

Effect of preoperative functional exercise on cephalic vein diameter, anastomotic blood flow, and postoperative complications in patients with arteriovenous internal fistuloplasty

Juan Zhang,¹ Wei Sun,² Tingting Wang,³ Jie Li,⁴ Min Yu⁵

Abstract

The purpose of this study was to investigate the effect of preoperative functional exercise on cephalic vein diameter, anastomotic blood flow, and postoperative complications in patients with arteriovenous internal fistuloplasty. A total of 140 patients who underwent arteriovenous fistuloplasty from March 2019 to October 2021 were randomly divided into two groups: intervention group (n=70) and control group (n=70). The control group was treated with routine nursing intervention, while the intervention group was treated with preoperative functional exercise and routine nursing intervention. There was no significant difference in the diameter of cephalic vein between the two groups two weeks before the operation ($p=0.742$). The diameter of cephalic vein in the intervention group was larger than that in the control group two weeks after the operation ($p < 0.001$), and the blood flow of anastomotic vein in the intervention group was higher than that in the control group two weeks after the operation ($p < 0.001$). There was no significant difference in the total prevalence of postoperative complications such as vascular stenosis, thrombosis, and swelling hand syndrome between the intervention group and the control group ($P=0.546$). The findings show that preoperative functional exercise may increase the diameter and blood flow in the vessels, and improve vascular conditions in patients with arteriovenous fistuloplasty, but may have no effect on postoperative complications.

Keywords: Preoperative; Functional exercise; Arteriovenous fistuloplasty; Blood flow.

DOI: 10.47391/JPM.6224

Submission completion date: 15-02-2022

Acceptance date: 03-09-2022

Introduction

Arteriovenous internal fistuloplasty is mainly used to
^{1,3-5}Department of Nephrology, ²Department of Anesthesiology, Fifth Medical Center of Chinese PLA General Hospital, China.

Correspondence: Min Yu. Email: yumin326@163.com

ORCID ID:

provide and maintain a vascular pathway in haemodialysis patients. Through surgery, the superficial vein and peripheral artery are anastomosed, allowing arterial blood flow to the superficial vein and thus meeting the blood flow needs of haemodialysis.¹⁻² Arteriovenous internal fistuloplasty includes temporary and permanent plasty, and permanent vascular pathway is the most commonly used method, which plays a decisive role in the success of the operation.³⁻⁴ However, it has been observed that arteriovenous internal fistuloplasty can improve the therapeutic effect in patients to a certain extent, but it is prone to combine complications such as infection, thrombosis, and vascular stenosis.⁵

At present, there is no standard for perioperative management in patients with arteriovenous fistuloplasty, and most studies focus on postoperative exercise, while there is a lack of studies on preoperative functional exercise. A study shows that functional exercise before arteriovenous fistula surgery can improve the success rate of the operation and increase brachial artery blood flow, but does not extend the survival time of the internal fistula and reduce complications.⁶ Another study shows that preoperative functional exercise can increase the vessel diameter and blood flow, and improve vascular conditions in patients with arteriovenous fistuloplasty.⁷ A review of the studies show that there are different viewpoints on the preoperative functional exercise for patients with arteriovenous internal fistuloplasty.

The objective of this study was to investigate the effect of preoperative functional exercise on cephalic vein diameter, anastomotic blood flow, and postoperative complications in patients with arteriovenous internal fistuloplasty.

Patients / Methods and Results

A total of 140 patients who underwent arteriovenous fistuloplasty from March 2019 to October 2021 were included. This study was approved by the Institutional Ethics Committee of Fifth Medical Centre of Chinese PLA General Hospital, China. Patients who had surgical indications for arteriovenous fistuloplasty, were expected

to enter haemodialysis within half a year, and had no limb dysfunction were included in the study. All the participants signed informed consent.

The exclusion criteria were the presence of thrombosis or stenosis in the proximal arteriovenous or central venous of the upper limb, or the venous reflux was affected by thrombosis, stenosis and other diseases, and the fistula could not be made; patients with chronic renal insufficiency needed to start dialysis in emergency; patients with complications due to diseases such as severe coagulation dysfunction and severe hypertension; and those unable to cooperate with this research.

A total of 140 patients were randomly divided into intervention group (n=70) and control group (n=70). The control group was treated with routine nursing intervention. The intervention group was treated with preoperative functional exercise and routine nursing intervention. The preoperative functional exercise was as follows: (i) two weeks before surgery, training the anterior arm with silica gel ring grip force, exercise twice a day for 10 minutes each time; (ii) hot compressing the forearm twice a day for at least 10 minutes; (iii) from four weeks before operation till post-operation, keeping the upper limbs warm and completing the self-clenched fist exercise under the guidance of the doctor; and (iv) holding the ball and forcing with the operation side under guidance, maintaining the pressure > 20 kPa (kilopascal) for ≥10 seconds until the operation.

End-to-end or end-to-side anastomosis of radial artery-cephalic vein was used in all the patients with arteriovenous fistula. The diameter of cephalic vein two weeks before the operation and two weeks after the operation, the blood flow of anastomotic vein two weeks after the operation, and the frequency of postoperative complications such as vascular stenosis, thrombosis and swelling hand syndrome were compared between the two groups.

The diameter of cephalic vein was evaluated by colour doppler ultrasound by the same doctor. The venous blood flow at 5cm from the proximal end of the anastomosis was evaluated by the same doctor.

SPSS 25.0 was used for processing the data. Measurement data were expressed by mean ±SD, and independent samples T-test was used. The enumeration data were expressed by n (%), and the chi-square test was used. P<0.05 indicated that the difference was statistically significant.

In the control group, 40 (57.1%) patients were males and 30 (42.9%) patients were females, aged 47-74 (52.94 ±5.10) years. There were 30 (42.9%) patients with chronic glomerulonephritis, 25 (35.7%) with diabetic nephropathy, 5 (7.1%) with polycystic kidney, and 10 (14.3%) patients with chronic pyelonephritis.

In the intervention group, 42 (60.0%) patients were males and 28 (40.0%) were females, aged 45-73 (53.02 ±5.45) years. There were 31 (44.3%) patients with chronic glomerulonephritis, 26 (37.1%) with diabetic nephropathy, 4 (5.7%) with polycystic kidney, and 9 (12.9%) patients with chronic pyelonephritis.

There was no significant difference in the diameter of cephalic vein between the two groups two weeks before the operation (p=0.742, Table 1). The diameter of cephalic vein in the intervention group was larger than that in the control group two weeks after the operation (p < 0.001, Table 1), and the blood flow of anastomotic vein in the intervention group was higher than that in the control group two weeks after the operation (p < 0.001, Table 1).

Table-1: Comparison of cephalic vein diameter and blood flow of anastomotic vein between the two groups.

Parameter	Control group (n=70)	Intervention group (n=70)	p value
Diameter of cephalic vein 2 weeks before operation (mm)	2.12 ±0.13	2.11 ±0.09	0.742
Diameter of cephalic vein 2 weeks after operation (mm)	3.75 ±0.24	4.20 ±0.19	<0.001
Blood flow of anastomotic vein 2 weeks after operation (mL/min)	983.90 ±61.76	1349.61 ±64.31	<0.001

There was no significant difference in the total incidence of postoperative complications such as vascular stenosis, thrombosis, and swelling hand syndrome between the intervention group and the control group (P=0.546, Table 2).

Table-2: Comparison of the frequency of postoperative complications between the two groups.

Group	Vascular Thrombosis stenosis [n (%)]	Swelling [n (%)]	Total incidence of hand syndrome [n (%)]	Total incidence of postoperative complications[n (%)]
Control group (n=70)	2 (2.9)	2 (2.9)	3 (4.3)	7 (10.0)
Intervention group (n=70)	1 (1.4)	2 (2.9)	2 (2.9)	5 (7.1)
P value	—	—	—	0.546

Conclusion

Preoperative functional exercise may increase the diameter and blood flow of blood vessels and improve vascular conditions in patients with arteriovenous fistuloplasty, but may have no effect on postoperative complications. The limitation of this study was that the sample size was small and the postoperative follow-up time was short, which needs to be further expanded for clinical verification.

Disclaimer: None to declare.

Conflict of Interest: None to declare.

Funding Sources: None to declare.

References

1. Karydis N, Bevis P, Beckitt T, Silverberg D, Halak M, Calder F. An implanted blood vessel support device for arteriovenous fistulas: A randomised controlled trial. *Am J Kidney Dis.* 2020; 75:45-53. doi:10.1053/j.ajkd.2019.05.023
2. Ghanwat SP, Yeramsetti S, Sahu T, Sheorain V, Grover T, Parakh R. A prospective observational study to evaluate utility of USG (ultrasound)-guided arteriovenous fistuloplasty in our institute. *Indian J Vasc Endovasc Surg.* 2021; 8:66-71. doi:10.4103/ijves.ijves_145_20
3. Duque JC, Martinez L, Tabbara M, Dvorquez D, Mehendru SK, Asif A, et al. Arteriovenous fistula maturation in patients with permanent access created prior to or after haemodialysis initiation. *J Vasc Access.* 2017; 18:185-91. doi:10.5301/jva.5000662
4. Khatri N, Nasir K, Dhrolia M, Qureshi R, Ahmad A. Delay in permanent vascular access formation and referral to a nephrologist in incident haemodialysis patients: A single centre experience. *Cureus.* 2021; 13: e20728. doi:10.7759/cureus.20728
5. Wärme A, Hadimeri H, Nasic S, Stegmayr B. The association of erythropoietin-stimulating agents and increased risk for AV-fistula dysfunction in haemodialysis patients. A retrospective analysis. *BMC Nephrol.* 2021; 22:30-9. doi:10.1186/s12882-020-02209-6
6. Chen H, Liu J. A prospective clinical study of functional exercises before arteriovenostomy. *J Clin Nephrol.* 2020; 20:490-3. doi: 10.3969/j.issn.1671-2390.2020.06.010
7. Lv Z, Zhu Y, Gu Y, Wang X. Research on the starting time of perioperative functional exercise in patients with arteriovenous fistula. *Chin J Nurs.* 2019; 54:1224-8. doi: 10.3761/j.issn.0254-1769.2019.08.022.