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Clinical aspects and Outcome of Vascular Access Surgery in End stage Renal Disease

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ABSTRACT

The study was done to access the outcome of the factors affecting Atrio-Venous Fistula procedure in Indian subjects. A prospective study based on evaluation for construction of Atrio-Venous Fistula for haemodialysis in Indian patients of ESRD was carried out. Pre-operative assessment of both arterial and venous components by physical examination and by CDFI was done and feasibility of construction of AVF was based on the same. Studies on Western subjects have shown the success of AVF with vein diameter more than 2.5mm and arterial diameter more than 2mm plus AVF has maximal flow if the Fistula if the Fistula diameter is 75% more than the diameter of the artery. In this study we incorporated similar guidelines ,however AV Fistulas were constructed even if caliber of vessels were lesser than the above mentioned caliber ,it is a known fact that that Europeans and Western subjects have larger caliber blood vessels as compared to Indian subjects. Of all the radio-cephalic AVF the diameter of radial artery was more than 02 mm, .range 2.1mm-2.5mm and however cephalic vein diameter was less than 2.5mm,range 1.0-2.3mm and in brachio-cephalic AVF the diameter of brachial artery was > 2mm,range 3.7-6.0mm and cephalic vein diameter >2.5mm,range3.9-4.1mm. After one year follow up 38 AVF were functional(01 underwent renal transplant) and 12 AVF were non-functional. The AVF should be constructed even if the vein diameter is less than 2.5mm and arterial diameter is less than 2.0mm in Indian subject, as the patency was 75.6% after 01 year.

Keywords: **AVF**-Atrio-Venous Fistula, **ESRD**-End Stage Renal Disease, **HD**- Haemodialysis.

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INTRODUCTION

Since 1920, when George Haas first described the application of a Hemodialysis (HD) technique on a human subject, uraemic support has fascinated both the scientific and medical community. The problems of access however remained the Achilles heel of the emerging discipline [1].

It was only in 1960 ,when Scribner introduced the Teflon–sialastic AV shunt, that regular HD become feasible and regular dialysis therapy became a standard method of treatment [1].

Development of Bresica–Cimino Arterio Venous fistula in 1966, alleviated many drawbacks of external shunt and permitted greater patient activity with reduced complications related to access [2].

Arteriovenous fistula (AVF) is the preferred access for long-term hemodialysis, with superior long-term patency rates; however, early failure rates are significant [3]. Recent evidence has brought into question the preferred site of AVF creation in many patient groups. A preoperative test that could reliably predict the outcome of a proposed AVF would be of great benefit [4]. Doppler ultrasound has been the most extensively studied and widely used test to guide access creation. Accurate and validated measurements of internal vessel diameter, both arterial and venous, and blood flow in the upper extremity are obtainable by Doppler ultrasound. Studies evaluating the utility of Doppler ultrasound prior to AVF creation suggest that vessel size and blood flow are predictive of AVF outcome [5,6]. Silva et al. have shown that by using minimum venous diameter of 2.5 mm for fistulas (using a tourniquet), 4 mm for grafts and minimum arterial diameter of 2 mm with equality of bilateral arm systolic blood pressure, they were able to improve the proportion of fistulas to grafts compared with an earlier period where clinical examination alone was used. An AVF created using a cephalic vein and/or radial artery smaller than the above mentioned calibre is likely to fail; such preoperative data may indicate that an upper arm AVF should be the primary access attempted[6].

The preoperative noninvasive evaluation of the upper extremity helps in planning the optimal site for hemodialysis access construction, on the basis of preoperative venous and arterial mapping, and maximizing the creation of autogenous AVF.

Aims and Objectives

The aim of the study is to evaluate the factors affecting the outcome of the Atrio-Venous Fistula procedure in Indian subjects. Role of Colour Doppler Study before AVF construction for hemodialysis access.

Objective

Studies on European and Western subjects have shown the success of AVF with vein diameter more than 2.5mm and arterial diameter more than 2mm plus AVF has maximal flow if the

Fistula if the Fistula diameter is 75% more than the diameter of the artery.In this study we incorporated similar guidelines ,however AV Fistulas were constructed even if caliber of arteries and veins were lesser than the above mentioned caliber ,it is a known fact that that Europeans and Western subjects have larger caliber blood vessels as compared to Indian subjects.

MATERIALS AND METHOD

Studies on European and Western subjects have shown the success of AVF with vein diameter more than 2.5mm and arterial diameter more than 2mm and AVF has maximal flow if the Fistula diameter is 75% more than the diameter of the artery [4,5,7].In this study we incorporated similar guidelines; however, AV Fistulas were constructed even if caliber of arteries and veins were lesser than the above mentioned caliber.

A prospective study based on detailed evaluation of construction of AVF for hemodialysis in Indian patients of ESRD was carried out at this institute from Aug 2015 upto Aug 2018.

Pre-operative assessment of both arterial and venous components by physical examination and by Color Doppler Flow Imaging(CDFI) was done and feasibility of construction of AVF was based on the same (Fig 1 and 2). Post-operative evaluation based on CDFI was done at one week, one month, three months and one year of surgery to assess the patency of AVF(Fig 3).

Inclusion criteria

All ESRD patients who were referred for construction of AVF were taken up for the study .

Exclusion criteria

- Presence of segmental stenosis of veins.
- Presence of ipsilateral central venous stenosis/occlusion.
- Obliterated calcification of arteries.
- Unwilling individual.

This report presents my total experience with End vein to Side artery fistula construction[8,9,10] during the same period (Fig 4). All operations, including those which were not successful are considered. A total of 50 patients were studied. The data has been carefully analysed and results tabulated

Statistical Analysis

The assessment of study data was investigated and the distribution of categorical measurements according to the frequency and percentages was done to describe our numerical parameters with mean and standard deviations. For categorical variables, Fisher's exact test was applied. The results were evaluated at a significance level of $p<0.05$.

RESULTS AND OBSERVATIONS

In my series, 50 patients were studied who underwent End to Side AV Fistulas construction The analysis are as follows :

Total number of cases studied	50
Total number of patients who underwent A.V fistulas construction at wrist – (radio-cephalic)	45
Total number of patients who underwent AV fistulas construction at Cubital fossa – (brachio-cephalic)	05

Sex:

In my series of 50 patients who underwent AV fistula construction majority were males. Fifty AVF (End to Side) operations were carried out, of which 36 were male and 14 females.

Males - 72%

Females - 28%

The statistical analysis reveals that sex has no predilection on the outcome of a fistula (Table 1).

Table 1: Statistical Analysis of Sex and Outcome of AVF

Result	**Sex**			
	Male		**Female**	
	No	%	No	%
Successful	28	77.8	10	71.4
Failure	08	22.2	04	28.6
Total	36	100	14	100

Test	**p value**	**Association**
Pearson Chi-Square	0.637	Not significant
Fisher's Exact Test	0.718	Not significant

Age:

In my series of 50 patients after careful analysis it was found that majority of the patients were between the 3rd and 6th decade. This indicates that ESRD is a disease of middle age in India hence chronic dialysis though remains a mainstay of their treatment, it is definitely not an ultimate answer. The age of the patients was between 16 to 72 years with a mean of 48.54 years for study group(Table 2).

Table 2: Age Distribution

Age in years	**Total No. of Patients**	**Males**		**Females**	
		No.	**%**	**No.**	**%**
0-10	00	00	00.00	00	00.00
11-20	01	01	100.00	00	00.00
21-30	05	04	80.00	01	20.00
31-40	07	05	71.42	02	28.58
41-50	15	12	80.00	03	20.00
51-60	12	08	66.66	04	33.34
61-70	09	05	55.55	04	44.45

71-80	01	01	100.00	00	00.00
Total	50	36	-	14	-

The statistical analysis of age and outcome of AVF brings out the observation that age is inversely proportional to the outcome of AVF, therefore younger the patient greater the chances of a successful AVF(Table 3).

Table 3: Statistical Analysis of Age Group and Outcome of AVF

Result	**Age**					
	< 45 YRS		**YRS**		**> 60 YRS**	
	No	%	No	%	No	%
Successful	18	94.7	15	71.4	05	50
Failure	01	5.3	06	28.6	05	50
Total	19	100	21	100	10	100

Test	**P value**	**Association**
Pearson Chi-Square	0.022	Significant

Aetiology:

The major causes of ESRD are diabetes and hypertension, which together account for 64% of dialysis patients. Diabetes is the most common attributed cause of ESRD, followed by hypertension, glomerulonephritis, cystic diseases and urological diseases (Table 4). In the youngest group, the most common diagnoses are glomerulonephritis and cystic/hereditary/congenital diseases, whereas diabetes is rare. For the oldest age group the most common attributed causes of ESRD are diabetes and hypertension. It was observed that diabetes is relatively more common in women and hypertension is relatively more common in men.

Table 4: Aetiological Factors

Aetiological factor	**No. of Patients**	**Percentage**
Diabetic nephropathy	17	34
Hypertensive nephropathy	15	30
C G N	09	18
Obstructive uropathy	05	10
Amyloid kidney	01	02
Bilateral polycystic kidney	01	02
Renal tuberculosis	01	02
Nephrotic syndrome	01	02

Pre-OP Assessment Of Caliber Of Blood Vessels By CDFI

Of all the radio-cephalic AVF the diameter of radial artery in most cases was more than 2mm,(range 1.6mm-2.5mm) (Mean-2.3mm).However, cephalic vein diameter was less than 2.5mm, (range 1.0-2.3)(Mean-1.87mm). [Table 5]

In brachial-cephalic AVF the diameter of brachial artery was > 2mm, (range 3.7-6.0mm) (mean-4.52mm) and cephalic vein diameter >2.5mm, (range 3.9-4.1mm) (mean-4.0mm). [Table 6] *Outcome*- All patients underwent End to Side AVF of which 42 patients had their operations on the left upper limb and 08 on the right upper limb with a total of 45 operations

situated at wrist (radio-cephalic) while 05 were at elbow(brachial-cephalic). In Radio-cephalic 75.55% AVF were successful and in Brachio-cephalic 80% AVF were successful (Table 7). The tabulated statistical analysis as per table 9 A ,9 B, 10 A and 10 B lead us to observe that arterial and venous diameters both >2mm have a positive predilection towards the outcome of AVF. It is also stated that of all the subjects who underwent radio-cephalic AVF none had a venous diameter >2.5mm.

Table 5: Sex Wise Distribution Of Pre-Op Assessment Of Caliber Of Radial Artery And Cephalic Vein In Radio-Cephalic Fistula

Calibre of vessels(mm)	Radial Artery		Cephalic Vein	
	Male	Female	Male	Female
00-01	00	00	00	01
1.1-02	05	04	20	08
2.1-03	26	08	13	03
3.1-04	02	00	00	00

Table 6: Sex Wise Distribution Of Pre-Op Assessment Of Caliber Of Brachial Artery And Cephalic Vein In Radio-Cephalic Fistula

Calibre of vessels(mm)	Brachial Artery		Cephalic Vein	
	Male	Female	Male	Female
00-01	00	00	00	00
1.1-02	00	00	00	00
2.1-03	00	00	00	00
3.1-04	01	01	02	02
4.1-05	01	00	01	00
5.1-06	01	01	00	00

Table 7: Outcome of AVF

AV Fistula	Radio-cephalic		Brachial-cephalic	
	No	%	No	%
Successful	34	75.55	04	80
Unsuccessful	11	24.45	01	20
Total	45		05	

Table 9A: Statiscal Analysis of Venous Diameter And Outcome Of AVF

Result	Venous Diameter			
	<= 2.5 mm		> 2.5 mm	
	No	%	No	%
Successful	34	75.6	04	80
Failure	11	24.4	01	20
Total	45	100	05	100

Test	P value	Association
Pearson Chi-Square	0.825	Not Significant

Table 9b : Statiscal Analysis Of Venous Diameter And Outcome Of AVF

Result	Venous diameter			
	<= 2 mm		> 2 mm	
	No	%	No	%
Successful	19	65.5	19	90.5
Failure	10	34.5	02	9.5

Total	29	100	21	100

Test	P value	Association
Pearson Chi-Square	0.041	Significant

Table 10 A: Statistical Analysis Of Compatibility Of Arterial And Venous Diameter In Outcome Of AVF

	Result	Arterial and Venous Diameter IN mm							
		Arterial diameter <2 mm Venous diameter < 2.5 mm		Arterial diameter >2 mm Venous diameter < 2.5 mm		Arterial diameter <2 mm Venous diameter > 2.5 mm		Arterial diameter >2 mm Venous diameter > 2.5 mm	
		No	%	No	%	No	%	No	%
	Successful	04	50	30	81.1	NIL	-	04	80
	Failure	04	50	07	18.9	NIL	-	01	20
	Total	08	100	37	100	NIL	-	05	100

Test	P value	Association
Pearson Chi-Square	0.171	Not Significant

Table 10 B : Statistical Analysis Of Compatibility Of Arterial And Venous Diameter In Outcome Of AVF

Result	Arterial and Venous Diameter IN mm							
	Arterial diameter <2 mm Venous diameter < 2 mm		Arterial diameter >2 mm Venous diameter < 2 mm		Arterial diameter <2 mm Venous diameter > 2 mm		Arterial diameter >2 mm Venous diameter > 2 mm	
	No	%	No	%	No	%	No	%
Successful	04	50	15	71.4	NIL	-	19	90.5
Failure	04	50	06	28.6	NIL	-	02	9.5
Total	08	100	21	100	NIL	-	21	100

Test	P value	Association
Pearson Chi-Square	0.060	Significant

Follow Up

After a year of follow up, 38 AVF were functional ie; 76% (Table 11)(01 underwent renal transplant) and 12 AVF were non-functional (05 AVF had primary failure and 07 became non functional subsequently). Silva et al. showed the primary patency rate of 84% after one year in a series of 89 patients in whom arteries and veins were identified with duplex scanning as suitable for primary AVF [4].They demonstrated a dramatic improvement in their autogenous fistula rate with the institution of the protocol of routine use of duplex scanning for preoperative access planning. In our study 76% were successful after 01 year follow up.(Figure 3)

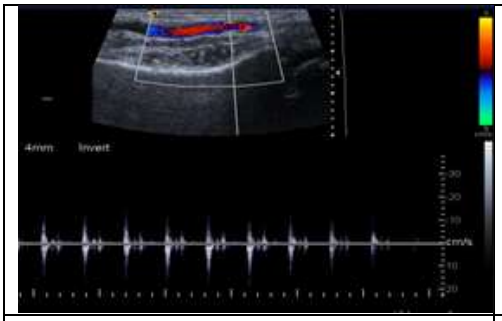

Figure 1: Pre op CDFI of Radial artery

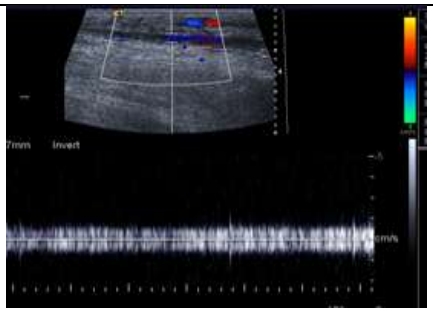

Figure 2: Pre op CDFI Cephalic Vein

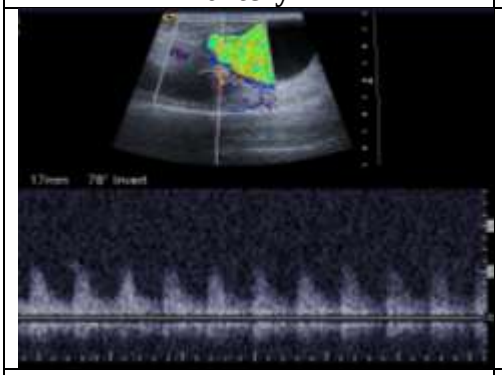

Figure 3: Flow through AVF after 01 yr follow up

Figure 4: End to Side AVF

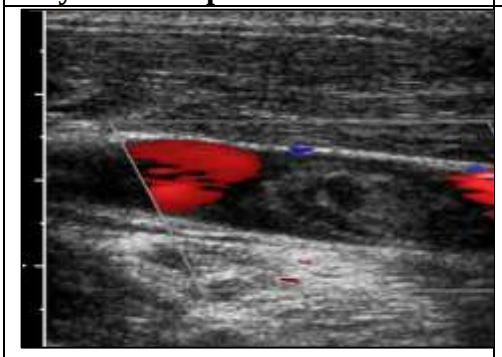

Figure 5 : Venous Thrombosis

Figure 6: Pseudoaneurysm

Table 11: Follow UP AT 01WK,01 MTH, 03 MTH, AND 01 YEAR

AVF (Out of 50)	At 01 Wk	At 01Mth	At 03 Mth	At 01 Year
Functional	44 (88%)	42(84%)	41(82%)	38(76%)
Non Functional	06 (12%)	08 (16%)	09 (18%)	12 (24%)

Transplantation:

In our series only one patient finally received renal transplant.

Total number of patients - 50

Total No. of Transplantation - 01

Complications

In our series of 50 patients, we came across early as well as late complications. The most common complication that we came across was early or spontaneous thrombosis(Fig 5). In my series we came across 05 such cases. The other complications that we came across are as follows(Table 12). The above three statistical data tables lead to the observation that complications are not influenced by age, sex or aetiological factors affecting the subjects

Table 12: Complications

Complications	Cases	Percentage
Early thrombosis	05	10.00
Haemorrhage from anastomosis (Early)	01	02.00
Late thrombosis	03	06.00
Infection	01	02.00
Burst open fistula	NIL	00.00
Aneurysm (Fig 6)	02	04.00
Oedema hand	04	08.00
Ischaemia of hand	NIL	00.00
Failure to develop prominent veins	NIL	00.00
Carpel Tunnel Syndrome	NIL	00.00
Embolism	NIL	00.00
Endocarditis	NIL	00.00
Increased cardiac output	NIL	00.00

DISCUSSION

Arteriovenous fistula (AVF) is the preferred access for long-term hemodialysis, with superior long-term patency rates; however, early failure rates are significant. Recent evidence has brought into question the preferred site of AVF creation in many patient groups [7]. Doppler ultrasound has been the most extensively studied and widely used test to guide access creation. Accurate and validated measurements of internal vessel diameter, both arterial and venous, and blood flow in the upper extremity are obtainable by Doppler ultrasound. Studies evaluating the utility of Doppler ultrasound prior to AVF creation suggest that vessel size and blood flow are predictive of AVF outcome [5]. Such preoperative data may indicate that an upper arm AVF should be the primary access attempted. Further prospective studies are needed to evaluate the utility of Doppler ultrasound.

A fundamental prerequisite for hemodialysis is the intermittent access to the blood stream of the patient. In the early stages of the development of the techniques of hemodialysis, a peripheral artery and a vein were individually cannulated. Since these vessels were sacrificed at the completion of each dialysis, there was a limit to the number of dialysis that could be performed on each patient. This technique was therefore restricted only to a patient suffering from acute reversible renal failure, while the unfortunate patient with end stage renal disease was doomed [10,11].

Bresica and Cimino in 1966, described the technique of creating a subcutaneous arteriovenous fistula between the radial artery and an adjacent vein [12]. This approach permits easy access for multiple percutaneous cannulation of the arterialized veins in the forearm[13]. Several modifications of this basic technique and use of a saphenous vein graft, have been described for patients with unavailable radial arteries or unsuitable distal veins.

Vascular access management is central to maintain the health and quality of life of end-stage renal disease (ESRD) patients. Early referral for a decision about replacement therapy, preservation, clinical evaluation of vessels and planning for timely placement of an arteriovenous fistula (AVF) should be done [14]. A native arteriovenous fistula (AVF) distally created is the "gold standard" for vascular access for hemodialysis treatment[15,16,17]. Complications of central venous catheters are well known: high rate of infections and stenosis or even thrombosis of the host vein[18].

Color doppler vascular mapping before hemodialysis access placement now is an established procedure[6]. Studies demonstrated that preoperative sonographic mapping before placement of hemodialysis access can change surgical management, with an increased number of AVFs placed and an improved likelihood of selecting the most functional vessels . Superficial and deep veins of the forearm and upper arm, as well as arteries, are evaluated for their suitability for fistula placement. Criteria such as the diameter of the vein and the depth of the superficial vein from the skin are used to determine whether a fistula is recommended. Color Doppler also has a role after access placement. Also Doppler ultrasound can play a key role in addressing the two primary goals of the Vascular Access Work Group of the National Kidney Foundation, to increase the prevalence and use of native AVFs and to detect access dysfunction before occlusion[2,19,20] . Doppler evaluation will play an increasingly important role in determining the maturity of a hemodialysis AVF [6]

Most HD patients nowadays are older and have diabetes or cardiovascular disease. These vascular risk factors are associated with increased arterial disease and an increased risk of AVF failure. Pre-existing arterial disease can be assessed by color doppler ultrasound assessment that is particularly important for the radial artery. Furthermore, clinical assessment may be inconclusive in a considerable proportion of patients, for instance when veins are not apparent in the obese. Pre-operative ultrasound assessment predicts AVF patency and maturation for dialysis. Ultrasound is of particular benefit when physical examination is insufficient but has little added value when physical examination is satisfactory. Therefore, physical examination should be used initially for all patients to evaluate a suitable site for AVF surgery. Patients who are likely to benefit most from pre-operative color doppler ultrasound evaluation are those with- insufficient clinical examination (obese, absent pulses, multiple previous access surgery, possible arterial disease ,older age, diabetes, cardiovascular disease), possible venous disease (previous cannulation).

Using color duplex ultrasound surveillance, Grogan and colleagues found an unexpectedly high prevalence of critical stenoses in patent AVFs before initiation of hemodialysis and concluded that stenoses seem to develop rapidly after arterialization of the upper extremity

superficial veins. They postulated that turbulent flow conditions in AVFs might play a role in inducing progressive vein wall and valve leaflet intimal thickening, although stenoses may be caused by venous abnormalities that predate AVF placement. Detection of stenosis, graft degeneration, or pseudoaneurysm formation may be important in triaging the patient toward appropriate care [21,22] . Color Doppler may prove useful in triaging patients toward the appropriate therapy for an immature AVF. A successful fistula must have adequate inflow and outflow, pre-operative examination must include assessment of both arterial and venous components. Silva et al. have shown that by using minimum venous diameter of 2.5 mm for fistulas (using a tourniquet), 4 mm for grafts and minimum arterial diameter of 2 mm with equality of bilateral arm systolic blood pressure, they were able to improve the proportion of fistulas to grafts compared with an earlier period where clinical examination alone was used [6].

This study on vascular access procedures, presents our experience with End to Side AV Fistulas as the vascular access. This study has been spanned over a period of 3 years. It has been our endeavor to provide a baseline data and to emphasize some of the principles with which improved results can be obtained. The need for effective procedures and a systematic approach is emphasized by the simple consideration that a routine upper extremity arteriovenous fistula for hemodialysis will be punctured by two 14 gauze needles more than 120 times/year. Thus durability, reliability, ease for approach by paramedical assistants, resistance to infection and potential for revision, are the basic vascular access goals[23,24,25].

A total number of 50 cases were studied, All the patients were treated as indoor patients. As a rule I dealt with each case as an individual and subjected them to preoperative Color Doppler study of blood vessels of both upper limbs. As the pre-op evaluation was non-invasive the patients and their relatives accepted our view regarding the same. Also the siting of AVF based on the Color Doppler study. We constructed End to Side AVF even if the caliber of vein was less than 2.5 mm and arterial diameter less than 2 mm. and in case of arteries absence of oblitrative calcification, absence of blood pressure differential >20mmHg and patent palmer arch were kept as criteria for construction of AVF.

In constructing AVF, the presence or absence of venous valves just adjoining the anastomotic site are important consideration in the success of a fistula. Veins usually have valves at or near the wrist joint, which if not carefully searched for, may cause frustrating failures In our study we always used to search for venous valves meticulously after a venotomy incision had been made. Cannulation of vein through the venotomy incision by polyethylene cannulas also helped in searching for venous valves. If the valves were found proximal to the venotomy, we

always tried to excise them with the help of a sharp scissors. Such a procedure also helped us in reducing troublesome hand oedema[26].

Veins usually go into spasm once dissection starts, leading to difficulty in anastomosis and frequently post-operatively thrombosis. Liberal use of local anaesthetic agent *(*2 % xyiocaine) and Heparin in saline solution was used to counter the element of spasm. We also avoided unwanted handling of the veins, as excessive handling of veins prolongs the spasm component and cause sluggish blood flow leading to thrombosis and failure. Therefore, radial artery was always dissected first and dissection of the vein left till the end [10].

The use of vessels loop, Bulldog clamps should be delayed just before making arteriotomy incisions.

Anastomosis was always done with 7/0 ePTFE wherein End of vein was always anastomosed with Side of artery. Placing of sutures plays a definite role in longitivity and success of a fistula. sutures were always placed 1 mm apart with just adequate tension, of continuous type. While anastomosing the anterior layer special care was taken not to include the posterior layer in anastomosis which would otherwise give rise to on table failure. Intimal tear is to be avoided by minimizing rough handling. Proper hemostasis is must[5].

We also found it necessary to discuss with the patients taking them into confidence regarding the pre-operative Color Doppler evaluation type of access to be formed, Its site and its post-operative care.

In preoperative preparation, stress was always laid on a good skin preparation. For same, the parts were painted with liquid betadine which is a good skin antiseptic by any standard. These minor details helped a lot in bringing down the failure rate due to avoidable reasons.

Out of the AVF , end to side radio-cephalic anastomosis was done in 45 cases (90 %) with a success rate of 75.55%. In 5 cases due to unavailability of suitable vessels at wrist joint during color doppler study, proximal brachial-cephalic fistulas had to be created. This anastomosis being placed just over a major joint (Elbow joint), it was found to be more of a burden to the patient as the patient's joint mobility was restricted due to associated oedema and constant nagging fear in mind of damage to the anastomosis[27,28,29,30]. In one such case due to repeated puncture, traumatic, troublesome aneurysm developed which had to be closed down in emergency[22].

It has been mentioned earlier that arterial diameter more than 2 mm and venous diameter more than 2.5 mm gave better results ,however in our study it was observed that though the arterial diameter of more than 2 mm gave favourable results but venous diameter of 2 mm gave results as good as those with a diameter of more than 2.5 mm[5,6].

Looking at the various complications which we observed Thrombosis of a fistula emerged on the top with a score of 16% (08 cases). Cases of early as well as late thrombosis were seen. Factors attributed to repeated attacks of clotting were hypotension, peripheral vasosccclusive diseases, infection and mechanical obstruction to blood flow[21,23].

Hand oedema was also a common complication. Hand oedema developed in 04 cases (08%). Thus to prevent hand oedema, we had started ligating the distal cephalic end. In those patients who developed oedema of hand, conservative treatment was given in form of hand elevation and regular hand exercises.

Infection was another factor which led to fistula failure. In my series 01 fistula failed due to infection which led to thrombosis. From the very beginning, stringest care and steps to prevent such complications were taken, dressing inwards was routinely avoided to prevent cross infection. Dressings were always changed in minor operation theatre taking all aseptic precautions.

Aneurysm was also noticed as a complication. Two patients developed aneurysm at fistula site. Hemorrhage was noted in one patient which was controlled with re-exploration and ligation of vessels[22].

Looking into the other technical aspect which are of importance, we found that proper alignment of vessels, skin closure, operative time, post-operative bandaging, adequate maturation of a fistula and finally proper and adequate training to, the hemodialysis staff are also of utmost importance. A good alignment of the vessels is necessary. Sufficient length of vein and artery should be mobilized to prevent angulation, kinking and obstruction.

Skin closure, though thought to be of least importance has a very strong effect on the outcome of a vascular access. The skin should merely be opposed without tension preventing compression; on the newly created fistula. Such a compression causes decreased flow rate through the fistula, ultimately leading to failure. I have always taken into consideration this matter and have always personally opposed the skin margin loosely.

Tight bandaging/compression dressing post-operatively is also to be avoided. we found that the oozing which occurs at the wound site invariably stops and does not give rise to troublesome bleeding for which compression is required. Hence we always followed the principle of loose bandaging/ non-compression dressing of the fistula site post-operatively[24].

It is important to complete the anastomosis within minimum operative time to reduce the possibility of early thrombosis and failure. The operative time in my series ranged from 45 minutes to one hour which was just adequate. Flushing of' the proximal and distal ends of vessels by inserting a polyethylene cannula just before taking the last 2 stitches is very important. This helps to dislodge soft clots that may have formed in vein and artery.

Maturation time required is also of vital importance, There has always been a constant pressure from the nephrology team, for starting hemodiaysis, but no haste must be shown. In our study, the maturation time remained between 4-6 weeks[13]. patients should not be subjected to needle punctures before adequate maturation. To declare a fistula mature, the various aspects that I took into consideration were:

1. Wound should have completely healed.
2. No oozing from the wound.
3. A good palpable thrill.
4. A good auscultable bruit.
5. Visible dilated (arterialized) veins on hand and forearm.
6. Post-operative color Doppler study of flow through AVF and absence of stenosis and thrombosis.

Puncture of veins prior to maturation is very hazardous as veins are ill developed and, proper pressure required for hemodialysis is not achieved, requiring repeated punctures and application of pressure over the fistula site leading to thrombosis, aneurysm formation and subsequently closure of fistula.

Hemodialysis technician should be well trained and should practice proper aseptic precautions while puncturing the arterialized veins.

Finally in the study it was found that the patient population was middle and older age group. The mean age was 48.54 yrs. Looking at the age group of the patients, we can say that hemodialysis though remains the mainstay of treatment in ESRD, it doesn't remain the answer for it. During our study live related renal transplant was offered to only one patient. Rest of the patients were offered chronic dialysis.

Thus patients of ESRD can now look for a better future with the development of renal transplant both live related and cadaveric. To reach this stage, both these vascular access procedures have played a vital role. This remains the main difference between renal failure and other organ failure, as patient of kidney failure can be maintained long with chronic dialysis whereas other organ failure requires urgent replacement[31,32].

Table 13 A ; Statistical Analysis of Complications and Age Group

Complications	**Age**					
	< 45 YRS		**45-60 YRS**		**>60**	
	No	%	No	%	No	%
Thrombosis	01	50	04	57.1	03	42.9
Edema	01	50	01	14.3	02	28.6
Infection	Nil	-	01	14.3	0	-
Others	Nil	-	07	14.3	02	28.6
Total	02	100	13	100	07	100

Test	p value	Association
Pearson Chi-Square	0.797	Not Significant

Table 13 B ; Statistical Analysis Of Complications And Sex

Complications	Sex				Total	
	Male		Female			
	No	%	No	%	No	%
Thrombosis	05	41.7	03	75	08	50
Edema	04	33.3	Nil	-	04	25
Infection	01	8.3	Nil	-	01	6.2
Others	02	16.7	01	25	03	18.8
Total	12	100	04	100	12	100

Test	P value	Association
Pearson Chi-Square	0.668	Not Significant

Table 13 C ; Statistical Analysis Of Complications and Aetiological Factors

Complications	Aetiological Factors								Total	
	HTN WITH ESRD		Diabetes Mellitus With ESRD		CGN		B/L WITH ESRD	HDUN		
	No	%	No	%	No	%	No	%	No	%
Thrombosis	03	75	04	40	Nil	-	01	100	08	50
Edema	01	25	02	20	01	100	Nil	-	04	25
Infection	Nil	-	01	10	Nil	-	Nil	-	01	6.2
Others	Nil	-	03	30	Nil	-	Nil	-	03	18.8
Total	04	100	10	100	01	100	01	100	16	100

Test	P value	Association
Pearson Chi-Square	0.668	Not Significant

CONCLUSION

Hemodialysis remains the main stay of treatment for most of the patients with ESRD and Vascular access procedures are the means through which patient can receive this form of treatment. Internal AVF remains the “gold standard” access procedure and has become the method of choice for vascular access for chronic hemodialysis today. Early referral for creation of AVF should be done so that adequate maturation is allowed. Pre-op Color Doppler study is vital for planning dialysis access and for the assessment of AVF. The construction of AVF should be attempted even if the vein diameter is not more than 2.5mm in Indian subjects. Adequate preoperative preparation is must and Strict aseptic precautions during the procedure and during dialysis is extremely important. Adequate mobilization of vessels is must andPolyethylene cannulation and flushing with heparinised saline is must before taking last stitches in a fistula. End to side anastomosis considerably decreases troublesome hand oedema and steal syndrome. Strict hemostasis is important as pressure bandaging over a fistula site is prohibited. Regular post-op color doppler follow up helps in early detection of complication/failure with immediate treatment/revision of AVF . In close co-operation with the dialysis team, color doppler is highly effective in reducing the failure of accesses and

improving the quality of life of those undergoing haemodialysis. Hand exercises prevents early thrombosis and helps in maintaining the venous end patent by increasing the flow through it. Adequate maturation time (approximately 4-6 weeks) is required before starting hemodialysis. Early puncture may cause formation of a hematoma that could cause pressure on the fistula site. The hand for fistula operation should not be used for intravenous puncture, because this leads to thrombosis and increase in failure rate. Construction of AVF for hemodialysis is both safe and cost effective and as such we strongly recommend their placement for maintenance.

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