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Research Article

Radiocephalic versus Brachiocephalic Arteriovenous Fistula for Hemodialysis: A Comparative Study

Dr. G V Praveen Kumar[1]

[1]Chief Consultant, Vascular and Endovascular DepartmentVascular Care Center, Somajiguda, Hyderabad, Telangana, India – 500082Email: email2gvpk@gmail.com

*Corresponding Author
G V Praveen Kumar
Email: email2gvpk@gmail.com

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Abstract: ***Introduction:*** Arteriovenous fistula (AVF) remains the preferred vascular access for maintenance hemodialysis, with radiocephalic (RC) and brachiocephalic (BC) fistulas being the most commonly performed types.**Aim:** To compare outcomes between RC AVF and BC AVF in terms of maturation, patency, and clinical performance.**Materials and Methods**: This prospective comparative study included 500 patients undergoing AVF creation over 10 months (2020–2021). Patients were categorized into RC AVF (n=300) and BC AVF (n=200). Outcomes assessed included time to maturation, primary patency, complications, and long-term usability. Statistical analysis was performed using Chi-square test and independent t-test.**Results:** RC AVF demonstrated significantly higher primary patency rates (82%) compared to BC AVF (68%) ($p<0.001$). Early diagnosis of access dysfunction and salvage rates were better in RC AVF. BC AVF showed faster maturation (mean 4 weeks), but higher complication rates including thrombosis and steal syndrome.**Conclusion:** Although BC AVF matures earlier, RC AVF provides superior long-term patency and fewer complications, supporting its role as the preferred first-line vascular access when feasible.
Advancement to knowledge: This study reinforces prioritization of distal fistula creation for improved long-term dialysis outcomes.
Keywords: Arteriovenous fistula; Radiocephalic; Brachiocephalic; Hemodialysis access; Vascular patency

INTRODUCTION

Chronic kidney disease (CKD) represents a growing global health burden, with increasing numbers of patients requiring long-term renal replacement therapy such as hemodialysis [1]. Reliable vascular access is essential for effective dialysis, and arteriovenous fistula (AVF) remains the gold standard due to its superior patency and lower complication rates compared to grafts and catheters [2]. Among AVFs, radiocephalic (RC) fistula at the wrist and brachiocephalic (BC) fistula at the elbow are most commonly performed [3].

The principle of "distal first" approach recommends RC AVF as the initial access site to preserve proximal vessels for future use [4]. RC AVFs are associated with lower rates of complications such as steal syndrome and high-output cardiac failure; however, they often demonstrate delayed maturation and higher primary failure rates, especially in elderly and diabetic populations [5]. In contrast, BC AVFs provide larger vessel diameter and higher blood flow, facilitating faster maturation and earlier usability for dialysis [6].

Despite these advantages, BC AVFs are associated with increased risk of complications including venous hypertension, aneurysm formation, and steal syndrome [7]. Additionally, the long-term patency of BC AVF may be compromised due to higher flow dynamics leading to intimal hyperplasia and access dysfunction [8].

Several studies have compared RC and BC AVFs, but the results remain inconsistent due to variations in patient demographics, surgical expertise, and follow-up duration [9]. Understanding the comparative performance of these two fistula types is critical for optimizing vascular access strategies, particularly in resource-limited settings.

This study aims to evaluate and compare the outcomes of RC AVF and BC AVF in terms of maturation time, patency, complication rates, and long-term usability in a tertiary vascular care center.

MATERIALS AND METHODS

This prospective comparative study was conducted at a tertiary vascular care center in Hyderabad between 2020 and 2021 over a duration of 10 months. A total of 500 patients with end-stage renal disease requiring hemodialysis access were included. Ethical approval was obtained from the institutional review board, and informed consent was taken from all participants.
Patients were divided into two groups based on the type of AVF created: radiocephalic AVF (RC group, n=300) and brachiocephalic AVF (BC group, n=200). Inclusion criteria included patients aged 18–75 years with suitable vascular anatomy confirmed by Doppler ultrasound. Patients with previous AVF failure, central venous stenosis, or severe peripheral vascular disease were excluded.

All procedures were performed under local anesthesia by experienced vascular surgeons. Preoperative vessel mapping was performed to assess arterial diameter (>2 mm) and venous diameter (>2.5 mm). Standard end-to-side anastomosis technique was used.

Patients were followed up weekly for the first month and monthly thereafter. AVF maturation was defined as successful use for dialysis with adequate flow (>600 mL/min) and vein diameter ≥6 mm. Primary patency, complications (thrombosis, infection, steal syndrome), and need for intervention were recorded.

Statistical analysis was performed using SPSS version 22. Continuous variables were expressed as mean ± SD and compared using independent t-test. Categorical variables were analyzed using Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1

The distribution of AVF types among the study population showed that radiocephalic AVF was more frequently performed (60%) compared to brachiocephalic AVF (40%). This reflects the institutional preference for distal fistula creation as the first-line approach. The demographic characteristics were comparable between both groups with no statistically significant difference in age or gender distribution (p>0.05), ensuring homogeneity and minimizing confounding bias in outcome comparison.

Table 1. Distribution of AVF Types (n=500)

AVF Type	Number (n)	Percentage (%)
Radiocephalic (RC)	300	60.0
Brachiocephalic (BC)	200	40.0
Total	500	100

Table 2

Comparison of maturation time revealed that BC AVF matured significantly faster with a mean duration of 4.1 ± 1.2 weeks compared to 6.3 ± 1.8 weeks in RC AVF (p<0.001). Early usability favored BC AVF, which is clinically advantageous in patients requiring urgent dialysis initiation. However, delayed maturation in RC AVF did not affect eventual usability, highlighting the trade-off between early access and long-term outcomes.

Table 2. Comparison of Maturation Time

AVF Type	Mean Maturation Time (weeks)	SD	p-value
RC AVF	6.3	1.8	
BC AVF	4.1	1.2	<0.001

Table 3

Primary patency rates were significantly higher in RC AVF (82%) compared to BC AVF (68%) (p<0.001). This indicates superior long-term durability of distal fistulas. The lower patency observed in BC AVF may be attributed to higher flow-related complications and intimal hyperplasia. These findings support the strategy of prioritizing RC AVF when vascular anatomy permits.

Table 3. Primary Patency Rates

AVF Type	Patent (n)	Failure (n)	Patency (%)	p-value
RC AVF	246	54	82.0	
BC AVF	136	64	68.0	<0.001

Table 4

Complication rates were significantly higher in BC AVF compared to RC AVF. Thrombosis and steal syndrome were more commonly observed in BC AVF, whereas RC AVF demonstrated relatively fewer complications. The overall complication rate was 28% in BC AVF versus 16% in RC AVF (p<0.001), indicating a safer profile for distal fistula creation.

Table 4. Complications in AVF

Complication	RC AVF (n=300)	BC AVF (n=200)	p-value
Thrombosis	30 (10%)	38 (19%)	
Steal Syndrome	6 (2%)	18 (9%)	
Infection	12 (4%)	10 (5%)	
Total Complications	48 (16%)	56 (28%)	<0.001

DISCUSSION

The present study demonstrates a clear comparative advantage of radiocephalic AVF over brachiocephalic AVF in terms of long-term patency and complication

profile, despite slower maturation. These findings are consistent with established vascular access guidelines and prior clinical studies.

RC AVF showed superior primary patency (82%), which aligns with the findings of Al-Jaishi et al., who reported better long-term survival of distal fistulas due to lower hemodynamic stress [11]. Similarly, Lok et al. emphasized that RC AVFs maintain functional integrity longer due to reduced turbulence and intimal injury [12]. In contrast, BC AVF demonstrated lower patency (68%), likely due to increased blood flow leading to endothelial damage and venous dilation.

The faster maturation of BC AVF observed in this study (mean 4 weeks) corroborates earlier reports by Sidawy et al., who highlighted the benefit of proximal fistulas in achieving early dialysis readiness [13]. This is particularly relevant in patients with urgent dialysis needs. However, this advantage must be balanced against the higher complication rates.

Complication analysis revealed significantly higher rates in BC AVF, especially thrombosis and steal syndrome. These findings are supported by Lazarides et al., who reported increased risk of ischemic complications in proximal AVFs [14]. The incidence of steal syndrome (9%) in BC AVF group in our study is comparable to previously reported ranges of 5–10% [15].

RC AVF demonstrated better early detection of dysfunction and higher salvage rates, likely due to easier clinical monitoring and accessibility. Miller et al. have suggested that early intervention strategies are more effective in distal fistulas [16].

The “distal first” principle remains justified based on these findings, as emphasized by NKF-KDOQI guidelines, which recommend RC AVF as the initial access whenever feasible [17]. Preservation of proximal vessels ensures future access options, which is critical in patients requiring lifelong dialysis.

The study is limited by its single-center design and relatively short follow-up duration. However, the large sample size (n=500) strengthens the validity of the findings. Future multicentric studies with longer follow-up are recommended to further validate these outcomes.

CONCLUSION

Radiocephalic AVF demonstrates superior long-term patency and lower complication rates compared to brachiocephalic AVF, despite a relatively longer maturation period. While brachiocephalic AVF provides the advantage of early maturation and quicker usability, it is associated with increased risks of thrombosis and steal syndrome. The findings of this study strongly support the “distal first” approach in vascular access planning for hemodialysis patients. Early diagnosis and better salvage potential further enhance the clinical utility of radiocephalic AVF. Therefore, whenever vascular anatomy permits, radiocephalic AVF should be considered the preferred first-line option for long-term dialysis access. Careful patient selection and regular follow-up are essential to optimize outcomes and reduce complications.

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