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Original Article

Effect of self-management and thrombus monitoring on patients with autogenous arteriovenous fistula

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Abstract: Objective: the objective of this study is to explore the effect of a self-management mode on hemodialysis in autogenous arteriovenous fistula patients, and assess the improvement in their self-care, as well as the management and protection abilities of patients through the self-management mode, so as to improve the quality of dialysis. Method: A total of 100 patients undergoing maintenance hemodialysis, who have autogenous fistula and were cared for in the First Affiliated Hospital of Wenzhou Medical University from August 2019 to February 2020 were selected. All patients were divided into either an experimental group (group A, 50 people) or a control group (group B, 50 people), at random. Patients in group A were given self-management education and self-protection behavior education of internal fistulas based on routine nursing, while patients in group B were only given routine nursing. Initially, the general clinical data between the two groups was compared. Then, the patient self-management scale and internal fistula quality assessment were used to evaluate the patients' self-management ability and internal fistula quality. A Philips ClearVue 850 color Doppler ultrasound diagnostic instrument was used to monitor thrombus in patients. Results: we found no significant difference in gender, dialysis frequency (3 times a week), dialysis time and blood biochemical indexes between the two groups ($P > 0.05$). There were statistically significant differences in the self-management ability, internal fistula quality, time effect, grouping effect and interaction effect between the two groups before and after the experiment ($P < 0.001$). The result of the ultrasound examination show that 75 patients with arteriovenous fistula results were normal, while 25 patients had complications, including 11 patients with steal phenomenon, 8 patients with stenosis, and 6 patients had thrombosis. Conclusion: self-management intervention and ultrasonic thrombus monitoring for hemodialysis patients can improve the quality of autogenous arteriovenous fistulas, and help doctors treat patients according to their individual complications and improve the cure rate of the disease.

Keywords: Self-management, ultrasound, thrombus monitoring, hemodialysis, autogenous arteriovenous fistula

Introduction

Blood access during hemodialysis promotes good health of patients [1]. An autogenous fistula can enable smooth blood access for hemodialysis patients, creating a stable blood path, which is a necessary condition for hemodialysis. It helps ensure that hemodialysis patients can carry out efficient dialysis and prolong their life span [2, 3]. With the gradual increase of population aging, the number of patients with chronic kidney disease (CKD) is gradually increasing, and the number of elderly people who need hemodialysis every year is also increasing. In 2012, the number of hemodialysis patients in the world exceeded 2.1 million. According to this estimation, the number of hemodialysis patients in 2020 may exceed 3.8 million. In China, the annual growth rate of uremic patients who need hemodialysis has exceeded 10% [4, 5]. In reality, the number of uremic patients who need hemodialysis is increasing rapidly, so quality management of internal fistulas in medical institutions needs attention. Enhancing the quality of internal fistulas in hemodialysis patients can directly determine the life quality of patients. Improving the quality of internal fistula has become an important concern of hemodialysis patients and the related medical field [6, 7].

In 2015, under the concept of a healthy China, the health management subcommittee of the Chinese Medical Doctor Association proposed

the *Declaration of Self-Health Management* to call on people to carry out health self-management and health protection actions. Although China's medical equipment and technology have gradually matured, there are still many patients who have survival problems after dialysis [8, 9]. Self-health management has a decisive impact on the life quality of patients. The higher the self-management ability of patients is, the faster their recovery speed is [10]. Research shows that in addition to drug treatment, hemodialysis patients with a reasonable diet, a healthy psychology, and good disease monitoring can help improve the quality of treatment. On the contrary, if patients do not manage themselves well, this can cause a series of complications, such as hypertension, renal insufficiency or other chronic diseases [11, 12]. The related research of arteriovenous fistulas in China has a late start, and there is no unified conclusion between the clinical data and the medical viewpoint.

Based on this, self-management concepts and health protection behaviors are being innovatively implemented as patients undergo maintenance hemodialysis with autogenous fistulas to assist them to establish a good self-management mode. With ultrasound detection systems, complications and thrombosis of patients are detected, so as to improve the treatment efficiency of patients.

Materials and methods

Research subjects

A total of 100 patients undergoing maintenance hemodialysis with an autogenous fistula in the First Affiliated Hospital of Wenzhou Medical University from August 2019 to February 2020 were selected. All patients were divided into an experimental group (group A, 50 people) or a control group (group B, 50 people), at random. Patients in group A were given self-management education and self-protection behavior education of internal fistulas based on routine nursing, while patients in group B were only given routine nursing. The data of all patients were complete. This study was approved by the hospital ethics committee. All patients signed the informed consent.

(1) Inclusion criteria: the patient's age was between 18 and 60 years old, with autonomous ability and end-stage renal disease. Patients needed to be accompanied by their relatives for hemodialysis, and could be fully cared for after surgery. The treatment time was more than 3 months.

(2) Exclusion criteria: patients who had heart and other important organ dysfunction, or who were accompanied by other serious complications. Patients who withdrew from hemodialysis were excluded from the study.

Nursing strategy

(1) Group A: routine nursing included: popularizing the knowledge of internal fistulas; popularizing a simple self-assessment of internal fistula quality (feeling the tremor of the internal fistula site, whether there was blood flow that impacted the sound and other abnormal conditions); teaching patients how to relax the internal fistula bandage; thermotherapy (ordinary hot compresses added with a non-thermal CommScope infrared treatment instrument) (Guangxi Nanning Demai Medical Equipment Co., Ltd., China); applying medicine to the internal fistula (Hirudoid (Mobilat Produktions GmbH, German), lidocaine (Guangzhou Hongcheng Biotechnology Co., Ltd., China)); thrombus detection. The self-management model included: popularization of concepts; popularization of behavioral items of patients in a self-management scale; companionship and support of relatives; evaluation of self-management behavior; protection of internal fistula (cleaning the arm thoroughly before dialysis, not touching water within 24 h of dialysis); not bearing weight on the arm of the fistula side; checking whether the fistula had a tremor or vascular murmur every day (at least twice).

(2) Group B: routine nursing included: popularizing the knowledge of an internal fistula; popularizing simple self-assessment of the internal fistula quality (feeling the tremor of the internal fistula site, whether there was blood flow that impacted the sound and other abnormal conditions); teaching patients how to relax the internal fistula bandage; thermotherapy (ordinary hot compress added with a non-thermal CommScope infrared treatment instrument); applying medicine to the internal fistula (Hirudoid and Lidocaine); thrombus detection.

Table 1. Comparison of clinical data of patients

Category		Group A	Group B	P
Gender	Male	35	30	0.554
	Female	15	20	
Dialysis frequency	Twice a week	18	21	
	Four times a week	11	9	0.887
Blood index	blood potassium	5.67±0.28	5.75±0.31	0.399
	blood phosphorus	1.99±0.13	2.04±0.11	0.854
	serum creatinine levels	103±5.98	104±6.01	0.311

Evaluation scale

(1) The Likert 4 scale was used as the patient's self-management scale, which contained 20 items and 4 dimensions. The scoring criteria were 1 (never), 2 (occasionally), 3 (often) and 4 (always). The score range was from 20 to 80 points, and the average score range of each dimension was from 1 to 4. The higher the score was, the stronger the self-management ability of patients was. The scale was revised by experts, and the evaluation results were divided into three levels. The first level represented 'good', the second level represented 'general', and the third level represented 'poor'. Patients with a score aroind 80 points had strong self-management ability, patients with a score between 40-80 points had a general self-management ability, and patients with a score less than 40 had poor self-management level.

(2) Internal fistula quality assessment scale: classification, location, tremor and pulsation of the internal fistula, whether there was thrombus, blood flow during dialysis, whether there was swelling, heat, pain and expansion of the fistula, puncture resistance, and whether there was induration. The nurses who participated the study made a comprehensive evaluation on the results of the scale, and the evaluation criteria were divided into three grades: excellent, good and poor.

Thrombus monitoring

The complications and thrombosis were monitored by Philips ClearVue 850 color Doppler ultrasound diagnostic instrument (SonoSite S-Cath Ultrasound System). A high frequency linear array probe was adopted, and the frequency of the ultrasonic probe was 7.5 MHz. Before dialysis, the two groups of patients were assessed by ultrasound, and the parameters of brachial artery blood flow were measured to determine the situation and type of thrombosis.

Statistical analysis

SPSS 26.0 software was used for statistical analysis. The measurement data were expressed by mean ± standard deviation ($\bar{x} \pm s$). t-test was used for the comparative analysis of the data. The count data were compared by χ^2 test. $P < 0.05$ meant that the difference was statistically significant.

Results

Comparison of clinical data of patients

The clinical data of group A and group B were compared, including gender, hemodialysis time and frequency, and blood indexes, as shown in **Table 1**. The results of **Table 1** were analyzed visually, as shown in **Figure 1A** and **1B** below.

The above results were tested by independent sample t test, and **Figure 2** presents the results.

Self-management ability of patients

Before and after the experiment, the total score of self-management ability of patients in group A and group B was compared. **Table 2** shows the results.

The results in **Table 2** are analyzed visually, as shown in **Figure 3** below.

Quality comparison of internal fistula in patients

The internal fistula quality of group A and group B before and after the experiment was compared (the quality comparison is the percentage of the patients whose internal fistula is above a good level as evaluated by a nurse). **Table 3** presents the results.

The results in **Table 3** are analyzed visually, as shown in **Figure 4** below.

The time effect, grouping effect and interaction effect of the self-management ability and inter-

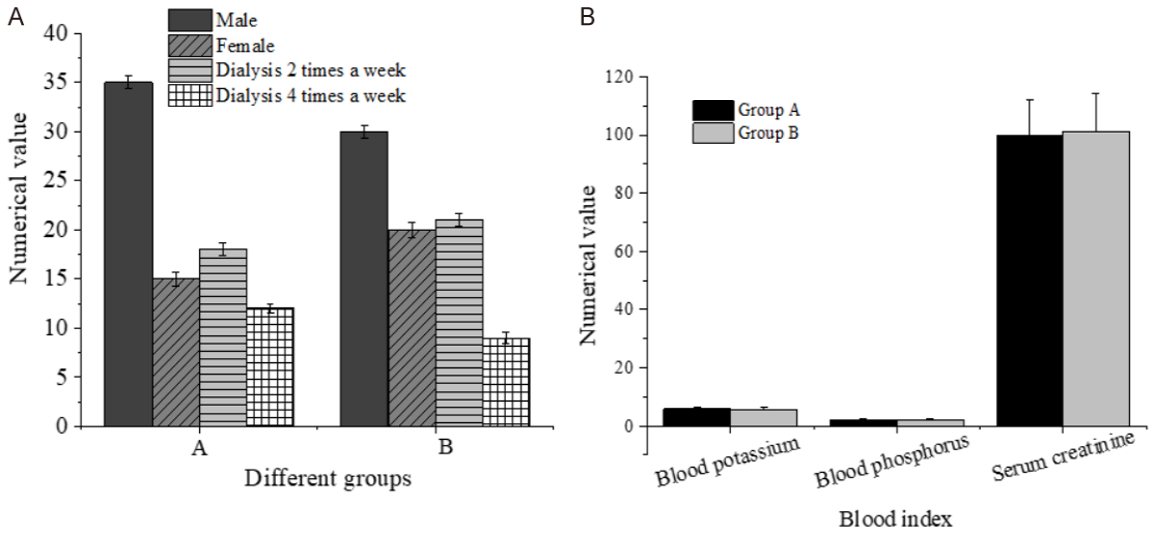

Figure 1. Comparison of general clinical data of the patients between the two groups (A: Male to female ratio and dialysis frequency of the two groups; B: Comparison of potassium, phosphorus and serum creatinine levels in the blood between the two groups).

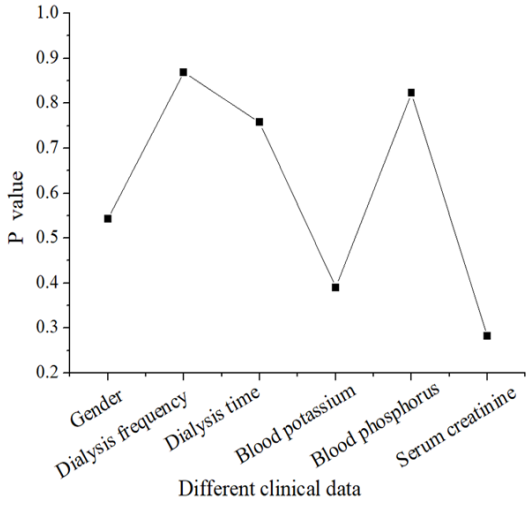

Figure 2. Comparison of clinical data and *p* value between the patients in the two groups. The figure shows the results of an independent sample t-test for the above results. **Figures 1** and **2** reveal that there is no significant difference in the gender ratio between group A and group B ($P > 0.05$); there is no significant difference in dialysis frequency between the two groups (dialysis twice a week and dialysis four times a week) ($P > 0.05$); the blood potassium content of the two groups are 5.67±0.28 and 5.75±0.31, respectively, with no significant difference ($P > 0.05$); the blood phosphorus content of the two groups are 1.99±0.13 and 2.04±0.11, respectively, with no significant difference ($P > 0.05$); the serum creatinine levels of the two groups are 103±5.98 and 104±6.01, respectively, with no significant difference ($P > 0.05$).

nal fistula quality of the two groups before and after the experiment are compared, as shown in **Figure 5** below.

Comparison of time effect, grouping effect and interaction effect of patients

Color Doppler ultrasound was used to monitor the complications of patients, and **Table 4** presents the results.

Figure 6 is the B-ultrasound image of patients with thrombosis.

Discussion

Generally, strengthening the self-health management ability of patients with diseases can help them to regulate their physical functions, reduce the spread rate of the disease, and reduce the occurrence of other symptoms. In addition, the management ability of patients' physical and mental health and quality of life will be improved [13, 14]. Intervention management was carried out in the experimental group. The total score of self-management in the experimental group was significantly higher than that in the control group ($P < 0.05$). This shows that self-management intervention can enhance the self-management and nursing ability of patients, which is consistent with the research results of Konstadina et al. (2018)

Table 2. Comparison of scores of patients' self-management ability

Self-management category	Group A	Group B	t	P
Before experimental intervention	48.98±4.01	49.01±3.78	0.711	0.503
One month after the intervention	64.89±5.21	52.67±4.03	0.565	0.498
Three months after the intervention	63.78±5.14	50.73±3.99	0.688	0.371

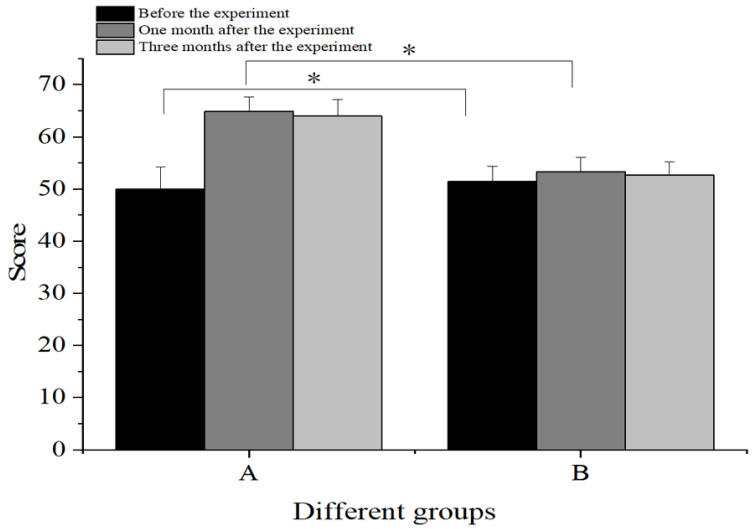

Figure 3. Total score of self-management of patients (*stands for significant difference). **Figure 3** shows that the total scores of self-management of group A and group B before the experiment are 48.98±4.01 and 49.01±3.78, respectively, with no significant difference (P > 0.05). The total scores of self-management in group A and group B one month after the experiment are 64.89±5.21 and 52.67±4.03, respectively, which are significantly different from those before the experiment (P < 0.05).

Table 3. Comparison of internal fistula quality between group A and group B

Self-management category	Group A	Group B	P (time effect, grouping effect and interaction effect)
Before experimental intervention	79%	78%	< 0.001
One month after the intervention	8.5%	74%	< 0.001
Three months after the intervention	90%	79%	< 0.001

[15]. They believed that there is a positive relationship between the self-management ability of hemodialysis patients and the quality of the internal fistula; moreover, self-management intervention can reduce the symptoms of depression and anxiety of patients, so as to enhance the ability of patients to control the disease. Therefore, with the help of medical staff, patients can establish a good self-health management mode, improve their health management knowledge, and better pay attention to the maintenance and management of the body, which all make the effect significantly higher health and treatment recovery than before [16, 17]. If the self-management mode of patients is determined, patients can actively cooperate with medical staff for appropriate treatment. Moreover, patients can establish a good way of life by their own efforts, and manage their bodies well while establishing a good mental state [18].

The self-management ability of patients is investigated by a scale. The results suggest that after the establishment of the self-management mode, the total score of the experimental group was significantly higher than that before the intervention (P < 0.05), which is consistent with the research results of Thadhani et al. (2016) [19]. After self-management intervention, the treatment effect of patients is significantly enhanced. In the follow-up process, hemodialysis patients are treated with more care and help, which can relieve their own resistance and help them actively cooperate with treatment, strengthening their own health management, and greatly improve the recovery rate of patients. Our results also reveal that the self-management model can improve the quality of the internal fistula. Before intervention, there was no significant difference in the self-management index score and the internal fistula quality between the two groups. After the intervention, the scores of self-management indexes and the quality of the internal fistula in the experimental group were significantly enhanced, which was significantly different

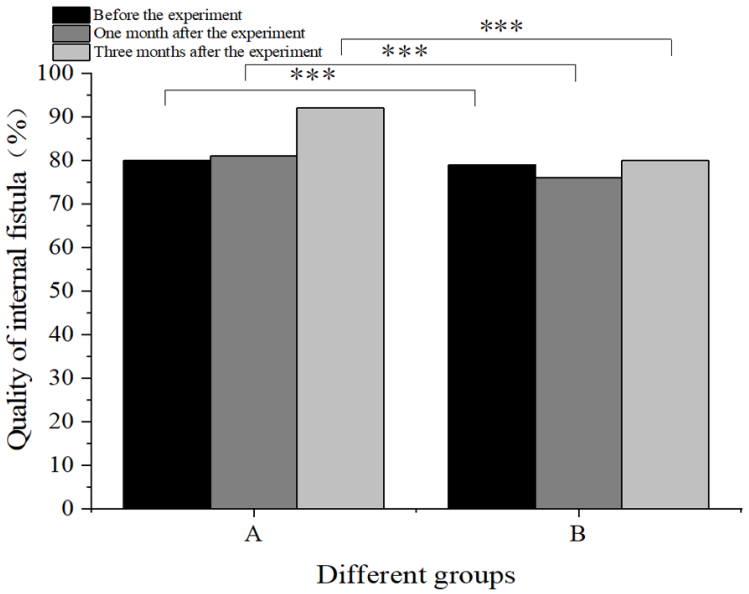

Figure 4. Quality comparison of internal fistula in patients (***stands for significant difference). **Figure 4** shows that the internal fistula quality of group A and group B before the experiment is 79% and 78%, respectively, and there are significant differences in time effect and grouping effect between the two groups ($P < 0.001$). One month after the experiment, the internal fistula quality of group A and group B is 78.5% and 74%, respectively, and there are significant differences in time effect and grouping effect between the two groups ($P < 0.001$). Three months after the experiment, the internal fistula quality of group A and group B is 90% and 79%, respectively, and there are significant differences in time effect and grouping effect between the two groups ($P < 0.001$). The quality of the internal fistula after the experiment is significantly higher than that before the experiment ($P < 0.001$).

from that of the control group ($P < 0.05$), and this result is consistent with the research results of Suk et al. (2015) [20]. The quality of the internal fistula in hemodialysis patients given self-management mode intervention is significantly improved. Thrombosis of the internal fistula may cause long-term vascular blockage [21]. B-ultrasound examination results of the two groups of patients shows that a thrombosis formed in some patients, and the thrombus was relatively strong. We speculated that this is from the stenosis, and the formation of thrombus begins here. Moreover, this kind of thrombus is also "pushed" by the pressure of the posterior blood flow in the process of formation. The scope of the thrombosis is relatively dense, and it does not leave space around it. This kind of thrombus is directly caused by the obstruction of blood flow due to stenosis, which can be considered as a kind of primary thrombosis. According to the individual results, the medical staff can carry out targeted treatment and nursing.

However, there are still some deficiencies in this study. The intervention time of the subjects is relatively short, and the quality control of the autogenous arteriovenous fistula is a long-term and continuous process. The effect of thrombus monitoring has not reached the optimal state because of the complications of the patient's own blood vessels and internal fistula. In the follow-up research, the monitoring time will be extended and the self-management mode will be improved and optimized.

Conclusion

The establishment of a self-management model of care in patients with an internal fistula can improve the self-management ability of hemodialysis patients, and enable patients to carry out daily self-nursing of the internal fistula, and help them diagnose any issues with the internal fistula, and actively communicate with medical staff in their daily life. After patients understand the application of the concept of self-management, based on the significantly improved nursing level of autogenous fistulas, the quality of the autogenous fistula can be significantly improved. This can provide a strong basis for smooth and efficient hemodialysis, and reduce the incidence of complications. With color Doppler ultrasound detection, complications and thrombosis can be mastered in a timely manner, so as to improve the dialysis quality of patients, improve the life quality of patients, and increase the cure rate of the disease.

Disclosure of conflict of interest

None.

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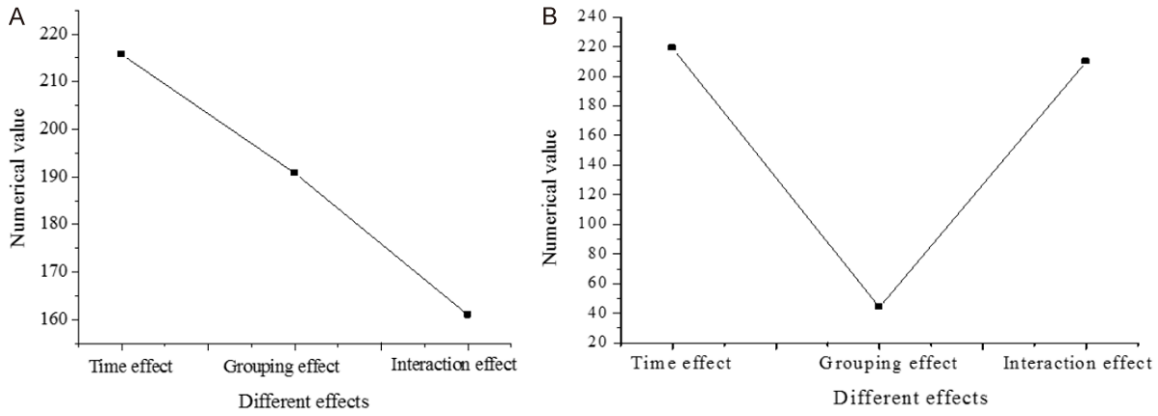

Figure 5. Comparison of time effect, grouping effect and interaction effect between two groups of patients after experiment (A: Time effect, grouping effect and interaction effect formed by self-management comparison between the two groups; B: Time effect, grouping effect and interaction effect formed by the quality comparison of internal fistula between the two groups) **Figure 5** shows the comparison of the self-management ability between group A and group B before the experiment and one month and three months after the experiment. There are significant differences in time effect, grouping effect and interaction effect formed by the comparison of self-management ability ($P < 0.001$). There are significant differences in the comparison of time effect, grouping effect and interaction effect formed by the quality comparison of internal fistula before and after experiment.

Table 4. Monitoring results of complications in patients

Category	Number of patients	Blood flow parameters
Normal	85	1221.58±116.15
Steal	11	1009±108.56
Stenosis	8	399.98±38.21
Thrombosis	6	1026.39±103.99

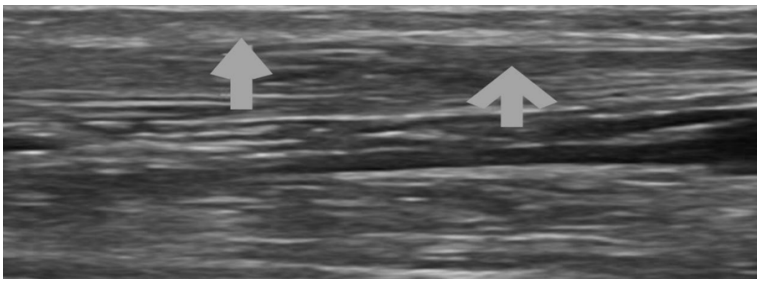

Figure 6. B-ultrasound images of patients with thrombosis. An internal fistula thrombosis can cause vascular occlusion, which will not automatically restore patency under normal circumstances. **Table 1** suggests that the blood flow parameters of patients with complications will be reduced to varying degrees. **Figure 6** shows that the thrombus fills the vascular cavity, is relatively firm, occluding the surrounding space, and the activity of the squeezed vessel thrombus is diminished. Thus the stenosis leads to thrombosis.

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