Comparative study between no touch technique and conventional method in the distal radio cephalic arterio venous fistula for hemodialysis

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Background
The distal radiocephalic arteriovenous fistula (RC-AVF) is the gold standard for hemodialysis but has significant failure rates owing to occlusions and failure to mature. The size and quality of the veins play an important role in the patency of the fistula.
Objective
The aim of this study was to evaluate the no-touch technique compared with the conventional method in the distal radiocephalic fistula for hemodialysis in terms of patency and complications.
Patients and methods
A prospective randomized study including 80 patients with ESRD in need for hemodialysis access was done between March 2016 and March 2017 and followed up to October 2017 at Menoufia university hospital. The patients were randomly categorized into two groups (no-touch group that included 40 patients where the vein and artery were dissected with the surrounding tissue cushion and conventional group that included 40 patients). Primary failure, primary and secondary patency rates, and complications of each group were collected and analyzed. Patients with vein caliber less than 2.5 mm, previous arteriovenous fistula, without venous continuity in the arm, or with severely atherosclerotic radial artery were excluded from the study.
Results
In the no-touch group, primary fistula failure was 7.5%, whereas three (7.5%) fistulas failed later one owing to thrombosis (one case), anastomotic pseudoaneurysm (one case), and anastomotic stenosis (one case). Primary and secondary patency rates at 6 months were 85 and 90%, respectively, whereas in the conventional group, primary fistula failure was 17.5%, whereas eight (20%) fistulas failed later owing to thrombosis (two cases), anastomotic pseudoaneurysm (two cases), anastomotic stenosis (three case), and venous hypertension (one case). Primary and secondary patency rates at 6 months were 62.5 and 67.5%, respectively
Conclusion
The results of this study indicate that no-touch technique can be used for primary radiocephalic fistula surgery with better patency rate and less complications compared with conventional method. This method offers the potential to create a RC-AVF in patients with distal cephalic veins 2.5 mm or more in caliber with encouraging results.

Keywords:
access, dialysis, no-touch technique, patency, radiocephalic fistula

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Introduction

Forearm autogenous arteriovenous access has been recommended as the first choice for primary access for hemodialysis [1].

The distal radiocephalic arteriovenous fistula (dRCF) at the wrist is the gold standard venous access for patients who require long-term hemodialysis as it reduces the risk of steal syndrome compared with elbow fistulas and preserves more proximal vessels for future access placement. However, it has been reported to have a high primary failure rate because of early thrombosis or failure to mature to permit adequate dialysis [2]. Primary patency rate at 1 year

is described to be ~58–63% in several studies but varies widely [3].

Autogenous fistulas demonstrate higher patency and lower infection rates as well as fewer general complications than fistulas created with synthetic material [4]. The 'no-touch technique' (NTT) for vein harvesting was developed by Souza and colleagues to increase patency in coronary bypass surgery, and then it becomes a well-established technique within cardiac surgery with better results; therefore, it can be applied for RC-AVF [5,6].

The vein wall spasm can be prevented by dissecting the vein graft with its adherent fat and connective tissue (vein pedicle). This technique prevents direct contact with the vein wall, thereby prevents damage and spasm of the vein wall in addition that intravenous sterile water flush is not used [7].

The NTT preserves the vein endothelium, causes minimal damage to the vein wall and the feeding vessels (vasa-vasorum), prevents vessel spasm during surgery and causes less inflammatory effect, thereby, reducing the endothelial damage indirectly, and the vein remains in a natural constitution until the maturation of the fistula [8,9].

There are several differences from conventional fistula surgery in the creation of the fistula. In the conventional method, both vein and artery are dissected separately and distended with sterile saline injection, whereas in the NTT the vein and artery are dissected with adherent surrounding tissue. They are neither distended nor directly manipulated with surgical instruments [9].

The aim of this study is to evaluate the NTT in distal RC-AVF for hemodialysis in patients with distal cephalic veins 2.5 mm or more in caliber in terms of patency and incidence of complications.

Patients and methods

Patients

A prospective randomized controlled study carried out between March 2016 and March 2017 and follow-up to October 2017 on 80 patients presented with end-stage renal disease in need for vascular access for hemodialysis in outpatient clinic in Menoufia University Hospital. Written informed consent was obtained from all patients to be included in this study. This study was accepted and approved by an ethical committee.

All patients were subjected to examination of the vessels of both upper limbs including clinical and duplex examination of the veins and arteries.

Patients with previous radiocephalic fistula in both arms, distal cephalic vein caliber less than 2.5 mm, no continuity in the venous system in the arm, or heavily calcified atherosclerotic radial artery were excluded from the study. The patients were randomly categorized into two groups (no-touch group included 40 patients and conventional group included 40 patients).

Patient characteristics collected for the purpose of this study were sex, age, and specific comorbidities (diabetes mellitus and hypertension).

Operative procedure

No-touch technique

(1) After local anesthesia injection (lidocaine 5%), skin incision of ~3–4 cm in the distal arm was done, and diathermy and scissors were used to dissect the subcutaneous tissue. The vein was identified and dissected by diathermy with an adherent tissue pedicle around it avoiding direct or near contact of the vein by diathermy to prevent thermal damage of the vein. Vein branches were ligated. The vein was thus dissected with a fat pedicle around it, but not yet ligated.
(2) The radial artery was identified and dissected by diathermy and scissors with its vena comitans and then isolated by vessel loops for proximal and distal control. The patient then received 5000 IU of heparin intravenously, and the vein was ligated distally.
(3) A 7–9 mm longitudinal anterior arteriotomy was performed using Potts scissors. Both vessels were prepared for the anastomosis while preserving the pedicle around it.
(4) Vein-to-artery anastomosis (end to side) was created with a 6.0- or nonabsorbable, monofilament, continuous suture.
(5) Fistula patency was confirmed on the table by presence of a palpable thrill and/or a bruit. The wound was closed in layers. Skin closure was done with 3/0 prolene, and aspirin was given postoperatively.

Conventional method

After local anesthesia injection, the distal cephalic vein and radial artery were identified and dissected and were anastomosed by end-to-side conventional technique.

Follow-up

Immediate surgical technical success was obtained in all patients as verified by clinical examination and stethoscope auscultation before leaving the surgical suite.

At 4 weeks, all patients were examined clinically and underwent a duplex ultra sonography (DUS) with flow measurements to evaluate the fistula blood flow. Patients were followed until fistula failure or patient death. Failure of maturation or inefficient blood flow rate in a fistula needs DUS examination and sometimes fistulography if needed for possibility of interventions such as percutaneous transluminal angioplasty (PTA) to maintain the flow in the fistula if needed. The patients who died or who underwent kidney transplantation were excluded from the follow-up.

Statistical analysis

Data were collected, tabulated, and statistically analyzed using an IBM personal computer with statistical package for the social science version 23 and Epi Info 2000 programs (released 2015; SPSS Inc., Chicago, Illinois, USA. IBM SPSS statistics for windows, version 23.0; IBM Corp., Armonk, New York, USA), where the following statistics were applied:

(1) Descriptive statistics: in which quantitative data were presented in the form of mean, SD, and range, and qualitative data were presented in the form of numbers and percentages.
(2) Analytical statistics:

Kaplan–Meier estimator curve is a nonparametric statistic used to estimate the survival function from life time data.

Patency definitions

Primary patency rate was defined as period from vascular access creation till any malfunction that indicates intervention for its correction. Secondary patency (including secondary assisted patency) was defined as the interval from the time of access placement until access malfunction (abandonment, thrombosis) or the time of patency measurement, including surgical or endovascular interventions done to maintain or reestablish fistula function [10].

Results

No-touch group

The mean age of patients in this group was 56.10 ±12.93 years and ranged from 28 to 76 years. Male to female ratio was 1.5 : 1. A total of 18 (45%) patients were diabetic and 32 (80%) patients were hypertensive. The mean distal cephalic vein size was 2.97±0.31 mm and ranged from 2.5 to 4 mm, whereas the mean distal radial artery size was 2.76±0.28 mm and ranged from 2.4 to 3.4 mm, as shown in Table 1. Primary fistula failure occurred in three (7.5%) cases whereas three (7.5%) fistulas failed later during the first 6 months owing to thrombosis, anastomotic aneurysm, and anastomotic stenosis. Two (6.7%) patients were lost (censored) during the follow-up period: one of them was died owing to causes unrelated to dialysis and the other was lost in follow-up. Fistula thrombosis occurred in one (2.5%) patient during the fourth month of follow-up and was managed by thrombectomy, which succeeded. One (2.5%) fistula showed weak blood flow (blood flow less than 200 ml/s within the fistula by duplex ultrasonography) on the fifth month of follow-up, after being sufficient, owing to anastomotic stenosis that was salvaged by

Table 1 Comparison between conventional method and no-touch method regarding patient's data

	Conventional method (*N*=40)	No-touch Technique method (*N*=40)	Fisher's exact test	*P* value
Sex				
Male	22 (55.0)	24 (60.0)	0.20	0.65
Female	18 (45.0)	16 (40.0)		
Age (years)				
Mean±SD	60.50±9.17ntd	56.10±12.93	1.24*	0.22
DM				
No	24 (60.0)	22 (55.0)	0.20	0.65
Yes	16 (40.0)	18 (45.0)		
HTN				
No	0 (0.0)	8 (20.0)	4.94	0.02
Yes	30 (100.0)	32 (80.0)		
Preoperative distal cephalic vein size				
Mean±SD	2.98±0.31	2.97±0.31	0.05*	0.96
Preoperative distal radial artery size				
Mean±SD	2.85±0.27	2.76±0.28	1.02*	0.31

DM, diabetes mellitus; HTN, hypertension. *student-t test.

percutaneous balloon dilation, and the fistula was reused for hemodialysis again. Anastomotic pseudoaneurysm occurred in one (2.5%) patient on the sixth month of follow-up and was managed by fistula ligation. Venous hypertension occurred in one (2.5%) patient that was mild and managed by conservative measures. In one (2.5%) patient, the cephalic vein was deep and required superficialization as a second stage; the vein was then needled successfully, as shown in Table 2. Primary and secondary patency rates at 6 months were 85 and 90%, respectively (Table 3).

Conventional group

The age of the patients in this group ranged from 35 to 84 years, with mean of 60.50±9.17 years. A total of 22 patients were male whereas 18 patients were female. Overall, 16 (40%) patients were diabetic and 30 (75%) patients were hypertensive. The mean distal cephalic vein size was 2.98±0.31 mm and ranged from 2.6 to 4.2 mm, whereas the mean distal radial artery size was 2.85±0.27 mm and ranged from 2.5 to 3.5 mm, as shown in Table 1. Primary fistula failure occurred in seven (17.5%) patients, whereas eight (20%) fistulas failed later on during the follow-up period owing to thrombosis, anastomotic pseudoaneurysm, venous hypertension, and anastomotic stenosis. Fistula thrombosis occurred in two (5%) patients on fourth and sixth month of follow-up. Thrombectomy was done in one case but failed whereas not trialed in the other case owing to thrombophlebitis of the vein. Anastomotic pseudoaneurysm occurred in two (5%) patients and was managed by fistula ligation. Venous hypertension developed in one (2.5%) case, which was managed by balloon angioplasty and stenting of the subclavian vein. Anastomotic stenosis developed in three (7.5%) fistulas and managed by percutaneous balloon dilation that succeeded in only one case (Table 2). Primary and secondary patency rates at 6 months were 62.5 and 67.5%, respectively (Table 3).

Table 2 Types of complications

Type of complications	Conventional group [*n* (%)]	No-touch group [*n* (%)]	Fisher's exact test	*P* value
Thrombosis	2 (5)	1 (2.5)	0.05	0.96
Anastomotic stenosis	3 (7.5)	1 (2.5)	0.20	0.65
Anastomotic aneurysm	2 (5)	1 (2.5)	0.05	0.95
Venous hypertension	1 (2.5)	1 (2.5)		

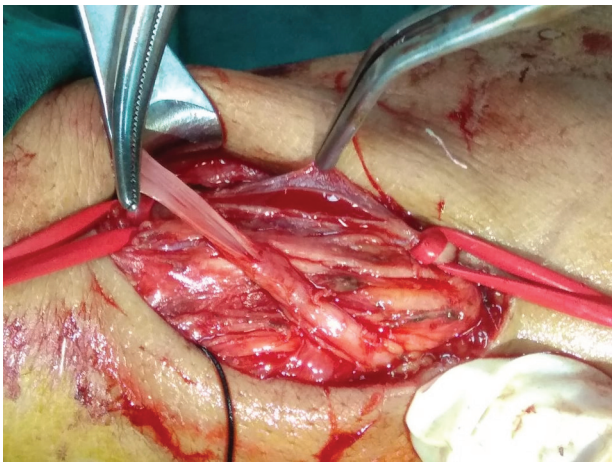
Complications

There were no major complications related to the technique or surgery. Ten patients had a slight temporary paresthesia in the operative region and the medial aspect of the thumb, which had practically disappeared at 6 month of follow-up. Local skin infections treated by antibiotics occurred in two patients (Figs 1 and 2).

Table 3 Comparison between both groups regarding failure and patency rates

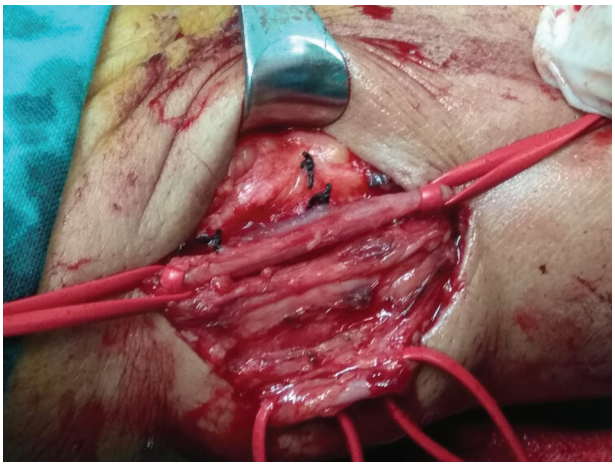
	Conventional method (*N*=40) [*n* (%)]	No-touch method (*N*=40) [*n* (%)]	Fisher's exact test	*P* value
Primary failure				
No	33 (82.5)	37 (92.5)	0.3109	0.3105
Yes	7 (17.5)	3 (7.5)		
Primary patency at 1 month				
No	7 (17.5)	3 (7.5)	0.3109	0.3105
Yes	33 (82.5)	37 (92.5)		
Primary patency at 3 months				
No	10 (25)	5 (12.5)	0.2515	0.2519
Yes	30 (75)	35 (87.5)		
Primary patency at 6 months				
No	15 (27.5)	6 (15)	0.0406	0.0421
Yes	25 (62.5)	34 (85)		
Secondary patency at 1 month				
Yes	32 (80)	37 (92.5)	1.0000	0.1941
No	8 (20)	3 (7.5)		
Secondary patency 3 months				
Yes	31 (77.5)	36 (90)	0.2247	0.2254
No	9 (22.5)	4 (10)		
Secondary patency at 6 months				
Yes	27 (67.5)	36 (90)	0.0269	0.0288
No	13 (32.5)	4 (10)		

Figure 1



Dissection of the cephalic vein with its surrounding fascia.

Figure 2



Dissection of the radial artery with its surrounding vena commitants.

Discussion

The short-term and mid-term results of NTT for creation of distal radiocephalic AVF in this study were better compared with conventional method (primary patency at 6 months was 85% in the no-touch group compared with 62.5% in the conventional group). These results are encouraging, as the need for dialysis treatment is increasing and the reported failure rate is high. Therefore, this technique is feasible and can be done in patients with distal cephalic veins 2.5 mm or more in caliber with better patency and less complications [3].

The study group included patients with multiple comorbidities that might influence patency rates, including obesity, arterial atherosclerosis, hypertension, diabetes mellitus, and cardiovascular disease, but patients with heavily calcified radial artery by duplex U/S were excluded from our study. The NTT is a well-established technique within cardiac surgery, but this trial demonstrates that it can be applied for RC-AVF. It can be done in patients with small distal veins for radiocephalic fistula with good results, less complications, and less interventions, such as anastomotic stenosis that lead to inefficient dialysis and needs balloon angioplasty because NTT causes less vein wall damage, preventing intimal hyperplasia that is considered as a major cause for failure of the fistula, so that anastomotic stenosis occurred only in one case in the no-touch group compared with three cases in the conventional method in our study [8]. The results of no touch technique is good in cardiac surgery harvesting great saphenous vein so, it can be applied in distal radiocephalic fistula for hemodialysis.

The results in this study in the no-touch group were good and favorable, indicating that RC-AVF can be achieved and function with NTT even in patients with small veins. Our results showed that small veins might develop into a full functional RC-AVF by the NTT. Considering the pathologies leading to interventions, some patients were treated in the upper arm vein owing to outflow stenosis. We consider these issues not to be solved by NTT, as the pathology does not lie in the operative field, and this occurred in two patients in our study owing to central venous obstruction: one case in the no-touch group that was mild and managed conservatively whereas the second case occurred in the conventional group and was salvaged by balloon angioplasty and stenting of the subclavian vein [11].

Vein size is considered to be an important prognostic criterion for patency and eventual functional fistula. Some studies have shown that cephalic veins of diameter less than 2.5 mm have very high failure rates and should not be considered for RC-AVF. In our study, we agreed on this opinion, and patients with distal cephalic vein less than 2.5 were excluded from our study [12,13].

Other authors recommend that patients selected for RC-AVF should have cephalic veins of at least 2.5 mm or greater in diameter, and this matched with our inclusion criteria for patients selected in our study [3,14,15].

The major limitation and possible explanation of the results of this study is the small number of patients, short period of follow-up, and that all fistulas were

created by a fixed team of at least one of two surgeons to exclude fallacies in surgical technique.

Conclusion

The short-term and mid-term results of NTT in distal radiocephalic fistulas in this study are good and encouraging with better patency and less complications compared with conventional method. By using this vessel-preserving technique, there is increase in the patency that encourages to create a RC-AVF in patients with distal veins 2.5 mm or more in caliber who are not usually considered appropriate for a distal arm fistula. The technique is feasible and should be evaluated in randomized controlled trials.

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Nil.

Conflicts of interest

There are no conflict of interest.

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