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COMPARATIVE STUDY OF OUTCOMES OF SIDE TO END AND SIDE TO SIDE DISTAL FOREARM RADIOCEPHALIC ARTERIOVENOUS FISTULAS FOR HEMODIALYSIS ACCESS

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ABSTRACT:

Background: Hemodialysis was only confined to Acute kidney injury (AKI), but development of concept of Arteriovenous fistula (AVF) changed the concept in Chronic kidney disease (CKD) and saves many lives. The most suitable anatomical position of artery and vain to make an ideal fistula is that they should be proximal to each other and vein diameter should be adequate.**Objective:**Aim and objectives of the study was to asses and observe outcomes (intraoperative, immediate and post operative) of side-by-side vs end to side radiocephalic AVF in distal forearm in CKD patients undergoing hemodialysis.**Materials and methods:**The study was carried out in Department of Plastic Surgery, SCB medical college, Cuttack, Odisha, India from January 2020 to December 2021. Total 50 patients with CKD, more than aged 18 years and clinically appreciable cephalic vein in distal forearm and good volume radial pulse were included. Results were put into chi square test and p value was calculated.**Results;**Majority of the patients were males. Female gender is not a risk factor for primary failure. Over-all percentage of primary failure was 32% similar to many studies. In this study, primary failure was high in side-to-side AVF as compared to side to end. Diabetes and hypertension are common risk factors for primary failure. Among the various complications hematoma is more frequent as compared to aneurysm or thrombosis.
Conclusion: It can be concluded that side to end configuration is better, as complications like venous hypertension and steal syndrome is less, though other complications are comparable.

Key words: distal forearm, radiocephalic arteriovenous, fistulas, hemodialysis

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INTRODUCTION:

Hemodialysis is a procedure where the patient blood circulation in an extracorporeal circulate and returned to the body after passing through as electrochemical gradient in which blood filters by a process of diffusion[1]. Previously hemodialysis was only confined to AKI but there was a need of permanent vascular access which can be used repeatedly[2]. This lead to development of AVF which saves life of many patients. KDOQI [3]and Fistula First Initiative has helped to increase the Fistula use,more and more in dialysis patients.Several studies have shown higher mortality[4] among the dialysis study in a catheter rather than in a fistula [5] (Dhingrae et.al 2001 ,Pasten et al 2002) It may be related to catheter infection or death. Also it improves erythropoiesis response and nutritional markers. (Wystrychowsk et al 2009)[6]. Fistula creation requires a direct anastomoses[7] between a high pressure artery and low pressure vein. When a fistula is created, the vein is exposed to a 10 fold increase in Blood flow[8].(Yerder etal)Natural Kidney Foundation(NKF) suggests a creation of Fistula 6 month prior to ESRD[9].It is also advised to create AVF in stage 4. Many guidelines suggests creation of AVF in between a GFR 15-25 ML/Min By Roojanetal, AVF with vessel size,[7]i.e arterial 1-2mm and venous diameter < 1.6mm. Cumulative 1 year fistula survival rate is 52%.

By Kiliteretal 2008 primary 1 yr. survival rate is better in transposed Brachio Basilic fistula compared to Brachiocephalic fistula (4.6 % to 22%)Fistula non maturation is sometimes associated with different factors like old age, female Sex, cardiovascular disease (Allex& Robbin 2002)[10,11]. Preoperative vascular mapping (most centers use Doppler USG) of arteries or vein <1.5 mm have bad outcome as compared to>1.5mm. Most centers prefer a minimum diameter of artery as 2mm and of vein as 2-3 mm. In Some trials also it had less value, i.e. effect of preoperative mapping with maturation[12].(Silva etal)Combination of an access Blood flow >500ml/min and vein diameter >4mm leads to >92 % fistula suitability.. Stenosis can be corrected by angioplasty, surgical revision. Complication of Fistula like stenosis[13],thrombosis,intimal hyperplasia can be solved by balloon angioplasty start or mechanical thrombectomy. Button hole cannulation is done to decrease pain during needle infiltration and avoid pseudoaneurysm. Here our aim is to assess outcomes of side by side vs side to end radiocephalic AVF in distal forearm in CKD patients undergoing hemodialysis.

MATERIALS AND METHODS:

The study was carried out in Department of Plastic Surgery, SCB medical college, Cuttack, Odisha, India from January 2020 to December 2021 after obtaining institutional ethical approval.

Inclusion criteria taken were -

1. Patients with chronic renal disease aged 18 years and above.
2. Clinically appreciable cephalic vein in distal forearm and good volume radial pulse should be present.

Exclusion criteria were;

1. Those who are not having clinically appreciable cephalic vein.
2. Those having feeble or absent radial pulse,

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3. Those where intraoperatively grossly atherosclerotic artery was found and the procedure couldn't be carried out.

All the patients underwent hemodialysis before the procedure. Allen's test was performed. Side to side and end to side radiocephalic fistula was performed in either left or right-side distal forearm. A 4-5 cm Skin incision was given. Loupe magnification was used. Cephalic vein identified then radial artery identified and brought upwards. 4cm segment of artery and vein was dissected free from the surrounding soft tissues. Atherosclerotic condition of radial artery if present was noted. 1.5cm of arteriotomy and veinotomy done.

RESULTS:

Total out of 50 patients enrolled in half of them end to side and in other half side to side anastomosis was carried out between the artery and vein. Data were compiled into master charts and from that the following tables were obtained.

Table 1. Showing age distribution

AGE RANGE	SIDE TO END	PERCENTAGE	SIDE TO SIDE	PERCENTAGE
18-29	3	12%	3	12%
30-39	4	16%	3	12%
40 and above	18	72%	19	76%

Out of 50 patients in the study, 40 years or more was 37, in the range 30 to 39 years were 7and 20 to 29 years of age was 6. Most patients were aged 40 years and above in each group.(table 1)Mean age and standard deviation in side to end group was 45.04 years and 12.45; and in side to side group was 47.88 and 13.97, almost similar as per age.

Table 2. Showing gender distribution

GENDER	SIDE TO END	PERCENTAGE	SIDE TO SIDE	PERCENTAGE
MALE	19	76%	18	72%
FEMALE	6	24%	7	28%

37 patients were male and 13 were female in our study and overall male to female ratio was found to be 2.8:1. Most of the patients undergoing the procedure were males, which shows a male preponderance of chronic kidney disease. (table 2)

Table 3. Showing distribution of comorbid condition in both groups

COMORBIDITIES	SIDE TO END	PERCENTAGE	SIDE TO SIDE	PERCENTAGE
DIABETES MELLITUS	19	76%	17	68%
HYPERTENSION	14	56%	17	68%

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In our study 36 patients were diabetic and 31 were hypertensive. Above values show that both diabetes mellitus and hypertension are frequently associated co-morbid conditions in chronic renal disease patients requiring hemodialysis access. Hematomais the most frequent complication in both the groups in our study, followed by thrombosis. Next common complication is venous hypertension which was exclusively found in the side to side group. Rate of aneurysm and infection were similar in both the groups. Steal syndrome was seen in only side to side group in our study. (table 3)

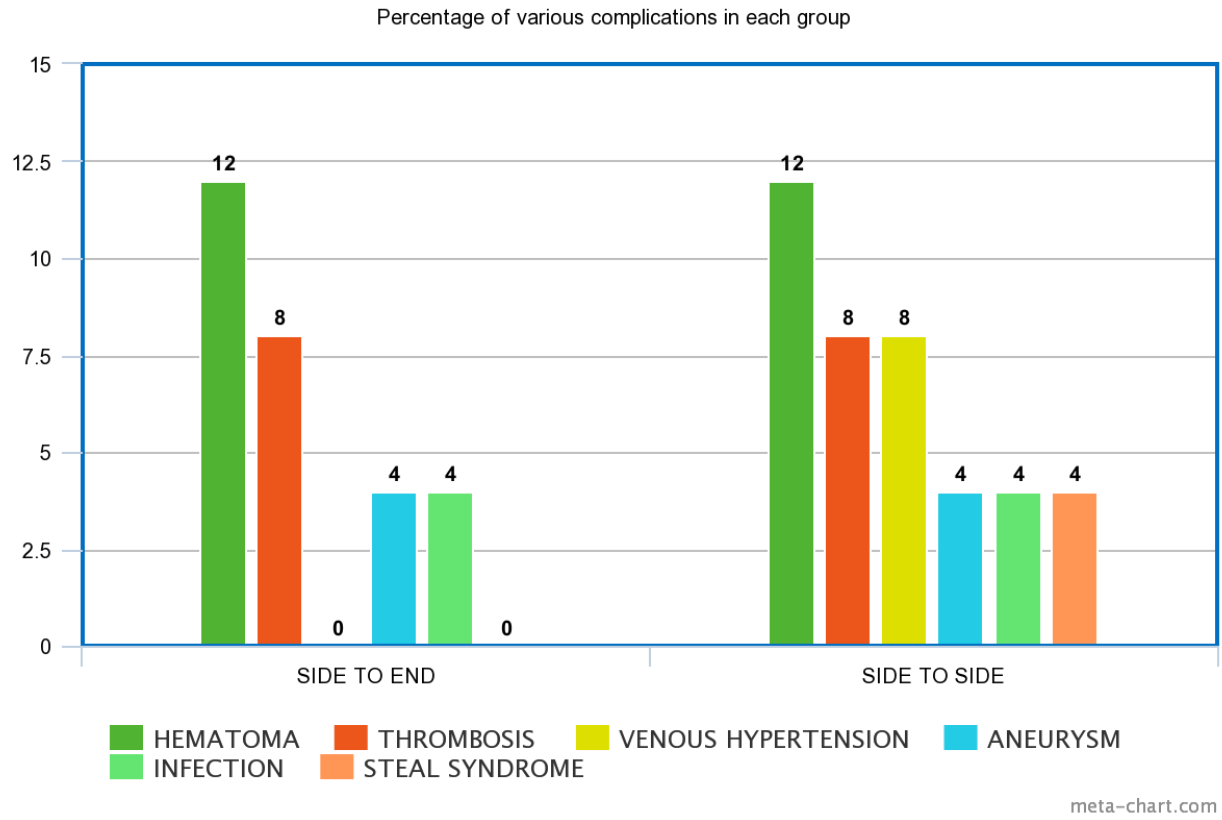

Fig 1. Bar diagram of complications in both groups

When followed after 3 months in the study group of 50 patients, 16 were unsuccessful. Nine were not matured in side to side group, in end to side group 7 was unsuccessful. Most of the cases from both the groups have similar rate of failure and p value rate was not significant. But cases of venous hypertension and steal syndrome are more in cases of side-to-side anastomosis group. Cases of venous hypertension presented with gross edema of the affected hand and forearm with skin excoriations, which subsided abruptly following distal vein ligation. Few cases of aneurysms presented with dilated swellings over the forearm were successfully treated with excision and ligation. Cases of swelling were explored and found to have large hematomas leading to thrombosis and absence of thrill. They were treated with evacuation and ligation of vein and subsequent new access site were done at other sites. Cases of infection were treated with antibiotics as per culture sensitivity, drainage of wound,

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ligation and access was created at other site on a later date. Case of steal syndrome treated with vein ligation which improved perfusion to hand.(figure 1)

Table 4. Showing outcomes of the procedure in each groups

GROUPS	FAILED	PERCENTAGE	MATURED	PERCENTAGE
SIDE TO END	7	28%	18	72%
SIDE TO SIDE	9	36%	16	64%
TOTAL	16	32%	34	68%

The chi-square statistics is 0.3676.

The p-value is 0.54429. Insignificancep is <.05

Yates correction along with chi square is 0.0919.with p-value at .0.761761.

So there is no significant difference between side to end and side to side distal radiocephalic arteriovenous fistula creation with regard to outcome. The Fischer exact test also revealed no significant difference in outcome. Ficher exact test statistic result is 0.7624. The result is insignificance at <0.05. Failure percentage was more in side to side group(36%) as compared to side to end group(28%) in our study but statistical analysis using chi-square test and fischer exact test showed no significant difference. (table 4)

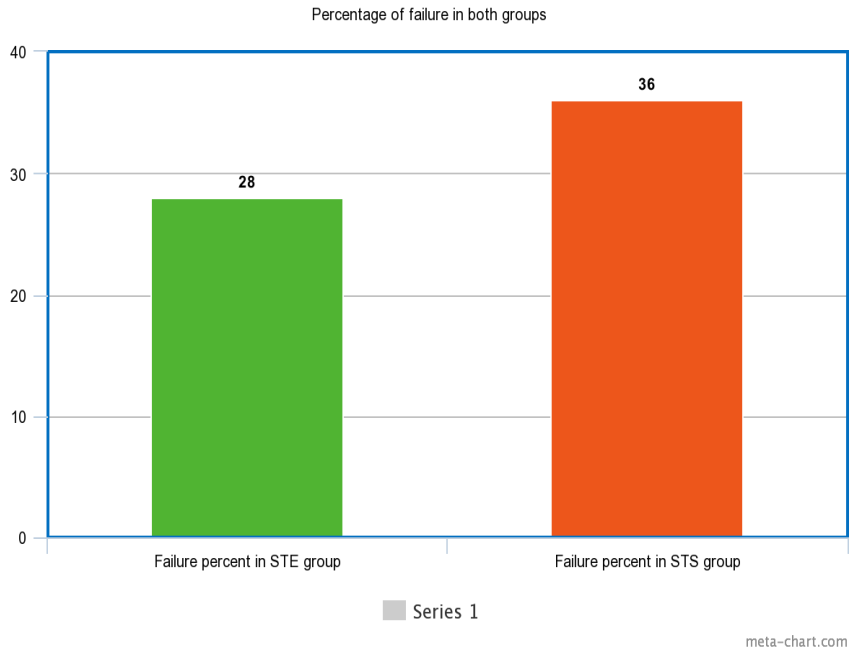

Fig 2. Percentage of failure in both the groups

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Table 5. Showing gender and age distribution in failed cases

GENDER	FAILED CASES	percentage	AGE	FAILED CASES	percentage
MALE	12/37	32%	40YRS AND ABOVE	15/37	40.5%
FEMALE	4/13	31%	LESS THAN 40YR	1/13	7.7%
TOTAL	16/50	32%	TOTAL	16/50	32%

Most of the failed cases were male and as per age distribution, most of the failed cases were 40yrs and above in our study. But the percentage of failed cases in each gender was similar. (table 5)(figure 2)

Table 6. Showing distribution of co morbidities in failed cases

COMORBITIES IN FAILED CASES	NUMBER OF FAILED CASES	percentage
DM AND HTN	13	81.25%
DM	1	6.25%
HTN	1	6.25%
NONE	1	6.25%
TOTAL	16	100%

13 out of the 16 failed cases were having both the co-morbidities that are DM and Hypertension. (table 6)

Table 7. Showing mean, range and standard deviation of blood flow rate in ml/sec and vein diameter in mm

GROUP	SIDE TO END	RANGE	SIDE TO SIDE	RANGE
MEAN BF(ml/sec)	793.63	608 to 944	788.13	610 to 903
STANDARD DEVIATION	121.49		98.33	
DIAMETER(mm)	4.556	4.0 to 5.4	4.613	4.2 to 6.1
TOTAL CASES	25		25	

Mean blood flow rate was relatively higher in side to end group. Unpaired t test results of mean blood flow: The different p values at 0.8890, was insignificant as per criteria. Confidence interval: mean as a result of difference between side to end and side-side was

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5.50, the difference at 95% confidence interval was 74.30 to 85.30. Standard error of difference=39.074. (table 7)

However mean blood flow volume is relatively higher in side to end group, which is beneficial for a hemodialysis access. Blood flow shows no significant difference as per t test. Unpaired t test results of vein diameter: The different p values at 0.7152, was insignificant as per criteria. Confidence interval: mean as a result ofdifference between side to end and side-side was 0.056, the difference at 95% confidence interval was 0.368 to 0.256, Standard error of difference=0.153. Statistically no significant difference in values of vein diameter was found.

Most of the cases from both the groups have similar rate of failure and p value rate was not significant. But cases of venous hypertension and steal syndrome are more in cases of side to side anastomosis group. Cases of venous hypertension presented with gross edema of the affected hand and forearm, which subsided abruptly following ligation. Few cases of aneurysms presented with dilated swellings over the forearm was successfully treated with ligation. Cases of swelling with haematoma were opened and thoroughly drained, vessels ligated and closed, which healed uneventfully.

Table 8. Showing prevalence of atherosclerotic radial arteries

	Number of atherosclerotic radial arteries	Percentage
In failed cases	9/16	56%
In matured cases	9/34	26%
Total atherosclerotic radial arteries	18/50	36%

Overall prevalence of atherosclerotic radial artery was 36% in our study, and it was 56% in failed cases and 26% in matured cases. Prevalence of atherosclerotic radial artery in failed cases of side to end group was 57% and 55% in side-to-side group. (table 8)

DISCUSSION:

Majority of the patients undergoing the procedure were males in our study, this showed that males are more affected by chronic kidney disease. It has been seen in different studies that prevalence of fistula is low in women,, cause unknown.Various studies has shown that the the risk factors for primary AVF are women,old age and cardiovascualar risk factors.[15]As the study shows, female gender is not a risk factor for primary AVF failure, as percentage of failure were same in both the gender in our study.

The failure percentage in male population in our study was 32% while it was 31% in female population. The result was insignificant with relation to gender . Similar result was shown by a meta-analysis study by Huijbregts HJ et al[20], it is described that diabetes,female gender plays a very insignificant role in primary AVF failureIn this study the

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overall percentage of primary failure was 32%. Various studies in the literature showed primary failure percentage as; 32% by Miller PE et al[16], 26% by R Venkatnarayan et al [17], 19% by Allemang MT et al [18], 31% by Chan C et al [19]and 44% by Huijbregts HJ et al [20].
Both diabetes mellitus and hypertension were associated in 81% of failed cases in our study. Many studies concluded increased primary failure incidence in patients with diabetes. In our study also similar finding was noted.In this study 74% cases are more than 40 years age and male to female ratio was 2.8:1. Beladi et al study quotes the same age group(41-60 yrs) with a more male prevalence(56.7%).In our study failure percentage was 40.5% in age group 40 years and above, while it was 7.7% in age group <40 years. So, significantly higher percentage of failure was seen in older age group. The various risk factors for primary AVF failure or immature are diabetes,women,age,CV risk factor. [21,22,23]The incidence of hematoma in this study is 12% as compared to study in Suwitchakul C et al [13] where it is 3%.the incidence of aneurysm was 4% as compared to various studies i.e 5-7%.similarly thrombosis in this study was 8% as compared to other studies 2-7%. .the incidence of hematoma in this study is more.The percentage of wound infection, steal syndrome described in Haimov M et al is 4.4% and 1.6% and in Suwitchakul C et al[13] is 2.0% and 2.0%.similarly in this study it is 4% and 2% respectively.The mean blood flow was 793.63 ml/min in STE and 788.13 ml/min in our study. As we come across various studies [24] the flow rate across fistula is 500-1000 ml/min in 72 out of 100 patients. It is observed that it is low in females and diabetes. The mean vein diameter was 4.5mm in side to end group and 4.6mm in side to side group. The various factors needed for a successful AVF , as described by R Venkatnrayan[17] are venous diameter > 3mm,side-side AVF,AVF diameter >5mm,hearing of thrill once clamp removed at 24 hr. In our study also all cases were performed under loop magnification and thrill present in all cases after release of clamps.Overall prevalence of atherosclerotic radial artery was 36% in our study, and it was 56% in failed cases and 26% in matured cases. Prevalence of atherosclerotic radial artery in failed cases of side to end group was 57% and 55% in side to side group. So presence of atherosclerosis of radial artery is associated with higher chances of failure. In our study percentage of primary failure was higher in side to side group as compared to side to end group, but R Venkatnarayan et al[17] had shown side to side to be a better configuration. Also mean blood flow rate in side to end group was higher in our study. Limitation of our study was that, in most cases we couldn't get vivid result as sample size was small, and was conducted during COVID pandemic period, and cases were operated by different surgeons.

Conclusion:

In our study, we observed no statistical difference in failure rate in side to end and side to side group. The incidence of complications like hematoma, infection, thrombosis and aneurysms are almost similar in both group. The venous hypertension and steal syndrome were mostly found in side to side group of our study. Mean blood flow rate was relatively higher in side to end group in our study. It can be concluded that side to end configuration is better as complications like venous hypertension and steal syndrome is less and there is higher blood flow rate.

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References:

1. Abdulrahman Bu Ali, Ahmed Elsayed, Huwaida Al Baloshi, Ahmed Al Ansari. Right atrial thrombus post hemodialysis catheter: Case reports. Int J Med Sci Public Health. 2013; 2(3): 767-769

2.Siracuse JJ, Cheng TW, Arinze NV, Levin SR, Jones DW, Malas MB, Kalish JA, Rybin D, Farber A. Snuffbox arteriovenous fistulas have similar outcomes and patency as wrist arteriovenous fistulas. J Vasc Surg. 2019 Aug;70(2):554-561.

3.Lok CE, Huber TS, Lee T, et al. KDOQI clinical practice guideline for vascular access: 2019 update. Am J Kidney Dis. 2020;75:S1– S164.

4. Gil Giraldo Y, Munoz Ramos P, Ruano P, Quiroga B. Vascular access-related mortality in hemodialysis patients during and after hospitalization. Therapeutic Apheresis and Dialysis. 2020 Dec;24(6):688-94.

5. Dhingra, R. K., Young, E. W., Hulbert-Shearon, T. E., et al. (2001). Type ofvascular access and mortality in U.S. hemodialysis patients. Kidney Int, 60, 1443–51.

6.Wystrychowski, G., Kitzler, T., Thijssen, S., et al. (2009). Impactof switch of of vascular access type on key clinical and laboratoryparameters in chronic hemodialysis patients. Nephrol DialTransplant, 24, 2194–200.

7. Bae E, Lee H, Kim DK, Oh KH, Kim YS, Ahn C, et al. Autologus arteriovenous fistula is associated with superior outcomes in elderly hemodialysis patients. BMC Nephrol. 2018;19:306

8. Jindal K, Chan CT, Deziel C, Hirsch D, Soroka SD, Tonelli M, et al. Canadian Society of Nephrology Committee for Clinical Practice Guidelines. Hemodialysis clinical practice guidelines for the Canadian Society of Nephrology. J Am Soc Nephrol. 2006;17(Suppl 1):S1–27.

9.National Kidney Foundation. KDOQI Clinical Practice Guideline for Hemodialysis Adequacy: 2015 update. Am J Kidney Dis. 2015 Nov;66(5):884-930.

10. Lee T, Thamer M, Zhang Q, Zhang Y, Allon M. Vascular access type and clinical outcomes among elderly patients on hemodialysis. Clin J Am Soc Nephrol. 2017;12:1823–30.

11. Drew DA, Lok CE, Cohen JT, Wagner M, Tangri N, Weiner DE. Vascular access choice in incident hemodialysis patients: a decision analysis. J Am Soc Nephrol. 2015;26:183–91.

12. Ilhan G, Esi E, Bozok S, Yürekli I, Özpak B, Özelçi A, Destan B, Gürbüz A. The clinical utility of vascular mapping with Doppler ultrasound prior to arteriovenous fistula construction for hemodialysis access. J Vasc Access. 2013 Jan-Mar;14(1):83-8

13.Quencer KB, Arici M. Arteriovenous fistulas and their characteristic sites of stenosis. Am J Roentgenol. 2015;205:726–34.

14.Almasri J, Alsawas M, Mainou M, Mustafa RA, Wang Z, Woo K, Cull DL, Murad MH. Outcomes of vascular access for hemodialysis: A systematic review and meta-analysis. J Vasc Surg. 2016 Jul;64(1):236-43.

15. Suwitchakul Chaiyaporn. Surgical Outcomes of Arteriovenous Fistula for Hemodialysis in End Stage Renal Disease Patients with Diabetes Mellitus. Vajira Med J. 2011;54(2):171–180

ISSN: 0975-3583, 0976-2833 VOL 13, ISSUE 05, 2022

16. Miller PE, Tolwani A, Luscy CP, Delerhoi MH, Bailey R, Redden DT, et al. Predictors of adequacy of arteriovenous fistulas in hemodialysis patients. Kidney Int 2019;56:275-80
17. R Venkatnarayan, Pavitra Manu Dogra, Rohit Bavdekar, Sanjeev Kumar Singh, Ashish Kumar Mondal, Primary failure of autogenous arteriovenous fistula: Critical analysis; Indian Journal Of Nephrology, 2020; VOL 30,iss6,382-90
18. Allemang MT, Schmotzer B, Wong VL, et al. Arteriovenous grafts have higher secondary patency in the short term compared with autologous fistulae. Am J Surg. 2014;208(5):800-805.
19. Chan C, Ochoa CJ, Katz SG. Prognostic factors for arteriovenous fistula maturation. Annals of vascular surgery. 2018 May 1;49:273-6.Fistula First Initiative indicated? J Am Coll Surg. 2013;216(4):679- 685.
20. Huijbregts HJ, Bots ML, Wittens CH, Schrama YC, Moll FL, Blankestijn PJ. Hemodialysis arteriovenous fistula patency revisited: results of a prospective, multicenter initiative. Clinical Journal of the American Society of Nephrology. 2018 May 1;3(3):714-9.
21. Chan C, Ochoa CJ, Katz SG. Prognostic factors for arteriovenous fistula maturation. Annals of vascular surgery. 2018 May 1;49:273-6.
22. Dember LM, Imrey PB, Beck GJ, Cheung AK, Himmelfarb J, Huber TS, Kusek JW, Objectives and design of the hemodialysis fistula maturation study. American journal of kidney diseases. 2014 Jan 1;63(1):104-12
23. Maya ID, O'Neal JC, Young CJ, Barker-Finkel J, Allon M. Outcomes of brachiocephalic fistulas, transposed brachiobasilic fistulas, and upper arm grafts. Clinical Journal of the American Society of Nephrology. 2022 Jan 1;4(1):86-92.
24. Ferring M, Claridge M, Smith SA et al. Routine preoperative vascular ultrasound improves potency and use of arteriovenous fistulas for hemodialysis: a randomized trial. Clin J Am Soc Nephrol. 2010;**5**:22-36.