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Original Article

Clinical utility of the modified frailty index for predicting postoperative complications in elderly patients with intertrochanteric femoral fractures

Liang Li[1*], Nannan Sun[1*], Changfeng Yue[1], Yongyun Xu[2], Shuai Cheng[1], Mengxue Xu[1]

[1]Department of Orthopedic Trauma, Dongying People's Hospital (Dongying Hospital of Shandong Provincial Hospital Group), 317 South First Road, Dongying 257091, Shandong, China; [2]Department of Medical Imaging, Dongying People's Hospital (Dongying Hospital of Shandong Provincial Hospital Group), 317 South First Road, Dongying 257091, Shandong, China. [*]Equal contributors.

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Abstract: Objective: To evaluate the clinical utility of the modified frailty index (mFI-5) in predicting postoperative complications among elderly patients with intertrochanteric femoral fractures. Methods: The clinical data of 432 patients aged 65 years or older were retrospectively analyzed. Based on their mFI-5 scores, patients were categorized into frail and non-frail groups. The incidence of postoperative complications was compared between the two groups. Binary multivariate logistic regression analysis was performed to identify the predictive role of frailty. Receiver operating characteristic (ROC) curve analysis was used to assess the predictive performance of mFI-5 and to determine its optimal cutoff value. A prediction formula was constructed according to the multivariate regression results. Results: The overall complication rate was significantly higher in the frail group than that in the non-frail group [42 cases (33.33%) vs. 10 cases (3.27%); P < 0.001]. Multivariate logistic regression analysis revealed that the risk of postoperative complications in frail patients was 11.26-fold higher than that in non-frail patients (odds ratio = 11.26, 95% confidence interval [CI]: 5.38-22.49; P = 0.003). Frailty was identified as an independent risk factor for postoperative lower-extremity deep vein thrombosis, delirium, and pneumonia. ROC curve analysis demonstrated that mFI-5 had good discriminative ability for predicting total postoperative complications (area under the curve = 0.86, 95% CI: 0.81-0.91). The optimal mFI-5 cutoff value was 2 points, corresponding to a sensitivity of 82.1% and a specificity of 79.3%. The prediction formula established was: Logit (P) = -3.24 + 1.86 × mFI-5 + 0.52 × American Society of Anesthesiologists classification (III-IV = 1, I-II = 0) - 0.03 × preoperative hemoglobin (g/L), which can be used to estimate the probability of postoperative complications. Conclusion: The mFI-5 score serves as an effective tool for predicting postoperative complications in elderly patients with intertrochanteric femoral fractures. The derived model formula and ROC curve analysis further support its clinical applicability. Preoperative mFI-5 assessment can provide a useful reference for comprehensive perioperative c management and help improve patient outcomes.

Keywords: Modified frailty index, intertrochanteric femoral fracture, deep vein thrombosis, delirium, postoperative complications

Introduction

Elderly individuals frequently present with varying degrees of osteoporosis, making them highly susceptible to hip fractures following a fall. Among these, intertrochanteric femoral fractures are particularly common, accounting for approximately 36% of all hip fractures and about 3.5% of all fractures of the body [1]. Most elderly patients have one or more pre-existing comorbidities, and the one-year mortality rate following intertrochanteric femoral fracture can exceed 50%, earning it the grim designation of "the last fracture of life". These comorbidities often worsen after the fracture, and prolonged bed rest can result in complications such as atelectatic pneumonia, urinary tract infections, and pressure ulcers. Consequently, intertrochanteric femoral fractures represent a major health concern in the elderly population and remain a leading cause of disability and mortality. Extensive evidence has demonstrated that prolonged immobilization can lead to delayed union or nonunion of fractures, malunion, mus-

cle atrophy, bone pain, and functional impairment. The vast majority of elderly patients with hip fractures fail to regain their pre-injury level of function, often losing the ability to perform daily activities independently. To minimize the complications associated with prolonged bed rest, promote the recovery of hip joint function [2], and reduce mortality and disability rates [3], surgical intervention has become the preferred and standard treatment modality for intertrochanteric femoral fractures.

Frailty represents a state of increased vulnerability characterized by a rapid decline in the physiological reserve of multiple organ systems, resulting in a diminished ability to withstand stressors such as surgery and a heightened susceptibility to disability [4]. Elderly patients often exhibit reduced physical capacity, slowed metabolism, and impaired compensatory mechanisms. Many also present with multiple chronic comorbidities, placing them at elevated risk during anesthesia and surgical procedures. Previous studies have reported that the one-year disability rate following hip fracture surgery in elderly patients can reach 50%, while the mortality rate may be as high as 30% [5]. Therefore, preoperative assessment and optimization of frail elderly patients are of clinical importance for selecting appropriate treatment strategies and predicting postoperative complications [6].

The modified frailty index (mFI) is a multidimensional assessment tool that provides a comprehensive and systematic evaluation of a patient's overall condition, allowing prediction of hospital stay and clinical prognosis [7]. This assessment is critical for guiding clinical decision-making. The American College of Surgeons first proposed the 11-item mFI (mFI-11), which quantifies the degree of frailty in elderly patients prior to surgery based on multiple preoperative indicators [8]. The simplified 5-item mFI (mFI-5) is easier to apply in clinical practice, requiring fewer variables while maintaining high screening accuracy, sensitivity, and specificity at its optimal cutoff value [9].

This retrospective study included 432 elderly patients who underwent internal fixation surgery for intertrochanteric femoral fractures. The objective was to evaluate the clinical utility of the mFI-5 in predicting postoperative complications following internal fixation in this population. Furthermore, the study aimed to provide a basis for comprehensive perioperative management and prognostic assessment in elderly patients with intertrochanteric femoral fractures.

Subjects and methods

Research subjects

The clinical data of 432 elderly patients (aged ≥ 65 years) who underwent internal fixation surgery for intertrochanteric femoral fractures at Dongying People's Hospital between June 2015 and November 2024 were retrospectively analyzed.

Inclusion criteria: 1. Complete clinical and medical records; 2. Diagnosis of intertrochanteric femoral fracture confirmed by clinical and imaging examinations, with all fractures being fresh and resulting from low-energy trauma; 3. Meeting the diagnostic criteria for osteoporosis; 4. Absence of autoimmune diseases or local/systemic infections; 5. No history of hormone therapy or use of other medications affecting bone metabolism within six months prior to surgery.

Exclusion criteria: 1. Presence of old intertrochanteric femoral fractures, multiple fractures, or polytrauma; 2. Coexistence of other diseases affecting bone metabolism; 3. Severe dysfunction of vital organs rendering the patient unable to tolerate surgery; 4. Presence of malignant tumors; 5. Incomplete clinical data.

Methods

The preoperative condition of each patient was evaluated using the mFI-5, based on information extracted from medical records, laboratory test results, and clinical examinations. Postoperative complications were subsequently identified and recorded. All data were independently reviewed and verified by three experienced physicians from Dongying People's Hospital who had received professional training to ensure the accuracy and reliability of the dataset.

Assessment of preoperative frailty using the mFI-5

The mFI-5 was used to evaluate the preoperative frailty status of patients, providing an

objective reflection of their overall health condition. The index comprises five assessment components: 1. Non-independent functional status [10]; 2. History of type 2 diabetes mellitus; 3. History of chronic obstructive pulmonary disease (COPD) or pneumonia; 4. History of congestive heart failure within 30 days before surgery; 5. Hypertension requiring pharmacological treatment. Non-independent functional status was defined as requiring assistance from others to perform activities of daily living within 30 days before surgery, including bathing, eating, dressing, and mobility. Each positive item was assigned 1 point, and each negative item 0 point, yielding a total score ranging from 0 to 5. A higher score indicated a greater degree of frailty. In accordance with previous studies [11], patients were categorized into two groups based on their mFI-5 scores: a non-frail group (mFI-5 < 2) and a frail group (mFI-5 ≥ 2).

Surgical procedures

Proximal femoral nail antirotation (PFNA) fixation: Intertrochanteric femoral fractures were treated using PFNA internal fixation. After satisfactory fracture reduction was achieved under C-arm fluoroscopic guidance, a longitudinal incision was made above the greater trochanter. Following exposure of the entry point at the apex of the greater trochanter, a guidewire was inserted along the medullary canal. After reaming the canal, the main nail was introduced. Once the anteversion angle was properly adjusted, a guidewire was inserted into the femoral neck through the aiming device, with its position confirmed to be in the central or inferior-central region on both anteroposterior and lateral fluoroscopic views. A spiral blade of appropriate length was then inserted, ensuring that its tip was approximately 5 mm from the subchondral arc of the femoral head and that the tip apex distance was less than 25 mm. The spiral blade was locked, followed by insertion of the distal locking screw and placement of the end cap. After confirming satisfactory reduction and fixation under C-arm fluoroscopy, the incision was closed in layers.

InterTAN intramedullary nail fixation: Intertrochanteric femoral fractures were treated using InterTAN intramedullary nail fixation. After satisfactory fracture reduction was achieved under C-arm fluoroscopic guidance, a longitudinal incision was made above the greater trochanter. Following exposure of the entry point at the apex of the greater trochanter, a guidewire was inserted along the medullary canal. After reaming, the InterTAN main nail was introduced. The interlocking lag screw and the compression screw were then inserted sequentially, followed by insertion of the distal locking screw and placement of the end cap. After confirmation of satisfactory reduction and fixation under C-arm fluoroscopy, the incision was closed in layers.

Comparison of baseline characteristics and postoperative complications

Baseline variables: The following variables were compared between the two groups: age, sex, body mass index, American Society of Anesthesiologists (ASA) Physical Status Classification, preoperative hemoglobin level, smoking history, drinking history, operation time, and anesthesia method. The ASA classification criteria were as follows: Class I: No significant systemic disease; Class II: Mild to moderate systemic disease; Class III: Severe systemic disease that limits daily activities but does not preclude work; Class IV: Severe systemic disease that significantly impairs function and poses a constant threat to life; Class V: Critically ill patients with minimal chance of survival. Approximately 5 mL of venous blood was collected, allowed to stand for 30 minutes, and centrifuged at 3000 rpm for 10 minutes. The serum was separated, and hemoglobin levels were measured using a fully automated biochemical analyzer. The normal reference range of hemoglobin was 120-160 g/L for adult males and 110-150 g/L for adult females.

mFI-5 variables: The mFI-5 scoring variables were compared between the two groups.

Postoperative complications: The incidence of postoperative complications was compared between the two groups. Postoperative complications included heart failure, delirium, stroke, urinary tract infection, pneumonia, and deep vein thrombosis (DVT).

Receiver operating characteristic (ROC) curve analysis

ROC curve analysis was performed to evaluate the predictive performance of the mFI-5 for postoperative complications. The area under the curve (AUC) was calculated to quantify its

discriminative ability, with an AUC > 0.7 indicating acceptable discrimination and an AUC > 0.8 indicating good discrimination. The optimal cutoff value of mFI-5 was determined using the Youden index (sensitivity + specificity-1), and the corresponding sensitivity and specificity were recorded.

Development of the predictive model

Based on the variables identified in the multivariate logistic regression model (mFI-5, ASA classification, and preoperative hemoglobin), a predictive formula was derived using the corresponding regression coefficients. The formula was expressed as:

$$\text{Logit}(P) = \beta_0 + \beta_1 \times X_1 + \beta_2 \times X_2 + \ldots + \beta_n \times X_n$$

Where P represents the probability of postoperative complications, β_0 is the intercept, β_1-β_n are the regression coefficients, and X_1-X_n denote the independent variables, including the mFI-5 score, ASA classification (III-IV = 1, I-II = 0), and preoperative hemoglobin level (g/L).

Statistical methods

All statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation ($\bar{x}$ ± sd) and compared using independent-samples *t*-tests. Categorical variables were presented as number frequencies and percentages and compared using chi-square (χ^2) tests. Binary logistic regression analysis was conducted to identify independent risk factors associated with postoperative complications in elderly patients with intertrochanteric femoral fractures. A P value < 0.05 was considered statistically significant.

Results

Comparison of baseline characteristics between the frail and non-frail groups

A total of 432 elderly patients (aged ≥ 65 years) who underwent internal fixation surgery for intertrochanteric femoral fractures were included in this study. Among them, 126 patients (29.17%) were classified into the frail group and 306 patients (70.83%) into the non-frail group. Significant differences were observed in the ASA classification and anesthesia method between the two groups (both $P < 0.05$). No significant differences were found in sex, body mass index, age, smoking history, drinking history, preoperative hemoglobin levels, or operative duration (all $P > 0.05$; **Table 1**).

Representative case images are shown in **Figure 1**. An 82-year-old female patient presented with left hip pain and restricted mobility following a fall while walking. She was admitted to the hospital 2 hours after the injury. Preoperative X-ray imaging (**Figure 1A**) revealed a left intertrochanteric femoral fracture. On the third day after injury, closed reduction and intramedullary nail fixation of the left intertrochanteric femoral fracture were performed. Postoperative X-ray obtained one week later (**Figure 1B**) demonstrated satisfactory fracture reduction and proper positioning of the internal fixation device.

Comparison of mFI-5 components between the frail and non-frail groups

No significant difference was observed in the incidence of congestive heart failure within 30 days before surgery between the two groups ($P > 0.05$; **Table 2**). However, the frail group exhibited significantly higher rates of COPD or chronic pneumonia, non-independent functional status, type 2 diabetes mellitus, and hypertension requiring pharmacological treatment compared with the non-frail group (all $P < 0.05$; **Table 2**).

Comparison of postoperative complication rates between the frail and non-frail groups

Univariate analysis of postoperative complications

No significant differences were observed between the two groups in the incidences of stroke, heart failure, or urinary tract infection (all $P > 0.05$; **Table 3**). However, the incidences of delirium, pneumonia, DVT, and the overall complication rate were significantly higher in the frail group than those in the non-frail group (all $P < 0.05$; **Table 3**).

Multivariate logistic regression analysis of postoperative complications

After adjusting for age, sex, ASA classification, anesthetic method, and preoperative hemoglobin level, the risk of postoperative complications in the frail group was 11.26 times higher

Table 1. Comparison of baseline characteristics between the frail and non-frail groups

Group	n	Female [n (%)]	BMI (kg/m^2, $\bar{x} \pm s$)	Age (years, $\bar{x} \pm s$)	Smoking [n (%)]	Drinking [n (%)]	ASA [n (%)]		Anesthetic Method [n (%)]		Duration of Operation (min, $\bar{x} \pm s$)	Preoperative Hemoglobin (g/L, $\bar{x} \pm s$)
							I-II	III-IV	Epidural	General		
Non-frail group	306	138 (45.10)	25.12 ± 4.02	72.68 ± 6.26	98 (32.03)	132 (43.14)	252 (82.35)	54 (17.65)	201 (65.69)	105 (34.31)	55.46 ± 24.86	115.86 ± 21.28
Frail group	126	72 (57.14)	25.44 ± 4.74	78.24 ± 7.94	42 (33.33)	58 (46.03)	75 (59.52)	51 (40.48)	79 (62.70)	47 (37.30)	53.21 ± 28.42	108.42 ± 26.94
t/χ^2			1.462	2.504	1.065	2.026	1.438	5.062	4.841	1.162	2.248	-1.446
P-value			0.602	0.422	0.728	0.142	0.294	< 0.001	< 0.001	0.816	0.742	0.217

BMI: body mass index; ASA: American Society of Anesthesiologists.

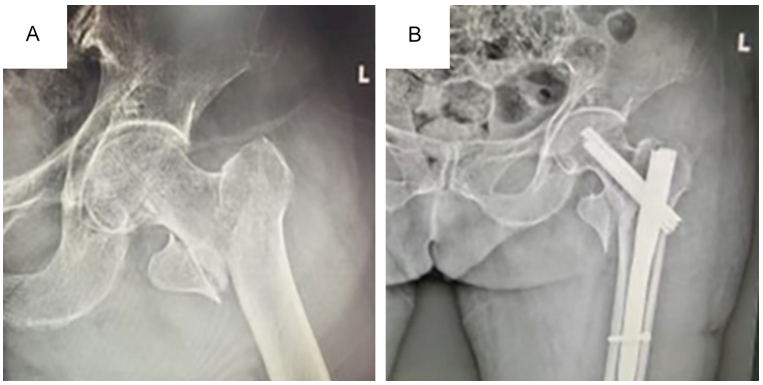

Figure 1. Representative radiographs of an elderly patient with a left intertrochanteric femoral fracture. A. Preoperative X-ray showing a left intertrochanteric femoral fracture. B. Postoperative X-ray obtained one week after closed reduction and intramedullary nail fixation, demonstrating satisfactory fracture reduction and proper positioning of the internal fixation device.

than that in the non-frail group. There was a significant difference in the incidence of total complications between the two groups ($P < 0.05$). Frailty was identified as an independent risk factor for postoperative delirium, stroke, and DVT (**Table 4**).

ROC curve analysis of mFI-5 for predicting postoperative complications

The ROC curve of the mFI-5 for predicting total postoperative complications is shown in **Figure 2**. The AUC was 0.86 (95% confidence interval [CI]: 0.81-0.91, $P < 0.001$), indicating good discriminative ability. The optimal cutoff value of mFI-5 was 2 points, with a Youden index of 0.614, a sensitivity of 82.1% (95% CI: 73.5-88.9%), and a specificity of 79.3% (95% CI: 74.2-83.8%).

Establishment of the predictive formula for postoperative complications

Based on the results of multivariate logistic regression analysis, the predictive formula for postoperative complications was established as follows:

Logit (P) = -3.24 + 1.86 × (mFI-5) + 0.52 × [ASA classification (III-IV = 1, I-II = 0)] - 0.03 × preoperative hemoglobin, g/L)

where $P = 1/(1 + e^{-\text{Logit}(P)})$

For example, in a patient with an mFI-5 score of 2, ASA classification III, and preoperative hemoglobin of 100 g/L:

Logit (P) = -3.24 + 1.86 × 2 + 0.52 × 1 - 0.03 × 100 = -3.24 + 3.72 + 0.52 - 3 = -2.0

$P = 1/(1 + e^{2.0}) \approx 11.9\%$

This result indicates that the predicted probability of postoperative complications for this patient is approximately 11.9%.

Discussion

With the rapid development of the social economy and continuous improvement in medical care, the degree of population aging in China has been steadily increasing. Owing to progressive bone mass loss, deterioration of bone quality, and a higher risk of falls among the elderly, both the prevalence of osteoporosis and the incidence of hip fractures have shown a continuous upward trend in recent years [12]. According to the estimation by Gullberg et al. [13], the proportion of hip fractures occurring in Asia is expected to rise to approximately 45% by 2050, with the total number of cases projected to increase from 7.3 million to 21.3 million worldwide.

Elderly hip fractures primarily include femoral neck fractures, intertrochanteric femoral fractures, and subtrochanteric femoral fractures [14]. Among these, intertrochanteric femoral fractures are the most common type, accounting for approximately 50% of all hip fractures in older adults [15]. Conservative treatment for intertrochanteric femoral fractures is associated with prolonged immobilization, which severely affects quality of life. Moreover, long-term bed rest markedly increases the risk of complications, and the mortality rate may reach as high as 34.1% [16]. Therefore, unless absolute contraindications exist, surgical intervention is generally preferred in clinical practice. Both the PFNA and the InterTAN intramedullary nail enable minimally invasive reduction and internal fixation. These devices offer the advantages of stable fixation, simplified surgical procedures, shorter operative duration, reduced intraoperative trauma, and biomechanically sound antirotational stability. In recent years, they have been widely applied for the management of intertrochanteric femoral frac-

Table 2. Comparison of mFI-5 variables between the frail and non-frail groups [n (%)]

Group	n	COPD or Chronic Pneumonia	Non-Independent Function Status	Type 2 Diabetes Mellitus	Heart Failure within 30 Days before Surgery	Hypertension Requiring Pharmacological Treatment
Non-frail group	306	7 (2.29)	21 (6.86)	19 (6.21)	0 (0.00)	108 (35.29)
Frail group	126	23 (18.25)	82 (65.08)	70 (55.56)	2 (1.59)	115 (91.27)
χ^2		4.016	10.246	14.818	9.921	3.173
P-value		< 0.001	< 0.001	< 0.001	0.082	< 0.001

mFI-5: 5-factor modified frailty index; COPD: chronic obstructive pulmonary disease.

Table 3. Univariate analysis of postoperative complications between the frail and non-frail groups [n (%)]

Group	n	Delirium	Stroke	Pneumonia	DVT	Heart Failure	Urinary Tract Infection	Total Complications
Non-frail group	306	4 (1.31)	1 (0.33)	2 (0.65)	1 (0.33)	1 (0.33)	1 (0.33)	10 (3.27)
Frail group	126	20 (15.87)	2 (1.59)	10 (7.94)	8 (6.35)	1 (0.79)	1 (0.79)	42 (33.33)
χ^2		3.226	13.747	-8.019	-2.282	0.142	0.142	4.514
P-value		< 0.001	0.058	< 0.001	< 0.001	0.694	0.694	< 0.001

DVT: deep vein thrombosis.

Table 4. Multivariate logistic regression analysis of factors associated with postoperative complications after adjustment for confounding variables

Outcome	B	OR	95% CI	*P*-value
Total complications	2.48	11.26	5.38-22.49	0.003
Delirium	2.01	11.58	6.02-23.94	0.006
Stroke	3.68	23.11	4.23-42.03	0.032
Pneumonia	2.92	3.09	0.923-6.26	0.518
DVT	4.27	26.82	4.28-51.93	0.008
Heart failure	3.16	12.74	1.26-60.78	0.648
Urinary tract infection	3.16	12.74	1.26-60.78	0.648

DVT: deep vein thrombosis; B: regression coefficient; OR: odds ratio; CI: confidence interval.

tures and have achieved favorable clinical outcomes [17].

As physical function declines in elderly patients, both physiological reserve capacity and tissue repair ability become significantly reduced. Many of these patients also suffer from chronic comorbidities of varying severity. Consequently, their tolerance to surgical stress is often poor, and the risks associated with anesthesia and surgery are substantially increased. Surgical trauma can further weaken the body's compensatory mechanisms, leading to disturbances in metabolic homeostasis and immune dysfunction, thereby increasing the likelihood postoperative complications. At present, the ASA Physical Status Classification System is commonly used in clinical practice to evaluate patients' preoperative conditions. However, the ASA classification provides only a general estimation of surgical risk based on physical status and lacks quantitative precision. To date, there remains no comprehensive and standardized scoring system capable of accurately assessing the overall health status of elderly patients [18]. Therefore, identifying simple and effective indicators for preoperative risk assessment is of great clinical importance. Such measures can help predict the risk of postoperative complications, guide individualized perioperative management, and ultimately improve patients' postoperative outcomes and quality of life.

Frailty is a nonspecific clinical condition characterized by a decline in physiological reserve and functional capacity in the elderly, resulting in increased vulnerability and diminished resistance to external stressors [19]. Previous studies have shown that frailty reduces the ability to cope with physiological stressors such as surgery and increases susceptibility to adverse outcomes and disability [4]. Frail patients have been reported to experience higher rates of postoperative complications, mortality, and

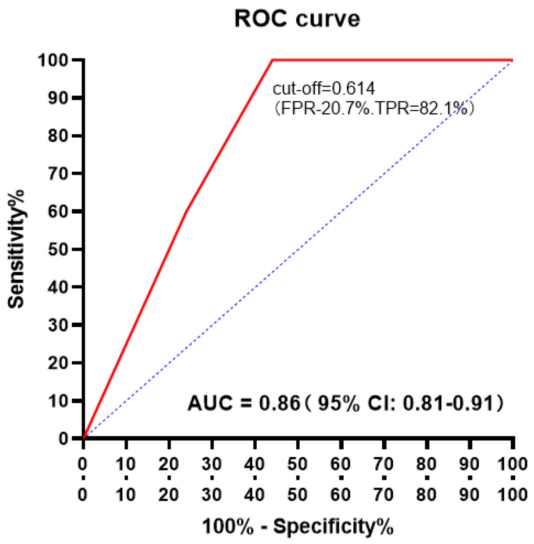

Figure 2. ROC curve of the mFI-5 for predicting total postoperative complications.

hospitalization costs compared with non-frail patients [20]. International studies have identified frailty as a key indicator for preoperative risk assessment in elderly surgical patient, capable of independently predicting both short-term and long-term prognoses [21]. Early recognition of frailty through standardized assessment enables clinicians to comprehensively evaluate its contributing factors and implement targeted, individualized interventions, thereby improving perioperative management and patient outcomes.

The mFI-5 comprehensively evaluates preoperative patient status based on five clinical variables, providing an objective reflection of a patient's degree of frailty [22]. The mFI-5 score has been widely applied for perioperative risk assessment in various surgical settings, including colorectal surgery [23], radical cystectomy [24], pancreatoduodenectomy [25], and joint replacement procedures [26]. However, limited evidence is available regarding the application of the mFI-5 in elderly patients with intertrochanteric femoral fractures. In the present study, we investigated the predictive value of the mFI-5 score for postoperative complications in 432 elderly patients undergoing internal fixation for intertrochanteric femoral fractures. The findings demonstrated that frail patients had an 11.26-fold higher risk of postoperative complications compared with non-frail patients ($P = 0.003$). Moreover, the overall incidence of postoperative complications in the frail group (33.33%) was significantly greater than that in the non-frail group (3.27%) ($P < 0.05$). These results suggest that higher mFI-5 scores are strongly associated with an increased risk of postoperative complications in elderly patients with intertrochanteric femoral fractures, further supporting the clinical utility of the mFI-5 as a simple and effective frailty assessment tool in this population.

Frail patients often experience prolonged postoperative bed rest and weakness in the affected limb, which may lead to venous stasis. Local tissue hypoxia and metabolic alterations further predispose these patients to postoperative DVT [27]. In the present study, postoperative rehabilitation began on the first day after surgery, including ankle rotation, ankle pump, quadriceps contraction, and hip-lifting exercises. From one week postoperatively, patients gradually progressed to passive knee-chest flexion, thigh and adductor muscle training, hip adduction, and straight-leg raising exercises with limb support.

Before surgery, frail patients frequently present with comorbidities such as anemia, hypoproteinemia, diabetes, and COPD, as well as reduced functional independence, all of which increase the risk of postoperative delirium. Postoperative delirium is considered multifactorial, potentially resulting from structural brain damage [28], neurotransmitter imbalance [29], and neuroinflammatory and stress responses [30]. Clinicians can perform preoperative assessments using the mFI-5 score to identify frail patients early. Once identified, targeted perioperative management strategies should be implemented. These include nutritional optimization with adequate protein and caloric supplementation, perioperative transfusion to correct anemia, nebulized inhalation therapy to clear airway secretions, and respiratory function training to improve pulmonary capacity. Additionally, individualized surgical and nursing plans, early rehabilitation guidance, and close postoperative follow-up can effectively reduce the incidence of complications, readmission rates, and overall frailty progression. Continued follow-up and reassessment after discharge are also essential for improving long-term recovery and functional outcomes.

This study has several limitations that should be acknowledged. First, it was a retrospective

single-center study with a relatively small sample size, which may limit the generalizability and external validity of the findings. Second, the follow-up period for postoperative complications was confined to the perioperative phase, providing limited information on long-term outcomes such as functional recovery, readmission, and mortality. Third, the study may have potential confounding factors during the process of retrospective data collection. In the future, we will expand the sources and size of our samples to conduct multi-center and large-sample studies. Going forward, we will extend the follow-up period and broaden the follow-up content to carry out more comprehensive research on patients' frailty status and prognosis, thereby providing better evidence for clinical decision-making. We will also control confounding factors during the data collection process to enhance the reliability of the model.

In conclusion, the mFI-5 is closely associated with the incidence of postoperative complications in elderly patients with intertrochanteric femoral fractures. Patients with higher mFI-5 scores are more likely to experience postoperative complications. Preoperative assessment using the mFI-5 can serve as a valuable tool for identifying high-risk individuals, guiding comprehensive perioperative interventions, optimizing clinical management, and ultimately reducing postoperative complications and improving patient outcomes.

The ROC curve analysis demonstrated good predictive performance of the mFI-5 for postoperative complications, with an AUC of 0.86 and an optimal cut-off value of 2 points, consistent with the grouping criteria used in this study. These findings indicate that the mFI-5 can effectively discriminate between high-risk and low-risk patients for postoperative complications. Furthermore, the established predictive formula integrates the mFI-5 with other key preoperative indicators, including the ASA Physical Status Classification and preoperative hemoglobin levels. This model enables quantitative estimation of an individual's risk probability, enhancing its clinical applicability. Clinicians may use this formula for preoperative risk stratification and to design personalized perioperative management strategies aimed at reducing complication rates and improving postoperative outcomes.

Disclosure of conflict of interest

None.

Address correspondence to: Mengxue Xu, Department of Orthopedic Trauma, Dongying People's Hospital (Dongying Hospital of Shandong Provincial Hospital Group), 317 South First Road, Dongying 257091, Shandong, China. E-mail: XUMENGXUE126@126.com; dysrmyykjk@163.com

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