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A Study of Various Angioaccess in Haemodialysis Patients

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Abstract: *Contemporary societies are in the midst of an epidemic of chronic non communicable diseases including that of chronic kidney disease (CKD). India is no exception to this rule. Hemodialysis is still the main treatment given for patients of Chronic Kidney Disease, although renal transplantation is slowly changing the trends with better immunosuppression and better surgical techniques with wider acceptance of the masses. The provision of effective and timely hemodialysis requires a stable and reliable vascular access. Thus, vascular access is not only the obvious 'Achilles heel' of hemodialysis (HD) but it is also the quiet undercurrent of trends in patient outcomes. Data on the comparisons between various angioaccess are very limited in literature. So we undertook a study to compare the various angioaccess used for hemodialysis in patients of CKD.*
Key Word: *CKD- Chronic Kidney Disease, HD- Hemodialysis*

I. Introduction

Contemporary societies are in the midst of an epidemic of chronic non communicable diseases including that of chronic kidney disease (CKD). India is no exception to this rule. Many parts of India are undergoing rapid epidemiological transition as a consequence of economic and social changes.[1] The increase in non communicable diseases is real and not simply due to better diagnosis. This epidemiologic transition is partially attributable to better nutrition, control of infectious disease and gain in life expectancy. An untoward consequence of this extension of life is the emergence of chronic diseases as leading causes of death.[2]

Chronic kidney disease is a worldwide health problem. According to World Health organization (WHO) Global Burden of Disease project, diseases of the kidney and urinary tract contribute to global burden with approximately 850,000 deaths every year and 115,010,107 disability adjusted life years. CKD 12th leading cause of death and 17th cause of disability.[3] This global prevalence, however, may be grossly underestimated for a number of reasons. Patients with CKD are at high risk for cardiovascular disease (CVD) and cerebrovascular disease (CBVD), and they are more likely to die of CVD than to develop end-stage renal failure. Moreover, patients with CVD often develop CKD during the course of their disease, which may go unrecognized. Therefore, an unknown proportion of people whose death and disability attributed to CVD have kidney disease as well.[4]

Moreover, most epidemiological data (prevalence, incidence, patient demography, morbidity, and mortality) on CKD are derived from renal registries. However, most registries record data of patients who are at late stage of kidney disease. Much less is known about the prevalence of the earlier stages of the CKD. Indeed, it has been acknowledged that the majority of the individuals at early stages of CKD have gone undiagnosed and under treated.[4] The number of end stage of renal disease patients that need dialysis or renal transplantation increased in the world. The overall magnitude and pattern of chronic kidney disease (CKD) in India has been studied sporadically. The CKD Registry of India is a new initiative that has been started to document CKD and its course in our country.

Modern haemodialysis therapy started on 17 March 1943, when Willem Kolff, a young doctor in the small hospital of Kampen (The Netherlands), treated a 29-year-old housemaid suffering from malignant hypertension and 'contracted kidneys'. Kolff had constructed a 'rotating drum kidney' with the support of Mr Berk, the director of the local enamel factory. First, Kolff used only venipuncture needles to obtain blood from the femoral artery and to reinfuse it by puncturing a vein. Later, he performed surgical cut-down of the radial artery which caused severe bleeding during heparinization.

In the years that followed, substantial technical developments are linked to the names of Nils Alwall in Lund (Sweden) and John P. Merril in Boston (USA). In the 1950s, the technical devices were available for regular haemodialysis treatments, e.g. Kolff's so-called twin-coil kidney[5] but, the Achilles heel was a reliable access to the circulation for multiple use which did not yet exist. Vascular access is not only the obvious 'Achilles heel' of hemodialysis (HD) but it is also the quiet undercurrent of trends in patient outcomes.

It took another 16 years before Quinton and Scribner introduced the first permanent vascular access: the Scribner shunt.[6] This device consisted of 2 Teflon® tubes connecting the patient to the dialyser; one tube was inserted into a suitable peripheral artery and one into a suitable vein. After treatment, the circulatory access

was kept open by connecting the two tubes outside the body using a small U-shaped Silastic device over a stainless steel plate. The major disadvantages of Scribner shunts were high thrombosis and infection rates resulting in a limited shunt and hence patient life span.

In 1962, Cimino and Brescia reported on veno-venous access for HD which used a sphygmomanometer to dilate an accessible forearm vein and a blood pump, and in which blood was returned through another vein, usually in the ankle.[6] This experience led them to make one of the most important developments in HD - the arteriovenous fistula.[7] Even though this required a blood pump for dialysis, the blood access problem was solved and use of the shunt declined rapidly. In 1966, Brescia and Cimino solved the blood access problem with a surgically created arteriovenous fistula (AVF) between the radial artery and a vein.[7] This new vascular access was able to deliver flow rates of 250-300 mL/min for unlimited intervals. Results were satisfactory, 13 AVFs (87%) functioned without any complication and two failed before cannulation. Nowadays, the Brescia-Cimino (radio-cephalic) AVF is still the preferred type of vascular access.[8-9]

In 1961, Shaldon Higgs and Chiandussi introduced temporary HD catheters and these catheters continue to be the primary means of achieving acute hemodialysis access. The ready availability of the CVC as a vascular access (VA) for HD often makes them the access of choice, especially when urgent or emergent HD is required either at the time of initiation of renal replacement therapy or when a permanent access becomes dysfunctional.[10]

Central Venous Catheter remain an important method to obtain VA as a bridge to the placement and maturation of an arteriovenous fistula (AVF) or arteriovenous graft (AVG), pending renal transplantation, and as the sole access in many patients. The use of CVCs has several advantages in short term: It does not require the integrity of the peripheral blood vessels, a number of sites are available for immediate insertion, it can be used immediately and for prolonged periods, and it provides painless access.

A catheter conundrum' remains in existence where we hate catheters, but cannot live without them.[11] Thus, while advantageous in very short term, unavoidable and often necessary, CVC are a hazard in most other situations, especially if used for longer periods.

It has been convincingly argued that there is a disproportionately high use of Central venous catheters for dialysis in the US. According to the Dialysis Outcomes and Practice Patterns Study (DOPPS), CVC were the major type of vascular access for initiation of hemodialysis in the US in comparison to countries in Europe and in Japan.[12]

There is a lack of pre dialysis care by nephrologists in US and this seems to have an important correlation with the use of catheters as incident access. According to USRDS 2009 report, in year 2007, 43% of ESRD patients were not followed by a Nephrologist prior to the initiation of HD.[13] The early referral to nephrologist by primary care physicians, and an early referral to surgeon for fistula placement by nephrologists are the key interventions to improve incident CVC use. Preoperative vascular mapping can improve fistula placement rates, and perhaps the fistula maturation rates, which has the potential of reducing prevalent CVC rates.[14]

The provision of adequate hemodialysis is dependent on repeated and reliable access to central circulation. An ideal access delivers a flow rate adequate for the dialysis prescription, has a long use-life and has a low rate of complications (e.g. stenosis, thrombosis, aneurysms, limb ischemia, and infections). Although no current access type fulfils all of these criteria, the native arteriovenous (AV) fistula comes the closest to doing so.

For prevalent patients, it would be important to consider placing secondary AVF as a conscious strategy to reduce use of CVC in patients with failing primary access. It has been shown that a significant number of patients using CVC as their access have suitable veins for AVF creation.[15] Special attention should be paid to the patients using TDC on a 'permanent' basis, as a significant percentage of these patients tend to have suitable veins for AVF creation. Continual evaluation and patient education regarding their next access is extremely important, as it is a challenge for dialysis staff and nephrologists to convince patients to give up the "ease" of catheter use for the safety and long term benefits of an AVF or AVG.

Basic principles of using distal sites first and preferring autogenous fistulae over grafts are the mainstay of decision making. Among autogenous fistulae, direct fistulae, transpositions and translocations should be considered in that order with an aim of performing simpler and less-morbid procedures first. Lower limb and body wall sites should be considered after all upper limb options are exhausted. Use of non-dominant hand first holds true only when access opportunities are equal on both sides, otherwise hand with more suitable veins gets preference.[16]

Aims and Objectives

1. To study the percentages and frequencies of the various types of angioaccess used in our hospital.
2. To study the failure rates of various types of angioaccess in our hospital and associated co-morbidities.
3. To identify the prevalence of various complications of the angioaccess under consideration.

II. Materials And Methods

Study centre: Department of Nephrology and Renal Transplant Centre, Mahatma Gandhi Mission's Medical College & Hospital, Aurangabad.
Sample size: 211
Sampling technique: outpatient and inpatients visiting the hospital for dialysis
Duration of study: 2 ½ years

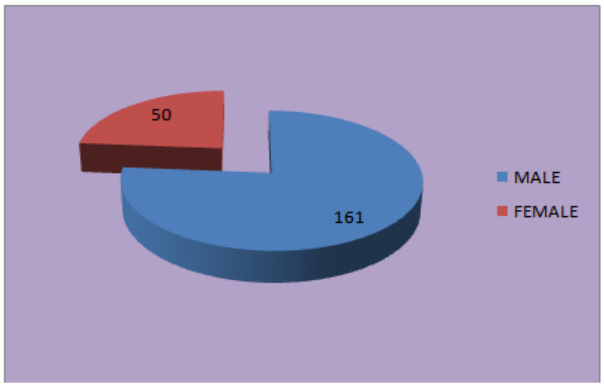
Study Design: observational prospective, single centre, non-randomized prospective study.
Inclusion criteria: Testing and evaluation was carried out on all OPD and IPD patients above the age of 18 years of chronic kidney disease and candidates on dialysis (maintenance or first time or emergency basis).
Exclusion criteria: All patients who were below the age of 13 years, those patients with acute renal failure and those with normal kidney function tests.

Methodology: Detailed history taking, regarding the condition: onset, duration, symptoms, first time diagnosed, personal history, co-morbid conditions, mode of angioaccess used, surgical measures undertaken such as AV Fistula creation.

- Assessment of patency and frequency of change of angioaccess and follow up along with complications.
- Assessment of serum creatinine at onset of dialysis.
- Assessment of eGFR was done by the Cockcroft-Gault equation.
- Chi square test was used to find any statistical significance amongst the groups under comparison.

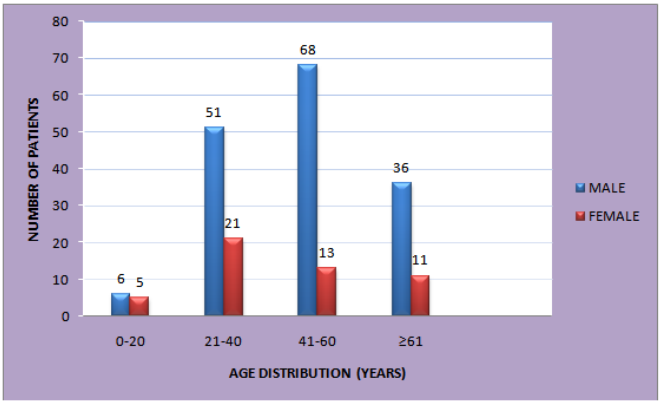
III. Observations

Graph 1 - Gender Distribution



In this study, total number of patients were 211. Of these, 161 (76.30%) participants were male and 50 (23.69%) were female. The Male : Female ratio was 161:50 = 3.22:1. Thus, a male preponderance was seen in our study.

Graph 2 - Age And Sex Distribution

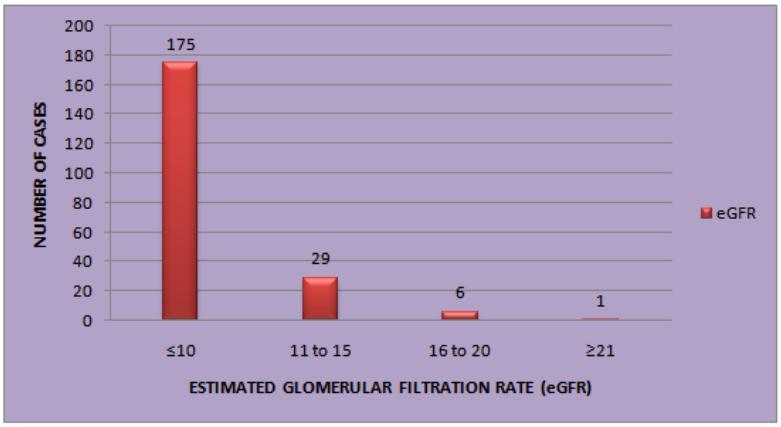


The mean age in the present study was 46.84 years with a range of 13-80 years. The maximum number of patients were from the 41-60 age group, i.e. 81/211(38.38%). The maximum number of male participants were from the 41-60 age group, i.e. 68/161 (42.23%). The maximum number of female patients were seen in the 21-40 age group, i.e. 21/50(42%). Male preponderance was seen as shown in the above graph.

Table No. 1 -Estimated Glomerular Filtration Rate (Egfr) In The Study Population

eGFR	NUMBER OF PATIENTS	PERCENTAGE %
≤10	175	82.93%
10-15	29	13.74%
15-20	6	2.84%
≥21	1	0.47%
TOTAL	**211**	

Graph-3 - Comparison Of Estimated Glomerular Filtration Rate (Egfr) In The Study Group

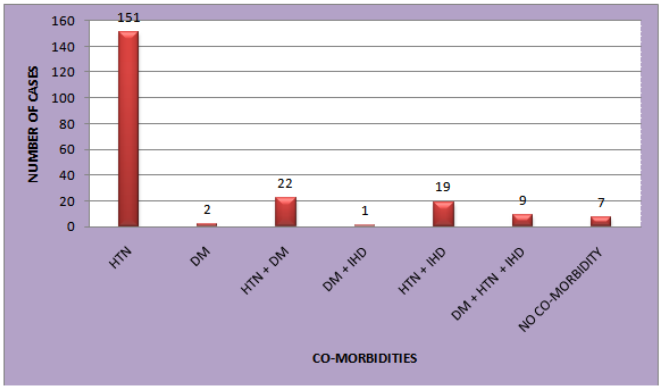


The maximum number of patients had eGFR ≤10, i.e 175 (82.93%) in the study population.

Table No.2 - Co-Morbidities Present In The Study Population

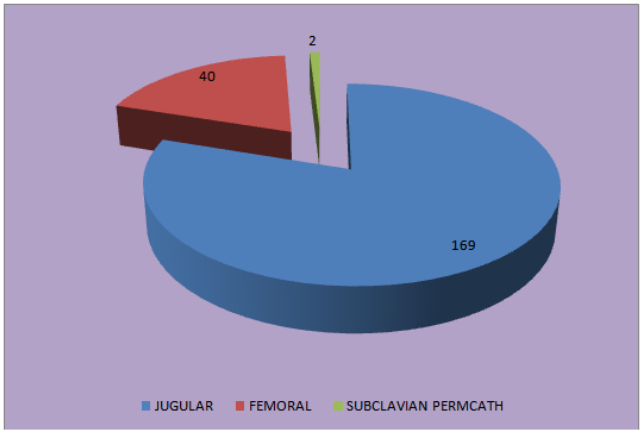
CO-MORBDITIY	NUMBER OF PATIENTS	PERCENTAGE %
HTN	151	71.56%
DM	2	0.94%
HTN + DM	22	10.42%
DM + IHD	1	0.47%
HTN + IHD	19	9.00%
DM + HTN + IHD	9	4.26%
NO COMORBIDITY	7	3.31%
TOTAL	**211**	**100%**

Graph 4 - Co-Morbidities Present In The Study Population



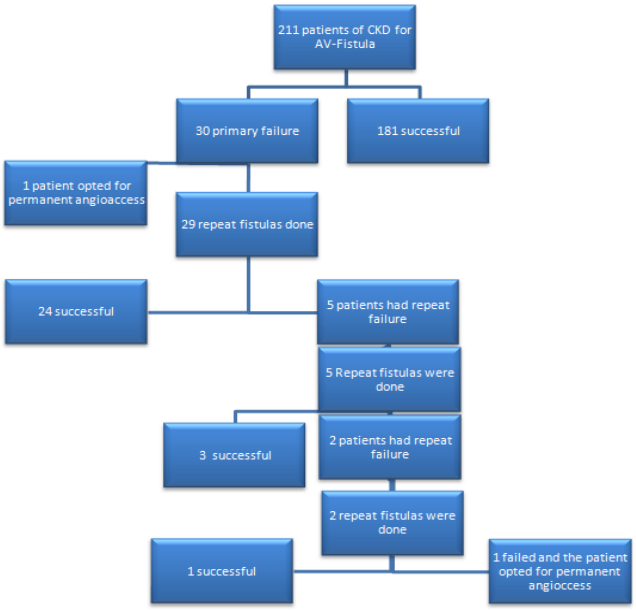
In the study population, 71.56% of the study population had hypertension as the single most common co-morbidity as compared to diabetes and ischemic heart disease.

Graph 5 - Type Of Artificial Angioaccess Used In Ckd Patients On Hemodialysis

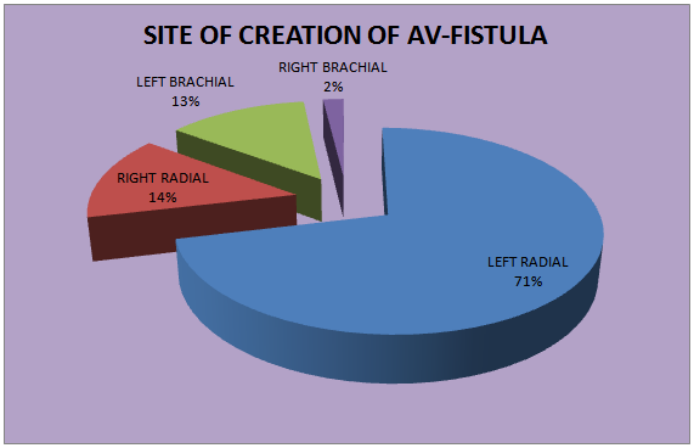


The total number of artificial angioaccess established was 211. In this study, the most commonly used angioaccess was the Internal Jugular 169 (80.09%) as compared to the femoral route 40 (18.95%) and subclavian permanent catheter 2(0.94%)

Flow-Chart



Graph 6 - Site Of Arterio-Venous Fistula Creation In Ckd Patients On Hemodialysis



The total number of AV-Fistulas created in 211 patients during the duration of the study was 248. Amongst these there were 39 documented primary failures and repeat fistulas were done. In one patient, after primary AV-fistula failure, the patient opted for permanent angioaccess. In a second patient, after 4 failed AV-fistulas, the patient opted for permanent artificial angioaccess. Thus only in 209 patients AV-fistula was used as the primary medium for CRRT. Out of 211 patients in whom AV-fistula was the access used for providing CRRT, 170 never had any primary failures. Thus there was a primary success rate of 80.56%(170/211). In this study, the preferred site for AV-fistula creation was the left radial; 149(71.29%) and the least preferred site was the right brachial with 4(1.9%).

Table No. 3 -Complications Of Artificial Angioaccess

COMPLICATION	JUGULAR (NO.)	FEMORAL (NO.)	TOTAL
INFECTION	14 (8.28%)	10 (25%)	24(11.48 %)
BLEEDING	17 (10.05%)	6 (15%)	23(11 %)
POOR FLOW	15 (8.87%)	8 (20%)	22(10.52%)

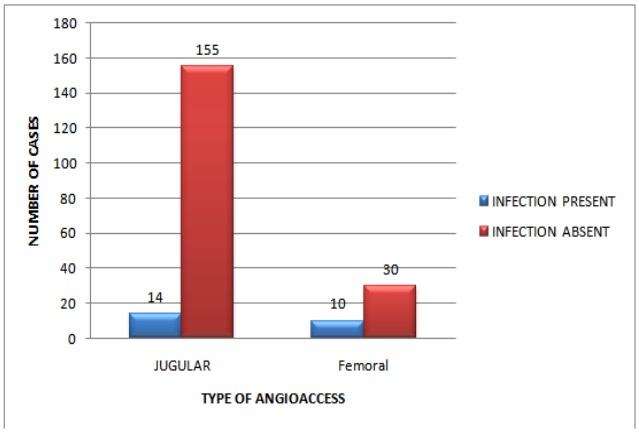
In the present study, infection was the commonest complication associated with use of artificial angioaccess in CKD patients. The incidence of complications were higher with femoral as compared with the internal jugular HD catheter.

Table No.4 - Relation Of Infection With Artificial Angioaccess.

ANGIOACCESS	INFECTION PRESENT	INFECTION ABSENT	TOTAL
JUGULAR	14	155	169 (8.28%)
FEMORAL	10	30	40(25%)
TOTAL	**24**	**185**	**209(11.48%)**

Chi square = 8.89 $p < 0.01$ (Significant)

Graph 7 - Relation Of Infection With Angioaccess



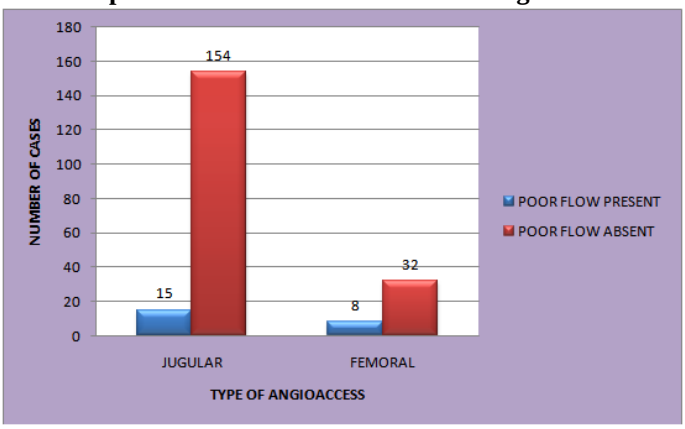
In this study, the total number of infections were 11.48% (24/209). It was noted that a significant higher rate of infection occurred amongst femoral HD catheters, i.e. 10/40 (25%), as compared to the jugular access 14/169 (8.28%). This increased percentage of infection in femoral angioaccess as compared to jugular angioaccess was statistically significant.

Table No.5 - Relation Of Poor Flow To Angioaccess

ARTIFICIAL ANGIOACCESS	POOR FLOW PRESENT (NO.)	POOR FLOW ABSENT (NO.)	TOTAL
JUGULAR	15	154	169 (8.87%)
FEMORAL	8	32	40 (20%)
TOTAL	**23**	**186**	**209(11%)**

Chi Square = 4.09 $p < 0.05$ (Significant)

Graph 8 - Relation Of Poor Flow To Angioaccess



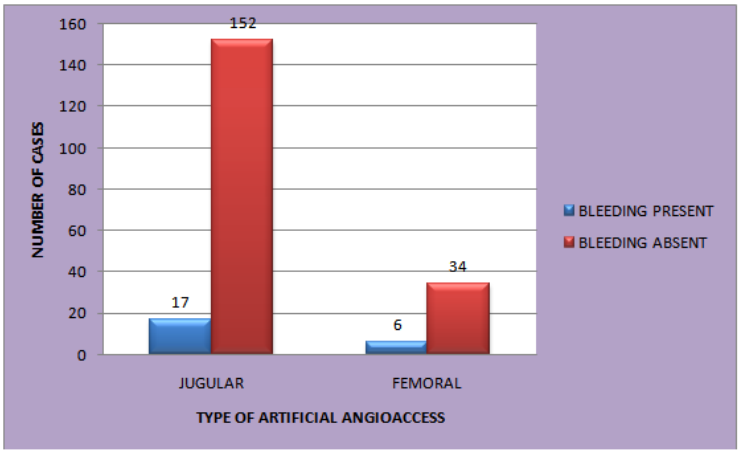
In the study, poor flow was recorded in 11.00% (23/209) of artificial angioaccess. A higher incidence of poor flow was associated with the femoral type, i.e. 8/40(20%) of artificial angioaccess as compared to the jugular 15/169 (8.87%), which was statistically significant.

Table No.6 - Relation Of Bleeding With Artificial Angioaccess

ANGIOACCESS	BLEEDING PRESENT (NO.)	BLEEDING ABSENT (NO.)	TOTAL
JUGULAR	17	152	169 (10.05%)
FEMORAL	6	34	40 (15%)
TOTAL	**23**	**186**	**209 (11 %)**

Chi Square= 0.806 p > 0.05 (not significant)

Graph 9 - Incidence Of Bleeding In Various Artificial Angioaccess



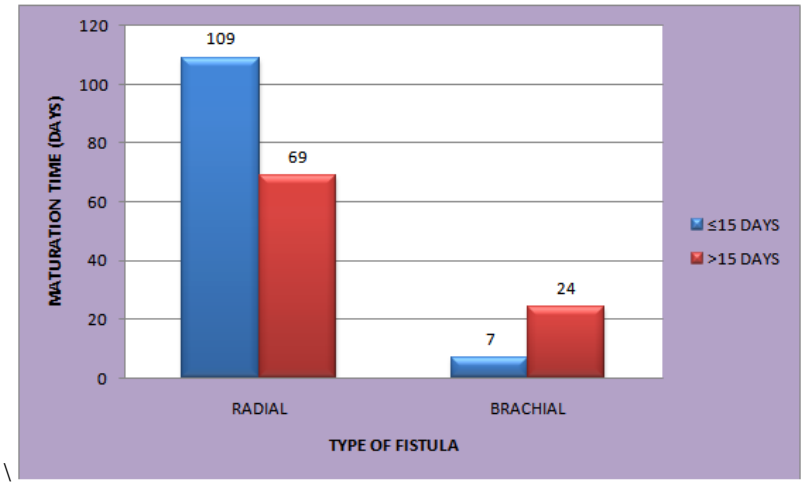
The overall incidence of bleeding was in 11.00% (23/209). Although the percentage of bleeding was more in femoral catheter (15%) as compared to jugular, (10.05%), it was not statistically significant.

Table No. 7 - Relation Of Fistula With Maturation

SITE OF AV-FISTULA	MATURATION ≤15 DAYS	MATURATION >15 DAYS	TOTAL
RADIAL	109	69	178 (38.76%)
BRACHIAL	7	24	31 (77.41%)
TOTAL	**116**	**93**	**209 (44.49%)**

Chi Square =15.9 p< 0.05 (Significant)

Graph 10 - Relation Of Fistula With Delayed Maturation



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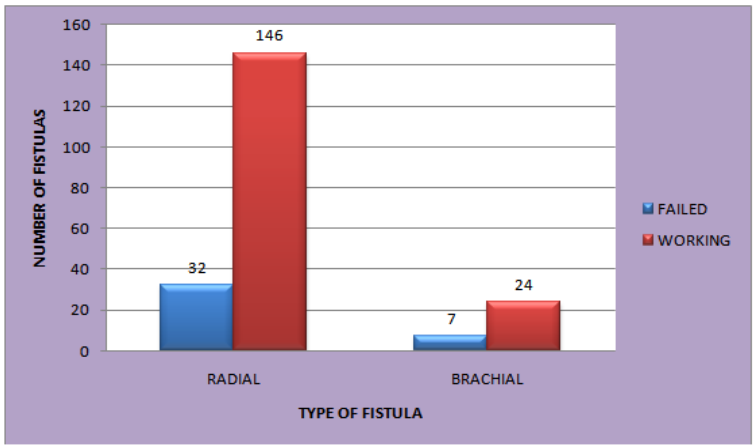
In the study, of 44.49% (93/209) of AV-Fistulas matured after 15 days. There was a higher significant incidence of delayed maturation (>15 days) with Brachial fistulas (77.41%) as compared to Radial fistulas (38.76%).

Table No.8 - Relation Of Site Of Fistula With Failure.

SITE OF AV-FISTULA	FISTULA FAILED ≥ 1 TIME	FISTULA NOT FAILED	TOTAL
RADIAL	32	146	178 (17.98%)
BRACHIAL	7	24	31(22.58%)
TOTAL	**39**	**170**	**209 (18.66%)**

Chi Square = 0.368 p>0.05 (Significant)

Graph 11 - Relation Of Site Of Fistula With Failure



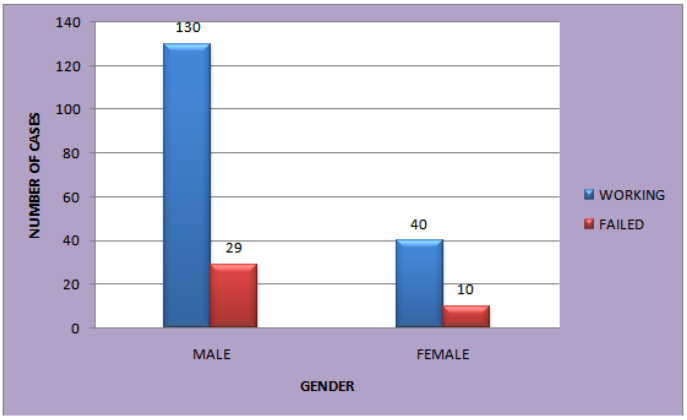
In the study, AV-Fistula failure was seen in 18.66% (39/209) of patients. Higher failure rates were noted with brachial fistulas, i.e. 7/31 (22.58%) as compared to radial AV-Fistulas32/178(17.98%), which was statistically significant.

Table No.9 - Fistula Failure Rate Comparison In Gender

GENDER	FISTULA FAILED (NO.)	FISTULA WORKING (NO.)	TOTAL (NO.)
MALE	29	130	159 (18.23%)
FEMALE	10	40	50 (20%)
TOTAL	**39**	**170**	**209 (18.66 %)**

Chi Square = 0.07 p > 0.05(not significant)

Graph 12 - Gender Comparison Of Av-Fistula Failure Rates



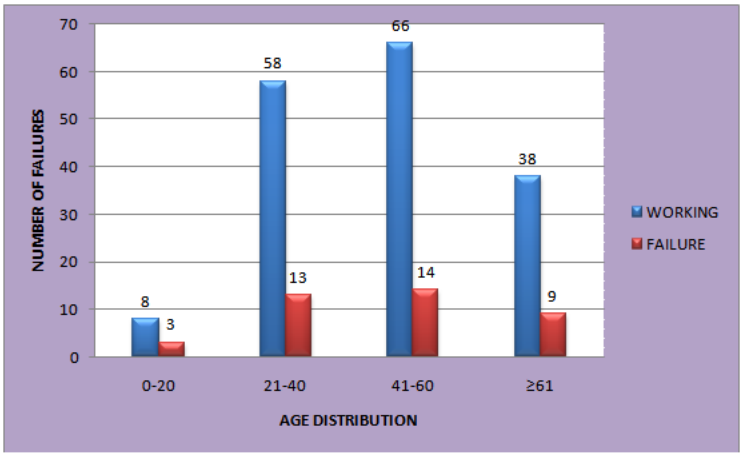
The AV-Fistula failure rate amongst males was 18.23% while that in females was 20%. Although the failure rate was more in females, there was no statistically significant difference in failure rates recorded between male and female gender.

Table No.10 - Relation Of Age Distribution To Failure Rates

AGE GROUP	FAILURE (NO.)	WORKING (NO.)	TOTAL
0-20	3	8	11 (27.27%)
21-40	13	58	71(18.31%)
41-60	14	66	80 (17.5%)
61-80	9	38	47 (19.14%)
TOTAL	**39**	**170**	**209 (18.66%)**

Chi Square = 0.59 p > 0.05 (not significant)

Graph 13 - Comparison of Av-Fistula Failure Rates In Various Age Groups



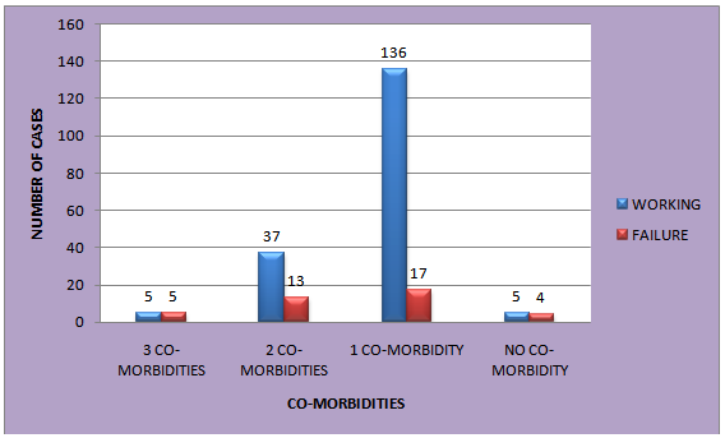
Although the failure rate was more in the age group of 0-20 years (27.27%) as compared to other age groups, it was not statistically significant.

Table No.11 - Relation Of Fistula Failure With Number Of Co-Morbidities

NUMBER OF CO-MORBIDITIES	FAILURE (NO.)	WORKING (NO.)	TOTAL
3 CO-MORBIDITIES	5	5	10(50%)
2 CO-MORBIDITIES	13	37	50(26%)
1 CO-MORBIDITY	17	136	153(11.11%)
NO CO-MORBIDITY	5	5	9(44.44%)
TOTAL	**39**	**183**	**222**

Chi Square = 18.65 p < 0.001(significant)

Graph 14 - Relation Of Number Of Co-Morbdities With Fistula Outcome

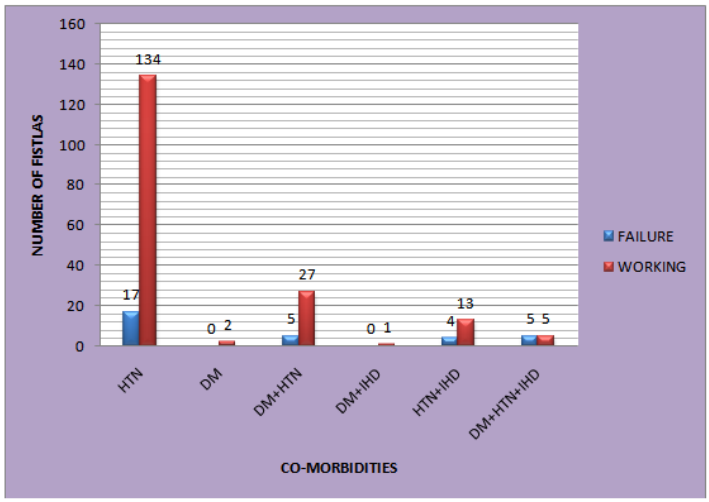


In the present study, the presence of 3 co-morbidities resulted in a greater incidence of failure 5/10 (50%) for AV-fistula. A significant incidence of failure in patients with no underlying co-morbidities (44.44%), but the number of subjects in that subset were small. The cause of failure was not evaluated.

Table No.12 - Relation Of Fistula Outcome With Co-Morbidities

CO-MORBIDITY	FISTULA FAILED (NO. OF CASES)	FISTULA WORKING (NO. OF CASES)	TOTAL
HTN	17	134	151 (11.25%)
DM	0	2	2 (0%)
HTN + DM	9	23	32 (28.12%)
DM + IHD	0	1	1(0%)
HTN + IHD	4	13	17 (23.52%)
DM + HTN + IHD	5	5	10 (50%)
NO CORMOBIDITY	4	5	9 (44.44%)
TOTAL	**39**	**183**	**222**

Graph 15 - Relation Of Co-Morbidities With Fistula Outcome



In the study, there was a significant higher incidence of failure in patients with co-existence diabetes, hypertension and ischemic heart disease - 5/10 (50%), as compared to each of these co-morbidities alone. Also noted were failure in 44% of patients with no co-morbidities, but the cause of failure was not further evaluated.

Table No.13 - Complications Of Av-Fistula

COMPLICATION	RADIAL (NO.)	BRACHIAL (NO.)	TOTAL
INFECTION	5 (2.80%)	2 (6.45%)	7 (3.34%)
BLEEDING	16 (8.98%)	1 (3.22%)	17 (8.13 %)
POOR FLOW	13 (7.30%)	4 (12.90%)	17 (8.13 %)

In the present study, poor flow was seen in 8.13% (17/209) fistulas. The complication of bleeding was similarly noted at 8.13%(17/209) and infection was less noted at 3.34%(7/209) of AV-Fistulas. There was greater incidence of infection (6.45% V/s 2.8%) and poor flow (12.90% V/s 7.30%) associated with brachial fistulas as compared to radial fistulas. The incidence of bleeding however was more with radial fistulas as compared to brachial fistulas (3.22% V/s 8.98%).

Table No.14 -Incidence Of Complications In Native Angioaccess (Av-Fistula) Vs Artificial Angioaccess

COMPLICATION	AV-FISTULA (NO.)	ARTIFICIAL ANGIOACCESS (NO.)	TOTAL
INFECTION	7(3.3%)	24 (11.48%)	31
BLEEDING	17(8.13%)	23(11.00%)	40
POOR FLOW	17(8.13%)	22(10.52%)	39

Complications of infection rate, poor flow and bleeding were higher amongst artificial angioaccess as compared to AV-fistulas (69 V/s 41).Thus, AV-Fistula is associated with lesser incidence of complications as compared to artificial angioaccess.

IV. Summary And Conclusions

The present study was done in Department of Nephrology and Renal Transplant Centre, Mahatma Gandhi Mission's Medical College & Hospital, Aurangabad in CKD patients who underwent AV-fistula creation and temporary angioaccess insertion and the associations with various risk factors.

- A male preponderance was seen in our study with the Male : Female Ratio 3.22:1
- The mean age in the study was 46.84 years with a range of 13-80 years.
- The maximum number of patients were from the 41-60 age group (38.38%). The maximum number of male participants were from the 41-60 age group (42.23%). The maximum number of female patients were seen in the 21-40 age group (42%).
- The maximum number of patients had eGFR < 10 (82.93%) in the study population.
- Hypertension was the most prevalent (71.56%) single co-morbidity in the study population.
- The most commonly used angioaccess was the Internal Jugular (80.09%).
- The primary success rate of AV-Fistula creation was 84.27%.
- The preferred site for AV-fistula creation was the left radial (71.29%) and the least preferred site was the right brachial (1.9%).
- Infection was the most commonly seen (11.48%) complication associated with the use of artificial angioaccess.
- A significant higher rate of infection was noted in femoral HD catheters (25%), when compared to the jugular access (8.28%).
- Poor flow was more commonly associated with the femoral HD catheters (20%) as compared to the jugular (8.87%).
- Although the percentage of bleeding was more in femoral catheter (15%) as compared to jugular (10.05%), but it was not statistically significant.
- A higher incidence of maturation (>15 days) was observed in our study with Brachial fistulas (77.41%) as compared to Radial fistulas (38.76%).
- There was equal incidence of bleeding and poor flow as complications of native angioaccess(8.13%).
- Infection was the least common complication seen in AV-Fistulas (3.34%).
- Higher failure rates were noted with brachial fistulas (22.58%) as compared to radial AV-Fistulas (17.98%).
- There was no statistically significant difference in failure rates recorded between male and female gender.
- The failure rate was highest in the 0-20 age group (27.27%), but this was not statistically significant.
- The presence of 3 or more co-morbidities resulted in a greater incidence of failure (50%)for AV-fistula.
- Although there was a significant incidence of failure in patients with no underlying co-morbidities (44.44%), the number of subjects in that subset were small. This was not statistically significant. The cause of failure was not further evaluated.

- The complications of bleeding and poor flow were more commonly seen (8.13%) as compared to infection (3.34%) among AV-fistulas.
- Bleeding however was seen more with radial fistulas (3.22% V/s 8.98%), whereas greater incidence of infection (6.45% V/s 2.8%) and poor flow (12.90% V/s 7.30%) was associated with brachial fistulas as compared to radial fistulas.
- The incidence of complications were more associated with artificial angioaccess as compared to native angioaccess. Thus, AV-Fistula was associated with lesser incidence of complications as compared to artificial angioaccess.

References

[1]. Joshi R, Magnolia C, Srinivas I, et al. : Chronic diseases now leading cause of death in rural India-mortality data from the Andhra Pradesh rural health initiative; Int J Epidemiol. 2006;35 (6):1522-9.
[2]. McClellam WM : The Epidemic of renal disease: What drives it and what can be done; Nephrol Dial Transplant 2006;21(6):1461-4.
[3]. World Health Organisation – Global Burden of disease project available at: http://www.3.who_int/whosis/menu.cfm?path, March 2006.
[4]. Schieppati A, Giuseppe R. Chronic renal diseases as a public health problem: Epidemiology, Social and conomic implications. Kidney Int 2005;68 (supp98):s7-10.
[5]. Kolff WJ. : First clinical experience with the artificial kidney; Ann Int Med 1965; 62: 608–19.
[6]. Quinton W, Dillard D, Scribner BH. : Cannulation of blood vessels for prolonged hemodialysis; Trans Am Soc Artif Intern Organs 1960; 6: 104-113.
[7]. Brescia MJ, Cimino JE, Appel K, Hurwich BJ. : Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula; N Engl J Med 1966; 275: 1089-1092.
[8]. NKF-K/DOQI Clinical practice guidelines for vascular access. Am J Kidney Dis 2006; 48 Suppl 1: S248-273.
[9]. Dagher F, Gelber R, Ramos E, Sadler J. : The use of basilic vein and brachial artery as an A-V fistula for long term hemodialysis; J Surg Res 1976; 20: 373-376.
[10]. The Open Urology & Nephrology Journal, 2012, 5, (Suppl 1: M3) 12-18.
[11]. Schwab SJ, Beathard G. : The hemodialysis catheter conundrum: hate living with them, but can't live without them; Kidney Int 1999; 56: 1-17.
[12]. Rayner HC, Pisoni RL, Gillespie BW, et al.: Creation, cannulation and survival of arteriovenous fistulae: data from the Dialysis Outcomes and Practice Patterns Study; Kidney Int 2003; 63: 323-30.
[13]. USRDS. Annual Data Report 2009-http://www.usrds.org/atlas09.aspx.
[14]. Silva MB Jr, Hobson RW, Pappas PJ, et al.: A strategy for increasing use of autogenous hemodialysis access procedures: impact of preoperative noninvasive evaluation; J Vasc Surg 1998; 27: 302-8. 4.
[15]. Asif A, Unger SW, Briones P, et al.: Creation of secondary arteriovenous fistulas: maximizing fistulas in prevalent hemodialysis patients; Semin Dial 2005; 18: 420-4.
[16]. Srivastava A, Sharma S. : Hemodialysis vascular access options after failed Brescia-Cimino arteriovenous fistula; Indian J Urol 2011;27:163-8