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ORIGINAL ARTICLE

Comparative Study Between Synthetic Brachioaxillary and Brachiovena Comitans Grafts for Hemodialysis

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Abstract

Background: **A good vascular access must be built, maintained, and preserved for hemodialysis to work.**

Aim: **The aim was to compare the patency, function criteria (fistula thrill), and complications between the brachioaxillary and brachiovena comitans grafts for patients with persistent kidney insufficiency with exhausted upper extremity peripheral vein access for routine hemodialysis.**

Patients and methods: **The 50 patients participating in this prospective, randomized research had end-stage kidney illness. It was performed at The Vascular Surgery Department of Alazhar University hospitals (Al-Hussein and Bab-Alsheryah hospitals). Cases were split into two categories: Group A: 25 patients underwent brachioaxillary grafts and group B: 25 patients underwent brachiovena comitans grafts.**

Results: **Primary patency was 68% at 6 months in group A and 56% at 6 months in group B. Secondary patency was 72% at 6 months in group A and 56% at 6 months in group B. Access failure was 12% at 6 months in group A and 32% at 6 months in group B. Between the two groups, there was little difference in terms of access failure, primary patency, and secondary patency.**

Conclusion: **Brachioaxillary arteriovenous graft has shown advantages in functioning and safety compared with brachiovena comitans grafts in patients with inadequate retention of all upper limb veins. The variation in the rates of complications between the two study groups was not statistically substantial. Therefore, for certain people, brachioaxillary arteriovenous graft formation is a suitable surgical procedure given their age, underlying condition, and predicted longevity.**

Keywords: Axillary vein, Fistula, Graft of the brachiovena comitans, Hemodialysis

1. Introduction

End-stage renal disease (ESRD), which causes severe morbidity, death, and financial burden, is a major public health issue. It is especially important to provide and maintain access for dialysis patients. Vascular surgeons have a major role in the provision of treatment for ESRD patients, particularly regarding obtaining and preserving access to hemodialysis (HD).[1]

The most popular kind of kidney replacement treatment for those with ESRD is still HD. HD was used by about 80% of Singapore's ESRD patients. Autogenous arteriovenous radiocephalic (RC AVF) or brachiocephalic fistula (BC AVF) was suggested as the first-line alternatives for vascular access (VA) by the Kidney Diseases Outcomes Quality Initiative (KDOQI) recommendations.[2]

The best location and conduit for VA must be chosen for HD to be successful. The arteriovenous fistula (AVF), which has greater patency, fewer rates of complications, and cheaper expenses, is regarded as the gold standard of VA.[3]

In contrast to arteriovenous grafts (AVGs) and tunneled dialysis catheters (TDCs), the AVF continues to be the optimum VA for patients receiving HD.[4]

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A mature AVF should be developed before beginning renal replacement treatment to decrease the risk of problems, morbidity, and death linked with central venous catheters.[2,5,6]

Unfortunately, autologous AVF formation is not always possible in individuals with chronic kidney disease due to their anatomy and vascular abnormalities. The only options for access choices are either a TDC or the production of AVGs, with AVGs being the more advantageous choice in the lack of appropriate veins for AVF formation. The long-term consequences of infections, constriction, and catheter failure are the three often occurring TDCs that may be troublesome for a variety of reasons.[6]

TDCs are linked to the highest rates of all-cause and infection-related death when matched with AVFs and AVGs. The above-mentioned options are thus the lowest preferable ones for long-term VA.[7]

Lower limb thigh grafting is an option, but as they have a higher risk of problems than upper limb AVGs, they should only be considered in the absence of any other access options.[8]

The primary goal of this research was to examine the patency, function criteria (fistula thrill), and consequences of brachioaxillary and brachiovena comitans grafts in cases with persistent renal impairment who had exhausting upper extremity peripheral vein access for routine HD.

2. Patients and methods

Patients had ethics committee approval and consent before procedure.

A prospective, randomized research including 50 patients with ESRD was done. It was performed at The Vascular Surgery Department of Alazhar University hospitals (Al-Hussein and Bab-Alsheryah hospitals).

The patients were split into two groups. Group A: 25 patients underwent brachioaxillary grafts and group B: 25 patients underwent brachiovena comitans grafts.

2.1. Inclusion criteria

Patients with ESRD who have exhausted their upper limb superficial venous accesses and require permanent access for HD.

2.2. Exclusion criteria

Patients having an appropriate superficial venous system for creating fistulas, those who had their brachial arteries previously ligated, and those who had a central venous obstruction on the same side.

Patients underwent the following procedures:

A thorough clinical examination;

A full history taking.

A general assessment.

A close look at the upper limbs.

Chest radiographs.

Duplex ultrasounds of both upper limbs' venous and artery systems.

Age, sex, and other chronic conditions including dyslipidemia, ischemic heart diseases, high blood pressure, and diabetes mellitus were all the patients of data collection and maintenance., in addition to comprehensive duplex scanning information.

2.3. Preoperative assessment

All patients had a Doppler/duplex scan. The duplex scan methodology allowed for both venous and arterial systems to be seen in addition to finding clogged capillaries in the upper limbs from several surgeries in the past, as well as destroyed or inappropriate tiny veins.

Operative procedure: group A: brachioaxillary straight grafts were performed on 25 patients under either local or total anesthesia and group B: Brachiovena comitans forearm loop grafts were performed on 25 patients under either local or total anesthesia.

The polytetrafluoroethylene (PTFE) synthetic graft was expanded. This transplant has greater resistance to infection and long-term patencies and is less prone to steal syndrome.

Patients' follow-up: patients were assessed and followed up immediately after surgery, then at 1 week, 1, 3, and 6 months to determine the patient's patency, graft function, infection resistance, primary patency, the length of the procedure's validity, the blood flow rate during HD, and the frequency of complications such as thrombosis, infection, steal disorder, development of pseudoaneurysms, and congestion of the veins.

3. Results

There are demographic differences between the two investigated groups. The average age of group A was 51.3 ± 5.3 while the mean age of group B was 52.7 ± 5.8. Males made up 56% of group A, whereas 60% of group B. There were no statistically substantial differences in demographic features of the two groups. There were no substantial differences in

Table 1. Demographic and anthropometric features of the groups analyzed.

	Group A (n = 25) [N (%)]	Group B (n = 25) [N (%)]	Test value	P value
Sex				
Males	14 (56)	15 (60)	$\chi^2 = 0.08$	0.77
Females	11 (44)	10 (40)		
Age	51.3 ± 5.3	52.7 ± 5.8	1.19	0.66
BMI (kg/m^2)				
Median ± SD	26.2 ± 2.22	26.50 ± 2.3	$\chi^2 = 1.07$	0.86
Weight				
Median ± SD	77.4 ± 6.2	77.6 ± 5.9	Z = MWU 1.10	0.81

^{Z}MWU, Mann–Whitney U-test.
P value < 0.05 substantial, P value < 0.01 highly substantial.

Table 2. Comparison of the examined groups' heart rates, SBPs, and DBPs in relation to their history of medical conditions.

	Group A (n = 25) [N (%)]	Group B (n = 25) [N (%)]	Test value	P value
Hypertensive	15 (60.0)	14 (56.0)	$\chi^2 = 0.08$	0.77
DM	11 (44)	10 (40)	0.082	0.77
Smokers	12 (48.0)	11 (44)	$\chi^2 = 0.08$	0.77
IHD	10 (40.0)	9 (36.0)	0.08	0.77
Cerebrovascular incident	6 (24.0)	5 (20)	0.11	0.73
Dyslipidemia	8 (32)	7 (28)	0.095	0.75
Pulse rate (bpm)				
Median ± SD	80.60 ± 6.20	80.50 ± 6.35	Z = MWU 1.19	0.54
SBP, mmHg				
Median ± SD	135.65 ± 13.41	135.96 ± 13.22	Z = MWU 1.39	0.25
DBP, mmHg				
Median ± SD	85.60 ± 6.20	84.50 ± 6.35	Z = MWU 1.022	0.93

DBP, diastolic blood pressure; DM, diabetes mellitus; IHD, ischemic heart disease; SBP, systolic blood pressure; ^{Z}MWU, Mann–Whitney U-test.

Table 3. Comparison of the time required for graft maturity, operation time, blood loss, and hospitalization between the study groups.

	Group A (n = 25)	Group B (n = 25)	Test value	P value
Hospitalization (days)				
Median ± SD	1.3 ± 0.24	1.28 ± 0.21	Z = MWU 1.30	0.51
Duration for graft maturity (days)				
Median ± SD	22.9 ± 2.5	39.9 ± 4.5	Z = MWU 3.24	0.005
Operation time (min)				
Median ± SD	121.2 ± 12.5	95.5 ± 10.5	1.41	0.39
Loss of blood (ml)				
Median ± SD	150 ± 10	200 ± 13	1.69	0.20

^{Z}MWU, Mann–Whitney U-test.

anthropometric features between the two groups (Table 1).

There were no substantial variation between the two groups in terms of their medical history. Furthermore, there was no substantial variation between the two groups regarding pulse rates, systolic blood pressure (SBP), or diastolic blood pressure (DBP) (Table 2).

In terms of time for graft maturity, there was considerable disparity between the two groups (days) (Table 3).

Table 4 shows that regarding graft thrombosis, group A had 12.0% additional thrombosis at 6 months whereas group B experienced 20.0% additional thrombosis at 6 months. Regarding graft thrombosis, there was no substantial variation

Table 4. Comparison of the study groups' rates of access failure and graft thrombosis.

	Group A (n = 25) [N (%)]	Group B (n = 25) [N (%)]	Test value	P value
Additional thrombosis at 6 months	3 (12)	5 (20)	0.59	0.44
A 6 months access failure	3 (12)	8 (32)	2.91	0.08

Table 5. Comparison of the main patency among the groups under study.

	Group A ($n = 25$) [N (%)]	Group B ($n = 25$) [N (%)]	Test value	P value
At 6 months, main patency	17 (68)	14 (56)	2.91	0.08

Table 6. Comparison of secondary patency between the analyzed populations.

	Group A ($n = 25$) [N (%)]	Group B ($n = 25$) [N (%)]	Test value	P value
Secondary patency at 6 months	18 (72)	14 (56)	2.91	0.08

Fig. 1. Showed brachio axillary graft after anastomosis between brachial artery and axillary vein.

between the two groups. Access failure rates were 12.0% at 6 months for group A and 32.0% at 6 months for group B. There was little variation between the two groups in terms of access failures.

About primary patency, 68.0% in group A and 56.0% in group B at 6 months. There was no substantial variation between the two groups according to main patency (Table 5).

Table 6 shows that in terms of secondary patency, group A had 72% at 6 months, whereas group B had 56.0% at 6 months. There was little variation in secondary patency between the two groups (Fig. 1).

4. Cases

(a) Brachioaxillary graft
Brachial artery and axillary vein anastomosis
(b) Brachiovena comitans forearm loop graft
Brachial artery and vena comitans anastomosis

5. Discussion

The present research revealed that the mean ages of the examined groups were 51.3 ± 5.3 and 52.7 ± 5.8, respectively, in terms of demographic data. Group A had 56% males, whereas group B contained 60% males. Between the two groups, there were no discernible differences in terms of demographic traits.

The present research also revealed that group A had a mean BMI of 26.2 ± 2.22 and group B had a mean BMI of 26.50 ± 2.3. In group A, the average weight was 77.4 ± 6.2; in group B, it was 77.6 ± 5.9. Regarding anthropometric traits, there was little variation between the two groups.

In patients with ESRD, the brachioaxillary and brachiovena comitant grafts were compared for the first time in the present research. We will thus contrast our findings with research that presented each approach independently.

The current research can be backed up by Yousef *et al.*[9], who examined two graft options for brachioaxillary HD access (saphenous vein vs. artificial graft). For the brachioaxillary shunt, 30 patients had surgery using a saphenous graft (group I), while the other 30 underwent surgery using a synthetic graft (PTFE) (group II).

Belczak et al.[10] evaluate the patency and complication rates of various graft types utilized for brachioaxillary accesses in HD patients; 49 patients had brachioaxillary bypass surgery as part of the trial, and autologous saphenous veins, PTFE, or PROPATEN grafts were implanted. There were 26 males and 23 women, and their average age was 57 years.

Davoudi et al.[11] assess the main patency times of prosthetic brachioaxillary access grafts with basilic vein transposition (BVT) in HD patients. Sixty HD patients were included in this randomized clinical study, and two intervention groups BVT or AVG were randomly allocated to each group. Each group under study underwent 30 BVTs and 30 AVG. Regarding age and sex, the groups were evenly matched. Thirteen (43.3%) men made up the AVG group's average age of 60.10 ± 16.53 years. Eight (26.7%) of the BVT group's 64.93 ± 15.42 average age's members were men.

In addition, Fumagalli et al.[12] in patients with weak superficial veins, BB-AVGs are implanted in the forearm. The majority of the patients were male and old, and the patients were 69 years old, on average. The research examined 105 BB-AVGs made in 105 recurring patients utilizing standard-walled PTFE grafting.

The current research revealed that there were 60% of patients with high blood pressure, 44.0% with diabetes mellitus, 48.0% smokers, 40% with ischemic heart disease (IHD), 24% with cerebrovascular accidents, and 32% with dyslipidemia in group A. Patients in group B included 56% with high blood pressure, 40% with diabetes mellitus, 44% smokers, 36% with IHD, 20% with cerebrovascular accidents, and 28% with dyslipidemia. There was little variation between the two groups in terms of their prior medical history.

Yousef et al.[9] revealed that diabetes mellitus, hypertension, IHD, and smoking were the more prevalent comorbidities in the examined groups, with no substantial variation.

Also, Fumagalli et al.[12] showed that the two biggest comorbidities were peripheral vascular diseases (43.8%) and hypertension (66.7%). A third or so of the individuals had both diabetes and coronary artery disease. Twenty-five patients were starting dialysis and 45 patients were receiving chronic dialysis (86.2 vs. 59.2%; $P < 0.01$); both had hypertension.

We discovered that group A's median heart rate was 80.60 ± 6.20, whereas group B's median heart rate was 80.50 ± 6.35. In group A, the median SBP was 135.65 ± 13.41; in group B, it was 135.96 ± 13.22. The median DBP was 84.50 ± 6.35 in group B and 85.60 ± 6.20 in group A. As far as heart rates, SBP, or DBP were concerned, there was no substantial variation between the two groups.

In HD patients, BP variability is highly linked to mortality and cardiovascular diseases. Furthermore, there are several variables that play a role in the complicated link between blood pressure and cardiovascular disease in HD patients.[13] For HD patients, techniques to lower BP variability may be advantageous.

The average hospitalization (days) was 1.3 ± 0.24 in group A, the average number of days for grafting maturity (group A) was 22.9 ± 2.5, the average procedural time (min) was 121.2 ± 12.5, and the average blood loss (ml) was 150 ± 10 in group A, according to a comparison between the researched groups regarding these factors. In group B, the average hospitalization was 1.28 ± 0.21 days; the average grafting maturity was 39.9 ± 4.5 days; the average operating time was 95.5 ± 10.5 min; and the average loss of blood was 200 ± 13 ml.

These outcomes compared with Yousef et al.[9] showed that the median total operation duration for the saphenous and synthetic groups using the brachioaxillary access approach was 120.7 ± 9.51 and 91.0 ± 2.04 min, respectively, showing a statistically substantial variation ($P < 0.001$). The saphenous and synthetic groups both saw grafting maturity within a median interval of 39.9 ± 7.71 and 14.0 ± 2.04 days following the process, respectively, with a statistically substantial variation ($P < 0.001$). The average blood loss in the saphenous and synthetic groups, respectively, was 200 and 125 ml, which is statistically substantial ($P < 0.001$). P value greater than 0.05 did not reveal any variation between the two groups in terms of length of hospital stay.

The present investigation found that group A had a 12.0% further thrombosis rate at 6 months in terms of graft thrombosis among the analyzed groups. In group B, 20.0% had additional thrombosis at 6 months. Regarding graft thrombosis, there were no notable differences between the two groups.

Besides, Fumagalli et al.[12] revealed that thrombosis or stenosis and associated interventions accounted for the majority of problems and interventions. There were underlying venous anastomotic stenoses in 57 (71.3%) of the 80 thromboses that had declotting operations. Such instances required revision of venous anastomosis or angioplasty in addition to other treatments. The remaining 23 thromboses (287%) did not have any underlying stenoses.

The present study's findings regarding access failures indicated 12.0% at 6 months in group A and 32.0% at 6 months in group B. Between the two groups, there was little variation in terms of access failure.

Yousef et al.[9] showed that failure of the PTFE brachioaxillary graft access occurs in 10, 20, and 26% of cases at 1, 6, and 12 months, respectively. However, the research by Yousef et al.[9] showed that at 3, 6, and 12 months, PTFE brachioaxillary graft access failure occurred in 8.7, 20, and 6.3% of cases, respectively.

The research by Fumagalli et al.[12] showed that before cannulation, PTFE brachial-comitans grafting main failing and surgical revisions rates were 7.8 and 5.9%, respectively. After removing main failures, the median access survival for primary and secondary patency, respectively, was 12.7 and 44.5 months.

Also, Fumagalli et al.[12] showed that the main failing and revision rates before cannulation were 7.6 and 5.7%, respectively, in the BB-AVG.

The current study's findings on initial patency indicated 56% at 6 m in group B and 68% at 6 months in group A. Between the two groups, there was hardly any variation in primary patency. In addition, in terms of secondary patency, group A had 72% at 6 months, whereas group B had 56% at 6 m. Between the two groups, there was hardly any variation in secondary patency.

Yousef et al.[9] showed that initial patency rates are greater in group II (brachioaxillary shunt PTFE) than in group I (for the brachioaxillary shunt, the saphenous connect), although they are not statistically substantial. At 1, 6, and 12 months, they were 86.7, 76.7, and 63.3%, respectively. In contrast to 66.7, 53.3, and 40% in group I, the assisted primary patency rate is also greater in group II, coming in at 86.7, 76.7, and 70% after 1, 6, and 12 months. Although, this difference is only statistically substantial at 12 months ($P < 0.05$), not at 1 or 6 months. In contrast to 70, 60, and 46.7% in group I, the secondary patency rate was 90, 80, and 73.3% at 1, 6, and 12 months in group II. Nevertheless, at those time points, the difference was not statistically substantial ($P < 0.05$).

Fumagalli et al.[12] revealed that brachial-comitans grafts made of PTFE initial patency rates were 49.5, 29.5, and 19.5% at 12, 24, and 36 months. At 12, 24, and 36 months, the secondary patency rates were 76.3, 62.7, and 54.6%, respectively.

In addition, Davoudi et al.[11] revealed that there was no statistically substantial variation between the two study groups as regards the median primary patency time between the arteriovenous access grafts (AVG) and BVT groups, which was 244.13 ± 103.65 and 264.97 ± 149.28, respectively ($P = 0.533$).

5.1. Conclusion

Brachioaxillary AVG has shown advantages in functioning and safety compared with brachiovena comitans grafts in patients with inadequate retention of all upper limb veins.

The variation in complication rates between the two study groups was not statistically substantial. Therefore, for certain people, B-Ax AVG formation is a suitable surgical procedure given their age, underlying condition, and predicted longevity.

Conflicts of interest

Authors declare that there is no conflict of interest, no financial issues to be declared.

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