



(RESEARCH ARTICLE)



## Arteriovenous fistula access for dialysis using vessels of the arm

Christian Emeka Amadi\* and Kelechi Emmanuel Okonta

*Cardiothoracic Surgery Unit, Department of Surgery, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria.*

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### Abstract

**Background:** Site selection, configuration of the access and technical performance of operation are keys to a successful arteriovenous fistula (AVF) for haemodialysis.

**Objective:** To evaluate the primary success rate and complications of AVF performed in Port Harcourt using vessels of the arm.

**Materials and Methods:** This was a prospective cross-sectional study on the success rate of the Arteriovenous fistulas done using vessels of the arm in patients with End Stage Renal Disease (ESRD) undergoing dialysis across public and private health facilities in Port Harcourt. The study was conducted between March 1, 2017, and February 29, 2024. Preoperatively, using a duplex scan (and sometimes through clinical examination) with and without a tourniquet, the selected vein size was  $\geq 2.5$ mm and the artery  $\geq 2$ mm with a healthy wall and good flow. Parameters monitored were thrill and bruit intra-operatively, immediate, one-week and 6-8 weeks post-operative periods; the size of the vein intra-operatively, one-week and 6-8 weeks post-operatively. In addition, the patients were monitored for complications. Data were analyzed using statistical packages for social sciences (SPSS) version 25. The demographic data and medical information were summarized using descriptive statistics (mean, median, frequency percentage and standard deviation) as appropriate.

**Result:** There were 87 patients during the period under review. The age range was 14-85 years with mean age of  $54 \pm 6.4$  years. Of these, 18 (20.69%) were females, and 69 (79.31%) were males; 92 AVFs were done in 87 patients (87 primary and 5 repeat) with ESRD for dialysis; 69 (75%) Brachiocephalic (BC) and 23 (25%) Brachio basilic (BB) AVFs. The AVFs were primarily successful in 82 cases (94.25%), with 5 primary failures (5.75%), and a total of 5 repeat AVFs within this period, excluding secondary failures. Complications were 1 (1.15%) upper limb oedema, 6 (6.90%) delayed wound healing, 4 (4.60%) cases of seroma, 1 (1.15%) case of steal syndrome, 4 (4.60%) cases of spontaneous thrombosis and 3 (3.45%) cases of superficial wound infection.

**Conclusion:** The primary success rate of AVF for dialysis in Port Harcourt using vessels of the arm is quite good with few complications.

**Keywords:** Arm vessels; Arteriovenous fistula; Complications; Haemodialysis; Primary success

### 1. Introduction

There has been a rising case of End stage renal disease (ESRD) in the subregion and thus the need to institute haemodialysis for patients' survival<sup>1</sup>. The performance of a successful haemodialysis session is hugely dependent on vascular access<sup>2</sup>. A functional access site must have a good blood flow rate, be easily available, have great patency, minimal complications, support easy and withstand repeated cannulation<sup>1,2</sup>. Three main devices have been indicated

\* Corresponding author: Christian Emeka Amadi

for vascular access creation which includes arteriovenous fistula (AVF), arteriovenous graft (AVG) and dialysis catheter<sup>3</sup>.

AVF is an autologous access created by connecting a vein to an artery, whereby the vein acts as the accessible conduit<sup>4</sup>. AVF has been tagged the gold standard for maintaining vascular access to the body's circulation for haemodialysis<sup>5</sup>. Characteristics such as reduced complication rate, long-term usage, lower maintenance costs, lowered associated mortality, high durability, little or no interventions; have made AVF the best for vascular access, when compared to AVG and catheters<sup>1,6,7</sup>. However, the major challenges associated with the use of AVF are frequent primary failures and the long duration before maturation<sup>7,8</sup>.

The best maturation time for AVF remains a debatable discussion, although quick detection of dysfunctional AVFs, assessment for complications, and administration of indicated interventions, help to reduce AVF failure<sup>9</sup>. AVF failure could be early (primary) or late (secondary); while early (primary) failure occurs between the duration of AVF creation and first 3 months before usage, late (secondary) AVF failure occurs after 3 months of its creation and when it has started being used for haemodialysis<sup>1</sup>. Furthermore, after the failure of the primary AVF, a secondary fistula could be created by converting an arterial outflow vein to a direct or transposed AVF<sup>10</sup>.

Although complications associated with AVFs had been reportedly low with about 0-16%, however arterial emboli, pulmonary oedema, haematoma, infection, thrombosis and rarely death had been reported in some cases<sup>8</sup>. Primary suggestions in AVF creation using the upper limb vessels include radio-cephalic fistula (RCF), brachio-cephalic fistula (BCF) and the brachio-basilic fistula (BBF)<sup>8</sup>.

There is paucity of data on the success rate and complications of AVF creation using the arm vessels. Hence, this study sought to evaluate the success rate and complications of AVF performed in Port Harcourt using vessels of the arm.

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## 2. Materials and methods

### 2.1. Study Area

The study was conducted at the University of Port Harcourt Teaching Hospital, Rivon Clinic, Atinu Critical Care Hospital, Sterling Specialist Hospital, Princess Medical Centre, Lifeforte Specialist Hospital, and Raziela Specialist Clinic among patients presenting with End Stage Renal Disease (ESRD) needing vascular access for hemodialysis, all in Port Harcourt, Rivers State.

### 2.2. Methods

This was a prospective study from March 1, 2017 to February 29, 2024. We evaluated the success rate of Arteriovenous fistulas done using the arm vessels of patients with End Stage Renal Disease (ESRD) for haemodialysis. Preoperatively, using duplex scan (and occasionally through clinical examination) with and without tourniquet, the selected vein size was  $\geq 2.5\text{mm}$  and artery  $\geq 2\text{mm}$  with healthy wall and good flow. Parameters monitored were thrill and bruit intra-operatively, immediate, one week and 6-8 weeks post-operative periods; and size of the vein intra-operatively, one week and 6-8 weeks post-operatively. The patients were followed up for complications.

### 2.3. Data Analysis

Data were obtained using predesigned semi-structured pro-forma which were entered into excel spreadsheet. Data analysis was done using Statistical Packages for Social Sciences (SPSS) version 25, with demographic data and medical information summarized using descriptive statistics (mean, median, frequency percentage and standard deviation) as appropriate.

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## 3. Results

There were 87 patients during the period under review. The age range was 14-85years with mean age of  $54 \pm 6.4$  years. Of these, 18 (20.69%) were females, and 69 (79.31%) were males as shown in table 1. Table 2 showed the complications which included: 1 (1.15%) upper limb oedema, 6 (6.90%) delayed wound healing, 4 (4.60%) cases of seroma, 1 (1.15%) case of steal syndrome, 4 (4.60%) cases of spontaneous thrombosis and 3 (3.45%) cases of superficial wound infection, giving the total complication rate of 21.8%.

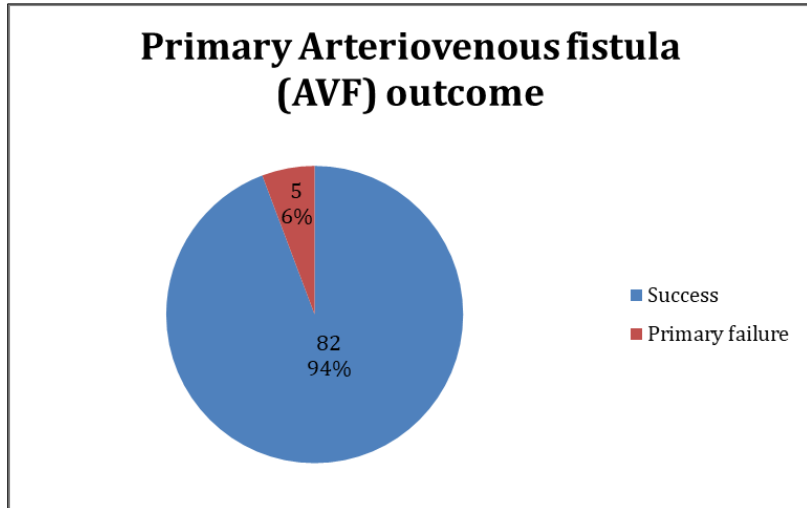
As presented in Figure 1, of the 87 primary procedures, AVFs were primarily successful in 82 cases (94.25%) with 5 primary failures (5.75%). A total of 92 AVFs; 69 (75%) Brachiocephalic (BC) and 23 (25%) Brachiobasilic (BB)] were done, with 87 being primary AVFs and 5 redo-AVFs within the period, excluding those of secondary failures, as shown in figure 2. The Brachiocephalic (BC) - AVF, Brachiobasilic (BB) - AVF, arm suture, and haemodialysis session after successful maturation of AVF, are all shown in Figs 3 - 6 respectively.

**Table 1** Demographic Characteristics

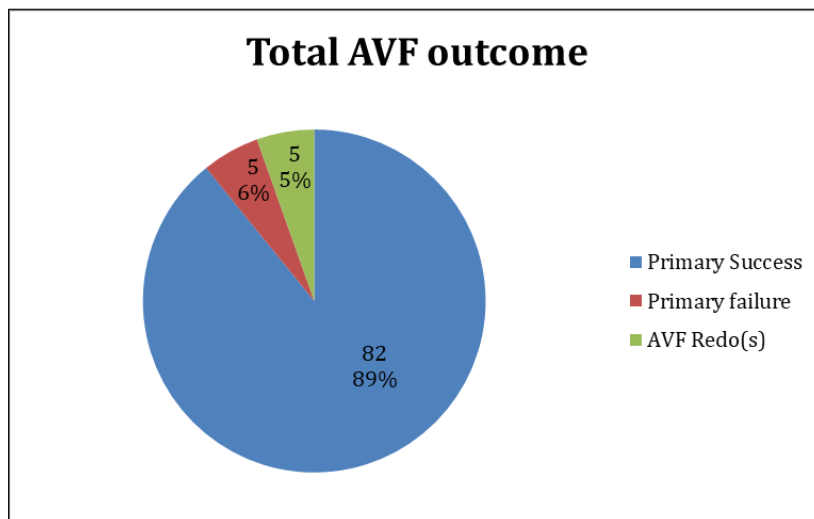
Parameter	Frequency (n)	Percentage (%)
<b>Age Group (years)</b>		
14-19	1	1.15
20-29	3	3.45
30-39	12	13.79
40-49	15	17.24
50-59	15	17.24
60-69	33	37.93
70-79	6	6.90
80-85	2	2.30
Mean	54 +/- 6.4	
<b>Gender</b>		
Male	69	79.31
Female	18	20.69

**Table 2** Complications associated with Primary AVF Creation

Complications	Frequency (n)	Percentage (%)
Upper limb oedema	1	1.15
Delayed wound healing	6	6.90
Seroma	4	4.60
Steal syndrome	1	1.15
Spontaneous thrombosis	4	4.60
Superficial wound infection	3	3.45



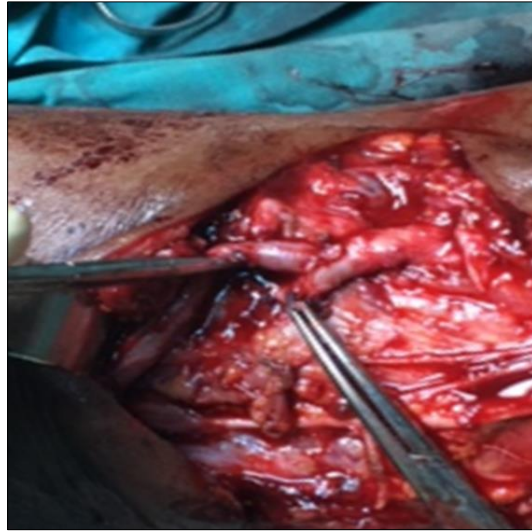
**Figure 1** Primary Outcome of AVF Creation



**Figure 2** Outcome of Total AVF Creation



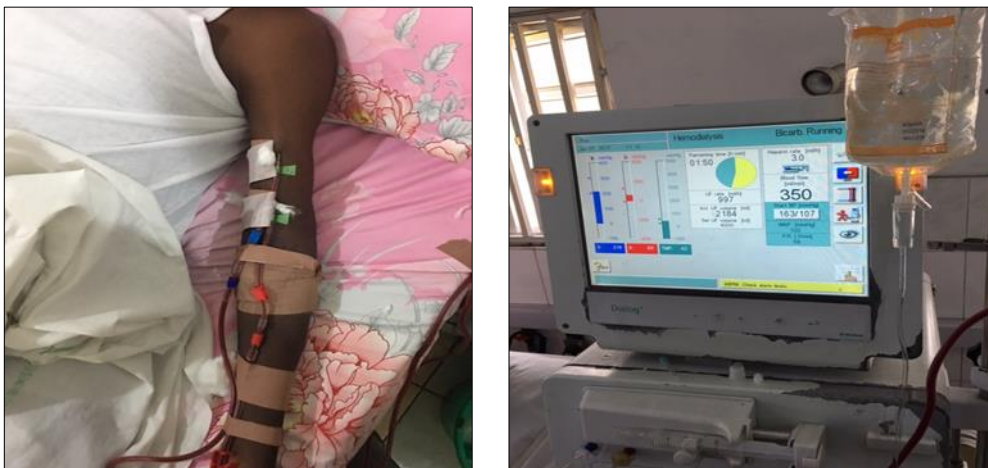
**Figure 3** Surgical slide for Brachiocephalic (BC) - AVF



**Figure 4** Surgical slide for Brachiobasilic (BB) - AVF



**Figure 5** Arm suture after AVF



**Figure 6** Haemodialysis session after maturation of AVF

#### 4. Discussion

The mean age of the patients was  $54 \pm 6.4$  years. The majority of the patients were males with 79%, while females were 21%. This demography is similar to the studies by Fitzgerald et al,<sup>11</sup>Shahnawaz et al,<sup>12</sup> Demiral et al,<sup>13</sup> Korepta et al,<sup>14</sup> and Yoo et al,<sup>15</sup> who all documented in their respective studies that higher percentages of men had AVF access created for haemodialysis. Similarly, the mean ages of 55, 56 and 59 years were reported by Sahasrabudhe et al,<sup>16</sup> Fitzgerald et al,<sup>11</sup>and Yoo et al,<sup>15</sup> respectively. This correlated with that obtained in this study indicating that most ESRD patients undergoing haemodialysis are of middle age.

The outcome of AVF using the arm vessels was 94%, as 82 patients had primary success after AVF creation and usage. Only 5 (6%) cases of primary failure were recorded, prompting redo of these 5 AVFs. This success rate is however higher than the 80% and 87% achieved by Fitzgerald et al<sup>11</sup>and Shahnawaz et al<sup>12</sup> respectively. The high success rate in our study could be attributed to the operative techniques during the AVF creation and the bigger sizes of the arm compared to the forearm vessels, aiding faster maturation of the arm fistula. Furthermore, the success rate in this study is consistent with the 96.4% previously reported by Yoo et al,<sup>15</sup>while using 338 autologous AVFs through the arm vessels, at a tertiary facility in South Korea. In addition, , Korepta et al<sup>14</sup>also recorded 89%, 94% and 97% success rates for AVFs created using the forearm cephalic vein, upper arm cephalic vein and the upper arm basilic vein respectively, while Nguyen et al<sup>17</sup> reported a 98% primary success rate in a study in Vietnam.

Although, the failure rate in this study was 6%, this was however lower than the 13% and 11% using the forearm cephalic vein reported by Shahnawaz et al<sup>12</sup> and Korepta et al<sup>14</sup> respectively. Moreover, the arm cephalic vein and the arm basilic vein had a lower failure of 6% and 3% respectively, as reported by Korepta et al<sup>14</sup>, while Yoo et al<sup>15</sup>also did record a low failure rate of 3.6%. Several factors such as female gender, older age, obesity, African American ethnicity, and commencement of haemodialysis before AVF maturation, have been implicated in AVF failure<sup>18-20</sup>, though, the failure rate in our study was relatively low.

The complication rate in this study was 21.8%, with delayed wound healing being the most common 6 (6.90%). Others were seroma (4.60%), spontaneous thrombosis (4.60%), superficial wound infection (3.45%), steal syndrome (1.15%) and upper limb oedema (1.15%). Previous studies had reported complication rates of 17.7%,<sup>16</sup> 22.22%,<sup>21</sup> 33.18%<sup>13</sup>and 47%<sup>11</sup> respectively in their studies.

Delayed wound healing being the most common complication in this study, has not been reported by previous studies, while seroma had been reported by Demiral et al<sup>13</sup> as a late complication. Furthermore, thrombosis as both early and late complications have been reported by Demiral et al<sup>13</sup>and Fitzgerald et al<sup>11</sup>, Gupta et al<sup>21</sup> and Nguyen et al<sup>17</sup> respectively. The incidence of wound infection had been reported by other researchers.<sup>11,13,14</sup>

Steal syndrome has also been documented by Fitzgerald et al<sup>11</sup>, Korepta et al<sup>14</sup>and Sahasrabudhe et al<sup>16</sup> while oedema has been reported by Sahasrabudhe et al<sup>16</sup>and Gupta et al<sup>21</sup>respectively. Although, AVF remains the best vascular access for haemodialysis, the site for AVF creation still plays a major role in influencing the complications rates in patients.

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#### 5. Conclusion

The primary success rate of AVF for haemodialysis in Port Harcourt using vessels of the arm is very good with few complications. This will encourage more ESRD patients to embrace AVF as the Gold Standard vascular access for haemodialysis, thereby reducing the use of catheters and catheter-associated morbidity and mortality.

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#### Compliance with ethical standards

##### *Acknowledgments*

The authors would like to acknowledge all the patients who despite the discomfort agreed to take part in the study.

##### *Disclosure of conflict of interest*

The authors declare no conflicts of interest.

### *Statement of ethical approval*

Ethical approval for the study was obtained from the ethics and review board of the University of Port Harcourt Teaching Hospital, Port Harcourt and the Medical Directors of the private medical facilities that participated in the study.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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