INTRODUCTION

Patients with end-stage renal disease, who are not suitable candidates for kidney transplantation therapy and even the majority of potential transplant recipients need dialysis before their transplantation.\(^1\)

In these patients successful vascular access is of key importance. Arteriovenous fistulae are the procedure of choice for vascular access.\(^2,3\) Whenever, the veins are not suitable for radiocephalic or brachiocephalic arteriovenous fistula construction, or when these arteriovenous fistula have failed, the options left for vascular access are basilic vein transposition or the use of a synthetic graft.\(^2,4\) The National Kidney Foundation Dialysis Outcome Quality Initiative Clinical Practice (DOQI) guidelines advocate to increase the number of patients dialyzing with native arteriovenous fistulas (AVF) rather than with synthetic grafts.\(^5\) This type of fistula is created by dissecting, harvesting, and tunneling the basilic vein in arm.\(^6\) The operation is time consuming, technically challenging and has increased perioperative morbidity and low maturation rates.\(^8,9\)

Since the introduction of this procedure only limited studies have been conducted to confirm the place of this operation and its technique in providing vascular access for haemodialysis. The authors modified the conventional technique of basilic vein transposition earlier described by Dagher,\(^9\) for haemodialysis aiming at better maturation rate, longer survival and lesser complications.

The objective of this study was to modify the technique of basilic vein transposition for vascular access for haemodialysis aiming at better maturation rate, longer survival of fistula and lesser complications.

METHODOLOGY

This case series stretching from February 2008 to July 2011 included patients from Shaikh Zayed Hospital and Omer Hospital, Lahore, who were either already on dialysis or had indication for dialysis. Informed consent was obtained from all study patients or their authorized surrogates in case of patients 16 years and younger. The patients selected were those who did not have suitable vein on forearm and arm for primary vascular access procedure or had failed previous radiocephalic or brachiocephalic arteriovenous fistula with no further such options in both upper extremities.

Patients with bilateral subclavian vein stenosis due to previous double lumen catheter insertion for haemodialysis, poorly managed end stage renal disease with volume overload or peripheral vascular disease, detected as clinically non-palpable radial and ulnar pulses were excluded from the study.

ABSTRACT

**Objective:** To modify the technique of basilic vein transposition for vascular access for haemodialysis aiming at better maturation rate, longer survival of fistula and lesser complications.

**Study Design:** Case series.

**Place and Duration of Study:** Shaikh Zayed Hospital and Omer Hospital, Lahore, from February 2008 to July 2011.

**Methodology:** Patients referred for basilic vein transposition for haemodialysis vascular access were prospectively enrolled. The surgical technique included small tracking incisions, an extra 3 – 4 cm of vein length harvesting to avoid tension in the vein in its new course, an oval arteriotomy and a smooth curved pathway, away from vein harvesting incision to avoid entrapment of vein in the scar. Maturation rate, fistula survival and other complications were noted.

**Results:** There was no immediate failure in 51 patients. The complications during follow-up period were infection and thrombosis, bleeding and non-development of basilic vein in 2 patients each; and false aneurysm formation in one. Four patients died during follow-up period. The maturation time was 4.9 ± 1.1 weeks. The early patency rate was 92.2%, same at 6 months and 90.7% at 12 months.

**Conclusion:** Arteriovenous fistula constructed with modified technique of basilic vein transposition is an acceptable and valid option of vascular access for haemodialysis.

**Key Words:** Arteriovenous fistula. Basilic vein. Transposition. Haemodialysis. Vascular access.
Before surgery, all patients were assessed clinically. Pre-operative venography of the both upper limbs was done to assess the suitability of the basilic veins in patients whose clinical examination alone did not reveal required information, and in those who had history of subclavian insertion of double lumen catheter for haemodialysis.

Appropriate antibiotics were given with the consultation of nephrologist. General anaesthesia was given to the patients 16 years or less while the rest got local anaesthesia with monitored anaesthesia care. Monitored anaesthesia care was defined as patient having secured IV access along with non-invasive haemodynamic monitoring with or without oxygen administration through nasal cannula or face mask in the presence of a specialist anaesthetist.

During the surgical procedure basilic vein was harvested through 3 – 4 small incisions with interposition skin bridges (Figure 1) in the medial aspect of the arm. Split incisions started from antecubital fossa upto the axillary hairline following the pathway of the basilic vein to avoid skin flap formation. The branches of the vein were ligated with 3/0 silk rather than with clips to avoid their accidental dislodging during the pulling of a vein through the tunneled passage using metallic graft introducer. Once the dissection of the vein was completed, it was disconnected in the antecubital fossa 3 – 4 cm longer in length than what was expected for proposed brachio-basilic anastomosis site. The vein was then inflated gently with saline to assess its caliber, patency and leakage. It was then tunneled subcutaneously in a slightly curved fashion to the proposed anastomosis site using a metallic graft introducer having 7 mm diameter olive head. For arteriotomy, an oval hole was made in the artery approximately equal to the diameter of the brachial artery using a # 11 blade and a Potts scissors, rather than the conventional straight arteriotomy incision (Figure 2). The venotomy was made double the size of the arteriotomy to make typical cobra head of vein at the anastomosis site. The vein was then anastomosed end to side, to the brachial artery with 7-0 Prolene on 8 mm round body needle just proximal to the antecubital fossa. The incisions were then closed after having a final look on the axillary end of basilic vein for any kinking, tension or twisting (Figure 3). On completion, the patency 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. During the follow-up, the vascular access procedure was considered successful if it was used by the end of 6 weeks and gave flow greater than 250 ml/minute on dialysis machine. The surgeries were performed on an outpatient basis except those who were already admitted in nephrology ward. The follow-up period ranged from 5 to 12 months. The study data was collected through a pre-designed comprehensive follow-up proforma containing patient's demographic data, complication during and after operation and patency of fistula on follow-up visits.

Data were analyzed by using Statistical Package for Social Sciences (SPSS) version 15.0. The age and maturation time was presented by using mean ± SD. Gender, complications and comorbidities were presented by using frequency and percentages.
RESULTS

A total of 51 patients underwent vascular access operation for haemodialysis with transposition of basilic vein.

The age of the patients ranged from 12 to 69 years with mean age of 50.7 ± 14.4 years. Majority of the patients were hypertensive (n = 43, 84.3%) followed by diabetes mellitus (n = 38, 74.5%). Out of 51 patients, 23 (45%) were females.

Majority of the patients had their basilic vein transposition on right upper limb (n = 18, 35.3%) due to a previous failed AVF attempt on left side or vein was found more suitable on right side by venogram.

There was no immediate failure of arteriovenous anastomosis. The complications in basilic vein transposition fistula (BVT) with the modified technique during follow-up period are given in Table I. Fistula maturation time was 4.9 ± 1.1 weeks. Failure of BVT was observed in 4 patients due to infection, thrombosis and non-development of basilic vein, resulting in overall early patency rate of 92.2%. The same patency rate was observed at 6 months and 90.7% at 12 months. Bleeding from the surgical site was observed in 2 patients who had a previous surgical history of AV fistula construction at the same operative site. Although their coagulation profile was not disturbed pre-operatively but the difficult tissue dissection due to adhesions contributed to a larger raw area and bleeding. The situations were dealt with insertion of drain and its removal on the second postoperative day.

Two patients with diabetes and hypertension had wound infection, causing basilic vein thrombosis after 15 days of operation resulting in failure of the fistula. There were failure to develop the basilic veins in 2 female patients, which were never used for vascular access for haemodialysis.

One patient age 23 years developed false aneurysm of the basilic vein, 5 cm distal to the anastomosis site of arteriovenous anastomosis. Still the patient has a functioning transpositioned basilic vein fistula and is under follow-up. Four patients died after 6 months of the follow-up period, one due to lower respiratory tract infection and three from ischaemic heart disease.

DISCUSSION

End stage renal disease (ESRD) is a significant health problem. All patients with end stage renal disease have to undergo haemodialysis by one or the other way to escape the ill effects of the disease on their health. With improved medical care and haemodialysis efficiency, and in the absence of a cadaveric transplant program, more patients require secondary and tertiary vascular access procedures. Primary AV fistulae are the preferred vascular access. The radiocephalic and brachiocephalic fistula of Brescia and Cimino is well established as the operations of first and second choice respectively. They have a good long-term patency rates and rarely develops complications. Their good access to circulation and easy cannulation is also well observed.

In the absence of suitable superficial veins due to previous fistula formation or repeated cannulation, the choice of vascular access is generally between prosthetic graft and basilic vein transposition. Prosthetic grafts, usually polytetrafluoroethylene grafts, can be cannulated earlier than autologous veins, but are associated with a higher complication rate including infection, thrombosis, and require frequent re-operations to maintain patency.

The basilic vein is usually of good caliber and well protected in its deep subfascial position and, therefore, acts as a hidden resource of vein material. Brachio-basilic fistula were first described in 1976 by Dagher, where the basilic vein dissection and brachiobasilic anastomosis were performed. Since the introduction of this procedure only limited studies have been conducted to confirm the place of this operation and its technique in providing vascular access for haemodialysis.

El Mallah and Zielinski advised a staged procedure, where the arteriovenous anastomosis was done first and
dissection of the basilic vein was delayed for 2 – 4 weeks later. This allowed easier dissection of an arteriolised vein.\textsuperscript{14}

To avoid a long incision along the arm, endoscopic and video-assisted mobilization of the basilic vein out of its bed have also been reported.\textsuperscript{15}

An oval arteriotomy was opted because the linear arteriotomy equivalent to native diameter of the brachial artery causes low flow AV fistula and at the same time a longer linear incision in the artery causes more chances of distal limb ischaemia. Moreover, many vascular studies showed that not only an oval arteriotomy incision reduces power losses (less gradient) across the anastomosis,\textsuperscript{16} but also with a longitudinal arteriotomy in small vessels, it is often necessary to remove an elliptical area of arterial tissue to have good flows across the anastomosis which may produce an excessive defect and later leads to distal ischaemia.\textsuperscript{17} Christopher and James also reported a significantly higher incidence of stenosis in the longitudinal arteriotomies of carotid and femoral arteries of their canine subjects.\textsuperscript{18}

In view of limited published international literature, the author modified the surgical technique which include an extra 3 to 4 cm vein length harvesting to avoid tension in the vein in its new curved course, an oval arteriotomy and a smooth curved extra anatomical pathway away from vein harvesting incision to avoid entrapment of vein in the healing scar (Figure 4).

Inspired by minimally invasive basilic vein dissection, we performed the small incisions technique.\textsuperscript{19} Small tracking incision over the vein is better option rather than a conventional long incision, to avoid flap formation of the skin which results in increased infection rate, poor healing and more scar formation.\textsuperscript{2,20} Muthu and colleagues concluded that the small incision technique for transpositioning of the basilic vein has an added advantage of small incision, less arm edema and comparable complication rate to that of standard technique.\textsuperscript{2}

A straight 7 – 10 mm incision independent of the diameter of the artery causes a higher incidence of distal ischaemia of the limb.\textsuperscript{17,21} An oval arteriotomy is more physiological than straight incision with lesser power loss (less gradient) and less chances of stenosis, secondly, it is easy to make an approximate size hole in comparison with the diameter of artery.\textsuperscript{16,18}

Some studies have reported elevation of the basilic vein in the same incision.\textsuperscript{22} In authors’ experience this type of transposition can cause entrapment of basilic vein in the scar resulting in non-development of AV fistula. Keeping in view the past experience, as well as the published data, the authors opted for smooth curved extra anatomical pathway, away from harvesting incisions for basilic vein’s transposition.

There was not immediate failure of arteriovenous anastomosis, while the reported incidence of immediate failure is 3%,\textsuperscript{23} The rate of non-maturation of AV fistula is 3.9% in this study, while it is reported upto 38% in literature.\textsuperscript{22-25} In comparison to 47 – 71% of reported overall complication rate for basilic vein transposition,\textsuperscript{2} the present study found complication in only 13%. This difference in complication rate shows the simplicity of the modified technique in comparison to a rather more complex and difficult to learn endoscopic basilic vein harvesting which leads to more chances of branch evulsion, haematoma formation and infection or two stage procedure which causes more pain and financial burden to a patient. The patency rate is 90.7% over 12 months of follow-up in this study, while reported one year patency rate is 45 – 77% in past literature.\textsuperscript{23,24} Being agreed with DOQI guidelines,\textsuperscript{6} modification in the conventional technique has given better results in respect to fistula maturation, fistula survival and complication rates. Although further studies and trials are needed to reveal the exact role of oval arteriotomy and extra anatomical vein pathway as an independent factors establishing better flow rates and lesser complications. Whereas longer vein harvesting can be considered to be as a necessity for extra anatomical curved pathway of the vein and split skin incision has a better healing rate because of their being less traumatic and less ischaemic.

These presently reported modifications and observations merely represent the preliminary experience with basilic vein transposition fistulas, and further trials for studying above mentioned modifications are individually required in future to establish their exact standing and role in basilic vein transposition technique.

**CONCLUSION**

Arteriovenous fistula constructed with modified technique of basilic vein transposition is an acceptable surgical technique. The authors recommend the need of future studies to establish the exact standing of these modifications individually in this rarely addressed but valid option for haemodialysis vascular access.

**REFERENCES**


5. NKF-DOQI clinical practice guidelines for vascular access. 
   *Jourdanian Royal Medical Services J* 2002; 9:5-7.
   Long-term results of arteriovenous fistulas using transposed autologous basilic vein. 
8. Oliver MJ, McCann RL, Indridason OS, Butlerly DW, Schwab SJ. 
   Comparison of transposed brachiobasilic fistulas to upper arm grafts and brachiocephalic fistulas. 
    Arteriovenous fistula using transposed basilic vein. 
12. Farooq Z, Mehmoood A, Saeed S, Raja KM, Khan MN, Murtaza B. 
    Early versus late arterio-venous fistulae: impact of failure rate. 
    Transposition of the basilic vein for arteriovenous fistula: 
    an endoscopic approach. 
    Brachial vein superficialization: a special method of vascular access for haemodialysis. 
    *Timisoara Medical J* 2008; 58:149-54.
16. Weale AR, Bevis P, Neary WD, Lear PA, Mitchell DC. 
    A comparison between transposed brachiobasilic arteriovenous fistulas and prosthetic brachioaxillary access grafts for vascular access for haemodialysis. 
17. Keuter XH, De Smet AA, Kessels AG, van der Sande FM, Hoeks APG, Tordoir JHM. 
    Excellent performance of one-stage brachial-basilic arteriovenous fistula. 
18. Xavier HA, van der Sande FM, Kessels AG, de Haan MW, Wellen RJ, Tordoir JH. 
    A randomized multicenter study of the outcome of brachial-basilic arteriovenous fistula and prosthetic brachial-antecubital forearm loop as vascular access for haemodialysis. 