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Comparative Study of Distal Radiocephalic Fistulas Versus Brachiocephalic Fistulas in Chronic Kidney Disease Patients: A Single-Center Study in Bangladesh

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ABSTRACT

Background: Arteriovenous fistulas (AVFs) are the preferred vascular access for hemodialysis in chronic kidney disease (CKD) patients. Distal radiocephalic (DRC) and brachiocephalic (BC) fistulas are common, but their comparative efficacy remains debated, especially in resource-limited settings like Bangladesh.

Objective: This study compared the outcomes of distal radiocephalic and brachiocephalic fistulas in chronic kidney disease patients at a single center in Bangladesh.

Methods: A prospective comparative study was conducted at Bangladesh Medical University (Ex- BSMMU), Dhaka, from July 2022 to June 2025. Sixty CKD patients (30 DRC, 30 BC) were selected via purposive sampling and randomized. Fistula maturation, patency rates, and complications (e.g., thrombosis, infection, steal syndrome) were evaluated. Data were analyzed using SPSS version 23.0, with $p < 0.05$ considered statistically significant.

Results: Brachiocephalic fistulas demonstrated superior maturation rates (86.7% vs 73.3%) and shorter maturation time (4.2 vs 6.5 weeks) compared to distal radiocephalic fistulas. However, distal fistulas showed lower thrombosis rates (10% vs 23.3%) and no steal syndrome. Primary patency at 6 months favored brachiocephalic fistulas (80% vs 63.3%), while 12-month secondary patency was comparable (76.7% vs 70%). Blood flow rates were significantly higher in brachiocephalic fistulas (650±120 vs 480±90 mL/min).

Conclusion: While brachiocephalic fistulas offer better maturation and short-term patency, distal radiocephalic fistulas present fewer complications. The choice should consider patient- specific factors, balancing immediate usability with long-term safety in hemodialysis access planning.

Keywords: *Arteriovenous Fistula, Brachiocephalic, CKD, Hemodialysis, Radiocephalic, Thrombosis*.

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INTRODUCTION

Chronic kidney disease (CKD) is a major public health concern globally, with an increasing prevalence in developing countries like Bangladesh [1]. Hemodialysis remains a cornerstone of renal replacement therapy, and a well-functioning vascular access is critical for its success. The arteriovenous fistula (AVF), first described by Brescia and Cimino in 1966 [2], is the gold standard due to its superior longevity and lower complication rates compared to grafts and catheters [3,4]. Among AVFs, the distal radiocephalic (DRC) fistula is traditionally the first choice due to its preservation of proximal vessels for future access [5]. However, brachiocephalic (BC) fistulas are increasingly used, particularly in patients with inadequate distal vessels, offering potentially higher maturation rates [6]. The optimal choice between DRC and BC fistulas remains controversial. Studies suggest that while DRC fistulas have lower complication rates, they suffer from higher primary failure rates (up to 30–50%) compared to BC fistulas [7,8]. In contrast, BC fistulas mature faster and have better primary patency but may be associated with higher risks of steal syndrome and cardiac overload [9,10]. These differences are particularly relevant in low-resource settings like Bangladesh, where late referral of CKD patients and limited surgical expertise may influence outcomes [11]. Bangladesh faces unique challenges in vascular access management, including a high burden of diabetes and hypertension leading causes of CKD and limited infrastructure for routine vascular mapping [12,13]. Most studies comparing DRC and BC fistulas originate from high-income countries, where patient demographics, surgical practices, and follow-up protocols differ significantly [14,15]. Local data are scarce, and existing studies often lack standardized outcome measures [16]. This gap underscores the need for context-specific research to guide clinical decision-making. This study aimed to compare the outcomes of DRC and BC fistulas in CKD patients at a tertiary care center in Bangladesh, focusing on maturation rates, patency, and complications. By providing locally relevant evidence, we hope to optimize vascular access strategies and improve hemodialysis outcomes in this population.

METHODOLOGY

This prospective comparative study was conducted at Bangladesh Medical University (Ex- BSMMU), Dhaka, from July 2022 to June 2025. The study included 60 chronic kidney disease patients who required hemodialysis access, with 30 patients assigned to the distal radiocephalic fistula group and 30 patients to the brachiocephalic fistula group. Patient selection followed strict inclusion and exclusion criteria. Eligible participants were adults aged 18 years or older with stage 4 or 5 chronic kidney disease and no prior arteriovenous fistula surgery. Patients were excluded if they had severe peripheral vascular disease, central vein stenosis, or a life expectancy of less than six months. Participants were selected through purposive sampling and then randomly allocated into the two study groups using a computer- generated randomization table. All surgical procedures were performed by two experienced vascular surgeons under local anesthesia. Distal radiocephalic fistulas were created at the wrist, while brachiocephalic fistulas were placed at the antecubital fossa. Postoperative monitoring assessed fistula maturation at six weeks, patency rates over six months, and complications such as thrombosis, infection, and steal syndrome. The primary outcomes measured were successful maturation and primary and secondary patency rates. Secondary outcomes included complication rates and time to fistula maturation. Data analysis was conducted using SPSS version 23.0, with statistical significance set at a p-value less than 0.05. Chi-square tests, t-tests, and Kaplan-Meier survival analysis were used to evaluate the results. This standardized methodology was designed to ensure reproducibility and minimize bias in the study findings.

RESULTS

The study included 60 chronic kidney disease patients undergoing arteriovenous fistula creation, with 30 patients in the distal radiocephalic and brachiocephalic fistula groups. Baseline characteristics were well-balanced between groups. The mean age of participants was 52.3±10.7 years in the distal radiocephalic group versus 54.1±9.8 years in the brachiocephalic group (p=0.423, Independent t-test), with comparable gender distribution (60.0% vs. 56.7% male, p=0.792, Chi-square test). Comorbidities such as diabetes mellitus (46.7% vs. 50.0%, p=0.802, Chi-square test) and hypertension (83.3% vs. 86.7%, p=0.712, Chi-square test) showed no significant differences. Fistula maturation rates favored the brachiocephalic group (86.7%) over the distal radiocephalic group (73.3%, p=0.021, Chi-square test), with a significantly shorter mean time to maturation in brachiocephalic fistulas (4.2±1.1 weeks) compared to distal radiocephalic fistulas (6.5±1.4 weeks, p=0.003, Independent t-test). Patency outcomes revealed higher 6-month primary patency in brachiocephalic fistulas (80.0%) versus distal radiocephalic fistulas (63.3%, p=0.032, Log-rank test), though 12-month secondary patency rates were comparable (70.0% vs. 76.7%, p=0.284, Log-rank test). Complications varied between groups. Thrombosis occurred less frequently in distal radiocephalic fistulas (10.0%) than in brachiocephalic fistulas (23.3%, p=0.042, Chi-square test), while steal syndrome was exclusive to the brachiocephalic group (13.3%, p=0.020, Fisher's exact test). Infection rates were similar (6.7% vs. 10.0%, p=0.642, Fisher's exact test). Hemodynamically, brachiocephalic fistulas achieved higher blood flow rates at maturation (650±120 mL/min) than distal radiocephalic fistulas (480±90 mL/min, p<0.001, Mann- Whitney U test). However, dialysis adequacy (Kt/V) did not differ (1.4±0.3 vs. 1.5±0.2, p=0.152, Independent t-test). Multivariate logistic regression identified diabetes mellitus (OR=2.1, 95% CI:1.1- 4.3, p=0.040) and low intraoperative blood flow (OR=3.4, 95% CI:1.5-7.8, p=0.010) as independent predictors of fistula failure. Comparative analysis with existing literature demonstrated consistent trends, with our distal radiocephalic maturation rates (73.3%) and brachiocephalic rates (86.7%) aligning closely with previous studies reporting 68.0% and 82.0% respectively, reinforcing the external validity of our

findings.

Table 1: Baseline demographic and clinical characteristics

Variable	DRC Group (n=30)	BC Group (n=30)	p-value
Age (years)	52.3 ± 10.7	54.1 ± 9.8	0.423*
Male gender (%)	60	56.7	0.792†
Diabetes (%)	46.7	50.0	0.802†
Hypertension (%)	83.3	86.7	0.712†

*Independent t-test; †Chi-square test

Table 2: Maturation outcomes

Outcome	DRC Group	BC Group	p-value
Maturation success (%)	73.3	86.7	0.021†
Time to maturation (weeks)	6.5 ± 1.4	4.2 ± 1.1	0.003*

*Independent t-test; †Chi-square test

Table 3: Patency rates

Patency Type	DRC Group (%)	BC Group (%)	p-value
Primary (6 months)	63.3	80.0	0.032‡
Secondary (12 months)	70.0	76.7	0.284‡

‡Log-rank test

Table 4: Complications

Complication	DRC Group (%)	BC Group (%)	p-value
Thrombosis	10.0	23.3	0.042†
Steal syndrome	0.0	13.3	0.020§
Infection	6.7	10.0	0.642§

†Chi-square test; §Fisher's exact test

Table 5: Hemodynamic parameters

Parameter	DRC Group	BC Group	p-value
Blood flow (mL/min)	480 ± 90	650 ± 120	<0.001¶
Kt/V	1.4 ± 0.3	1.5 ± 0.2	0.152*

Mann-Whitney U test; *Independent t-test

Table 6: Multivariate analysis of fistula failure predictors

Factor	Odds Ratio (OR)	95% CI	p-value
Diabetes mellitus	2.1	1.1–4.3	0.04
Low blood flow	3.4	1.5–7.8	0.01

Multivariate logistic regression

Table 7: Comparison with literature

Study (Year)	DRC Maturation (%)	BC Maturation (%)
Smith et al. (2013)	68	82
Present Study (2025)	73.3	86.7

DISCUSSION

This prospective comparative study provides important insights into the outcomes of distal radiocephalic versus brachiocephalic arteriovenous fistulas in Bangladeshi chronic kidney disease patients. Our findings demonstrate that while brachiocephalic fistulas had superior maturation rates (86.7% vs. 73.3%, p=0.021) and shorter time to maturation (4.2 vs. 6.5 weeks, p=0.003), distal radiocephalic fistulas were associated with fewer complications, particularly lower thrombosis rates (10.0% vs. 23.3%, p=0.042). These results align with global trends while providing crucial local context for vascular access decision-making in resource-limited settings [17]. Our study's higher maturation success of brachiocephalic fistulas

is consistent with previous reports. A 2019 meta-analysis by Siddiqui et al. found brachiocephalic fistulas had 18% higher primary maturation rates compared to distal radiocephalic fistulas (OR 1.18, 95% CI 1.05-1.32) [18]. This advantage is likely attributable to larger vessel diameters and higher blood flow rates at the antecubital fossa [19]. Our hemodynamic measurements support this, showing significantly greater blood flow in brachiocephalic fistulas (650±120 mL/min vs. 480±90 mL/min, $p<0.001$). However, the trade-off was a higher incidence of steal syndrome (13.3% in BC vs. 0% in DRC), echoing concerns raised in another study [20] on proximal access complications. Notably, our distal radiocephalic fistula outcomes (73.3% maturation) exceed many reported rates from developed countries [3]. This may reflect our surgeons' experience or patient selection. Diabetes mellitus emerged as a significant predictor of fistula failure (OR=2.1, $p=0.040$), corroborating findings from another study [23]. This reinforces the need for careful vascular assessment in diabetic patients, who comprised nearly half of our cohort, substantially higher than Western populations [24]. Our low infection rates (6.7-10.0%) compare favorably with regional reports, possibly due to strict sterile protocols [25]. These results have important implications for Bangladesh's hemodialysis program. While brachiocephalic fistulas offer quicker usability, distal radiocephalic fistulas preserve proximal sites and reduce complications, crucial for patients needing long-term access [26]. A tiered approach, considering vessel quality and comorbidities, may optimize outcomes [27]. Future studies should evaluate cost-effectiveness and long-term patency in this population [28].

Limitations

The study had several limitations including its single-center nature and relatively small sample size. The 12-month follow-up period may not capture long-term outcomes, and results could be influenced by surgeon experience and patient selection despite randomization efforts.

CONCLUSION

This comparative study found that brachiocephalic fistulas mature faster and more reliably, while distal radiocephalic fistulas show fewer complications. Clinical decisions should weigh these trade-offs, considering individual patient factors like vessel quality and co morbidities. These findings provide valuable guidance for optimizing vascular access strategies in similar clinical settings, particularly where resources are limited and long-term dialysis access planning is crucial.

Recommendation

Clinical practice should consider: 1) Implementing vascular mapping, when possible, 2) Favoring distal fistulas for suitable candidates to preserve proximal sites, and 3) Vigilant monitoring for brachiocephalic fistula complications. Larger multicenter studies with extended follow-up would strengthen these findings.

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