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Comparison of Efficacy Outcome of Side to Side End to Side Radiocephalic Arteriovenous Fistula in Patients of Chronic Kidney Disease

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Abstract: ***Introduction: Chronic Kidney Disease (CKD) is a global health problem which is growing in prevalence. Hemodialysis is the most common treatment for end-stage renal disease (ESRD) which requires a permanent vascular access. Vascular accesses should have a good patency and low complication. Objectives: The present study aimed to compare the efficacy & outcome of side-to-side (STS) versus end-to-side (ETS) methods in radiocephalic arteriovenous fistulas in dialysis patients. Patients and Methods: In this randomized, single-blind clinical trial, 60 ESRD patients who required venous access for hemodialysis were divided equally into two groups. STS arteriovenous anastomosis was employed in one group and in the other, the ETS approach was conducted. Follow ups were done after 1, 6, and 24 weeks to detect fistula maturation and immediate or delayed complications. Results: The STS anastomosis group demonstrated higher rates of delayed maturation, vascular aneurism, and venous hypertension syndrome than ETS anastomosis group. The ETS group, however, showed higher rates of venous thrombosis and vascular stenosis. Overall, the rate of complications was 11% and 8% for STS and ETS anastomosis group respectively (P =0.03). Conclusion: In comparison, ETS arteriovenous fistulas involve less complications than STS method in ESRD patients. However, more thrombosis and stenosis detected by ETS method. ETS arteriovenous fistulas had less delayed maturation, aneurism, venous hypertension and overall complications than STS approach. ETS arteriovenous fistulas contribute to establishing a more stable connection to hemodialysis machine to conduct a more effective hemodialysis.***

Keywords: arteriovenous fistulas, hemodialysis, STS, ETS, Chronic Kidney Disease (CKD), ESRD, radiocephalic

1. Introduction

Chronic kidney disease (CKD) is a worldwide health problem. CKD has an increasing rate due to an aging population and increasing of diabetes, hypertension and cardiovascular disease (1). Currently, there are more than one and a half billion CKD patients living worldwide.

Vascular accesses should provide an easy and acceptable flow, during hemodialysis. Arteriovenous fistula (AVF) is known as the best way for vascular access in dialysis (4,5). AVF is created by anastomosis of an artery to a vein. This technique provides blood flow from deep arteries to surface veins. A 200-400 mL/min blood flow is provided by cannulation of the surface veins which is required for hemodialysis (6)

The widely used definition for AVF maturation is the one published in the updated Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines that define mature fistulae as those placed within 6 millimetres from the skin surface, at least 6 millimetres in diameter and finally allow for flow rate of ≥ 600 ml/minute. Around 20% - 50% of fistulae fail to mature into a usable access for haemodialysis, [1,9-11]. AVF fail when they are not usable for hemodialysis, AVF failure is an important problem, both in terms of establishing vascular access initially ("primary failure"), as well as maintaining functional access ("secondary failure") for ongoing hemodialysis use.[12-13]

It remains challenging to accurately predict whether an individual AVF will mature and be usable for hemodialysis vascular access. In part, this is due to the heterogeneity of ESRD populations studied as these have varied in terms of age structure, background ethnicity and the relative prevalence of different ESRD etiologies. The natural history of AVF maturation is also confounded by multiple comorbid conditions, such as diabetes, hypertension and peripheral vascular disease, which may be present in ESRD patients.

Arteriovenous Fistula is the gold standard for vascular access for hemodialysis with an overall success rate of about 84.0%, designed to improve the effectiveness of dialysis[14]

The most common AVF locations are radiocephalic (wrist), brachiocephalic (elbow), or brachiobasilic transpositions. Low resistance in the venous system leads to a substantial increase of blood flow in the artery and therefore, in the communicating vein. The artificially induced high venous blood flow leads to the dilatation of the vein and to the thickening of its wall, providing a vascular access segment that can be punctured several times a week with a large gauge needle for performing hemodialysis. The common complications of fistulae include thrombosis, venous hypertension, steal syndrome, aneurysm formation, bleeding and seroma accumulation[15].

Since radiocephalicarterio-venous fistula are the most commonly performed procedures for hemodialysis access. So the aim of this study was to compare the efficacy and outcome of the two different techniques side to side and end to side of radiocephalic AV fistula.

2. Objectives

To compare the efficacy ,patency failure rates and complications of ETS (end to side) & STS (side to side) radiocephalic AV fistula.

Patients and Methods

Study design and setting The study was conducted in the Department of Urology, PGIMS Rohtak from November

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2018 to November 2020.

Study population: The study was conducted on patients who were admitted with a clinical diagnosis of chronic kidney disease and requires venous access for haemodialysis.

Study size: The study included 60 patients of CKD who requires venous access for haemodialysis. Patients were randomly divided into two groups. Eligible patients randomly assigned to each group of STS and ETS anastomosis. There was no significant difference between the groups at the beginning of the study. Participants were assigned to one of the two groups of 30 patients in each group. The first group underwent STS anastomosis and the second group went by ETS anastomosis.

3. Operative Procedure

Radiocephalic fistula: A suitable cephalic vein just proximal to the wrist is identified preoperatively and a negative Allen's test confirmed. The whole arm including the axilla, is prepared and draped. A vertical incision is fashioned just proximal to the flexion crease of the wrist between the radial artery and the cephalic vein .The incision is carried through the subcutaneous tissue, and then medial and lateral flaps are raised. Both the cephalic vein and radial artery are very superficially located and can readily be exposed. The cephalic vein is mobilized as far proximally and distally as possible and any large branches ligated. The radial artery is also mobilized for a short distance. Once mobilization is complete, both the cephalic vein and radial artery are placed adjacent to each other in a side-by-side fashion. This can be accomplished by placing a vessel loop proximally and distally, with each loop incorporating the artery and vein. By tightening up on the loop, the two vessels are brought. If necessary, systemic heparin can now be administered. Control of the vessels can be achieved by tightening up on the vessel loops or by using small vascular clamps.

A corresponding venotomy and arteriotomy are made in the cephalic vein and radial artery. The arteriotomy should be limited to 7mm to prevent a steal syndrome. A side-to-side anastomosis is then constructed using fine, nonabsorbable monofilament (6-0 prolene). Prior to reperfusion, the anastomosis can be probed through an opening created in the distal cephalic vein. The probe is passed sequentially up the cephalic vein and the radial artery. The distal cephalic vein is then ligated and the arterial clamps released to perfuse the fistula can be created by dividing the vein initially andthen anastomosing it to the artery. Once an adequate length of vein is dissected free, it is divided. Alternatively, an end-to-side or end-to-end anastomoses between the radial artery and cephalic vein is then constructed using fine, non absorbable monofilament suture fig (1,2)

Radiocephalic fistula (end to side anastamosis)

Radiocephalic fistula (side to side anastamosis

One week after surgery, patients returned for the first follow up to check consistency of fistula. The next follow up was scheduled for 8 weeks later. Fistula maturation was determined by Doppler sonography. This examination revealed artery diameter size and mean blood velocity per time unit of brachial blood flow. Moreover, blood flow volume was calculated by cc/min. Accordingly fistula blood flow volume was determined by color Doppler sonography too. Fistula was considered mature if the venous diameter was about 6 mm. The skin-fistula distance was also 6 mm, and the flow was more than 600 cc/min. If the fistula was not matured during this period, patients will return every 2 weeks for another sonography until the date of delayed fistula maturation was established. All patients were followed up for 6 months after the procedure for consideration of probable complications. Assessments Doppler sonography and physical examinations were applied for assessment of complications. Fistula aneurism was defined by localized inflation of the vein with a diameter of 1.5 times the size of a healthy fistula segment. Skin thinness or injuries, scars, or spontaneous bleedings were recorded during the examinations. Steal syndrome was determined as an immediate or late complication determined by severe muscle weakness, sensory weakness, chill and also discoloration of the skin of the hand and pain that intensified during dialysis. Diagnosis of venous hypertension syndrome was made by observing various clinical symptoms such as pitting edema, redness, warmness, and heaviness of the limb in acute conditions and lasting hand edema and distal extremity ulcers in chronic

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conditions. Thrombosis was diagnosed by absence of thrill and bruit and impalpable distal pulse. Stenosis was determined by a bruit at a narrowed segment (high pitch) which could only be heard during the systolic time. In such cases, fistula output was reduced and dialysis conducted with a decreased speed and volume. This was a sign that the fistula needed attention.

Ethical issues

The study protocol was approved by Ethical Committee of PGIMS Rohtak. Written informed consent was obtained from all patients and remained confidential.

Statistical analysis

The data was analyzed using IBM SPSS Statistics for Windows, Version 20.0. Categorical data are expressed in true value and as percentages and were compared using the Chi-Square (X2) test, whereas continuous data were reported as mean and SD and compared using the independent sample t-test. If the p-value was <0.05, then the results considered to be significant.

4. Results

In our study, Out of total 60 patients the majority were males 36(60%), whereas females were 24 (40%). Among Group STS (Radiocephalic fistula) females were 13 (53.33%) and males were 13(43.3%). Whereas in Group ETS (Radiocephalic fistula) females were 11 (36.6%) and males were 20 (66.6%). Overall male to female ratio was 1.5:1. In our study Diabetes mellitus (40%) was the most common cause of ESRF among patients, followed by hypertension (20%),

Risk factor associated

Parameters	N(60)
Age	51.8±3.85yrs
Diabetic nephropathy	24(40%)
Hypertensive nephropathy	12(20%)
Chronic glomeronephritis	6(10%)
IgA nephropathy	4(6.6%)
CIN	3(5%)
Obstructive nephropathy	11(18.3%)

In our study Diabetes mellitus (40%) was the most common cause of ESRF among patients, followed by hypertension (20%), Obstructive nephropathy 18.3%), Chronic glomeronephritis (10%), IgA nephropathy 4(5%) and CIN 3(5%). Mean age of presentation was 51.8±3.85 years.

Table: Comparative table showing Failure rate among STS and ETS Radio cephalic fistula

Type of fistula	Primary failure	Secondary failure	Total
STS	1	5	6 (20%)
ETS	1	4	5(16.6%)

In our study out of the Total 6 Failure patient in STS group 4 of them are because of thrombosis and 2 of them are because of Venous hypertension.

In ETS group all 5 failure patients are becaue of thrombosis. Total failure rate is 18.3% and during 6 months followup no significant difference was detected in the efficacy rate.

Comparative table showing patency among STS and ETS Radio cephalic fistula

Age	Patency at 0 day	at 10 Day	at 45 Day	at 90 Day
STS	29	27	27	24
ETS	29	28	28	25
Total	58	55	55	49

In our study primary patency at 0, 10 and 45 day was approximately same for group A and group B On 90th day follow up primary patency for STS group was 80% and in ETS group was 83.3%. P value between the two comparative group was 0.36 which is not significant, thus showing that Both ETS & STS techniques have similar patency rate..

Comparative table showing various Complications STS and ETS fistulas

Complications	N(60)
Pseudoaneurysm	3(5%)
Thrombosis	3(5%)
Rupture	1(1.6%)
Infection bleeding and wound gaping	9(15%)
Limb edema	3(5%)
Total	19(31.6%)

In our study various complication which occurred in Group 1 and Group 2 were Pseudoaneurysm 3 (5%)**,** Thrombosis 3(5%)**,** Rupture 1 (1.6%)**,** Infection, bleeding & wound gaping 9(15%) and Limb edema 3(5%) Overall complications were 19(31.6%).

The rate of complication was less in STS AVF (15%)as compared to ETS Radiocephalic AVF(16.6%).

On comparison between the two groups, Infection was present in 4(6.6%) and 5(8.3%) patients of STS and ETS groups respectively. Pvalue was 0.197 showing the difference statistically insignificant

Aneurysm occurred in 1 patient in Both STS and ETS groups respectively. Pvalue was 0.61 showing the difference statistically insignificant.

Thrombosis occurred in 2(3.3%) and 1(1.6%) patients of STS and ETS group respectively. Pvalue was 0.07 showing the difference statistically insignificant.

Rupture of fistula occurred in 1(1.6%) case of ETS RCAF only. Pvaue was 0.15 showing the difference statistically insignificant.

None of our patients developed vascular steal phenomenon

5. Conclusion

It seems that the STS arteriovenous fistula construction carries fewer complications compared to ETS approach in ESRD patients who require hemodialysis. Although thrombosis and stenosis are often reported in ETS method however, it comprises less delayed maturation, aneurism, venous hypertension, and lower overall complications rate which are essential for a successful dialysis.

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6. Limitations of the Study

The most important limitation of the study was its small sample size. We suggest larger studies on this topic in hemodialysis patients.

7. Conflicts of Interest

The authors declare that they have no competing interests

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