

Application Effect of an Antithrombotic Management Strategy Based on the 5A Model in Patients after Anterior Cruciate Ligament Reconstruction of the Knee Joint

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Abstract [Objectives] To investigate the application effect of an antithrombotic management strategy based on the 5A model in patients after anterior cruciate ligament (ACL) reconstruction of the knee joint. [Methods] A total of 120 patients who underwent ACL reconstruction were selected and randomly divided to either the control group or the observation group, with 60 patients in each. The control group received standard antithrombotic care, whereas the observation group received antithrombotic management based on the 5A model. Outcomes compared between the two groups included the mastery rate of antithrombotic knowledge, Lysholm knee joint scores, incidence of lower extremity deep vein thrombosis (DVT), rehabilitation compliance, and patient satisfaction during hospitalization. [Results] The observation group demonstrated significantly higher mastery rates of antithrombotic knowledge, Lysholm scores at one week and one month post-operation, rehabilitation compliance, and satisfaction compared to the control group. The incidence of DVT was significantly lower in the observation group. These differences were statistically significant ($P < 0.05$). [Conclusions] Antithrombotic management based on the 5A model can enhance patients' understanding of antithrombotic knowledge and rehabilitation compliance after ACL reconstruction, facilitates the recovery of knee joint function, and decreases the risk of DVT.

Key words 5A model, Anterior cruciate ligament (ACL) reconstruction, Venous thromboembolism (VTE), Deep vein thrombosis (DVT), Rehabilitation care

1 Introduction

Anterior cruciate ligament (ACL) injury is a prevalent sports-related injury that often results in pain, swelling, restricted movement, and joint instability, thereby affecting motor function and overall quality of life^[1]. Arthroscopic ACL reconstruction is an important intervention for restoring knee joint stability^[2]. However, postoperative factors such as pain, brace fixation, reduced physical activity, and inadequate adherence to rehabilitation training can slow down venous return in the lower extremities, thereby increasing the risk of venous thromboembolism (VTE). In severe cases, this condition may progress to pulmonary embolism, which poses a significant threat to life^[3–4]. At present, there are still challenges in the antithrombotic management after ACL reconstruction, including inadequate risk identification, limited methods of education and publicity, insufficient patient engagement, and weak continuity of care post-discharge. The 5A model, comprising assessment, advice, agreement, assistance, and follow-up arrangement, emphasizes behavioral modification, self-management, and sustained care^[5–6]. This study implemented an antithrombotic management strategy based on the 5A model for patients undergoing ACL reconstruction, aiming to evaluate its clinical application effect in postoperative antithrombotic therapy and rehabilitation management.

2 Materials and methods

2.1 Research objects A quasi-experimental research design was employed in this study. A total of 120 patients who underwent ACL reconstruction and were admitted to the Department of Orthopedics at Taihe Hospital in Shiyan City between May 1, 2025, and May 1, 2026, were selected as objects. Based on the nursing management methods implemented, the patients were divided into two groups: a control group and an observation group, each comprising 60 individuals. The control group received conventional antithrombotic care, whereas the observation group was provided with antithrombotic management based on the 5A model.

Inclusion criteria: participants aged 18 years or older; ACL rupture confirmed by clinical symptoms, physical examination, and imaging studies; eligibility for arthroscopic ACL reconstruction; complete clinical information; and provision of informed consent along with willingness to cooperate with the study. **Exclusion criteria:** age below 18 years; concomitant posterior cruciate ligament rupture; avulsion fractures of the posterior tibial margin or intercondylar spine fractures necessitating open reduction and internal fixation; history of vascular surgery; presence of thrombosis or predisposition to thrombosis prior to surgery; coagulation disorders; malignant tumors; severe dysfunction of vital organs; and severe mental illness or cognitive impairment.

2.2 Nursing methods The control group received standard antithrombotic care, which encompassed VTE and bleeding risk assessments, documentation of risk classification, bedside alerts for medium- to high-risk patients, and risk notifications. Additionally, care was administered in accordance with physicians' recommendations, including basic preventive measures, physical prophylaxis, and pharmacological interventions. Patients were also in-

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structed to perform ankle pump exercises and isometric quadriceps femoris contractions, alongside reinforced guidance regarding water intake, diet, adherence to prescribed medications, and follow-up visits.

The observation group implemented the 5A model of antithrombotic management in addition to standard care. (i) Assessment: an integrated VTE management process involving both physicians and nurses was established. A closed-loop management system encompassing "assessment and screening, risk early warning, intervention implementation, and dynamic re-assessment" was conducted. Patients' basic information, medical history, body mass index (BMI), lifestyle, injury type, pain and swelling, joint range of motion, muscle strength, brace fixation, weight-bearing status, VTE risk, bleeding risk, psychological status, antithrombotic knowledge, and self-management capabilities were comprehensively evaluated. (ii) Advice: based on the patient's risk level, educational background, and stage of rehabilitation, a comprehensive explanation of the risks associated with VTE, the necessity of thrombus prevention, rehabilitation exercises, anticoagulant medication usage, physical prevention strategies, and the recognition of abnormal symptoms was provided through various methods, including oral explanations, graphic and textual manuals, video demonstrations, bedside demonstrations, WeChat official account notifications, and WeChat group reminders. (iii) Agreement: short-term and phased goals were collaboratively established by physicians, nurses, and patients, such as mastering antithrombotic knowledge, performing daily ankle pump exercises, correctly wearing braces, adhering to prescribed medication regimens, and attending follow-up visits punctually. The primary responsibility of patients was reinforced through rehabilitation schedule check-ins, feedback within WeChat groups, and supervision by family members. (iv) Assistance: the patients were managed collaboratively by orthopedic physicians, specialist nurses, rehabilitation therapists, pharmacists, nutritionists, and diagnostic departments. Specialist nurses conducted bedside demonstrations, corrected patients' movements, and evaluated therapeutic outcomes. They implemented rehabilitation pathway guidelines to clarify key points and training standards for thrombus prevention at each stage, and promptly intervened in response to pain, anxiety, improper movements, reduced compliance, and concerns regarding medication. (v) Follow-up arrangement: before discharge, the patient's risk of VTE, proficiency in antithrombotic knowledge, training skills, medication use, and family support status were reassessed, and discharge instruction sheets were provided. After discharge, follow-up visits were conducted via telephone calls, WeChat groups, or official accounts to monitor the patient's

rehabilitation training, pain and swelling, medication compliance, and any abnormal symptoms. Timely follow-up visits were encouraged, and patients identified as high-risk received focused tracking and management.

2.3 Observation indicators

2.3.1 Mastery rate of antithrombotic health knowledge. At the time of discharge, the responsible nurse assessed the patients' and their families' comprehension of risk factors, clinical manifestations, preventive strategies, ankle pump exercises, medication precautions, physical prevention methods, and the abnormal handling of VTE. Mastery rate = (Number of cases fully mastered + Number of cases partially mastered) / Total number of cases $\times 100\%$.

2.3.2 Lysholm knee joint score. The function of the knee joint was assessed at three time points: prior to operation, one week post-operation, and one month post-operation. The evaluation utilized a 100-point scale, with higher scores indicating superior knee joint function.

2.3.3 Incidence of DVT. Lower extremity vascular color Doppler ultrasound examinations were conducted on the 1st, 7th, and 14th d after the operation. The detection of DVT at any of these time points was recorded as a single case.

2.3.4 Rehabilitation training and compliance with lifestyle behaviors. The Clinical Rehabilitation Compliance Assessment Form was utilized to evaluate adherence to in-hospital rehabilitation, out-of-hospital rehabilitation, and lifestyle behaviors, with each item scored on a scale of 0 to 100 points.

2.3.5 Satisfaction during hospitalization. Satisfaction during hospitalization was assessed either one day prior to discharge or on the day of discharge. Satisfaction rate = (Number of very satisfied cases + Number of satisfied cases + Number of generally satisfied cases) / Total number of cases $\times 100\%$.

2.4 Statistical methods Data analysis was performed using SPSS 25.0. Measurement data were presented as mean $\pm$ standard deviation ($\bar{x} \pm s$), and comparisons between groups were conducted using the independent samples *t*-test. Counting data were expressed as number of cases and percentages (%). The chi-square (χ^2) test was employed for group comparisons, with Fisher's exact test applied when expected frequencies were small. A *P*-value less than 0.05 was considered statistically significant.

3 Results and analysis

3.1 General information There were no statistically significant differences between the two patient groups regarding age, gender, BMI, injured side, preoperative Lysholm score, or the number of medium- to high-risk VTE cases ($P > 0.05$), indicating that the two groups were comparable (Table 1).

Table 1 Comparison of general data between the two patient groups ($n = 60$)

Group	Age//year	Male/female	BMI//kg/m ²	Left knee/right knee	Preoperative Lysholm score//point	Number of medium- to high-risk VTE cases
Control	31.76 $\pm$ 7.52	36/24	23.58 $\pm$ 2.67	29/31	56.83 $\pm$ 6.92	21
Observation	32.14 $\pm$ 7.29	34/26	23.72 $\pm$ 2.81	32/28	57.12 $\pm$ 7.05	22
t/χ^2	0.281	0.137	0.280	0.300	0.227	0.036
<i>P</i>	0.779	0.711	0.780	0.584	0.821	0.849

3.2 Mastery rate of antithrombotic knowledge After the intervention, the mastery rate of antithrombotic health education knowledge in the observation group was 95.00% , higher than the 76.67% observed in the control group, and the difference was statistically significant ($P < 0.05$, Table 2).

Table 2 Comparison of mastery rate of antithrombotic knowledge between the two patient groups ($n = 60$)

Group	Number of cases fully mastered	Number of cases partially mastered	Number of cases not yet mastered	Mastery rate//%
Control	30	16	14	76.67
Observation	50	7	3	95.00
χ^2				8.292
P				0.004

3.3 Lysholm knee joint score There was no statistically significant difference in the Lysholm scores between the two groups before the operation ($P > 0.05$). However, at one week and one month post-operation, the scores of the observation group were higher than those of the control group, and the difference was statistically significant ($P < 0.05$, Table 3).

Table 3 Comparison of Lysholm knee joint scores at different time points between the two patient groups ($n = 60$, points)

Group	Before operation	One week post-operation	One month post-operation
Control	56.83 $\pm$ 6.92	67.24 $\pm$ 7.63	79.36 $\pm$ 7.82
Observation	57.12 $\pm$ 7.05	73.58 $\pm$ 7.05	88.41 $\pm$ 6.38
t	0.227	4.727	6.946
P	0.821	<0.001	<0.001

Table 6 Comparison of satisfaction rate during hospitalization between the two patient groups ($n = 60$)

Group	Number of cases	Number of very satisfied cases	Number of satisfied cases	Number of generally satisfied cases	Number of unsatisfied cases	Satisfaction rate//%
Control	60	30	16	6	8	86.67
Observation	60	43	13	3	1	98.33
P						0.032 ^①

NOTE ^①Fisher’s exact test was employed.

4 Discussion

Although patients after ACL reconstruction are mainly young and middle-aged adults, factors such as postoperative pain, swelling, brace fixation, and inadequate early weight-bearing can slow down venous return in the lower extremities, thereby increasing the risk of DVT. Some patients underestimate the importance of VTE prevention due to their perception of good baseline health, which adversely affects their early mobilization, adherence to physical prophylaxis, and compliance with anticoagulant therapy. Therefore, effective postoperative antithrombotic management requires not only the implementation of preventive measures by medical staff but also the enhancement of patients’ risk awareness and self-management capabilities.

Traditional antithrombotic care primarily emphasizes unidi-

3.4 Incidence of DVT The incidence of DVT in the observation group was 3.33% , which was lower than the 16.67% observed in the control group (Table 4). This difference was statistically significant ($P < 0.05$).

Table 4 Comparison of incidence of DVT between the two patient groups ($n = 60$)

Group	Incidence of DVT	No incidence of DVT	Incidence//%
Control	10	50	16.67
Observation	2	58	3.33
χ^2			5.926
P			0.015

3.5 Rehabilitation compliance The scores for in-hospital rehabilitation training, out-of-hospital rehabilitation training, and adherence to lifestyle behaviors in the observation group were significantly higher than those in the control group ($P < 0.05$, Table 5).

Table 5 Comparison of rehabilitation training and compliance with lifestyle behaviors between the two patient groups ($n = 60$, points)

Group	Compliance with in-hospital rehabilitation training	Compliance with out-of-hospital rehabilitation training	Compliance with lifestyle behaviors
Control	79.15 $\pm$ 8.34	75.62 $\pm$ 9.16	77.23 $\pm$ 8.57
Observation	90.21 $\pm$ 6.18	86.94 $\pm$ 7.31	89.02 $\pm$ 6.44
t	8.253	7.482	8.519
P	<0.001	<0.001	<0.001

3.6 Satisfaction during hospitalization The satisfaction rate during hospitalization in the observation group was 98.33% , higher than the 86.67% observed in the control group, and the difference was statistically significant ($P < 0.05$, Table 6).

rectional knowledge transmission and lacks systematic monitoring and dynamic feedback regarding patients’ comprehension, execution difficulties, and post-discharge behaviors. This limitation hinders the provision of continuous rehabilitation care after ACL reconstruction^[7]. The 5A model engages patients as active participants in their care through a structured process involving assessment, advice, agreement, assistance, and follow-up arrangement. Utilizing individualized health education, collaborative goal setting, guidance on rehabilitation pathways, bedside demonstrations, family involvement and supervision, as well as ongoing follow-up visits, this model enables patients to clearly understand the critical aspects of antithrombotic prevention and rehabilitation tasks at each stage. This study demonstrated that the observation

clude bone resorption inhibitors, bone formation stimulators, and dual-action agents that possess both therapeutic effects^[1]. In clinical practice at Wuxi Traditional Chinese Medicine Hospital, bisphosphonates and calcitonins were administered in a total of 424 cases, suggesting that treatment remains suboptimal for certain patients. It is imperative for clinicians to emphasize the standardized management of OP. Furthermore, the utilization of calcium supplements and vitamin D as part of basic treatment has not yet achieved comprehensive implementation. Moving forward, enhanced health management and therapeutic interventions should be prioritized for high-risk populations and diagnosed patients with OP.

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group exhibited higher mastery rate of antithrombotic knowledge, greater adherence to both in-hospital and post-discharge rehabilitation training, improved compliance with recommended lifestyle behaviors, and increased patient satisfaction compared to the control group. These findings suggest that the implemented model effectively facilitates a transition from passive receipt of care to active patient engagement in management. Furthermore, the observation group achieved significantly higher Lysholm scores at one week and one month post-operation, alongside a notably lower incidence of DVT relative to the control group. These outcomes may be attributed to comprehensive interventions, including dynamic risk assessment, coordinated collaboration between physicians and nurses, standardized rehabilitation guidance, and sustained follow-up management after hospital discharge.

In conclusion, antithrombotic prevention management based on the 5A model incorporates risk assessment, health education, rehabilitation training, multidisciplinary collaboration, and continuous care into a comprehensive, closed-loop process. This approach enhances patients' knowledge of VTE prevention and treatment, improves rehabilitation adherence after ACL reconstruction, facilitates knee joint function recovery, reduces the risk of DVT, improves the quality of care, and increases patient satisfaction. Furthermore, it offers a valuable reference for clinical postopera-

tive antithrombotic prevention management.

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