

The Effect of Arteriovenous Fistula Aneurysm Morphology on Patient Satisfaction and Quality of Life: A Cross-Sectional Study

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ABSTRACT

Background

Arteriovenous fistulae are a lifeline for patients on hemodialysis, but they are prone to complications, thus have a tendency to compromise patients' quality of life.

Objective

This study was done to determine the frequencies of different types of arteriovenous fistula aneurysms and to study their association with patient satisfaction and quality of life.

Methods

Patients reporting to dialysis unit for routine hemodialysis sessions were selected by convenience sampling. Inclusion criteria included age greater than 18 years, arteriovenous fistulas in use for more than 3 months. Unwilling patients were excluded. A detailed inspection of fistula vein was done to classify aneurysms, as per Valentini classification. The Vascular Access and 12-Item Short Form Survey questionnaires were administered in face-to-face interviews to assess satisfaction and quality of life.

Results

There were 101 patients aged 51.00 ± 16.31 years. Median duration of arteriovenous fistula was 24 (8-45) months. Median Vascular Access Questionnaire score was 8 (5-13). Mean Short Form Survey score was 31.41 ± 2.90 . Among the patients with aneurysms ($n=45$), Type 1B fistulae were seen in 26 (57.78%), Type 2A in 7 (15.56%), Type 2B in 8 (17.78%), and Type 3 in 4 (8.89%) patients. There was no correlation between Vascular Access Questionnaire scores and 12-Item Short Form Survey

Score (Spearman's $r=-0.158$; $p=0.300$). There was no difference in Vascular Access Questionnaire scores and 12-Item Short Form Survey scores among groups of patients with different types of arteriovenous fistulas ($p=0.970$ and 0.381 , respectively).

Conclusions

There was no relationship between fistula aneurysms and satisfaction or quality of life.

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INTRODUCTION

Chronic kidney disease (CKD), especially end-stage renal disease (ESRD), has caused distress in millions of lives, and the global burden of this non-communicable, highly morbid, and mortality-affected ailment is ever-growing. It is estimated that the number of people receiving renal replacement therapy will increase to 5.4 million globally from the current 2.5 million by 2030 [1]. Renal replacement therapy (RRT), in the form of hemodialysis (HD) and peritoneal dialysis, has significantly increased survival rates and improved the health-related quality of life (HRQOL) as well as life expectancy. Patients on HD are known to have a lower HRQOL and face several health risks [2]. Vascular access is often described as the lifeline of patients undergoing maintenance HD, as it determines not only the technical success of HD but also impacts long-term health outcomes. HD is the most common modality for RRT used in up to 69% cases [3]. It requires vascular access such as arteriovenous fistulas (AVF), artificial vascular grafts (AVG), and central venous catheters (CVC), including double-lumen and tunneled double-lumen catheters, as a lifeline. Each vascular access method has its pros and cons, but clinician-centered guidelines have advocated the Fistula First initiative [4]. However, recent research is more focused on

patient-reported outcomes and experiences, highlighting patients' needs and preferences - what they want for themselves [5]. These researchers have highlighted the preferred mode of vascular access by patients on maintenance RRT. Many would prefer AVF, but some would prefer AVG or central venous catheters due to recurrent AVF-associated complications, and vice versa.

A systematic review of 11 studies found that AVFs are the most preferred type of vascular access with the highest patient satisfaction scores [6]. Still, they also cause physical discomfort that is outweighed by social acceptance. Most other patient-centered studies have also found better HRQOL and social functioning, lower hospitalization rates, and better survival rates among AVF users [7]. It has been established that vascular access has a significant role in determining the course of quality of life, social functioning, mental health, treatment compliance, and outcomes [8].

Robust data on the technical performance and clinical outcomes of AVF are abundant. However, patients lived experiences remain critically underexplored. This study was therefore planned to evaluate the effect of AVF aneurysms on patient satisfaction and the quality of life. The results of this study would



help prioritize patients requiring early intervention to salvage structurally abnormal AVF or those requiring counselling/psychological support.

METHODS

This cross-sectional study was conducted from January to September 2025 at the Department of Nephrology at Combined Military Hospital, Lahore, Punjab, Pakistan. The Ethical Review Board approved it vide certificate no 738/2025. All procedures complied with the Declaration of Helsinki and local regulations for human research. Written informed consent was taken from all patients.

Sample Size

The sample size of 59 participants was calculated using an online sample size calculator, assuming a Type I error (α) of 0.05, a Type II error (β) of 0.20 (power = 80%), and an anticipated correlation coefficient (r) of 0.358 between patient satisfaction and vascular access-related problems, as reported by Sikora *et al* [9]. Although the minimum calculated sample size was 59 participants, all eligible patients presenting during the study period were consecutively recruited, resulting in a final sample of 101 participants. The patients were selected using convenience sampling, and informed consent was obtained from all participants.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were as follows. Adult patients (≥ 18 years), undergoing maintenance HD for at least 3 months for ESRD. Both incident and prevalent HD patients were considered, provided they had an AVF. Patients under peritoneal dialysis, as well as individuals with psychiatric disorders, advanced dementia, or active severe illness at the time of recruitment, were omitted. Those unable to understand the questionnaire or who declined participation were also excluded. Moreover, patients without information regarding their initial vascular access were omitted.

Data Collection

The enrolled patients were interviewed for basic demographic details and clinical parameters like age, gender, comorbid conditions, duration of dialysis, marital status, cause of CKD, duration of fistula, and arm used for fistula creation. It was followed by a detailed physical examination of the fistula site, fistula aneurysm type (if any), and anastomosed vessel types. Aneurysmal dilatation was defined as a localized abnormal enlargement of the arteriovenous fistula vein exceeding the expected diameter of the adjacent normal fistula segment, identified clinically by inspection and palpation. Morphological classification was performed by experienced clinicians according to the Valentini



classification based on aneurysm size, extent, and associated skin changes. The fistula aneurysms were classified using the Valentini classification that divides them into six types: dilated along the length of the vein (type 1a); post-anastomotic aneurysm (type 1b); classic "camel hump" (type 2a); combination of type 2a and 1b (type 2b); complex (type 3); and pseudoaneurysm (type 4). The Short-Form Vascular Access Questionnaire (SF-VAQ) and 12-Item Short-Form Health Survey (SF-12®) were administered by two questionnaire-trained researchers. Both questionnaires have been validated in patients with ESRD and CKD.(1, 2) These assess physical functioning, social functioning, and satisfaction with access. To maintain uniformity in results, the researchers interviewed patients using questionnaires and completed them accordingly. The SF-12® was scored from 0 to 100, with scores above 50 indicating better-than-average health and scores below 50 indicating below-average health. The SF-VAQ is rated on a Likert scale from 1 to 7, where 1 indicates the highest possible satisfaction and 7 indicates extreme dissatisfaction.

Statistical Analysis

Data were collected in an Excel sheet and subsequently analyzed using the Statistical Package for Social Sciences version 25. The normality of the data was assessed using the Shapiro–Wilk test. Numerical variables were

expressed as mean $\pm$ standard deviation (SD) for normally distributed data, or as median (interquartile range, IQR) for non-normally distributed data, based on the results of the Shapiro–Wilk test. Quality of life (SF-12 scores) was compared across fistula types (Valentini classification) using a one-way Analysis of Variance (ANOVA) test. SF-VAQ scores were also compared across different fistula types using the Independent-samples Mann-Whitney U test. Finally, the relationship between SF-VAQ scores and SF-12 was assessed using Spearman's correlation.

RESULTS

This study included 101 patients, of whom 78 (77.23%) were male. The mean age was 51.00 ± 16.31 years. The brachiocephalic fistula was the most common anastomotic type and was present in 61 (60.40%) patients, followed by radiocephalic fistula in 26 (25.74%) and brachio basilic fistula in 14 (13.86%) patients. The median hemodialysis vintage was 24 months (IQR, 12–57 months), while the median duration of arteriovenous fistula (AVF) use as vascular access was 24 months (IQR, 8–45 months). Other demographic and clinical characteristics are presented in Table 1.



Table 1. Clinical and demographic characteristics of the study population

Characteristic	Value
Age, years	51.00 ± 16.31
Sex, n (%)	
Male	78 (77.23)
Female	23 (22.77)
Marital status, n (%)	
Married	96 (95.05)
Single	5 (4.95)
Diabetes mellitus, n (%)	
Yes	26 (25.74)
No	75 (74.26)
Cause of end-stage renal disease, n (%)	
Diabetic nephropathy	59 (58.42)
Hypertension	26 (25.74)
Glomerulonephritis	9 (8.91)
Autosomal dominant polycystic kidney disease	4 (3.96)
Other causes	3 (2.97)
AVF location, n (%)	
Brachiocephalic	61 (60.40)
Radiocephalic	26 (25.74)
Brachiobasilic	14 (13.86)
Arm used, n (%)	
Non-dominant	82 (81.19)
Dominant	19 (18.81)
Median hemodialysis vintage, months	24 (12–57)
Median duration of AVF use, months	24 (8–45)
Valentini type, n (%)	
Type 1A	—
Type 1B	26 (57.78)
Type 2A	7 (15.56)
Type 2B	8 (17.78)

Type 3	4 (8.89)
SF-12 score, mean	31.41 ± 2.90
VAQ score, median	8.00 (5.00–13.00)

Values are presented as mean ± standard deviation, median (interquartile range), or frequency (percentage), as appropriate. Percentages may not total 100% because of rounding.

Abbreviations: ADPKD, autosomal dominant polycystic kidney disease; AVF, arteriovenous fistula; ESRD, end-stage renal disease; SF-12, 12-Item Short Form Health Survey; VAQ, Vascular Access Questionnaire.

Aneurysms were observed in 45 (44.55%) patients. Although the Valentini classification comprised six aneurysm types, no patient in the present study was classified as Type 1A or Type IV (pseudoaneurysm). Therefore, only the aneurysm categories observed in the study population are presented. The distribution of aneurysms according to the Valentini classification is shown in Figure 1.

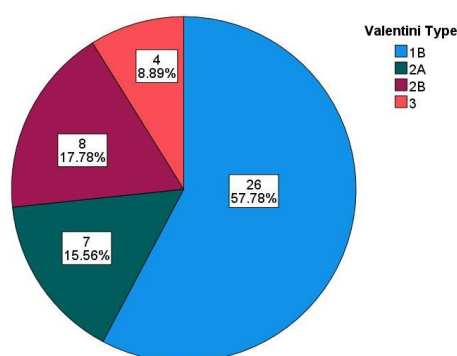


Figure 1. Types of AVF according to Valentini's classification

Subgroup Analysis as per Valentini classification

SF-12 scores were not different among patients with or without AVF aneurysms (31.27±3.09 vs 31.52±2.76; $p=0.671$). Similarly, there was no difference in median VAQ score among patients with or without AVF aneurysms ($p=0.970$). The mean SF-12 scores were equal across different types of AVF aneurysms ($p=0.381$), as shown in Figure 2.

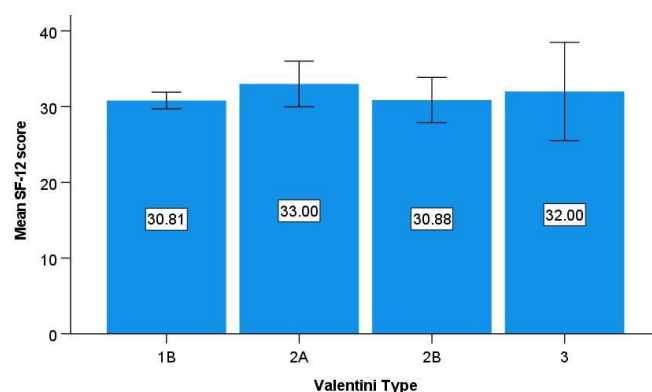


Figure 2. SF-12 scores across different fistula types

The median VAQ scores were equal across different types of AVF aneurysms ($p=0.806$), as shown in Figure 3. SF-12 scores did not correlate with VAQ scores (Spearman's $r=-0.158$; $p=0.300$), as shown in Figure 4.

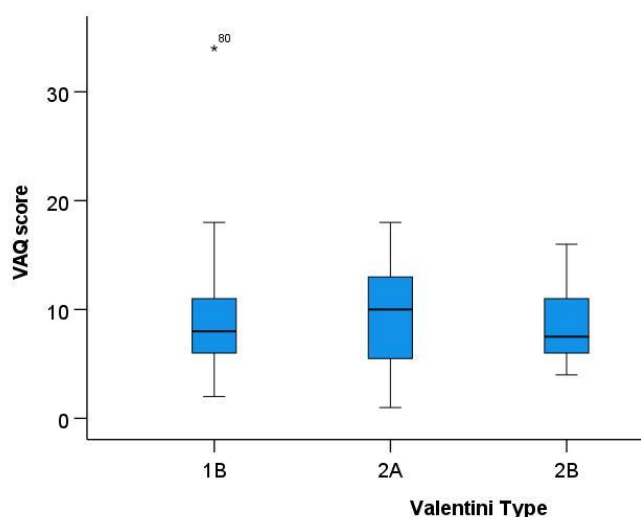


Figure 3. VAQ scores across different AVF types

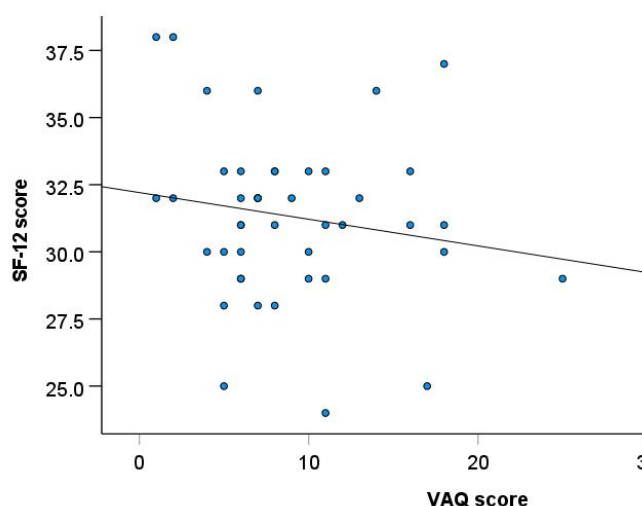


Figure 4. Correlation between VAQ and SF-12 scores

DISCUSSION

We conducted a study to shed light on patients' feedback and opinions regarding vascular access decision-making. Our study investigated patient satisfaction and functioning in relation to fistula aneurysm morphology, using pre-approved, pre-validated questionnaires. We found that regardless of the aneurysm morphology, patient satisfaction or

dissatisfaction was the same, as evidenced by the SF-12 and VAQ.

In comparison with other literature, a 2024 UK study also assessed patient-reported satisfaction using the VAQ across different aneurysm morphologies [10]. Similar to our findings, the study reported no significant difference in overall VAQ score by aneurysm status or morphology ($p=0.816$ and $p=0.277$), reinforcing the notion that aneurysm type alone does not substantially influence patient satisfaction. However, patients with AVF aneurysm expressed significant concern regarding the appearance of the fistula ($p<0.001$), an aspect not captured in our study. Another study by Rusyno *et al.* supports our findings that, once the AVF is successfully established, the morphological variation of the aneurysm appears secondary to the physical and emotional impact of its creation [11]. This emphasizes the need for clinical practice to prioritize techniques and interventions that minimize the need for reoperation to preserve long-term quality of life.

In contrast to our findings, a study conducted by Field *et al.* evaluated patient-reported experiences with endovascular versus surgically created AVFs [12]. Patients frequently commented on the appearance of the fistula, particularly regarding comfort and confidence, even when functional outcomes were comparable, highlighting the importance of appearance in some dimensions of vascular access. Similarly, Chen *et al.* demonstrated



that, despite anatomical differences not immediately leading to changes in patient-perceived experiences, the functional consequences experienced by patients, i.e., difficult cannulation, prolonged bleeding, or thrombosis, may alter patient-reported outcomes [13]. This was further corroborated by Płoński *et al.*, who argue that it is not morphology alone but the development of symptoms or the risk of rupture that prompts dissatisfaction or concern [14].

While keeping the above studies in mind, it can be safely assumed that patients' aesthetic concerns may only emerge when specifically assessed. Also, incorporating objective assessments of aneurysm morphology, as done by Chen *et al.*, may provide a more comprehensive understanding of how these changes affect patient satisfaction [13]. This can be integrated with appearance-specific patient-reported outcome measures (PROMs) to more accurately capture the point at which morphological changes begin to affect patient experience.

Similarities in SF-12 score showed that HRQOL is determined mainly by the overall burden of ESRD rather than anatomical characteristics of the fistula due to the profound burden of physical and emotional limitations, comorbid conditions, and treatment dependency. This was also highlighted in a previously conducted study at this hospital [15]. Similarly, similarities in the VAQ scores indicated that patient satisfaction is more

affected by ease of procedures, reliability, and prior complications. Such factors tend to overshadow the fistula's morphology and cosmetic effects in patients' eyes, as the fistula is perceived as a lifeline rather than a cosmetic feature [16]. Even concern regarding the cosmetic appearance of the fistula is related to functional means and ease of procedures, i.e., the morphology does not necessarily translate into satisfaction unless accompanied by symptoms or functional decline.

There was no relationship between VAQ scores and the quality of life. This indicates that multiple factors contribute to quality of life, in addition to AVF morphology. These could be clinical, socioeconomic, psychological, or treatment related. A previous study from Pakistan found that older age and lower levels of education best predicted poorer quality of life in these patients [17]. Because AVF morphological changes develop gradually, patients may adapt to them without a meaningful impact on quality of life.

From a clinical perspective, morphology alone is not a reliable indicator of patient dissatisfaction. Functional performance should be the primary determinant of patient-reported experience [18]. Clinicians, therefore, should focus on maintaining access function, early detection of high-risk aneurysms, and preventing complications rather than solely relying on visual assessment to gauge patient comfort [19]. Furthermore, existing PROMs may not capture cosmetic and psychosocial



concerns; there remains a need for appearance-specific assessment tools. As mentioned before, incorporating morphological changes related to patient experience and concerns, along with functional performance, into routine care may result in more holistic, patient-centered decision-making.

This study focuses on the relationship between arteriovenous fistula morphology and patient outcomes, an underexplored area in the regional literature. Through the use of Valentini classification and direct clinical examination, we were able to characterize aneurysmal patterns instead of relying on patient self-report or chart review, thus reducing recall bias and response-shift bias. The use of pre-validated questionnaires, such as VAQ and SF-12, further strengthens the reliability of the findings. In addition, these questionnaires were administered by trained researchers, reducing response bias and ensuring standardization across participants.

Despite the negative results of this study, it is essential to monitor patients with AVF, especially those with aneurysms, for progression. Such patients are predisposed to complications such as rupture and may need vascular surgery intervention [20].

Several limitations demand consideration. This was a single-center study that used convenience sampling, which limits its generalizability to broader populations. Using a cross-sectional rather than a cohort design prevents assessing patient satisfaction as the aneurysm

morphology evolves. The distribution of aneurysm subtypes was also uneven, with type 1B being most prevalent at 57.78%, despite an adequate sample size, thereby reducing statistical power for subgroup comparisons. Morphology was assessed solely by clinical examination, and no ultrasound measurements were used to assess size, flow, or wall integrity, potentially leading to underestimation of disease severity. The VAQ does not assess cosmetic or appearance-related concerns addressed in previous studies and has also been shown to influence patient perception, albeit in a function-related manner [10]. Also, the SF-12 is only related to general measures of quality of life, rather than dialysis-specific measures. Finally, cultural perceptions and the in-person interview format may have influenced the extent to which patients disclose their concerns. Future studies should incorporate ultrasound-based assessment of aneurysm severity and appearance-specific PROMs to capture the patient experience better. Longitudinal, multi-center studies with larger samples are needed to determine how aneurysm progression affects satisfaction and quality of life, and to guide patient-centered clinical decision-making.

CONCLUSION

Aneurysm morphology in arteriovenous fistulas did not significantly influence patient satisfaction or quality of life in this cohort. These findings suggest that functional performance outweighs anatomical variation in



shaping patient experience. Integrating clinical assessment with patient-reported concerns may enhance individualized vascular access care and improve long-term outcomes.

DECLARATIONS

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Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this study.

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All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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