

A Comparison of Economy and Efficacy of Vascular Access for Hemodialysis with PTFE Graft and Extra-Anatomical Subcutaneous Placement of Basilic Vein

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ABSTRACT

Native arteriovenous fistula is the method of choice for chronic intermittent hemodialysis. When it is not possible, the options for vascular access are either brachio-basilic arteriovenous fistula with subcutaneous placement of basilic vein or the use of a prosthetic implant, as recommended by the Kidney Disease Outcome Quality Initiative (KDOQI) and European guidelines. **Aim:** To find out reasonable and economical alternate method of vascular access, in patients with previous multiple access failure. **Methods:** During the period from February 2008 to July 2009, 29 patients prospectively enrolled in the study and the patients were divided into two groups according to the selection criteria. Group 1. Patients selected for insertion for PTFE graft. Group 2. Patients selected for Extra- Anatomical Subcutaneous placement of basilic vein (EASPBV). **Results:** Equal distributions were seen regarding the preoperative patient characteristics and other risk factors in the both groups. No immediate failure of AVF in the both groups. A primary early patency rate was 93.8% and 92.3%, twelve months patency rate was 87.5% and 84.6%, and 22 months patency rates were 81.3% and 77% in group one and two respectively. In group 1, One patient with graft developed early symptoms of infection, managed with appropriate antibiotics. Two other patients in the same group had thrombosis and graft occlusion after eight months and one year respectively, after the first prick in the graft for hemodialysis. One female patient of this group developed distal ischemia of the hand and we had to remove the graft 15 days after its insertion. In group 2 male patient with diabetes and hypertension got wound infection, his basilic one vein thrombosed within few days resulting in failure of the fistula. A 23 years old patient got false aneurysm of the basilic vein 5 cm distal to the anastomosis at the puncture site of the arteriovenous fistula after 14 months, it is still functioning and is under follow up. The group one with AVF with graft shows more tendencies for bleeding, thrombosis, and distal ischemia of the limb while group two with AVF with EASPBV shows more tendencies towards false aneurysm formation. The arteriovenous fistula with subcutaneous placement of the basilica vein has significantly low cost. **Conclusion:** The both methods of vascular access have good comparable results. The AVF with EASPBV has advantage of less complications and being more cost effective.

Keywords: Vascular access, efficacy, economy.

INTRODUCTION

Successful vascular access is very important for chronic intermittent hemodialysis in patients with end stage renal disease. Arteriovenous fistulas are the method of choice. Whenever vessels are not suitable for radio cephalic or brachiocephalic arteriovenous fistulas construction or when these

arteriovenous fistula have failed, the options for vascular access are either brachio-basilic arteriovenous fistula with superficialization of basilic vein or the use of a prosthetic implant as recommended by the Kidney Disease Outcome Quality Initiative (KDOQI) and European guidelines.^{1, 2}

In many developing countries including

Pakistan the cost of synthetic graft is not affordable to most of the patients with end stage renal disease, so another cost effective method is necessary to be considered.

Autogenous arteriovenous fistulas are known for their better long-term patencies and lower thrombotic complication rates compared with prosthetic implants.^{3,4} However the advantage of prosthetic implants are the low primary failure rate, less maturation time, and ease of cannulation. On the other hand, the infection and thrombosis rates are reported higher in the literature.⁵

Because there is no general agreement on which of these types of vascular accesses has advantage on the other, we bring about a randomized clinical trial between the two above-mentioned methods of vascular access to annotate this problem. The purpose of our study is to compare patency rates, complications and cost of procedure in both subsets of vascular access.

PATIENTS AND METHODS

Most of the patients were referred to us when they were already on dialysis or having indication for dialysis. During the period from February 2008 to July 2009, twenty nine patients prospectively enrolled in the study and the patients were divided into two groups according to the selection criteria.

Group 1: Patients selected for insertion of PTFE graft.

Group 2: Patients selected for Extra- Anatomical Superficial placement of Basilic Vein (EASPBV).

Selection criteria

The selection criteria was solely economy based, the patients those can afford graft underwent graft insertion and non-affording patients offered EASPBV.

Exclusion criteria

1. Bilateral subclavian vein stenosis due to previous double lumen subclavian catheter insertion.
2. Poorly managed end stage renal disease with volume overload.

3. Peripheral vascular disease, clinically non palpable radial and ulnar pulses.

Assessment of suitability of the vein

Before surgery vascular surgeon assessed all patients clinically. Preoperative venography was performed selectively as follow in

1. All patients undergoing basilic vein exteriorization.
2. Patients undergoing graft insertion with history of double lumen catheter insertion at subclavian site proposed for vascular access.

Anesthesia

1. Patients' 16 years or less got general anesthesia.
2. All other patients got local anesthesia with monitored anesthesia care.

The Procedure

All EASPBV fistulas were formed as one-stage procedure. A single long incision was made in the medial aspect of the arm and the basilic vein from antecubital fossa to axilla was harvested. Once dissection of the vein completed, it was disconnected in the antecubital fossa preferably 4 to 5 cm longer than the length of proposed brachio-basilic anastomosis site. Then the incision was closed except small but sufficient length to perform rest of surgical procedure. The vein was then tunneled subcutaneously in a slight curved fashion and anastomosed end to side, to the brachial artery with 7-0 Prolene on 8 mm needle just proximal to the antecubital fossa. The remaining incision on the both ends then closed. On completion the competency of the fistula was assessed clinically by its palpable thrill and at the same time the perfusion of distal limb was assessed by palpable radial pulse. In brachioaxillary graft insertion, the axillary vein and brachial artery were exposed through suitable incisions in the axilla and antecubital fossa. A 7mm polytetra-fluoroethylene graft was tunneled subcutaneously in a curved configuration, and the graft was anastomosed at first instance to the vein and then to the artery by end to side anastomosis using 6-0 Prolene with 9.3mm needle on venous end and 7/0 prolene with 8mm needle on arterial end. Postoperative anticoagulation

was not used. The immediate patency of graft was assessed as stated before. During the follow up, the access procedure was considered successful if it was used by six weeks and gave flow greater than 250ml/minute on dialysis machine. The surgery was performed on out patient bases except those patients already admitted in nephrology ward. The follow up period ranges from 5 to 22 months.

Statistical analysis

For numerical values student's t test and for nominal values Chi square test is used.

RESULTS

A total of 29 patients under went vascular access operation, 16 in group one and 13 in group two. The demographics and clinical diagnosis are summarized in Table 1.

Table I. Patient demographics

	Access graft (n=16)	Access EASPBV (n=13)	P-value
Age (years)	52.6±10.7	50.7±14.4	NS
Females	6	6	S
Diabetes	7	6	NS
Hypertension	11	9	NS
Ischemic heart disease	5	5	NS
Double lumen cath. <i>in situ</i>			

p>0.05 (non significant)

Table 2: Complications and outcome of the two subsets.

	Access graft (n=16)	Access EASPBV (n=13)	P-value
Venous hypertension	0	0	NS
Infection	1	1	NS
Early failure	0	0	NS
Thrombosis	2	1	NS
Bleeding	2	0	<0.05
Distal ischemia	1	0	<0.05
Cardiac failure	0	0	NS
Nerve injury	0	0	NS
False aneurysm	0	1	<0.5

Equal distributions were seen regarding the preoperative patient characteristics and other risk factors in the both groups. The age of the patients in group one ranges from 28 to 70 years and in group two from 12 to 69 years.

We did not have immediate failure of AVF in the both groups. The primary early patency rate was 93.8% and 92.3% (*p*=NS) and 12 months patency rate was 87.5% and 92.3%, (*p*<0.5). 22 months patency rates was 81.3% and 92.3% (*p*<0.5) in group one and two respectively. In group 1, one patient with graft developed early symptoms of infection, managed with appropriate antibiotics. Two other patients in the same group had thrombosis and graft occlusion after eight months and one year respectively after having first prick in the graft for hemodialysis. The cause in first patient was occlusion of graft at arterial needle insertion site resulting in thrombosis, it was repaired successfully. The second patient got venous stenosis at the graft insertion site due to intimal hypertrophy, successfully dealt with reanastomosis of the venous end of the graft to more proximal site with a 5cm another interposition PTFE graft of the same caliber. A female patient of this group developed distal ischemia of the hand and we had to remove the graft 15 days after its insertion. In group 2, one male patient with diabetes and hypertension got wound infection, his basilica vein thrombosed after 15 days of operation resulting in failure of the fistula. A 23 years old patient got false aneurysm of the basilic vein 5 cm distal to the anastomosis site the arteriovenous fistula after 14 months. It is functioning and is under follow up. The group one with AVF with graft shows more tendencies for bleeding, thrombosis, and distal ischemia of the limb while group two with AVF with EASPBV shows more tendencies towards false aneurysm formation.

The cost calculation is for one patient and in PAK rupees.

The hospital and miscellaneous charges remained constant in both groups.

The economy comparison of the two groups was quite obvious. The arteriovenous fistula with EASPBV has significantly low cost (*p*<5e-8)

Table 3: The economy comparison of the subsets.

	Access graft (n=16)	Access EASPBV (n=13)	P-value
Medicine and disposables	5000	2000	
The cost of graft	40000	00	
Total cost	45000	6000	P<e-8

DISCUSSION

The long-term survival and quality of life of patients on hemodialysis is dependant on the adequacy of dialysis via an appropriately placed vascular access. However in the present dialysis population with various co-morbidities, it becomes extremely difficult to create an autogenous radial or brachial-cephalic arteriovenous fistula (AVF), as recommended by European and American guidelines. A brachio-basilic arteriovenous fistula or prosthetic graft implants are considered to be acceptable alternative methods.⁶

Although an native AVF is preferred, an interposition graft has some advantages including a large surface area, easy cannulation, shorter maturation time and relatively simple surgical placement. Opinion-based recommendations in the 2000 K/DOQI guidelines are that PTFE AVGs should not routinely be cannulated until 14 days (and preferably 3–6 weeks) after placement.

Kidney Disease Outcome Quality Initiative (K-DOQI) recommends that the primary failure rate (failure within 30 days or before use for dialysis) 5% for upper arm grafts. Primary failure of dialysis through AV graft is often caused by technical problems influenced by surgical access construction, patient demographics, co-morbidity and graft loss due to premature cannulation and hematoma formation. Many authors report 1 and 2 years cumulative patency rates of 59-90% and 47-85%, respectively. The results of our study fall in the limits of these recommendations and outcome.

The basilic vein can be transposed or elevated subcutaneously, making it accessible for cannulation and haemodialysis. Both one-stage and two-stage basilic vein transposition procedures have been reported with generally good results.

Because there is no general agreement on which of these types of vascular accesses is to be preferred, we performed a clinical trial between the brachio-basilic arteriovenous fistula with subcutaneous placement of basilic vein and prosthetic brachio-axillary graft to address this problem. The purpose of our study was to compare patency rates, complications and interventions in the said vascular access procedures.

Some studies⁹ showed an equivalent patency rates in both subsets of vascular access. In our study, there was no significant difference in the early survival in both groups but a clear cut advantage of higher patency rates was observed in basilica vein arteriovenous fistula group in the in 12 and 22 months of follow up. These results are also supported by other studies.^{10,11}

One less common complication of AV grafts and basilic vein arteriovenous fistula is distal limb ischemia caused by the diversion of arterial flow through the access site. The risk factors for steal syndrome include female gender, age >60 years, diabetes mellitus, previous operations on the same limb.¹⁵

In our study only one patient had ischemia of the distal limb, of which we needed to remove the graft. Limiting the length of the arteriovenous anastomosis may possibly prevent the occurrence of ischemia¹²

The non-maturation was not seen in our small number of patients, compared with those reported in the literature (15–38%)^{13,14}

PTFE usage compared to autogenous AVF is associated with a five-fold increase in infection rate, infection may present in the form of bacteremia, abscess around the graft, septic emboli, secondary hemorrhage and death. Infection is a common cause of graft loss.¹⁶ one patient showed early signs of infection in our patients in graft group with redness on the arterial anastomosis site and settled with intensive antibiotic therapy. Another patient in the EASPBV group got infected and his fistula was lost. Both of the patients were diabetics and having double lumen catheter in situ for hemodialysis.

In our study two patients in group had thrombosis and graft occlusion after eight months and one year respectively. The cause in first patient was occlusion of graft at arterial needle insertion

site resulting in local graft damage and growth of tissue into the graft, repaired successfully. The second patient got venous stenosis at the graft insertion site due to intimal hypertrophy, also dealt successfully.

Thrombosis is usually due to outflow tract obstruction in most cases other causes include dehydration, hypotension, and compression during sleep and excessive pressure to stop hemorrhage after dialysis. Intimal hyperplasia is responsible for stenosis at the graft-vein anastomosis site and causes of this hyperplasia include, compliance mismatch between the vein and graft, boundary layer separation, enhanced particle residence time, increased low shear stress and high flow velocity of blood at the anastomosis.^{17,18}

One of our patient got false aneurysm of the basilic vein five cm distal to the anastomosis site. Pseudo aneurysms have been reported to develop in response to repeated needling in the same segment of the access site and can be avoided by careful rotation of needling sites.

In short the comparison of both subsets for vascular access showed a predominantly longer survival, less bleeding, less thrombosis and less distal ischemia of the limb in group two, arteriovenous fistula with EASPBV. The recent studies support these results.¹¹

It is important to consider the economical aspects of the two methods especially in developing countries like Pakistan. Our comparison results showed that Extra- Anatomical Subcutaneous placement of Basilic Vein vascular access is very cost effective method as compared with vascular access with PTFE graft.

CONCLUSION

The both methods of vascular access have good comparable results. The AVF with EASPBV has advantage of less complications and being more cost effective.

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