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Analysis of the Effectiveness of Evidence-Based Multidimensional Nursing Interventions in Preventing Deep Vein Thrombosis in Patients with Lower Limb Fractures

Jianglin Hu

Yichang Central People's Hospital, Yichang 443003, Hubei, China

Abstract: Lower limb fractures are common orthopedic injuries in clinical practice. Due to factors such as prolonged bed rest, immobilization, and vascular injury, patients are at a higher risk of developing deep vein thrombosis (DVT), which can lead to pulmonary embolism in severe cases, endangering their lives and affecting their prognosis and quality of life. Evidence-based nursing, guided by clinical problems, integrates high-quality clinical evidence, nursing expertise, and individual patient needs to develop scientific and standardized nursing plans, offering greater effectiveness compared to traditional empirical nursing. Evidence-based multidimensional nursing interventions break through the limitations of single nursing approaches by constructing a comprehensive prevention system from multiple dimensions, including physiology, medication, rehabilitation, psychology, and health education, precisely targeting the risk factors for DVT formation. This article reviews the implementation content of multidimensional nursing interventions for patients with lower limb fractures and analyzes their application effectiveness in DVT prevention, providing a reference for optimizing clinical DVT prevention nursing plans, improving nursing quality, and enhancing patient prognosis for those with lower limb fractures.

Keywords: Evidence-based; Multidimensional nursing; Lower limb fractures; Deep vein thrombosis

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1. Introduction

Lower limb fractures are a common type of orthopedic trauma in clinical practice, primarily caused by factors such as external impact, falls from heights, and accidental slips. After surgery, patients experience restricted mobility and are required to rest in bed, leading to a slower blood flow and an increased risk of developing deep vein thrombosis (DVT) [1,2]. Once DVT forms, it can cause limb swelling and severe pain, and in severe cases, may progress to venous gangrene, shock, or even be life-threatening. During the acute phase, if a

thrombus detaches and triggers a pulmonary embolism, patients may experience symptoms such as chest pain and dyspnea [3]. Scientific and efficient preventive interventions are the core focus of perioperative nursing for lower limb fractures. Evidence-based nursing, guided by clinical problems, involves retrieving, screening, and integrating high-quality clinical evidence, and combines this with individual patient needs and the professional experience of nursing staff to develop tailored nursing plans. Compared to traditional empirical nursing, it is more scientific, standardized, and effective [4]. Evidence-based multidimensional nursing interventions break through the limitations of a single nursing model by constructing a comprehensive and systematic nursing system from multiple dimensions, including physiological, psychological, behavioral, and rehabilitation aspects, demonstrating significant advantages in preventing DVT in patients with lower limb fractures.

2. Implementation content

2.1. Physiological nursing

Physiological nursing focuses on promoting venous return and alleviating blood stasis, serving as a fundamental aspect of DVT prevention. All measures are developed based on the evidence-based conclusion that "insufficient limb movement leads to blood stasis". In terms of positional care, nursing staff instruct patients to elevate the affected limb at an angle of 15° to 30° above heart level, avoiding compression or lowering of the limb to facilitate venous return. Patients are also encouraged to avoid prolonged periods in the same position, with regular assistance in turning to prevent localized vascular compression [5]. For bedridden patients, turning is assisted every 2 hours, with gentle movements to avoid pulling on the affected limb and causing vascular injury [6]. Regarding skin and pressure care, based on evidence, appropriate medical elastic stockings or intermittent pneumatic compression devices are selected for patients. Elastic stockings are worn from the toes to the upper thigh, put on before getting out of bed in the morning and removed before bedtime at night. Intermittent pneumatic compression devices are used 2 to 3 times daily for 30 to 60 minutes each session to promote venous blood flow and reduce blood stasis through external pressure. Additionally, skin care of the affected limb is strengthened, with observations of skin color, temperature, and swelling to maintain cleanliness and dryness, preventing skin breakdown and subsequent infection, thereby indirectly reducing thrombotic risk [7]. In terms of daily life care, patients are guided to maintain a reasonable diet rich in high-protein, high-fiber, low-fat, and high-vitamin foods such as lean meat, vegetables, fruits, and whole grains, while avoiding spicy, high-fat, and high-sugar foods to prevent increased blood viscosity. Patients are encouraged to drink plenty of water, with a daily intake of no less than 2000 mL, to promote blood circulation, dilute blood, and reduce thrombotic risk. Maintaining regular bowel movements is also emphasized to prevent increased abdominal pressure during straining, which could hinder venous return.

2.2. Pharmacological nursing

Pharmacological intervention is a crucial means of preventing DVT in patients with lower limb fractures, particularly for high-risk patients. Anticoagulant drugs effectively inhibit hypercoagulability, and their use must strictly adhere to evidence-based guidelines while balancing anticoagulant effects with bleeding risks [8]. Based on evidence, the nursing team selects appropriate anticoagulant drugs for patients at different risk levels. Low-to-moderate-risk patients may receive subcutaneous injections of low molecular weight heparin

calcium or low molecular weight heparin sodium, while high-risk patients may be prescribed oral rivaroxaban or dabigatran in combination. Dosage and timing strictly follow medical advice to avoid unauthorized dose adjustments or discontinuation. During medication administration, nursing staff closely monitor for signs of bleeding, such as skin bruising, gum bleeding, nosebleeds, hematuria, or melena, and regularly assess coagulation function (e.g., prothrombin time, activated partial thromboplastin time) to adjust medication regimens accordingly [9]. Patients are instructed on proper injection site compression after subcutaneous low molecular weight heparin injections, pressing for 5 to 10 minutes with moderate pressure without rubbing to prevent bleeding or hematoma at the injection site. Patients are also advised to avoid strenuous exercise, trauma, and medications affecting coagulation (e.g., aspirin) during treatment to minimize bleeding risks.

2.3. Rehabilitation nursing

Functional exercise effectively promotes limb blood circulation and improves venous return, serving as a key measure in preventing DVT. Exercise regimens are developed based on evidence, considering the patient's fracture type, surgical approach, and recovery status, following the principles of "gradual progression and individualization" [10]. In the early postoperative period (days 1–3), with limited limb movement, patients are guided to engage in a combination of passive and active exercises. Passive exercises, assisted by nursing staff or family members, involve massaging the affected limb muscles (from the dorsum of the foot to the thigh, proximally to distally) for 10 to 15 minutes, 3 to 4 times daily, to prevent muscle atrophy and promote blood flow. Active exercises include toe flexion and extension and ankle dorsiflexion and plantarflexion, with each movement held for 5 to 10 seconds and repeated 10 to 15 times, 3 to 4 times daily, based on patient tolerance and without exacerbating pain. In the mid-postoperative period (days 4–14), as pain subsides, exercise intensity is gradually increased. Patients are guided to perform knee flexion and extension, mild hip movements, and isometric quadriceps contractions, holding contractions for 10 seconds and relaxing for 5 seconds, repeated 20 to 30 times, 3 times daily. Rehabilitation equipment may also be used to facilitate limb movement and gradually restore limb function, promoting venous return. In the late postoperative period (2 weeks and beyond), based on fracture healing, patients are guided to ambulate, progressing from standing beside the bed and slow walking to normal activities. Elastic stockings are worn during walking to avoid prolonged standing or walking. Patients are closely monitored for dizziness or limb pain during activity, with adjustments made to activity intensity as needed. Through scientific exercise, the fundamental issue of blood stasis due to insufficient limb movement is addressed [11].

2.4. Psychological nursing

Patients with lower limb fractures often experience negative emotions such as anxiety, depression, and fear due to sudden trauma, limited limb function, and concerns about prognosis. These emotions can lead to sympathetic nervous system excitation, vasoconstriction, increased blood viscosity, and indirectly elevate DVT risk. Additionally, negative emotions reduce patient compliance with nursing interventions, affecting prevention outcomes. Therefore, psychological nursing is an essential component of multidimensional intervention. Nursing staff actively communicate with patients, patiently listening to their concerns and assessing their psychological state. For anxious patients, the healing process of fractures, the importance of DVT prevention, and the effectiveness of intervention measures are explained to instill confidence in recovery [12]. For fearful patients, successful case studies are shared to alleviate concerns about disease

prognosis. Family members are encouraged to provide companionship and support, offering psychological comfort and creating a positive rehabilitation environment. Furthermore, before implementing nursing measures, nursing staff thoroughly explain the purpose, process, and precautions to patients, ensuring understanding and active cooperation. For example, patients are informed about the significance of wearing elastic stockings and engaging in functional exercise to prevent resistance and ensure the effective implementation of prevention measures, enhancing DVT prevention outcomes [13].

2.5. Health education

Health education aims to enhance patients' and their families' understanding of DVT, enabling patients to master self-monitoring and self-care skills and strengthen self-management capabilities, serving as an important guarantee for long-term DVT prevention. Education content is developed based on clinical issues related to insufficient patient knowledge about DVT [14]. Diversified educational methods are employed, including one-on-one explanations, distribution of health manuals, playing educational videos, and conducting group lectures, to ensure comprehension by patients and their families. Education content covers three aspects: first, DVT-related knowledge, including high-risk causes, clinical manifestations (limb swelling, pain, increased skin temperature, purplish skin color), and harms (risk of pulmonary embolism) of DVT in patients with lower limb fractures, enabling early symptom recognition and timely notification of healthcare staff; second, prevention measures, including positional care, dietary requirements, functional exercise methods, elastic stocking wearing techniques, and precautions for anticoagulant drug use, encouraging active patient cooperation with nursing and continued adherence to prevention measures after discharge; third, self-monitoring points, guiding patients to observe limb swelling and pain daily after discharge, regularly review coagulation function, and seek medical attention promptly for abnormalities to avoid delayed treatment.

3. Application effects

3.1. Reducing the incidence of deep vein thrombosis

Multiple clinical studies have confirmed that evidence-based multidimensional nursing interventions can significantly reduce the incidence of DVT in patients with lower limb fractures [15]. Under traditional nursing models, nursing measures often lack systematicity and scientific rigor, primarily focusing on single aspects such as positional care and verbal education, with insufficient attention to individual patient differences, leading to a relatively high incidence of DVT. In contrast, multidimensional nursing interventions address DVT risk factors from multiple dimensions, including physiological, pharmacological, rehabilitation, psychological, and educational aspects. By promoting venous return, standardizing anticoagulant medication use, and implementing scientific functional exercises, these interventions reduce the conditions conducive to thrombus formation at the source. Relevant data indicate that implementing multidimensional evidence-based nursing not only effectively reduces the incidence of pressure injuries and lower limb deep vein thrombosis in patients after tibiofibular fracture surgery but also alleviates patient pain and improves nursing satisfaction [7].

3.2. Improving clinical indicators and rehabilitation progress in patients

Multidimensional nursing interventions can effectively improve clinical indicators in patients and accelerate the rehabilitation process [16]. Through measures such as positional care and functional exercises, the time

for swelling resolution and pain relief in the affected limb is significantly shortened, and limb mobility recovers more rapidly. Standardized anticoagulant medication nursing maintains stable coagulation function in patients, avoiding hypercoagulability while reducing the risk of bleeding and minimizing treatment delays caused by bleeding. Simultaneously, psychological nursing alleviates negative emotions in patients, enhancing their enthusiasm for rehabilitation. Health education equips patients with self-care skills, enabling them to actively cooperate with rehabilitation training, further shortening hospital stays, reducing medical costs, and improving rehabilitation efficiency [17].

3.3. Enhancing patient nursing satisfaction and health literacy

Evidence-based multidimensional nursing interventions, centered on patients and addressing both their physiological and psychological needs, offer more targeted and humane nursing measures, significantly improving patient nursing satisfaction [18]. Through proactive communication and meticulous care, nursing staff establish a positive nurse-patient relationship, making patients feel cared for. Additionally, diversified health education enables patients and their families to comprehensively grasp DVT prevention knowledge and rehabilitation skills, enhancing patients' health literacy. This not only facilitates cooperation with nursing during hospitalization but also ensures sustained implementation of preventive measures after discharge, reducing the long-term risk of thrombus recurrence. Furthermore, standardized nursing procedures improve nursing quality, reduce nursing disputes, and further enhance recognition of nursing work among patients and their families [15].

4. Conclusion

Patients with lower limb fractures are at high risk of developing deep vein thrombosis (DVT) due to factors such as prolonged bed rest and vascular injury. Therefore, DVT prevention represents a core task in perioperative nursing care for lower limb fractures. In the future, clinical nurses should further strengthen the concept of evidence-based nursing, continuously monitor the latest clinical evidence, and optimize multidimensional nursing plans based on individual patient differences. Nursing interventions should extend beyond hospital discharge to establish an integrated in-hospital and post-discharge DVT prevention and nursing system. This approach aims to provide higher-quality, scientific, and efficient nursing services for patients with lower limb fractures, facilitating their swift recovery.

Disclosure statement

The author declares no conflict of interest.

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