Can Native Arteriovenous Fistula Be Safely Made by Trainees? Comparison of Results of Native Arteriovenous Fistula for Vascular Access Made by Trainees with that by Consultant

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ORIGINAL ARTICLE

Can Native Arteriovenous Fistula Be Safely Made by Trainees? Comparison of Results of Native Arteriovenous Fistula for Vascular Access Made by Trainees with that by Consultant

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Abstract

Native arteriovenous fistula (AVF) is the preferred mode of vascular access for hemodialysis. Few studies suggest that the results of AVF are influenced by the experience of the operating surgeons. The present study compares the results of the AVF surgery performed by the surgical trainees with consultant. The retrospective data of the patient operated during the period of January to December 2016 was evaluated. The primary success rate and functional status of the AVF at 1 year were compared in the AVFs created by consultant and trainees. A total of 111 patients who underwent AVF were included in the study. Out of these, 47 (41%) were forearm fistulas (radiocephalic) and 64 (59%) were upper arm fistulas. Out of the total, 57 were operated by consultant and 54 were operated by trainees. The distribution of age, gender, diabetes, and type of fistulas was similar in the two groups. The primary success was established in 91 AVF (81.9%). The failure to use the fistula for the dialysis made by trainee was 10/54 (18.5%) and 10/57 (17.5%) by consultant. There was no statistical difference in the result of AVF made by trainees and consultants ($p = 0.89$, chi-square test). AVFs can be safely made by resident surgeons as a part of clinical training program. This approach may be evaluated in other centers, which could train resident surgeons in general surgery in microvascular surgery and thereby reducing the waiting period for AVF creation.

Keywords Arteriovenous fistula · Surgical training · Vascular surgery

Introduction

Chronic renal failure (CRF) is a major global health issue. In India, the age-adjusted incidence of end-stage renal disease (ESRD) is 229 per million population and more than 100,000 new patients enter renal replacement programs annually [1]. Hemodialysis (HD) is the most common method of renal replacement therapy in India. Vascular access for HD can be achieved with either arteriovenous graft (AVG), central venous catheter (CVC), or arteriovenous fistula (AVF). AVF is the preferred mode of vascular access for hemodialysis because of reduced rates of infections and complications as compared with AVG and CVC [2].

If an AVF is not made early, the superficial veins necessary for creating the AVF are liable to get thrombosed following repeated punctures for withdrawing blood samples or for performing dialysis. "Fistula first initiative" addresses this issue and advocates making of AVF early in patients with CRF, even before the commencement of dialysis to avoid damage of the superficial veins. Initially, the primary goal of the initiative was to increase the use of AVF for HD in 50% in incident and 40% in prevalent patients of ESRD. However, in 2009, the goal for AVF usage in prevalent hemodialysis patients was revised to 66% [3]. To achieve this target, the surgical procedure had to be made widely available to patients. The implementation required the presence of sufficiently trained surgeons and appropriate facilities in health centers to help decrease the waiting period for making the AVF. In India, vascular surgery is yet to achieve the status of a well-established stand-alone sub-specialty. Vascular surgery is part of a much wider specialty of cardiothoracic and vascular surgery (CTVS), as a result of which, peripheral vascular surgery does not get its desired importance [4]. A majority of AVFs are made by renal transplant surgeons. Training of General

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Surgery residents in making AVF in a large pool of patients will provide opportunity to resident surgeons to get exposure in vascular surgery and increase the availability of trained surgeons competent to make AVF. It has been reported in literature that the result of AVF is dependent on the expertise of the surgeon [5]. Such conclusions may have eventually resulted in reduced opportunities for the trainees to make AVF and get hands-on training. The present study was conducted in the General Surgery Department of a tertiary care teaching hospital with an aim to compare the results of native AVF created by General Surgery Consultants and trainees.

Material and Methods

Surgeons making AVF: From 2015 onwards, we implemented the creation of AVF by senior residents independently under the supervision of consultant. Senior residency is a 3-year tenured training post and is offered after completion of 3 years post-graduation in General Surgery. To be eligible to make AVF independently, the trainees had to assist at least 10 AVF surgeries with the consultant followed by doing 10 AVF surgeries under their direct supervision (consultant scrubbed). Consultants were involved in the planning and decision of the site of making the AVF. During the operation done by the trainees, consultant reviewed the surgical procedure on at least at two steps—first, when the artery and vein were dissected out and second, upon completion of the AVF after releasing the vascular clamps. The consultant was a single person who had been making AVF for 5 years and had made more than five hundred AVFs.

Deciding the site of fistula: Preoperative Doppler scan of the upper limb was performed in all patients. The cutoff value of the luminal diameter of 2 mm for the artery and 2.5 mm for the vein was taken to select the site of AVF and to check the patency of vein till central vein [6]. AVF was preferably performed in the non-dominant arm and the site of choice was radiocephalic, brachiocephalic, and brachiobasilic vessels in that order.

Procedure: The operation was done as a day care procedure under local anesthesia. Whenever feasible, fistulas were made between the side of vein to the side of the artery using 6–0 polypropylene suture (Prolene Ethicon Inc.®). If the tension was appreciated on the approximation of mobilized vein and artery, the end of the vein was anastomosed to the side of the artery. The length of the fistula was kept between 3 to 5 mm for brachial and 5 to 7 mm for radial artery fistula.

The retrospective data of the patients operated during the period of January 2016 to December 2016 were evaluated. In the duration of the study, there were four trainees in the unit who were senior residents in the Department of Surgery and were eligible to make AVFs. The patients in whom a previous attempt for AVF creation has failed were excluded from the study.

Patients were followed up after a period of 48 h, 1 week, 3 weeks, and at the time of commencement of dialysis, which is usually around 6 weeks to 2 months. The primary success was taken as the AVF which could be used for three sessions of the dialysis, to achieve a flow rate of 350 to 400 mL/min without access recirculation to maintain a treatment time less than 4 h [7]. The time of the initiating the dialysis after the creation of AVF was decided by the nephrologist and dialysis technician. For assessing the long-term success of AVF, patients were contacted telephonically after 1 year of the procedure and enquired about the functionality for adequate dialysis. Patients underwent dialysis at different centers.

Demographic factors of the patients were compared using the Mann-Whitney *U* test for continuous variables while categorical variables were compared using the chi-square test. The success rate of the fistulas was compared using chi-square test. All the complications were also noted. Statistical analysis was done using Software Package for the Social Sciences (version 20 for Windows, SPSS Inc.®, Chicago, IL, USA). Statistical significance was confined to those results where the p value was < 0.05.

Results

During the 1-year period, 111 patients met the inclusion criteria and were included in the study. Forty-nine (44.1%) were forearm fistulas (radiocephalic) and 62 (55.9%) were upper arm fistulas (brachiocephalic and brachiobasilic). Fifty-seven were operated by consultants and 54 were operated by trainees. The distribution of age, gender, diabetes, type of fistulas, and Pre-AVF HD was similar in the two groups (Table 1).

The primary success was established in 91 AVFs (81.9%). The failure rates of fistulas made by trainee and consultants were 10/54 (18.5%) and 10/57 (17.5%), respectively. There was no statistical difference in the result of AVF made by trainees and consultants ($p = 0.89$, chi-square test). At 1 year follow-up, the failure rates of AVF made by trainees and consultants were 20/54 and 17/57, respectively, without a significant statistical difference ($p = 0.68$). Major complications were encountered in three patients—one patient in the resident group with brachiocephalic AVF developed pseudoaneurysm while another one had blowout of brachiocephalic AVF following wound infection. In the consultant group, one patient of brachiocephalic fistula had vascular steal for which AVF had to be ligated.

Discussion

Well-Functioning vascular access is essential to perform an efficient hemodialysis procedure. Of the available options,

Table 1 Results

	Operated by consultant ($n = 57$)	Operated by trainee ($n = 54$)	p value (sig. < 0.05)
Age mean in years(SD)	45.89 (12.89)	44.4 (14.89)	0.71
Gender male n (%)	32 (56.14%)	31 (57.4%)	0.89
Diabetes n (%)	18 (31.6%)	15 (27.8%)	0.63
Radiocephalic fistula n (%)	26 (45.6%)	23 (42.6%)	0.75
Brachiocephalic fistula n (%)	26 (45.6%)	28 (51.8%)	0.51
Brachiobasilic fistula n (%)	5 (8.8%)	3 (5.6%)	0.51
Pre-AVF HD	54 (94.7%)	52 (96.2%)	0.69

CVC, AVF, and AVG, AVF has the lowest associated morbidity and hence, it is the most preferred option. Literature reports 1-year patency rate of 56–79% for distal and 70–84% for proximal access [8].

Patient factors which favor better maturation rates of AVF include young age, male gender, low BMI, and no evidence of comorbidities such as peripheral vascular disease, diabetes, or angina. In contrast, peripherally placed first fistula, a female gender, and the presence of diabetes are risk factors for a poorly functioning fistula [9].

Results of AVF are important, as there are limited options for creating native AVF. Failure of a site limits further options in patients on hemodialysis. Many non-modifiable factors like gender, age, and diabetes have shown to affect the success of AVF. However, the surgical technique is one of the factors which can be modified and hence, the expertise of the surgeon as a prognostic factor in the success of AVF has been studied. There are conflicting reports in the literature regarding the outcome of AV fistula in relation to the experience and the seniority of the surgeons. It has been particularly suggested that surgeon's seniority and expertise affect the outcome of radiocephalic fistula (RCF) and the most experienced member of a team dedicated to vascular access creation should make or supervise RCF [5, 10]. These outcomes may have resulted in AVF surgery not being used to its full potential as a training opportunity. The chances of a resident trainee surgeon to be the lead surgeon in AVF operation are very limited. In fact, El-Sharkawy et al. observed that the trainees were lead surgeon in only 7.3% of AVF operations in daycare surgeries under local anesthesia and in only 5.8% in AVF operations under general anesthesia, even though operation times, readmission rates, or length of stay were comparable between the trainee and consultant groups [11]. A questionnaire-based survey has also shown that there is a lack of appropriate training in vascular access creation for HD [12].

AVF provides an excellent opportunity to the surgical residents for training in microvascular procedures and to get acquainted with micro-instruments, magnifying loops, and color doppler ultrasound devices. It is important to incorporate AVF training in the curriculum of surgery residency to give an exposure of vascular surgery to the students as well as improve the future results of AVF. It has been shown that the risk of primary fistula failure was 34% lower when placed by surgeons who had created more than 25 fistulae compared with surgeons who had created less than 25 fistulae during training [13]. Recent studies also support the fact that results of the AVF are not affected by the experience and seniority of the surgeons [14, 15].

AVF is made by surgeons belonging to various specialties, like transplant surgeons, vascular surgeons, and general surgeons. In some centers, fistulae are even made by renal physicians. One study shows that the waiting period for AVF surgery was only 21.5 days in the group where it was performed by nephrologists as compared with 103 days in the group where the General Surgeon performed the procedure. The success of AVFs made by physicians was also comparable with the surgeons [16]. Therefore, the concern is not who places the fistula but rather who does it rightly [17].

There are no randomized control trials comparing the results of a consultant versus trainees, understandably, because of ethical issues. Most of the studies to date compared the results without randomization. These studies may have a bias that the difficult cases may have been operated upon by the consultants rather than the trainees [14]. Complicated procedures, like the brachiobasilic fistula with transposition, are usually performed by consultants. Randomization was not done in our study. The number of cases was less to allow inter-operator comparison. Our study supports the view that resident surgeons can perform AVF independently after adequate exposure. This will improve their training and competence in the microvascular procedures. Facilities for creation of AVF in government-funded public sector hospitals are limited. There is a shortage of government-funded public hospitals offering the services of AVF creation. The cost of making AVF in private-run hospitals is quite high and out of reach of many patients. One of the reasons for limited facilities for making AVF is the lack of separate vascular surgery subspecialty [4]. As discussed previously, vascular surgery specialty training in India is clubbed with cardiac and thoracic surgery. As a result, vascular surgery takes a back seat in the combined

specialty, and most of the AVFs are made by transplant surgeons. It is imperative that General Surgeons should be trained to make AVFs cater to the requirement of the huge number of patients awaiting surgery.

The present study suggests that AVFs can be safely made by resident surgeons as a part of a clinical training program. This approach may be evaluated at other centers, which could train resident surgeons in general surgery in microvascular surgery and thereby reducing the waiting period for AVF creation.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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