

Comparative Study Between Forearm Straight and Loop (u-shaped) PTFE Arterio-Venous Grafts

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INTRODUCTION: forearm grafts take a place in haemodialysis access if autogenous fistula at wrist cannot be created or failed. Two types are usually applied; the straight and Loop shaped grafts.

OBJECTIVE: To evaluate the long term patency and rate of complications and efficiency of dialysis of straight and loop PTFE forearm arterio-venous grafts.

METHODS: Between January 2005 and December 2008, 147 patients with ESRD referred from the dialysis center at DR. ERFAN & Bagedo General hospital (EBH) to the vascular unit for creation of a vascular access. PTFE AV grafts were created in Fifty one patients, 42 of them were for forearm PTFE grafts, 23/42 (54.7%) of them u shaped AV grafts and 19 (45.3%) were straight. All of them were followed up as regard primary and secondary patency rate, efficacy of dialysis (Kt/V), and postoperative complications including hematoma, steal phenomenon, upper limb swelling and pain. The median follow up was 18.1 months.

RESULTS: The two groups were well matched for age, sex, diabetes, and number of prior access procedures. Significantly fewer straight grafts were successfully used for dialysis: 69.0% straight compared with 89.4% looped grafts (P = .001; χ^2). One- and two-year primary patency rates were 45.3% and 40.0%, respectively, for straight and were 56.4% and 43.2% for looped grafts (P = .579; log rank). There was no significant difference in secondary patency between the two procedures (P = .868; log rank). However, complications including post-operative hematomas, upper limb swelling, steal phenomenon and pain were significantly higher in the looped grafts group (6.2% vs. 0%; for steal phenomenon P = .031; Fisher exact test).

CONCLUSIONS: Although brachio-venous looped grafts are more liable to postoperative hematomas, swelling, steal phenomenon and pain at upper limb but they showed better primary and secondary patency rate than straight radio-venous grafts and nearly equal in dialysis blood flow (efficacy of dialysis).

Outcome

Renal patient records were accessed in October 2008 to identify the outcome of each fistula. Median follow up was 18.1 months (interquartile range [IQR], 8.7-34.9 months). A successful graft was defined as a graft that had been successfully needed for dialysis. The presence or absence of a thrill was not used to define technical success, because the simple presence of a thrill does not determine whether the graft can be used for dialysis. Primary functional patency was defined according to the recommended reporting standards, the percentage of all grafts attempted that were still being used for dialysis that had not required any intervention designed to maintain or re-establish patency at 1 and 2 years. Interventions included angioplasty, thrombectomy, and surgical revision of the graft. Secondary functional patency was defined as the percentage of all grafts attempted that were being used irrespective of interventions to re-establish or maintain patency at 1 and 2 years. The time to graft used and the dates of death or transplantation were recorded as relevant. Patients who underwent transplantation, died, or never proceeded to long-term haemodialysis were considered as lost to follow-up and were censored for all survival analysis.

Results

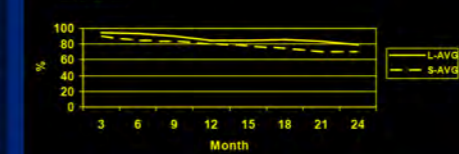
Early complications (within 30 days post-operative) were assessed in both groups. For looped grafts group, one graft showed inadequate low flow (300 < 250ml/min), but maintained dialysis at rate 250-300ml/min which was satisfactory because of associated cardiac problems. One graft that showed inadequate low flow (<250ml/min) at the straight grafts group and failed to do dialysis via. This graft was clotted and this considered as primary failure. Three patients expressed significant steal (3/23=13%), they developed pain with compromised blood flow at radial and ulnar arteries (detected clinically by absent pulsations with impaired capillary circulation + duplex scan examination). One graft was removed due to severe steal and critical limb ischemia, central permanent access inserted for adequate dialysis. The other two developed steal during dialysis sessions, they required readmission and close observation, one of them required revision which improved and the other was treated conservatively. None of the straight grafts group expressed significant steal.

Significant hematomas developed in four patients (4/23=17%), three treated conservatively and only one underwent surgical evacuation with repair at site of graft by direct suture. Significant hematomas developed in two patients of straight grafts group (2/19=10.5%), all treated conservatively. Upper limb swelling (persists more than two months) developed in five patients (5/23=22%), all of them underwent follow up duplex and CT venography. Two patients developed during dialysis increase in venous pressure. One showed subclavian vein stenosis that underwent percutaneous venous dilatation and stenting that showed marked improvement in edema and also in venous pressure during dialysis the other one showed venous anaestmosis stenosis and also underwent percutaneous balloon dilatation using cutting balloon. After balloon angioplasty, the venous pressure markedly improved and also the edema. One showed acute subclavian thrombosis that was treated by anticoagulation and also improved after 2 months. One showed severe venous hypertension associated with distal veins dilatation with aneurysmal venous formation at index finger that required ligation of the vein distal to the anaestmosis, converting the venous anaestmosis to end to end instead of end to side. The last one showed no significant pathology which treated conservatively. Upper limb swelling (persists more than two months) developed in three patients in the straight grafts group (3/19=15%), all of them underwent follow up duplex and showed no significant pathology which treated conservatively. Upper limb pain (pain scoring > 3) occurred in (6/23=26%) patients, three were associated with steal. The other three were neurotic in whom neuroleptic medications markedly improved the symptoms. Upper limb pain (pain scoring > 3) occurred in (2/19=10%) of straight grafts group. Pain was neurogenic in whom neuroleptic medications markedly improved the symptoms.

For straight grafts group, six grafts were thrombosed during 1st year (13/19) making the primary patency rate in first year 68.0%. One of the clotted 4 grafts occluded before use due to severe hypotension and did not go to another intervention due to delayed organized clot and bad general condition, considered as primary failure. The other five grafts underwent surgical intervention, two grafts saved, and increasing 2ndry patency in one year from 68% to 78%. The saved graft showed severe stenosis at venous anaestmosis that required opening of venous site and we did patch (Dacron) venoplasty. The other three failed, two showed also severe stenosis at radial artery anaestmosis in whom revision was not possible and the last one failed declothing due to organized clot. Nine grafts were occluded in 2nd year of follow up (10/19) making the primary patency rate 52.63%. Three grafts were saved and increasing 2ndry patency in two years from 53% to 68%. Two saved grafts showed severe stenosis at venous anaestmosis that required opening of venous site and we did patch (Dacron) venoplasty. One graft also required arterial anaestmosis opening and patch angioplasty. The remaining six grafts, three were delayed with completely occluded graft by organized clot before intervention, one refused intervention and the other two underwent trial of declothing but failed in maintaining good flow and reoccluded within 24 hours after the procedures.

Two patients had clotted grafts in 1st year that underwent successful declothing and maintained patency but reoccluded again in the 2nd year follow up and also 2ndry patency of these grafts maintained by successful declothing.

Figure (5): Assisted cumulative AVG patency during the study period



Adequacy of dialysis was checked using the Urea reduction ratio (URR). A simpler model uses the urea reduction ratio. $URR = (1 - \frac{\text{postdialysis BUN}}{\text{predialysis BUN}})$. Efficiency of dialysis as estimated by Urea Reduction Ratio (URR) was slightly higher (69.18 + 1.24) for Loop grafts vs. (64.4 + 7.25) for straight shaped grafts. However, on comparison, there was statistically significant difference between the 2 groups (p < 0.01).

Conclusion

Although brachio-venous looped grafts are more liable to postoperative hematomas, swelling, steal phenomenon and pain at upper limb but they showed better primary and secondary patency rate than straight radio-venous grafts but no significant difference in efficacy of dialysis between both groups.

Picture (1) angioplasty for subclavian vein stenosis for loop AV graft case



Picture (3) u shaped (loop) AV graft



Picture (4) showed steel phenomenon that need ligation of the AV graft



Table 1: Baseline data for both groups

Patients	Loop AV Graft	Straight AV Graft
Total No.	23	19
Age (Years)	58.48 + 13.5	57.58 + 10.57
Males	16 (69.6%)	13 (68.4%)
DM	11 (47.8%)	16 (84.2%)
HTN	16 (69.6%)	7 (36.8%)
Anemia	7 (30.4%)	5 (26.3%)
CAD	11 (47.8%)	8 (42.1%)
Dyslipide	12 (52.2%)	10 (52.6%)
Smoking	9 (39.1%)	7 (36.8%)

Figure 1 showed demographic features of both groups

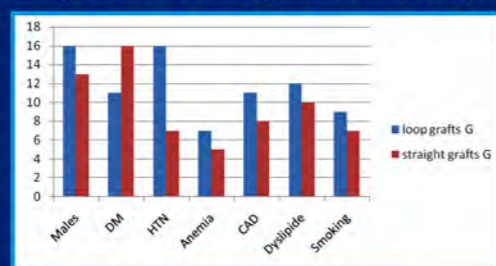
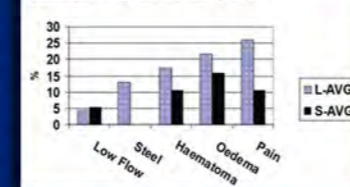
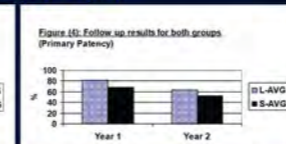
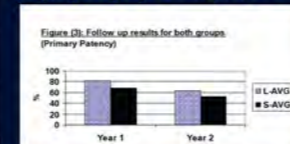


Figure (2): Complications both groups



Primary patency rates in 1st and 2nd years were 81.1%, 63.6% for looped grafts group and 68%, 52% for straight grafts group. Secondary patency rates in 1st and 2nd years were 86%, 77% for looped grafts group and 78%, 68% for straight grafts group.



For looped grafts group, one patient (patient n 4) was excluded from follow up for patency as he underwent ligation of graft due to severe steel so total patients were followed 22 patients. Four grafts were thrombosed during 1st year (18/22) making the primary patency rate in first year 81.0%. One of the clotted 6 grafts occluded before use due to severe hypotension and did not go to another intervention due to delayed organized clot and considered as primary failure. The other three grafts underwent surgical intervention, one graft saved, and increasing 2ndry patency in one year from 81% to 86%. The saved graft showed severe stenosis at venous anaestmosis that required opening of venous site and we did patch (Dacron) venoplasty. The other failed two showed completely organized clot and adherent to the graft wall. Eight grafts were occluded in 2nd year of follow up (14/22) making the primary patency rate 63.63%. Three grafts of these eight were saved and increasing 2ndry patency in two years from 64% to 77%. The three saved grafts showed severe stenosis at venous anaestmosis that required opening of venous site and we did patch (Dacron) venoplasty. One graft also required arterial anaestmosis opening and patch angioplasty. The remaining five grafts, two were delayed with completely occluded graft by organized clot before intervention, one refused intervention and the other two underwent trial of declothing but failed in maintaining good flow and reoccluded within 24 hours after the procedures.

All patients had assessed preoperatively on clinical basis and by duplex examination for veins and arterial mapping including the diameters, patency and blood flow. According to the clinical and duplex assessment, decision for taking the radial or brachial arteries as take off conduit for the graft was determined. The sonographic parameters include veins diameter more than 2.9mm, radial artery diameter is more than 2mm and brachial artery diameter equals or more than 3mm considered satisfactory parameters. The PSV at brachial artery should be not less than 60 cm/second with no significant stenotic lesions at radial and ulnar arteries. If the radial artery is the target artery, the PSV should be no less than 40 cm/second. Selection of basilic versus the cephalic veins depends on which is bigger in diameter and with healthy wall. If both were equal in diameter, the cephalic or antecubital veins were used as first choice because easily exposure and to spare the basilica vein for possible later superficilaization

Operative techniques

All operations were performed with patients under local anesthesia with sedation. In all cases for looped grafts (group 1), curved incision made at the cubital fossa exposing both brachial artery and the vein either the cephalic and antecubital veins (n 16) or basilic vein (n 7).

Six-millimeter expanded polytetrafluoroethylene (ePTFE) was tunneled subcutaneously in a u shaped configuration, and the graft was anastomosed to the vein and artery end to side by using 6-0 Prolene. For this tunneling another small incision made at the bottom of the u graft to facilitate the delivery of the other limb of the graft. In the straight grafts group (group 2), two incisions were done, one at the cubital fossa directly over the used determined vein (cephalic and antecubital veins in 11 patients and basilic vein in 8 cases) and the other incision, straight one over the radial artery above the wrist joint. Tapered 7-4 mm PTFE graft was tunneled subcutaneously in a straight configuration, and the graft was anastomosed to the vein and artery end to side by using 6-0 Prolene. Routine postoperative anticoagulation was not used. Post-operative duplex investigation and surveillance were performed only in patients in whom fistulas or grafts failed to mature or in whom dialysis was poor.

Reference

- Rooijens PP, Tordoir JH, Stijnen T, Burgmans JP, Smet de AA, Yo TI. Radiocephalic wrist arteriovenous fistula for hemodialysis: meta-analysis indicates a high primary failure rate. Eur J Vasc Endovasc Surg. 2004; 28:583-589.
- Dagher FJ, Gelber RL, Ramos EJ, Sadler JH. Basilic vein to brachial artery fistula: a new access for chronic hemodialysis. South Med J. 1976; 69:1438-1440.
- Hossny A. Brachio-basilic arteriovenous fistula: different surgical techniques and their effects on fistula patency and dialysis-related complications. J Vasc Surg. 2003; 37:821-826
- Tsai YT, Lin SH, Lee GC, Huen GG, Lin YF, Tsai CS. Arteriovenous fistula using transposed basilic vein in chronic hypotensive hemodialysis patients. Clin Nephrol. 2002; 57:376-380.
- Rao RK, Azin GD, Hood DB, Rowe VL, Kohl RD, Katz SG, et al. Basilic vein transposition fistula: a good option for maintaining hemodialysis access site options? J Vasc Surg. 2004; 39:1043-1047
- Wolford HY, Hsu J, Rhodes JM, Shortell CK, Davies MG, Bakhr A, et al. Outcome after autogenous brachial-basilic upper arm transpositions in the post-National Kidney Foundation Dialysis Outcomes Quality Initiative era. J Vasc Surg. 2005; 42:951-956.
- Hill BB, Chan AK, Faruqi RM, Arko FR, Zarins CK, Fogarty TJ. Keyhole technique for autologous brachio-basilic transposition arteriovenous fistula. J Vasc Surg. 2005; 42:945-950.