

The comparison of the complications of axillobrachial and femorofemoral arteriovenous shunt prostheses in hemodialysis, a 3 year study in Alzahra general hospital

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Abstract

Background: This study was performed to compare the outcome and complications of axillobrachial and femorofemoral graft as upper and lower limb arteriovenous shunt prostheses.

Materials and Methods: In a prospective cohort study, we observed and followed-up all cases with a new insertion of ePTFE between February 2006 and February 2009. Assessment of patency and the complication rates of their prostheses were the essential parts of this observation.

Results: A total of 69 grafts were performed. Forty-nine of them were successfully followed-up (18 femorofemoral and 31 axillobrachial grafts). Immediate primary patency was 100%. For axillobrachial type, primary patency at 1, 3, and 6 months, respectively, was 86%, 60%, and 47%. Secondary patency at 1, 3, and 6 months was 86%, 75%, and 50%, respectively. For femorofemoral type, primary patency at 1, 3, and 6 months, respectively, was 88%, 40%, and 34%. Secondary patency at 1, 3, and 6 months was 94%, 47%, and 41%, respectively. ($P > 0.05$) Complications included a puncture-site hematoma, thrombosis, infection, venous hypertension, need of an excision and pseudoaneurysm formation. Pseudoaneurysm rate difference between the two groups was interestingly significant, while others were relatively similar; however, the rates were different.

Conclusion: The significant difference of aneurysm rate among our two groups, besides the insignificant difference of other complications and also the similar primary and secondary patency rates, manifest a brilliant guidance chart for the surgeons in order to choose the most compatible site for inserting ePTFE grafts (Gore-tex) as arteriovenous shunt prostheses for HD accessing.

Key Words: Axillobrachial, end-stage renal disease, femorofemoral, Gore-tex, polytetrafluoroethylene

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INTRODUCTION

Availability and knowledge of chronic maintenance hemodialysis (HD) is increasing nowadays.^[1] As a result of repeated venous puncture, in a growing number of HD patients, circulatory access cannot be provided by the standard arteriovenous fistula.^[2]

Survival of HD patients is increased by using native arteriovenous fistulae (AVF) and expanded

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polytetrafluoroethylene (ePTFE) grafts and dialysis by single-lumen or double-lumen catheters greater than 30 years.^[3,4]

Favorable reports with the use of ePTFE grafts in the upper and lower limbs, different rates of complications reported and, for sure, different problems with the other methods of HD, such as AVF, jugular access and permanent catheter, prompted our interest for evaluation of patency and complications of upper and lower limb ePTFE grafts.^[1]

Primary patency is defined as the duration of time that the anastomosis is functional after the first insertion of the graft. But, secondary patency shows the time period after the second surgery undergone for resolving the thrombosis, infection or any other reasons of malfunctioning.^[2]

MATERIALS AND METHODS

In a prospective cohort study in the Al-Zahra General Hospital of the Isfahan University of Medical Sciences, we followed-up all cases with a new insertion of ePTFE done in the vascular operation rooms between February 2006 and February 2009. During this period of time, we kept in touch with the patients by 3-monthly visits and sooner visit if any complication occurred. At each visit, the site of the surgery was observed and vital signs and relative clinical exams were applied.

Patients were candidates for ePTFE if they had no functional access for HD at the time of referral and the vessels were not proper for native bypasses. All of the ePTFE grafts were made by the JOTEC Company (Germany, Hechingen).

During this following-up, we observed the patency, types of complications due to prostheses and also their rates. A total of 69 insertions were performed and 49 grafts of 45 patients were followed-up successfully.

The ethical considerations of this study were approved by the Ethics Committee of the Isfahan University of Medical Sciences; the general medicine thesis number was 390192.

Surgical procedures

Ethical consent for conducting the study was granted. During general anesthesia, the patients were positioned in the decubitus form while the shoulders were placed between the saline bags in order to prevent movements. During the surgery, the patients' heads were extended. For placing bridge AV graft

between an artery and a vein, an interposition graft was to be placed. There are varieties of options for bridge AV graft, including reverse grafts between the axillary artery and the brachial or the antecubital vein or axilloaxillary grafts in the upper limb.

About half an inch below lateral third of the clavicle, an incision was made. Subsequently, the pectoralis major, pectoralis minor, and clavi-pectoro-axillary fascia were opened and dissected. Finally, the axillary artery and contralateral vein were dissected. This procedure was performed exactly on the other side of the patient's body. A subcutaneous curved tunnel was constructed in the upper third part of the sternum for graft implantation (6 mm adjusted lumen graft). The venous and then the artery anastomosis were built. After retaining hemostasis, the cuts were closed. In the lower limb, the same pre-op and general surgery method were applied. It could be done by placing a looped graft between the proximal superficial femoral artery and the proximal saphenous vein at the saphenofemoral junction or superficial femoral vein. Adjusted lumen ePTFE graft was chosen (tapered 8 mm lumen graft) and then passed through a superficial tunnel between the two incisions. Both anastomosis were end-to-side, beginning with the arterial side. Systemic heparin (2000 IU) was administered intravenously to avoid occlusion formation in the end arteries.^[2,3]

Results were analyzed using the PASW-18 with descriptive statistics (mean \pm SD), Chi-square, independent sample *T* tests and Log Rank test for survival analysis. *P* values less than 0.05 were considered as significant.

RESULTS

Forty-nine PTFE grafts were created successfully in 45 patients. Thirty-one of them were upper limb grafts (Group A), including 26 axillobrachial grafts and five other types, while there were 18 lower limb grafts in the femorofemoral type (Group B).

Mean age of the patients in Group A was 64 (\pm 11) years and the duration of HD was 34 (\pm 29) months, while in Group B the patients were 58 (\pm 14) years old with duration of HD of 47 (\pm 42) months.

In Group A, there were 26 (84%) men and five (16%) women, while in Group B, there were 12 (67%) men and six (33%) women. In Group A, 51% (16) of the members had diabetes mellitus (DM), while this percentage in Group B was 22% (4). Eighty percent (25) of Group A faced hypertension (HTN) and 66% (12) of Group B had this problem.

Fortunately, both our groups were so similar because there was no significant difference in age, sex, history of DM and HTN in the two groups ($P > 0.05$). This makes the study more reliable [Table 1].

In Group A, there were histories of 22% (7) jugular access, 51% (16) perm catheter and 66% (20) AVF. These numbers in Group B were, respectively, 33% (6), 72% (13), and 44% (8).

Twenty-seven (87.1%) patients of Group A and 15 (83.4%) patients of Group B had a history of other dialysis access before.

The amounts of the complications of the two groups are described in Table 2.

Venous HTN was in seen in one patient in Group A, which needed ePTFE removal, but, in Group B, it was treated by hematoma drainage.

Pseudoaneurysm in Group A was a graft pseudoaneurysm that occurred in the mid arm after 5 months, with disruption of graft to the artery site

that caused ePTFE removal.

Pseudoaneurysms in Group B contained 1 on the site of arterial anastomosis of the graft, which were repaired by patching, 3 ruptured pseudoaneurysm in femoral artery, which were reconstructed by ileofemoral synthetic bypass graft and 1 femoral pseudoaneurysm, which appeared after 2 years and was primary repaired.

Among all the complications in the two groups, we found that aneurysm had a significant difference ($P < 0.05$), while the other complications differences were not very significant ($P > 0.05$). This important finding could lead vascular surgeons to prefer upper limb Gore-tex in patients with a higher risk of aneurysm.

Thirteen (26.53%) thrombosis were noted in the study. From nine thrombosis in Group A, four (44.4%) grafts were corrected by thrombectomy. From the four thrombosis in Group B, three (75%) were corrected successfully. The overall salvage success rate was 53.84%.

There was four deaths in Group A (12.5%) and one death (5.6%) in Group B, which were not relevant to catheter insertion or complication of surgery. The death rate was not different in both groups ($P > 0.05$).

For the axillobrachial type, primary patency at 1, 3, and 6 months, respectively, was 86%, 60%, and 47%. Secondary patency at 1, 3, and 6 months was 86%, 75%, and 50%, respectively. For the femorofemoral type, primary patency at 1, 3, and 6 months, respectively, was 88%, 40%, and 34%. Secondary patency at 1, 3, and 6 months was 94%, 47%, and 41%, respectively. Using the Log Rank test, primary patency and secondary patency were similar in both groups.

DISCUSSION

It has been supposed that lower limb AV grafts increase the risk of potentially limb-threatening infection and make upper extremity grafts the choice for PTFE placement. The infection rate has been reported as 22% in previous studies.^[5] There was an infection rate of 38.9% in the lower limb PTFE in the present study, while it was 25.8% in the upper limb PTFE in the same situation. Our overall rate of infection was 30.06%; difference in comparison with the results of previous studies is not significant.

71.42% PTFE salvage was reported by Gracia Medina *et al.*,^[6] which was close to our lower limb result.

Table 1: The comparison of two groups' members and their P values

Factors	Group A (n=31)	Group B (n=18)	P value
Mean age	64 (± 11) years	58 (± 14) years	>0.05
Duration of hemodialysis	34 (± 29) months	47 (± 42) months	>0.05
Male (%)	26 (84)	12 (67)	>0.05
Female (%)	5 (16)	6 (33)	>0.05
Having diabetes mellitus (%)	16 (51)	4 (22)	>0.05
Having hypertension (%)	25 (80)	12 (66)	>0.05
History of former jugular access (%)	7 (22)	6 (33)	>0.05
History of former permanent catheter (%)	16 (51)	13 (72)	>0.05
History of AVF (%)	20 (66)	8 (44)	>0.05
History of any hemodialysis access generally (%)	27 (87.1)	15 (83.4)	>0.05

Table 2: Complication of polytetrafluoroethylene in two groups

Complication	Overall (%)	Group A (n=31) (%)	Group B (n=18) (%)
Bleeding	5 (10.2)	2 (6.5)	3 (16.7)
Thrombosis	13 (26.5)	9 (29)	4 (22.2)
Infection of surgical site	15 (30.6)	8 (25.8)	7 (38.9)
Hypertension of limb veins	4 (8.1)	3 (9.7)	1 (5.6)
Need to surgical revise	12 (24.4)	9 (29)	3 (16.7)
Need to PTFE removal	10 (20.4)	7 (22.6)	3 (16.7)
Pseudoaneurysm	6 (12.2)	1 (3.2)	5 (27.7)
Death	5 (10.2)	4 (12.9)	1 (5.6)

PTFE: Polytetrafluoroethylene

Similar to previous studies,^[7] death rate was not different in the lower limb group.

Recent studies have shown the superiority of cuffed ePTFE graft to prevent stenosis and improve patency rate.^[8]

In a review of the literatures from Klinkert *et al.*, the superiority of venous bypass versus PTFE grafts is clearly mentioned. Eighty-one percent of the primary patency rate in venous bypass versus, with 67% in PTFE grafts.^[9] According to this study, and according to the results of our study, we strongly confirm that in the presence of suitable vessels, venous bypass is prior to synthetic grafts. It must be mentioned that the results of the above study was just saphenous vein versus femoropopliteal bypass, but the results can be expanded according to the following study.

Another study from Kherlakian *et al.* represents that, in 30 months of patency, pseudoaneurysms, vascular steal, venous HTN and infection were significantly at a higher incidence in ePTFE grafts than in autogenous fistula (RCAV graft). This is clearly a confirmation to the above paragraph. As is, this study has concluded the lesser primary thrombosis in ePTFE grafts and the same secondary thrombosis rate in both kinds of assessed grafts.^[10]

One of the most interfering parts that severely cause invalid and incorrect conclusions is using different surgeons for these vascular surgeries in a particular study that will cause bias in results. In the present study, all the patients were undergoing the surgery by an expert vascular surgeon, apart from being in poor operative risks, just in order to reduce the bias and surgical errors; this being one of the best points of this study.

CONCLUSION

During the initial years of ePTFE usage, it was known as an advantageous instrument because of the easy handling power and the cheap prosthetic material, but the needle hole bleeding in the suture site and the 2-year cumulative patency rate of only 29% were severely disappointing.^[11] But, since then, the patency rate is developed and the different complications are completely assessed. By paying more attention to the most common complications and improving the quality of the surgery and operation rooms, less complications and higher patency rates seem to be reachable goals.

We found that the femorofemoral and axillobrachial arteriovenous shunt prostheses as HD access have

different complication rates that are significant in the pseudoaneurysm and non-significant in the other ones, and we have a significant rate of pseudoaneurysm in femoral anastomosis of graft in the lower extremities; most of these were treated by ileo-graft anastomosis. This could lead the surgeons to choose the most suitable site for the insertion according to the patient's history and other interfering factors.

Our method of choice for repairing the pseudoaneurysm in the arterial side of the lower extremity graft was at first removing the pseudoaneurysm from the arterial side and, primarily, repair of the femoral artery. Then, by using a synthetic ePTFE graft and using an internal or external iliac artery, bypass grafting of the ileo-graft was performed.

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