

Resection of True Aneurysmal Arteriovenous Fistulas and Preserving Their Functions Using Segmental Saphenous Graft Interposition

Gerçek Arteriovenöz Fistül Anevrizmalarının Rezeksiyonu ve Safen Ven Greft İnterpoze Edilerek Fonksiyonunun Korunması

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ABSTRACT Objective: Arteriovenous fistulas (AVF) created for hemodialysis may be complicated by aneurysm formation. The aim of this article is to describe our experience with segmental saphenous graft interposition to treat AVF aneurysms. **Material and Methods:** Between June 2007 and June 2011, 23 patients who admitted to our clinic with symptoms related to single or multiple AVF aneurysms were included in the study. Under general anesthesia, the aneurysms were resected and a reverse saphenous vein graft was implanted in an end-to-end manner, after inflow and outflow of aneurysmatic fistula tract was clamped. **Results:** Aneurysms were secondary to brachial-cephalic fistula in 16 (69.5%) patients and radial-cephalic fistula in 7 (30.5%) patients. The mean follow-up period was 40.2±9.4 months, with a range 13 to 61 months. The saphenous vein thrombosed in 3 patients in brachial-cephalic fistula and in 3 patients in radial-cephalic fistula groups. There were no vascular complications in the remaining. **Conclusion:** Our results show that this method preserves AVF functions and prevents the complications of the aneurysms. Preservation techniques such as segmental saphenous graft interposition may be performed for treating functioning AVF aneurysms.

Key Words: Arteriovenous fistula; aneurysm; saphenous vein

ÖZET Amaç: Hemodiyaliz amacıyla oluşturulan arteriovenöz fistüllerin önemli bir komplikasyonu, anevrizma gelişmesidir. Bu çalışmanın amacı anevrizma gelişmiş arteriovenöz fistüllerin safen ven grefti kullanılarak onarılmasıyla ilgili tecrübemizi aktarmaktır. **Gereç ve Yöntemler:** Haziran 2007 ve Haziran 2011 tarihleri arasında tek veya çoklu arteriovenöz fistül anevrizması nedeniyle kliniğimize başvuran 23 hasta çalışmaya dahil edildi. Genel anestezi altında, anevrizmatik fistül segmenti proximal ve distalden klemplenerek rezeksiyon yapıldı ve yerine safen ven grefti interpoze edildi. **Bulgular:** Anevrizmalar 16 (%69,5) hastada brakial-sefalik fistül, 7 (%30,5) hastada radial-sefalik fistüle sekonderdi. Hastalar ortalama 40,2±9,4 (13-61) ay takip edildi. Safen ven grefti brakial-sefalik fistül ve radial-sefalik fistül gruplarında 3'er hastada tromboze oldu. Diğer hastalarda vasküler komplikasyon izlenmedi. **Sonuç:** Sonuçlar arteriovenöz fistül anevrizmalarının güvenle tamir edilerek fonksiyonlarının korunabileceğini ortaya koymuştur. Segmental safen ven grefti interpozisyonu gibi koruyucu teknikler fonksiyonel arteriovenöz fistül anevrizmalarını tedavi etmek için kullanılabilir.

Anahtar Kelimeler: Arteriovenöz fistül; anevrizma; safenöz ven

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The use of native veins for creation of arteriovenous fistulas (AVF) results in better patency rates, and the incidence of complications is lower when compared to a prosthesis. Thrombosis, infection, aneurysm formation and stenosis are the most common complications related

to AVF.¹ Upper limb vein aneurysms complicate all types of autogenous AVF and comprise false aneurysms secondary to venipuncture trauma as well as true aneurysms, characterized by dilatation of the native veins. Incidence of aneurysm formation is approximately 5- 7%.² The aim of this article is to describe our experience with segmental saphenous graft interposition to treat AVF aneurysms.

MATERIAL AND METHODS

Between June 2007 and June 2011, 23 patients admitted to our clinic with symptoms related to single or multiple AVF aneurysms were included in the study. Their complaints were a pulsating mass, pain, erosion of overlying skin, problems in hemodialysis, cosmetic reasons and sudden rupture. In Doppler ultrasonography, transverse diameter of the fistula tracts were greater than 40 mm, having at least threefold larger the vessel segments just above and below the aneurysmatic area. The transverse diameter of greater saphenous vein was measured at proximal and distal levels. In only one patient, admission was urgent due to sudden-onset rupture, so that Doppler ultrasonography could not be performed. Informed consents were obtained

from all the patients, and the study protocol was approved by the ethical committee.

OPERATIVE TECHNIQUE

All operations were performed under general anesthesia. First, 5000 IU heparin and 1 g cefuroxime were infused. Arterial inflow of fistula tract was dissected to control incoming arterial flow. Then aneurysmatic segment and vessel segments were dissected just above and below the aneurysmatic area, sometimes small skin areas over the aneurysm were left in place during resection (Figure 1). Great saphenous vein was prepared usually above the knee level. Since diameter measurements above the knee level were more suitable for refoundation of optimal fistula tract hemodynamics. Inflow and outflow of aneurysmatic fistula tract was clamped. The aneurysm was resected. A reverse saphenous vein graft was implanted in an end-to-end manner (Figure 2). After placement of a suction drain, skin was sutured primarily. A temporary central vein hemodialysis catheter was placed for one month after surgery. Postoperative prophylactic antibiotics and antiagregants were applied to all patients.



FIGURE 1: The aneurysmatic segment of the arteriovenous fistula was dissected from the surrounding tissues.



FIGURE 2: A reverse saphenous vein graft is implanted in an end-to-end manner after resection of the aneurysmatic segment.

STATISTICAL ANALYSES

The data were analyzed using SPSS software (SPSS 18.0.1 for Windows; SPSS, Chicago, IL, USA). Continuous variables were shown as mean±standard deviation along with their ranges. Categorical variables were expressed as frequencies and percentages.

RESULTS

A total of 23 patients were included in this study. Aneurysms were secondary to brachial-cephalic fistula in 16 (69.5%) patients and radial-cephalic fistula in 7 (30.5%) patients. The follow-up period ranged between 13 and 61 (mean 40.2) months. In brachial-cephalic fistula group, the saphenous grafts were thrombosed in 3 patients (at 1st, 2nd and 4th months postoperatively). After thrombectomy, grafts thrombosed again, and alternative access methods were applied. In the same group, percutaneous transluminal angioplasty was applied in one patient. for anastomotic stenosis at 11th month In the radial-cephalic fistula group, saphenous grafts were thrombosed in 3 patient (at 1st, 2nd and 8th months postoperatively). After thrombectomy, grafts thrombosed again and an alternative access methods was applied (Table 1). In other patients, there were no vascular complications in follow up period.

DISCUSSION

Endogenous AVF was first described in 1966, and it still remains as the optimal vascular access for chronic long-term dialysis therapy.³ The most common late complication of AVF formation is the development of an aneurysm, which is generally a true

aneurysm and it usually does not affect fistula function for hemodialysis.⁴

Incidence of aneurysm formation is approximately 5-7%, and the majority of them occur in the upper arm.^{2,5} Aneurysms are defined as fusiform or saccular dilatations with a diameter three times larger than that of the upstream and downstream segments of the access site.⁶ The pathophysiology of venous aneurysms is still unclear.⁷ Cannulation routes appear to be preferential locations for the aneurysms due to repeated needling.⁸ The Kidney Disease Outcomes Quality Initiative guidelines recommend that aneurysmal AVF segments should not be cannulated.⁹ Another factor influencing the formation of a venous aneurysm as well as the management decisions involves downstream or upstream stenosis, that is, pre-stenotic or post-stenotic aneurysm.

Most of the time, the problem is considered to be merely cosmetic and procedure is done only to avoid further punctures in the aneurysmal segment. Repair is indicated in the presence of pain, infection, limited puncture sites, skin erosion, rapid expansion, low flow associated with stenosis and rupture.

Methods for treating the aneurysms include ligation or resection of the AVF.¹⁰ This is effective and will eliminate the risk of bleeding, but it is also wasteful because an otherwise functional AVF is sacrificed. In a large study including 44 aneurysms involving both AVF and grafts, Georgiadis et al. concluded that the outcome of salvage surgery was better for AVF compared to grafts, and for true aneurysms compared to false aneurysms.¹¹ Aneurysmorrhaphy was recommended to preserve an aneurysmatic functioning AVF.^{6,12} In another study Karabay et al. recommended only color duplex ultrasonographic examination of the upper extremity preoperatively.¹³ One of the recommended techniques for aneurysm repair is application of the exceeding (redundant) vein wall, which precludes the need for resection according to Lo and Tan.² Stent grafting is another option of treatment, but it is usually indicated for a pseudoaneurysm repair (not true aneurysm), and mainly for AVF with

TABLE 1: Aneurysms, types of vascular access, complications.

Variables	N (%)
All aneurysms	23 (100%)
Brachial-cephalic fistula	16 (69.5%)
Radial-cephalic fistula	7 (30.5%)
Thrombosis in brachial-cephalic fistula group	3 (13%)
Stenosis in brachial-cephalic fistula group	1 (4.3%)
Thrombosis in radial-cephalic fistula group	3 (13%)

prosthesis.^{14,15} Pierce et al. reported the use of longitudinal stapling to reduce the aneurysmal lumen to normal diameter.¹

In our study, the aim of the treatment of the aneurysmatic fistula was to treat the aneurysm while maintaining fistula's function. The normal vein diameter of a mature AVF measures 4 to 7 mm. The most hemodynamically suitable autogenous graft was the suprapopliteal great saphenous vein. Thromboembolic complications of the auto-

genous grafts has been smaller than the prosthetic grafts. We resected aneurysmatic vessel segment, and replaced it with a reverse saphenous graft. As a result, preservation techniques like segmental saphenous graft interposition may be performed for treating functioning AVF aneurysms.

Conflict of Interest

Authors declared no conflict of interest or financial support.

REFERENCES

- Pierce GE, Thomas JH, Fenton JR. Novel repair of venous aneurysms secondary to arteriovenous dialysis fistulae. *Vasc Endovascular Surg* 2007;41(1):55-60.
- Lo HY, Tan SG. Arteriovenous fistula aneurysm-plicate, not ligate. *Ann Acad Med Singapore* 2007;36(10):851-3.
- Grauhan O, Zurbrugg HR, Hetzer R. Management of aneurysmal arteriovenous fistula by a perivascular metal mesh. *Eur J Vasc Endovasc Surg* 2001;21(3):274-5.
- Terada Y, Tomita K, Shinoda T, Iona Y, Yoshiyama N. Giant serpentine aneurysm in a longterm hemodialysis patient. *Clin Nephrol* 1988;30(3):164-7.
- Salahi H, Fazelzadeh A, Mehdizadeh A, Razmkon A, Malek-Hosseini SA. Complications of arteriovenous fistula in dialysis patients. *Transplant Proc* 2006;38(5):1261-4.
- Berard X, Brizzi V, Mayeux S, Sassoust G, Biscay D, Ducasse E, et al. Salvage treatment for venous aneurysm complicating vascular access arteriovenous fistula: use of an exoprosthesis to reinforce the vein after aneurysmorrhaphy. *Eur J Vasc Endovasc Surg* 2010;40(1):100-6.
- Diskin CJ, Stokes TJ, Dansby LM, Radcliff L, Carter TB, Understanding the pathophysiology of hemodialysis access problems as a prelude to developing innovative therapies. *Nat Clin Pract Nephrol* 2008;4(11):628-38.
- Clinical practice guidelines for hemodialysis adequacy update 2006. *Am J Kidney Dis* 2006;48 Suppl 1:S2-90.
- KDOQI Clinical Practice Guidelines and Clinical Practice Recommendations for 2006 Updates: hemodialysis adequacy, peritoneal dialysis adequacy and vascular access. *Am J Kidney Dis* 2006;48(suppl 1):s1-s322
- Karabay O, Yetkin U, Silistreli E, Uskent H, Onol H, Açikel U. Surgical management of giant aneurysms complicating arteriovenous fistulae. *J Int Med Res* 2004;32(2):214-7.
- Georgiadis GS, Lazarides MK, Panagoutsos SA, Kantartzis KM, Lambidis CD, Stamos DN, et al. Surgical revision of complicated false and true vascular access related aneurysms. *J Vasc Surg* 2008;47(6):1284-91.
- Otken CC, Günday M, Demirbaş M. Hemodializ hastalarında arteriyovenöz fistüle bağlı gelişen venöz anevrizmaların cerrahi tedavisi. *Turkish J Thorac Cardiovasc Surg* 2010;18(3):196-9.
- Karabay Ö, Yetkin U, Silistreli E. Hemodializ amaçlı arteriyovenöz fistüllerde oluşan dev anevrizmalarda cerrahi yaklaşım. *Turkish J Vasc Surg* 2003;12(2):11-15.
- Ananthakrishnan G, Bhat R, Severn A, Chackraverty S. Stent graft exclusion of pseudoaneurysm arising from PTFE hemodialysis graft after recurrence following ultrasound guided thrombin injection. *J Vasc Access* 2008;9(4):293-5.
- Criado A, Marston WA, Ligush J, Mauro MA, Keagy BA. Endovascular repair of peripheral aneurysms, pseudoaneurysms and arteriovenous fistulas. *Ann Vasc Surg* 1997;11(3):256-63.