Development and Validation of an Accurate and Simple Preoperative Prognostic Scoring System for One-Year Mortality in Elderly Patients Undergoing Surgery for Hip Fractures

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INTRODUCTION: Hip fractures in the elderly result in increased mortality. Although there have been many reports on factors associated with the prognosis of hip fractures and scoring systems have been developed, none of them have excellent predictive ability or simple methods of assessment. The purpose of this study was to investigate prognostic factors affecting one-year mortality in elderly patients with hip fractures and to develop an accurate and simple prognostic scoring system that can be evaluated preoperatively.

METHODS: Patients aged ≥ 65 years with hip fractures undergoing surgery between January 2011 and December 2021 were enrolled. Univariate analysis was performed using the χ^2 test for each explanatory variable between the survival versus death groups. Variables with a p-value less than 0.1 in the univariate analysis were included in the multivariate analysis. Variables with a p-value less than 0.05 in multivariate analysis by logistic regression were defined as prognostic predictors. The regression coefficient for each prognostic factor was multiplied by two and rounded to the nearest integer, which was defined as the point for that factor. The prognosis score was calculated by adding points corresponding to each factor. The patients were divided into three groups according to their prognostic score: good, intermediate, and poor prognostic groups. A log-rank test was performed to determine if there was a significant difference in one-year survival rates among the three groups. The predictive ability of the prognostic scoring system was assessed by generating receiver operating characteristic (ROC) curves and calculating the area under the ROC curve (AUC).

RESULTS: We included 1,026 patients in the study (fig. 1). Of the 1,026 cases, 139 patients (13.5%) died within one year after surgery. Table 1 presents the patients' baseline characteristics and the results of the univariate analysis. Table 2 shows the results of the multivariate logistic regression analysis. Eight factors were identified as significant prognostic factors with a p-value of < 0.05. The scoring system was as follows: 1 point: chronic heart failure, hemoglobin level at initial visit < 10.0 g/dL, and American Society of Anesthesiologists Physical Status III or IV; 2 points: male sex, body mass index < 18.5 kg/m^2, malignancy, and not being able to walk with a cane before injury; and 3 points: prognostic nutritional index (PNI), which is calculated using the following formula: 10 × Albumin (g/dL) + 0.005 × total lymphocyte count (/mm³) < 40.0 (Table 3). The prognostic scores were divided into three groups: 0–4 points for good prognosis, 5–9 points for intermediate prognosis, and 10–14 points for poor prognosis. Fig. 2 shows the Kaplan–Meier curves for the three groups. The one-year survival rates for the good, intermediate, and poor prognosis groups were 97.8%, 75.6%, and 35.4%, respectively. The AUC for the scoring system was 0.861 (fig. 3).

DISCUSSION AND CONCLUSION: We were able to develop a scoring system using eight factors that can be evaluated preoperatively. The scoring system is simple and easy to evaluate without complicated calculations. Furthermore, the AUC of this scoring system was 0.861, indicating superior predictive ability compared to previous reports. Our prognostic system could be a significant tool for predicting the one-year mortality of hip fractures. In addition, this study is the first prognostic scoring system, to the best of our knowledge, for hip fractures that includes the PNI as a prognostic predictor. In our study, the PNI was shown to be the most important prognostic factor, correlating most strongly with one-year mortality for hip fractures. Moreover, this study had a large number of cases and may play a major role in demonstrating the importance of the PNI in predicting the prognosis of hip fractures.