Original Article

Outcome of Arterio-Venous Fistula With and Without Central Venous Catheter in Patients with End Stage Renal Disease

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ABSTRACT

End stage renal disease (ESRD) patients often need to secure a vascular access for haemodialysis and arterio-venous fistula (AVF) is intended to serve the purpose. However, an AV fistula needs at least 4-6 weeks to get anatomically set and physiologically functional. We observe that a good number of patients undergo haemodialysis by central venous catheter (CVC) before securing an AV fistula. This cross-sectional, descriptive study was conducted among 80 patients of ESRD referred to the Department of Surgery, Sylhet MAG Osmani Medical College Hospital, Bangladesh, between January and June of 2016, to compare early outcome of arterio-venous fistula with and without central venous catheter. Patients having AV fistula with CVC were enrolled in group A (n=40), and patients without CVC were in group B (n=40). The mean age was 59.25±10.95 years in group A and 60.62±10.35 years in group B. A male predominance was observed; male-female ratio was 3.44:1. During follow-up visits, adverse events like erythema, haematoma formation, serous or serosanguinous discharge were found less in group B compared to group A. Among complications, wound infection, pseudoaneurysm, stenosis and total fistula failure (within three months) was observed less in group B. Our study demonstrated that patients having arterio-venous fistula without central venous catheter had better outcome along with less complications than those had A-V fistula with central venous catheter. Hence, A-V fistula first strategy can be implemented with low morbidity in ESRD patients.

Keywords: *Arteriovenous fistula, central venous catheter, haemodialysis, end stage renal disease.*

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INTRODUCTION

The prevalence and incidence of end-stage renal disease (ESRD) continues to rise worldwide.[1] End-stage kidney disease (ESKD) is now a rapidly increasing global health and health-care burden. Inability to care for many patients at risk for and in need of treatment for ESKD disproportionately impacts low and middle-income countries (LMICs).[2] In Bangladesh, the number of patients with end-stage renal disease requiring renal replacement therapy has increased progressively over decades.[3] The care and outcome of the patient with end-stage renal disease (ESRD) on chronic haemodialysis are dependent on their access. Therefore, successful formation and maintaining the stability of a

permanent vascular access are crucial for managing those patients in order to deliver adequate haemodialysis (HD) therapy. Permanent vascular access for haemodialysis is provided in many ways, e.g., arteriovenous graft (AVG), arteriovenous fistula (AVF), or central venous catheter (CVC).[4]

According to the '*National Kidney Foundation. KDOQI Clinical Practice Guideline for Hemodialysis Adequacy: 2015 update'*, the preferred permanent vascular access for haemodialysis patients is a native arteriovenous fistula (AVF),[5] which is ideally created at the wrist or barring that possibility at the elbow. Only if such an AVF cannot be established, an upper arm (brachio-basilic) AVF should be created or an AVG used.[6] The guidelines also set goals of primary AVF being constructed in at least 50% of all new kidney failure patients electing to receive haemodialysis as their initial form of renal replacement therapy and 40% of prevalent hemodialysis patients with a native AV fistula. Cuffed hemodialysis catheters are discouraged, and Guideline 30 sets a goal of less than 10% of chronic maintenance hemodialysis patients being maintained on catheters as their permanent haemodialysis access.[5]

In our clinical practice, a significant proportion of patients with ESRD present for the first time to a nephrologists immediately before requiring dialysis. Moderate differences exist between countries in the percentage of patients presenting late.[3] The chances of dialysis commencing via permanent rather than temporary access and via AV fistula rather than graft are significantly higher in patients who receive nephrology care for more than 30 days before starting dialysis. Although the use of central venous catheter (CVC) is discouraged, it is recognized that haemodialysis catheters are unavoidable in some patients. K/DOQI Vascular Access Guideline recommended that when required, dialysis catheters be inserted in the right internal jugular vein, not in the subclavian vein, because of the risk of subclavian vein stenosis. It also recommended that cuffed rather than temporary uncuffed haemodialysis catheters be inserted if the duration of catheter use is expected to exceed three weeks.[7] However, a central venous catheter (CVC) is a foreign body that may incite chronic inflammation and thus malnutrition, anaemia, and cardiovascular disease. It may deliver lower than expected blood flows and inefficient dialysis from access re-circulation and thereby predispose to under dialysis.[8]

With the increasing incidence of ESRD, the rate of using AVF is also increasing day by day; however, we still lack a national guideline or protocol for creating a permanent vascular access such as AVF. Therefore, we proposed this study to see the differences of AV fistula in ESRD patient with CVC with history of haemodialysis prior to AV fistula or without CVC (fistula first), so that the results of the study may help experts in the field and policy makers to develop a guideline on permanent vascular access for ESRD patients undergoing haemodialysis in our resource-poor settings. To our knowledge, such study has never been done previously comparing the outcome of AV fistula with CVC and without CVC in our country.

METHODS

This cross-sectional, descriptive study was conducted in the Department of Surgery, Sylhet MAG Osmani Medical College Hospital, Sylhet, Bangladesh, between January and June of 2016. Consecutive sampling technique was applied in this study. Our inclusion criteria were: i) ESRD patients referred to the Department of Surgery for securing an AV fistula for prospective haemodialysis; and ii) voluntarily consented for participation in this study. Exclusion criteria were: i) patients having previous arteriovenous graft (AVG) or arteriovenous fistula (AVF) failure in both forearms; ii) poor cardiac functions e.g., ejection fraction (EF) <30%; iii) gross atherosclerosis or peripheral vascular disease (PVD) of both upper limbs; and iv) patients with septicaemia. A total of 80 participants were selected based on inclusion and exclusion criteria. They were divided into two groups: patients already having CVC were enrolled in group A (n=40) and patients without CVC were enrolled in group B (n=40). Each patient was thoroughly examined. Detail history and previous investigations especially his/her cardiovascular status and Doppler study of the upper limbs were recorded. Preoperative assessment and preparation for surgical procedure were done by evaluating the distribution of blood vessels in the patient's arm and determine which arm is more suitable for the operation were done. Most of the patients were advised to exercise the arms four times daily to increase blood flow and calibre of veins. Each exercise should last for 10-15 minutes. With proper preoperative preparation and venous mapping A-V fistula were created preferably on non dominant forearm. Radial-cephalic fistula under local

anesthesia and an end-to-side anastomosis was done in all the cases. In four cases brachial-cephalic fistula were made due to non suitable venous mapping for that distal site. Patients of both groups got appropriate analgesic and antibiotic. All the patients were released or referred back to nephrologist on the next day with the advice to keep the dressing dry and not to do anything that may affect the blood flow of the AVF such as, wearing clothes with elasticized sleeves at the cuff, wearing jewellery, watches or bracelets on the fistula arm, sleep with the pillow on the fistula arm or carry anything heavy with the fistula arm. They were also advised not to draw blood, check blood pressure or administer intravenous injection or infusion on the operated arm. Sutures were removed on 14th day for all the non complicated, well healed patients. All the patients were advised to attend Outpatient Department (OPD) of Surgery, if any complication arises. During discharge of the patients full address and mobile numbers were preserved for communication and follow up the patients. Postoperative complications were identified and managed in accordance with a standard protocol. All the patients were followed up routinely after one weak, one month and at the end of third month of discharge from the hospital. For detection of early fistula failure regular physical examination for easily palpation of superficial AVF with adequate diameter (venous >3mm) and uniform thrill were done by myself and suspected patients were sent for duplex ultrasonography for accessing vascular diameter & flow rate. In each follow up condition of the wound, any discharge if present the quality of that discharge, swelling and evidence of distal flow change were assessed. Any evidence of infection was assessed by using ASEPSIS score.[9] Vascular access (of AV fistula) related information including previous vascular access and type, location of present fistula, peroperative complications, date of creation, first cannulation and failure, fistula related infection and any further procedure done – all were recorded in the data collection sheet.

Data was presented as frequency and percentage as well as mean±SD (standard deviation), as applicable. The statistical analysis was done by using Statistical Package of Social Sciences (SPSS) version 22.0 for Windows. Unpaired Student's t-test, Chi-square test and Fisher's exact test were performed for comparison in between variables, as applicable. A p-value <0.05 was considered as statistically significant.

This study was approved by the Ethical Review Committee of Sylhet MAG Osmany Medical College, Sylhet, Bangladesh.

RESULTS

Among 80 study participants, most of them 58(74.5%) were in the >60 years age group. The mean age was 59.25±10.95 years in group A and 60.62±10.35 years in group B. A male predominance was observed; male-female ratio was 3.44:1. In group A, 32(80%) were male and 8(20%) were female, while in group B, 30(75%) were male and 10(25%) were female. No difference was observed in terms of age and sex between two groups (p>0.05). In group A, 16(40%) had diabetes mellitus (DM) and 9(22.5%) patients had ischaemic heart disease (IHD), while in group B, 18(45%) had DM and 8(20%) had IHD (p>0.05) (Table-I). Higher serum creatinine levels (e"9mg/dl) were found in most 47(58.8%) of the patients, i.e., 25(62.5%) and 22(55%) in group A and group B respectively. Serum creatinine levels <9 mg/dl were found in 15(37.5%) and 18(45%) cases in group A and group B respectively (p>0.05). Plasma haemoglobin levels e"10gm/dl were recorded in most 54(67.5%) of the patients, i.e., 22(55%) in group A and 32(80%) in group B. Lower levels of haemoglobin <10gm/dl were recorded as 18(45%) and 8(20%) in group A and group B respectively (p<0.05) (Table-II). During the 1st follow-up visit (after 1 week of discharge from the hospital), the rate of early complications like erythema, haematoma formation, serous or serosanguinous discharge were found in 12(30%), 4(10%), 6(15%), and 3(7.5%) patients in group A respectively, while in group B, 5(12.5%), 2(5%), 3(7.5%) and 1(2.5%) respectively. A positive thrill on palpation and low pitch bruit on auscultation were found in 37(92.5%) and 35(87.5%) in group A respectively and 38(95%) and 38(95%) in group B respectively. Significantly higher incidence of erythema and serous discharge were found in group A compared to group B (p<0.05) No significant differences were observed in other parameters between two groups (p>0.05) (Table-III). During the 2nd follow up visit (after 1 month), complications like erythema, haematoma formation, discharge were found in 4(10%), 0(0%) and 10(25%) respectively in group A and 2(5%), 0(0%), 5(12.5%) respectively in group B. Palpable thrills and low pitch bruit were found in 30(75%) and 33(82.5%) in group A respectively, while in group B, 35(87.5%) and

37(92.5%). However, no significant differences were observed in any parameter between two groups (p>0.05) (Table-IV). During the 3rd follow-up visit (after 3 months), healthy wounds and wound with discharge (unhealthy) were observed in 35(87.5%) and 5(12.5%) patients in group A and 38(95%) and 2(5%) in group B. Palpable thrill was present in 26(65%) patients in group A and 33(82.5%) patients in group B. However, no significant differences were observed in any parameter between two groups (p>0.05) (Table-V). Among complications, wound infection was evident in 18(45%) and 8(20%) in group A and B respectively (p<0.05), while pseudoaneurysm was found 3(7.5%) and 2(5%) in group A and B respectively (p>0.05) and stenosis was documented 10(25%) and 4(10%) in group A and B respectively (p>0.05). Vascular access steal syndrome was found in 1(2.5%) patient in each group (p>0.05). No heart failure was found in any group. However, total fistula failure (within three months) was documented in 14(35%) and 6(15%) in group A and B respectively (p<0.05) (Table-VI).

Table-I: *Demographic and clinical characteristics of the patients (N=80)*

Variables	Group A (n=40)	Group B(n=40)	p-value
Age group (in years)			
≤60	30 (75%)	28 (70%)	
>60	10 (25%)	12 (30%)	>0.05^{NS}
Mean±SD	59.25±10.95	60.62±10.35	
Sex			
Male	32 (80%)	30 (75%)	>0.05^{NS}
Female	8 (20%)	10 (25%)	
Comorbidities			
DM	16 (40%)	18 (45%)	>0.05^{NS}
IHD	9 (22.5%)	8 (20%)	>0.05^{NS}

Unpaired Student's t-test and Chi-square test were done to reach the p-values; NS=not significant.

Table-II: *Biochemical parameters of the patients (N=80)*

Variables	Group A (n=40)	Group B(n=40)	p-value
Serum Creatinine			
<9 mg/dl	15 (37.5%)	18 (45%)	>0.05^{NS}
≥9 mg/dl	25 (62.5%)	22 (55%)	
Plasma haemoglobin			
<10 mg/dl	18 (45%)	8 (20%)	<0.05^{S}
≥10 mg/dl	22 (55%)	32 (80%)	

Chi-square test was done to reach p-value; S=significant, NS=not significant.

Table-III: *Clinical parameter of A V fistula at 1st follow-up (N=80)*

Variables	Group A (n=40)	Group B(n=40)	p-value
Erythema	12 (30%)	5 (12.5%)	<0.05^{S}
Haematoma	4 (10%)	2 (5%)	>0.05^{NS}
Discharge			
Serous	12 (30%)	5 (12.5%)	<0.05^{S}
Serosanguineous	3 (7.5%)	1 (2.5%)	>0.05^{NS}
Thrills on palpation	37 (92.5%)	38 (95%)	>0.05^{NS}
Low-pitch bruit on auscultation	35 (87.5%)	38 (95%)	>0.05^{NS}

Chi-square test was done to reach p-value; S=significant, NS=not significant.

Table-IV: *Clinical parameter of A V fistula at 2nd follow-up (N=80)*

Variables	Group A (n=40)	Group B(n=40)	p-value
Erythema	4 (10%)	2 (5%)	>0.05^{NS}
Haematoma	-	-	>0.05^{NS}
Discharge	10 (25%)	5 (12.5%)	>0.05^{NS}
Thrills on palpation	30 (75%)	35 (87.5%)	>0.05^{NS}
Low-pitch bruit on auscultation	33 (82.5%)	37 (92.5%)	>0.05^{NS}

Chi-square test was done to reach p-value; NS=not significant.

Table-V: *Clinical parameter of A V fistula at 3rd follow-up (N=80)*

Variables	Group A (n=40)	Group B(n=40)	p-value
Wound (healthy)	35 (87.5%)	38 (95%)	>0.05^{NS}
Wound (unhealthy)	5 (12.5%)	2 (5%)	>0.05^{NS}
Thrills on palpation	26 (65%)	33 (82.5%)	>0.05^{NS}

Chi-square test was done to reach p-value; NS=not significant.

Table-VI: *Complications related to A V fistula in patients (N=80*

Variables	Group A (n=40)	Group B(n=40)	p-value
Wound infection	18 (45%)	8 (20%)	<0.05^{S}
Pseudoaneurysm	3 (7.5%)	2 (5%)	>0.05^{NS}
Stenosis	10 (25%)	4 (10%)	>0.05^{NS}
Vascular access steal syndrome	1 (2.5%)	1 (2.5%)	>0.05^{NS}
Heart failure	-	-	-
Fistula failure	14 (35%)	6 (15%)	<0.05^{S}

Fisher's exact test was done to reach p-value; S=significant, NS=not significant.

DISCUSSION

The incidence of chronic kidney disease (CKD) is increasing rapidly in people ages 60 and older. However, now-a-days, the incidence of end stage renal disease (ESRD) in younger age group is also increasing. In this study, we found that 30(75%) patients in group A and 28(70%) in group B patient were in the ≤60 years age group. On the other hand, 10(25%) in group A and 12(30%) in group B belonged to the 60years age group. Evidence showed a continuous increasing incidence and prevalence of ESRD with advancing age; the overall incidence of chronic renal failure (CRF) was found nearly six times higher in patients aged between 60 and 74 years.[2] owever, this result does not support our study, as because in our country, older people hardly seek treatment like the young patients. In this study, there were 62(77.5%) male and 18(22.5%) female; male-female ratio was 3.44:1. Jungers et al. found the incidence two times higher among men than women in all age groups up to 60 years, and three times higher in male patients aged ≥75 years.[10] In two separate previous studies, glomerular filtration rate (GFR) was found lower among male patients compared to females, among patients with CKD Stage 3-5 and CKD Stage 4 respectively.[11,12] The male predominance of the present study (more than three times of female) may be due to our male dominant society, as more men turned up for the treatment, while women are less health conscious, and often neglected owing to societal and financial issues.

In the present study, there were 16(40%) and 18(45%) patients having coexisting DM and 9(22.5%) and 8(20%) patients having IHD in group A and in group B respectively. According to the IDF diabetes atlas

reports, up to 40% of people living with diabetes develop CKD, which correlates with our study findings.[13] Rosolowsky et al. found that despite renoprotective treatment (including transplantation and dialysis) patients with type 1 diabetes and macroalbuminuria remain at high risk for ESRD.[14] Landray et al. found that 34% of CKD patients had a history of cardiovascular disease. Even in those with mild renal impairment (serum creatinine <2.1mg/dL), approximately one third had cardiovascular disease.[15] In this study, haemoglobin levels ≥10gm/dl were found in 22(55%) patient in group A and 32(80%) in group B, while haemoglobin levels <10gm/dl were observed in 18(45%) and 8(20%) patients in group A and B respectively. On the other hand, serum creatinine levels ≥9mg/dl were found in 25(62.5%) in group A and 22(55%) in group B, while creatinine levels (<9mg/dl) were found in 15(37.5%) in group A and 22(55%) patients in group B. Evidence showed that 29% of the patients referred for specialists' consultation had creatinine levels <300μmol/L (i.e., <4mg/dL), while ≥500μmol/L (i.e., ≥6mg/dl) of serum creatinine was observed in 31% of patients.[16,17] Our study also showed a higher levels of serum creatinine among patients referred to the Department of Nephrology; the reason may be lack of early screening and less awareness among people as well as lack of health facilities especially in rural areas of our country.

Quality of dialysis vastly depends on complications related to vascular access.[18,19] In the first follow-up, erythema were found in 12(30%) and 5(12.5%) patients in group A and group B respectively ($p<0.05$), while during the second follow-up visit, it was found only in 4(10%) and 2(5%) patients respectively ($p>0.05$). The prevalence of such inflammatory response in chronic haemodialysis patients were found ranging from 35% to 70%, depending on the assay used and the cut-off value for C-reactive protein.[20] Haematoma was observed in 4(10%) and 2(5%) patients respectively in group A and B, while in the second follow up no patients had any haematoma, as because some of them were resolved automatically and others by using anti-inflammatory medication ($p<0.05$). Even serous or serosanguinous discharge were observed more in group A than group B. Similar adverse events were reported in different studies, which included signs of inflammation (e.g., erythema, tenderness, warmth and swelling) at the vascular access puncture/placement or exit site.[18,19,21] In our study, among complications of the vascular access, wound infection, pseudoaneurysm, stenosis and total fistula failure (within three months) was observed less in group B compared to group A. Studies showed that use of central venous catheter (CVC) as vascular access was associated with much higher rates of infection compared with arteriovenous graft (AVG) and arteriovenous fistula (AVF), the results are in congruence with our study.[19,21]

Patients who are undergoing recurrent haemodialysis within one month of referral to the nephrologist (late referral) have poor HD outcomes. It is now well known that formal pre-dialysis educational and follow-up programs are more beneficial concerning early dialysis outcomes and resource utilization than the unstructured specialist follow-up. Strategies to increase AV fistula creation require early referral to nephrology and early placement of AVF, as part of Pre-ESRD care at general practice and hospital levels.[19,22]

Our study has several limitations. The study was conducted in a single centre with a small sample size and short duration, which may limit the generalizability of the study findings in a greater population, and lacks an evidence of long term outcomes of AV fistula. Moreover, due to lack of logistics, we took creatinine levels to measure renal insufficiency instead of measurement of GFR, which could reflect more accurate assessment.

CONCLUSION

Our data suggests that arterio-venous fistula without central venous catheter tends to show better outcome along with less complications than A-V fistula with central venous catheter among ESRD patients undergoing haemodialysis. Hence, we recommend that when it is feasible, permanent vascular access by creating AV fistula without CVC may be done in ESRD patients at least 4 weeks prior to haemodialysis for allowing the fistula to get mature. However, further studies with larger samples from different regions of the country and high-technical and advanced pathology facilities are warranted to re-evaluate the results of the present study.

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