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Brachio-Cephalic AVF as a Preferred Autogenous Hemodialysis Access in Elderly Chronic Kidney Disease Patients

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ABSTRACT

Objective: To identify the preferred method of primary autogenous hemodialysis vascular access in elderly patients with End Stage Kidney Disease.
Study Design: Prospective comparative study
Place and Duration of Study: Department of vascular surgery, Combined Military Hospital, Rawalpindi Pakistan, from June 2020 to May 2021.
Methodology: Outcomes of the patients with Radiocephalic (RCAVF) and Brachiocephalic (BCAVF) Arteriovenous fistula were analyzed, undergoing a first surgical vascular access procedure for hemodialysis (HD). We examined the effect of age and other factors including sex, diabetes mellitus and preoperative duplex ultrasound imaging on AVF maturity and primary patency.
Results: We recruited 460 patients who underwent Radiocephalic (RCAVF) and Brachio-Cephalic AVF (BCAVF) primary HD vascular access procedure. The mean maturity time in RCAVF group was 8.30±2.3 weeks while in the BCAVF group was 4.60±2.2 weeks and result was statistically significant (p<0.001). Primary Patency at 6 months was 59.9% in RCAVF group while 85.7% in the BCAVF group, the chi square test result showed statistical significance (<0.001). Likewise mean Operative Time in RCAVF group was 70.26±1.48 minutes while in the BCAVF group was 50.01±1.52 minutes and the result of independent sample t test showed statistical significance. Patient survival in our study was 86.0% at 12 months.
Conclusion: Brachiocephalic AVFs is feasible choice, as hemodialysis vascular access in Elderly CKD patients in terms of Maturity, Primary patency and mean operative time as compared to forearm Radiocephalic AVFs.

Keywords: Elderly, Hemodialysis, Primary Patency, Vascular Access,

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INTRODUCTION

By 2019, more than 60, which is 7 percent of the country's population, almost 15 million people live in Pakistan. Older people are projected to twice as many as 12 per cent by 2050 and 40 million are over 60 years old. The demand for health services is increasing as a population ages. In Pakistani adult population the overall CKD prevalence was 21.2%. The highest prevalence of CKD in Pakistan was reported as 29.9 percent, and the lowest prevalence 12.5 percent.[1,2] according to high-quality studies. In some studies, the common reasons for CKD were disease-inducing (28%), glomerulonephritis (22%), hypertension (14.6%), tuberculosis (13.4%) and kidney stone disease (8 %).

A significant number of patients do not know the cause (10.6%). Other causes included 2 percent of cases of post-partum renal failure.[3]

The best way of choosing optimal vascular hemocentric access for patients with end-stage kidney disease is a patient-centersed, multidisciplinary, coordinated team approach.[4] In order to find the right balance between the probability of vascular access/survival, potential complications and available resources, it will be important to choose which modality (hemodialysis, peritoneal dialysis) suits the patient.[5]

For instance, in anticipation of live donor renal transplantation, a young active pre-dialysis patient with residual kidneys may best initiate a peritoneal dialysis using a PD catheter; if that transplant fails eventually, the patient is given a native AVF to begin hemodialysis, etc. In contrast, an older, more medically complex but functionally active patient with a central venous catheter could have started hemodialysis as soon as possible with plans to create an AVF.[5]

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If the AVF does not mature promptly, a synthetic arteriovenous grease (AVG) back-up plan should be developed to prevent long-term dependency in central venic catheter (CVC). If ESKD Life-Plan includes a patient with an anticipated long-term (e.g. >1 year on HD), it is appropriate to use the AVF forearms (e.g. radio snuff box, radio-cephalic or radio-basic transferred), or the AVG forearms or the AVF proximal forearm (e.g., radio-cephalic proximal) (Figure).[6]

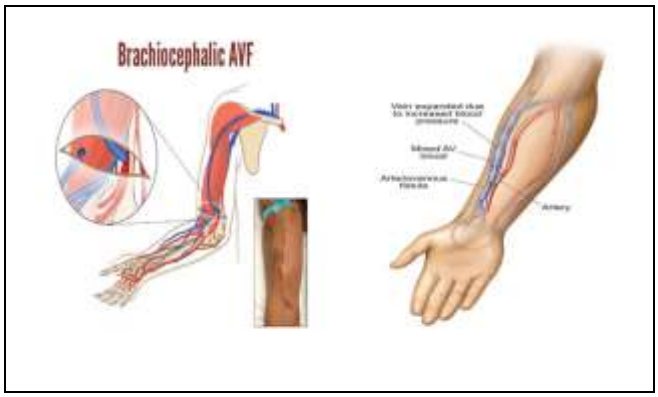

Figure: Schematic illustration of BCAVF & RCAVF

Where an ESKD Lifespan for patients includes an expected limited duration (for example, <1year) on HD, the forerunner loop AVG or brachiocephalic AVF is better. If all AV access options in the upper extremity are exhausted and the ESKD life-plan of the patient covers a long period (for instance>1 year) on HD, the following may be considered on the basis of individual patient conditions and the best clinical assessment and know-how of the operator. AVF or AVG or HeRO Graft lower extremity.[6]

Finally, for a short-term hemodialysis, a palliative can be served best with an initial cannulation grease or CVC. In elderly patients, it is extremely challenging to find the correct options for vascular hemodialysis in the framework of patient survival, time for hemodialysis, prior care, and individual patient preferences. The risks, benefits, costs and timing of placement of available accesses for elderly people are all these challenges.[7]

Our study examined a safe, cost-effective and convenient way of generating autogenous vascular hemodialysis in increasing numbers of elderly patients living with CKD in our population. In order to find a consensus method to create new AVFs in elderly CKD patients, it's important to take account that the ageing population poses a unique challenge because it's limited access to healthcare in our country, particularly when multidisciplinary treatment is needed.

METHODOLOGY

A prospective comparative study was conducted at Dept. of vascular surgery in Combined Military hospital, Rawalpindi Pakistan, from June 2020 to May 2021.

Inclusion Criteria: All the Patients (both genders) aged 65 years and above who underwent their first HD vascular access procedure undergoing autogenous RCAVF or BCAVF were included.

Exclusion Criteria: Patients with cardiac failure, EF<40%, previous surgical access procedures and unstable co-morbids were excluded.

All cases were prospectively identified by universal sampling technique. Our study was approved by Institutional Ethical Review Board (ERC/IERB no.170/06/2021) with approval certificate number. Informed consent was obtained from all the patients. Information on age, sex, ethnicity, diabetic status, hypertension, obesity, viral markers , use of central venous catheters for HD and preoperative duplex imaging were recorded.

The operating surgeon carried out ultrasound vessel mapping with physical examination on all patients at the initial consultation. As a general sequence for all other age groups for vascular access: 1) If feasible, Radiocephalic AVFs. 2) Mid-arm, radial artery-based AVF's when possible for inflow. 3) Armed Brachiocephalic (BCAVF). 4) AVFs staggered or primarily transposed. However, the brachial vein offers an acceptable alternative. The Basil vein was the best conduit.

The Ultrasound (US) examination was a key component in selecting the best site and vessels for the AVF options. In addition to years of intravenous access and venipuncture, many older patients have thinning and fragile forearm skin and soft tissue. In many of these patients, we feel that the upper arm cerebral vein is being chosen since the AVF outflow vein leads to rapid maturation and cancellation. Our minimum exit diameter requirement was 2.5 mm with an arterial diameter of 2.0 mm and a tourniquet inside. In the operating suite, the USA was again used briefly to confirm the targeted venous outflow and surgical plan.

In the surgical clinic, all patients were monitored regularly 2 weeks until new vascular access was

functionally mature (A mature fistula can consistently deliver 2 needles of dialysis for more than two-thirds of the dialysis sessional within 4 consecutive weeks). The primary patent rate (a time duration of measurement of intra-access patentability that starts on the date the access vascular (AV access) was created or inserted (Central Venous Catheter) to one of the following events (whichever comes first) was followed up for 6 months: thrombosis or any interventions facilitating, maintaining or restore patentability (e.g. angioplasty).

In addition to the physical examination, ultrasound was routinely used in order to evaluate AVF flow volume, vein size and position and to mark the targeted exit location before initial access was used. The flow volume by Doppler USG is 450-600 mL/min vein diameter 6 mm and the depth of skin <6mm, our main criteria for initial cancellation after creation of access. The data analysis included these people as a functional patent if the above criteria were complied with that. Those patients who underwent access procedure but could not undergo HD via autogenous access due to death or other reasons were excluded while calculating AVF maturity and primary patency rates.

An intervention (endovascular or open) or conversion to secondary AVF was evaluated for all patients with failed or unsuccessful AVFs. Our clinic has monitored no intervention in patients who suffer mild steal symptoms, but who have no motor deficit, rest pain, ulceration or threat of tissue loss. We build a standard vascular access for all patients. It is our practice. In general, during the procedure, patients received systemic heparinisation. All patients used prophylactic antibiotics. All procedures performed under local anesthesia administered by the surgeon. The operations were performed on an outpatient basis. Both RCAVF and BCAVF were created by end to side (vein-artery) anastomosis with Prolene 6/0 & 7/0 monofilament sutures for each vascular anastomosis.

Data was analyzed by using SPSS software. For quantitative variables, mean and standard deviations were calculated and frequency and percentages for qualitative variables were calculated. . Independent sample t test and chi-square test were applied. Statistically significant was taken at the *p*-value ≤0.05.

RESULTS

We have recognized 460 consecutive new patients who have undergo the primary HD vascular access procedure for RCAVF and BCAVF aged 65 years and older. The average age was 73.45±2.3 years (range; 65-94 years). In 276(59.9 %) persons, diabetes was the cause of renal failure. 236 patients (51.2%) were female, and 103(22.3%) patients identified as obese in medical records. Functional access maturity and primary patency rates were compared between RCAVF & BCAVF groups.

The mean maturity time in RCAVF group was 8.30±2.3 weeks while in the BCAVF group was 4.60±2.2 weeks and result was statistically significant (<0.001). Primary Patency was see in 59.9% in RCAVF group while 85.7% in the BCAVF group, the chi square test result showed statistical significance (<0.001). Likewise mean Operative Time in RCAVF group was 70.26±1.48 minutes while in the BCAVF group was 50.01±1.52 minutes and the result of independent sample t test showed statistical significance (Table).

Twelve patients developed hematomas/seroma (3 requiring surgical draining) , three patients with mild to moderate cellulitis that resolved with antibiotics and did not required surgical intervention.

The wound separation was developed in two patients. Vascular access operations were not associated with any deaths. Six patients regained renal function and their dialysis was discontinued.

Seven individuals were lost to follow-up at 2-4 months. Steal syndrome for the treatment was not different for patients undergoing RCAVF versus individuals undergoing BCAVF. Steal syndrome warranted intervention in two patients (open and endovascular).

Table: Comparison of Mean Maturity Time, Primary Patency and Mean Operative Time Between the Study Groups (Independent Sample t test & Chi-Square Test)

Parameters	Study Groups		*p*-value
	Group A RCAVF (n=230)	Group B BCAVF (n=230)	
Maturity Time (weeks) (Mean±Sd)	8.30±2.3	4.60±2.2	<0.001
Primary Patency (n,%)	138(59.9%)	197(85.7%)	<0.001
Mean Operative Time (minutes) (Mean±SD)	70.26±1.48	50.01±1.52	<0.001

DISCUSSION

Vascular hemodialysis by AVF, which shows lower morbidity, mortality and costs than greys and in particular catheters, has been widely recommended. With the population ageing and the incidence of renal

failure in the elderly increasing, there has been a major debate about the type of recommendations regarding vascular access for elderly people. Renal disease and age are among the independent morbidity and mortality predictors in older persons. Both the dialysis prevalence and the middle age of the population incident were increasing globally and are projected to increase further in the future years.[8,9]

In our study, the mean maturity time in RCAVF group was 8.30±2.3 weeks while in the BCAVF group was 4.60±2.2 weeks and result was statistically significant (<0.001). Primary Patency was see in 59.9% in RCAVF group while 85.7% in the BCAVF group, the chi square test result showed statistical significance (<0.001).Likewise mean Operative Time in RCAVF group was 70.26±1.48 minutes while in the BCAVF group was 50.01±1.52 minutes and the result of independent sample t test showed statistical significance.

KDOQI finds it reasonable to have a personalized living plan for ESKD that is regularly reviewed, updated and documented in its medical records, for every patient with progressive CKD and/or with an eGFR 15-20 mL/min/1.73 or already on renal replacements.[8,9]

It is reasonable for KDOQI to educate, in all modalities of kidney substitute therapy (KRT) options, including transplantation, adult patients and paediatric ones with an eGFR = 30 mL/min/1, 73 m2 (CKD G4) with a progressive decrease, so that, if necessary, a timely referred procedure and the development of the functional dialysis access may be made.[10,11]

Initial assessment of the patient must be focused on patient clinical examination of vascular anatomy and further planning of access creation.

KDOQI proposes selective preoperative ultrasounds for AV failure patients and does not recommend routine vascular mapping for all patients and recommends that the first assessment and plan of vascular access creation be carried out by physical examinations focused on vascular anatomy.

A reasonable approach is to have detail history of previous access placement or related complications and clinical examination of patient's vessels, to perform Allen's test , to look for signs of central venous obstruction, use non-dominant arm first, examination of cardiovascular status, Ultrasound (including intraoperative ultrasound) for peripheral vessels and venography for suspected central vein occlusion. Although an AVF cannot be created with a minimum diameter threshold, arteries and veins >2 mm in diameter are available and the vessels should undergo a thorough feasibility and quality evaluation to create an AVF by evaluating multiple characteristics of vessel quality (size, distendibility, flow,etc.).

The choice of anaesthesia for creation of AVF can be based on the discretion and best clinical judgement of the operator, given that current evidence shows no differences in usability, patentability, operations or patient experiments between regional or local anaesthesia blocks.[12-14]

As per Medicare data, the death risk was higher in patients with initial vascular access of a catheter or graft compared to an AVF in more than 66,000 patients over 66,000 years old. Several authors have reported successful autogenous vascular access results in older patients but the challenge remains that which autogenous AVF type is better so we observed the outcome difference in two main types of AVF which are frequently created i.e. RCAVF and BCAVF.[15,16]

The most probable successful autogenous access operation is important to all patients and can be a key element in the success of AVF in older patients. Another key factor in the success of both older and younger patients is the mapping of ultrasound vessels before fistula production.[17] Simple AVFs and distal sites selected at first when possible are recommended.

However, our study have noted delayed fistula maturity and decreased primary patency rates for radio-cephalic fistulas. In addition to poor forearm vena with multiple intravenous infusion and cancellation areas, we have observed that many of our older patients have smooth and fragile skin changes consistent with chronic sun-exposure. The construction of an AVF with top arm access sites served these patients best. In this study the patentability rates were lower for women >65 years of age than for men. The overall size of the vessel for females is smaller and may be an explanation.

Our speculation is that patients with a serious arteriosclerotic disease with these elderly chronic kidney diseases may have less chance of survival, and this part of our research shows that stealing syndrome is no different for two groups. AVFs with radial arters usually provide less access rates than AVFs with brachial arteries, and this is also significant from a cardiac point of view for the elderly population.

Our RCAVF and BCAVF follow-up assessment was similar in 4-6 weeks for cancellation into new AVFs.

When indicated, prompt and skilled AVF procedure is important for timely ripening and access maintenance in a significant percentage of successful AVFs by fistulogram of angioplastic treatment. Elderly patients are at increased risk for hospitalisation, morbidity, mortality and eventual nutritional care and may have geriatric syndromes characterised by frailty, fall and cognitive impairment.[18,19] Frailty is common among older patients with dialysis and increases their risk of mortality after dialysis is initiated. Early reference in older patients is thought to reduce chronic negative outcomes of kidney disease; however, the benefits of long-term dialysis remain controversial in fragile, older patients.

CONCLUSION

Brachiocephalic AVFs is feasible choice, as hemodialysis vascular access in Elderly CKD patients in terms of Maturity, Primary patency and mean operative time as compared to forearm Radiocephalic AVFs.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MAR & MJ: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

KSK & MI: Data acquisition, data analysis, approval of the final version to be published.

RB & TMB: Critical review, concept, drafting the manuscript, approval of the final version to be published.

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.

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