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**ORIGINAL ARTICLE**

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# Complications of arteriovenous fistula with polytetrafluoroethylen grafts in hemodialysis patients

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## Abstract

**Purpose:** Vessels with high venous flow rate are needed for the application of hemodialysis in patients needing chronic hemodialysis. The increase in the number of chronic hemodialysis patients has led to an increase in the number of vascular surgical operations. The aim of this study was to evaluate the results of polytetrafluoroethylen (PTFE) graft arteriovenous fistula (AVF) applications.

**Materials and Methods:** Files of 596 patients who received hemodialysis treatment at the Nephrology Unit of the Şanlıurfa Mehmet Akif İnan State Hospital between September 2009 and 2013 were retrospectively analyzed. PTFE grafts and autogenous AVFs applied in 22 patients were analyzed, and demographic data and PTFE graft associated complications of these patients were evaluated.

**Results:** We found that the graft patency duration (months  $\pm$  standard deviation) and the patency after graft revision were  $16 \pm 13$  and 83.3%. Complications were detected in 14 patients (63%). One patient developed hematoma in early stages.

**Conclusions:** We conclude that even if PTFE graft AVF applications cause significant complications, the procedure has a high patency rate after graft revision.

**Key words:** Complication, polytetrafluoroethylen graft, vascular access

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## Introduction

Late phase kidney failure is a chronic disease that results from the accumulation of metabolic effluents in the body. The primary treatment is renal transplantation. In cases where renal transplantation cannot be applied, renal replacement treatment is the second choice.<sup>[1]</sup> Renal replacement treatment is being performed with hemodialysis and peritoneal dialysis. Hemodialysis is preferred over peritoneal dialysis since peritoneal dialysis has a high infection risk.<sup>[2]</sup> Vessels with high venous flow rate are needed for the application of hemodialysis in patients requiring chronic hemodialysis and the increase in the number of chronic hemodialysis patients has led to an increase in the number of vascular surgical operations.<sup>[3]</sup>

Today, autogenous arteriovenous fistula (AVF) created at the level of the wrist, described by Brescia–Cimino, is the method that is widely used in hemodialysis patients. Polytetrafluoroethylen (PTFE) graft is being used in patients that lack appropriate venous access. Biological grafts can be used for hemodialysis access as well, but these have a higher complication rate.<sup>[2,4]</sup>

The first aim of this article is to share our experiences with graft complications. The second aim of the article is to present graft patency rates of patients where we applied a PTFE graft AVF with a retrospective evaluation.

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## Materials and Methods

Files of 596 patients who were in the hemodialysis program of the Şanlıurfa Mehmet Akif İnan Training and Research Hospital between September 2009 and 2013 were analyzed. Ethics Committee approval was obtained from Harran University on 08.11.2013 with session 10 ruling 07. Twenty-two patients (11 male; mean age  $55 \pm 21$ ) with no chance of native vessel AVF, who received AVF treatment with PTFE were retrospectively evaluated.

The demographic data of these patients were recorded [Table 1]. Graft related complications, graft patency durations and mortality rates were also recorded [Table 2]. Arteriovenous graft complications were categorized in two groups: Early and late. Early complications refer to complications monitored during the surgical procedure or the day after the procedure and late refer to complications that were monitored after the 1<sup>st</sup> day of the procedure.

### Specification of grafts

Grafts with a diameter of 6-7 mm made of PTFE were used (Impra Carboflo, Cravley, UK). The lengths of the grafts varied in accordance with the position of the graft and the need. Patencies and flow rates of the PTFE grafts were controlled with ultrasonography (Mindray Model: UMT-200, Hamburg, Germany) from distal and proximal anastomosis area. The position of the application, target vessels and graft choices were determined in light of the data from the ultrasonography.

Antibiotic prophylaxis was done with sefalozine sodium 1 h before the operation in every case. All of the cases were operated in an elective position, in a sterile surgery room and under local anesthesia (Prilokaine, Citanest, AstraZeneca, Germany). After the incisions, first we explored and suspended to the arteria and vein. 50-100 units of unfractionated heparin were given to all patients before vascular clamp. The grafts were used after being washed with 5000 units of heparinized SF. A radio-basilic front arm loop AVF was applied to one, femoral arteria-femoral vein fistula in the thigh position in the case of one patient; brachioaxillary AVF was applied to all of the other patients. Anastomosis were performed with 6/0 prolene end to side anastomosis technique. When the thrill were received from anastomosis after the surgery the procedure were ended. After placing the graft into position, antibiotic prophylaxis was prolonged for an extra 24 h using intravenous cefalosizine sodium. With regards to early complications, the patients were monitored for 24 h and treated in case of need. The control Ultrasonography of the patients was taken after the operation and when discharged from the hospital. During discharge, 100 mg/day acetylsalicylic acid was added to their treatment. After a week of graft maturation, use of grafts for dialysis was allowed.

## Statistical analysis

SPSS 15.0 (SPSS, Chicago, IL, USA) was used in the evaluation of the results. Data are given as mean  $\pm$  standard deviation.

## Results

Data from 22 patients were analyzed in this study. The mean age of the patients was 55 (minimum = 15, maximum = 80) and 11 of them were male. In the 4-year period of this study, AVF was applied to 596 patients. Among these patients, the PTFE graft usage rate was 3.6%. The follow-up time of the cases varied between 1 and 48 months. Radio-basilic front arm loop AVF was applied to one patient, femoral arteria-femoral vein in the leg position to one patient and brachio-axillary AVF was applied to 20 patients. Complications were detected in 14 patients with grafts (63%). In one patient, early complications were bleeding and hematoma. Late complications were monitored in 13 patients. The most frequent type of late complication was graft thrombosis, which was seen in 12 patients (54%) [Figure 1]. Other complications were, in order of decreasing frequency, graft infection in 3 cases (13%) [Figure 2], graft aneurysm in 2 (9%), late

**Table 1: Demographic data of the patients**

Parameter	Patient (n=22)
Age (years $\pm$ SD)	55 $\pm$ 21
Gender (male-%)	50
DM (%)	45.5
Hypertension (%)	54.5
Coronary heart disease (%)	27.03
Duration of dialysis (months $\pm$ SD)	43 $\pm$ 24

SD=Standard deviation; DM=Diabetes mellitus

**Table 2: Complication rates in patients and clinical characteristics**

Parameters	n	Patient
Early bleeding (%)	22	4.5
Early hematoma (%)	22	4.5
Early trombosis (%)	22	0
Late bleeding (%)	22	9.1
Late hematoma (%)	22	4.5
Late trombosis (%)	22	54.5
Aneurysm (%)	22	9.1
Arteriovenous fistula infection (%)	22	13.6
Graft patency duration (months $\pm$ SD)	22	16 $\pm$ 13
Patency after graft revision (%)	12	83.3
Revision and embolectomy execution time (months $\pm$ SD)	12	12 $\pm$ 11
Patency after embolectomy (months $\pm$ SD)	10	5 $\pm$ 3
Permanent catheter (%)	22	36.4
General mortality (%)	22	27.3
Mortality due to PTFE graft	22	4.5

SD=Standard deviation; PTFE=Polytetrafluoroethylene



**Figure 1:** Late complication graft thrombosis materials



**Figure 2:** Graft infection with skin erosion



**Figure 3:** Late bleeding in graft infection

bleeding in 2 (9%) [Figure 3] and late hematoma in 1 (4.5%) patient. Mortality was observed in six patients (27.3%) during follow-up in the study. Graft dependent mortality was seen in one patient after aneurysm rupture.

## Discussion

According to a 2011 report, the number of patients receiving

renal replacement treatment due to renal failure in Turkey was 60,443. Hemodialysis was predominant (83.6%) being performed for renal replacement treatment. According to the same report, arteriovenous graft was being used in 2.8% of the patients.<sup>[5]</sup> As a result of our 4-year period retrospective study, we found that the PTFE graft rate of use was 3.6%, which is close to the data from the Health Ministry. Süleymanlar *et al.* reported that the main causes of chronic renal failure were diabetes mellitus (DM) (32%) and hypertension (HT) (28%).<sup>[5]</sup> In this study group, we observed DM in 45% and HT in 54% of patients. Turan *et al.* showed that HT and DM was observed with a percentage of 61% in venous thrombosis complication in autogenous AVF treated group.<sup>[6]</sup> We observed 58% DM and 75% HT in the patients that had PTFE graft thrombosis, and we can conclude that the results are consistent with previous studies.

Many complications can be seen due to AVF treatment for hemodialysis, such as venostasis, infection, pseudoaneurism and finger amputation.<sup>[7]</sup> It has been shown that stenosis and thrombosis are the most prevalent complications in the hemodialysis access path.<sup>[8-10]</sup> In the data from our study, we found graft thrombosis to be the main complication (54%). Odabaşı *et al.*, stated that thrombosis and infection were the most prevalent complications in their study.<sup>[9]</sup> Raju reported 64% thrombosis, 35% infection, 16% pseudoaneurism and 3% steal.<sup>[3]</sup>

In the present study, we observed complications in 14 of the patients (63%). We also observed hematoma and bleeding at the incision line as an early complication in one patient. We drained the hematoma and brought the bleeding under control. Other complications occurred at a later stage. Thrombosis was detected in PTFE graft AVF in 12 patients (54%). We found that the PTFE graft AVF thrombosis was at the earliest in the 1<sup>st</sup> month and the latest in the 36<sup>th</sup> month. We performed thrombectomy for all the thrombosed grafts, and the procedure was not successful for two patients. Graft patency was later done for 10 patients. Başel *et al.* showed graft thrombosis was the most common complication in a group of 1043 patients that were treated with graft AVF. It has also been shown that patency was obtained in only 36% of patients after surgical revision to the thrombosed AVF.<sup>[10]</sup> In a study of 20 patients, Odabaşı *et al.* observed 85% graft thrombosis in PTFE AVF patients. They also reported a 70% patency after revision. In our study, the graft thrombosis rate was 54% in PTFE graft AVF patients. Patency after revision thrombectomy was 83% and patency continuum duration was between 2 and 12 months after thrombectomy.

In the light of the data given, in cases of thrombosis, PTFE grafts respond better to thrombectomy and revision than

autogenous AVFs. The second common complication is graft infection (13%). We observed infection in three patients. Graft resection was performed, and a permanent hemodialysis catheter was inserted for two of these patients. The other patient was treated with intravenous antibiotics and medical dressing. Graft aneurysm was seen in two patients (9%) and graft resection was performed. A permanent hemodialysis catheter was inserted for one of the patients and the other patient, then he died from aneurysm rüptür and bleeding. In two patients, there was bleeding at the hemodialysis needle access site in the late stage. Both of these patients were operated. The bleeding was stopped with a 7-0 prolene. Mortality was seen in six patients (27.3%) during follow-up. Chronic kidney failure occurred in two patients, heart failure in two patients, mortality due to sepsis in one patient and mortality due to graft aneurysm rupture was also observed.

### Conclusion

The higher rate of complications in patients that have a PTFE graft AVF in comparison to patients with an autogenous AVF can be considered as a disadvantage, but it provides an early hemodialysis access path and a higher rate of patency after graft thrombosis, which is an advantage. Even though autogenous AVF is primarily recommended, AVF using PTFE can be preferred for hemodialysis access if there are no other alternatives.

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