Prediction model for prolonged length of stay in hip fracture patients

Jian Yu
Tianjin University of Traditional Chinese Medicine
Hong Cao (Caohong1968@yeah.net)
Tianjin Hospital
XueJiao Li
Tianjin University of Traditional Chinese Medicine
YaRu Chang
Tianjin University of Traditional Chinese Medicine
Yue Li
Tianjin University of Traditional Chinese Medicine
HongYu Guo
Tianjin University of Traditional Chinese Medicine

Research Article

Keywords: delayed discharge, Hip fracture, Risk factor, Nomogram

Posted Date: May 24th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1628874/v1

Abstract

Background: The length of hospital stay in hip fracture patients is closely associated with medical costs, the burden of which is increasing in aging societies. Herein, we developed and validated models for predicting prolonged length of stay in hip fracture patients to support efficient care in these patients.

Methods: This was a retrospective analysis of all patients undergoing hip fracture from January 2019 to December 2021. Univariate and multivariate logistic regression analyses were used to evaluate the association between risk factors and delayed discharge after hip fracture . Finally, the risk factors obtained from the multivariate regression analysis were used to establish the nomogram model. The validation of the nomogram was assessed by the concordance index (C-index), the receiver operating characteristic (ROC) curve, decision curve analysis (DCA), and calibration curves.

Results: A total of 684 patients were included in the present study for evaluation. Multivariate logistic regression analysis demonstrated that bone traction, pneumonia, second fracture, multiple trauma, venous thrombosis, pulmonary infection and ACCI were independent risk factors for delayed discharge after hip fracture. The C-index of this model was 0.794 (95% CI, 0.744-0.844). Internal validation proved the nomogram model's adequacy and accuracy, and the results showed that the predicted value agreed well with the actual values. **Conclusions:** Our prediction models may help policymakers in developing strategies for the optimal management of hip fracture patients with a focus on patients at a high risk of prolonged length of stay.

Introduction

Of all the fracture types in the elderly, hip fracture is considered to be the most serious fracture. Due to the characteristics of poor prognosis, many complications and high mortality, hip fracture in the elderly is regarded as "the last fracture in life"[1]. Due to the decline of body function, the decrease of coordination and response ability, the decline of muscle strength around the hip joint, and the increase of age, the calcium loss in the body is serious, and the bone mineral density decreases. Fracture can occur when the hip joint is slightly impacted by external force. In recent years, with the acceleration of the aging process of the population, the elderly are gradually increasing, accordingly, the number of people with hip fractures is increasing year by year. According to statistics, the number of hip fractures worldwide is expected to increase from 1.26 million in 1990 to 4.5 million in 2050, about half of which may occur in Asia, especially in China[2]. Hip fractures account for only 14% of all osteoporotic fractures, but require 72% of the total cost, and are expected to cost more than $18.2 billion in the United States by 2025[3].

Studies have shown that hip fracture is the fracture that has the most serious impact on the elderly, which has the characteristics of poor prognosis, many complications and high mortality, which leads to prolonged hospitalization and serious burden on patients and their families[4–6]. In addition, the prolongation of hospital stay will also increase the postoperative infection rate of patients[7]. According to the study, factors that may affect the LOS of hospitalized patients after hip fracture include osteoarthritis,

women, severe postoperative pain, history of stroke, cognitive impairment, comorbid depression, postoperative weight-bearing limitation, and concomitant multiple fractures[8]. However, the current literature on the risk factors of delayed hospitalization of hip fractures varies in quality due to different locations, there is a certain degree of uncertainty, and the risk of delayed hospitalization can not be quantified.

Therefore, in order to better understand the factors affecting the length of stay of patients with hip fracture, shorten the length of stay, reduce the cost of hospitalization, and make more efficient use of medical resources, the independent risk factors related to the length of stay of patients with hip fracture were obtained by using logistics regression analysis, and the nomogram model was established. Through the scientific and systematic evaluation of the probability of prolonged hospitalization, the application of nomogram model before operation can more accurately guide clinicians to intervene and treat patients in advance and reduce the occurrence of delayed discharge.

Methods

Patients

In total, 684 patients who underwent treatment for hip fracture between January 2018 and December 2021 were enrolled, and the ethics committee approved the trial at our hospital. The inclusion criteria were as follows:low-energy injury□Medical records are complete□The exclusion criteria were as follows: Patients who leave hospital quickly due to non-disease reasons; Pathological fracture; Death in hospital. Of these, 46 patients were excluded: 15 were operated with unknown type, and 31 left the hospital voluntarily.

Ultimately, 684 patients were included in the study, and they were randomly divided into a training set (70%) and a testing set (30%). Patients in the training set were used to develop the nomogram model, whereas patients in the testing set were used to validate the resulting nomogram.

Data collection

In this study, the factors influencing the delay of discharge were collected through the electronic medical record system. All factors were included age, sex, length of stay, type of operation, type of fracture, bone traction, complications, hypertension, coronary heart disease, diabetes, cerebrovascular disease, cerebral sequelae, cardiac insufficiency, arrhythmia, atrial fibrillation, COPD, bronchopneumonia, renal insufficiency, hepatic insufficiency, anemia, hypoproteinemia, electrolyte disorder, malignant tumor, brain atrophy, senile dementia, Parkinson's disease, refolding, multiple trauma□ACCI, delirium, venous thrombosis, pulmonary infection and urinary tract infection. the types of fracture and complications were diagnosed by bone physicians according to the results of imaging examination or laboratory examination after consultation. The hospitalization time is defined as the time from the day of hospitalization to the day before discharge. The 75th percentile of the patient's hospitalization time is used as the boundary value for the extension of hospitalization time. the patients who stayed in hospital for more than 28 days

were included in the delayed discharge group, while other patients were included in the normal group. If there is a missing value in the patient data, take the mean value of this variable to replace it. In addition, two team members complete the work of code entry, database establishment and statistical analysis, etc. If there are differences, a third party will solve them to ensure the accuracy of the data.

Statistical analysis

Data were analyzed using the SPSS 22 software for Windows (IBM Corp., Armonk, NY, USA). First, the risk factors that may affect length of stay were classified. Student's t test or the Mann-Whitney U test was used to perform delayed discharge and non-delayed discharge group comparisons for quantitative variables. Categorical variables were compared using the chisquare or Fisher's exact test. Second, all the training set factors were included in the univariate and multivariate logistic regression analyses to exclude unrelated risk factors. The independent risk factors obtained based on the multivariate regression method were used to construct a nomogram model with the "rms" package of R software (version 3.6.1).

Finally, the C-index, the area under the ROC curve (AUC), calibration curve, and DCA were used to evaluate the predictive ability and performance of the risk model. The C-index enables evaluation of the predictive accuracy and discriminative ability of nomograms . The C-index values ranged from 0.5-1.0, with low accuracy (< 0.5), moderate accuracy (0.5- 0.7), high accuracy (0.7 -0.9), and extreme accuracy (> 0.9). A calibration curve was used to compare the actual risk and predicted risk. The clinical usefulness of the nomogram was estimated by DCA based on the net benefit and threshold probabilities. Statistical tests used $p<0.05$ as a significance level.

Results

A total of 684 patients were included in this study: 479 patients were included in the training set, and 204 patients were included in the testing set. In the training set, the delayed discharge group was compared with the non-delayed discharge group, and the results showed that Type of fracture, type of operation, bone traction, complications, pneumonia, liver insufficiency, anemia, malignant tumor, whether to refold, multiple trauma, ACCI, venous thrombosis, pulmonary infection and urinary tract infection were correlated with delayed discharge. (Table 1). Risk factors (Bone traction, pneumonia, refolding, multiple trauma, venous thrombosis, lung infection and ACCI.) for prolonged length of stay were obtained by multivariate regression in the training set (Table 2). A new nomogram was constructed to evaluate the postoperative blood transfusion probability after hip fracture (Fig. 1). To apply the nomogram model, the scores of different variables are first obtained on the vertical line on the nomogram. Then, the scores of all variables are added to obtain the total score, which finally allows determination of the corresponding predicted risk value by connecting the prediction line to the total score line at the bottom of the nomogram.

The accuracy of the nomogram model was estimated by internal validation in the training set and testing sets. This model's C-index was 0.794(95% CI,0.744~0.844), which indicated that the model was predictive with high accuracy. Furthermore, the ROC curve was constructed, and the AUC was calculated for both the

training and testing sets. The AUC was 0.794 in the training set (Fig. 2a) and 0.782 in the testing set (Fig. 2b), illustrating that the model had high discrimination. The calibration curves demonstrated good consistency between the model's actually observed probability and the predicted probability (Fig. 3). DCA indicated that this nomogram model could be an excellent prediction tool for prolonged length of stay after hip fracture (Fig. 4).

Table 1 demographic characteristics in the training set

Characteristics	Delayed discharge	Non-delayed discharge	$t/z/\chi^2$	P
Age	81（73，86）	81（73，86）	-0.388[1]	0.698
Gender			0.124	0.725
Male	31（29.6）	87（88.4）		
Female	89（90.4）	272（270.6）		
Fracture type			20.532	0.000
Femoral neck fracture	36（56.6）	190（169.4）		
Intertrochanteric fracture	79（60.9）	164（182.1）		
Subtrochanteric fracture	5（2.5）	5（7.5）		
Type of operation			19.254	0.000
Unoperated	67（47.1）	121（140.9）		
Hip arthroplasty	29（43.1）	143（128.9）		
Closed reduction and internal fixation	18（23.8）	77（71.2）		
open reduction and internal fixation	6（6）	18（18）		
Bone traction			58.169	0.000
Yes	57（26.9）	50（80.1）		
No	63（93.1）	308（277.9）		
Complication			4.952	0.026
Yes	82（71.6）	204（214.4）		
No	38（48.4）	155（144.6）		
high blood pressure			0.529	0.467
Yes	78（74.7）	139（135.7）		
No	42（45.3）	220（223.3）		
coronary artery disease			0.156	0.693
Yes	95（93.4）	278（279.6）		
No	75（74.4）	222（222.6）		
Cerebral vascular disease			0.009	0.925
Yes	40（39.6）	118（118.4）		

No	80（80.4）	241（240.6）		
Brain sequelae			0.109	0.742
Yes	14（13.0）	38（39.0）		
No	106（107.0）	321（320.0）		
Cardiac insufficiency			1.642	0.2
Yes	21（16.8）	46（50.2）		
No	99（103.2）	313（308.8）		
Arrhythmia			1.134	0.287
Yes	23（19.3）	54（57.7）		
No	97（100.7）	305（301.3）		
atrial fibrillation			0.335	0.563
Yes	15（13.3）	38（39.7）		
No	105（106.7）	321（319.3）		
COPD			0.313[2]	0.576
Yes	3（4.5）	15（13.5）		
No	117（115.5）	344（345.5）		
pneumonia			16.992	0.000
Yes	44（27.6）	66（82.4）		
No	76（92.4）	293（276.6）		
Renal insufficiency			0.172	0.678
Yes	9（8.0）	23（24.0）		
No	111（112.0）	336（335.0）		
Liver insufficiency			3.896	0.048
Yes	4（1.8）	3（5.2）		
No	116（118.2）	356（353.8）		
anemia			13.831	0.000
Yes	97（80.4）	224（240.6）		
No	23（39.6）	135（118.4）		
Hypoproteinemia			0.169	0.681

Yes	98（96.5）	287（288.5）		
No	72（70.5）	22（23.5）		
Electrolyte disorder			2.274	0.132
Yes	63（55.9）	160（167.1）		
No	57（64.1）	199（191.9）		
Malignant tumor			6.520	0.011
Yes	12（6.5）	14（19.5）		
No	108（113.5）	345（339.5）		
Brain atrophy			0.541	0.462
Yes	20（17.5）	50（52.5）		
No	100（102.5）	309（306.5）		
dementia			0.463[2]	0.496
Yes	3（4.8）	16（14.2）		
No	117（115.2）	343（344.8）		
Parkinson's disease			0.538[2]	0.463
Yes	4（2.5）	6（7.5）		
No	116（117.5）	353（351.5）		
Secondary fracture			7.773	0.005
Yes	18（10.5）	24（31.5）		
No	102（109.5）	335（327.5）		
Multiple trauma			7.495	0.006
Yes	23（14.5）	35（43.5）		
No	97（105.5）	324（315.5）		
ACCI			27.792	0.000
（9	38（19.5）	40（58.5）		
≥9	82（100.5）	319（300.5）		
Delirium			0.00	0.995
Yes	7（7.0）	21（21）		
No	113（113）	338（338）		

Venous thrombosis			10.341	0.001
Yes	68（52.9）	143（158.1）		
No	52（67.1）	216（200.9）		
Gastrointestinal bleeding			3.082	0.079
Yes	7（4）	9（12）		
No	113（116）	350（347）		
Pressure sore			0.066[2]	0.797
Yes	2（1.3）	3（3.7）		
No	118（118.7）	356（355.3）		
Pulmonary infection			14.853	0.000
Yes	23（12）	25（36）		
No	97（108）	334（323）		
Urinary tract infection			6	0.014
Yes	29（20.3）	52（60.7）		
No	91（99.7）	307（298.3）		

1） Z）2）

Table 2 Univariate and multivariate logistic analysis of risk factors for prolonged length of stay after hip fracture

	Univariate		Multivariate	
	OR (95% CI)	P	OR (95% CI)	P
Fracture type				
Femoral neck fracture	Ref.		Ref.	
Intertrochanteric fracture	2.542(1.627-3.972)	0.000	1.256(0.513,3.116)	0.610
Subtrochanteric fracture	5.278(1.453-19.169)	0.011	2.250(0.348,14,544)	0.395
Type of operation				
Unoperated	Ref.		Ref.	
Hip arthroplasty	0.366(0.222-0.603)	0.000	1.212(0.512,2.868)	0.661
Closed reduction and internal fixation	0.422(0.233,0.764)	0.004	0.797(0.333,1.970)	0.611
open reduction and internal fixation	0.602(0.228,1.590)	0.306	0.923(0.281,3.028)	0.894
Bone traction				
Yes	5.573(3.495,8.887)	0.000	4.841(2.280,10.278)	0.000
No	Ref.		Ref.	
Complication				
Yes	1.640(1.058,2.540)	0.027	0.608(0.289,1.279)	0.19
No	Ref.		Ref.	
pneumonia				
Yes	2.570(1.627,4.061)	0.000	2.250(1.291,3.921)	0.004
No	Ref.		Ref.	
anemia				
Yes	2.542(1.538,4.200)	0.000	2.135(1.187,3.840)	0.11
No	Ref.		Ref.	
Liver insufficiency				
Yes	4.092(0.903,18.552)	0.068	1.933(0.313,11.927)	0.478
No	Ref.		Ref.	
Secondary fracture				
Yes	2.463(1.286,4.719)	0.007	2.683(1.238,5.812)	0.012

No	Ref.		Ref.	
Multiple trauma				
Yes	2.195(1.238,3.893)	0.007	1.794(0.903,3.564)	0.095
No	Ref.		Ref.	
Venous thrombosis				
Yes	1.975(1.300,3.001)	0.001	2.616(1.342,5.098)	0.005
No	Ref.		Ref.	
pneumonia				
Yes	3.168(1.722,5.829)	0.000	3.070(1.459,6.463)	0.003
No	Ref.		Ref.	
Urinary tract infection				
Yes	1.881(1.129,3.136)	0.015	1.487(0.746,2.963)	0.26
No	Ref.		Ref.	
Malignant tumor				
Yes	2.738(1.229,6.098)	0.014	2.262(0.892,5,735)	0.085
No	Ref.		Ref.	
ACCI				
9	Ref.		Ref.	
≥9	3.696(2.228,6.130)	0.000	3.391(1.778,6.195)	0.000

Discussion

In this study, the construction of hip fracture patients with prolonged hospital stay risk prediction model, whether the model construction or the internal verification of the data have good sensitivity and specificity, indicating that the prediction effect of the model is good and the result is stable (AUC = 0.794). The model can directly reflect the risk factors of delayed hospitalization in the formula, which can not only predict the risk of delay in patients with clinical hip fracture, but also provide a basis for the follow-up medical staff to systematically evaluate the influencing factors of discharge delay. According to this line map, nurses can evaluate the hospitalization time of patients with hip fracture in advance, according to their ACCI, bone traction, refracture, anemia, venous thrombosis, pneumonia, pulmonary infection and other influencing factors, to speculate that patients may have delayed discharge risk, so as to shorten hospital stay, reduce the occurrence of postoperative complications, promote postoperative rehabilitation, and optimize the rational allocation of medical resources.

In this study, it was found that the hospitalization delay of patients with hip fracture with CCI ≥ 8 increased by 3.326 times. The ACCI score includes the patient's age and various complications, reflecting the patient's overall health at the time of admission. Similar to the conclusions of this study, wei[9] et al. [9] found that the co-disease weight of elderly patients with hip fracture (based on age-adjusted CCI assessment) was associated with increased length of stay. A meta analysis also showed that there was a positive correlation between comorbid disease and length of stay of patients with hip fracture[10]. It is possible that patients with severe comorbidities may be more prone to complications and require multiple medication, so they will be given longer hospital stay for treatment and care[11, 12]. In addition, these patients with a variety of chronic diseases lead to poor self-care ability, but also need a longer recovery period to return to their original self-care level. Bone traction is generally used in patients with hip fractures who are unable to tolerate surgery and receive conservative treatment. Yoo et al[5]found that most of the postoperative patients in secondary and primary surgical hospitals can be discharged early. Hip arthroplasty can replace the damaged site with artificial hip joint, and walk on the ground as soon as possible to reduce the complications caused by long-term bedridden. In addition, patients after hip arthroplasty can take early rehabilitation exercise to reduce the risk of infection, venous thrombosis and delayed healing, and reduce the length of stay of patients with hip fracture [13]. As bone traction patients can not tolerate surgery, need to stay in bed for a long time, prone to infection, bedsores and other complications, resulting in prolonged hospitalization.

This study found that refracture is closely related to the prolonged hospitalization of patients with hip fracture. Compared with the primary fracture, the secondary fracture has a higher mortality and incidence of complications, often has limited function, and has worse self-care ability after operation[14]. The study reported that the admission function and activity level of patients with secondary fracture of hip fracture was significantly worse than that of patients with primary fracture, and the difference of Basel index between the two groups was almost 20 points[15].Due to the complex injury and many complications in patients with secondary fracture, it is very difficult to treat, which seriously affects the prognosis and requires a longer hospital stay to restore their function.

This study found that anemia is closely related to prolonged hospitalization in patients with hip fractures. Nissenholtz et al.[16]found that anemia has a significant effect on the length of stay of elderly patients with hip fracture. On the one hand, because anemic patients need to supplement blood volume and give allogeneic blood transfusion after operation, allogeneic blood transfusion will cause a variety of adverse reactions, affect the patient's immune system and blood coagulation system, and increase the incidence of complications [17] .On the other hand, the degree of postoperative anemia in patients with preoperative anemia of hip fracture is relatively severe, which affects the transport of nutrients in the fracture site, weakening the body's defense barrier and hindering the ability of self-repair, resulting in the invasion of pathogenic microorganisms. the final manifestation is an increase in the incidence of complications[18]. uncorrected anemia after hip fracture may hinder the functional recovery of patients with hip fracture and affect medical complications and length of stay [19] .

This study found that pneumonia and pulmonary infection were independent risk factors for delayed discharge in patients with hip fractures. Pneumonia and pulmonary infection are common in elderly patients with hip fracture due to the weakening of movement and respiratory muscle ability. SalarbaksAM et al. [20]found that the hospitalization time of elderly patients with hip fracture treated with anti-pneumonia was 1.6 times longer than that of patients with hip fracture observed. The study found that elderly patients with hip fractures who received anti-pneumonia treatment spent an average of 1.6 times longer in hospital than those with observed hip fractures. On the one hand, pulmonary infection can damage the immune system and lead to the decline of the body's physiological function, which requires further clinical treatment[21]. On the other hand, the longer the patient stays in the hospital, the longer the time of exposure to pathogens in the hospital, thus increasing the risk of infection.The study found that lower limb venous thrombosis is also a risk factor for delayed discharge of hip fractures. It is reported in foreign literature that venous thrombosis is related to prolonging hospitalization time and increasing hospitalization expenses[22]. On the one hand, venous thrombosis will increase the probability of pulmonary embolism. In order to prevent fatal pulmonary embolism, clinicians will give antithrombotic preventive measures for a period of time. Even the minimum dose of antithrombotic regimen takes 10–14 days[23]. On the other hand, the longer the hospitalization time of patients with hip fracture, the longer the immobilization time, resulting in slow blood flow and hypercoagulable state, thus increasing the risk of venous thrombosis.

Limitations: this study is a retrospective, single-center study, some indicators are not available; the inclusion of disease heterogeneity, underlying diseases, different etiology of primary diseases, these confounding factors to establish predictive models. The effectiveness of the prediction model still needs to be further verified by multicenter, prospective studies.

Conclusions

In this study of Chinese hip fracture patients, we used management data including clinical information to develop and vali-date risk-adjusted models to predict long-term LOS. Our model and line chart show that high ACCI, bone traction, refracture, anemia, venous thrombosis, pneumonia, and pulmonary infection are the determinants of long-term LOS. Our prediction model can support decision makers in planning strategies for the best management of hip fractures.

Declarations

Ethics approval and consent to participate

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Consent for publication

Written informed consent for publication of this paper was obtained from the Tianjin University of Traditional Chinese Medicine and all authors

Competing Interests

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Author contributions

Jian Yu contributed to the work design, draft the article, revise important intellectual content of the article, and the final approval of the version to be submitted.

Hong Cao contributed to the work design, analysis, draft the article, and the final approval of the version to be submitted.

XueJiao Li contributed to the analysis of the work, draft the article, and the final approval of the version to be submitted.

HongYu Guo YaRu Chang and Yue Li contributed to the analysis of the work, writing of the article, and final approval of the version to be published.

Funding

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

References

1. Parker M, Johansen A. Hip fracture[J]. BMJ (Clinical research ed.), 2006, 333(7557): 27–30.
2. Veronese N, Maggi S. Epidemiology and social costs of hip fracture[J]. Injury, 2018, 49(8): 1458–1460.
3. Burge R, Dawson-Hughes B, Solomon D H,et al. Incidence and economic burden of osteoporosis-related fractures in the United States, 2005–2025[J]. Journal of Bone and Mineral Research: The Official Journal of the American Society for Bone and Mineral Research, 2007, 22(3): 465–475.
4. Leal J, Gray A M, Prieto-Alhambra D, et al. Impact of hip fracture on hospital care costs: a population-based study[J]. Osteoporosis international: a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA, 2016, 27(2): 549–558.
5. Yoo J. Length of hospital stay after hip fracture surgery and 1-year mortality[J]. Osteoporos Int,: 9.

6. Cauley J A, Chalhoub D, Kassem A M, et al. Geographic and ethnic disparities in osteoporotic fractures[J]. Nature Reviews. Endocrinology, 2014, 10(6): 338–351.
7. Burgers P T P W, Van Lieshout E M M, Verhelst J, et al. Implementing a clinical pathway for hip fractures; effects on hospital length of stay and complication rates in five hundred and twenty six patients[J]. International Orthopaedics, 2014, 38(5): 1045–1050.
8. Daly N, Fortin C, Jaglal S, et al. Predictors of Exceeding Target Inpatient Rehabilitation Length of Stay After Hip Fracture[J]. American Journal of Physical Medicine & Rehabilitation, 2020, 99(7): 630–635.
9. Wei J, Zeng L, Li S, et al. Relationship between comorbidities and treatment decision-making in elderly hip fracture patients[J]. Aging Clinical and Experimental Research, 2019, 31(12): 1735–1741.
10. Olthof M, Stevens M, Bulstra S K, et al. The association between comorbidity and length of hospital stay and costs in total hip arthroplasty patients: a systematic review[J]. The Journal of Arthroplasty, 2014, 29(5): 1009–1014.
11. Wong R M Y, Zu Y, Chau W W, et al. High Charlson Comorbidity Index Score is associated with early fracture-related complication for internal fixation of neck of femur fractures[J]. Scientific Reports, 2022, 12(1): 4749.
12. Charlesworth C J, Smit E, Lee D S H, et al. Polypharmacy Among Adults Aged 65 Years and Older in the United States: 1988–2010[J]. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 2015, 70(8): 989–995.
13. Santoni B G, Diaz M A, Stoops T K, et al. Biomechanical Investigation of an Integrated 2-Screw Cephalomedullary Nail Versus a Sliding Hip Screw in Unstable Intertrochanteric Fractures[J]. Journal of Orthopaedic Trauma, 2019, 33(2): 82–87.
14. Juhász K, Boncz I, Kanizsai P, et al. [Analysis of mortality and its predictors in patients with contralateral hip fracture after femoral neck fracture][J]. Orvosi Hetilap, 2017, 158(20): 783–790.
15. Trevisan C, Bedogni M, Pavan S, et al. The impact of second hip fracture on rehospitalization and mortality in older adults[J]. Archives of Gerontology and Geriatrics, 2020, 90: 104175.
16. Nissenholtz A, Levy Y, Cooper L, et al. [ANEMIA IN PATIENTS AFTER HIP FRACTURE REPAIR SURGERY][J]. Harefuah, 2020, 159(9): 689–693.
17. Zhang Li, Zhang Chunlei. Effect of perioperative allogeneic blood transfusion on blood coagulation and immune function in patients undergoing orthopedic surgery [J]. Chinese Journal of Modern Medicine, 2020, 22(12): 49–52.
18. Sequeira S B, Quinlan N D, Althoff A D, et al. Iron Deficiency Anemia is Associated with Increased Early Postoperative Surgical and Medical Complications Following Total Hip Arthroplasty[J]. The Journal of Arthroplasty, 2021, 36(3): 1023–1028.
19. Sinclair R C F, Moppett I K, Gillies M A. Patient blood management and hip fracture[J]. Anaesthesia, 2021, 76(3): 417–418.
20. Am S, R L, W N. Pneumonia in hospitalized elderly hip fracture patients: the effects on length of hospital-stay, in-hospital and thirty-day mortality and a search for potential predictors[J]. Injury, Injury, 2020, 51(8).

21. Blasi F. Lung Diseases: Chronic Respiratory Infections[J]. International Journal of Molecular Sciences, 2018, 19(10): 3051.
22. Trivedi N N, Abola M V, Kim C Y, et al. The Incremental Cost of Inpatient Venous Thromboembolism After Hip Fracture Surgery[J]. J Orthop Trauma, 2020, 34(4): 5.
23. Feng L, Xu L, Yuan W, et al. Preoperative anemia and total hospitalization time are the independent factors of preoperative deep venous thromboembolism in Chinese elderly undergoing hip surgery[J]. BMC Anesthesiology, 2020, 20: 72.

Figures

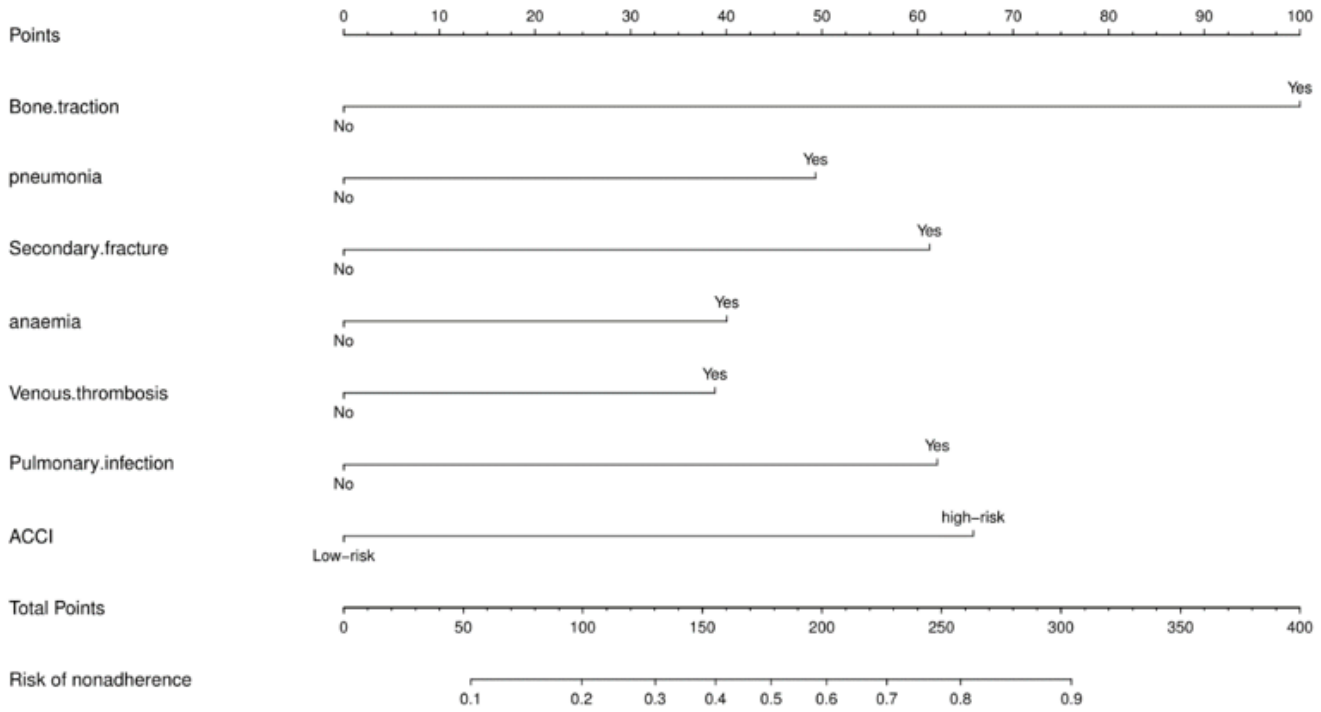

Figure 1

Nomogram for predicting length of stay in patients with hip fracture

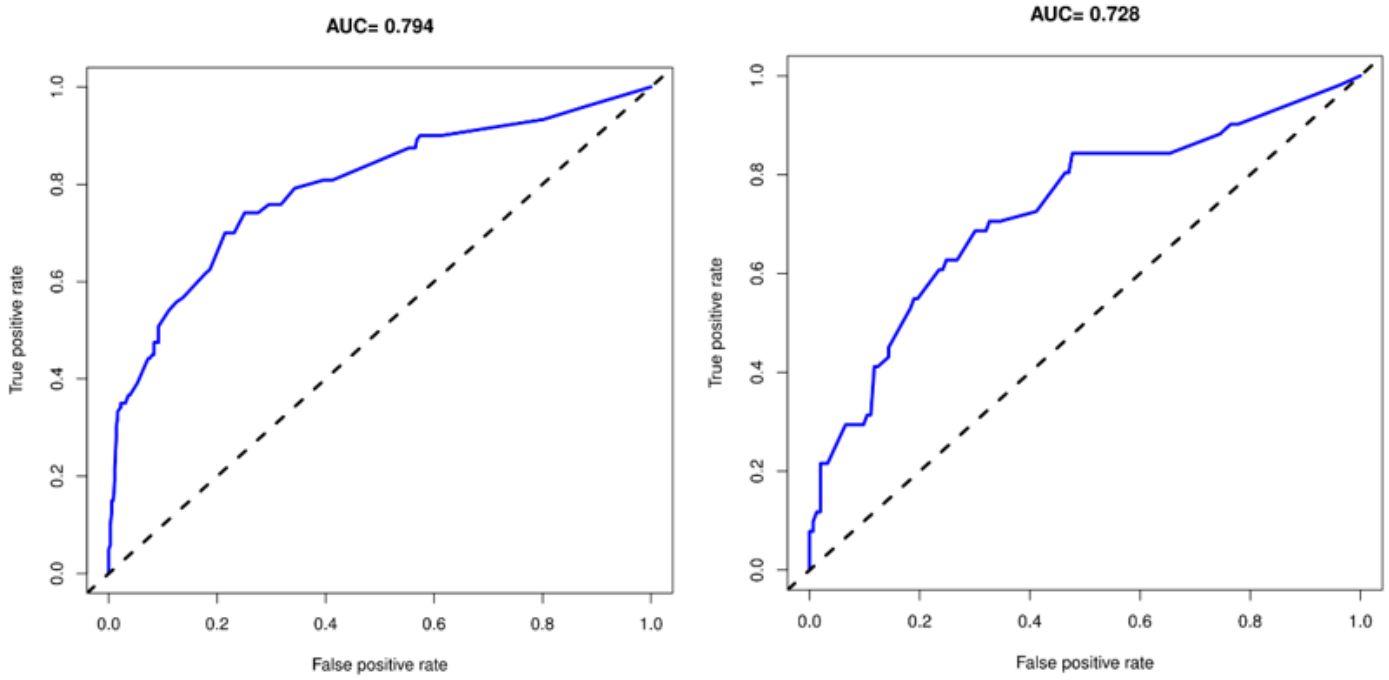

Figure 2

Comparison of the area under the receiver operating characteristic curve between nomogram-independent predictors in the training set (a) and the testing set (b)

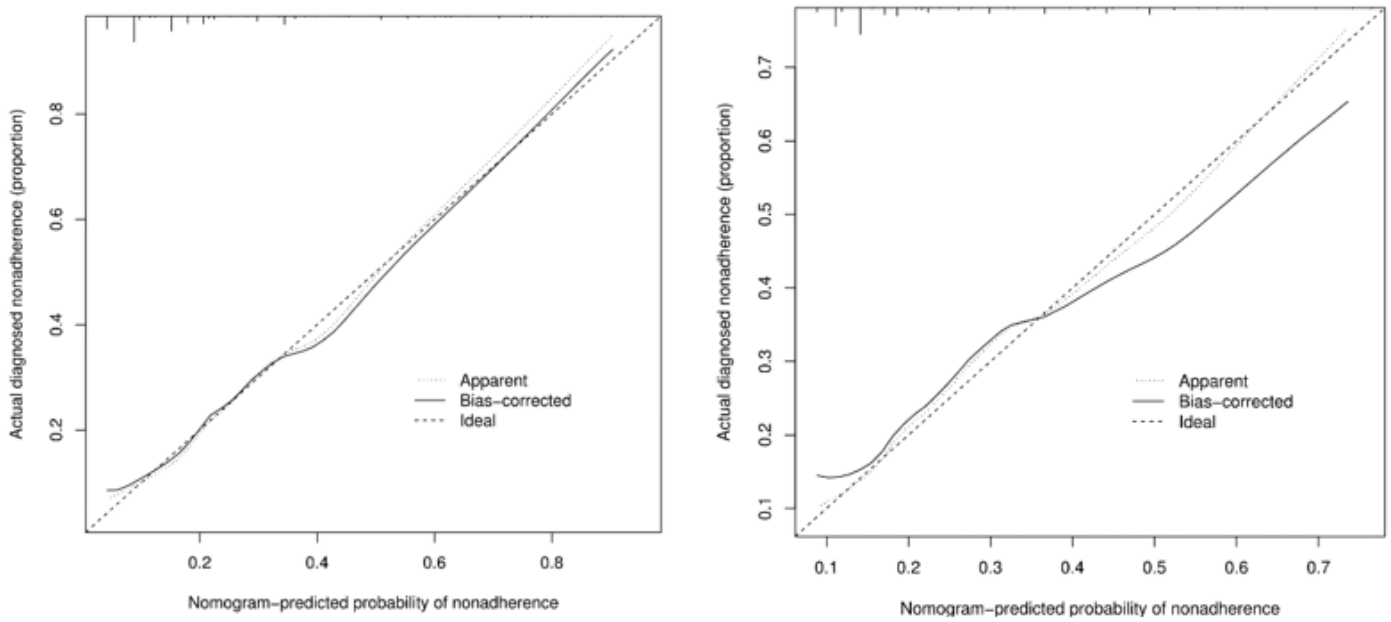

Figure 3

Comparison of calibration curves between the training set (a) and the testing set (b)

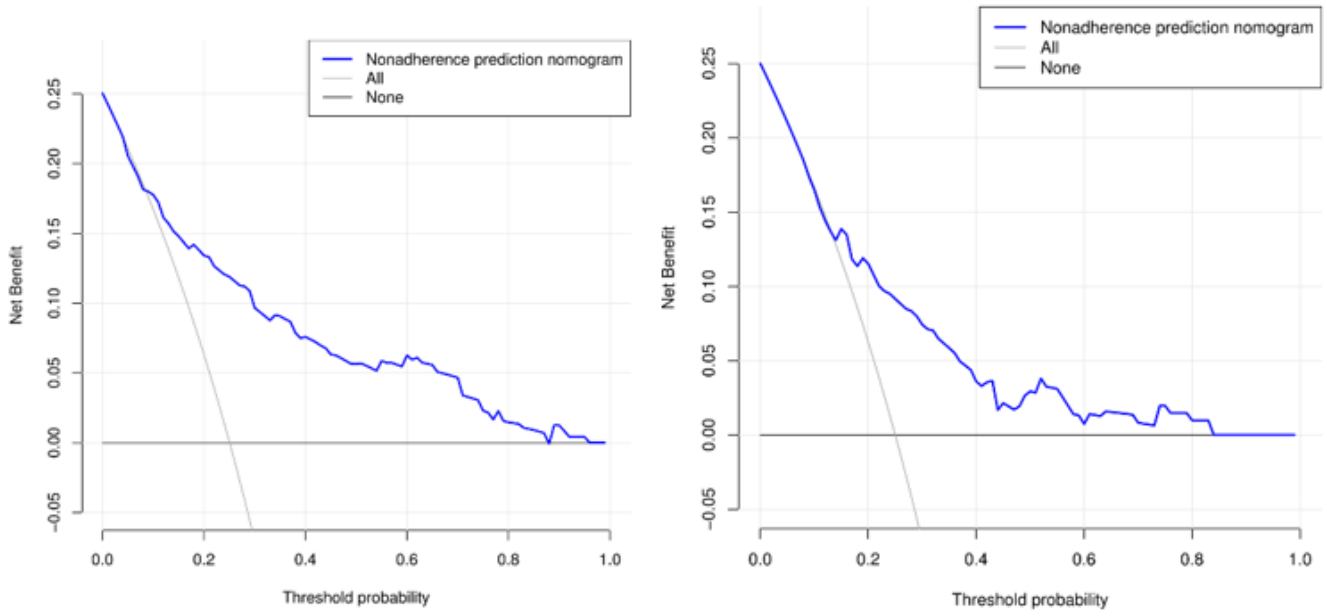

Figure 4

Comparison of decision curve analyses between the training set (a) and the testing set (b)