

Vascular Preoperative Venous Mapping Decreases the Frequency of Negative Exploration in Arteriovenous Fistula Creation

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ABSTRACT

Objective: To assess the impact of preoperative venous mapping on the incidence of negative exploration for arteriovenous fistula (AVF) in patients requiring hemodialysis.

Patients and Methods: This case control study was conducted in Department of Vascular Surgery Combined Military Hospital Lahore and Peshawar, from January 2016 to June 2016. A total of 200 consecutive patients fulfilling the inclusion criteria were divided into Case (with preoperative mapping) and Control (without mapping) groups. Negative exploration rate along with fistula maturation rates were recorded and compared.

Results: In Control group 24% patients had negative exploration when compared with 0% in Case group (p-value 0.000). In Case group, 16 % patients had change in type and site of AVF based on the results of venous mapping hence bringing down the negative exploration rate to zero in this group.

Conclusion: Routine preoperative venous mapping decreases negative exploration in AVF creation and is helpful in deciding the best site and type of AVF.

Keywords: Arteriovenous, Exploration, fistula, Imaging, Venous mapping

Author's Contribution

¹ Conception, synthesis, planning of research and manuscript writing

² Interpretation and discussion

³ Data analysis, interpretation and manuscript writing, ^{4,5} Active participation in data collection

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Introduction

The population of patients with renal disease is progressively increasing worldwide and hemodialysis (HD) being patient's 'lifeline' is one of the important developments for management of patients with ESRD.¹ It has been found that of the 3 types of hemodialysis vascular access, arteriovenous fistulae (AVF) are the preferred access for HD. They have higher patency rates, lower infection rates and lower overall costs.¹⁻³ However, with continuously increasing the number of patients on HD, complications following this procedure have been

increasing as major causes of morbidity with subsequent hospitalization and increased the cost to HD patients. This repeated venous access causes superficial thrombophlebitis and segmental venous occlusion or stenosis when it is re-canalized.⁴ Moreover, frequent phlebotomies and a high prevalence of comorbid conditions including diabetes, obesity, and vascular disease in this high-risk population may negatively affect the vasculature and contribute to early AVF dysfunction. Creating an AVF in such patients may result in negative

exploration when no suitable vein is found. AVF failures have also been attributed to inadequate vessels used for surgery. Consequently, the selection of suitable vessels by preoperative vascular mapping is recommended before AVF creation for both pre-dialysis CKD and ESRD patients on hemodialysis and measures to improve the durability of VA are needed.

Preoperative evaluation with Doppler ultrasonography (USG) is an excellent choice and may facilitate selection of suitable vessels and reduces AVF failures. Preoperative venous mapping not only provides a road map of upper limb superficial veins but also tells us about their diameters and patency which are very important in preventing perioperative and postoperative AVF complications.^{4,5} We conducted this study to check whether the preoperative venous mapping is helpful in reducing the negative exploration rate.

Patients and Methods

All consecutive patients from January 2016 to June 2016, reporting to Vascular Surgery Clinic in Combined Military Hospital Lahore and Peshawar for AVF creation, were included in this study. Patients with uncontrolled diabetes (fasting blood sugar of more than 120mg/dl), uncontrolled hypertension (blood pressure of more than 160/90 mmHg), unwilling to undergo mapping, severe congestive cardiac failure were excluded. After taking informed consent, patients were randomly divided into two groups by simple random draw method generated at the time of enrolment in clinic. Group A (Control) had all patients who had no preoperative venous mapping done and Group B (Case) had all patients who underwent venous mapping. All patients in this group underwent duplex scan to assess the preoperative venous diameter and patency of superficial veins and diameter of brachial and radial artery. Magnetic Resonance Venogram (MRV) was performed only in patients with inadequate duplex findings.

All patients underwent AVF procedure by a Consultant Vascular Surgeon who had a minimum of five years of experience of doing such procedure under local anaesthesia. In control group, based on clinical experience and patient's examination, the operating surgeon made a decision to choose the type and site of AVF creation. In group B, the type and site of AVF was

decided based on the findings of preoperative mapping. All patients were given oral antibiotics and analgesics on discharge. They were also provided with written instructions about hand and forearm exercises and general care of the AVF.

Patients were regularly followed up in clinic at 2 weeks, 4 weeks, 2 months and 3 months. A functionally mature AVF is defined as per Kidney Disease Outcome Quality Initiative (KDOQI) guidelines as one that can be easily cannulated and has at least six successful consecutive dialysis sessions⁶ Negative exploration rate, fistula failure rate and other procedure-related complications were recorded.

The data was analyzed using Statistical Package for Social Sciences (SPSS) version 22. The numerical outcomes e.g. age was calculated as mean and standard deviation. Gender was recorded as frequency and percentage. Chi Square test was applied to assess qualitative variables such as failure of fistula and negative exploration rate. Independent sample t-test was applied to assess quantitative variables like age. The results were considered statistically significant if the p-value was found to be ≤ 0.05 .

Results

A total of 200 consecutive patients fulfilling the inclusion criteria were included in this study. The age range was from 19-55 years with mean age of 31.5 ± 4.5 years. Out of 200 cases, 142 (71 %) were males and 58 (29 %) were females. Male to female ratio was 2.44:1. Patients were divided into two equal groups depending upon whether they had a preoperative mapping done or not. Group A (Control; n=100) had all patients without preoperative mapping and Group B (Case; n=100) with venous mapping. In Group B all patients underwent duplex scan however 18 patients underwent MRV also for full venous assessment. Regarding age, gender, diabetes and hypertension; there was no statistically significant difference between two groups (Table 1).

In Control group, 24% (n=24) patients had negative exploration however in Case group the negative exploration rate was 0% (Table 2). This difference between the two groups is statistically significant. In group B, the average preoperative diameter of the anastomotic vein in group B was 22 ± 4 mm. In this group, we had to

change our initial plan of AVF creation after MRV, and brachio-basilic AVFs were created instead of brachiocephalic in 24% patients. In terms of fistula maturation; in group A, out of 76 patients who had AVF created, only 52 got matured, hence maturation rate was 68.4%. While in group B, 21 AVFs failed to mature hence the maturation rate was 79%. The difference in terms of maturation rate was again statistically significant.

fail due to thrombosis or can result in rapid swelling of the upper limb due to proximal outflow obstruction. Preoperative Doppler scan and MRV as routine or on selective basis has decreased negative exploration and fistula failure rate.¹⁷ However, there has been systemic reviews, which suggest that preoperative mapping may not have a statistical impact on fistula failure. Wong et al in 2013 concluded that preoperative mapping may help to

Table 1: Comparison of baseline characteristics between Control and Case groups

Variable	Group A (Control) n = 100	Group B (Case) n = 100	p value
Age (Years); Mean±SD	36.1±7.3	34.4±6.9	0.624
Gender			
Male (n)	67	75	0.914
Female (n)	33	25	0.817
Diabetes Mellitus (n)	80	91	0.668
Hypertension (n)	55	60	0.562

Table 2: Comparison of fistula maturation and negative exploration rates between two groups

Outcome Variable	Group A (Control) n = 100	Group B (Case) n = 100	p value
Fistula maturation n (%)	52/76 (68.4)	79/100 (79)	0.003
Negative exploration (n)	24	0	0.000

Discussion

Recent advances in medicine and improvement in general health measures have grossly decreased the morbidity and mortality in ESRD patients on renal replacement therapy as maintenance haemodialysis.⁷⁻⁹ Vascular access is required in these patients for hemodialysis to be done in the form of AVF, Arteriovenous graft (AVG) or insertion of dialysis catheter.^{8,9} The first choice is creating a native AVF and according to KDOQI guideline at least 50% of patients on chronic hemodialysis should have a functionally mature AVF as it provides better long term patency as compared to AVG and dialysis catheter.^{10,11} Studies have suggested that 40-55% of AVFs in Unites States do not mature adequately^{12,13} and in Europe such rate is 7-10%.^{14,15} Many factors has been blamed for this fistula failure including advanced age, female gender, diabetes, hypertension, smaller diameter of vein or artery, obesity, late AVF creation and diseased vessels.^{13,16} Repeated blood sampling and intravenous infusions in ESRD patients cause superficial thrombophlebitis and segmental venous occlusion or stenosis after recanalization which clinically sometimes gives impression of the normal veins. Creating AVF in these patients may

improve the maturation rate but they failed to find a statistically significant impact.¹⁸ Similarly Bashar et al concluded that selective use of preoperative duplex increases the maturation rate of fistula however, routine use was not recommended by them.¹⁹

On the contrary, Dageforde et al concluded that larger vein diameter on preoperative vein mapping are at lower risk for failure of fistula maturation and have increased long-term AVF patency. They noted that one third of their fistulae with a venous diameter of less than 2.7mm failed to mature. Hence, preoperative mapping is helpful in identifying such cases.²⁰ In our series, we also found that the mean venous diameter was 22mm in the group with negative exploration and the maturation rate was 79% which was 10.5% more than the group where no mapping was done. To have a better idea about outline, diameter of superficial veins and patency of deep veins of upper limb; all 100 patients in case group underwent AVF creation after having preoperative Doppler scan as a routine and only 18% (n=18) out of these 100 had preoperative MR venography to further confirm the patency and diameter in patients with equivocal duplex scan findings. Patel et al reported that 32% patients required MR venography in addition to Doppler scan¹⁸.

Use of selective MR venography helped us to change our initial plan for AVF creation and instead of brachiocephalic, brachio-basilic AVF were created.

There was no negative exploration in our series. On the basis of our results and of the other studies, we can say that routine venous mapping of the upper limb in ESRD patients results in marked increase in AVF creation and decrease in the negative exploration for a suitable vein for AVF.

Conclusion

Routine preoperative venous mapping decreases negative exploration in AVF creation and is also helpful in deciding the best site and type of AVF.

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