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Original Article

The Preventive Effect of the FOCUS-PDCA Management Mode on Deep Vein Thrombosis in Elderly Patients Following Orthopedic Surgery

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Abstract

Objectives: To explore the preventive effect of the FOCUS-PDCA management model on deep vein thrombosis (DVT) in elderly orthopedic patients after surgery. **Methods**: A total of 229 elderly patients who underwent orthopedic surgery in our hospital between January 2021 and December 2023 were divided into two groups: the control group (n=104) and the intervention group (n=125), based on their admission order. The control group received routine intervention, while the intervention group was treated with the FOCUS-PDCA model. Coagulation function, DVT risk symptoms, incidence of DVT, intervention quality, and patient satisfaction were compared between the two groups. **Results**: After the intervention, the PT and APTT/s levels in the intervention group were significantly better than those in the control group, while the Fibrinogen (FIB) level was significantly lower ($P < 0.05$). The DVT risk symptoms and incidence of DVT were also lower in the intervention group ($P < 0.05$). Additionally, the intervention quality and patient satisfaction were higher in the intervention group compared to the control group ($P < 0.05$). **Conclusions**: The FOCUS-PDCA management model improves coagulation function and reduces the incidence of deep vein thrombosis in elderly orthopedic patients after surgery.

Keywords: Coagulation Function, Deep Vein Thrombosis, Elderly, FOCUS-PDCA Management Model, Intervention Quality

Introduction

Deep vein thrombosis (DVT) is a disorder of deep venous return, most commonly occurring in the lower limbs, and is a frequent complication following orthopedic surgery[1,2]. Once DVT forms, it can spread to major deep veins. If not detected and treated promptly, it may lead to pain, ulcers, limb edema, or even death due to thrombus detachment. DVT significantly affects a patient's physical and mental health, quality of life, and overall safety[3]. It is characterized by a high incidence, low detectability, and high mortality, making it a central concern in the diagnosis and treatment of postoperative orthopedic complications[4]. Elderly patients are particularly at risk due to age-related physical decline and postoperative immobility, which increases their likelihood of DVT and associated complications[5].

The FOCUS-PDCA management model has shown promising results in the prevention and treatment of various diseases[6,7]. This continuous quality improvement model integrates the FOCUS framework with the PDCA (Plan-Do-Check-Act) cycle, and is also known as the FOCUS cycle management method. However, there are few studies on the application of the FOCUS-PDCA model for preventing DVT in elderly patients after orthopedic surgery. Therefore, this study aims to explore its preventive effect on DVT in this population, with the goal of reducing the incidence of DVT, enhancing postoperative intervention outcomes, and improving patients' quality of life.

The authors have no conflict of interest.

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Methods

General Information

A total of 229 elderly patients requiring orthopedic surgery were admitted to our hospital between January 2021 and December 2022 were enrolled in this study. They were divided into a control group (104 patients) and an intervention group (125 patients) based on their admission dates. The control group, admitted from January to December 2021, consisted of 59 males and 45 females, aged 65 to 74 years, with a mean age of 69.17 ± 4.54 years. The intervention group, admitted from January to December 2022, included 79 males and 46 females, aged 65 to 75 years, with a mean age of 69.21 ± 4.15 years.

Inclusion criteria

1. Age between 65 and 75 years.
2. Diagnosed by an orthopedic surgeon as requiring orthopedic surgery at our hospital and scheduled for orthopedic surgery.
3. Undergoing orthopedic surgery for the first time.
4. Intact cognitive and communication abilities.
5. Consent form signed by the patient and their family.
6. Availability of complete clinical data.

Exclusion criteria

1. History of multiple orthopedic surgeries.
2. Long-term use of anticoagulant medications.
3. Cognitive or communication impairments.
4. Previous diagnosis of deep vein thrombosis.
5. Impaired liver or kidney function.
6. Presence of malignant tumors.
7. Cardiovascular or cerebrovascular diseases.
8. Abnormal D-dimer levels.
9. Incomplete clinical records.

Diagnostic criteria for DVT

1. Swelling and pain in the affected limb, characterized by significant swelling, "shiny" skin, and the presence of superficial varicose veins, along with low-grade fever.
2. Positive DVT results from the straight leg raise test and sural compression test.
3. Diagnosis of DVT confirmed by ultrasound examination

Control group: Routine orthopedic postoperative interventions were implemented, including vital sign monitoring, postoperative care, symptomatic medication (such as anticoagulants and anti-inflammatory drugs, including heparin, warfarin, and rivaroxaban), condition monitoring, rehabilitation treatment, and dietary guidance.

The intervention group received the FOCUS-PDCA management intervention in addition to the standard care provided to the control group. Based on the FOCUS-PDCA model, the intervention is divided into five components: FOCUS analysis (F), plan setting (P), plan implementation (D), observation of implementation effects (C), and improvement (A), encompassing a total of nine steps. The specific details are as follows:

1. FOCUS Analysis

Identify the Problem (F): Based on the occurrence of DVT in the control group, past intervention data was reviewed and analyzed using standardized intervention protocols to identify existing issues. The identified problems included patient complaints, adverse events, and intervention management challenges, which became the focus for rectification.

Organize a Team (O): A joint intervention quality improvement team was established, led by the head nurse of the department, and included the chief physician and key personnel from related departments (such as the medical and quality inspection departments). Team members were responsible for educating their subordinates and promoting the intervention plan. The team leader supervised the plan's implementation within the department, while the quality inspection department managed the overall planning and promotion of the intervention at each post.

Clarify the Problem (C): The team clarified the specific implementation standards for the intervention process, DVT risk assessment methods, and prevention incidence rates outlined in the "DVT Intervention Improvement Plan and Prognosis Evaluation Standards for Geriatric Orthopedic Surgery." These were formulated according to relevant guidelines and norms. A strict reward and punishment system was also established to encourage adherence to the plan.

Understand the Problem (U): Team members analyzed factors contributing to DVT after geriatric orthopedic surgery during a communication meeting, using insights from relevant literature and issues identified in daily work. The team leader compiled these factors into questionnaires, and some team members assigned scores based on their observations. Higher scores indicated greater impact. Factors identified as affecting DVT occurrence included: variations in age, physical condition, and disease course; low patient compliance; inadequate knowledge of DVT prevention among patients and families; poor intervention quality; insufficient operation and supervision by interventionists; lack of effective evaluation tools; and inadequate mastery of DVT intervention knowledge among diagnostic and treatment staff.

Select an Intervention (S): Team members evaluated the information related to DVT occurrence factors in elderly orthopedic surgery patients and selected feasible intervention projects for plan formulation, in line with daily intervention practices.

Plan (P): Based on the identified focus for rectification, team members collaboratively discussed and adjusted the existing intervention process in accordance with relevant guidelines and standards. They developed the "DVT Intervention Improvement Plan and Prognosis Evaluation Criteria for Geriatric Orthopedic Surgery."

Table 1. Comparison of general data of patients between the two groups (x ± s, n%).

		Control group (n=104)	Intervention group (n=125)	t/X^2	P
Sex	Male	59(56.73)	72(57.60)	0.018	0.895
	Female	45(43.27)	53(42.40)		
Mean Age		69.17±4.54	69.21±4.15	0.070	0.945
Type of Surgery	Spinal surgery	29(27.88)	39(31.20)	0.388	0.943
	Hip arthroplasty	34(32.69)	41(32.80)		
	knee arthroplasty	22(21.15)	24(19.20)		
	Fractures	19(18.27)	21(16.80)		

Do (D): a. Strengthen intervention quality management by formulating standardized processes and conducting regular evaluations of intervention implementation within the department.

b. Conduct psychological assessments and interventions for patients based on their clinical data and daily status, and provide DVT health education for patients and their families to enhance their health awareness and compliance.

c. Assess patient status using the Caprini model[8] and develop personalized interventions according to patient needs, such as increasing daily activities, managing pain, optimizing posture, formulating rehabilitation training plans, wearing elastic stockings, conducting DVT risk assessments, and implementing dietary interventions.

d. Enhance the quality training of medical staff in the department by inviting DVT experts for academic exchanges and holding regular academic seminars to strengthen professional knowledge.

Check (C): Monitor the effectiveness of plan implementation through daily assessments of intervention outcomes, feedback on intervention quality from patients, data collection from the information platform, and collaboration with the medical and quality inspection departments.

Act (A): Organized by the team leader, the medical staff in the department will hold a monthly intervention exchange and summary meeting. During these meetings, they will review and summarize the effects and challenges encountered in the intervention work over the past month. Based on this summary, they will adjust the intervention and improvement plan for the following month to facilitate continuous quality improvement.

Observation indicators

General Information

The general data of patients from both groups were recorded and compared. The data items included: sex, age, type of surgery (spinal surgery, hip arthroplasty, knee arthroplasty, fracture (including radial joint fracture and ankle joint fracture)).

Coagulation function

Fasting venous blood (3 to 5 mL) was collected prior to intervention (on the second day post-operation) and again after intervention (before discharge). Coagulation function in both groups was measured using an automatic coagulation analyzer (UD-C2000, Shenzhen UD-BIO Co., Ltd.). The tests performed included prothrombin time (PT), Fibrinogen (FIB) and activated partial thromboplastin time (APTT).

Incidence of DVT Risk Symptoms and DVT

Using the diagnostic criteria for DVT, the incidence of DVT risk symptoms and the incidence of DVT were compared between the two groups. Risk symptoms included lower limb swelling, pain in lower limbs, and varicose veins. DVT occurrence was confirmed via ultrasound.

Intervention Quality

The quality of the intervention received by both groups was assessed using a custom-developed intervention quality assessment form. The evaluation was carried out by the head nurse, attending physician, medical department, quality inspection department, and patient scores for joint evaluation. The assessment covered five dimensions: service attitude, professional expertise, responsibility, patient care, and health education. Each dimension was scored out of 10 points, with a total of 50 points. Higher scores indicated better intervention quality.

Patient Satisfaction

A custom-developed satisfaction questionnaire (scored out of 100) was used to compare patient satisfaction in both groups. Scores below 60 were considered dissatisfied, 60-79 generally satisfied, and 80 or above highly satisfied. Higher scores indicated greater overall patient satisfaction.

Statistical Analysis

Statistical analysis was performed using SPSS 22.0 software. Measurement data were expressed as mean ±

Table 2. Comparison of coagulation function between the two groups of patients (x ± s).

Group	PT/s				APTT/s				FIB(g·L-1)			
	Before inter-vention	After inter-vention	*t*	*P*	Before inter-vention	After inter-vention	*t*	*P*	Before inter-vention	After inter-vention	*t*	*P*
Control group (n=104)	12.08± 1.31	14.11± 1.42	10.720	<0.001	28.91± 3.42	32.61± 4.48	6.695	<0.001	3.25± 0.43	2.81± 0.36	8.001	<0.001
Intervention group (n=125)	12.16± 1.54	15.27± 1.39	16.760	<0.001	29.13± 3.86	35.49± 4.27	12.350	<0.001	3.30± 0.41	2.24± 0.44	19.710	<0.001
t	0.419	6.226			0.452	4.969			0.899	10.590		
P	0.676	<0.001			0.652	<0.001			0.370	<0.001		

Table 3. Comparison of incidence of DVT risk symptoms and incidence of DVT between the two groups of patients (n, %).

Group	Lower limb swelling	Lower extremity pain	Varicose veins	Risk rate	DVT incidence rate
Control group (n=104)	13(12.50)	12(11.54)	15(14.42)	40(38.46)	26(25.00)
Intervention group (n=125)	6(4.80)	5(4.00)	8(6.40)	19(15.20)	10(8.00)
X^2	4.424	4.694	4.187	16.060	12.381
P	0.035	0.030	0.041	<0.001	<0.001

Table 4. Comparison of intervention quality scores between the two groups of interventionists (x ± s, points).

Group	Service attitude	Professional skills	Sense of responsibility	Patient care	Health education	Total score
Control group (n=104)	7.35±1.46	8.61±0.47	8.53±0.62	7.84±1.57	8.14±1.28	41.32±1.64
Intervention group (n=125)	8.49±1.02	9.13±0.42	9.17±0.54	8.59±1.36	8.83±0.95	43.01±1.39
t	6.932	8.836	8.347	3.873	4.675	8.441
P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

standard deviation ($\bar{x} \pm s$). An independent sample t-test was used for comparisons between groups, and a paired sample t-test was used for within-group comparisons. Categorical data were expressed as case numbers and percentages (%), and comparisons between groups were made using the xÇ test. A P-value of less than 0.05 was considered statistically significant.

Results

Comparison of General Information

There were no significant differences between the two groups in terms of sex, mean age, or type of surgery (P>0.05) (Table 1).

Comparison of Coagulation Function

Prior to the intervention, there were no significant differences in coagulation function between the two groups (P > 0.05). After the intervention, the PT and APTT levels in the intervention group were significantly better than those in the control group, while the FIB level was lower in the intervention group. These differences were statistically significant (P < 0.05) (Table 2).

Comparison of Incidence of DVT Risk Symptoms and DVT

The incidence of DVT risk symptoms and confirmed cases of DVT in the intervention group were significantly lower than those in the control group (P < 0.05) (Table 3).

Table 5. Comparison of patient satisfaction between the two groups (n, %).

Group	Very satisfied	Relatively satisfied	Not satisfied	Satisfaction rate
Control group	35(33.65)	49(47.12)	20(19.23)	80.77(84/104)
Intervention group	51(40.80)	62(49.60)	13(10.40)	90.40(113/125)
X^2	4.380			
P	0.036			

Comparison of Intervention Quality

The intervention group scored higher than the control group in service attitude, professional skills, sense of responsibility, patient care, health education, and overall intervention quality. These differences were statistically significant ($P < 0.05$) (Table 4).

Comparison of Satisfaction

The satisfaction rate in the intervention group was significantly higher than that in the control group ($P < 0.05$) (Table 5).

Discussion

DVT is a common complication following orthopedic surgery, and pulmonary embolism caused by the detachment of DVT emboli is a leading cause of death[9,10]. Orthopedic surgery is highly invasive, often leading to reduced mobility and vascular injury, which in turn increases the incidence of DVT post-surgery[11]. Elderly patients are particularly prone to developing DVT after orthopedic procedures due to decreased blood flow, muscle function, digestive function, and mobility[12]. Research has shown that enhancing the quality of interventions can reduce the incidence of DVT in elderly orthopedic patients[13]. The FOCUS-PDCA management model, introduced in the 1990s, is a quality management tool that has been widely applied to improve quality management in various medical disciplines and departments[14]. The FOCUS-PDCA management model identifies key issues through data analysis, determines critical steps, and implements continuous cycles of improvement to address these focus areas. This systematic approach aims to enhance overall quality[15]. In this study, by analyzing the preventive effect of the FOCUS-PDCA model on deep vein thrombosis (DVT) in elderly patients following orthopedic surgery, it was found that the model can improve coagulation function, reduce the incidence of DVT risk symptoms and DVT itself, and enhance patient satisfaction by improving the quality of interventions.

In elderly patients, blood flow is generally slower. After orthopedic surgery, prolonged bed rest leads to reduced physical activity, further decreasing blood flow and impairing venous return, which increases the risk of DVT[16]. Routine postoperative interventions often have notable shortcomings in providing individualized and comprehensive care. Common issues include neglecting the patient's physical condition and recovery progress in rehabilitation planning, overlooking the psychological state, and inadequate monitoring of complications. These problems arise not from a single issue but from a lack of clear, systematic standards and protocols for each step of the intervention process. The results of this study indicated that after intervention, the quality of care in the intervention group significantly improved. The PT and APTT levels in this group were higher than those in the control group, while the FIB level was lower. Additionally, the incidence of DVT risk symptoms and confirmed DVT cases in the intervention group were lower than in the control group. These findings suggest that the FOCUS-PDCA management model can enhance coagulation function and reduce the incidence of DVT risk symptoms and DVT in elderly patients after orthopedic surgery by improving the quality of interventions. Previous studies have shown that the FOCUS-PDCA model positively impacts intervention quality, aligning with the findings of this study[17]. Coagulation function is closely linked to the occurrence of postoperative DVT in the elderly, and monitoring coagulation function is a vital method for assisting in the clinical diagnosis of DVT. In this study, the intervention group demonstrated a more significant improvement in coagulation function compared to the control group. Therefore, we conclude that the FOCUS-PDCA management model effectively enhances coagulation function in elderly patients undergoing orthopedic surgery and reduces the incidence of DVT.

The FOCUS-PDCA management model can systematically organize and analyze data collected during the intervention process for elderly patients after orthopedic surgery. It highlights the issue of inadequate execution in the intervention process as a key focus for enhancing intervention quality. This approach promotes collaborative progress among departmental members and strengthens oversight through joint efforts with relevant departments. Improving intervention quality is a gradual process that requires continuous identification, discussion, and resolution of problems throughout implementation, which aligns with the fundamental principles of the FOCUS-PDCA management model. Studies have shown that the FOCUS-PDCA management model can reduce the incidence of DVT[18]. This model identifies key issues within the existing postoperative interventions for geriatric orthopedic surgery and enhances the entire intervention process by

addressing these focus areas. It establishes clear standards and methods for management and implementation. These include: educating medical staff on DVT prevention and facilitating regular communication and evaluations to enhance their understanding; developing standardized processes in collaboration with relevant departments to ensure quality control; providing psychological counseling to patients to mitigate negative emotions; offering health education to patients and their families to boost confidence in postoperative recovery and improve psychological support; and implementing personalized interventions based on individual patient needs. These refinements are continuously adjusted and improved at every stage of the intervention, leading to a more refined and standardized process that enhances overall intervention quality.

The FOCUS-PDCA management model establishes a comprehensive improvement process to address weaknesses in the intervention process. Once issues are identified, the model outlines the direction for corrective actions, formulates a rectification plan, and supervises its implementation[19]. In this study, weaknesses such as insufficient knowledge of DVT prevention and a lack of personalized interventions were addressed through the FOCUS-PDCA management model. By enhancing the DVT prevention knowledge of interventionists, they were able to identify DVT risk symptoms earlier during the intervention process and focus more on monitoring and managing these symptoms, thereby reducing the incidence of DVT in elderly patients following orthopedic surgery.

The results showed that patient satisfaction in the improvement group was higher than in the control group, indicating that the FOCUS-PDCA management model effectively enhances patient satisfaction among elderly individuals after orthopedic procedures. Previous studies have also confirmed that the FOCUS-PDCA model improves patient satisfaction, aligning with the findings of this study[20]. Guided by the FOCUS-PDCA management model, the entire postoperative intervention process for geriatric orthopedic surgery was systematically refined through ongoing improvements to key issues. As a result, the quality of intervention was enhanced, leading to a better overall experience for patients and increased satisfaction.

In conclusion, the FOCUS-PDCA management model effectively enhances coagulation function in elderly patients following orthopedic surgery, reduces the incidence of DVT risk symptoms and DVT, and positively impacts patient satisfaction by improving the quality of interventions. This model is therefore worthy of clinical application.

Ethics approval

This study was approved by the Ethics Committee of Wuhan Third Hospital, Tongren Hospital of Wuhan University, China (Approval No. KY2021-016).

Authors' contributions

FL designed the study and drafted the manuscript, while LL was responsible for collecting and analyzing the experimental data. FL and LL critically revised the manuscript for significant intellectual content. Both authors have read and approved the final version of the manuscript.

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