

## Original Article

# Practical value of predictive nursing in the operating room for stress reaction and risk events in elderly patients with lower limb fractures

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**Abstract:** Objective: To explore the effects of predictive nursing in the operating room on the stress response and risk events of elderly patients with lower limb fractures. Methods: The medical records of 114 elderly patients with lower limb fractures who underwent surgical reduction from August 2020 to May 2022 in Baiyin First People's Hospital were collected for this retrospective analysis. Among them, 54 patients who received routine nursing during the perioperative period were the control group, and 60 patients who received predictive nursing in operating room during the perioperative period were the observation group. The two groups were compared in terms of the changes of intraoperative stress response indexes and the occurrence of risk events, general data, postoperative complications, nursing satisfaction and changes in anxiety and depression. Logistic regression was used to analyze the risk factors affecting the occurrence of risk events in patients. Results: After nursing, the observation group showed significantly lower levels of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), noradrenaline (NE), and adrenaline (AD) than the control group ( $P < 0.05$ ). After nursing, the observation group got significantly lower self-rating anxiety scale (SAS) and self-rating depression scale (SDS) scores than the control group ( $P < 0.05$ ). A lower incidence of risk events was found in the observation group than in the control group ( $P = 0.037$ ). Additionally, the observation group experienced less intraoperative blood loss and shorter operation time than the control group ( $P < 0.05$ ). The observation group presented a lower incidence of complications after operation than the control group ( $P = 0.009$ ), and greatly higher nursing satisfaction than the control group ( $P = 0.001$ ). According to multivariate logistic regression analysis, age and nursing plan were independent risk factors affecting the risk events in patients ( $P < 0.05$ ). Conclusion: Predictive nursing in the operating room can substantially improve the intraoperative nursing quality of elderly patients with lower limb fractures, which can reduce intraoperative stress reaction, negative emotions, and surgical risk events and complications, and improve postoperative rehabilitation.

**Keywords:** Predictive nursing, in operating room, lower limb fractures, elderly, stress response, risk events, negative emotion

## Introduction

Open fracture of lower limb is a serious traumatic injury, which damages the bones, the surrounding skin, muscles, nerves, and blood vessels. They can occur in any part of the lower limbs, including hip, femoral shaft, knee, tibia and fibula, ankle, and foot, causing different degrees of trauma [1]. This kind of fracture often needs surgical treatment to ensure the accurate reduction and stability of the fractured ends while avoiding infection and complications [2]. However, patients with open frac-

ture of lower limbs often suffer severe traumatic stress reaction [3]. Surgical treatment may further increase traumatic stress, resulting in severe postoperative pain, long recovery time, and high incidence of complications, which challenges the treatment [4]. Therefore, it has become a common pursuit of clinicians to explore an ideal nursing intervention mode for patients with open fracture of lower limbs [5]. Good nursing intervention can effectively promote postoperative rehabilitation, shorten hospitalization time, and reduce complications [6].

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However, traditional nursing intervention modes are unable to meet the needs of patients well due to severe postoperative pain, long recovery time, and various complications [7, 8]. Accordingly, it is imperative to explore a new nursing intervention mode to promote the rehabilitation of patients to the maximum extent. Predictive nursing is a new concept of modern nursing that aims to comprehensively analyze and judge the patient's condition and take corresponding preventive measures according to risk factors, so as to reduce the probability of complications and improve the therapeutic effect [9]. In practice, predictive nursing covers overall evaluation, risk identification, and intervention measures [10]. Based on patient-centred prediction, analysis, and intervention, nurses can actively prevent possible adverse events, such as preparing human and material resources in advance, communicating with doctors and coordinating their work, and actively intervening in risk factors that may bring serious complications [11]. Patients with open fracture need special attention and care, because the broken ends of the fracture are exposed to the outside world, accompanied by different degrees of wound contamination, and ensuring the rehabilitative effect of limb function while avoiding wound infection during treatment is difficult [12]. However, there is no clear report on whether predictive nursing in operating room has a positive effect on stress reaction and postoperative risk events in elderly patients with lower limb fractures.

The innovation of this study lies in the use of predictive nursing intervention for elderly patients with lower limb fractures. Unlike the traditional nursing mode, predictive nursing mode responds to patients' illness, uses proactive methods to predict complications and risks, and plans nursing strategies to prevent their occurrence. This method greatly improves efficiency of the nursing service, reduces the occurrence of complications, and thus improves the quality of nursing. This study also specifically explored the negative effects of stress and negative emotions on the rehabilitative process and used predictive nursing to effectively alleviate these factors.

### Methods and data

#### *Ethical statement*

This study was approved by the Medical Ethics Committee of Baiyin First People's

Hospital, with ethical approval number of 2020LL514.

#### *Sample collection*

The medical records of 168 elderly patients with lower limb fractures who underwent surgical reduction from August 2020 to May 2022 in Baiyin First People's Hospital were collected for retrospective analysis.

#### *Inclusion and exclusion criteria*

Inclusion criteria: elderly patients at 65 years old or above; patients diagnosed with lower limb fractures [13], including femur, tibia, or fibula fractures; patients with complete operating room nursing records and related clinical data for research. The operation and anesthesia schemes of all patients were the same.

Exclusion criteria: patients with old fracture, pathologic fracture or complicated fracture in other parts; patients with mental and psychological diseases; patients with malignant tumors, immune system diseases; patients with severe organ dysfunction; patients comorbid with malignant tumor or other major diseases; or patients with impaired body function.

#### *Sample screening*

According to inclusion and exclusion criteria, 114 patients who met the requirements were screened in. We selected patients during the period from August 2020 to June 2021 as the control group (n=54), mainly based on the actual implementation of the care plan in our hospital. Before June 2021, a routine care plan was implemented for all patients our hospital. Patients during July 2021 to May 2022 that were given predictive nursing in the operating room were taken as the observation group (n=60).

#### *Nursing plan*

##### *Nursing plan of the control group*

During the perioperative period, routine nursing measures were taken. Before the operation, nursing staff were arranged to assist patients with necessary examinations and to assess their physical and psychological readiness for surgery, providing any necessary education and emotional support. They also communicated closely with the physician team to ensure comprehensive evaluation of the patients' suit-

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ability for surgery. During the operation, the staff monitored the patient's vital signs and cooperated with the surgeon to facilitate the operation. After the operation, the staff actively implemented measures to prevent common post-operative complications.

### Nursing plan of the observation group

*Preoperative nursing:* During the preoperative visit, the utility nurse and the nurse in charge of the ward were arranged to consult the medical records together to understand the basic situation, fracture condition and complications of the patient. Later, they were required to visit the patient at the patient's bedside, introduce the location and layout of the operating room, and detailly explain the process of entering and leaving the operating room, anesthesia scheme, surgical steps and matters that need the patient's cooperation, so that the patient can prepare in advance and suffer no excessive tension and fear during the operation. When emphasizing the operation of combined spinal-epidural anesthesia, the utility nurse was required to guide the patient to cooperate in posture, such as taking deep breaths and slow breaths and using healthy limb and/or both arms to support, so as to alleviate the pain caused by posture changes.

*Intraoperative nursing:* The patients was picked up from the operating room by the utility nurse who checked the wristband logo transfer of the patient to the operating bed. The utility nurse was also responsible to assist the patient inhaling oxygen by nasal catheter, monitor the vital signs, and open peripheral veins. After a three-way check of the operation information, the utility nurse assisted in setting the anesthesia position when the anesthesiologist gave the patient intravenous analgesia drugs. During the operation, the utility nurse was responsible for temperature care, posture care, and psychological care to avoid complications such as pressure ulcers, venous extravasation, and hypotension. The utility nurse was also responsible to closely monitor the changes of patient's vital signs, and report to doctors in time in the case of abnormal conditions. In order to alleviate the negative emotions of the patient such as nervousness and fear, the utility nurse was required to use body language such as verbal comfort and caressing the patient's arms to build up the patient's confidence in the operation. The instrument nurse was responsible to prepare all kinds of equipment, articles, and

sterile clothes, and check with utility nurse. During the operation, the utility nurse cooperated closely with the orthopedic surgeon to ensure the efficient operation and paid attention to aseptic protection during filming. The utility nurse also actively communicated with the instrument nurse, orthopedic surgeon, and anesthesiologist to master the situation of surgery and anesthesia to ensure the comfort and safety of the patient.

*Postoperative nursing:* After the operation, the utility nurse was required to inform the patient of the completion of the operation and its success in time to enhance the confidence of the patient in rehabilitation. After that, a tripartite check was conducted again to ensure the safety of the operation. The utility nurse was also required to remind the anesthesiologist to install the analgesic pump in time and give the analgesic drug load and inform the patient of the application of the analgesic pump to ensure that the patient knows and uses it correctly. Subsequently, the utility nurse was arranged to escort the patient back to the ward together with the anesthesiologist and orthopedic surgeon, and hand over the shift to the responsible nurse. The utility nurse helped the patient lift the injured limb to promote venous return and relieve pain and explained to the patient to avoid head elevation within 6 hours after operation, so as to lower the incidence of postoperative headache. Both the utility nurse and responsible nurse emphasized the importance and significance of early functional exercise to improve the patient's compliance with early exercise. On the first day after operation, the utility nurse followed up the patient, focusing on postoperative pain, psychological needs, health knowledge, and functional rehabilitation. In the process of explanation, the utility nurse used easy-to-understand language to eliminate the patient's worries, improve the cognitive level of diseases and promote functional rehabilitation. The utility nurse was arranged to evaluate the color of wound dressing, the presence of exudate and the color of drainage tubes, and instruct the patient to eat more fruits, vegetables, and foods rich in fiber, as well as increase the amount of water to avoid postoperative constipation, deep venous embolism of lower limbs and urinary system infection. Additionally, the utility nurse was also expected to understand the patient's psychological needs and expectations after operation, and explained the changes of the condition, the rehabilitation process and the prognosis, and

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informed the patient of the possible negative psychological impact, so as to improve the patient's psychological adaptability and stress ability. The utility nurse was also responsible to guide the families of the patient to participate in postoperative care and early rehabilitation exercises to play the role of family support.

### *Collection of clinical indexes*

Relevant data of patients were collected through electronic medical records, including age, gender, admission time after trauma, surgical site, fracture reason, Gustilo classification, past medical history, smoking history, intraoperative blood loss and operation time, postoperative complications, nursing satisfaction, surgical risk events, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), norepinephrine (NE) and adrenal hormone (AD) before and after nursing, and self-rating anxiety scale (SAS) score and self-rating depression scale (SDS) scores before and after nursing [14]. The raw score was 80 points. The total score = raw score \* 1.25, namely 100 points. A higher total score indicates more serious negative emotion.

### *Scoring content and index detection*

#### Score content

SAS was used to assess the severity of anxiety symptoms. The scale consists of 20 items, with a total score of 100. The higher the score, the more severe the anxiety symptoms. SDS was used to assess the severity of depressive symptoms. The scale includes 20 items, and the higher the total score of 100 points, the higher the score, the more severe the depressive symptoms.

#### Index detection

Hitachi 7600 automatic biochemical analyzer was used to detect the levels of NE and AD in patients, and the kit was provided by the manufacturer. HM 81-01 hemodynamic analyzer was used to detect HR, SBP, and DBP of patients.

### *Outcome measures*

#### Primary outcome measures

The two groups were compared in the changes of intraoperative stress response indexes and

the occurrence of risk events. Logistic regression was used to analyze the risk factors affecting the occurrence of risk events in patients.

#### Secondary outcome measures

The two groups were compared in terms of clinical data, general data, postoperative complications, nursing satisfaction, and changes of anxiety and depression.

#### *Statistical analyses*

This study adopted SPSS26.0 (Asia Analytics Formerly SPSS China) for statistical analyses of comprehensive data. Measured data were described by (Mean  $\pm$  SD) and analyzed using the t test. The comparison within the groups was conducted using a paired t-test, whereas the comparison between groups was carried out using an independent sample t-test. Counted data were analyzed using the  $\chi^2$  test. Logistic regression analysis was used to analyze the risk factors affecting patients' risk events.  $P < 0.05$  was considered significant.

## **Results**

### *Comparison of baseline data*

According to comparison of baseline data between the two groups, there were no statistical differences in age, gender, admission time after trauma, surgical site, fracture cause, Gustilo classification, past medical history and smoking history (all  $P > 0.05$ , **Table 1**).

### *Comparison of stress response indexes*

According to the comparison of stress response indicators between the two groups, there were no differences in HR, SBP, DBP, NE or AD between the two groups before nursing (all  $P > 0.05$ , **Figure 1**); however, after the intervention, these indices decreased significantly and were significantly lower in the observation group than those in the control group (all  $P < 0.05$ , **Figure 1**).

### *Changes of anxiety and depression*

The scores of anxiety and depression were compared between the two groups before and after nursing. According to the results, before nursing, the SAS and SDS scores of the two groups were not greatly different (all  $P > 0.05$ ,

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**Table 1.** Comparison of baseline data between the two groups

Factors	Control group (n=54)	Observation group (n=60)	P value
Age			0.124
≥70 years old	35	47	
<70 years old	19	13	
Gender			0.409
Male	41	41	
Female	14	19	
Admission time after trauma			0.291
≥3 h	18	15	
<3 h	36	45	
Surgical site			0.461
Fracture of tibia and fibula	14	20	
Tibial fracture	22	18	
Femoral fracture	18	22	
Cause of fracture			0.132
Motor accident	28	20	
Heavy object-caused injury	15	24	
Falling injury	11	16	
GUSTILO classification			0.501
Class I	12	18	
Class II	27	30	
Class III	15	12	
Past medical history			
Hypertension	25	20	0.157
Diabetes mellitus	19	22	0.869
Smoking history			0.409
Yes	41	41	
No	14	19	

### Comparison of postoperative complications

Comparison of postoperative complications in the two groups revealed a lower incidence of postoperative complications in the observation group than that the control group (P=0.009, **Table 4**).

### Comparison of nursing satisfaction

Lastly, the nursing satisfaction of the two groups was evaluated. According to the results, the observation group expressed greatly higher nursing satisfaction than the control group (P=0.001, **Table 5**).

### Analysis of risk factors of risk events

According to the occurrence of risk events, the patients were re-grouped: 17 patients with risk events were assigned to the occurrence group and the other 97 patients were assigned to a non-occurrence group. According to univariate analysis, age and nursing plan were found to be the risk factors affecting the occurrence of risk events in patients (both P<0.05, **Table 6**). Then, according to multivariate logistic regression analysis, age and nursing plan were also independent risk factors affecting

the risk events in patients (both P<0.05, **Table 7**).

### Discussion

With the social development and aging society, the incidence of lower limb fractures remains high [15]. Body deformation, swelling and pain triggered by fracture can easily trigger negative emotions such as anxiety and depression and compromise their daily life and quality of life [16]. Although reduction and internal fixation is an effective method to treat lower limb fractures, the operation itself will bring psychological pressure to patients [17]. Additionally, nursing intervention in the operating room has an important influence on operation effect and postoperative rehabilitation.

**Figure 2**), while after nursing, the observation group got lower SAS and SDS scores than the control group (all P<0.05, **Figure 2**).

### Statistics of risk events

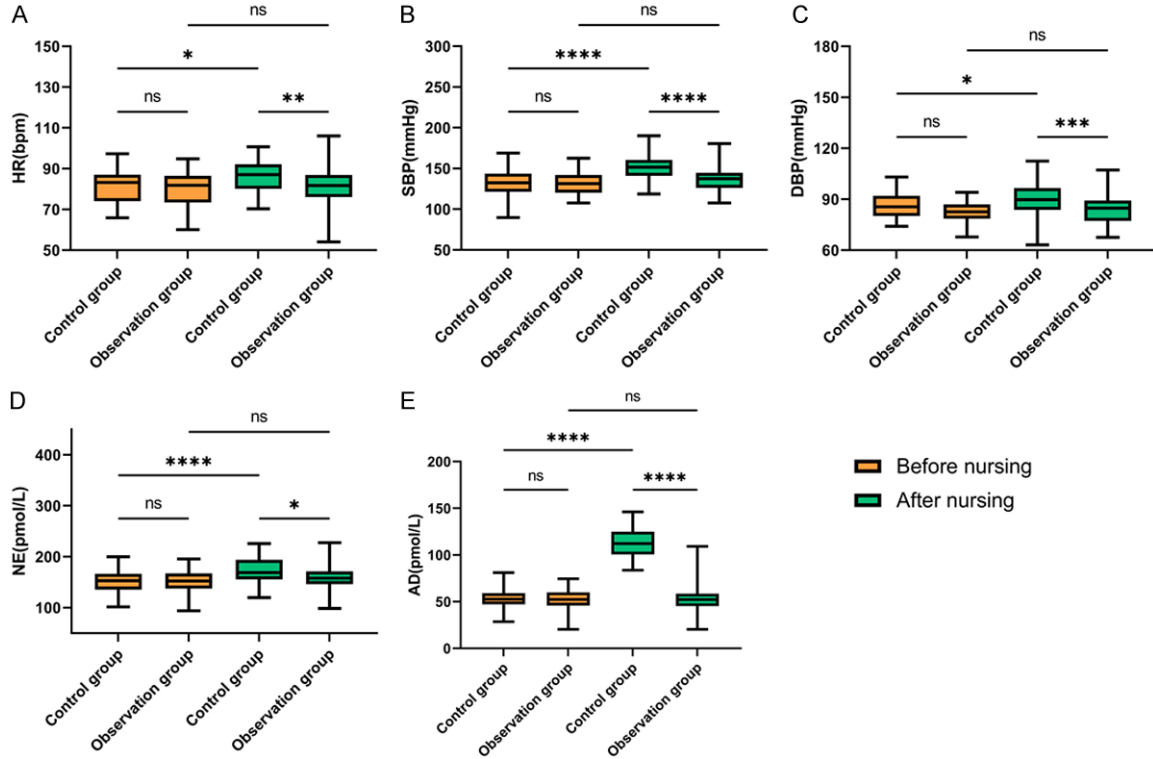
Statistical analysis of the occurrence of risk events in the two groups revealed a notably lower incidence of risk events in the observation group than that in the control group (P=0.037, **Table 2**).

### Comparison of intraoperative data

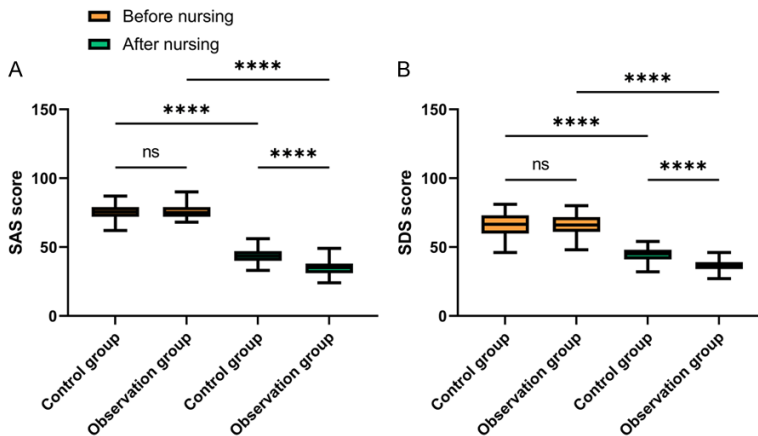
According to the analysis of intraoperative data, the observation group experienced significantly less intraoperative blood loss and shorter operation time than the control group (P<0.05, **Table 3**).



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**Figure 1.** Changes in stress response indexes in patients before and after nursing. A: Comparison of HR in patients before and after nursing; B: Comparison of SBP in patients before and after nursing; C: Comparison of DBP in patients before and after nursing; D: Comparison of NE in patients before and after nursing; E: Comparison of AD in patients before and after nursing. Notes: HR: Heart rate; SBP: systolic blood pressure; DBP: Diastolic blood pressure; NE: Noradrenaline; AD: Adrenaline. nsP>0.05, \*P<0.05, \*\*P<0.01, \*\*\*P<0.001, \*\*\*\*P<0.0001.



**Figure 2.** Changes of anxiety and depression between two groups of patients. A: Comparison of SAS in patients before and after nursing; B: Comparison of SDS in patients before and after nursing. Notes: SAS: Self-rating anxiety scale; SDS: self-rating anxiety scale. \*\*\*\*P<0.0001.

Currently, many kinds of nursing modes are available [18, 19]. Predictive nursing is a holistic nursing mode with prevention as the core. Under such a mode, predictions according to

the specific situation of the patient and corresponding nursing strategies are made according to possible risks of the patient to minimize the occurrence of complications and improve the nursing effect [12]. In the present study, in the observation group, the amount of bleeding during the operation and the time required for the operation were both greatly reduced after nursing, and the effect of the lower limb fracture operation was thus improved, which was more obvious than that in the control group. This is because the adoption of predictive nursing has substantially improved the efficiency of nursing service. The predictive nursing requires nursing professionals to comprehensively understand the surgical proce-

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**Table 2.** Comparison of risk events between the two groups

Group	Hypothermia	Skin overheating	Air embolism	Total incidence rate
Control group (n=54)	4	5	3	12
Observation group (n=60)	2	1	2	5
$\chi^2$ value				4.321
P value				0.037

**Table 3.** Comparison of intraoperative data between the two groups

Group	Intraoperative blood loss (mL)	Operation time (min)
Control group (n=54)	289.70±26.77	135.00±15.93
Observation group (n=60)	257.27±27.35	122.85±15.63
T value	6.438	4.105
P value	<0.001	<0.001

**Table 4.** Comparison of postoperative complications between the two groups

Group	Deep vein thrombosis	Infection	Pressure injury	Total incidence rate
Control group (n=54)	4	5	4	13
Observation group (n=60)	1	1	2	4
$\chi^2$ value				6.787
P value				0.009

**Table 5.** Comparison of nursing satisfaction between the two groups

Group	Very satisfied	Satisfied	Dissatisfied	Total satisfaction
Control group (n=54)	33	6	15	39
Observation group (n=60)	45	12	3	57
$\chi^2$ value				11.091
P value				0.001

dures, instruments, and articles needed for this kind of disease, to have a deep understanding of orthopedic surgeons' surgical characteristics and working habits, and to work closely with anesthesiologist to maintain the stability of patients' vital signs. Additionally, Yu et al. [20] have effectively reduced the bleeding volume and operation time of patients through humanized nursing. In this study, nursing professionals in the operating room enhanced their initiative and predictive ability in nursing intervention by implementing predictive nursing, and were able to identify and eliminate potential nursing problems in time, which improved the nursing efficiency and the surgical effect.

Fracture injury, pressure caused by operation, pain, and unfamiliar environment in the operating room may give rise to negative emotions

such as anxiety and depression, which may weaken the immune response and hinder the recovery process [21-23]. In this study, before nursing, the SAS and SDS scores of the two groups were not greatly different, but after nursing, the observation group got notably lower SAS and SDS scores than the control group. The results indicate that predictive nursing is helpful to relieve patients' anxiety and depression symptoms and suppress negative emotions. In this study, factors that may cause physical and psychological discomfort to patients were identified and prevented by implementing predictive nursing before, during, and after operation, and emotional management was strengthened, which effectively alleviated negative emotions. Surgery is a stressful event for both body and mind, especially for the elderly [24]. In elderly patients with lower extremity fractures, the surgical stress

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**Table 6.** Univariate analysis of factors affecting the occurrence of risk events

Factors	Occurrence group (n=17)	Non-occurrence group (n=97)	P value
Age			0.021
≥70 years old	16	66	
<70 years old	1	31	
Gender			0.058
Male	9	73	
Female	8	24	
Admission time after trauma			0.377
≥3 h	3	30	
<3 h	14	67	
Surgical site			0.384
Fracture of tibia and fibula	6	28	
Tibial fracture	5	35	
Femoral fracture	6	34	
Cause of fracture			0.503
Motor accident	6	42	
Heavy object-caused injury	7	32	
Falling injury	4	23	
GUSTILO classification			0.450
Class I	3	27	
Class II	9	48	
Class III	6	21	
Past medical history			
Hypertension	5	40	0.357
Diabetes mellitus	6	35	0.950
Smoking history			0.228
Yes	10	71	
No	7	26	
HR (bpm)	78.94±7.46	81.14±8.1	0.298
SBP (mmHg)	136.11±18.28	131.45±14.68	0.247
DBP (mmHg)	81.96±6.99	84.37±6.84	0.185
NE (pmol/L)	143.86±21.61	152.19±21.27	0.139
AD (pmol/L)	51.88±11.12	52.89±11.22	0.731
SAS score	75.12±5.29	75.69±5.15	0.674
SDS score	65.24±5.68	65.85±8.18	0.768
Intraoperative blood loss (mL)	281.18±31.17	270.97±31.54	0.220
Operation time (min)	131.88±20.66	128.03±16.15	0.868

Notes: HR: Heart rate; SBP: systolic blood pressure; DBP: Diastolic blood pressure; NE: Noradrenaline; AD: Adrenaline; SAS: Self-rating anxiety scale; SDS: self-rating anxiety scale.

response may be particularly pronounced. Physiological responses can include enhanced activities of the neuroendocrine system, increased release of glucocorticoids and catecholamines, which may provoke physiological alterations such as acceleration of heart rate,

blood pressure, and respiration, along with an escalation in blood pressure [25]. This investigation reveals that predictive nursing ameliorates the stress response, as demonstrated by the lower levels of HR, SBP, DBP, NE, and AD in the observation group compared to the control group. A study conducted by Li et al. [26] unveiled that a high-quality nursing mode integrating medical care and nursing could ameliorate the adverse psychological states and stress responses in elderly patients with femoral neck fractures. Under the predictive nursing mode in our research, surgical preparations were more thorough, and the sedative effect was enhanced, thereby diminishing postoperative pain and other stimuli and considerably avoiding abrupt fluctuations in HR and blood pressure. Moreover, due to sufficient physical and psychological preparedness and the maintenance of a relatively comfortable temperature environment during surgery, the stimuli from external factors such as the surgical procedure on the body were minimized, which reduced the incidence of stress reactions.

In this study, we counted the postoperative complications and risk events of patients. The results revealed a lower total incidence of surgical risk events such as hypothermia, skin overheating, and air embolism in the observation group than that in the control group. This emphasizes the

importance of systematic nursing in controlling surgical risk events such as hypothermia and ensuring intraoperative safety. On the basis of fully taking into account the poor physical tolerance of the elderly patients, predictive nursing in operating room increases the heat preserva-



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**Table 7.** Multivariate analysis of factors affecting the occurrence of risk events

Factors	B value	Standard error	Chi-square value	Sig.	Exp (B)	95% CI	
						Lower limit	Upper limit
Age	2.117	1.062	3.972	0.046	8.307	1.036	66.633
Nursing plan	1.239	0.583	4.510	0.034	3.451	1.100	10.825

tion care and strengthens the prevention of intraoperative infection, thus increasing the nursing quality for elderly patients and effectively controlling the related risks. In addition, the observation group showed a lower total incidence of postoperative complications than the control group, indicating that systematic nursing intervention can reduce complications and help shorten the postoperative hospitalization time of patients. This is mainly because the occurrence of postoperative complications is bound up with the stress response. Stress reaction may greatly affect the immune system function and increase the risk of infection and stress injury [27, 28]. The stress response of the observation group was reduced, so the risk of complications was significantly reduced accordingly. In this study, the observation group showed higher nursing satisfaction than the control group, suggesting that systematic nursing can also promote the harmonious development of nurse-patient relationship.

At the end of the study, age and nursing plan were found to be the risk factors affecting the occurrence of risk events in patients. People over 70 have less ability to recover from surgery, because physical function and organ function usually deteriorate with age. This means that they are more likely to have risk events during or after surgery [29]. Careful nursing before, during and after operation can effectively reduce the occurrence of these risk events, so as to improve the success rate of operation and the comfort of patients. The core of predictive nursing is to predict and avoid possible problems in advance through scientific nursing means, so as to ensure the safety of patients.

This study has confirmed that predictive nursing in operating room can improve the stress response in elderly patients with lower limb fractures and reduce risk events and the score of negative emotions, but it has some limitations. First, we have not collected the follow-up results of patients in this study, so whether the

two nursing schemes impact the prognosis of patients needs more research for verification. Secondly, in this study, the relatively few samples that met the requirements may have biased the results analysis. Therefore, we hope to carry out more experiments in the follow-up research to improve the conclusions.

To sum up, predictive nursing in operating room can greatly improve the intraoperative nursing quality of elderly patients with lower limb fractures, which can reduce intraoperative stress reaction, negative emotions, and surgical risk events and complications, and improve postoperative rehabilitation.

### Disclosure of conflict of interest

None.

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