The use of basilic vein transposition in the forearm as an alternative autogenous hemodialysis access

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Abstract

Purpose: To evaluate the basilic vein transposition into the volar aspect of the forearm and anastomosis with the distal radial artery, as a native vein for the construction of arteriovenous fistulas before shifting to the use of upper arm basilic vein or arteriovenous prosthetic graft .

Methods: From January 2008 to December 2010, 75 patients who underwent AV access for hemodialysis in Zagazig University hospitals were retrospectively reviewed with following up the patients in the dialysis centers and the current AVF functions were evaluated in the outpatient clinic. Patients were grouped by the operation type into radiocephalic fistulas (RCF) in the forearm (above the wrist or mid forearm),forearm loop arteriovenous graft (FAVG) and forearm basilic vein transposition (FBVT). The outcomes compared were primary, secondary patency rates, maturation failure, and early or late complications.

Results: 49 patients (65.3%) were males, 57 patients (76%) were diabetics, and 38 patients (50.6%) had previous access surgery. In 29 patients (38.6%) the cephalic vein was used as outflow vein, in 14 patients (18.6%) brachial vein was used as outflow for FAVG, in 7 (9.3%) patients midcubital vein was used as outflow for FAVG and in 25 patients (33.3%) the forearm basilic vein was transposed and used as outflow vein after anastomoses with the radial artery. Overall complications occurred in 36 (48%) patients over the follow up period and included hematoma (n=2), thrombosis (n=19), infection (n=9), ischaemic steal syndrome (n=3) and venous hypertension (n=3). Meanfollow-up was 15 months (range, 3-24 months). Maturation failure occurred in 3 radiocephalic fistula patients and in 4 FBVT patients.The primary patency rates for RCF, FBVT, and FAVG were 68.9%, 52%, and 42.8% at 12 months respectively.

Conclusion: Whenever the presence of adequate forearm basilic vein with a suitable caliber, forearm basilic vein transposition is a good alternative autogenous option to be considered before forming an upper arm AVF or forearm AVG.

Introduction:

Arteriovenous fistulas constructed from autogenous upper extremity veins are the vascular access of choice as they offer the best patency and lowest complication rates.l While the life expectancy of patients on chronic dialysis continues to lengthen due to more advances in the health care, the durability of these vascular accesses is limited.2 Repeating fistula construction at different levels of the upper extremity (wrist, forearm, and upper arm) and shifting to other sites as the lower limb veins is often necessary and can ultimately result in exhaustion of autogenous vascular access sites one by one.3

The use ofbasilic vein in the ann was widely discussed by many groups either by one stage transposition or by two stages beginning with brachio-basilic fistula as a 1st stage and basilic vein superficialization after maturation as a 2nd stage, but fewer studies have been discussing FBVT, although of its valuable role and relatively old rout.4

As the basilic vein lies in a medial position on ulnar side of the forearm, and both radial artery and basilic vein are not in close proximity for direct surgical anastomosis, while ulnar-basilic fistulas do not offer a comfortable position for the patient and do not give easy chance for canulation by dialysis nursing so basilic vein transposition into a subcutaneous

tunnel on the volar aspect of the forearm makes it easy for access after maturationS

This study focuses on the use of forearm basilic vein transposition as dependable arteriovenous access route in patients with failed radiocepalic fistulas or unsuitable cephalic veins before attempts for the use of arm basilic veins or synthetic grafts.

Patients and methods:

From January 2008 to December 2010,75 randomly selected patients underwent AV access for hemodialysis in Zagazig University hospitals. In this study the surgical approach was to construct a vascular access for each patient, as it was attempted to first place a wrist radiocephalic fistula if anatomically favorable. From there, we moved to a simple brachiocephalic fistula at the antecubital fossa. If this was not feasible due to either small or thrombosed cephalic vein due to previous operation then we shift to FBVT if there was suitable forearm basilic vein or loop FAVG using brachial, mid cubital or basilic vein in the arm as outflow veins.

Venous examination for patency assessment was done clinically by percussion or duplex ultrasound if needed in some cases in this study both were done under tourniquet in place. Some veins were spastic but certain maneuvers, such as gentle tapping, warming the extremity, or exercise, were used to alleviate spasm and cause venous distention. Vein mapping was routinely performed to outline and defme the size and quality of cephalic, basilic or midcubital veins, which decreased surgical exposure and dissection times. Allen's test was done to assess palmar arch patency and arterial pulsations were detected and skin marked.

All operations of radiocephalic fistula were performed under local anesthesia, 14 cases of forearm basilic vein transposition were done under local anesthesia, the remaining 11 cases were done under supraclavicular block, and all cases of forearm AVG were operated on under general anesthesia.

For the basilic vein transposition in the forearm, longitudinal incision was made directly over the skin mark of the mapped vein beginning at medial aspect of anticubital fossa where complete dissection and freeing the basilic vein at this site prevents angulations of the vein at this point after transposition, and then dissection proceeded distally towards the wrist, then the vein was wrapped with a saline-soaked sponge. Separate skin incision over the radial artery above the wrist, after dissection of the radial, longitudinal arteriotomy was done followed by flushing the artery with heparinized saline before clamping proximally and distally, then subcutaneous tunnel in the volar aspect of the forearm was created followed by passing the vein in the tunnel after marking the vein with continuous inflation with heparinized saline and filling thrill overlying the vein course. Finally end to side anastomosis was done between the radial artery and basilic vein with polypropylene 6/0. Lastly removing the clamps and filling the propagating thrill overlying the transposed basilic vein were done.

Figure (1): (A) Complete dissection of the basilic vein by separate skin incisions made along the vein course from the elbow to the wrist, (B) Passing the vein in the subcutaneous tunnel in the volar aspect of the forearm with continuous inflation with heparinized saline, (C) End to side anastomosis was done between the radial artery and basilic vein.

AVG were constructed as a forearm loop graft between the brachial artery and either mid cubital vein if available or brachial vein using standard polytetrafluoroethylene (PTFE) material. AVOs were cannulated for hemodialysis if the surgical wound was considered to be appropriately healed after a 2 weeks postoperative time frame.

Figure (2): Synthetic graft was anastomosed to the venous side and tunneled subcutaneously as a loop on the volar aspect of the forearm.

Functionality of the fistula was defined as the full use of the access in the dialysis unit with removal of the access catheter.

Patients were followed in the outpatient clinic for postoperative care including detection and management of complications and assessment of fistula maturation, the latter being based on the physical examination (development of basilic vein dilatation and thrill for a sufficient length). Following the

procedures, fistulas were released for dialysis after at least 6 weeks to allow the fistula to mature.

Primary and secondary patency rates as defined by Sidawy et al6 were determined and presented as Kaplan-Meier life-tables. Primary patency was defined as the interval from the time of access placement until any intervention designed to maintain or reestablish patency; secondary patency was defined as the interval from the time of access placement until access abandonment or thrombosis. Patency rates of the 3 groups were compared using the Cox-Mantel log-rank test with a P value ofless than 0.05 considered significant. Statistical analysis was performed using SPSS 17.0 software.

Results:

Demographic data:

The mean age in all groups was 49.3 ± 10.1 years and there were 49 (65.3%) males, 26 (34.6%) females. In the 75 patients included in this study the distribution of the procedures was: 29 patients (38.6%) had radiocephalic fistulas, 25 patients (33.3%) had forearm basilic vein transposition and 21 patients (28%) had forearm arteriovenous grafts in which 7 (9.3%) patients had midcubital vein as outflow vein and 14 patients (18.6%) had brachial vein as outflow vein. The patients in the radiocephalic group were significantly younger and had undergone fewer previous vascular accesses for dialysis than the patients in the forearm AVG group (p value <0.001). Diabetes and hypertension were distributed frequently in prevalence in the three patients groups with no statistical significance.

The 12-months primary patency rates for RC fistulas was 68.9 %(20/29), FBVT was 52% (13/25), and AVGs was 42.8% (9/21).

The 18 months primary patency rates for RCF, FBVT and FAVG were 34.4%, 16%, 9.5% respectively. 2ry patency rates at 12 months were 82.7, 60% and 61.9% and at 18 months 41.3%, 24% and 14.2% respectively.

By revising Table(2) showing the Pairwise comparison between the three groups it is found that RCF group showed significantly better patency than the FBVT or FAVG groups (P value <0.05). The difference between the primary patencies of the FBVT and FAVG groups was not statistically significant {P value =0.187)

Mean follow-up was 15 months (range, 3-24 months). Maturation failure occurred in 3 radiocephalic fistula patients and in 4 FBVT patients.

One patient of RCF group developed infection and abscess formation close to the anastomosis, which was treated by drainage and ligation of the fistula. One patient ofFBVT group developed infection at a puncture site which was treated conservatively by antibiotics. Seven patients of FAVG group were complicated by infection, 4 of them were treated by total graft excision and ligation of the artery and vein, 3 of them were treated by partial graft excision where the anastomotic line was not included. One patient of FBVT group developed hematoma related to vein harvesting incision, was treated by evacuation and one patient of FAVG group developed seroma and was treated by surgical drainage and insertion of suction drain. 2 patients of FAVG group developed venous hypertension and were treated conservatively by limb elevation and compression therapy. One patient ofRCF group developed venous hypertension with oedema of the upper limb and failed to respond to conservative management and was treated by ligation of the fistula and creation of another in the contra lateral limb.

3 cases ofFAVG group were complicated by ischaemic steal syndrome; one of them was managed conservatively and the other 2 cases were treated by ligation of the grafts. Six cases of FBVT group were complicated by thrombosis, successful thrombectomy and excision of stenotic segment with direct end to end anastomosis of the vein was done for 2 cases, saphenous vein interposition graft was done for one case and arm brachio-basilic fistulas were done for the remaining 3 cases. As regard RCF group, 4 patients were complicated by thrombosis, thrombectomy was done for one case only and upper arm fistulas were done for the remaining 3 patients. Successful thrombectomy was done for 6 patients of FAVG, 2 patients had brachia-axillary graft and one had FAVG on the contralateral limb.

Table (1): Patients' demographics.

	Radiocephalic fistulas	Basilic vein transposition	Arteriovenous graft	Pvalue
Total procedures	29(38.6%)	25(33.3%)	21(28%)	
Age				
Mean	43.7±8.01	48.4±8.8	58.1±8.1	< 0.001
Range	17-52	29-63	32-71	
Male sex	17(58.6%)	19(76%)	13(61.9%)	0.389 (NS)
Hypertension	23(79.3%)	20(80%)	16(76.1%)	0.948 (NS)
Diabetes	18(62%)	15(60%)	19(90.4%)	0.788 (NS)
Previous access	8(27.5%)	20(80%)	19(90.4%)	< 0.001
Previously on dialysis	20(80%)	23(92%)	21(100%)	0.004
Left arm use	23(79.3%)	16(64%)	11(52.3%)	0.132 (NS)

Table (2): Pairwise comparison of patency rates between each two groups separately.

Operation done		Radiocephalic fistulas		Basilic transposition		Arteriovenous graft	
		Chi-Square	Sig.	Chi-Square	Sig.	Chi-Square	Sig.
Log Rank (Mantel-cox)	Radiocephalic fistulas			5.000	0.025	10.600	0.001
	Basilic transposition	5.000	0.025			1.740	0.187
	Arteriovenous grafts	10.600	0.001	1.740	0.187		

Table (3): Patients at risk during time intervals for primary patency analysis.

Number of patients at risk at the beginning of the interval	Months after the procedure					
	0	5	10	15	20	25
RCF	29	25	23	17	3	0
FBVT	25	20	11	7	1	0
FAVG	21	16	12	4	0	0
Total	75	61	46	28	4	0

Table (4): Ptltients at risk during time intervals for secondary patency analysis.

Number of patients at risk at the beginning of the interval	Months after the procedure					
	0	5	10	15	20	25
RCF	29	27	24	19	6	2
FBVT	25	22	17	10	2	0
FAVG	21	18	16	6	1	0
Total	75	67	57	25	9	2

Table (5): Various complications occu"ed in the 3 groups.

Complications	FBVT	AVG	RCF	Pvalue
Hematoma or seroma	1	1	0	0.602(NS)
Thrombosis	6	9	4	0.450 (NS)
Infection	0	2	1	0.001
Venous hypertension	0	2	1	0.343 (NS)
Steal syndrome	0	3	0	0.015

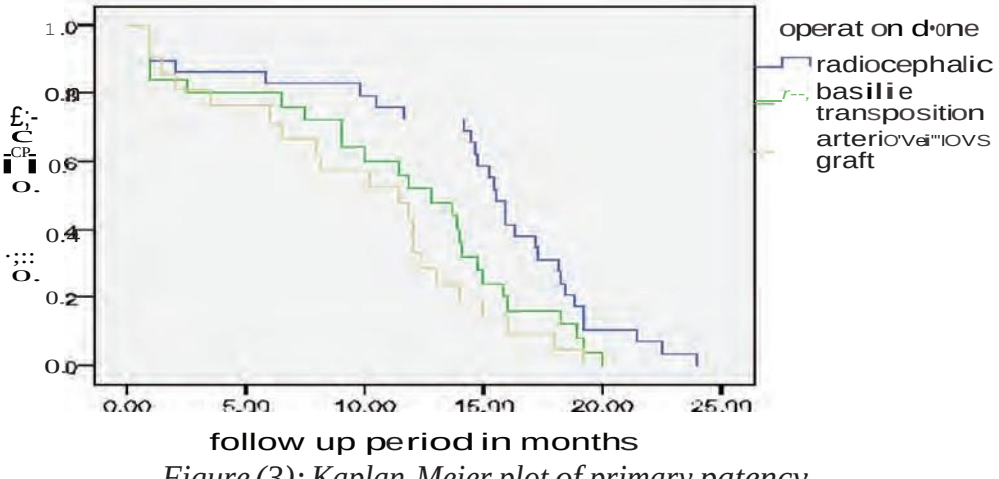

Figure (3): Kaplan-Meier plot of primary patency.

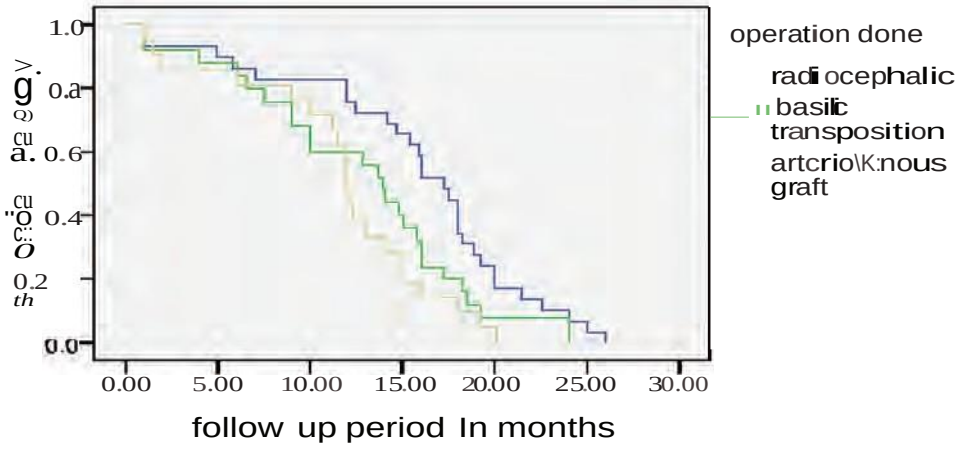

Figure (4): Kaplan-Meier plot of secondary patency.

Discussion:

Arm basilic vein transposition either by one or two stages was discussed and considered as a standard operation for autogenous access, which is often available and kept away by its deep medial position away from vein punctures.7,8 The 12 months primary patency rates of the arm basilic vein transposition were reported as 23% to 90%, whereas 12 months secondary patency rates are 47% to 96%.13-16 On the other hand still few reports discussing basilic vein transposition in the forearm either comparative studies done by Gormus et al,10 with upper arm basilic vein who reported 10 months 1ry patency reaching 90%, while results obtained by Weyde et alll who compared autogenous wrist ulnar-basilic access and radiobasilic transposition are 70.4% after 12 months and 6.6% after 24 months, while Son et ai12 reported 41.5%, 30.2% 1ry patency rates at 12, 24 months respectively but higher 2ry patency rates reaching 79.1%, 74.4% respectively, mentioned due to their policy to perform active surveillance and early intervention.

In this study 1ry patency rates at 12 and 18 months rates for FBVT were 52% and 16% respectively, while 2ry patency rates at 12 and 18 months were 60% and 24% respectively, which were relatively lower than the other studies, that was attributed to the lack of close surveillance program for following up the patients, where a big ratio of them seek advice in vascular outpatient clinics after nearly thrombosed accesses which made trials for access salvage so difficult, but attempts for contact with dialysis units aiming at awareness for continuous monitoring of any problems concerning the accesses, for early referral and interventions if needed. As it is previously reported that it is important to recognize the value of surveillance program strongly which depends on the adequacy of clinical monitoring done by skilled personnel.9

Disadvantages of basilic vein transposition are, longer operative time, bigger doses of local infiltration anesthesia or the need for general anesthesia, possibility of vein injury during dissection with subsequent stenosis or thrombosis, over distention of the vein after dissection, which may lead to intimal injury and resultant intimal hyperplasia. Frequent vein dissection wound problems with possibility of hematoma, skin necrosis. Tunneling can place the basilic vein at risk of kinking, stretching, or trauma, particularly at the swing segment, which can result in sudden postoperative occlusion. However, the above mentioned difficulties can be minimized with meticulous surgical techniques, as described above.

In the present study we did not include a cost analysis comparing the 3 procedures, but in fact the cost of arteriovenous prosthetic graft is higher if compared with RCF or FBVT procedures which is another favor added to the side of autogenous accesses.

So based on the previous results it should be considered to have a plan for performing an FBVT before an AVG due to higher patency rates of the FBVT if compared with that of an AVG, lesser infectious complications and also if the FBVT does not increase in size enough to be used for dialysis, it may contribute to a larger upper arm basilic vein, which then could be used for long-term dialysis, and finally, when FBVT fails, a forearm AVG can be the next option, but the reverse is not usually possible. Also it should be considered to place a forearm loop AVG in a patient who is not a candidate for a forearm AVF, thus making use of the forearm before going to an upper-arm access.

Conclusion:

In case of the previous use or the absence of adequate cephalic vein above wrist or in the forearm, basilic vein transposition in the forearm is a good alternative autogenous option to be considered before forming an upper arm AVF or forearm AVG, which offers a potential benefit for patients on chronic hemodialysis, especially with prolonged life expectancy by modem hemodialysis techniques. Also Nephrologist& should refer patients early for access assessment when possible; avoid temporary subclavian lines, instead better using internal jugular ; and early recognize problems with subsequent referral. Dialysis nurses should have skillfully needling techniques that reduce the risk of infection, haemorrhage and aneurysm formation, recognize and report

dysfunctional fistulas and grafts at any stage. Patients, prior to dialysis, should be taught not to allow venepuncture and blood pressure recording on their non-dominant arm, and again to report any changes in their vascular access.

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