

Arteriovenous fistula procedure for end stage renal disease in newly established transplant center, Addis Ababa, Ethiopia

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Abstract

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Background: A native arteriovenous fistula (AV fistula) is an artificially created communication between a peripheral artery and vein in order to serve as a vascular access for hemodialysis in end stage renal disease (ESRD). The aim of this study was to describe the commonly performed types of arteriovenous fistulas and associated complications among patients with end stage renal disease that undergo AV fistulas surgery in a newly established renal transplant center.

Methods: Descriptive cross sectional study was investigating the characteristics of patients who had undergone vascular surgery at St. Paul's Hospital Millennium Medical College (SPHMMC). All patients for whom AV fistula was constructed were recruited retrospectively. Data was extracted using a pretested questionnaire from medical records and analyzed using SPSS 20.

Result: A total of 346 patients with end stage renal disease received vascular access surgery for hemodialysis during the study period. The age of patients ranged from 17 to 80 with mean (SD) of 46.1 (15.4) years. Males constituted 223(64.5%) of the cases with male to female ratio of 1.8:1. Out of 346 patients 262 (75.7%) had prior history of catheter use, of those, 176 (67.3%) of the patients the catheter was located in the internal jugular prior fistula was reported in one third of the patients. All the 346 patients received vascular access surgeries out of which 81.5% of the procedures done under local anesthesia, and over a two-third (n=240, 69.4%) received no antibiotics. Considering the vessels involved, 216(62.4%) were on the brachiocephalic followed by brachiobasilic in 94 (27.2%) of the patients. A palpable thrill was detected and documented at the end of each of the procedures in 332 (96.0%) of the patients.

Conclusions: The commonest vascular access created in the center is a AV fistula and the commonest vessel involved is brachiocephalic and majority of the patient received local anesthesia and almost all had a palpable thrill at the end of the procedure. The center shall consider to do a follow up study on the outcome of vascular access surgeries.

Keywords: AV fistula, AV graft, Brachiobasilic, ESRD, Brachiocephalic, Hemodialysis Transposition, Vascular access

Background

Renal replacement therapies in the form of Hemodialysis, Peritoneal dialysis and Kidney Transplant are the main stay of treatments for patients with End Stage Renal Disease (ESRD). Hemodialysis is the most common form of renal replacement therapy used by many patient of ESRD. This treatment option can only be made possible in the presence of a reliable vascular access. Options of vascular access for hemodialysis include native arteriovenous fistula (AVF), arteriovenous graft (AVG) and central venous catheter [1].

Long term hemodialysis via a native arteriovenous fistula is made a possible choice for patients with ESRD following introduction of Brescia- Cimino AV fistulas. In the report released in the year 1966 it was mentioned that the procedure was performed in fourteen patients (28- 54 years) with a maximum period of usage being less than one and half year(15 ½ months) [2]. An arteriovenous (AV) fistula for hemodialysis access is achieved by a deliberate creation of end - to- side or side- to- side connection (anastomosis) between a peripheral vein and artery [3, 4]. Commonly AV fistulas are created by anastomosing the radial artery to the cephalic vein (Radiocephalic fistula) or by anastomosing the brachial artery to the cephalic vein (brachiocephalic fistula) or basilic vein (brachio basilic fistula) [5]. Successful creation of AV access for a patient with ESRD needs a through medical and physical evaluation of the patient [6, 7]. Preoperative clinical evaluation of patients can also be augmented with ultrasound evaluation of upper extremity vessels for an improved outcome [8].

The goal of vascular access creation is to provide an accessible native or artificial vascular structure with sufficient blood flow that can be cannulated repeatedly to permit adequate dialysis. Arteriovenous fistula is the preferred type of vascular access for chronic hemodialysis. When a matured AV fistula is compared with than that of hemodialysis catheters, hemodialysis catheter use has been consistently associated with worse complication and survival rates [9]. An AV fistula is also recommended over an AV graft for hemodialysis because a mature AV fistula has the lowest morbidity and mortality, lowest need for intervention, and the best long-term patency [10].

Although AVF is the best vascular access for hemodialysis it is associated with complications that include primary failure and failure to mature; which both happen more commonly in AV fistulas than in AV grafts. Other AV fistula related complications include late failure, excessive flow, steal syndrome, aneurysm formation and infection [11].

A functional AV fistula is a life line for patients with ESRD.

A mature AV fistula has the lowest morbidity and mortality, lowest need for intervention, and the best long-term patency when it is compared with that of AV graft [12].

Higher rate of primary AV fistula failure commonly seen among individuals with risk factors that include old age, nonwhite race, obesity, female sex, diabetes, peripheral arterial disease [13]. There are additional factors that impact the rate of primary AV fistula failure which include site of the procedure (Upper arm Vs. Lower arm) and surgical skill or surgical experience of the operating surgeon in implementing improved surgical techniques for creating AV fistulas [14]. In one of a pooled systemic review the estimated percentage of primary failure in AV fistula is found to be 23% [15]. However many AVF failure rates vary significantly among different groups of patients; one can appreciate the difference by comparing between younger patients and individuals older than 65 years (27 Vs. 37) and upper arm AV fistulas and lower arm AV fistulas (20 Vs. 28) [16]. Some authors found out in their study that the rate of primary AV fistula failure is strongly associated with the competency of the surgical center where the patient underwent vascular access surgery in addition to skill and decision making experience of the operating surgeon [17].The rate of AV fistula failure can be as high as 33%; which is in line with the above stated factors for possible variation in outcome of vascular access surgeries [18, 19, 20]. This study was purposed to determine the commonly performed types of arteriovenous fistulas and associated complications among patients with end stage renal disease who had undergone AV fistulas surgery at SPHMMC, Addis Ababa, Ethiopia. This study was paramount importance in filling the literature gap that existed regarding AV fistulas and associated complication from health facilities of low income countries.

Methods

Study setting, design, period, and population

A descriptive cross-sectional study was done at SPHMMC to assess outcome of AV fistula surgeries done for patients with End stage Renal Disease (ESRD) at SPHMMC from February 1, 2017 to January 30, 2019. At SPHMMC AVF surgery was first started by visiting Egyptian surgeons in the Ethio-Egypt collaboration group in line with organizing the first Kidney transplant center in the country. AVF surgeries were erratically done by visiting surgeons from India and the US during the establishment of the kidney transplant center. After the establishment of the kidney transplant center, more formal skill training on AV was started in collaboration with Resolute Health. Resolute Health group formerly known as SAO (Seattle Alliance for Health) had long years of experience in Ethiopia performing multiple campaigns of AVF at Zewditu hospital in collaboration with the national association of kidney disease patients. The Resolute Health team travels to the national kidney transplant center twice a year to provide hands on skill transfer. The team is composed of Vascular Surgeon/s, Anesthesiologist, A research advisor, Vascular Sonographers, scrub nurse and coordinator with consumable supplies like prolene stiches and graft material besides skill transfer. Currently there is regular AVF service at the national Kidney transplant center by the now Transplant surgeons and a Plastic surgeon.

All Patients with ESRD who underwent AV fistula surgery at SPHMMC from February 1, 2017 to January 30, 2019 were taken as study population. Patient data was collected from medical charts using a well-structured questioner then added to an excel sheet. The collected data was analyzed using SPSS Version 20.1 after coding the subjects of the study and making all the necessary procedures for data clearance and consistency check. The data analysis results are presented as the means for continuous variables and as proportions for categorical variables. Demographic and clinical data will be described.

Results

Characteristics of patients

A total of 346 patients with end stage renal disease received vascular access surgery for hemodialysis during the study period. The age of patients ranged from 17 to 80 with mean (SD) of 46.1 (15.4) years. The majority were in the age group of 46-65 years (137, 39.6%). Males constituted 223(64.5%) of the cases with male to female ratio of 1.8:1 (Table 1).

Table 1: Age and Sex distribution of patients who underwent vascular access surgery for hemodialysis at St. Paul's Hospital Millennium College, Addis Ababa, Ethiopia (n = 346)

Characteristics	Category	Frequency	Percent
Age (yrs.)	30 or less	73	21.1
	31-45	96	27.7
	46-65	137	39.6
	66 or above	40	11.6
Sex	Male	223	64.5
	Female	123	35.5

Catheter used for hemodialysis and prior history of AV fistula

From the 346 patients 262 (75.7%) had prior history of catheter use of those, 206(78.6%) had their catheter on the right side whereas, the remaining were in the left side. In a two-third (176, 67.3%) of the patients the catheter was located in the internal jugular (Table 2).

Of all, about a third (108, 31.2%) had prior fistula. Out of those who received this procedure,

For over a two-third (68.5%) of those patients with prior fistula, the location was brachiocephalic followed by brachio basilic (27, 25.0%) (Table 2).

The reason for previous fistula failure among half (50.0%) of the patients was not known or documented. From the known reasons infection is the leading 13 (12.0%), followed by swollen arm and thrombosis accounting for 12 (11.1%) each (Table 2).

Table 2:- Catheter related characteristics and prior AV fistula use of patients who underwent vascular access surgery for hemodialysis at St. Paul's Hospital Millennium College, Addis Ababa, Ethiopia (n = 346)

Characteristics	Category	Frequency	Percent
Prior Catheter use	No	84	24.3
	Yes	262	75.7
Vein accessed for catheter	Internal Jugular Vein	176	67.3
	Subclavian Vein	67	25.4
	Femoral Vein	19	7.2
Previous fistula status	No Prior Fistula	238	68.8
	Failed Prior Fistula	108	31.2
	Brachiocephalic	76	68.5
	Brachio basilic	28	25
	Radial Cephalic	7	6.5
reason for prior fistula failure	Unknown	54	50.0
	Infection	13	12.0
	Swollen Arm	12	11.1
	Thrombosis	12	11.1
	Small Vessel	10	9.3
	Pseudo-Aneurysm	7	6.5

Characteristics of current Arteriovenous Fistula procedure

Most of the patients (320, 92.5%) received a fistula procedure, and about a two-third (231, 66.8%) of the procedure was done in the left side. And, the majority (282, 81.5%) of the procedures done under local anesthesia, and over a two-third (240, 69.4%) received no antibiotics. Considering the vessels involved, 216 (62.4%) were on the Brachiocephalic followed by those via the Brachio basilic in 94 (27.2%) of the patients. A palpable thrill was detected and documented at the end of each of the procedures in 332 (96.0%) of the patients (Table 3).

Table 3:- AV fistula procedure details of patients who underwent vascular access surgery for hemodialysis at St. Paul's Hospital Millennium College, Addis Ababa, Ethiopia (n = 346)

Characteristics	Category	Frequency	Percentage
Type of anesthesia	Local	282	81.5
	Regional block	62	17.9
	General	2	0.6
Antibiotics used	Yes	106	30.6
	No	240	69.4
Side of the procedure	Right	115	33.2
	Left	231	66.8
Procedure type	Fistula	320	92.5
	Graft	26	7.5
Vessel involved in the AV fistula formation	Brachiocephalic	216	62.4
	Brachio basilic	94	27.2
	Radial cephalic	10	2.9
	Straight graft	16	4.6
	loop graft	10	2.9
Palpable thrill detected	Yes	332	96
	No	14	4

Discussion

This finding revealed that the most common Arteriovenous fistula created was brachiocephalic followed by Brachio basilic which is in contrary to the radial cephalic fistula which is the commonest in

Canadian and American guideline, followed by brachiocephalic and Brachio basilic [1,3]. It is also in contrary with the Indian report where 96% of the primary vascular access was radio cephalic fistula [21]. The reason for this difference may be attributed to Ethiopian patients having small cephalic vein on the forearm and small radial artery of less than 2.5mm in diameter, beside that most patients forearm vein were accessed for investigation or treatment and affected by thrombophlebitis. Further investigations are important to really understand the situations and propose tangible solutions.

The current study found out that the majority (282, 81.5%) of the procedures were done under local anesthesia this is in agreement of the concept that, AV fistulas can usually be constructed under local anesthesia. Transposed AV fistulas and AV grafts may require regional nerve blocks or general anesthesia due to the increased complexity of the operation [22]. There is some evidence that brachial plexus blocks may be beneficial for vascular access operations by causing regional sympathetic blockade, which results in arterial and venous vasodilation. However, there was no difference in rates of early failure between the two groups [23]. however doing brachial plexus block may require additional expertise, like a trained anesthesiologist or anesthetist, using this method as routine is not feasible in resource limited country like Ethiopia. This study revealed that most of the fistula failure was not documented and from the documented reasons infection and thrombosis were the commonest, which are also the main reasons, documented by other researchers in the field [24, 25, 26]. The high rate of unknown reasons for fistula failure in this research shall be a lesson to the care givers in the hemodialysis service.

In conclusion, the commonest vascular access created in the center is a AV fistula and the commonest vessel involved is Brachiocephalic and majority of the patient received local anesthesia and almost all had a palpable thrill at the end of the procedure. The center shall consider to do a follow up study on the outcome of vascular access surgeries. In addition the center must develop a mechanism to detect and document reasons for failure of vascular access as that will be used as entry point to find a solution and implement a preventive strategies.

Abbreviations

AVF: Arteriovenous fistula

AVG: Arteriovenous graft

ESRD: End Stage Renal Disease

SPHMMC: St. Paul's Hospital Millennium Medical College

Declarations

Ethics approval and consent to participate

Ethical approval for undertaking of this study was requested and obtained from the SPHMMC institutional review board. Confidentiality of patients' information obtained during the study period were maintained throughout the study and during research finding disseminations.

Consent for publication

Further, informed consent for publication was also obtained from each study participant under the consent form by mentioned for all of them that the data will be published in international journals. So, this is to confirm that informed consent for publication was obtained from all the study participants. The collected data is kept confidentially under the primary investigator and co-investigators.

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Competing interest

All authors read and approved the final manuscript. The authors declare that they have no competing interests.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

AB, MT, EA, TB, RL, KJ and MB were involved starting from conceiving the idea, developing the proposal, the study design, reviewed the article. AB and MB involved in data cleaning, analysis, report writing and write up of the manuscript; MT, EA, TB, RL and KJ involved in data analysis and review of the drafted manuscript. All authors read and approved the final manuscript submitted to this journal.

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