Secondary Vascular Access Procedures for Hemodialysis After Primary Snuff-Box Arteriovenous Fistula

Hemodializ Hastalarında Açılan İlk Snuff-Box Fistüllerden Sonra İkincil Arteriovenoz Fistüllerinin Sonuçları

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Özet

Amaç: hemodializ için açılan snuff-box fistüllerden sonra ikincil arteriovenoz fistüllerinin sonuçlarını araştırmak. Gereç ve Yöntem: Merkezimizde ocak 2007 ile Aralık 2015 tarihleri arasında açılan snuff box arteriovenoz fistül sonrası ikincil 95 AVF geriye dönük olarak değerlendirildi. Bu hastaların tamamına snuff box AVF sonrası ikincil olarak 58'ine (%61) dirsek düzeyinde brakio-sefalik AVF, geriye kalan 37 (%39) hastaya ise radiyo-sefalik AVF açıldı. Bulgular: Tüm AVF postop erken dönemde çalıştı. Primer açıklık oranları bir yıllık brakiosefalik AVF'de %88 iken radio-sefalik AVF'de %87 , dört yıllık açıklık oranları ise brakiosefalik AVF'de %70 iken radio-sefalik AVF'de %61 oranındaydı. Sekonder açıklık oranları ise bir yıllık brakiosefalik AVF'de %91 iken radio-sefalik AVF'de %93 , dört yıllık açıklık oranları ise brakiosefalik AVF'de %71 iken radio-sefalik AVF'de %63 oranındaydı. Erken dönemde herhangi bir komplikasyon olmadı. 15 hastada ise geç dönemde AVF durdu. Başarısızlığın en sık nedeni 8 hastada stenoz 5 hastada anevrizma, 2 hastada ise santral ven stenozu idi. Tartışma: Bu veriler ışığında radyal-sefalik veya brakiosefalik arteriyovenöz fistül oluşturulmadan önce, snuff box fistül açılması damarların gelişmesini sağlamaktadır ve ikincil açılacak AVF'lerin başarı şansını artıracağını düşünmekteyiz. Bu nedenle radyal-sefalik arteriyovenöz fistül veya brakiyal-sefalik arteriyovenöz fistüller ikincil Olarak tercih edilmelidir.

Anahtar Kelimeler

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Abstract

Aim: To investigate the secondary arteriovenous fistulas constructed after a snuff-box fistula. Material and Method: We reviewed data on 95 arteriovenous fistulas that were created as a secondary vascular access between January 2007 and December 2015. Of those 95 fistulas, 37 (39%) were ipsilateral elbow brachial-cephalic arteriovenous fistulas and 58 (61%) were ipsilateral wrist radial-cephalic arteriovenous fistulas; all were created after a primary snuff-box fistula. Results: All arteriovenous fistulas had matured. The primary patency rates for elbow brachial-cephalic arteriovenous fistulas and radial-cephalic arteriovenous fistulas were as follows: 1-year rate, 88% to 87% and 4-year rate, 70% to 61%. The secondary patency rates for were as follows: 1-year rate, 91% to 93%; 4-year rate, 72% to 63%. No early failure occurred. There were 15 late failures. The most common causes of failure were stenosis within the vein (n=8 patients), aneurysm (n=5 patients), and central vein stenosis (n=2 patients). Discussion: These data suggest that before a radial-cephalic or brachial-cephalic arteriovenous fistula is created, the construction of a snuff-box fistula enable the vascular structures to dilate, and may so fascilitate the success rate of seconder AVFs. For this reason a radial-cephalic arteriovenous fistula or an elbow brachial-cephalic arteriovenous fistula should be the second choice

Keywords

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Introduction

The original and recently updated national kidney foundation dialysis outcomes quality initiative practice guidelines (NKF-DOQI) recommend to increase the placement of native arteriovenous fistulas (AVFs) for the first choice of vascular access for hemodialysis. These guidelines also recommend that the order of preference for AVF creation should be the wrist radial-cephalic (RC) type as the primary AVF and then the elbow brachial-cephalic (BC) type as the secondary AVF. If either of these is not viable, then another type of fistula made of synthetic material should be used. The RC type of AVF is recommended as the primary and best option for vascular access[1].

The first AVF should be created as distally as possible to provide a long segment of arterialized vein for repeated venipuncture and to save alternative sites for creation of additional fistulas. Distal AVFs have the lowest complication rates[2,5]. A radial-cephalic AVF in the anatomical snuff-box is the other alternative to a wrist RC AVF, and the most distal site of the forearm has been recommended by several authors as the primary option for an AVF.[2-5]The main advantage of the snuff-box AVF is that preserving the proximal vessels to create additional AVFs also provides a long segment of vein for needling. In case of failure of a snuff-box AVF after maturation, creation of a secondary arteriovenous access site is often facilitated by the presence of an already arterialized vein[5,6].

It has been informally suggested that creating a snuff-box AVF before an RC or a BC AVF may dilate the veins of the forearm and upper arm and improve the outcome of subsequent AVF construction in the ipsilateral arm. That this suggestion? suggestion has never been systematically studied, and little is known or has been published about it[6].

The aims of this retrospective study were to investigate the types of fistulas and the patency, maturation rates, complications, and late results of ipsilateral AVFs created after a snuff-box fistula.

Material and Method

Between January 2007 and December 2015, 323 snuff-box AVFs for hemodialysis were created at our institution. Sufficient data were was available for 75 patients (95 fistulas) with secondary AVFs created after primary functional snuff-box fistulas. When a snuff-box AVF failed, a standard ipsilateral RC AVF was constructed if possible, or a contralateral snuff-box AVF or a contralateral wrist access was created. If the contralateral wrist was not suitable for both a snuff-box and an RC AVF, then an ipsilateral BC AVF was created in the same extremity. All fistulas in this study were secondary ipsilateral RC AVFs (n=58) or BC AVFs (n=37). Moving to the contralateral extremity for creation of the secondary vascular access was the exclusion criterion. All AVFs were constructed with the same surgical technique by general surgeons experienced in vascular access. Thirty-seven ipsilateral BC AVFs and 58 ipsilateral RC AVFs were created after 95 primary snuff-box fistulas.

Fistula patency and maturation time were obtained from dialysis unit and hospital medical records.

Demographic factors and comorbid conditions (the duration of treatment with hemodialysis; and the frequency of hemodialysis) were also assessed. The time until fistula failure occurred was determined from dialysis unit notes.

Before the operation, the adequacy of the cephalic vein and the arterial supply of the upper limb (brachial, radial, ulnar pulses) were determined by clinical examination. All secondary accesses were created under local anesthesia. All operations were performed as outpatient procedures.

A palpable thrill or a bruit on auscultation was taken as an indicator of good fistular function. Primary failure was defined as those fistulas that failed within 6 weeks, before the fistula could be used for hemodialysis, including those that were technical failures. Primary patency refers to the duration of access patency until the first intervention to maintain patency or until fistula failure. Cumulative secondary patency refers to fistulas functioning for dialysis, regardless of the number of interventions required to maintain patency. Fistula failure was defined as an inability to use the fistula for hemodialysis owing to a cause other than transplant or death. Operative ligations were classified as failures. Patients who underwent renal transplant were considered as lost to follow-up, not as failures. Deaths being unrelated to fistula failure also were treated as lost to follow-up. A fistula was considered to have matured when it provided adequate dialysis. Complication rates refer to fistula-related problems only and include the causes of fistula failure.

The mean ± SD was the descriptive statistic used to express results for quantitative variables. A Kaplan-Meier survival analysis was performed according to primary and secondary patency rates. Differences in patency rates between RC and BC AVFs were assessed using the log-rank test. A p value <0.005 was considered statistically significant for all comparisons.

Results

Seventy-five patients underwent the creation of a total of 95 snuff-box fistulas. Demographic data are listed in Table I. The most common cause of renal failure was diabetes in 32 patients (42% of total). The other causes of renal failure were hypertension in 18 (24%), glomerulonephritis in 12 (16%), unknown etiology in 7 (9%), and chronic pyelonephritis 6 (8%).

Table 1. Demographic factors and comorbid diseases of the study subjects.

Age (years, mean ± SD)	50 ± 17 (range, 18-84)
Mean time on hemodialysis (years, mean ± SD)	8 ± 3 (range, 1-20)
Fistula type (RC/BC)	93/59
Gender (male/female)	51/85
Hemodialysis frequency (d/wk)	9 (2 d/wk), 66 (3d/wk)
Side (left/right)	102/50
Diabetes mellitus	68 (50%)
Hypertension	30 (22)
Glomerulonephritis	25(18%)
Chronic pyelonephritis	6 (4%)
Unknown	7 (5%)

Of those 95 secondary AVFs, 37 (39%) were ipsilateral BC AVFs and 58 (61%) were ipsilateral RC AVFs. Forty-five RC AVFs (77%) and 30 BC AVFs (81%) were placed on the left side.

Thirty-seven BC AVFs were constructed after a primary snuff-box AVF. The reasons for creating the BC AVFs were, extensive thrombosis in 20 patients (54%), stenosis (needle sites) of

forearm cephalic outflow vein in 9 patients (24%), aneurysm formation of forearm cephalic outflow vein in 8 patients (21%). Those complications changed the operative plan to creation of a BC AVF. In 37 BC AVFs created at our institution, extensive disease within the outflow vein was the main cause of BC AVFs procedures.

Maturation and complications

There were no primary failures among 95 secondary access procedures. The median follow-up for the patients studied was 50 months (range, 3-65 months). All of the AVFs matured, and the median maturation time was 19.5 ± 3.2 days (range, 15-30 days) for RC AVFs and 19.4 ± 2.9 days (range, 15-30 days) for BC AVFs. All of the secondary accesses were matured and functional.

Postoperative complications included 2 infections (none of which required drainage) that were treated with antibiotics, and 4 hematomas (none of which required drainage). One patient presented with minimal "steal" symptoms after a left-sided RC fistula operation. Those symptoms resolved spontaneously within 1 week of their onset. The overall morbidity rate was 6%, and no patient died during the 30 days after the procedure.

Patency

Figures 1 and 2 show the primary and secondary patency rates determined with the Kaplan-Meier survival analysis for RC AVFs and BC AVFs. The primary patency rates for BC AVFs and RC AVFs were as follows: 1-year rate, 91% to 89%; 2-year rate, 82% to 74%; 3-year rate, 65% to 67%; and 4-year rate, 60% to 62%. The difference in primary patency between the 2 groups was not significant (p=0.9, log rank). The secondary patency rates for BC AVFs and RC AVFs were as follows: 1-year rate, 96% to 93%; 2-year rate, 90% to 83%; 3-year rate, 83% to 73%; and 4-year rate, 76% to 62%. The difference in secondary patency between the 2 groups was not significant (p=0.4, log rank).

There were 12 late failures among 95 functional AVFs. The most common cause of failure was stenosis within the vein in 9 patients (9.4%) (6 RC AVFs and 3 BC AVFs) and an aneurysm in 3 patients (3%) (2 RC AVFs and 1 BC AVF).

Secondary patency (successful recanalization) was attempted in 22 fistulas (11 RCs and 11 BCs) and was successful in the 15 AVFs (68%) (6 RC and 9BC). Of these thrombectomies, 13 were surgical and 9 were performed via interventional radiology. Subclavian vein stenoses, which were confirmed by venographic studies, developed in 4 patients. We attempted to correct the stenoses with percutaneous transluminal angioplasty, but the interventions were unsuccessful because 2 of the stenoses were not elastic.

Discussion

The number of patients worldwide with end-stage renal disease receiving hemodialysis treatment increases every year[7]. By 2001, more than 1 million patients were undergoing dialysis, and the annual global average rate of increase was 7%[7,8]. In Europe, 80% of hemodialysis patients have an autogenous AVF as a vascular access, but only 24% of patients in the United States have an autogenous AVF[9]. According to the Turkish Nephrology Society Registry, which records data for 25 321 patients at 388 hemodialysis centers in Turkey, of patients who had started hemodialysis treatment for the first time, 35.6% have an autogenous AVF as the first intravenous route in; and in individuals treated with regular hemodialysis, 90.1% have an autogenous AVF[10]. Of those AVFs, 42% were localized 1/3 distal region of the forearm, 25% were localized 1/3 mid region of the forearm and 8.5% had a snuff-box AVF[10]. .

The NKF-K/DOQI clinical practice guidelines for vascular access suggest placement of an autogenous AVF for primary vascular

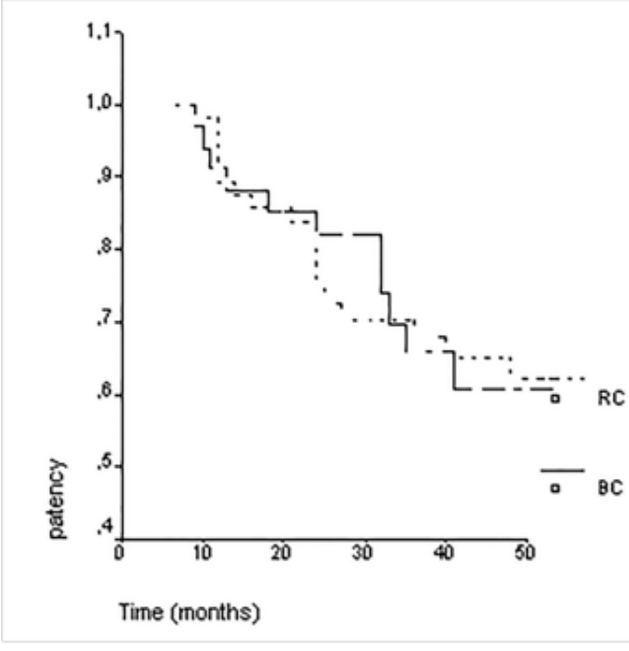

Figure 1. Primary survival analysis (Kaplan-Meier) for patency of wrist radial-cephalic arteriovenous fistulas and elbow brachial-cephalic arteriovenous fistulas in the study subjects. (Abbreviation; RC: radial-cephalic arteriovenous fistula; BC: brachial-cephalic arteriovenous fistula)

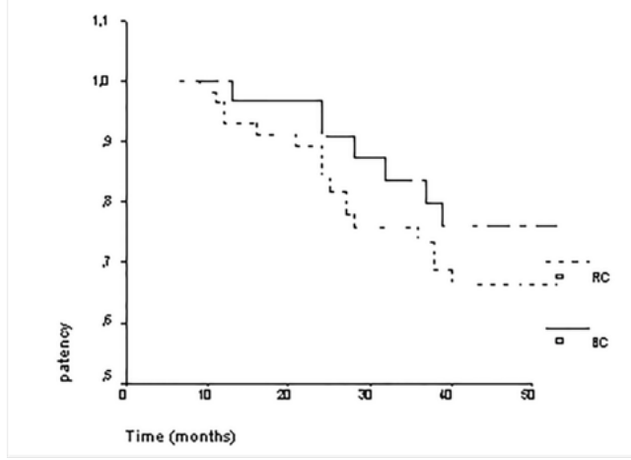

Figure 2. Secondary survival analysis (Kaplan-Meier) for patency of radial-cephalic arteriovenous fistulas and brachial-cephalic arteriovenous fistulas in the study subjects. (Abbreviation; RC: radial-cephalic arteriovenous fistula; BC: brachial-cephalic arteriovenous fistula)

access for hemodialysis[1]. An autogenous RC AVF is regarded as the first and best choice for vascular access. In our study, all secondary fistulas were native after the initial snuff-box AVF, which led to a reduction in the number of more complicated secondary access procedures such as AV prosthetic grafts.

The present study shows that 58 RC AVFs (61%) and 37 BC AVFs (39%) were feasible after primary snuff-box AVFs. Multiple stenoses may develop at the site of multiple venipunctures. Stenosis and aneurysm formation at the inflow vein can lead to thrombosis. Multiple stenotic areas are associated with unsuccessful thrombectomy and the need for additional BC AVFs instead of RC AVFs. There was no immediate failure and all AVFs were functional after 30 days. These 2 types of secondary vascular access procedures that were made after a primary snuff-box AVF were successful.

"Failure to mature" is defined as the inability to use a fistula for hemodialysis at 6 weeks after its construction[11]. However, 10% to 24% of RC AVFs are either compromised by a thrombosis directly after surgery or do not function adequately because of a failure to mature[12,16]. RC AVFs have a reported maturation rate of 25% to 80%[17]. Rao and colleagues reported that failure to mature was as high as 38%, although most other authors have not reported such high rates as this[18]. In our report, maturation rates and times were better than those cited in the literature[11]. Arterialized vein segments resulted in better maturation rates and shorter maturation times. However, the study group was young and the mean hemodialysis time was short, these factors could influence the maturation rate.

A review of the literature showed that the primary patency rate of RC AVFs ranges from 70% to 91% at 1 year, although a recent meta-analysis reported that the primary patency rate may be as low as 62.5% and the secondary patency rate may be as low as 66.0% at 1 year after the creation of the fistula[11,19,20]. The 1-year primary patency rates of BC AVFs and forearm prosthetic arteriovenous grafts have been reported to range from 70% to 84% and 62% to 87% respectively[12,21,25].

In this study, the primary and secondary patency rates of RC AVFs are better than the rates listed in a recent meta-analysis of radial-cephalic patency and better than the patency rates for prosthetic arteriovenous grafts. The primary and secondary patency rates of BC AVFs are better than the patency rates of both BC AVFs and prosthetic grafts[11,12].

The main reason for the failure of functional secondary RC AVFs in this study was multiple needle puncture site stenoses in the outflow vein.

One of the most commonly performed alternative secondary fistulas is the prosthetic graft. This type of fistula results in high rates of infection, steal symptoms, high-output cardiac failure, aneurysm formation, and thrombosis[26,27].

According to the Turkish Nephrology Society Registry, in 25.7% of the patients receiving the routine hemodialysis treatment for the first time, the initial intravenous route is the temporary (nontunneled) subclavian catheterization[28]. Subclavian vein occlusion or stenosis can occur in up to 50% in patients who have had an indwelling subclavian catheter[29]. Subclavian vein occlusion confirmed by venography, contributed to 2 AVF failures in this study.

These data suggests that it is more vital to create a snuff-box fistula, if possible, for primary vascular access before construction of an RC AVF is attempted. By doing so, a long vein segment is well preserved for needling, and this segment also preserves proximal vessels for further AVF creation. An RC AVF should be the secondary choice in 61% of patients undergoing creation of a secondary access after a snuff-box AVF. This operation is often facilitated by the presence of arterialized vein segment. This type of secondary AVF is associated with better outcomes, although additional studies are required.

The limitations of our study were that there were no randomized trials in literature, from which conclusions could be drawn. For that reason, this paper is the only report analyzing the secondary vascular access procedures created after functional snuff-box fistulas. It is clear that well-planned randomized trials are needed to provide additional information about access surgery.

Competing interests

The authors declare that they have no competing interests.

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