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ORIGINAL ARTICLE

PATENCY RATE OF BRACHIOCEPHALIC VERSUS RADIOCEPHALIC AVF IN CHRONIC KIDNEY DISEASE PATIENTS IN POPULATION OF D.I.KHAN DIVISION, PAKISTAN

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ABSTRACT

Background: All patients with chronic renal failure need vascular access for hemodialysis that is possible with CVP line but it shorter life. The most suitable and effective vascular access on long term basis is the creation of arteriovenous fistula (AVF). The objective of this study was to compare the patency rate of Brachiocephalic vs. Radiocephalic AVFs in population of D.I.Khan division, Pakistan.

Materials & Methods: This randomized control trail was conducted in Department of Surgery Gomal Medical College, D.I.Khan, Pakistan from January 2017 to December 2019. 266 patients were equally randomly allocated into Brachiocephalic AVF (BCAVF) and Radiocephalic AVF (RCAVF). Sex, age groups and patency of AVF were nominal variables. Data for sample was described by count & percentages and for population as confidence interval at 80% confidence level. McNemar chi-square test was used to test hypothesis to compare patency rate of Brachiocephalic AVF vs. Radiocephalic AVF.

Results: Patency was present in 129 (97%, 80% CI 94.45-98.39%) and absent in four (3%, 80% CI 1.61-5.55%) cases in Brachiocephalic, while it was present in 107 (80.5%, 80% CI 76.04-84.86%) cases and absent in 26 (19.5%, 80% CI 15.52-24.32%) cases in Radiocephalic AVF group. McNemar chi-square test showed p <.0001, so the null hypothesis was rejected, showing higher patency rate in BCAVF.

Conclusion: In our population, Brachiocephalic AVF showed higher patency rate than Radiocephalic AVF. Creation of Brachiocephalic AVF is more ideal in terms of patency and maturation as compared to Radiocephalic AVF because of increased vessel diameter and increased arterial pressure at proximal site below elbow joint.

KEY WORDS: Arteriovenous Fistula; Elderly; Survival; Vessel Diameter; Cannulation; Hemodialysis; Radiocephalic; Brachiocephalic; End Stage Renal Disease; Patency; Vascular Access Type.

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1. INTRODUCTION

1.1 Background: All patients with chronic renal failure need vascular access for hemodialysis that is possible with CVP line but it can be retained for only 02-03 weeks due to infection. The most suitable and effective vascular access on long term basis is the creation of arteriovenous fistula (AVF). AVF is usually created on the non-dominant arm .There are different sites at which it can be created e.g. Radiocephalic in distal forearm and Brachiocephalic or Brachiobasalic in proximal forearm depending upon the availability of suitable vein and arterial pressure. The most preferable site for AV fistula construction is the most distal one on the wrist between radial artery and cephalic vein.[1] Other suitable sites are brachiocephalic AV fistula just below or above the elbow joint.

Brescia, et al.[2] was the first one who introduced autologous vascular access for hemodialysis in 1966. AVF is usually superior to that of arteriovenous grafts (AVGs) and require less frequent interventions to maintain long-term functioning for hemodialysis.[3] The National Kidney Foundation recommends that

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AV Fistula should be created at least six months prior to initiation of hemodialysis treatment so that it gets sufficient time for vein arterialization and maturation. It is therefore recommended that all patients with end stage renal disease should be counseled on AVF creation.[4] Most common AVF complications are infection, failure to maturation, thrombosis and aneurysm formation and distal limb edema. These complications are associated with high morbidity, mortality & put high economic burden.[5,6] AVF failure can be due to failure of venous dilation or thrombosis due to less pressure in the artery and narrowing of stromal diameter.[7] AVF is created by side to side or end to side anastomosis technique between artery and vein. AVF maturation requires gradual increase in the blood flow from artery to vein, this leads to arterialization of the vein to cope with increase blood flow. This increase in pressure is necessary for hemodialysis in the dialysis circuit.[8-10]

Kim, et al.[11] from Torrance, California performed research on a retrospectively collected prospective data during 2 periods, period one was from October 2009 to April 2012 & period 2 was from May 2012 to March 2014. Overall primary patency rate was 54.97% (105) (105*100/191=54.97) for Brachiocephalic (BCAVF), Brachiobasalic, Brachiobrachial & Radiocephalic (RCAVF) AVFs while the patency rate was 62.92% (56) (56*100/89=62.92) for BCAVF & was 45% (27) (27*100/60=45) for RCAVF.

Bae, et al.[12] from Seoul, South Korea for the period between January 2008 and March 2014, found that overall primary patency rate was 74.29% (393) (393*100/529=74.29) in BCAVF, RCAVF & Arteriovenous graft, while the it was 74.40% (125) (125*100/168=74.40) for BCAVF & 68.18% (84) (84*100/264=68.18) for RCAVF.

Miller, et al.[13] from Birmingham, Alabama, USA during two year period from January 1, 1999 to December 31, 2000 created 249 Radiocephalic & Brachiocephalic AVFs & overall primary patency rate was 31.13% (80) (80*100/249=31.13).

Fitzgerald, et al.[14] from California, USA for a period from January 1999 to December 2002 found overall patency rate of 80.23% (69) (69*100/86=80.23) for Brachiocephalic, Brachiobasalic & median antecubital vein AVFs.

Lok, et al.[15] from Toronto, Canada for the period between January 1, 1995 and July 1, 2003 in a large dialysis center found the overall patency rate of 74.09% (118) (118*100/444=74.09) for Radiocephalic, Brachiocephalic, Brachiobasalic & Femoral AVF, while the patency rate was 90.86% (169) (169*100/186=90.86) for BCAVF & 88.31% (204) (204*100/231=88.31) for RCAVF.

Weale, et al.[16] from Bristol, United Kingdom for the period between January 1, 2000 and December 31, 2005 found the overall patency rate of Radio cephalic & Brachiocephalic AVF was 46.35% (305) (305*100/658=46.35), while it was 47.47% (141) (141*100/297) for BCAVF & 45.43% (164) (164*100/361=45.43) for RCAVF.

DT, et al.[17] from Nepal for the period of 24 months from September 2017 to September 2019 found that overall patency for RCAVF & BCAVF was 87.25% (349) (349*100/400=87.25). It was 91.5% (183) (183*100/200=91.5) for BCAVF & 83% (166) (166*100/200=83) for RCAVF.

Mishra, et al.[18] from Berhampur, Odisha, India conducted a longitudinal study from January 2018 to July 2019 & found overall patency of 81.13% (43) (43*100/53) for proximal Radiocephalic AVF and distal Radiocephalic AVF.

1.2 Research problem (RP), Knowledge Gap (KG) & Research Question (RQ): Unawareness about the patency rate comparison between Brachiocephalic AVF & Radiocephalic AVF in population of D.I.Khan division, Pakistan was our research problem. Unavailability of data regarding this problem was our knowledge gap. What is the difference in patency rate between Brachiocephalic AVF & Radiocephalic AVF was our research question.

1.3 Research Objective: The objective of this study was to compare the patency rate of Brachiocephalic vs. Radiocephalic AVFs in population of D.I.Khan division, Pakistan.

1.4 Research Null Hypotheses: There is statistically no significant difference in patency rate of Brachiocephalic vs. Radiocephalic AVFs in population of D.I.Khan division, Pakistan.

1.5 Significance: This study will provide us an important data about the patency rates of Brachiocephalic vs. Radiocephalic AVFs. It will guide & help surgeons about the type of AVF that has a higher patency rate & is more effective for AVF maturation.

2. MATERIAL AND METHODS

2.1 Design, Setting & Duration: This randomized control trail was conducted in the Department of Surgery, Gomal Medical College, D.I.Khan, Pakistan from January 2017 to December 2019. The data was collected from its affiliated DHQ Teaching Hospital. Approval for the project was taken from Institutional Ethical Committee & informed consent was taken from patients/ attendants.

2.2 Sampling & Randomization: All patients with chronic renal failure requiring haemodialysis through AVF formation were included in the study. Patients having thrombosis of cephalic veins, having uremic symptoms or negative Allens's test were excluded from the study. Two hundred and sixty six (266) patients were equally randomly allocated by toss method into two groups, one for Brachiocephalic AVF (BCAVF) & second for Radiocephalic AVF (RCAVF).

2.3 Procedure, Intervention & Follow up: Vascular assessment was done by Allen's test. Veins were assessed manually for diameter, venous filling & distensibility and in case of any doubt; clinical evaluation was further reinforced by Doppler studies to see for vascular patency.

The Radiocephalic AVFs were formed by using radial artery & cephalic vein side to side anastomosis in non-dominant hand. When Radiocephalic AVFs were not suitable for formation because of small venous size or previous failure in maturation of Radiocephalic AVFs, then Brachiocephalic AVFs were created using side to side anastomosis between brachial artery & cephalic vein. Postoperative patients were kept on low dose heparin for five days, antibiotics and analgesics. All patients were educated about proper post op care of AVF. First follow up was on two weeks of AVF formation at nephrology unit to check for the patency & maturation of AVF. Fistula cannulation was done by the experienced technician in dialysis unit to check for the patency of AVF. When there was no audible bruit and no flow, then fistula was labeled as failed. Last follow up for AVF patency was done at nephrology unit after six weeks of fistula creation.

2.4 Data collection & Analysis plan: Sex (men/women) and age groups (≤ 40 years & >40 years) were our matching variables, while the patency rate of AVF was our research variable, all on nominal scale. The data for the sample were described by count & percentages and for the population as confidence interval at 80% confidence level.[19] McNemar chi-square test was used to test hypothesis to compare the patency rate of Brachiocephalic AVF vs. Radiocephalic AVF at alpha .05 with Yates continuity correction using online statistical calculator.[20]

2.5 Marwat Logical Trajectory of Research Process: We have adopted this 8-steps logical model for our research project as improvised by Dr. Muhammad Marwat.[21-22] McNemar chi-square test is well explained in two cited books[23-24] & two cited articles.[25-26]

3. RESULTS

Out of 133 patients in Brachiocephalic AVF group 79 (59.4%) were men and 54 (40.6%) women. Out of 133 patients in Radiocephalic AVF group, 72 (54.1%) were men and 61 (45.9%) women. There were 53 (39.8%) patients in age group ≤40 years and 80 (60.2%) in >40 years age group in Brachiocephalic AVF group, while there were 69 (51.9%) patients in age group ≤40 years and 64 (48.1%) in >40 years age group in Radiocephalic AVF group.

The patency was present in 129 (97%, 80% CI 94.45-98.39%) cases & absent in four (3%, 80% CI 1.61-5.55%) cases in Brachiocephalic AVF, while it was present in 107 (80.5%, 80% CI 76.04-84.86%) cases & absent in 26 (19.5%, 80% CI 15.52-24.32%) cases in Radiocephalic AVF group.

McNemar chi-square test showed p-value of <.0001 (less than alpha). So the null hypothesis was rejected, showing significant difference between patency rate of Brachiocephalic AVF and Radiocephalic AVF, with higher patency rate for Brachiocephalic AVF. (Table 1)

4. DISCUSSION

Chronic renal failure (CRF) is the irreversible declension of kidneys function that slowly promotes to end stage renal disease (ESRD). Renal transplantation is the decisive treatment option for ESRD. The goals of hemodialysis in ESRD patients are either as a bridge to transplantation or for long term maintenance or a final treatment option in ESRD patients because of advanced age or severe comorbidities.[27] AVF construction is the lifesaving procedure for CRF patients and is the most suitable access for hemodialysis, which is universally accepted in different studies.

Arteriovenous fistulas (AVFs) are considered as a good option for hemodialysis as compared to arteriovenous grafts (AVGs) due to their longer post cannualtion secondary patency rate for hemodialysis. Mature AVFs have higher survival rate as compared to AVGs.[28]

It was observed in our study, in most of the patients distal site at wrist joint didn't have suitable veins or veins were thrombosed due to repeated venous cannulation & as a result failed to distend. In case of any doubt Doppler ultrasound was done or distal site AVF was not attempted for Radiocephalic AVF at wrist joint and proximal site below elbow joint was explored for Brachiocephalic AVF formation.

Our study showed higher patency rate i.e. 97% (80% CI 94.45-98.39%) cases in Brachiocephalic

Table 1: Comparison of patency rate of Brachiocephalic vs. Radiocephalic AVF in chronic kidney disease patients in population of D.I.Khan division, Pakistan

Groups		Brachiocephalic AVF		Columns Total	χ^2 value	d.f.	p-value
		Patent	Non-patent				
Radiocephalic AVF	Patent	104	3	107	17.2857	1	<.0001
	Non-patent	25	1	26			
Rows Total		129	4	133 pairs	H_0 rejected at alpha .05		

AVF group & lower patency rate i.e. 80.5% (80% CI 76.04-84.86%) cases in Radiocephalic AVF group. The difference was statistically very significant (p-value=<.0001).

Four following studies have similar results to our study. DT, et al. from Nepal found higher patency rate of Brachiocephalic AVF as compared to Radiocephalic AVF. The patency rate was 91.5% for BCAVF and 83% for RCAVF.

Weale, et al. from Bristol, United Kingdom found statistically significant higher patency rate for Brachiocephalic AVF than Radiocephalic AVF. The patency rate was 47.47% for BCAVF and 45.43% for RCAVF.

Lok, et al. from Toronto, Canada also found higher patency rate for Brachiocephalic AVF as compared to Radiocephalic AVF. The patency rate was 90.86% for BCAVF and 88.31% for RCAVF.

Kim, et al. from Torrance, California demonstrated higher patency rate for Brachiocephalic AVF in comparison with Radiocephalic AVF. The patency rate was 62.92% for BCAVF and was 45% for RCAVF.

In literature no study was retrieved with same or higher patency rate of Radiocephalic AVF as compared to Brachiocephalic AVF.

CONCLUSION

In our population, Brachiocephalic AVF showed higher patency rate than Radiocephalic AVF. Creation of Brachiocephalic AVF is more ideal in terms of patency and maturation as compared to Radiocephalic AVF because of increased vessel diameter and increased arterial pressure at proximal site below elbow joint.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	WA, SR
Acquisition, Analysis or Interpretation of Data:	WA, SR, MA, DW
Manuscript Writing & Approval:	WA, SR, MA, DW

All the 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.