Comparative study between 1-year patency of brachiobasilic arteriovenous fistula versus brachial to basilic forearm loop graft in patients with end-stage renal disease

Islam B. Mohammed, Mahmoud S. Khattab, Ramez M. Wahba, Mohammed E. Fakhr

Department of Vascular Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Islam B. Mohammed, BSc, Department of Vascular Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt. Tel: +20 100 124 5513; e-mail: islambadry42@gmail.com

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Background
The most preferred method of vascular access is the autogenous arteriovenous fistula (AVF). When ready for dialysis, autogenous AVF outperforms arteriovenous grafts (AVG) in terms of patency and survival. An alternate method of vascular access for such individuals is the transposed AVF or AVG.
Aim
The goal of this trial is to evaluate and contrast the results of those who were treated with a brachiobasilic (BB) AVF to those who were treated with a polytetrafluoroethylene brachial to basilic forearm loop graft.
Primary endpoints
Assisted primary patency, primary patency also secondary patency. Secondary endpoints: postoperative complications (wound infection, bleeding, steal syndrome, and procedure-related mortality), functional maturity.
Patients and methods
This is a prospective cohort observational trial performed at the Vascular Surgery Department, Faculty of Medicine, Ain Shams University. Data about patients who had forearm loop grafts or BB AVFs during the period from January 2021 to January 2022 were collected according to the study inclusion criteria. There was a total of 50 individuals included (25 patients in each group). The first group included cases who had BB AVF with basilic vein transposition (BB tAVF) whereas the second group included patients who had brachial-basilic forearm loop graft (BB AVG).
Results
Regarding age and sex distribution or risks of cardiovascular events, there was not a statistically significant distinction among the two study groups. The fistula group required statistically significant longer time to achieve functional maturity mean±SD (BB tAVF=9.64±2.29 vs .BB AVG=6.6±2 assisted and secondary patencies at 3, 6, 12, and 18 months). No statistically significant variation existed among groups regarding postoperative bleeding, infection, and procedure-related mortality.
Conclusion
Both BB AVF and polytetrafluoroethylene brachial to basilic forearm loop graft can be considered as viable options for vascular access in this patient population. The choice of procedure may depend on individual patient factors, possible risks of prolonged central venous catheter (CVC) use, as well as the risks of infection and thrombosis, which should be carefully evaluated.

Keywords:
brachiobasilic arteriovenous fistula, forearm loop graft, end stage renal disease patients

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Introduction

Guidelines for vascular access were developed by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative, forearm arteriovenous fistula (AVF) (snuffbox or distal radial-cephalic fistula AVF or transposed radio-basilic AVF) is the first choice for creating vascular access for end-stage renal disease (ESRD) persons who are anticipated to receive long-term dialysis, and the second option is forearm loop graft or brachiocephalic AVF then brachiobasilic (BB) AVF [1]. However, the European guidelines recommend autogenous AVF to be primary option for vascular access. This includes brachiocephalic autogenous AVF, radiocephalic AVF, and BB AVF with basilic vein transpositioning, whereas expanded polytetrafluoroethylene (ePTFE) arteriovenous graft (AVGs) are reserved as secondary options [2].

There appears to be a preference for basilic vein transposition over PTFE loop placement because of reduced infection and reintervention rates [3]. Additionally, variables such as comorbidities, age, as well as life expectancy may play a role in the decision [4].

The number of studies that directly compare the results of BB AVF along with PTFE loop graft insertion in the forearm is few. Noncomparative research is often utilized in systematic reviews which involve a wide range of individual subgroups. Thus, there have been reports of various patency and complication rates [5].

Aim of this study was to compare purposes among BB AVF as well as PTFE brachial to basilic forearm loop graft results. This research should assist vascular surgeons choose the best vascular access approach.

Patients and methods

The trial is a prospective cohort observational study carried out at the Vascular Surgery Department, Faculty of Medicine, Ain Shams University. Data about patients who had forearm loop grafts or BB AVFs during the period from January 2021 to January 2022 was collected according to the study inclusion criteria.

Inclusion criteria

ESRD patients aged from 18to 70 from both sexes, who are anticipated to have long-term (more than 1 year) dialysis, patients not suitable for forearm AVF/or had failed forearm AVF, and patients with favorable basilic vein diameter at distal arm or elbow region (diameter more than 2.5 mm).

Exclusion criteria

Patients with heart failure, uncontrolled blood pressure or uncontrolled diabetes. Patients with central venous occlusion or upper limb deep venous thrombosis and favorable basilic vein diameter at forearm.

Fifty patients were included (25 patients in each group). The first group included patients who had BB AVF with basilic vein transposition while the second group included patients who had BB forearm loop graft.

Study techniques

All the surgeries were carried out under either local anesthetic with sedation, regional anesthesia, or general anesthesia. All of the participants underwent preoperative arterial as well as venous duplex ultrasonography evaluations.

During the operation, with the help of ultrasound, the exact locations of the brachial artery and basilic vein anastomoses were chosen. Surgeon preference determined whether BB AVFs were performed in a single stage or two stages. Both the arterial and venous anastomoses were completed in an end-to-side fashion in the brachial to basilic forearm loop graft that was constructed using a synthetic ePTFE graft.

During the research period, no modifications were made to the methods used to create BB AVGs to connect the brachial artery to the basilic artery in the forearm. Patients consented to either procedure after being informed of the benefits and risks of each option.

Follow-up

At 2-, 4-, 3-, 6-, 12-, and 18-month follow-up visits to the outpatient clinic, the fistula was examined as well as a duplex scan was performed to assess its anatomical along with hemodynamic state.

Failed BB tAVFs as well as BB AVGs were treated with balloon angioplasty as a salvage procedure. Clinical and dialysis factors were taken into account while making the call to intervene. The rescue method for BB AVGs that had been thrombosed involved first performing a graft thrombectomy, and then performing an angiography and angioplasty. If the thrombosis only affected a small section of the BB tAVF, balloon angioplasty with or without thrombectomy could be performed. Long-segment thrombosis meant the BB tAVF had to be stopped.

Study endpoints

Primary endpoints: assisted primary patency, primary patency, and secondary patency.

Secondary endpoints: functional maturity, postoperative complications (wound infection, bleeding, steal syndrome, and procedure-related mortality).

Definitions

Primary patency (intervention-free access survival) refers to the amount of time that has passed after the initial construction of the access point before any intervention that was designed to maintain or reestablish patency, access thrombosis, or the time at which patency was measured [6].

Assisted primary patency (thrombosis-free access survival) refers to the amount of time that has passed from the point in time when an access was created until the point in time when access thrombosis

Table 1 Age distribution among the trial groups

	Fistula group (*N*=25)	Graft group (*N*=25)	Test of significance	*P*
Age				
Mean±SD	52.8±14.33	57.44±13.63	*t*=−1.173	0.247
Range (minimum–maximum)	56 (18–70)	52 (20–72)		
Sex [*n* (%)]				
Male	14 (56)	16 (64)	χ^2=0.333	0.564
Female	11 (44)	9 (36)		

P, *P* value for comparing between the studied groups; *t*, independent *t* test; χ^2, χ^2 test. *P* value more than 0.05: nonsignificant; *P* value less than 0.05: significant; *P* value less than 0.001: highly significant.

occurred, or the point in time when patency was measured, including any manipulations (surgical or endovascular procedures) that were performed during that time to maintain the functionality of a patent access [6].

Secondary patency (access survival till abandonment) refers to the amount of time that passes throughout the time an access is created in addition the time it is either abandoned or measured for patency. During this time, any manipulations (such as surgical or endovascular treatments) that are performed to reestablish the functionality of a thrombosed access are included [6].

Functional maturity: the fistula has been cannulated successfully, as well as the access can provide a flow rate of 350–400 ml/min, allowing for continuous dialysis for no more than 4 h [6].

Ethical considerations: Ain Shams University's Faculty of Medicine's General Surgery Department's Ethics Committee gave their consent to the research, which was then carried out.

Statistical analysis

All of the data was gathered, tabulated, and analyzed statistically with SPSS 26.0 for Windows (provided by SPSS Inc., Chicago, Illinois, USA). The qualitative data were characterized with the use of numbers and percentage. The range (both the minimum as well as highest values) as well as the mean, SD, in addition median were used to describe the quantitative data. Every statistical comparison was conducted with two distinct degrees of significance. A *P* value of less than 0.05 indicates that the distinction is significant, whereas a *P* value of less than 0.001 indicates that the variation is extremely significant. A *P* value of over 0.05 indicates that the variation is not significant.

Table 2 Clinical characteristics among the study groups

	Fistula group (*N*=25) [*n* (%)]	Graft group (*N*=25) [*n* (%)]	Test of significance	*P*
DM	11 (44)	16 (64)	χ^2=2.013	0.156
Hypertension	17 (68)	11 (44)	χ^2=2.922	0.087
IHD	9 (36)	6 (24)	χ^2=0.857	0.355
Hyperlipidemia	5 (20)	3 (12)	χ^2=0.595	0.44

Results

In this research, there were a total of 50 participants, 30 of whom were men and 20 of which were women. Individuals were split into two groups, with 25 patients participating in the BB group and 25 patients participating in the forearm BB loop graft. The ages of the participants ranged from 18 to 70 years on average.

Table 1 displayed that there was no significant alteration regarding age and sex distribution among both study groups. Other clinical characteristics of the study group are shown in Table 2.

Six patients in the fistula group received regional anesthesia (supraclavicular block), while 19 patients in the graft group received supraclavicular block (Table 3).

Table 4 presented that there was highly significant variance among the two groups according to time from access creation to first use and as regards time to achieve functional maturity.

Table 3 Type of anesthesia

	Fistula group (*N*=25) [*n* (%)]	Graft group (*N*=25) [*n* (%)]	Test of significance	*P*
Type of anesthesia				
Local anesthesia	19 (76)	6 (24)	χ^2=13.52	<0.001
Regional anesthesia	6 (24)	19 (76)		

Table 4 Time from access creation to first use and functional maturity among the study groups

	Fistula group (*N*=25)	Graft group (*N*=25)	Test of significance	*P*
Time from access creation to first use (weeks)				
Mean±SD	7.6±2.04	4.32±2.84	*t*=10.867	<0.001
Range (minimum–maximum)	6 (6–12)	10 (2–12)		
Time to achieve functional maturity (weeks)				
Mean±SD	9.64±2.29	6.6±2.83	*t*=4.177	<0.001
Range (minimum–maximum)	8 (7–15)	12 (3–15)		

Table 5 Functional maturity at 1, 3, and 6 months among the study groups

			Fisher's exact test	
Fistula group (*N*=25) [*n* (%)]		Graft group (*N*=25) [*n* (%)]	*P* value	Significance
1 month	0	2 (8)	0.490	NS
3 months	24 (96)	22 (88)	0.609	NS
6 months	25 (100)	25 (100)	NA	

The mean length of hospitalization was one day in the fistula group and two days in the graft group.

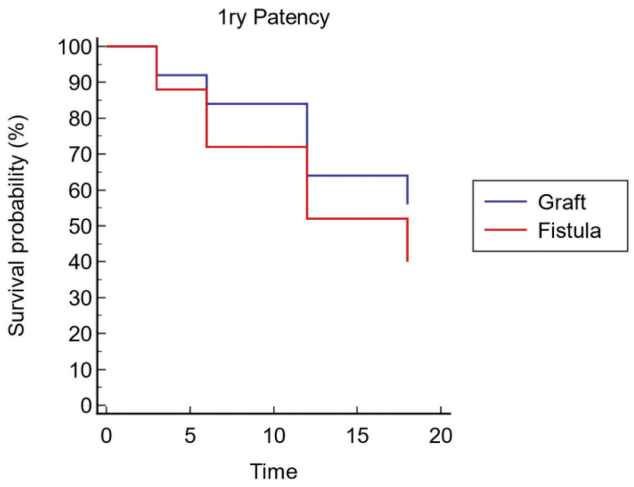
Table 5 indicated no statistically significant variance in functional maturity among each of the groups at 1, 3, and 6 months (Figs 1–3).

There was no statistically change among the two groups as regards early postoperative bleeding, infection, and procedure-related mortality (Table 6).

Discussion

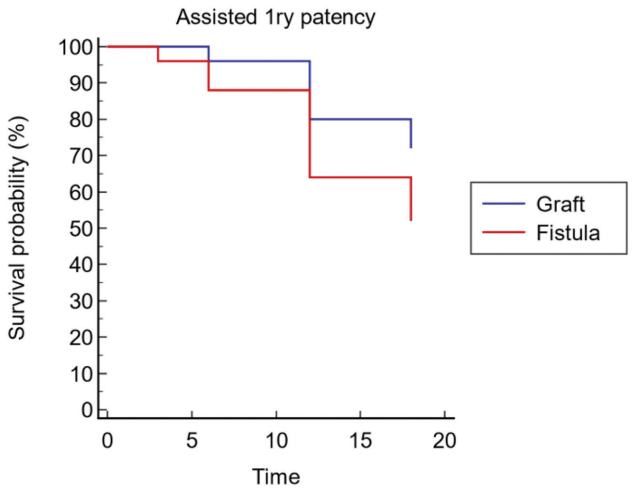
Persons diagnosed with ESRD frequently undergo hemodialysis as one of their therapeutic options. The use of autogenous AVF, forearm loop grafts, and CVCs are all viable options for vascular access [7]. For those who have used up all of their alternatives for vascular access through the cephalic vein AVF,

Figure 1



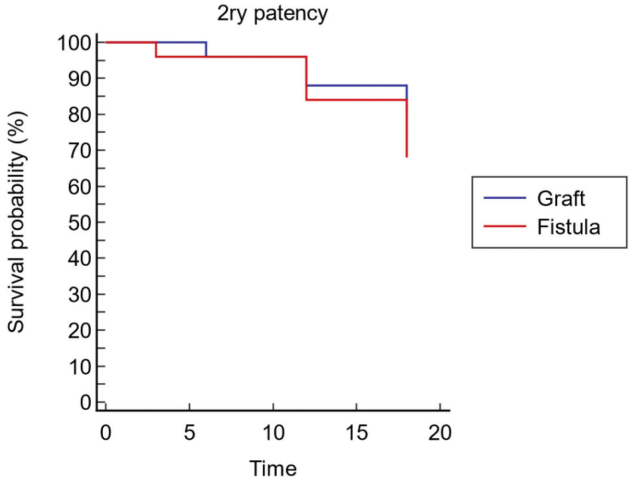
Primary patency.

Figure 2



Assisted primary patency.

Figure 3



Secondary patency.

Table 6 Postoperative complications

	Fistula group (*N*=25) [*n* (%)]	Graft group (*N*=25) [*n* (%)]	Test of significance	*P*
Bleeding at first 24 h of access creation	0	1 (4)	χ^2=1.02	0.312
Mild infection	6 (24)	2 (8)	χ^2=2.381	0.123
Sever infection	0	0	χ^2=0	1
Thrombosis	0	0	χ^2=0	1
Steal syndrome	0	0	χ^2=0	1
Mortality	0	0	χ^2=0	1

there is some debate as to whether a BB tAVF or a forearm loop AVG should be the next vascular access of choice [8]. The Kidney Disease Outcomes Quality Initiative guidelines recommend creation of forearm loop AVG before creation of BB AVF, while the ESVS guidelines recommend delaying the option of AVG till exhaustion of all available autogenous AVFs [1,2].

The aim of our study is to compare the results of cases treated with a BB AVF with basilic vein transpositioning to those of persons treated with a PTFE brachial to basilic forearm loop graft.

Fifty participants (30 men and 20 women) were studied, 25 in each of two groups (BB and forearm BB loop graft). Regarding sex, age, renal failure length, comorbidities, insulin, access side, as well as statin use, there was no statistically significant distinction among the groups analyzed.

In our study, there was no statistically alteration among the two groups for primary, assisted primary or secondary patency rates. This disagrees with a meta-analysis and systematic review by Tang *et al.* [7] who to evaluate the reliability and effectiveness of tAVF and AVGs in those on hemodialysis with regard to complications along with patency. They found that tAVF was far more effective than AVG in terms of primary patency, secondary patency, and primary-assisted patency. However, the studies included in this systematic review were not exclusive to BB AVF and forearm loop grafts. Chue *et al.* [8] compared between BB tAVF and forearm loop AVG, and they reported significant superior primary and secondary functional patency in tAVF than AVG at 12 months. Individuals with central venous catheter problems or poor prognoses, they reasoned, may benefit from forearm AVG since it allows for early vascular access.

In agreement to Chue and colleagues, the mean time to achieve maturation was significantly longer in the tAVF group compared with the AVG group.

In our study, the AVG group had no statistically significant higher functional maturity at 1 month, while the tAVF group had no statistically significant higher functional maturity at 3 months. Both groups had equal functional maturity at 6 months.

Regarding early postoperative bleeding, there was no statistically significant change among the two studied groups in this study, and there was no procedure-related mortality. Tang *et al.* [7], reported higher rate of early postoperative infection and thrombosis in the AVG group compared with the tAVF group. The difference in infection rate may be due to the presence of thigh AVGs in some studies included in systematic review. They reported higher postoperative bleeding in the tAVF group, and nonstatistically different rates of steal syndrome, aneurysmal formation, and procedure-related mortality.

According to the findings of a number of studies, BB AVF with basilic vein transposition is superior than forearm loop BB AVF because it has a higher patency rate and requires less interventions. On the other hand, these studies only disclose the results of access that were successful originally, as well as leave out cases of primary failure from their study. As a consequence of this, the success of BB tAVF may have been overestimated in comparison to that of AVG because the authors failed to take into account problems associated with the maturation and development of access [8]. In our research, 100% of the primary patencies were achieved across both groups, and 100% of the access procedures were successful initially.

Study limitations

The main limitations to this study include few numbers of patients, short follow up period and wide range of age group. Moreover, there are few studies specific to this research topic, which makes it difficult to reach a consensus about the best option for vascular access after exhaustion of radial-cephalic AVF.

Conclusion

In conclusion, both BB AVF and PTFE brachial to basilic forearm loop graft can be considered as viable

options for vascular access in this patient population. The choice of procedure may depend on individual patient factors, possible risks of prolonged CVC use, as well as the risks of infection and thrombosis, which should be carefully evaluated.

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Nil.

Conflicts of interest
There are nO conflicts of interest.

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