

A prospective study of arteriovenous fistula failure in a tertiary teaching hospital of Andhra Pradesh, India

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Background: An arteriovenous (AV) fistula is an abnormal connection between an artery and a vein. Normally, blood flows from your arteries to your capillaries to your veins. Nutrients and oxygen in your blood travel from your capillaries to tissues in your body. With an arteriovenous fistula, blood flows directly from an artery into a vein, bypassing some capillaries. When this happens, tissues below the bypassed capillaries receive diminished blood supply. **Methodology:** A prospective, study was conducted on 120 patients on hemodialysis in the Department of Surgery GEMS Srikakulam from February-November 2017. The failure rates, complications, and outcomes were assessed in this study. **Results:** A total of 120 AVF fistulae were created. It was radiocephalic in 94 cases and brachial fistula in 26 cases all of which were constructed in an end-side fashion. **Conclusion:** Complications developed in 27.5% (n=33) of patients who were managed appropriately.

Keywords: Arteriovenous fistula, Hemodialysis, Chronic Kidney Disease, Radiocephalic, Brachial fistula

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Introduction

An arteriovenous (AV) fistula is an abnormal connection between an artery and a vein. Normally, blood flows from your arteries to your capillaries to your veins. Nutrients and oxygen in your blood travel from your capillaries to tissues in your body. With an arteriovenous fistula, blood flows directly from an artery into a vein, bypassing some

Capillaries. Arteriovenous fistulas usually occur in the legs but can develop anywhere in the body. Arteriovenous fistulas are often surgically created for use in dialysis in people with severe kidney disease. Native arteriovenous fistula (AVF) is considered as the gold standard of vascular access (VA) for HD as it is associated with less infection and offers good dialysis adequacy. Therefore, the creation of an AVF in patients with ESRD

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One of the good practice measures, as recommended by the National Kidney Foundation, New York, NY, in Dialysis Outcomes Quality Initiative DOQI guidelines [1]. A large group of patients who suffer from both acute and chronic renal failure requires HD. In patients with ESRD, haemoaccess by means of an AVF is the most appropriate, because frequent access to the vascular system with a high-flow and the ability to withstand needle puncture is required. The most frequently used fistula and the standard one, by which all other fistulas are compared, is the Brescia-Cimino fistula [2,3]. Both physicians and patients encounter frequent problems with AVF. The Brescia-Cimino fistula is usually considered as the standard HD access of choice because of its high patency and low complication rate with the preservation of alternate access sites in the future. Even though this is a simple procedure, it requires well-experienced surgeons and ensuring an adequate collateral flow from the ulnar artery by performing Allen's test before surgery in order to minimize the problem of hand ischemia. In addition, evaluating superficial veins and distal arteries must be done for selecting the best site for fistula. Even then, the two most common reasons for the failure of AVF are the surgeon's inexperience and improperly selected vessels for creating AVF [4]. In this study, we review our experience of creating AVF and to analyze the patency rate and the various complications associated with the procedure.

Materials and Methods

Study Setting: Department of surgery, GEMS Hospital, Srikakulam.

Duration and Type of Study: February to November 2017. Prospective, Randomized, hospital-based study.

Sample Size: 120 patients who attended GEMS Hospital for Renal Diseases.

Inclusion criteria:

01. All patients of End-Stage Renal Disease(ESRD) or Chronic Kidney Disease(CKD)
02. Those who consented to take part in the study were recruited.

Exclusion criteria

01. Those who didn't consent to take part in the study.
02. Any patient with sepsis, acquired immunodeficiency syndrome, hepatitis C virus or hepatitis B virus, small or deformed limb,

Uremic-associated bleeding tendency, and negative Allen's test

The study was conducted after approval from the Institutional Ethics Committee.

Data collection and surgical procedure: All were candidates for HD, and Individual data such as age, sex, residence, occupation, cardiovascular risk factors (arteriosclerosis, diabetes, and hypertension), type of dialysis before the creation of vascular access, total duration on dialysis, arm used, different sites of AVF creation, state of function after the creation of AVF, their respective date of maturation and surgical complications were recorded for all patients. Pre-operative clinical assessment was done in all patients and appropriate pre-operative investigations were done such as complete blood count, blood urea, serum creatinine, electrolytes (Na⁺, K⁺), coagulation profile (PT, PTT, and INR), human immunodeficiency virus, serology for hepatitis B surface antigen and hepatitis C, antibody and blood grouping. Allen's test was also performed and the best site for fistula creation was chosen. The radio-cephalic fistula was performed whenever the cephalic vein was in good condition; otherwise, a fistula at the elbow was created. All procedures were performed by a single surgeon successfully. Post-operatively, all patients were evaluated on day 1, at the end of the first week, and after the fourth week for ensuring the fistula patency and performance of HD. After ensuring the patency of fistula and obtaining the thrill, the patient was discharged. During the follow-up, the patency of the fistula was assessed either by palpation for a thrill or auscultation for a bruit. Complications such as hematoma and subcutaneous thrombosis associated with fistula and blood pressure during HD were assessed by using color Doppler ultrasonography and were recorded.

Statistical analysis: The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Parameters were expressed in percentage or mean \pm SD. A comparison between qualitative variables was made using the chi-square test. A p-value <0.05 was considered significant.

Results

120 fistulae were created in our study subjects, which included 89 men (74.16%) and 31 (25.83%)

Women. The mean age of patients in the present study was 44.6years (range from 16 to 65 years) as shown in Table 1. All subjects had been dialyzed with a jugular catheter before the creation of AVF. A native AVF was created in all our patients as the first permanent access. It was radiocephalic (Cimino-Brescia fistula) in 78.3% (n=94) and at cubital fossa (brachial fistula) in 21.6% (n=26). All AVFs were end-to-side, and the condition of its function after operation varied, with 82.5% (n=99) functioning immediately, 5% (n=6) had delayed functioning and 12.5% (n=15) did not function at all and were not considered for the further follow up as shown in Table 2.

Table-1: Sex wise age distribution of study patients.

| Age(years) | Male | Female | Total |
|------------|------|--------|-------|
| 10-19 | 1 | 0 | 1 |
| 20-29 | 12 | 4 | 16 |
| 30-39 | 22 | 11 | 33 |
| 40-49 | 33 | 9 | 42 |
| 50-59 | 14 | 5 | 19 |
| >60 | 7 | 2 | 9 |

Table-2: Maturation and State of AVF in the study.

| State of AVF | Total | The time needed for maturation | | None |
|---------------------|------------|--------------------------------|------------|------|
| | | <6 weeks | >6 weeks | |
| | | Immediate functioning | 99 (82.5%) | |
| Delayed functioning | 6 (5%) | 0 | 7 | 0 |
| Non-functioning | 15 (12.5%) | 0 | 0 | 15 |

Table-3: List of complications.

| Early complications | No of cases |
|---------------------|-------------|
| Infection | 9 |
| Thrombosis | 6 |
| Bleeding/Haematoma | 4 |
| Seroma | 3 |
| Late complication | |
| Neuropathy | 8 |
| Pseudoaneurysm | 3 |
| Total | 33 |

AVF maturation was seen in 76.6% (n=92) of the cases within the first six weeks, 10.83% (n=13) in more than six weeks. Failure rate was 12.5% (n=15) who were not considered for further follow up in this study, 27.5% (n=33) developed complications. The most common early complication encountered with the primary AVF was infection

Seen in 9 out of the 33 cases and shown in Table 3. Treatment of these complications consisted of surgical intervention for aneurysm, conservative management in the form of antibiotics for infections, and compression in case of bleeding.

Discussion

With an increasing number of patients undergoing HD due to an increase in both the number of patients as well as HD centers, establishing and maintaining proper vascular access is necessary for successfully performing HD, and a well- functioning AVF is essential for the maintenance of HD in patients with ESRD. The aim of the present study was to review our experience of creating AVF and to assess its success rate and for common complications associated with the same. The native AVF is the optimal VA in HD [5,6]. It was created in all advanced CKD and ESRD patients, with radiocephalic (Cimino-Brescia) fistula being the most common in 94 cases (78.3%). This was in accordance with the international recommendations (K-DOQI guidelines). Time to first use for AVFs is one of the most important variables for clinical outcomes. If the time to maturation was known, nephrologists can plan the ideal time for referring patients for HD access surgery. If a patient undergoes AVF creation before starting HD, the AVF may mature before its first use for HD. In our study, all patients were referred for vascular access (CVC) after starting HD. This percentage is high compared with the percentage reported in Australian and USA patients (28% and 79%, respectively) [7,8] and this is due to the late referral of our patients to the nephrologists. Upper limb AVFs are commonly performed for dialysis in ESRD cases and, especially, distal (radial) fistulas are more preferred because this provides more superficial veins to cannulate and has fewer complications in comparison with proximal fistula, where greater and comparatively bigger vessels are used [9]. In our study, most of the AVF creations were distal forearm (Brescia-Cimino) in 78.3% (n=94). Our result is quite similar to that reported in Nigeria earlier, i.e. approximately 90% of the patients of HD have Brescia-Cimino fistula. In our study, the condition of the AVF after operation varies, but most of them functioned immediately, 87.5% (n=105), and the immediate failure rate in our group was 12.5% (n=15) correlate with the literature data, which varies from 10 to 30% [10,11]. Maturation is defined as successful cannulation for at least one complete HD session [12]. The National Kidney Foundation

Dialysis Outcomes Quality Initiative (DOQI) recommends that fistula should mature for at least one month before cannulation. The overall maturation rate was found to be 87.5% (n=105) compared favorably with published results for all types of native AVFs, both in the upper and in the lower arm. Our results are comparable to a similar study done by Dr. Manju Prasad and Dr. Ramesh [12]. Complications are well-known with any type of HD procedure. In the present study, 27.5% (n=33) had a complication interfering with the function of their upper arm AVF. Such complications are usually not directly life-threatening and can often be overcome with appropriate management. Most reinterventions took place before first use, indicating that once matured, upper arm AVFs tended to remain functional.

Conclusion

AVF failure also depends on the skill of the surgeon and the selection of the vessels. Hence, it is necessary to understand complications while planning AVF for a better outcome.

What does the study add to the existing knowledge?

Early diagnosis of CKD allows the creation of native AVF before ESRD sets in and, consequently, the use of a temporary catheter can be avoided. Regular monitoring of the VA and a close working relationship between the nephrologists, surgeon, interventional radiologists, and nurses can ensure prolonged survival of primary AVF and better treatment of its complications.

Author's contribution

Dr. Dumpala HariPrasad Rao: Formulated the aims and objectives along with study design and helped in data collection and analysis. **Dr. Sanjay Kumar Mohapatra:** Surgical procedure and manuscript.

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