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Original Article

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Comparison of Outcome between End-to-side and Side-to-side Anastomosis in Radiocephalic Fistula Construction for Haemodialysis Access

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Conflicts of interest: None

Abstract

Background: *Traditional end-to-side (ETS) anastomosis is a common technique for radiocephalic arteriovenous fistula (RCAVF) creation. However, Side-to-side anastomosis with distal cephalic vein ligation produces a functional ETS anastomosis which showed better outcomes. This study aimed to determine the best anastomotic technique between functional and traditional ETS anastomosis.*

Methods: *This single-blind randomized controlled trial was performed in the Department of Urology, Chittagong Medical College Hospital from May 2022 to May 2023. 100 adult patients with ESKD requiring new RCAVF were the study population. Patients were allocated randomly into functional and traditional ETS groups. Pre and postoperative duplex ultrasonograms were performed by the same radiologist and all anastomoses were performed by a single surgeon to avoid inter-personal variation. Patients were followed up for 12 weeks postoperatively.*

Results: *Both study groups were comparable in terms of their demographic and clinical characteristics. The 12-week patency rate was higher (p=0.362) in the functional ETS 48 (98.0%) than the traditional 46 (92.0%). Fistula became mature in 46(93.9%) of cases in the functional ETS group and 38 (76.0%) in traditional ETS and the difference is statistically significant (p=0.013). In the functional ETS group, 1(2%) of patients developed thrombosis, 1(2%) oedema and 1(2%) pseudoaneurysm. In traditional ETS, 3(6%) of patients developed thrombosis, 1(2%) oedema and 2(4%) pseudoaneurysm.*

Conclusion: *Functional ETS anastomosis has a better short-term outcome than traditional ETS. So, it can be a recommended anastomosis procedure for RCAVF surgery.*

Keywords: Arteriovenous fistula, radiocephalic arteriovenous fistula, functional end-to-side anastomosis, traditional end-to-side anastomosis.

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Conflicts of interest:

Currently I'm working in Rangpur Medical College Hospital, Rangpur, but at the time of study I was posted in Chittagong Medical College Hospital, Chattogram, Bangladesh where the study was conducted. Source of Funding: None.

Introduction:

End-stage kidney disease (ESKD) is a global healthcare burden.[1] The prevalence of CKD in Bangladesh is higher (22.48%) than globally.[2] Haemodialysis is the most common renal replacement therapy.[1] Arteriovenous fistula (AVF) is considered the gold standard vascular access modality.[3] Well-functioning AVF provides enough blood flow without complications for a long time, which is key to successful hemodialysis.[4] Considering the limitation of vascular resources, Radiocephalic Arteriovenous Fistula (RCAVF) is the most common choice. KDOQI Guideline 2019 recommends RCAVF as the first access of choice.[5] The most commonly reported techniques of AVF anastomosis are end-to-side (ETS), and side-to-side (STS).[6] Recently, a modified anastomosis technique using vein side to arterial side anastomosis with distal vein ligation, can achieve similar effects as those of ETS after STS anastomosis and shows promising results. Some scholars named it Functional ETS anastomosis. [6,7]

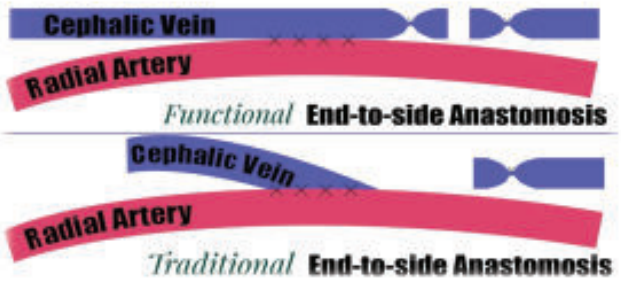

Fig.-1: *Graphical presentation of two types of anastomosis techniques*

A well-functioning AVF is an asset for ESKD patients. There is consensus regarding the location of the primary AVF. However, there is conflicting evidence regarding the superiority of anastomosis techniques. This issue is addressed by very few randomized controlled studies globally. No specific guidelines are available for anastomosis technique. To the best of my knowledge, no study has been conducted in our country using duplex ultrasound to measure the post-operative cephalic vein diameter and fistula flow to assess the maturation status of each study patient. Comparative study results are yet to be published. This study aims to determine the best anastomosis technique for the creation of RCAVF when both are anatomically feasible.

Materials and Methods:

This Randomized Controlled Trial was conducted in the Department of Urology, CMCH from May 2022 to May 2023. 100 patients ESKD patients visited or referred for AVF surgery were screened based on the inclusion and exclusion criteria. Eligible participants were enrolled consecutively. Then enrolled participants were allocated randomly into functional and traditional ETS groups according to the previous computer-generated random number table.

In group A (Experimental group), anastomosis was constructed using the functional ETS technique. In group B (Control group) anastomosis was constructed using the traditional ETS technique.

[Additional comment:2 surgical steps are now mentioned here in short]

Patients were followed up for 12 weeks post-operatively. Outcome measures were Anastomosis time, Primary patency, maturation and complications. It was a single-blind study as participants were not aware of the anastomosis technique.

ESKD patients, Aged: e"18 years requiring new arm RCAVF were included in this study. Patients with ipsilateral failed RCAVF, Allergic to injection Lignocaine, Puncture mark, scar mark or infective focus at the proposed surgical site, Absent distal pulses and chronic ischemia of the upper limb, Central venous stenosis or congestive cardiac failure, Significant neurological disorder affecting the upper limb, Radial artery or cephalic vein diameter <1.8 mm at the wrist (without tourniquet), uncorrected coagulopathy were excluded from this study.

After obtaining approval from the Ethical Review Committee, all these patients were informed about the study procedure and invited to participate in the study. Informed written consent was taken from those patients who have agreed to participate in the study.

All patients were assessed preoperatively by History: (age, co-morbidities, smoking behaviour, previous dialysis), physical examination: (Inspection, pulse, blood pressure, Allen's test), Investigations: CBC, BT, CT, APPT, RBS, S. creatinine, HBsAg, Anti HCV, duplex ultrasound: of upper limb vessels with vascular mapping (by same radiologist).

All the anastomosis were performed by a single surgeon, The surgeon followed a standard operating technique, Local anaesthesia Inj. 2% Lidocaine was infiltrated subcutaneously immediately before the commencement of surgery.

A 3-4 cm longitudinal skin incision is made along the radial forearm, starting 1-1.5 inches proximal to the

wrist crease. The skin and subcutaneous tissue are retracted bilaterally to identify and mobilize the cephalic vein and radial artery. The cephalic vein is dissected, skeletonized, and its branches are ligated and divided. The radial artery is then dissected and secured with bulldog clamps.

Functional end-to-side anastomosis (Group A): A 0.6 to 1 cm longitudinal arteriotomy and venotomy were performed. The cephalic vein was proximally dilated using fluid hydraulic pressure with heparinized saline. Anastomosis was created between the side of the cephalic vein and the side of the radial artery using 7.0 Prolene in a continuous suture pattern. Finally, the distal cephalic vein was ligated 0.5 to 1 cm distally with 4-0 Vicryl.

Traditional end-to-side anastomosis (Group B): The distal segment of the cephalic vein was ligated and divided. The vein was then dilated using fluid hydraulic pressure with heparinized saline. The proximal cut end of the cephalic vein was spatulated up to 0.6 to 1 cm, followed by radial arteriotomy. Anastomosis was performed between the end of the cephalic vein and the side of the radial artery using a continuous suture with 7.0 Prolene.

In both groups, after anastomosis and acquiring proper haemostasis, the wound was closed by using 3-0 Prolene and a light non-compressive bandage was applied.

[Additional comment:2, surgical steps are now mentioned here in detail]

Immediate patency was assessed for all patients, who were discharged after 6 hours of observation. On the 3rd postoperative day, dressing checks were conducted. On the 10th postoperative day, stitches were removed. At the 6th week, a Duplex USG of the forearm vessels was performed, and at the 12th week, the patient's haemodialysis history and any complications were reviewed.

A pretested structured case record form and Duplex ultrasonography (USG) report were used as research tools. Data were processed and analyzed by: SPSS-28, Quantitative data: was presented by Mean ± SD, Qualitative data: was by frequency and percentage, Numerical variables: differences between the groups were analyzed by Independent sample t-test, Categorical variables: were compared with the chi-square test and Fisher exact test.

[Additional comment:1, now Methodology written in a free flow manner]

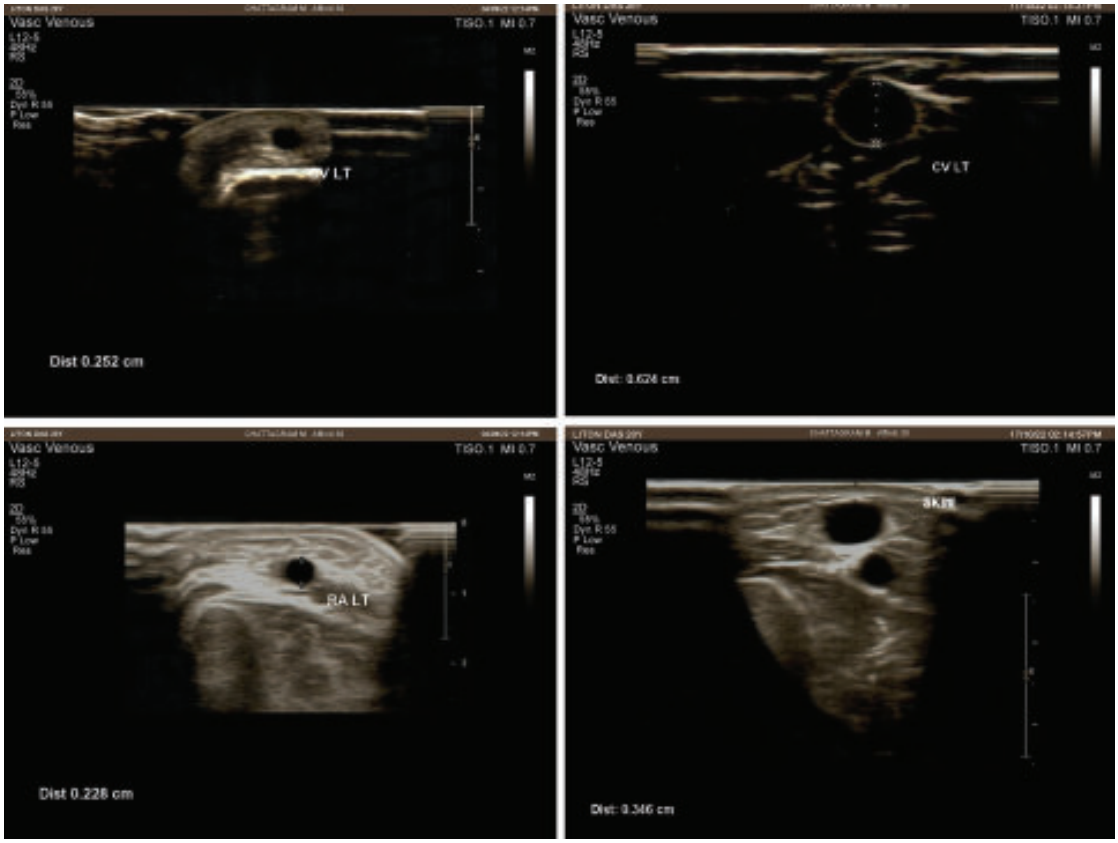

Fig.-2: *Preoperative & 6 weeks postoperative evaluation with duplex USG.*

Table I. *Comparison of fistula maturation factors between the groups*

Mean ± SD	Functional ETS (n=49)	Traditional ETS (n=50)	p value
Cephalic Vein diameter (millimetres)	6.3±1.1	5.9±0.5	0.0255
Cephalic Vein Flow (mL/minutes)	638.5±116.8	599.5±52.8	0.0345
Cephalic Vein depth from skin (millimeters)	2.48±0.50	2.64±0.48	0.109NS

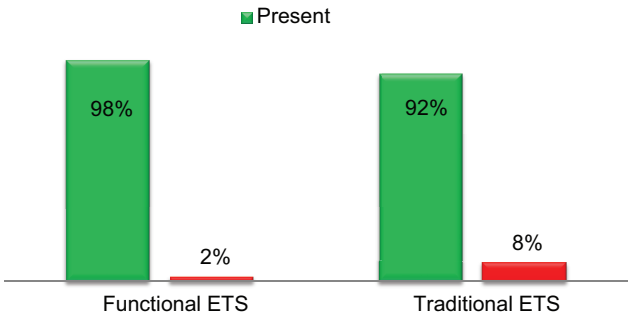

Fig.-3: *Comparison of 12th week primary patency between the groups (p=>0.05)*

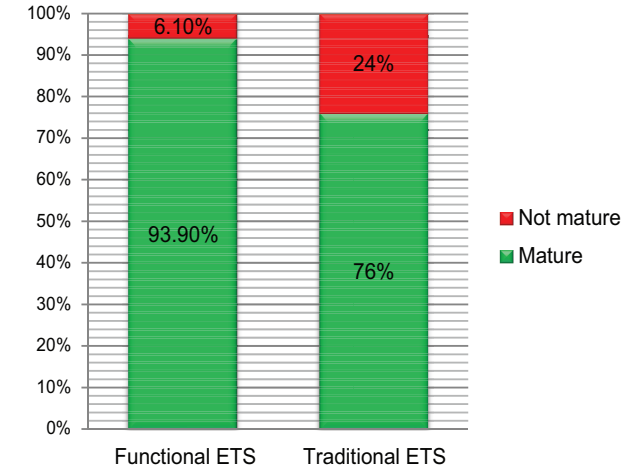

Fig.-4: *Comparison of study groups according to fistula maturation status (p=<0.05)*

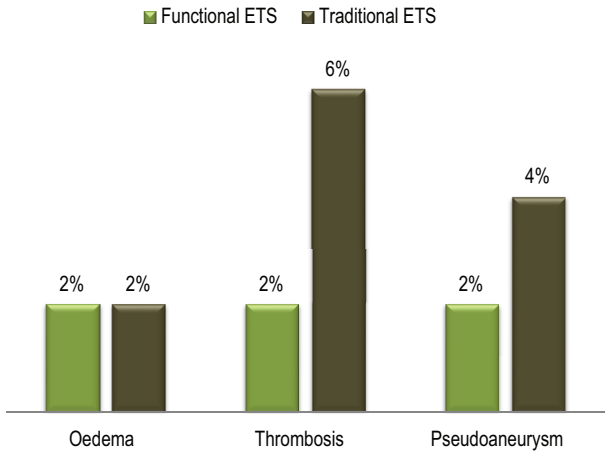

Fig.-5: *Distribution of 12 weeks complications between the groups (p=>0.05)*

Table II: *Distribution of Study Subjects Based on Demographic Characteristics, Preoperative, and Operative Findings*

	Functional ETS (n=49)	Traditional ETS (n=50)	P value
Age (in years)	49.2±12.6	46.7±12.3	0.286
Male gender	77.6%	66.0%	0.202
Comorbidities:			
HTN	100%	100%	
DM	38.8%	38.0%	
GN	18.4%	32.0%	
PCKD	4.1%	0%	
Smoker	32.7%	22.0%	0.234
On hemodialysis	19 (38.8%)	17 (34.0%)	0.621
Cephalic vein (mm)	2.1±0.3	2.1±0.3	0.922
Radial artery (mm)	2.2±0.4	2.1±0.3	0.222
Anastomosis time (minutes)	30.9±5.1	32.5±3.2	0.079

Table III: Distribution of Study Subjects Based on Outcome

	Functional ETS (n=49)	Traditional ETS (n=50)	P value
Primary patency 12th week	48 (98.0%)	46 (92.0%)	0.362
Cephalic vein diameter (mm)	6.3±1.1	5.9±0.5	0.025*
Fistula flow (ml/min)	638.5±116.8	599.5±52.8	0.034*
Cephalic vein depth from skin (mm)	2.48±0.50	2.64±0.48	0.109
Maturation rate at 6th week	46 (93.9%)	38 (76.0%)	0.013*
Overall complications	2 (4.1%)	4 (8.0%)	0.414
Thrombosis	1 (2.0%)	3 (6.0%)	0.317
Oedema	1 (2.0%)	1 (2.0%)	0.988
Pseudoaneurysm	1 (2.0%)	2 (4.0%)	0.570

Discussion:

This study compared the short-term (12 weeks) outcomes between functional and traditional ETS anastomosis techniques in 100 ESKD subjects requiring new RCAVF. After excluding one dropout, 99 subjects' data were analyzed: 49 in the functional ETS group and 50 in the traditional ETS group.

The primary patency rate was higher in the functional ETS group than in the traditional ETS group (98.0% vs. 92.0%, p=0.362) this is due to the formation of more thrombus in the traditional ETS group. However, the difference is not statistically significant.

In this study, mean cephalic vein diameter (6.3 mm) and flow (638.5 ml/min) were significantly wider in the functional ETS group compared to the traditional ETS group (5.9 mm and 599.5 ml/min) with p-values of 0.025 and 0.034, respectively. Mean cephalic vein flow was higher in the functional ETS group (638.5 ml/minute) than in the traditional ETS group (599.5 ml/minute) and the difference is also statistically significant (P= 0.034).

Maturation was measured according to Shenoy's criteria (2007)[8] as the "rule of 6", 6 weeks following the operation, fistula flow e" 600ml/min, vein e" 6mm in diameter, vein < 6mm deep from the skin surface to allow easy needle insertion. Here maturation rate was also significantly higher in the functional ETS group (93.9%) compared to the traditional ETS group (76.0%), with a p-value of 0.013.

In terms of complications, the study referenced Weigang et al. (2021)4, who reported fewer complications in the functional ETS group (3.3%) compared to the traditional ETS group (15.9%). The current study found that, overall, most patients developed a few complications: 4.1% in the functional ETS group and 8% in the traditional ETS group, over the 12-week postoperative follow-up period.

Specific complications include thrombosis (one case in the functional ETS group and three cases in the traditional ETS group, p=0.317), oedema (one case in each group), and pseudoaneurysm (one case in the functional ETS group and two cases in the traditional ETS group). Padberg et al. (2008)[9] describe pseudoaneurism of AV fistula may develop from degeneration of the vessel wall, infection or puncture hematoma.

Ahsan et al. (2010)[10] stated that the Functional ETS technique is technically simple and effectively creates a consistent wall shear stress profile reducing the neointimal hyperplasia. This reduces the development of juxta-anastomotic stenosis which is one of the key causes of primary fistula failure.

Management of these complications included both conservative and surgical approaches. In this study, none of the patients developed stenosis in either group, which may be due to the short period of follow-up, so long-term follow-up is recommended.

Conclusion:

Functional end-to-side anastomosis demonstrates higher primary patency, significantly better maturation rates and considerably lower incidence of thrombosis.

Limitations: This was a single-centre study with a short follow-up period.

Recommendations:

Functional end-to-side anastomosis is recommended as the preferred technique. Further multi-centre studies with larger sample sizes and long-term follow-up are needed to establish these findings.

References:

1. Thurlow JS, Joshi M, Yan G, Norris KC, Agodoa LY, Yuan CM, Nee R. *Global epidemiology of end-stage kidney disease and disparities in kidney replacement therapy*. American journal of nephrology. 2021 Jul 12;52(2):98-107.
2. Banik S, Ghosh A. *Prevalence of chronic kidney disease in Bangladesh: a systematic review and meta-analysis.* International Urology and Nephrology. 2021 Apr;53:713-8.
3. Bylsma LC, Gage SM, Reichert H, Dahl SL, Lawson JH. *Arteriovenous fistulae for haemodialysis: a systematic review and meta-analysis of efficacy and safety outcomes.* European journal of vascular and endovascular surgery. 2017 Oct 1;54(4):513-22.
4. Weigang, T., Wei, X., Lifeng, G., Jingkui, L., Yani, L., Huaqin, J. & Hui, L., 2021, *A meta-analysis of traditional and functional end-to-side anastomosis in radiocephalic fistula for dialysis access*, *International Urology and Nephrology*, 53(7), 1373–1382
5. Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, Allon M, Asif A, Astor BC, Glickman MH, Graham J. *KDOQI clinical practice guideline for vascular access: 2019 update. American Journal of Kidney Diseases*. 2020 Apr 1;75(4):S1-64.
6. Weigang T, Wei X, Lifeng G, Jingkui L, Yani L, Huaqin J, Hui L. A meta-analysis of traditional and functional end-to-side anastomosis in radiocephalic fistula for dialysis access. International Urology and Nephrology. 2021 Jul;53:1373-82.
7. GUAN S. Functional and traditional end-to-side anastomosis for arteriovenous fistulaplasty in hemodialysis patients: A randomized controlled study. Academic Journal of Second Military Medical University. 2010:1065-7.
8. Shenoy, S., 2007, September. Innovative surgical approaches to maximize arteriovenous fistula creation. In Seminars in vascular surgery (Vol. 20, No. 3, pp. 141-147). WB Saunders.
9. Perveg AK, Rahman H, Alam AK, Hossain TM, Ghosh KC, Rabbani RH. Effect of Anticoagulant and Antiplatelet Drugs on Outcome of Arterio-Venous Fistula Created for Hemodialysis Access. Bangladesh Journal of Urology. 2021;24(1):90-8.
10. Ahsan ZU, Waheed A, Zaeem FA, Nazir F. Arteriovenous fistulas constructed using side-to-side anastomosis with ligation and division of distal venous arm; a tertiary care hospital experience. The Journal of Vascular Access. 2010 Jan; 11(1):26-30.