Construction and Clinical Application of ACTED-based Management Strategy for Stiffness and Thrombus Prevention After Anterior Cruciate Ligament Reconstruction

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Abstract: To explore the clinical effect of an ACTED-based management strategy targeting stiffness and thrombus prevention in patients undergoing anterior cruciate ligament reconstruction. Methods: A total of 96 patients who received anterior cruciate ligament reconstruction in our hospital between May 2024 and May 2025 were enrolled and randomly divided into two groups, with 48 cases in each group. The control group received routine postoperative nursing, while the observation group was managed with the ACTED-based strategy for stiffness and thrombus prevention. The incidence of limb stiffness and thrombosis, pain intensity and knee joint function were compared between the two groups. Results: The observation group presented lower incidence of postoperative limb stiffness and thrombosis as well as milder pain than the control group (P<0.05). Meanwhile, the WOMAC scores of knee joint function in the observation group were significantly lower after intervention (P<0.05). Conclusion: The ACTED-based management strategy for stiffness and thrombus prevention can reduce the incidence of limb stiffness and thrombosis, relieve postoperative pain and facilitate the functional recovery of knee joints in patients after anterior cruciate ligament reconstruction.

Keywords: ACTED Model; Anterior Cruciate Ligament Reconstruction; Stiffness and Thrombus Prevention; Management Strategy; Construction; Clinical Application

1. Introduction

The anterior cruciate ligament is a core structure of the knee joint and plays a decisive role in maintaining knee stability. Anterior cruciate ligament injury is commonly seen in clinical practice, mostly caused by sports trauma and other external forces, which will severely impair normal knee function[1-2]. Anterior cruciate ligament reconstruction has become the mainstream treatment for such injuries, which can restore the anatomical structure of the damaged ligament effectively. Nevertheless, this surgical procedure causes certain trauma to the body and leads to slow postoperative recovery. Limited early mobility after surgery also raises the risk of limb stiffness and deep venous thrombosis of lower extremities, which hinders patient rehabilitation[3-4]. The ACTED-based management strategy for stiffness and thrombus prevention can deliver comprehensive and targeted postoperative nursing interventions, creating favorable conditions for patients' recovery. This study mainly discusses the clinical value of this nursing model.

2. Materials and Methods

2.1 General Data

From May 2024 to May 2025, 96 patients undergoing anterior cruciate ligament reconstruction in our hospital were selected as research subjects. All participants were randomly assigned into two groups, including 48 cases in the control group receiving routine postoperative nursing and 48 cases in the observation group adopting the ACTED-based management strategy for stiffness and thrombus prevention.

In the control group, there were 25 males and 23 females, with ages ranging from 32 to 57 years and a mean age of (43.45±1.58) years. The body mass index (BMI) was 22 to 25 kg/m², with an average of (23.68±1.45) kg/m². Among them, 26 patients had left-sided ligament injury and 22 had right-sided injury.

In the observation group, there were 26 males and 22 females, with ages ranging from 33 to 59 years and a mean age of (43.68±1.98) years. The BMI ranged from 22 to 25 kg/m², with an average of (23.23±1.15) kg/m². There were 27 cases of left-sided injury and 21 cases of right-

sided injury. No statistically significant difference was found in baseline data between the two groups (P>0.05).

2.2 Methods

The control group was given standard postoperative nursing. Medical staff closely monitored the wound condition and implemented routine wound care in the early postoperative stage. Nurses assisted patients to perform passive activities at first, and guided them to gradually switch to active exercises in line with individual recovery progress.

The observation group applied the ACTED-based management strategy focusing on stiffness and thrombus prevention, and the specific measures were as follows.

(1) Assessment (A): During postoperative rehabilitation, nurses conducted comprehensive assessment for each patient to evaluate the risk of limb stiffness and lower extremity deep venous thrombosis, as well as factors affecting early functional recovery. Corresponding nursing plans were formulated on the basis of individual conditions.

(2) Communication (C): Nurses explained the significance of early postoperative activities to patients in detail, so as to raise their attention to rehabilitation training.

(3) Training (T): Patients were informed of the characteristics of this nursing model and the purposes of various rehabilitation measures, helping them quickly master relevant rehabilitation knowledge and skills.

(4) Education (E): Patients were instructed to take the initiative in thrombosis prevention. Ankle pump exercises were required: keep the feet dorsiflexed for 3 to 5 seconds and then relax, and repeat the movement 20 times per set. Patients were also told to elevate the affected limbs appropriately and wear anti-thrombus compression stockings properly. Family members were guided to assist patients with early passive exercises to increase the activity volume of lower extremities. Leg hanging exercises beside the bed were initiated on the second day after surgery, lasting 10 to 15 minutes each time, three times a day. Patients were then guided to perform knee extension exercises with gradually increased range of motion. Straight leg raising training was started one week after surgery, 10 minutes each time, three times a day. The exercise intensity was increased progressively according to recovery status.

(5) Follow-up (D): Nurses tracked patients' postoperative recovery and the implementation of rehabilitation training, and offered timely guidance to standardize exercise methods.

2.3 Observation Indicators

(1) Incidence of limb stiffness and thrombosis, and postoperative pain intensity. Pain was evaluated via the Visual Analogue Scale (VAS), with a score ranging from 0 to 10. Higher scores indicated more severe pain. The incidence of limb stiffness and thrombosis in all patients was recorded statistically.

(2) Knee joint function. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was adopted to assess knee function. The scale consists of three dimensions: activity limitation (0-20 points), joint stiffness (0-8 points) and joint function (0-68 points), with a total score of 0 to 96 points. Higher total scores represented worse knee joint function.

2.4 Statistical Methods

SPSS 25.0 software was used for data analysis. Measurement data such as pain scores and knee function scores were expressed as mean ± standard deviation and compared via t-test. Enumeration data including incidence rates were presented as percentages and analyzed by Chi-square test. A P value less than 0.05 was considered statistically significant.

3. Results

3.1 Comparison of Postoperative Limb Stiffness, Thrombosis Incidence and Pain Intensity

The observation group had lower pain scores, lower incidence of limb stiffness and thrombosis than the control group, and the differences were statistically significant (P<0.05). See Table 1.

Table 1. Comparison of Pain Intensity, Incidence of Limb Stiffness and Thrombosis Between the Two Groups ($\bar{x}\pm s$)

Group	Number of Cases	Postoperative Day1	Postoperative Day5	Limb stiffness[n(%)]	Thrombosis [n(%)]
Observation	48	5.58±1.45	3.12±0.45	2（4.17）	1（2.08）
Control	48	5.51±1.05	4.23±0.32	6（12.50）	7（14.58）
t	-	0.271	13.927	3.345	4.909

P	-	0.787	<0.001	0.035	0.027

3.2 Comparison of Knee Joint Function Scores

After intervention, the WOMAC scores of the observation group were obviously lower than those of the control group (P<0.05). See Table 2.

Table 2. Comparison of WOMAC Scores of Knee Joint Function Between the Two Groups ($\bar{x}\pm s$)

Group	Number of Cases	Activity limitation		Joint stiffness		Joint function		Total score	
		Before Nursing	After Nursing	Before Nursing	After Nursing	Before Nursing	After Nursing	Before Nursing	After Nursing
Observation	48	14.56±1.23	3.68±1.25	7.15±0.23	2.86±0.89	56.45±2.45	13.45±3.05	78.45±5.44	20.45±3.35
Control	48	14.99±1.31	6.05±1.41	7.14±0.35	4.27±1.05	56.05±2.33	24.15±3.15	77.68±5.05	36.23±2.45
t	-	1.658	8.714	0.165	7.097	0.820	16.908	0.719	26.342
P	-	0.101	<0.001	0.869	<0.001	0.415	<0.001	0.474	<0.001

4. Discussion

Anterior cruciate ligament reconstruction is the primary treatment for patients with cruciate ligament injuries in clinical practice, which can repair the physiological structure of damaged ligaments effectively. However, the surgical trauma forces patients to stay in bed for a long time in the early postoperative period. Reduced physical activity and slowed blood circulation will increase the risk of limb stiffness and lower extremity deep venous thrombosis, which impedes the overall rehabilitation process[5-6].

The ACTED-based management strategy for stiffness and thrombus prevention is formulated in accordance with patients' clinical conditions. Medical staff assess individual risks of limb stiffness and thrombosis after surgery, conduct targeted communication and health education to help patients understand the inducing factors and adverse impacts of the two complications. Patients can fully recognize the importance of early rehabilitation, take an active part in training activities and adjust exercise plans under professional guidance, so as to restore knee joint function gradually[7]. In this study, this nursing intervention effectively reduced the incidence of limb stiffness and thrombosis, relieved postoperative pain and improved knee joint function, presenting satisfactory clinical effects.

In conclusion, the ACTED-based management strategy for stiffness and thrombus prevention is worthy of clinical promotion in postoperative nursing for patients undergoing anterior cruciate ligament reconstruction. It can effectively prevent limb stiffness and deep venous thrombosis and accelerate patient recovery.

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