

# Outcomes of Primary Arteriovenous Fistula for Hemodialysis in Elderly Patients (>65 Years) with End Stage Renal Disease: A Study on Indian Population

## Abstract

**Introduction:** The outcome of arteriovenous fistula (AVF) for hemodialysis (HD) in elderly population remains an issue. The aim of our study was to evaluate the outcomes of arteriovenous fistulas created at our institute in patients older than 65 years. **Methods:** All chronic HD patients with age >65 years who had an AVF created between January 1, 2010 and January 1, 2017 were included retrospectively. Baseline demographic information including age, gender, etiology of renal failure and comorbidities were recorded. Access characteristics including access type and anatomic location were recorded. The end point of study was primary and secondary patency. Minimum follow up period of study was 1 year. **Results:** A total of 422 AVF were created within the study period. The mean age was 69.3 years. The anatomical site of AVF creation was radiocephalic (RCF) in 74.8% ( $n = 316$ ), brachiocephalic (BCF) in 18.9% ( $n = 80$ ) and brachiobasilic (BBF) in 6.1% ( $n = 26$ ). At one year after creation, cumulative survival of the AVF was 64.7%. At 36 months the primary and secondary patency of RCF, BCF and BBF was 43.6%, 58.6%, 42.6% and 47.3%, 62.5%, 56.9% respectively. The overall median survival did not differ between RCF and BBF fistulas. However, when both were compared with BCF (median survival 1034 days), BBF (median survival 741 days) and RCF (median survival 592 days) had significantly poorer survival ( $P = 0.004$ ). The most common reason for access failure was thrombosis (28.4%) followed by failure to mature (9%) and aneurysm related complications (9%). **Conclusions:** Age should not be a limiting factor when choosing AVF as the preferred HD access. Brachiocephalic AVF has better primary and secondary patency with higher overall median survival. However RCF also provides reasonably good survival rates with acceptable complications in elderly population. Thrombosis and fistulas that fail to mature present as a primary concern to patients in elderly population, and demand further study.

**Keywords:** Arteriovenous fistula, elderly, hemodialysis, patency

## Introduction

In current era, the hemodialysis has achieved broad acceptance among patients and physicians due to improved technology and innovation to sustain life in patients of end stage renal disease.<sup>[1]</sup> The introduction of external arteriovenous shunt by Schribner was a milestone in making Chronic HD feasible for patients with end-stage renal disease (ESRD). This was further advanced by development of arteriovenous fistula (AVF) by Brescia *et al.*<sup>[2]</sup> The minimum cost of maintenance, least amount of intervention with easy and superior access, better patient survival and minimum rates of complications when compared with all other forms of vascular access has made arteriovenous fistula

first choice of vascular access for chronic HD.<sup>[3-7]</sup>

A group of young non diabetic patients were selected for creation of AVF in original description of AVF in 1966 by Cimino and Brescia. However, the number of older patients requiring maintenance HD has increased significantly due to better availability of dialysis along with increased prevalence of end-stage renal disease in the elderly.<sup>[8]</sup> Since arteriovenous fistulas (AVFs) have a limited life span, the primary approach for planning vascular access has been to use distal vessels first so that proximal vessels can be preserved for an anticipated future need of a new access. A counterview to this is the shortened life expectancy of elderly patients on maintenance hemodialysis as they may not

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survive to need a second AVF.<sup>[9,10]</sup> Moreover the maturation rates of AVF are poorer in older patients because of high incidence of diabetes and hypertension leading to poorer vascular endothelial health accompanied with higher incidence of peripheral vascular disease resulting in impairment of blood inflow to AVF.<sup>[11]</sup>

These facts have changed the preference of operating surgeons for creation of an elbow fistula (brachiocephalic AVF) rather than wrist fistula (radiocephalic AVF) in older patients.<sup>[1-5]</sup> However the higher rate of vascular steal syndrome with brachiocephalic AVFs remains a counterbalancing argument.<sup>[12]</sup> There is limited availability of literature describing outcomes of AVF placements in the elderly; more so in Indian population, with conflicting conclusions. Indians are affected by cardiovascular diseases more than a decade earlier as compared to European population.<sup>[13,14]</sup> Although the prevalence of traditional risk factors like hypertension, hypercholesterolemia and smoking is not higher in Indians, but, some risk factors for atherosclerosis such as higher total cholesterol to high-density lipoprotein cholesterol ratio, high triglyceride levels, visceral obesity and type 2 diabetes mellitus are particularly present in Indians.<sup>[15-17]</sup> The aim of our study was to evaluate the outcomes of arteriovenous fistulas in Indian elderly population.

## Materials and Methods

This study is a retrospective analysis of collected data (for clinical care) on a cohort of patients with consecutively created AVF. All chronic HD patients with age more than 65 years who had an AVF created within this program between January 1, 2010 and July 1, 2016 were included in the study. Prior to AVF creation, the surgeon assessed all patients. Preoperative USG with color Doppler for upper limb vessels using a pre-designed pro forma was routinely performed. All AVF were created using end to side anastomoses and were followed up by surgeon after creation and first venipuncture was done after assessment by nephrologist. The AVF were created by 4 surgeons with experience of 3 years or more using the same technique. Initially RCF was created provided the vessels had adequate caliber (2mm or more) and flow (25 ml/second or more). Otherwise the elbow was explored and BCF created. BBF was created when no suitable cephalic vein was found. A policy of minimum 6 to 8 weeks maturation period was strictly followed before first venipuncture.

Since January 1, 2010, baseline demographic information has been collected, including patient characteristics: age, gender, comorbidities, and etiology of renal failure. Access characteristics including access type and anatomic location were recorded.

## Definitions of outcomes

Primary patency was the “interval from the time of access creation until any intervention designed to maintain or

to re-establish patency, access thrombosis, or the time of measurement of patency”. Secondary patency “was the interval from the time of access placement until access abandonment, thrombosis, or the time of patency measurement including intervening manipulations (surgical or endovascular interventions) designed to re-establish functionality in thrombosed accesses.”<sup>[18]</sup> In our study, all patients who had failure of AVF, underwent evaluation by intervention radiologists. Angiography followed by balloon dilatation was done in these patients.

Secondary patency measures the period for which AVF was in use hence it was considered the most important end point. Minimum follow up period was 1 year. The patients who switched to peritoneal dialysis, died with a functioning AVF, underwent renal transplantation or transferred to another dialysis center were excluded from the study.

Data analysis was done using student *t*-test for continuous data and Chi-square test was used for dichotomous data. One way ANOVA was used to analyse continuous data when more than 2 groups were involved. Kaplan-Meier plots were used for estimation of time-to-event distributions. All tests of significance were two-sided with a *P* value <0.05. The statistical software SPSS 20.0 was used.

## Results

A total of 422 AVF were created within the study period. The patient and access characteristics are presented in Table 1. Seventy-five (75.8) percent of all study patients were male, and 24.2% were females. The mean age of group was 69.3 years. The etiology of renal failure was diabetes in 35.1% (*n*=148), hypertension in 11.1% (*n*=47) and glomerulonephritis in 38.3% (*n*=162). Diabetes as a comorbidity was present in 33% (*n*=139), hypertension in 83.1% and CAD in 19.4% (*n*=82) patients.

The anatomical site of AVF creation was radio-cephalic in 74.8% (*n*=316), brachiocephalic in 18.9% (*n*=80) and brachio-basilic in 6.1% (*n*=26). The primary patency rates (at 6 months, 1, 2 and 3 years) of RCF, BCF and BBF is summarized in Table 2. Primary patency of BCF was found to be significantly better than RCF at 1 year (70.5% vs 58.3%) and 3 years (58.6% vs 43.6%). However when compared to BBF, primary patency of BCF was marginally better at 1 year (70.5% vs 68.3%) but significantly higher at 3 years (58.6% vs 42.6%) as shown in Figure 1. At one year after creation, the cumulative survival of AVF was 64.7%. The overall median survival did not differ between radiocephalic and brachio-basilic fistulas. However, when both were compared with brachiocephalic AVF (median survival 1034 days), brachio-basilic and radiocephalic AVF (median survival 496 and 541 days respectively) had significantly poorer survival (*P* = 0.004). The primary patency rates

**Table 1: Patients and fistula characteristics (n=422)**

Number of patients	422
Age (years), mean±SD	69.3±2.5
Sex, n (%)	
Male	320 (75.8)
Female	102 (24.2)
Etiology, n (%)	
Diabetes	148 (35.1)
Hypertension	47 (11.1)
Glomerulonephritis	162 (38.3)
Interstitial nephritis	16 (3.7)
Other	49 (11.6)
Comorbidities, n (%)	
DM	139 (33)
HTN	351 (83.1)
CAD	82 (19.4)
CHF	51 (12)
PVD	21 (5)
COPD	17 (4)
Anatomical site, n (%)	
RC	316 (74.8)
BC	80 (18.9)
BB	26 (6.1)

SD: Standard deviation, COPD: Chronic obstructive pulmonary disease, PVD: Peripheral vascular disease, CHF: Congestive heart failure, CAD: Coronary artery disease, HTN: Hypertension, DM: Diabetes mellitus, RC: Radiocephalic, BC: Brachiocephalic, BB: Brachiobasilic

**Table 2: Primary patency of arteriovenous fistula**

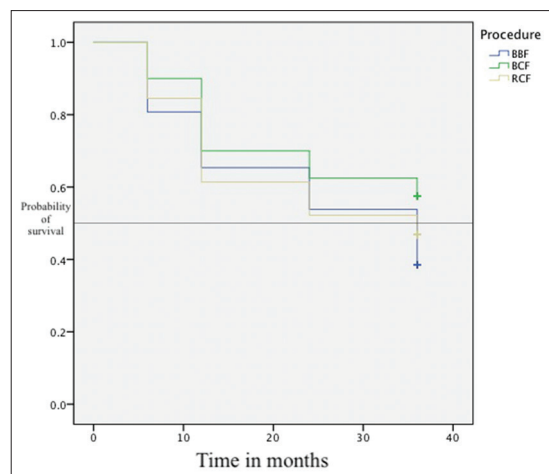
Fistula	6 months	12 months	24 months	36 months	Median days
RC	84.6%	58.3%	49.1%	43.6%	541
BC	89.5%	70.5%	63.2%	58.6%	1034
BB	79.9%	68.3%	56.8%	42.6%	496
Overall	83.3%	64.7%	58.8%	51.7%	692

RC: Radiocephalic, BC: Brachiocephalic, BB: Brachiobasilic

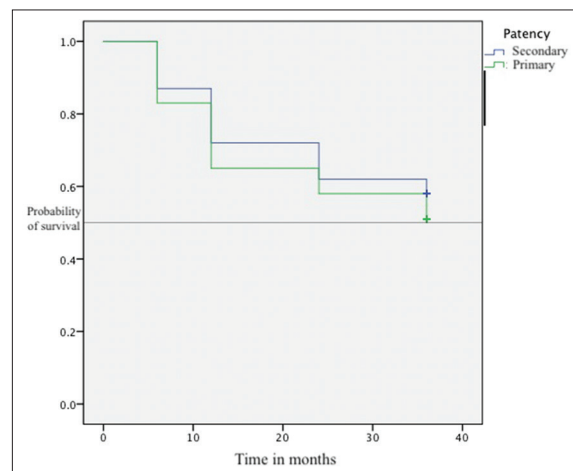
of RCF, BCF and BBF were not significantly different among age groups (65-70, 71-75 and >75 years) as given in Table 3.

The secondary patency rates are summarized in Table 4. The overall secondary patency at 1 year was 72.5% and was reduce to 58.3% at 3 years as shown in Figure 2. The secondary patency of BCF was significantly better than that of BBF and RCF at 1 year (75.2% vs 72.7% vs 68.1%) and at 3 years (62.5% vs 56.9% vs) as shown in Figure 3. The median survival of BC fistula was significantly higher than RC and BB fistula (1321 vs 741 vs 592 days respectively).

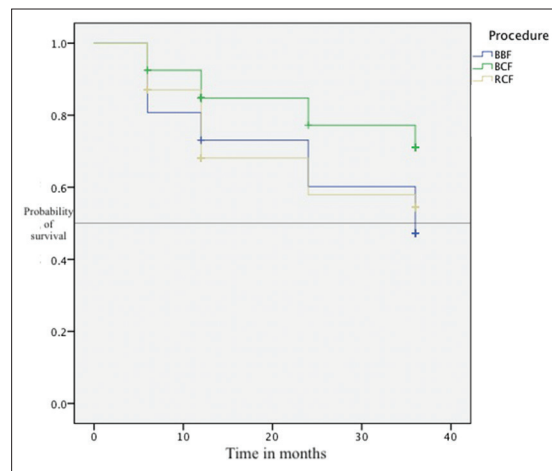
The primary reason for AVF loss was thrombosis in 28.4% (n=120 patients). Thirty-eight (9%) of AVF were lost each due to maturation failure and due to aneurysm related complications [Table-5]. In 2 patients, ligation of AVF done due to severe steal syndrome.



**Figure 1: Primary patency of brachiobasilic fistula, brachiocephalic fistula and radiocephalic fistula**



**Figure 2: Overall primary and secondary patency of arteriovenous fistula**



**Figure 3: Secondary patency for brachiobasilic fistula, brachiocephalic fistula and radiocephalic fistula**

## Discussion

This study, focused on functional outcome of AVF at different sites indicates that AVF is a viable option

**Table 3: Patency rates of arteriovenous fistula among different age groups at 1 year**

I year patency	RCF (n=316)	BCF (n=80)	BBF (n=26)	P
65-70 (n=229)	60.26% (n=172)	71.9% (n=43)	69.7% (n=14)	0.149
71-75 (n=113)	57.6% (n=85)	69.2% (n=21)	66.7% (n=7)	0.312
76 and above (n=80)	57.5% (n=59)	67.3% (n=16)	65.9% (n=5)	0.419

RCF: Radiocephalic fistula, BCF: Brachiocephalic fistula, BBF: Brachiobasilic fistula

**Table 4: Secondary patency of arteriovenous fistula**

Fistula	6 months	12 months	24 months	36 months	Median days
RC	87.1%	68.6%	56.4%	47.3%	741
BC	92.1%	75.2%	68.1%	62.5%	1321
BB	81.1%	72.7%	64.1%	56.9%	592
Overall	87.7%	72.5%	62.2%	58.3%	891

RC: Radiocephalic, BC: Brachiocephalic, BB: Brachiobasilic

**Table 5: Reason for arteriovenous fistula loss**

Reason for AVF loss	RC:BC:BB (n)
Thrombosis/stenosis	96:17:7
Failure to mature	32:4:2
Aneurysm related complications	26:9:3
Ligation due to severe steal syndrome/high cardiac output	0:2:0
Total	154:32:12

AVF: Arteriovenous fistula, RC: Radiocephalic, BC: Brachiocephalic, BB: Brachiobasilic

in elderly patients on hemodialysis. Our findings are supported by published recommendations promoting AVF as vascular access of first choice for HD among all age groups. Literature is full of studies that have analysed age as a covariate of access survival and various other outcomes, however the conclusions and results have largely been inconclusive. There are few studies which have specifically evaluated how older age is associated with AVF outcomes.<sup>[1,19-22]</sup> Lin *et al.*<sup>[23]</sup> studied 176 AVF, and showed that age alone did not contribute to poor outcomes, they also found that combination of age with diabetes increases the risk of AVF failure. Stamos *et al.*<sup>[24]</sup> studied patients older than 70 years. Their experience showed similar “primary cumulative patency” rates for both grafts and AVF. Their results contradict with another large retrospective study including 494 permanent accesses in elderly patients who had previous failed access.<sup>[25]</sup> The authors found that elbow AVF have best results.

The cumulative patency rate [Tables 1 and 2] observed in our study is comparable to the literature.<sup>[26-28]</sup> For example, Golledge *et al.*<sup>[29]</sup> found cumulative patency rates (after thrombolysis, surgical intervention or angioplasty) of 70% after first year and 63% two years later. In our study, the average one- and two-year cumulative patency for radiocephalic fistulas were 68.6% and 56.4%, respectively, and were consistent with average radiocephalic AVF patencies of 67.3% and 56.6%, obtained from a number

of studies that excluded AVF that failed to mature.<sup>[30]</sup> Our study is also consistent with a study by Konner *et al.*<sup>[31]</sup> comprising of 748 AVF and found excellent access survival in elderly patients. Although the most of AVF in their study were created at elbow, we can extend their results and denote that comparable survival rates can also be obtained in smaller, wrist vessels as more than one-third of AVF in our study were radiocephalic.

Based on our data we support K-DOQI recommendations for using wrist vessels first, whenever possible, before contemplating upper arm AVF creation. However, this study also demonstrated that median survival (in term of days) was almost twice as high for elbow AVF compared with wrist AVF. Dixon *et al.*<sup>[32]</sup> also support our data, they showed higher cumulative patency rates of 71%, 57%, and 57% at one, three, and five-year for elbow AVF as compared to 54%, 46%, and 36% for wrist AVF. Our experience with BVT is still early, and a prospective study is underway.

In our study primary patency (no intervention required) at one year was 64.7%. Similar results were published by Stamos *et al.* in a study of 68 elderly patients where he found one year primary patency of 67%,<sup>[24]</sup> and by Golledge *et al.* in their study of 107 radiocephalic fistula showing one year primary patency of 69%.<sup>[29]</sup> Therefore, these data demonstrate that, it is possible to achieve longer over-all survival and high cumulative patencies in the elderly population.

Our practice is to ensure confirmation of adequate vessel diameter and flow rates in the wrist vessels by Doppler study prior to creation of AVF in elderly patients, which may have had an impact on the outcome of AVF in this cohort. To ensure long term patency, the initial puncture should be done after at least 8 weeks of maturation and proper assessment by a nephrologist. All further punctures should be done by a well trained technician under observation of a experienced nephrologist.

In present study, failure to mature (FTM) and thrombosis are the primary reasons for loss of AVF. Pathophysiology of both is different yet somehow related to each other. Adequate flow in and out of fistula is required for its maturation, which in-turn is dependent on vessel wall integrity non-development of collaterals and absence of neo-intimal hyperplasia. One of the dreaded complications of BCF is steal syndrome, the incident of which can be reduced by making an optimal arteriotomy. Another option

is to use the proximal radial artery instead of the brachial but in our centre, a patient who is undergoing BCF is likely to have a failed distal RCF, which precludes the use of radial artery.<sup>[12]</sup>

Hereby we recognize the limitations of our study that it is a single-center experience and retrospective in nature, keeping this in view external validity of this study may be limited.

## Conclusion

Age should not be a limiting factor when choosing AVF as the preferred HD access. Brachiocephalic AVF has better primary and secondary patency with higher overall median survival. However, RCF also provides reasonably good survival rates with acceptable complications in elderly population. Thrombosis and fistulas that fail to mature present as a primary concern to patients in elderly population, and demand further study.

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## Conflicts of interest

There are no conflicts of interest.

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