vs 17% of age group less than 60 and more than 88 years. However, opposite to our study, they did not identify the age group between 60 to 80 years.^{15,16}

Females, the inability to ambulate and age more than 65 are risk factors for failure to maturation as concluded by Arhuidese *et al.*¹⁷ However, our results showed that although in the age group more than 65 years, a male is more prone to attain a mature fistula. We have not evaluated the relationship with ambulation, and some further research is needed in this area for our specific population that is refraining from most

of the international literature available. We can concluded that in our population, not only maturation rate is far superior to other studies, but also age between 60 to 65 is immune to this category, so they should get a chance for native AVF.¹⁸

Twenty-two (17.9%) access failed either due to complications. The most frequent complication of an AVF is thrombosis which is universally responsible for 50% of the access failure. We found that our rate of fistula thrombosis is far less than as reported in the literature, 20.5%

Furthermore, 22% as reported by Ahmed *et al.* and Miller *et al.* respectively.^{18,19} We found that the most frequent age group to have fistula complications was age less than 65, and 76.9% patients were due to thrombosis, a similar age group to Ferreira *et al.* but contrary to the very high rate of thrombosis in our population.²⁰ This calls for designing new strategies to pick a failing fistula early before it thromboses and leads to loss of access.

Ischemic steal syndrome(ISS) is associated with access-related limb pain, access loss, and even limb loss. The NKF KDOQI guidelines have estimated ischemic steal syndrome occurrence to be in a range of 1 to 4% for the upper arm, which is similarly reported in our study (1.8%).²¹ Al-Jaishi *et al.* conducted a study in which he divided the population into age group less and more than 65 years. He found that IST occurred in 1.7% of the study population, 1.5% in a younger population, and 2.2% in age more than 65 years.²¹ Similar pattern was seen in our study. All were male and hypertensive ($p < 0.001$). This is contrary to most other studies' usual presentation of females and diabetics.

The pseudoaneurysm is one of the deadliest complications of an angioaccess. It needs constant close monitoring as it decreases the available area for cannulation and is at risk of rupture. We found that it forms a total of 3.2% (6/184) of the cause of access failure, similar to a study conducted in Pakistan 10 years back by Ahmed *et al.* (3.2%)²² and far superior to 5.5% seen in the Sudanese population.¹⁸ However, they have not compared its frequency according to age groups. Rather, we found that it was an incident in all patients over 70 years of age. This complication, if left untreated, is at risk of rupture and severe haemorrhage and is mostly treated surgically, posing the already compromised elderly population with additional risk and surgical procedure. This calls for creating protocol and parameters to identify at-risk populations so they can be best avoided. This also requires to educate of dialy-

sis technicians and nurses to audit and optimize their needling technique

In terms of patient survival, 50 (27%) of the patients were not alive at the time of contact in the present study, which is similar to and contrary to Hemachandar *et al.*¹⁴ We found that 34 (68%) had functional AVF at the time of death ($p < 0.001$). In all literature searches, we could not find any study evaluating functional AVF at the time of death. However, no direct cause of mortality can be associated with AVF.^{14,16,21} Although more common in diabetics and patients with CVC, we found no significant association of mortality with previous dialysis line ($p = 0.102$), diabetes mellitus ($p = 0.234$), type of AVF ($p = 0.389$) and gender ($p = 0.718$). This contrasts with an Italian survey where CVC significantly affects mortality.⁹ Age was the only statistically significant factor associated with death ($p = 0.045$) which is comparable to the Italian population ($p < 0.001$).⁹ In contrast, the mortality benefit of AVF is consistently superior to that of AVG and CVC for patients of all ages.²²

In summary, through the present study, we have identified patients with a wide age range presented to our clinic, and in all three groups, there was male predominance which is statistically significant. In our wide practice, brachiocephalic fistula is created more often than radiocephalic fistula in contrast to the literature and access surgery guidelines. More than half of the fistula is functional in the age group over 71 years, but the majority (90%) of them already had a dialysis line for hemodialysis at the time of referral to access surgery clinic. Therefore, our study was a good addition to the literature regarding the outcome of access surgery in the elderly population of Pakistan.

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LIMITATION OF STUDY

The lack of practice of arteriovenous grafting in our centre due to the financial constraints of patients was a major limitation. Therefore, despite being an important component of KDOQI guidelines in the elderly population, we cannot comment on its outcome in the present study due to early dialysis.

CONCLUSION

Due to the considerable variation in life expectancy, health status, health priorities, and illness experiences of the elderly, no singular approach to Vascular Access can be expected to meet the needs of all.

Providing an optimal VA option for older adults is still questionable. It should address comorbidity as the main

subject line, and then age becomes one of the many covariates instead of an independent risk factor for mortality. Age should not be a limiting factor when determining optimal vascular access.

Conflict of Interest: None.

Author's Contribution

AA: Conceived, designed, did data collection, statistical analysis, and manuscript writing, AM: Final editing, and approval, AS: did data collection and assortment, UJ: Did data collection and data analysis, SN: Did data collection and final editing, BR: Final editing.

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