

Experience of Physical Examination as a Primary Tool for Surgical Access Planning in Hemodialysis Patients

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Abstract: Background: Understanding the importance of pre-operative assessment is something nephrologists are probing for years to avoid any post-operative complication and AVF failure.

Objective: To assess the physical examination as primary tool as compared to Ultrasound Doppler in assessment of AVF planning in hemodialysis patients.

Materials and Methods: This was a Retrospective, Cross-sectional study. Secondary data was collected from the Urology Department of Liaquat University of Medical and health sciences, Jamshoro starting from October 2021 to October 2022. For physical examination, both the arterial and venous circulation were evaluated. Arterial patency, pulse amplitude and Allen's test were recorded. After collection of data, statistical Package for Social Science (SPSS) version 17.0 statistical software was used for analysis.

Results: A total of 105 participants with mean age of 42.9 ± 13.9 years, 78 (74.3%) males and 27 (25.7%) females were included. The physical examination findings indicated facial swelling as the most frequently reported sign in with 59 (56.2%) of patients, followed by generalized body edema reported in 22 (21%) of participants. The estimated analysis of Allen's test indicated good results with a mean of 12.4 ± 2.8 seconds in all patients, indicating good blood flow of the ulnar artery. The mean duration of hemodialysis was 55.2 ± 23.4 days before AVF, while central venous line duration was 57.2 ± 20.5 days. After 6 days fistula maturation was assessed, while mean fistula maturation duration was 44 ± 7.1 days.

Conclusion: To monitor functioning, the Physical Examination of vascular access is convenient, straightforward, and cost-effective. Physical examination (PE) has been validated with diagnostic techniques for detecting stenosis.

Keywords: CKD, AVF, Physical examination, Hemodialysis, End stage renal disease, Diagnostic, Fistula maturation.

INTRODUCTION

Chronic kidney disease is a global issue, with a growing number of patients requiring renal replacement therapy. Although there are numerous choices for renal replacement therapy, including hemodialysis, peritoneal dialysis, kidney transplantation, and conservative management [1].

Hemodialysis is still the most common type of dialysis treatment. Many advances in hemodialysis treatment have been made, however good vascular access remains the fundamental constraint for optimal treatment. An arteriovenous fistula (AVF) is the most common and advantageous entrance to the bloodstream for patients who require hemodialysis [2]. Throughout the year, this phase is often repeated three times per week. Cannulation technique is therefore critical to providing optimal AVF care. Cannulation may have an impact on both the AVF outcome and the patient's experience, therefore the procedure must be carefully monitored [3].

When compared to prosthetic Arteriovenous Grafts (AVGs) or central venous catheters, Autogenous Arteriovenous Fistulas (AVFs) are the preferred vascular access for chronic hemodialysis due to superior results, a lower complication rate once matured, and lower expenses [4,5]. Nevertheless, due to maturation failure and stenotic problems, their main failure rates have been reported to range between 10% and 50%. Many pre-operative variables, most notably artery and vein sizes, have been proven to predict the probability of primary AVF failure [6].

Primary AVF failure is related to comorbidities such as diabetes, and systemic Atherosclerotic disease [7]. Duplex ultrasound vascular mapping to assess anatomical suitability before vascular access creation is recommended as part of preoperative planning for the accurate measurement of vessel diameter, but it is operative dependent. Duplex ultrasonography is used in both preoperative planning and postoperative evaluation of AVFs [8], it is unclear if routine use of preoperative duplex ultrasound will enhance AVF outcomes. The skilled vascular territory would reduce the unnecessary perception of Doppler ultrasound & ultimately it reduces the cost to the patient as well.

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Earlier research mostly contrasted rope ladder and buttonhole cannulation techniques utilizing blunt needles to characterize excellent cannulation techniques [9]. The results are mixed, and the best technique has yet to be determined. One reason for the disparity in outcomes is that the studies employed various procedures and did not completely disclose all of the preconditions used to allow cannulation [10,11]. Hygiene is an important helping component in the cannulation procedure. AVF infections are reduced when nurses are taught proper cannulation hygiene techniques.

AV fistula approach may not be suitable for all elderly patients. Some guidelines recommend that a more conservative approach such as CVP placement may be used according to comorbid conditions and life expectancy [12]. Many studies support an arteriovenous graft as a line strategy in the very elderly population especially those with an uncertain prognosis of survival, poor vasculature, or variable rate of progression to ESKD [13].

In Pakistan, the prevalence of chronic renal failure is alarmingly high and the requirement of AVF or DL (Double Lumen Catheter) is a necessity for kidney failure patients. Understanding the pre-operative assessment's importance is something nephrologists are probing for years to avoid any post-operative complications and AVF failure. This study assessed the physical examination as a primary tool as compared to Ultrasound Doppler in the assessment of AVF planning in hemodialysis patients.

MATERIALS AND METHODS

This is a Retrospective, Cross-sectional study. Secondary data was collected from the Urology Department of Liaquat University of Medical and health sciences, Jamshoro starting from October 2021 till October 2022. A purposive, non-probability sampling method was used, all chronic kidney disease stage 5 patients either candidate for renal transplantation or taking hemodialysis as a primary treatment modality under 80 years of age were included in the study. Patients with failed AVF, Uncontrollable Diabetes Mellitus, Hypertension (identified according to WHO definition with DM ≥ 180 ml/dL and HTN of ≥ 140 mmHg systolic and ≥ 90 mmHg diastolic blood pressure), any known physical disability and a history of any recent physical trauma were excluded.

The data was collected starting from demographic details of gender, age, comorbidities, candidate of transplantation and duration of hemodialysis were recorded while the second part of the questionnaire was used to assess the physical and clinical examination details including presenting examination results. The last part of the questionnaire reported fistula maturation duration and post-operative complications.

For physical examination, both the arterial and venous circulation were evaluated. Arterial patency, pulse amplitude and Allen's test were recorded. Blood pressure in both arms was also evaluated. Only 5 out of 105 patients had pre-procedure ultrasound Doppler for AVF assessment.

Allen's test was performed with the standardized method, PI asked the patient to make a tight fist and pressed the ulnar artery and radial artery to block blood flow to the hand causing hyperemia. After wards, the PI asked the patient to open the fist and counted the seconds of color returning to the hand palm. Cut-off duration of 6 seconds and 5 seconds indicated 54.4% and 81.7% of specificity respectively, while the diagnostic accuracy of 6 seconds and 5 seconds were estimated as 78.5% and 79.6% respectively. The predictive value was obtained as 0.8% for negative results and 53% for positive results.

STATISTICAL ANALYSIS

After the collection of data, it was analyzed using Statistical Package for Social Science (SPSS) version 17.0 statistical software. Mean & standard deviation will be calculated for age, duration of the central venous line, duration of hemodialysis, post-operative fistula maturation duration and maturation evaluation period. The normality of data was checked with the help of the Shapiro-Wilk test. Frequency and percentage will be calculated for quantitative variables such as AVF site, DL site, Comorbidities and physical examination results. Effect modifiers like duration of pre-operative or post-operative complications were controlled through stratification and post-stratification, and a chi-square test was applied to keep a P-value < 0.05 as significance.

RESULTS

A total 105 patients were included in the study retrospectively from 21-10-2021 TO 21-10-2022. The data was collected from the Urology Department of Liaquat University of Medical and Health Sciences, Jamshoro. Only adult patients were included and the estimated mean age was 42.9 ± 13.9 years with a range of 28 – 71 years. Gender distribution described male population dominance with 78 (74.3%) and females with 27 (25.7%) frequency. In our study population 75 (71.4%) were candidates for prospective renal graft recipient.

The physical examination findings indicated facial swelling as the most frequently reported sign in 59 (56.2%) of patients, followed by generalized body edema reported in 22 (21%) of patients. Edema over the face and body, Genital body edema, edema all over the body and swelling and edema on the face were reported in 4 (3.8%), 4 (3.8%), 4 (3.8%) and 5 (4.8%) respectively (Fig. 1).

The estimated analysis of Allen's test indicated good results with the mean of 12.4 ± 2.8 seconds in all patients, indicating good blood flow of the ulnar vein. The frequency was also estimated and reported as maximum frequency in 11 to 13 seconds with 52 (50%) patients, followed by the 08 to 10 seconds category reported in 20 (19%) of patients. The maximum duration of 15 seconds was reported in 7 (7%) of patients (Fig. 2).

Physical Examination Findings

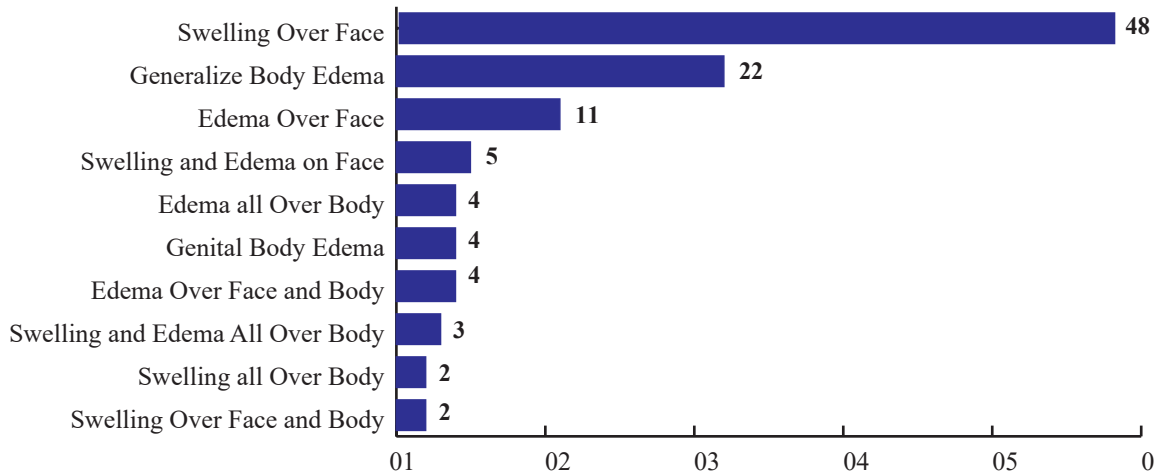


Fig. (1). Details of Physical Examination Findings in Study Subjects.

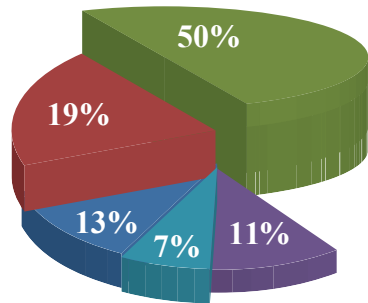


Fig. (2). Estimation of Allen's Test Results in Study Patients.

Analysis of Arterio-venous fistula and DL catheterization including sites and history of any previous relevant details is reported in Table 1, maximum subjects had AVF on Left radio cephalic with 79 (75.2%) while only 26 (24.8%) had left brachio cephalic fistula. The 05 patients who underwent ultrasound Doppler were compared with the rest of the study population and reported no significant difference between Intra-operative or post-operative

findings of vessel assessed on clinical examination. There was also no difference in complication post-operatively. The maturation time was also the same.

DL catheter site was measured as 68 (64.8%) with the Right internal Jugular vein, 33 (31.4%) in right femoral while only 4(3.8%) has Nil Femoral. 20 (19%) patients had previous AVF surgery, however, the p-value was insignificant in all comparisons (Table 1).

The most frequently reported comorbidity is Diabetes mellitus and IHD, in 16 (15.2%) followed by DM in 4 (3.8%) as comorbidity. The mean duration of hemodialysis was 55.2 ± 23.4 days before AVF, while central venous line duration was 57.2 ± 20.5 days, after 6 days fistula maturation was assessed, while mean fistula maturation duration was 44 ± 7.1 days.

DISCUSSION

The most common cause of AVF failure is thrombosis secondary to low blood pressure. Another cause is stenosis. AVF stenosis has a complex pathogenic mechanism. Some of the underlying conditions that predispose to the formation of venous neo-intimal hyperplasia and constriction are potential surgical injury

Table 1. Details of AVF and DL site.

Variables		Frequency	Percentage	P-Value
AVF site	Left radio cephalic	79	75.2	0.24
	Left brachio cephalic	26	24.8	
DL catheter site	Nil femoral	4	3.8	0.18
	Right Internal Jugular Vein	68	64.8	
	Right Femoral	33	31.4	
Prev. AVF	Yes	20	19	0.21
	No	85	81	

and recurrent traumatic cannulation leading to defective vascular remodeling and high blood flow inducing endothelial cell dysfunction and shear stress [14]. These well-documented lesions can cause VA stenosis and a consequent decrease in AVF flow rate, both of which can lead to thrombosis late. New promising techniques for preventing neo-intimal hyperplasia and increasing AVF lifetime are being developed [15]. Long-term patency of working vascular access is critical for quality of life and lifespan in hemodialysis patients with chronic kidney disease. The AVF is the recommended hemodialysis access. Yet, AVF failure is becoming increasingly common as patients' ages increase and more individuals develop diabetes or vascular disease [16]. It is generally known that AVFs as hemodialysis access are less common in older patients, female patients, and those with obesity, diabetes mellitus, or cardiovascular disease [17]. AVF failure has been linked to the use of better vessels for surgery, and the Kidney Disease Outcomes Quality Initiative guidelines recommended routine use of ultrasonography for mapping in all AVF patients, despite the lack of level I evidence to support this recommendation [18, 19].

The physical examination normally provides more information about the vein than the artery, but duplex ultrasonography provides slightly more information about the artery than the vein. In a significant proportion of patients, physical examination alone is insufficient, and ultrasound information affects the therapeutic approach in a significant number of individuals who could undergo an AVF rather than an AVG. Physical examination was used to establish appropriateness for AVF formation in the current study [20]. Additional duplex ultrasound was performed to increase vascular assessment used for AVF creation and reduce unnecessary exploration; we discovered that physical examination alone was sufficient in more than 90% of these patients and that duplex ultrasound made a significant contribution in difficult patients like in morbid obese [21]. Primary fistula failure is a distinct problem that plagues autogenously access. Physical examination and/or duplex to detect impending access failure is an essential element of arteriovenous fistula evaluation. It should consider a variety of observations such as the type of fistula, anatomical location, thrill strength, bruit audibility, pulsatility, presence of venous tributaries, adequacy of dominant outflow vein dilation (with and without hand exercises and elevation of the arm above the heart), superficiality, the length of the dilated outflow vein, bilateral hand temperature comparison, discoloration (especially rubor), skin lesions, capillary refill, the pulse that also assessed easily on physical examination [22-24].

Although the presence of an abnormality on physical examination is highly specific for an abnormal duplex (98% specificity), it lacks sensitivity to identify possibly correctable conditions [25, 26].

STRENGTH OF THE STUDY

Primary AVF formation was performed on all patients in which the decision had been made on vascular clinical examination in 90% of cases. A direct side-by-side comparison of physical

exams and AVF success was performed four weeks after the initial formation.

CONCLUSION

To monitor functioning, the PE of vascular access is convenient, straightforward, and cost-effective. Physical examination (PE) has been validated with diagnostic techniques for detecting stenosis. The effect of frequent PE on thrombosis prevention and AVF patency is unknown. While as compared to CDU, PE skills can be taught to physicians and nurses who care for HD patients more efficiently and early. This skill could potentially be taught to patients with the expectation that they will be able to detect early AVF malfunction. CDU needs trained staff and specific skill sets with excessive financial burdens. Finally, physical examination helped to reduce primary failure, resulting in much higher primary patency of AVFs and no increase in ultimate cost. This justifies its widespread preoperative usage, preventing suffering and difficulties associated with AVF failures in dialysis patients who already have severe pathology affecting their quality of life and survival. It is only indicated in very few cases. Additional research may aid in resolving these issues.

AUTHORS' CONTRIBUTION

- **Waqar Ahmed Memon:** Objective, Surgery.
- **Javed Altaf Jat:** Supervision, Final approval.
- **Pooran Mal:** ESRD patient assessment, Data collection.
- **Adeel Hyder Arain:** Data collection, Data entry.
- **Taimoor Ahmed Jatoi:** Data analysis, Consent requirements.
- **Ahsan Ali Arain:** Confidentiality, Results interpretation, Write-up.
- **Ansar Ahmed:** Write-up assistance.

CONFLICT OF INTEREST

Declared none.

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