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Original Article / Özgün Makale

Comparison of the one-year patency rates of radiocephalic arteriovenous fistulas created using no-touch versus conventional technique

No-touch'a karşı konvansiyonel teknik kullanılarak oluşturulan radiosefalik arteriyovenöz fistüllerin bir yıldaki açıklık oranlarının karşılaştırılması

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ABSTRACT

Background: This study aims to compare the patency rates of radiocephalic arteriovenous fistulas prepared preserving the perivenous vascular tissues versus those prepared using the conventional technique.

Methods: A total of 169 patients (107 males, 62 females; mean age 59.5 years; range, 39 to 87 years) who underwent a radiocephalic arteriovenous fistula construction were included in this study. In 95 patients, the tissues surrounding the cephalic vein were stripped off as per the conventional method, while the no-touch technique preserving the perivenous vascular tissues was utilized for vein harvesting in 74 patients. Patients were followed-up to compare primary and secondary patency rates of the arteriovenous fistulas at one year.

Results: Fistula failure developed in 22 patients within the first year resulting in primary patency rates of 90.5% versus 84.2% for the no-touch and the conventional groups, respectively (p=0.225). Likewise, secondary patency rates were 94.6% versus 93.7% for the no-touch and the conventional groups, respectively (p=0.803). The two groups did not differ with regards to primary or secondary patency rates.

Conclusion: Findings of this study were not in favor of the no-touch technique compared to the conventional methods in terms of arteriovenous fistula patency at one year.

Keywords: Arteriovenous fistula; hemodialysis; no-touch technique; radiocephalic.

ÖZ

Amaç: Bu çalışmada perivenöz vasküler dokuların korunması yoluna karşı konvansiyonel teknik kullanılarak hazırlanan radiosefalik arteriyovenöz fistüllerin açıklık oranları karşılaştırıldı.

Çalışma planı: Çalışmaya radiosefalik arteriyovenöz fistül yapımı uygulanan toplam 169 hasta (107 erkek, 62 kadın; ort. yaş 59.5 yıl; dağılım, 39-87 yıl) dahil edildi. Doksan beş hastada konvansiyonel yöntem uyarınca sefalik damarı çevreleyen dokular çıkarılırken 74 hastada damar hazırlanması için perivenöz vasküler dokuları koruyan no-touch tekniğinden yararlanıldı. Hastalar arteriyovenöz fistüllerin bir yıldaki primer ve sekonder açıklık oranlarının karşılaştırılması için takip edildi.

Bulgular: Yirmi iki hastada birinci yıl içinde fistül hatası gelişerek no-touch ve konvansiyonel gruplar için sırasıyla %90.5'e karşı %84.2 primer açıklık oranına neden oldu (p=0.225). Benzer şekilde, sekonder açıklık oranları no-touch ve konvansiyonel gruplar için sırasıyla %94.6'ya karşı %93.7 idi (p=0.803). İki grup primer ve sekonder açıklık oranları bakımından farklı değildi.

Sonuç: Bu çalışmanın bulguları bir yıldaki arteriyovenöz fistül açıklığı açısından konvansiyonel yöntemlerle karşılaştırıldığında no-touch tekniği lehine değildi.

Anahtar sözcükler: Arteriovenöz fistül; hemodiyaliz; no-touch tekniği; radiosefalik.

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Distal arteriovenous (AV) fistulas represent the preferred vascular access route for dialysis in patients with end-stage renal failure[1-3] owing to their advantages of a lower cost, economical use of available veins, and reduced risk of infection and steal syndrome.[3-6] On the other hand, one major drawback of them is their moderate patency rate of around 62% at one year.[3,6-10] Most cases of radiocephalic AV fistula failure occur due to stenosis in close proximity to the anastomotic site in 55-75% of the patients.[11,12]

In coronary artery bypass surgery, better patency rates have been reported with saphenous vein graft harvesting technique sparing the perivascular tissues compared to that performed without preservation of the perivascular tissues.[13-17] It has been proposed that vein preparation with preservation of the perivenous vascular tissues may reduce the injury at the vein wall and protect vasa vasorum, in addition to reducing venospasm and preventing kinking through mechanical support.[15] Furthermore, perivascular tissue is a source of relaxing factors derived from adipocytes such as leptin and adiponectin, which may potentially be involved in promoting graft patency.[18.19]

Minimizing surgical trauma through sparing of perivenous vascular tissues during AV fistula surgery might have similar favorable effects resulting in better patency rates. However, studies examining the role of perivascular tissue preservation in improving the patency of AV fistulas for dialysis are scarce in number.[20]

Therefore, in this study, we aimed to compare the patency rates of radiocephalic AV fistulas prepared through preservation of the perivenous vascular tissues versus those prepared using the conventional technique.

PATIENTS AND METHODS

A total of 169 patients (107 males, 62 females; mean age 59.5 years; range, 39 to 87 years) who underwent a radiocephalic AV fistula construction at Private Erdem Hospital between January 2011 and August 2015 were included in this study. In 95 patients, the tissues surrounding the cephalic vein were stripped off as per the conventional method, while the no-touch technique preserving the perivenous vascular tissues was utilized for harvesting in 74 patients. All patients were followed-up to compare primary and secondary patency rates at one year. The study protocol was approved by the Private Erdem Hospital Ethics Committee. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Prior to surgery, the vascular dimensions were all measured with Doppler ultrasound by the same surgeon, who actually carried out all of the procedures. Patients with no distal pulses or tri-phasic flow, or those with severe calcification of the radial artery were excluded from the study, as those which had a cephalic vein diameter of less than 2 mm after application of a tourniquet. Also excluded from the study group were the patients with a prior snuffbox or antecubital AV fistula.

A single dose of 100 mg acetylsalicylic acid was given prior to the procedure and the same was continued after the procedure in patients without any contraindication. All 169 procedures were performed under local anesthesia without administration of systemic heparin. In the conventional group, veins were stripped off as usual with care not to damage the veins (Figure 1), while a 2-3 mm fat tissue was spared around the veins in the "no-touch" group with care not to touch the vein itself (Figure 2). No cautery was used in both groups in locations adjacent to the vein, while further avoidance was practiced at the posterior part of the cephalic vein close to the nerve. In both groups,

Figure 1. Cephalic vein preparation with conventional technique.

Figure 2. Cephalic vein preparation in no-touch group sparing perivenous adipose tissue. Medial branch of superficial radial nerve is separated.

Figure 3. Completed arteriovenous fistula in no-touch group.

Figure 4. Completed arteriovenous fistula in conventional group.

veins were gently inflated using warm sterile saline solution containing heparin. A 4 to 6 mm arteriotomy was performed on the radial artery depending on the diameter of the vein. After arteriotomy, the radial artery was rinsed with a solution containing heparin. An end-to-site anastomosis was performed using 8/0 prolene sutures under 3.5× magnification with surgical loupes (Figures 3 and 4).

Follow-up visits were scheduled at one week, and one, three, six, and 12 months after the procedure. Presence of a thrill postoperatively and uneventful completion of dialysis sessions following maturation were both required for the fistula to be considered functional. Primary patency was defined as a patent fistula without any need for an additional procedure at one year. Secondary patency was defined as the presence of a functional fistula at one year with or without additional procedures.

Statistical analysis

IBM SPSS version 21.0 (IBM Corp., Armonk, NY, USA) was used for the analysis of data. Data were presented in mean ± standard deviation or number (percentage), where appropriate. Normality was tested using hypothesis tests and graphical methods. Intergroup comparisons of continuous data were carried out using Mann-Whitney U test or Student-t test for independent samples, depending on the distribution. Categorical data were compared using Pearson chi-square test. A p value of less than 0.05 was required for statistical significance.

RESULTS

Table 1 shows patient characteristics and study outcomes. The two groups did not differ with respect to age, gender, co-morbidities and vascular diameters prior to the procedure (p>0.05).

Table 1. Patient characteristics and study outcomes

	No-touch group (n=74)			Conventional group (n=95)			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			63.1±11.6			64.5±11.3	0.499
Gender							
Male	49	66.2		58	61.1		0.490
Diabetes mellitus	33	44.6		51	53.7		0.241
Hypertension	44	61.1		66	69.5		0.259
Arterial diameter (mm)*			2.2±0.1			2.3±0.2	0.081
Venous diameter (mm)*			2.3±0.2			2.3±0.2	0.987
Primary patency at 1 year	67	90.5		80	84.2		0.225
Secondary patency at 1 year	70	94.6		89	93.7		0.803

SD: Standard deviation; * Assessed by Doppler ultrasound prior to procedure.

All fistulas were functional right after fistula construction and all patients had a successful initial session of hemodialysis through the constructed fistula. AV fistula failure developed in 22 patients within the first year following the operation resulting in primary patency rates of 90.5% versus 84.2% for the no-touch and the conventional group, respectively (p=0.225). Among these 22 failures, 14 were suitable for endovascular therapy; however, the remaining eight patients had complete obstruction precluding an endovascular intervention through balloon angioplasty. Of the 14 failures that were amenable to endovascular therapy, 11 patients (78.6%) had successful interventions. Of all these patients, only one patient had a balloon angioplasty for a stenosis at the level of cephalic arch. All the remaining patients (n=13) had perianastomotic stenosis, i.e., within 2 cm of the anastomosis site. The distribution of perianastomotic stenosis was 4/74, 5.4% for the no-touch group versus 9/95, 9.5% for the conventional group; p=0.39. In an additional one patient with steal syndrome but with a functioning fistula, distal radial artery ligation resulted in cessation of symptoms. Secondary patency rates were 94.6% versus 93.7% for the no-touch and the conventional group, respectively (p=0.803). The two groups did not differ regarding primary or secondary patency rates. In the remaining 10 patients, a new fistula was created (n=5, 50%) or a catheter was placed (n=5, 50%) for hemodialysis access. None of the patients received transplantation during the follow-up period.

DISCUSSION

Considering the favorable results obtained with the no-touch technique employed for saphenous vein preparation during coronary artery bypass grafting operations, this study aimed to assess and possibly repeat a similar outcome utilizing a similar technique for vein preparation during creation of radiocephalic AV fistulas for hemodialysis access. According to our research in Pubmed and Google Scholar in the English literature, this study was one of the very few or the first to compare the patency rates of a no-touch technique preserving the perivenous vascular tissues with that of the conventional technique for radiocephalic AV fistula construction. However, the differences in the primary and secondary patency rates between these two groups did not reach a statistical significance.

Evidence supporting the benefits of a no-touch technique comes from several recent studies regarding saphenous vein preparation for coronary artery bypass surgery. In their randomized study, Souza et al.[14] found better graft patency rates at 18 months with the no-touch group compared to the conventional group, results of which were persistent at eight-and-a-half years. In addition, no-touch technique has been associated with better endothelial integrity when compared to the conventional technique particularly when the levels of adenosine, nitric oxide synthase, and vascular endothelial growth factor immunoreactivities[21] suggesting slower progression of atherosclerosis are taken into account.[22] A meta-analysis has supported these findings.[17]

Better patency rates with saphenous vein grafts harvested for coronary artery bypass grafting with no-touch technique have been explained by several mechanisms. A lesser amount of injury potentially preventing the occurrence of an early intimal hyperplasia,[13,14] a lower risk of manipulation, thus preventing spasm and kinking,[15] better preservation of feeding vessels to maintain oxygen and nutrients to the wall,[14,16,23] continuing release of relaxing factors from adipocytes,[18,19] and decreased inflammation due to perivenous adipose tissue-related biochemical factors[22,24-27] were proposed as potential explanations favoring use of a no-touch technique. However, whether all these factors apply similarly for saphenous vein grafts and cephalic vein used in AV fistula creation remains to be answered since the two vessels differ both anatomically and physiologically. For example, cephalic vein grafts have far lesser amounts of fat tissue compared to the saphenous veins harvested. In addition, in contrast to saphenous vein grafts, AV fistulas are *in-situ* and have higher flows.

To the best of our knowledge, the only other study that described and sought the functional outcomes of radiocephalic fistulas created using a non-touch technique was reported by Hörer et al.[20] This study reported primary and secondary patency rates of 54% and 80% at one year, respectively. The study by Hörer et al.[20] differs from our study both in terms of study design and preoperative vessel size. They did not have a control group for comparison but instead reported the functional outcomes of 31 patients all operated using the same technique. This study was mainly focused on vessel size as a potential predictor of patency and also included patients with small-sized vessels. Most patients had either a small sized vein or artery (≤2 mm) and more than one-third had small-sized cephalic vein (≤2 mm) with a mean distal cephalic vein diameter of 2.4 mm. In our study, on the other hand, those who had a cephalic vein diameter of less than 2 mm were excluded. The lower patency rates in Hörer's study compared to ours may be explained by this difference in cephalic vein size. Nevertheless, considering the anatomic characteristics of those patients, trying

radiocephalic fistula at wrist level before other options seems to be justified, particularly with the 80% secondary patency rate at one year. They also mention that their no-touch technique allows for the possibility of creating fistula at distal level in patients who are not usually considered eligible for a distal forearm fistula. However, it is of note to emphasize that patency rates were similar in that study across the two groups based on cephalic vein size (>2 mm versus ≤2 mm), which may be well explained by the small sample size precluding adequate statistical power.

To begin with, surgery with a no-touch technique may last slightly longer than the conventional technique. Medial and lateral branches of the superficial radial nerves course just beneath cephalic vein at wrist level, making them susceptible to trauma. Using cautery during cephalic vein preparation may be unpleasant for the patient. Therefore, making dissection at this region with scissors and separating the nerve using an elastic tape would provide comfort for both the patient and the surgeon (Figure 2).

Graft failures after fistula surgery and coronary artery bypass surgery have several differences. Most fistula failures, particularly for radiocephalic fistulas, are due to intimal hyperplasia at perianastomotic site, as it was the case in our study. No-touch technique aimed to address this problem and protect the perianastomotic site in particular. Peri-graft adipose tissue has the potential to minimize trauma and protect the vasa vasorum, thereby preventing vascular injury and kinking. However, several other factors including flow dynamic changes at needle insertion sites may well be responsible for fistula loss.

The main limitation of our study may be the small sample size, which might have prevented the achievement of a statistically significant difference, although patency rates were higher numerically with the no-touch group. Nevertheless, patency rates were quite high and satisfactory in both groups which may be attributed to the following factors: *(i)* all patients were operated by a single surgeon experienced in fistula creation and fine vascular anastomoses, *(ii)* all patients had venous diameter greater than 2 mm based on inclusion criteria, and *(iii)* extreme caution was exercised in both groups for not traumatizing the vessels and to avoid kinking. Another limitation of the study is the absence of any pathological or histochemical examination of the vessels, which might have shed light on the possible mechanisms related to the potential benefits of the no-touch method.

In conclusion, the no-touch technique seems to represent a viable option for patients undergoing radiocephalic arteriovenous fistula construction. However, it is not clear whether the same benefits exist for this limited length of conduit; and findings of this study do not support the superiority of the no-touch technique in terms of functional outcomes compared to the conventional technique.

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