# Complication of Arteriovenous Fistula for haemodialysis Patients in Taiz- Yemen

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**Abstract** This study was conducted to determine the complications of arteriovenous fistulae created for haemodialysis access in Yemen.

**Materials and Methods**: This study was a tow year prospective study conducted in Department of Vascular Surgery, Authority of Althawra Hospital, Taiz University Factuality of medicine, Taiz, Yemen. After determination of the appropriate limb for surgery, arteriovenous fistulae were done under local anaesthesia in the operation theatre. All anastomosis was end (vein) to side (artery) and were done by parachute technique. The fistula created was examined for a good thrill, pulse, and any immediate complication. After four to six weeks, a fistula with a good thrill was be release to puncture for haemodialysis. A 12-month follow up study was done, and the late complications of the fistulae were also noted. **Result:** The primary failure rate (within 3 months) was 33 (14.3%). During study period, the most common complication was thrombosis 30 (13%), followed by noninfectious fluid collections 24 (10.4%) wound infections 17 (7.4%), bleeding 9 (3.9%), postoperative edema 10 (4.3%), aneurysmal degeneration 9 (3.9%), venous hypertension 4(1.7%) and steal syndrome 3 (1.3%). There was a statistically significant correlation between developments of steal syndrome with Diabetes Mellitus (p = 0.002) and between venous hypertension with pervious central dialysis catheter used (p=0.001).

Conclusions: Early and timely detection of complications in AVF is essential for proper management. The complication rate in this study was similar compared to the average complication reported in other parts of the world.

**Keywords:** Haemodialysis access, arteriovenous fistula, complication, ESRD

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## 1 Introduction

Vascular access remains a significant challenge for patients on chronic hemodialysis (HD) and often requires creative thinking to preserve and construct durable long-term access. Routes for HD vascular access include (1) tunneled dialysis catheter (TDC), (2) arteriovenous graft (AVG), and (3) arteriovenous fistula (AVF).[1]–[3]

Despite efforts of the National Kidney Foundation Disease Outcomes Quality Initiative (NKF DOQI) and the Fistula First Breakthrough Initiative (FFBI) encouraging providers to recognize and refer patients earlier for permanent dialysis access establishment.[4], [5] AVFs have higher primary patency,[6] lower risk of infection, higher durability, lower mortality,[7]–[9] and fewer required interventions[6] when compared with prosthetic grafts and TDCs. However, AVFs have a high rate of nonmaturation (20–50%),[10],[11]–[13] which likely accounts for the fact that at 6 months after initiating HD, 55% of patients continue to be dialyzed with aTDC.[4], [5], [14],[15]–[17]

AVF is created by a surgical anastomosis between native artery and vein, to allow access to vascular system for HD.[18],[19] The preferred type of AVF is radiocephalic fistula which was the first AVF designed in 1966 by Brescia.[20] However, this access often fails to mature in the elderly patient with underlying vascular disease, particularly in diabetics.[21] Second preferred type is brachiocephalic fistula.[22],[23] This type of fistula is being placed with increased frequency because of the high failure rate of radiocephalic fistula, followed by a brachiobasilic transposition fistula.[24]

Failure of an AVF not only interrupts a functional access but also reduces the number of sites at which another access can be made. In addition, subjecting the patients to interventional procedures is required to salvage the failing AVFs. Therefore, it is important to evaluate risk factor that effect AVF patency and identify failure rate and post-operative complications that may occur after AVF placement.[25]

Studies have found that fistula complications are associated with morbidity, mortality, and a high economic burden.[26], [27]And it was reported that early detection and treatment of these complications can prevent more severe conditions and consequently save additional costs and reduce hospitalization periods.[28]

In Yemen, there is lack of data regarding the complications prevlent in patients who underwent AVFs. For that, the main aim of this study was to measure the prevalence of AVF in patients on HD and its complications in patients undergoing HD with AVF in Taiz, Yemen. The study also looked for any predisposing risk factors to the complications of AVF to prevent or minimize them in the future.

**Method and patients**

This prospectively study was conducted at Department of vascular surgery, Authority of Althawra Hospital in Taiz-Yemen, from 1st October 2017 to 30th September 2019. All patients with ESRD, who refer for creation AVF were include in this study. A total of 196 patients underwent 231 AVF operations were enrolled in the study. Details Demographic, Clinical, and preoperative dialysis variables were obtained for every patient. Allen's test and arterial pulses (i.e. axillary, brachial, radial, and ulnar) were examined. Patients with visible veins on the clinical examination were directly scheduled for AVF creation while patients with non-visible veins were undergo vein mapping by ultrasonography (US) before being scheduled for surgery.[29] The

distal part of the non-dominant extremity was selected as priority anatomical site, whenever possible.[30]

After determination of the appropriate limb for surgery, the procedure was done under local anaesthesia in the operation theatre. Intra operative heparin saline was used in all cases. All arteriovenous anastomosis was end (vein) to side (artery) and were done by parachute vascular technique using 6'0'/7'0' prolene. The fistula created was monitored for a good thrill, pulse, and any immediate complication such as bleeding or thrombosis. After four to six weeks, a fistula with a good thrill was considered to be mature and was subjected to cannulation and then haemodialysis.

Outcome Parameter

Maturation (Functional) of AVF was be defined as the successful use of the AVF for six consecutive sessions of HD. This definition for the evaluation of AVF maturation has been validated in the literature in several previous studies.[31]–[33] Primary failure define as an AVF that has never been usable for dialysis or that fails within three months of use.[34], [35] In our study, primary patency of AVF at immediate, 30 and 90 days, and at 6 months had been measured.

**Follow-Up Schedule**

All patient discharges on operation day with oral antibiotics and analgesics for three days. Patients were instructed to start hand exercise on the second postoperative day with ball. Skin stitches ware removed on the 10th post-operative day. The follow up performed on an outpatient basis, at 7th and 14th day then at 4 and 6 weeks post-operative, where fistula was released to puncture for HD. Periodic follow up was performed for at least 6 months (average 6 to 24 months). In follow up visit, all patients were be evaluated for the presence or absence thrill or complications i.e. seroma, hematoma, infection, bleeding, thrombosis, aneurysms, steal syndrome and venous hypertension.

**Study analysis**

Data collection and analysis conducted using SPSS (IBM SPSS Statistics 24.0). Initially, descriptive analysis of outcome and variables predominantly was analyzed as frequencies, tables and percentages for categorical variable and mean and SD for continuous variable. The association between variable and outcome or complication were analyzed by the Chi-square (x2) or fisher test for the categorical variable and unpaired Student's t-test for the continuous variable with the corresponding 95% confidence interval (CI). P-values ≤ 0.05 were considered statistically significant**.**

**Result**

From October 1/ 2017, through September 31/ 2019, the study included a total 231 AVF procedures in 196 patients. As (n=165, 84.2%) patients hand once AVF, while (n=27, 13.8%) and (n= 4, 2%) patients hand twice and three AVF procedures respectively. Of 231 AVF procedures, 140 (60.6%) were constructed in men while 91 (39.4%) in female patients with male to female ratio of 1.54:1. Age follow a normal distribution with regards to gender variation in our patients. Age of all patients was (mean ± SD) (48.3 ± 16.9); men aged (50.9 ± 15.5) with a median of 53.5 (9–85). While women aged (44.4 ± 18) with a median of 50 (11–74), this difference was statistically significant (P = 0.002). The mean weight (kg) of patient was (52.3± 13). Other patient's characters were show in (Table 1).

Medical history of disease (Table 2) included hypertension in 146 (74%), diabetes in 53 (27%), CHD in 31(15.8%) and PAD in 19 (9.7%) patients. History of smoking and chewing Qat were 41(20.9), 15(7.7) patients respectively.

***Table1*** **Demographics characteristics of 196 patients with NAVF**

| Baseline Characteristics | N. 196 (%) |
|---|---|
| **Age (years) at AVF placement (mean ± SD)** | 48.3 ± 16.9 |
| **Gender (231 AVF Procedures)** | |
| **Female** | 91(39.4) |
| **Male** | 140(60.6) |
| **Patient weight (kg) (mean ± SD)** | 52.3 ± 13 |
| **Viral Marker Positive** | 40(20.4) |
| **-HCV** | 27(13.8) |
| **-HBV** | 13(6.6) |
| **-HIV** | 0 |

***Table 2*** History of disease and risk for patients undergoing hemodialysis

| History of Disease | Frequency(n=231) | Percentage |
|---|---|---|
| **HTN** | 146 | 74.5% |
| **Diabetes** | 53 | 27% |
| **IHD** | 12 | 6.1% |
| **CHF** | 31 | 15.8% |
| **PAD** | 19 | 9.7% |
| **CVA** | 12 | 6.1% |
| **Smoking** | 41 | 20.9% |
| **Chewing Qat** | 15 | 7.7% |

Regarding the time of dialysis initiation, majority of patients 180 (91.8%) were be referred late (after initiation or within 1 month). As in our finding, 144(73.5%) patients had non-tunneled catheter at time of AVF creation. Furthermore, 175(89.3%) patients have already had other forms of vascular access before AVF creation; one or more non-tunneled catheters were be used. (Table 3) shows other pre dialysis history of patients before AVF creation.

In this study, all the patients had native AVFs with end-to-side anastomotic (parachute) technique. No grafts were used. Majority of patients 183 (79.2%) had left non-dominant arm, while the right was 48(20.8%). The most common AVF was the brachiocephalic 112 (48.5%), then radiocephalic 74 (32%), Brachiobasilic 43(18.6%), one ulniobasalic AVF and one Brachiobrachial AVF. The first time cannulation were achieved after four, four to six and more than six weeks in 43(18.6%), 134 (58%) and 28 (12.1%) patients respectively.

***Table 3*** Pervious dialysis history baseline character before AVF creation

| Dialysis history baseline items | Frequency (%) |
|---|---|
| **Non-tunneled Dialysis catheters.** | |
| NO | **21 (10.7)** |
| YES (Use one) | **90 (45.9)** |
| Use tow | **44 (22.4)** |
| Use three | **19 (9.7)** |
| Use four or more | **22 (11.2)** |
| **Current catheter at time of operation** | |
| NO | **52 (26.5)** |
| YES | **144 (73.5)** |
| **Pervious AVF** | |
| NO | **123 (62.8)** |
| YES | **73 (37.2)** |
| **Previous procedures same limb** | |
| No prior procedure | **139 (70.9)** |
| One prior procedure | **46 (23.5)** |
| Two prior procedures | **11 (5.6)** |
| **Dialysis at time of surgery** | |
| NO | **32 (16.3)** |
| YES | **164 (83.7)** |

**Analysis of complications and intervention:**

Thrombosis was the most common complication that was 30 (13%) in our study. Among thrombosis cases 26 (86.6%) of 30 AVFs (14 AVFs thrombosis within 72hrs, 12 AVF within first three months post-operative) were failed before maturity and not use on dialysis. The remain thrombosis cases 4 (14.4%) of 30 AVF; as one of them thrombosis within 3 months after using on dialysis for one month, 2ed AVF thrombosis at 4th month, the last two AVFs thrombosis after 6 months of using on dialysis in AVF. All these case was management by do new fistula proximal site except tow cases which management by surgical intervention; one of these tow case survive till now, the other case thrombosis after 6 months.

Infection was 17 (7.4%) in our series, majority of these cases 10 (4.4%) management with observation (antibiotic) or aspirated and surgical drainage, other 7(3%) infection progressive lead to busted AVF with active bleeding. These management with emergency surgical intervention to stop bleeding as well as, six of seven cases underwent, redo AVF fistula at proximal site on same operation. Post-operative follows up of these six cases; infection was successful control and AVFs was survive until maturation and using on dialysis in five cases. Further follow up, two cases developed aneurysmal degeneration within 6 months, one developed stenosis proximal to anastomosis.

In our study, history of diabetic disease was found statistically related to developed of Steal syndrome complication in AVF created, of the 59 fistulas created in patients with DM disease 3 patients were developed steal syndrome while there is no steal syndrome in patient who haven't history of DM disease ($p = 0.002$). However, female gander was not found to be statistically related to steal syndrome ($p = 0.33$). As management of steal syndrome, DRIL procedure was done in two cases and third cases was management by stop AVF with placed permanent tunneled catheters to continue.

*Table 4* **post-operative Complications of AVF**

| Complication | Frequency | % |
|---|---|---|
| **Thrombosis** | 30 | 13% |
| **Noninfectious fluid collections (hematoma/seroma/lymphocele)** | 24 | 10.4% |
| **Infectious** | 17 | 7.4% |
| **Limp edema** | 10 | 4.3% |
| **Bleeding** | 9 | 3.9% |
| **Infection and burst fistulae** | 7 | 3% |
| **Aneurysmal degeneration** | 9 | 3.9% |
| **Venous hypertension** | 4 | 1.7% |
| **Steal syndrome** | 3 | 1.3% |
| **Ischemic naturopathy** | 3 | 1.3% |

Aneurysmal degeneration was nine (3.9%) in our study. Venous hypertension of arm was developed in four cases, we found statistically related between pervious central dialysis catheter used and venous hypertension ($p=0.001$). The complications of created AVF were shown in (Table 4).

## DISCUSSION

HD is a temporary treatment for patients who are candidates for kidney transplantation and a permanent treatment for the ESRD patients with no chance of kidney transplantation.[36]

In our study, most of the patients who had AVF were above the age of 30 years and the prevalence increased as the age increased. Complication related to AVF increases as the age increases and the management is usually very difficult.[37], [38]

The mean age of patients with ESRD undergoing AVF in our series was 48.3 years which was similar or close to other studies.[39],[40] However, the mean age in developed countries was one or two decades older.[41],[33],[42] The influence of age on the patency of AVF is still controversial. Al-Jaishi et al[42] and Gibson et al[43] found that age had no effect on primary patency. These findings were also found in our study where age did not seem to influence the primary patency. On other hand A review of literature by Smith et al[44] on the factors influencing patency of AVF showed an increase of access failure in the elderly population. In a meta-analysis of 2007, Lazarides et al[45] showed a significant difference in secondary patency rates between the elderly and younger patients at 12 and 24 months with odds ratios (ORs) of 1.525 ($P = 0.001$) and 1.357 ($P = 0.019$).[45]

We did not find a significant effect of gender on AVF patency in our study. In a literature review of 2012, Smith et al[44] also found the same result. On the other hand, there're

Figure 1 pseudoaneurysmal complication of Lt RCAVF due to wrong injection for radial artery of Lt forearm. Management by resection and redo new AVF.

studies found significant differences in outcomes of AV fistula creation when comparing males and females.[46], [47] In one

study, females were at greater risk for failure of the AV fistula to mature compared with the males in spite of preoperative vascular mapping (hazard ratio 2.42, 95% CI 1.32-4.45).[48] The reasons for these differences are not clear. It has been suggested that females have smaller vessels.[43], [49]

Factors adversely affecting AVF patency in ESRD patients reportedly include diabetes.[50] Although da Cruz, R. N.et al[51] reported that AVF patency rates were significantly lower for diabetic patients, Erkut et al[52] also reported that diabetes mellitus was one of the factors affecting the primary patency of AVF. Other studies found that diabetes had no effect on AVF patency rates.[53], [54] No relationship was found between diabetes and fistula patency rate in this study. We could not show that smoking, hypertension and PAD could effect on the AVF patency , Kazemzadeh et al[49] had also reported Similar observation.

Timely placement of native AVF is the cornerstone of preoperative management for patients.[55], [56] Early referral strategy significantly decrease morbidity,[57]mortality,[58], [59]CVC insertion,[60] urgent HD[61] and length of hospital stay.[62] However, as has been alluded in many studies delayed presentation of ESRD patients to the hospital in developing countries and referral for AVF creation have provided the need for temporary vascular access to have HD.[63]–[65] In our study, Majority of patients 180 (91.8%) were referred late. We found that nine out of 10 patients in **our series** had a previous central venous access for emergency HD before referral for AVF creation.

Preservation of peripheral veins and the venous circuit back to the heart is an important component of vascular access planning. It is important to avoid iatrogenic trauma to the venous

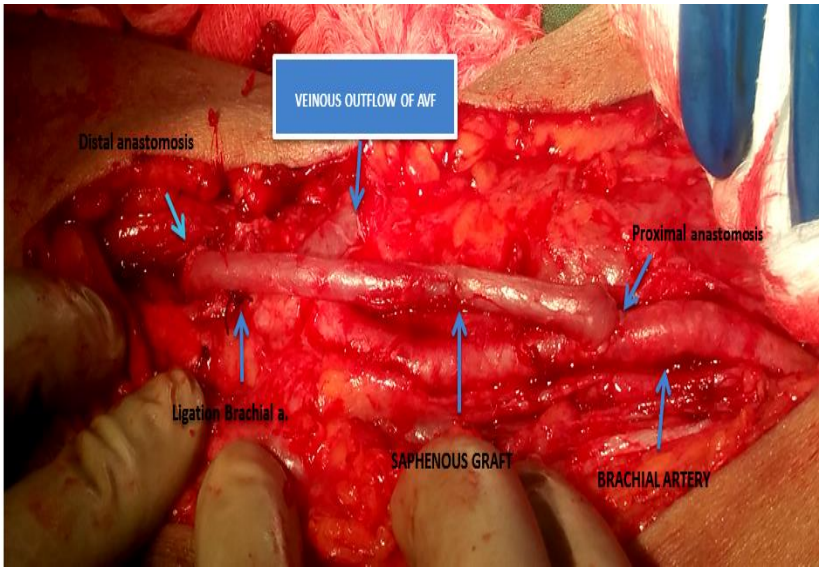


**Figure 2 DRIL procedure management of LT BCAVF complication by sever steal syndrome**

circulation due to phlebotomy or intravenous access in patients who are at risk for developing end-stage kidney disease or who are already receiving renal replacement therapy of any type. Unfortunately in our practice, many patients notice to have veins lesion of upper limbs due to repeated venous access and phlebotomy. This, adversely affect the available peripheral and central venous routes and more proximal vein was used for AVF creation. This recognized clearly in our study, as about forty-five present (105 patients) of our series had their first native AVF creation in proximal forearm or arm. Most experts agree that education regarding vein preservation should begin in individuals with stage 4 or 5 chronic kidney disease and strategies should be implemented to avoid unnecessary trauma to the venous circulation. These studies stress the need for early referral and education for predialysis patients to prevent the use of peripheral (upper limb vein preservation strategy) and central venous catheters and their subsequent complications.[66], [35]

The left upper limb being the nondominant limb in most of the patients was used for the creation of AVF in the majority (79.3%) of our patients. The preference for the nondominant limb is as a result of the need to carry out minimal work or activities with the limb to preserve the delicate AVF, especially in the first two weeks following surgery. Similar preference for the non-dominant upper limb is also practiced in other study.[39]

Brachiocephalic **(48.5%)** was the most common type AVF followed by radiocephalic type **(32%)**. Shan et al[67] and Mc Lafferty et al[68] found similar observation. In other hand many studies found radiocephalic most common.[41],[33] A fistula takes a number of weeks to mature, on average perhaps 4–6 weeks.[69], [70] In our study, the first time cannulation were

achieved after four, four to six and more than six weeks postoperative in 43(18.6%), 134(58%) and 28(12.1%) patients respectively.

Complications of AVFs adversely affect quality of life and survival of ESRD patients.[71] The most common complications after AVF surgery are thrombus formation rate of 3-14.5%[20],[40] and stenosis-induced occlusion.[72],[73] In our study, thrombosis was 30 (13%) cases of all patient. The major causes of early occlusion factors related to anastomosis technique, inadequate venous caliber and blood flow, hypotension, and compression by hematoma occurring due to early use. [73] In our study, 14 of 30 AVF procedures had thermoses early within 72hrs postoperative. Absent of thrill, arterial diameter < 2.6 and vain diameter < 2.4 ware found to be statistically significant with thrombosis of AVF.

Noninfectious fluid collections were 24 (10.4%) of all our cases, all cases management simply by dressing and evacuation of fluid. Post-operative bleeding was found in 9 (3.9%) cases of our patients, in other study bleeding was 33.0%.[25] In the studies by *Dekhaiya et al.*[40] and Schinstock et al[25] infection was 8% and 26.8% respectively, while in our patients, Infection was found in 17 (7.4%) patients, majority of these cases 10 (4.4%) management with observation (antibiotic) or aspirated and drainage. other seven (3%) infection progressive lead to burst fistulae, which management with emergency surgical intervention.

In the series, steal syndrome was observed in 1.6% - 8.0%.[40],[25],[74], [75] while in our study this rate was 3(1.3%). History of Diabetic disease was found statistically related to developed steal syndrome complication (p = 0.002). However, female gander was not found to be statistically related to steal syndrome (p = 0.33). Among these three cases, two cases were management by DRIL procedure, and one case by ligation with permanent tunneled catheters. Aneurysm was be found in 3.9% of our patients. While other studies it was observed in 2.0% to 8.5% cases.[63], [75] Venous hypertension of arm was developed in four cases, we found statistically related between pervious central dialysis catheter used and venous hypertension (p=0.001).

**Conclusion:-**

Early and timely detection of complications in AVF is essential for proper management. The complication rate in this study was similar compared to the average complication reported in other parts of the world. As the most common complication was thrombosis 30 (13%), followed by noninfectious fluid collections 24 (10.4%) wound infections 17 (7.4%), bleeding 9 (3.9%), postoperative edema 10 (4.3%), aneurysmal degeneration 9 (3.9%), venous hypertension 4(1.7%) and steal syndrome 3 (1.3%). There was a statistically significant correlation between developments of steal syndrome with Diabetes Mellitus (p = 0.002) and between venous hypertension with pervious central dialysis catheter used (p=0.001).

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