

## EARLY AND MID TERM RESULTS OF ARTERIOVENOUS FISTULA WITH LOOP PTFE GRAFT FOR HEMODIALYSIS

### Original Article

## HEMODİYALİZ AMAÇLI LOOP PTFE GREFT İLE ARTERİOVENÖZ FİSTÜLÜN ERKEN VE ORTA DÖNEM SONUÇLARI

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### ABSTRACT

**Objective:** Polytetraflourethylene grafts are the most preferred prosthetic graft for hemodialysis patients in whom autogenous fistula can not be constructed. The purpose of this study is to investigate the result of the arteriovenous fistula created with loop polytetraflourethylene grafts in patients with chronic renal failure, in the early and mid term.

**Methods:** This study includes a total of 23 chronic renal failure patients (10 patients (43,48%) were male and 13 patients (56,52%) were female) in whom we created arteriovenous fistula with loop polytetraflourethylene graft for hemodialysis between 01 January 2003 and 01 January 2004. The mean age of patients was 45,6 (range 16 to 73) years.

**Results:** Patients were followed up 6 to 20 (mean 11) months. Graft thrombectomy was performed in 3 patients (13,04%) due to thrombosis after first postoperative month. Graft resection was performed in 3 patients (13,04%) due to stenosis and infection. A total of 20 patients (86,95%) undergone hemodialysis without any problem with their fistula.

**Conclusion:** Arteriovenous fistula with loop polytetraflourethylene graft is a suitable access route in hemodialysis patients who has no autogenous fistula. Graft thrombosis and infection are the most complications of these fistulas. ^

**Key Words:** Arteriovenous fistula; PTFE graft; nonautogenous fistula.

### ÖZET

**Amaç:** Hemodiyaliz için otojen arteriovenöz fistüllerin oluşturulamadığı hastalarda, en çok tercih edilen prostetik greftler polytetrafloroethylene greftlerdir. Bu çalışmanın amacı, kronik böbrek yetmezlikli hastalarda, loop polytetrafloroethylene greftle oluşturulan

arteriovenöz fistüllerin erken ve orta dönem sonuçlarının araştırılmasıdır.

**Gereç ve Yöntem:** Bu çalışmaya, kliniğimizde 01 Ocak 2003 ile 01 Ocak 2004 tarihleri arasında kronik böbrek yetmezliği nedeniyle hemodiyaliz için loop polytetrafloroethylene greftle arteriovenöz fistül oluşturulan 10'u (%43,48) erkek, 13'ü (%56,52) kadın 23 hasta dahil edildi. Hastaların ortalama yaşı 45,6 (16-73) idi.

**Bulgular:** Hastalar 6 ile 20 (ortalama 11) ay takip edildi. 3 hastada (%13,04) postoperatif ilk 1 ayda tromboz nedeniyle greft trombektomi uygulandı. 3 hastada (%13,04) enfeksiyon ve stenoz nedeniyle greft rezeksiyonu uygulandı. Toplam 20 hasta (%86,95) problemsiz olarak fistüllerinden hemodiyalize devam etmektedir.

**Sonuç:** Loop polytetrafloroethylene greftle oluşturulan arteriovenöz fistül, otojen fistül imkânı olmayan hastalarda kullanışlı bir hemodiyaliz yoludur. Bu fistüllerin en sık komplikasyonları ise greft trombozu ve enfeksiyondur.

**Anahtar Kelimeler:** Arteriovenöz fistül; PTFE greft; nonotojen fistül.

## INTRODUCTION

The number of patients requiring dialysis for end stage renal disease is increasing rapidly. Chronic hemodialysis (HD) treatment requires vascular access. This can be provided by central venous catheter, autologous arteriovenous fistula (AVF) or arteriovenous graft interposed between arterial and venous blood vessel. A autologous AVF is considered the most favourable in terms of function, duration and absence of complications (1). There are always however, a number of patients with insufficient autologous venous vasculature where the native superficial venous vessels are hypoplastic or attrited due to previous surgical procedures. Various materials (autologous, homologous and heterologous) are used

as a graft. Synthetic prostheses made of expanded polytetrafluroethylene (ePTFE) graft were first introduced in 1970 (2). Currently, the ePTFE conduit is preferred for its availability. In this study, we aimed to discuss early and mid term results of AVF with loop ePTFE graft at the forearm created for haemodialysis in chronic renal failure patients.

## METHODS

This study includes a total of 23 chronic renal failure patients (10 patients (43,48%) were male and 13 patients (56,52%) were female) in whom we created arteriovenous fistula with ePTFE graft for haemodialysis between 01 January 2003 and 01 January 2004. Demographic factors and the following variables were recorded for all patients during hospitalization, using a questionnaire: age, sex, number of weekly dialysis sessions and presence of diabetes and hypertension (**Table 1**). The patients who did not have an appropriate vein for AVF were enrolled in this study. The patients received 1 g cephazolin intravenous, one hour prior to the operation as prophylaxis. The procedures were carried out with local anesthesia and sedation (when required). Vascular graft of ePTFE (5mm, Gore-Tex®) was used for all patients. The grafts were located on the nondominant forearm in all patients. Grafts were washed with normal saline solution and heparin prior to anastomosis. Grafts were located subcutaneously so that the arterial anastomosis to the brachial artery and the venous anastomosis to the cephalic vein would be near the elbow. End to side 6-8 mm arterial and 8-10 mm venous anastomosis were performed with prolene 6.0.

Gender	Male	43,48% (n=10)
	Female	56,52% (n=13)
Mean age	45,6 (range 16 to 73) years	
Comorbidity	Diabetes	47,82% (n=11)
	Hypertension	39,13% (n=9)
	Diabetes and Hypertension	26,08% (n=6)
Hemodialysis periods	Three times a week	69,56% (n=16)
	Twice a week	30,44% (n=7)
Complications	Thrombosis	13,04% (n=3)
	Stenosis	4,34% (n=1)
	Infection (graft and wound)	17,39% (n=2+2)
	Pseudoaneurysm	4,34% (n=1)
	Bleeding	8,69% (n=2)

**Table-1:** *General features of patients.***RESULTS**

The study population composed of 23 end stage renal disease patients referred for vascular access construction. The mean age of patients was 45,6 (range 16 to 73) years. Hemodialysis had been carrying out three times a week in 16 patients (69,56%) and twice a week in 7 (30,44%). Hypertension, diabetes or both were the present risk factors for atherosclerosis in 9 (39,13%), 11 (47,82%) and 6 (26,08%) of the patients respectively. Patients were followed up 6 to 20 (mean 11) months. Examination was carried out via touching the thrill, auscultating the bruit and assessing the outcome of the performed hemodialysis. Postoperative follow up included AVF patency and complications such as bleeding, thrombosis, occlusions, steal syndrome, venous hypertension, aneurysms, wound healing and infection were also evaluated.

There was no operative mortality in this study. There were no steal syndrome and cardiac insufficiency related to the fistula in this study. During 6 to 20 month follow up, cases of graft infection 2 (8,69%), cases of thrombosis 3 (13,04%), cases of bleeding 2 (8,69%), case of graft stenosis 1 (4,34%) and case of pseudoaneurysm 1 (4,34%) were observed. Infections from the surgical wound occurred during the postoperative period in 2 (8,69%) cases. Graft thrombectomy was performed in 3 patients (13,04%) due to thrombosis. Graft resection was performed in 3 patients (13,04%) due to stenosis and infection. Reoperation required for 2 (8,69%) patients due to bleeding. A total of 20 patients (86,95%) undergone hemodialysis without any problem with their fistula. Thrombosis and infection were the most common complications.

**DISCUSSION**

Due to the advances made in diagnostic and therapeutic methods, the number of patients requiring dialysis for end stage renal disease is increasing rapidly. The prolonged survival of this group of patients depends on the long-term functioning and patency of the vascular access for HD (3). This can be provided by central venous catheter, native AVF or arteriovenous graft interposed between arterial and venous blood vessel. A central venous catheter vascular access is indicated if acute HD procedure is necessary. Using AVF was first introduced by Brescia et al in 1966 (4). Preferably, an autologous AVF, either in the non-dominant wrist or elbow crease (upper extremities), is the best first choice for HD vascular access. The radiocephalic AVF remains the first choice vascular access procedure for those patients requiring long term haemodialysis. There are always however, a number of patients with inadequate forearm autologous venous vasculature where the native superficial venous vessels are hypoplastic or attrited due to previous failed surgical procedures for AVF (5). In addition, due to repeated punctures and new dissections, thrombophlebitis and occlusions are frequent complications leading to the vascular access loss. In these situations, prosthetic arteriovenous conduits are implanted.

In spite of many remarkable advantages of AVF, atherosclerosis can make AVF useless in many patients. Due to significant increase in the number of patients in need of HD, the use of vascular grafts in those without a suitable vein for AVF has increased significantly. Most of them are at risk of vascular diseases, because of elderliness, diabetes, hyperlipidemia, hypertension and early atherosclerosis. Subsequently, AVF may not work properly in all patients and in case of the disruption of AVF, no appropriate vascular access would be available. Thus, investigators have tried

innovative approaches in order to connect arteries and veins, which are distal to each other and have offered the usage of bovine carotid artery, Dacron grafts, saphenous vein and umbilical vein (6,7,8). Initially, natural materials were used as autologous, homologous and heterologous vein and arteries and later artificial materials such as modified polyester and ePTFE vascular prostheses began to be used. Nowadays, they are the most common exogenous prostheses used for providing vascular access and the ePTFE conduit is preferred for its availability.

PTFE grafts have been widely used as artificial grafts in vascular surgery; its expanded form has been reported to have acceptable outcomes (9). The ePTFE conduits vary in length of fibrils, wall thickness and wall reinforcement, number of wall layers, the cover of the internal surface and shape of the conduit. Of these, ePTFE grafts interponate best meets the requirements of sufficient arteriograft: availability and handling, material inertness, rapid healing, low incidence of post vein puncture bleeding, resistance to infectious complications and thrombosis and long term good cumulative access function. Initially, ePTFE graft was used in surgical procedures performed on the venous system and Volder was the first to use the ePTFE conduit as an arteriovenous graft for HD in 1973 (10). Regarding its special advantages such as low thrombogenicity, ample durability and the availability of its different diameters, ePTFE grafts could be a connector of arteries and veins distal to each other, providing an appropriate vascular access. Currently, there are many ePTFE conduits producers and various product modifications are available.

Synthetic grafts are constructed by anastomosing a synthetic conduit, usually ePTFE (also known as Gore-Tex), between an artery and vein. The conduit can be straight or looped and ranges between 4 to 8 mm in diameter. Grafts can be

modified to be tapered at the arterial side, to decrease complications (11). Common graft locations are straight forearm (radial artery to cephalic vein), looped forearm (brachial artery to cephalic vein), straight upper arm (brachial artery to axillary vein), or looped upper arm (axillary artery to axillary vein). The 2006 K/ DOQI work group prefers a forearm loop graft, preferable to a straight configuration (12). Chronic HD access complications include thrombosis, infection, steal, aneurysms, venous hypertension, seromas, heart failure, and local bleeding. Thrombosis, infection and seromas appear to occur more frequently with grafts than with fistulas (13). In this study, we created AVF with 5mm loop ePTFE graft at the nondominant forearm for 23 chronic renal failure patients.

Vascular access dysfunction is a major cause of morbidity and mortality in HD patients. In general elbow fistulas using native vein are felt to have superior patency and lower complication rates than prosthetic grafts (14). The best results with AVF for HD are still achieved with the classic Bescia and Cimino AVF, a distal anastomosis of the radial artery with the cephalic vein and the patency rates are around 80 to 87% in a follow-up of 36 months (15). The use of ePTFE grafts has recently become an accepted alternative to an AVF in patients plagued with vascular access problems. Several studies have reported different complications and patency rates for these artificial grafts. Thrombosis and infection are amongst the major causes of morbidity reported in patients with PTFE grafts (16). The most common complications, leading to graft loss were thrombosis (2 cases) and infection (1case) in our study, similar to other studies. The patency rate of our study was 86,95 (n=20 patients) in a follow-up of 6 to 20 (mean 11) months.

Studies have shown that a vascular access is one of the most important risk factors for infection. The lowest risk of infectious complications is in patients with

native AVF (17). The incidence of arteriovenous graft infection is affected by a large number of factors such as: impaired immunosurveillance, obesity, diabetes mellitus, hypalbuminemia and insufficient personal hygiene (18). In most cases, the causative organism of the angioaccess infection is *Staphylococcus aureus* (19). Compliance with the rules of aseptic surgical and operating techniques are the main prevention of early infectious complications following graft implantation (20). Such complication is prevent by prophylactic use of antibiotic, e.g. cephazolin (21). Clinical findings such as warmth and redness of the skin, local pain, edema, purulent secretion from the wound or abscess usually lead to a diagnosis of infection. Treatment for the graft infection can be conservative, surgical or most commonly, a combination of both. Sequential antibiotic therapy is set up according to the microbiological test results. The infected graft that cannot be treated by antibiotic therapy, must be resected. In terms of surgical treatment, the principal is removal of the infected prosthesis (total graftectomy), subtotal graftectomy or partial graftectomy (22). Cases of graft infection 2 (8,69%) and cases of wound infection 2 (8,69%) were observed in this study. The patients received 1 gr cephazolin intravenous, one hour prior to the operation as prophylaxis. Graft resection was performed in 1 patients (4,34%) due to infection.

The vast majority of HD vascular access dysfunction is due to; (I) venous stenosis and thrombosis at the graft-vein anastomosis of PTFE dialysis grafts, as a result of venous neointimal hyperplasia, (II) venous segment stenosis in AVF that results in both early and late failures (23). Once in the intima, these cells transform into myofibroblasts (vimentin and actin) and contribute to neointimal hyperplasia. Recently, it has been suggested that many of the actin positive cells within the neointima in a variety of experimental models of neointimal hyperplasia are in fact bone-marrow-derived stem cells that

have acquired a smooth muscle cell phenotype (24). Cases of thrombosis 3 (13,04%) were observed in our study. Graft thrombectomy was performed in 3 patients (13,04%) due to thrombosis. Graft resection was performed in 2 patients (8,69%) due to thrombosis.

In conclusion, AVF creation is mandatory for maintenance HD in chronic renal failure patients. If native fistula placement was not possible or failed, a prosthetic conduit would be the best substitute. They are the most common exogenous prostheses used for providing vascular access and the ePTFE conduit is preferred for its availability. Thrombosis and infection were the most common complications.

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