RESEARCH ARTICLE

Prediction of Mortality in Hip Fracture Patients: Role of Routine Blood Tests

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Abstract

Background: To assess the mortality predictive value of routine blood tests in patients with hip fracture.

Methods: In a retrospective descriptive study, medical records of 204 hip fractured patients with the age of 60 or older who were admitted to the Department of Orthopedics was considered regarding routine laboratory tests. Predictive values of these tests were assessed using receiver operating characteristic curve (ROC).

Results: The incidence of death due to hip fracture was 24%. The mortality rate was significantly increased with age > 65 (OR= 15). There was no significant difference between mortality in regards to gender. High plasma BUN (more than 20 mg/dl) and creatinine (more than 1.3 mg/dl) significantly increased the chance of mortality. [OR= 3.0 and OR=2.5 for BUN and creatinine, respectively]. Patients' mortality did not show any correlation with sodium and potassium plasma levels and blood hemoglobin.

Conclusions: There is direct correlation between plasma levels of BUN and creatinine and 3-month mortality after hip fractures. Patients with high plasma levels of BUN were three times more likely to die than those with normal BUN. Also, patients with high plasma creatinine levels were 2.5 times more likely to die than those who had normal values. Mortality was also associated with increasing age but did not vary with gender. Patients aging more than 65 were 15 times more likely to die following a hip fracture than those with younger age.

Key words: BUN, Creatinine, Hematologic tests, Hip fracture, Prognosis, Serologic tests

Introduction

Hip fracture in the elderly is a critical condition with significant morbidities and possible life-threatening complications (1). In the United States, 258,000 hospital admissions in 2010 were due to hip fractures among people aged 65 and older (2). The rate of hip fractures increase exponentially with age in both men and women (3). People with the age of 85 and older are 10 - 15 times more likely to sustain hip fractures than are people younger than 65 (4). Almost 10% of women and 5% of men older than 60 will sustain a hip fracture during their remaining lifetime in which osteoporosis may be responsible for the increase in the risk of sustaining a hip fracture (5, 6).

Roughly 1.6 million hip fractures annually occur in elderly worldwide making it one of the main public health burdens in the world (7). Our country, Iran, is accounted for holding 0.85% of the global burden of hip fractures and 12% of this burden in the Middle East (8). Management usually includes surgical intervention and hospitalization, typically for about one week with a need for long-term care and rehabilitation afterwards (2, 9, 10). Likewise, mortality rate after hip fracture is high which ranges from 6%-9% at 1 month that increases to 13%–19% at 3 months after fracture (11-16). Furthermore, one out of five elderly dies within a year of breaking their hip (14).

Since having knowledge about predictors of outcome after hip fracture may help us to develop the optimum treatment, we designed this study to assess the mortality predictive value of routine blood tests in patients with hip fracture.

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Table 1. Frequency of hip-fractured patients regarding age and outcome

Age	60-69 No (%)	70-79 No (%)	>80 No (%)	*P* value
Died	0(0)	17(22.7)	32(30.8)	<0.001
survivors	25(100)	58(77.3)	72(69.2)	
Sum	25(100)	75(100)	104(100)	204

Methods

After obtaining approval from our Institutional Review Board, in a retrospective descriptive study, medical records of 204 patients with hip fracture with the age of 60 or older were included. Patients were admitted to the Department of Orthopedics, Shahid Beheshti Hospital, Kashan, Iran, from March 2010 through March 2013. Subjects were excluded from the study if the age was < 60 years old, found to have a pathological fracture, and had a history of previous hip fracture. Routine laboratory tests including, hemoglobin (Hb), sodium (Na), potassium (K), blood urea nitrogen (BUN), and creatinine were extracted from the records. Data regarding survival or the date of death over 3 month (90 days) after the event were obtained from their families through phone call. Generally, patients admitted to the orthopedic service were all seen by an internist if needed. Medically unstable patients were admitted to the internal medicine service or intensive care unit. Patients were brought to surgery only if the medical issue was under control. All included patients underwent surgical treatment. Patients' accompanying diseases were recorded out of their medical records. The first blood test after admission was used to be collected in this study.

Continuous variables are presented as mean (SD). Chi-square test was used to compare categorical variables. Student's t-test was used for continuous, normally distributed variables. Receiver operation characteristic (ROC) curves and calculation of area under the curve (AUC) were used to estimate which laboratory tests could be used to predict the outcome. *P* value < 0.05 was considered statistically significant.

Results

A total of 204 patients with hip fracture (75 (37%) males, 129 (63%) females) and a mean (± SD) age of 78 (± 7.4) years were included in the study. Forty-nine out of 204 patients (24%) have died during the study period. Among 49 who died, 33(67%) were female, 23 (47%) deceased within 3 months and 26 (53%) died sometime later than 3 month. Our study showed that higher age significantly increased the odds of death during the first 3 month after hip fracture (OR= 15). In other words, according to our study, patients with hip fracture older than 65 were 15 times more likely to die than those who were below this age. There was no significant difference between mortality regarding gender [Table 1]. However, when we analyzed both genders with age subgroups of ≤ 79 and ≥ 80 years, the mortality rate was significantly higher among women when age was less than 80 years [OR=6.3 95% CI (1.3-29.1) *P*=0.009]. High plasma creatinine and BUN led to increased mortality.

Table 2. Frequency of hip-fractured patients regarding different risk factors (laboratory tests* and gender) and survival status

Risk Factor		Died %	Survivors %	OR (95% CI)	*P* value
Hb (<13.5mg/dl and <12 mg/dl in men & women respectively)		72.3	59.6	1.7 (0.86-3.62)	0.11
Cr 0.7-1.3 mg/dL (61.9-115 µmol/L)		27.5	13.7	2.48 (1.00-5.72)	0.048
BUN 8-20 mg/dL (2.9-7.1 mmol/L)		60	42.4	3.04 (0.98-4.23)	0.045
K 3.5-5.0 meq/L (3.5-5.0 mmol/L)		5.7	11.4	0.47 (0.1-2.2)	0.5
Na 135-145 meq/L (135-145 mmol/L)		36.1	28.3	1.43 (0.64-3.18)	0.37
Gender	Male	28.6	41.2	1.7 (0.87-3.5)	0.11
	Female	71.4	58.8		

*The upper or lower limits of normal laboratory reference intervals were considered as cutoff values. (Abbreviations: Hb; Hemoglobin, Cr; Creatinine, BUN; Blood Urea Nitrogen, K; Potassium, Na; Sodium)

Based on our findings, in the case of BUN > 20 mg/dl and creatinine > 1.3 mg/dl, the odds of death during the first 3 month after hip fracture was increased significantly (OR= 3.04 and OR=2.5 for BUN and Creatinine, respectively) [Table 2]. It means that patients with high plasma levels of BUN had died 3 times more than those with normal BUN and patients with high creatinine plasma levels had died 2.5 times more than those had normal creatinine values. Mortality rate in patients with age higher than 65 years, BUN more than 20 mg/dl, and creatinine more than 1.3 mg/dl was 25%, 32% and 34%, respectively while in those with age less than 65 years, normal BUN, and normal creatinine mortality rate was 2.2%, 13% and 17%, respectively.

Patients' mortality was not correlated with sodium and potassium plasma levels and blood hemoglobin [Table 2]. The area under Receiver Operating Characteristic (AUC) for the routine laboratory tests was also calculated to predict mortality, which showed that merely values related to BUN (0.64) and creatinine (0.59) were significant (*P*<0.05) [Figure 1 and 2].

Most patients had more than two accompanying condition (61%). Only 7.5% of patients had no comorbidities. The most common accompanying condition was hypertension with the other conditions in a decreasing order including cardiovascular diseases, anemia, chronic pulmonary diseases, diabetes, neuropathies and kidney complications.

Discussion

In the present study, values of routine blood tests were used as a death predictor in patients with hip fracture.

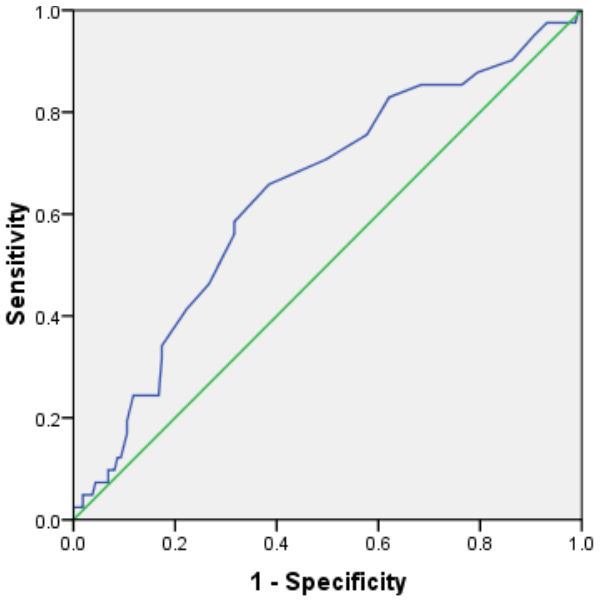

Figure 1. Receiver operating characteristic (ROC) curve for BUN to predict mortality after hip fracture.

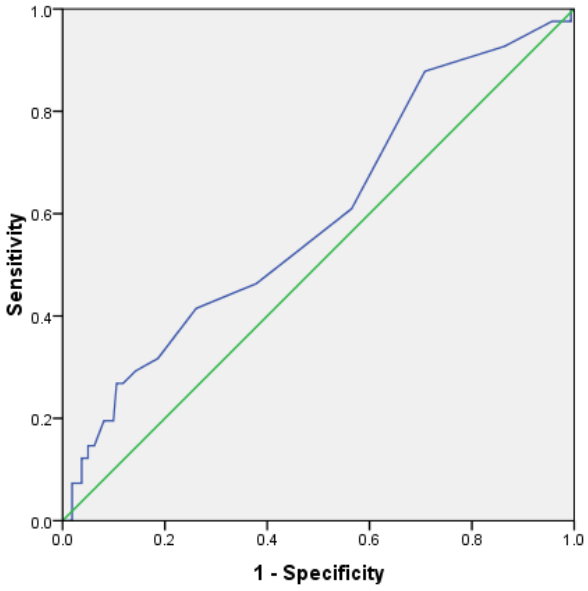

Figure 2. Receiver operating characteristic (ROC) curve for creatinine to predict mortality after hip fracture.

Our study showed that there is an association between plasma levels of BUN and creatinine and mortality after hip fracture in elderly patients. Mortality was also associated with increasing age, but not with gender.

Series of studies have investigated the value of routine blood tests for prediction of mortality in patients with hip fracture (1,17-22). Through a meta-analysis and after considering 15 eligible studies, Laulund et al concluded that low hemoglobin, low albumin and high creatinine plasma levels have prognostic value on mortality in patients after hip fractures (1). Due to nature of our study being retrospective, we could not consider albumin values (this test is not included in the routine blood test in patients admitted to our trauma center), but regarding other values, our results about high plasma levels of creatinine is in accordance with Laulund's results. Although we could not find an association between low hemoglobin and mortality after hip fracture, it may be due to different cut-off of values that have been used. In the studies considered by Laulund in his systematic review, hemoglobin concentration cut-off point for the diagnosis of anemia was ranged between Hb < 6.2 - 8.1 mmol/L, while in our study we used Hb < 7.4 and Hb < 8.4 mmol/L as cut-off points for the diagnosis of anemia in women and men, respectively.

The results of present study regarding the association between high creatinine levels and increased mortality are also in accordance with other studies (19, 20). Based on Mosfeldt's results, the mortality in patients with high plasma creatinine level was almost 3-fold that of those with normal creatinine. In addition to Laulund's study, many other studies also reported that low hemoglobin is associated with increased mortality in patients with hip fracture (18-20, 23). However, the reason why we could not find any relation between anemia and mortality may be due to the use of different cut-off points that were mentioned previously.

The results of this study showed that there is a positive correlation between aging and mortality in patients with hip fracture. This finding is in agreement with other studies including Haentjens et al study that showed older adults have a 5- to 8-fold increased risk for mortality during the first 3 months after hip fracture (22, 24, 25). However, higher mortality in our study may be related to inadequate care after surgery in our region.

We could not find significant association between sex and mortality after hip fracture. Gender as a risk factor for mortality after hip fracture has been noted in several studies (22-25). However, findings of the current study do not support previous studies that found male gender as a risk factor for higher mortality in patients after hip fracture (22, 24, 26). Nevertheless, our finding seems to be consistent with Öztürk et al study in which they found female gender as a significant risk factor associated with higher mortality after hip fracture (23). The results of Iranian Multicenter Osteoporosis study (IMOS) have shown that 70% of women and 50% of men older than 50 years have osteoporosis or osteopenia (26). This may justify the higher incidence of hip fractures among Iranian women.

In our study, the incidence of death during the first 3 month after hip fracture was 24% that is higher than the results of other studies with 13-19% rate of death (13, 15, 16). This difference may be related to the difference in postoperative care in our country compared to the developed ones. The standard of care typically includes surgery and hospitalization, usually for about one week, which will be followed by admission to a nursing home

and extensive rehabilitation (27). However, it may not be followed in our patients to receive an intensive postoperative care and early ambulation to prevent postoperative complications.

There were some limitations to be considered as well. First the current research was not designed to assess the correlation between companying conditions and mortality rate in patients with hip fracture. Therefore, we were unable to explain the influence of comorbidities on mortality. Second, it was a retrospective study; therefore we could only rely on tests that were requested for patients in our center. Some Important tests including albumin and C-reactive protein (CRP) plasma levels that were considered in many similar studies were not included in our study. Third, in patients with missing data we had to exclude them.

In conclusion, this study confirms that high BUN, high creatinine, and older age on admission are significant factors in predicting the 3 month mortality in patients with hip fractures. Predicting these risk factors may help with case management.

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