



## Original article

# Factors associated with mortality among elderly people hospitalized due to femoral fractures<sup>☆</sup>



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## ARTICLE INFO

## Article history:

Received 29 September 2015

Accepted 15 October 2015

Available online 17 August 2016

## Keywords:

Femoral fractures

Elderly

Hospital mortality

Survival analysis

## ABSTRACT

**Objective:** To analyze factors associated with mortality among elderly people hospitalized in a single-center regional hospital due to femoral fractures.

**Methods:** This was a retrospective cohort study. Patients aged 60 years or over who were hospitalized with a diagnosis of femoral fracture (ICD S72) between 2008 and 2013 were selected through the electronic medical records.

**Results:** The study evaluated 195 individuals of mean age  $78.5 \pm 9.6$  years; females predominated (68.2%). The main mechanism for falls was low-energy (87.2%). Surgery was performed on 93.3% of the patients; the mean length of hospital stay was  $13.6 \pm 7.5$  days and the mean waiting time for the surgery was  $7.7 \pm 4.2$  days. The prevalence of mortality was 14.4%, and this occurred mostly among older individuals ( $p = 0.029$ ); patients with leukocytosis ( $p < 0.001$ ); those who needed intensive care ( $p < 0.001$ ); and those who did not undergo surgery ( $p < 0.001$ ). The mean survival was significantly longer among patients who underwent surgery and shorter among those who needed intensive care.

**Conclusion:** Women predominated among the hospitalizations, and the degree of leukocytosis associated with advanced age presented a relationship with mortality, independent of the type of lesion or surgical procedure. More studies still need to be conducted in order to assess other factors associated with mortality.

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## Fatores associados à mortalidade em idosos hospitalizados por fraturas de fêmur

## RESUMO

**Objetivo:** Analisar os fatores associados à mortalidade em idosos hospitalizados por fratura de fêmur em um hospital unicêntrico regional.

**Métodos:** Estudo de coorte retrospectiva. Foram selecionados, por meio do prontuário eletrônico, pacientes internados com diagnóstico de fratura de fêmur (CID S72) com 60 anos ou mais de 2008 a 2013.

## Palavras-chave:

Fraturas do fêmur

Idoso

Mortalidade hospitalar

Análise de sobrevida

<sup>☆</sup> Study conducted at the Hospital Nossa Senhora da Conceição, Tubarão, SC, Brazil.

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<http://dx.doi.org/10.1016/j.rboe.2016.08.006>

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**Resultados:** Foram avaliados 195 indivíduos com idade média de  $78,5 \pm 9,6$  e o gênero feminino foi mais prevalente (68,2%). O principal mecanismo de queda foi o de baixa energia (87,2%), a feitura de cirurgia foi de 93,3%, o tempo de internação médio foi de  $13,6 \pm 7,5$  dias, o tempo de espera para a cirurgia médio foi de  $7,7 \pm 4,2$  dias. A prevalência de mortalidade foi de 14,4%, ocorreu principalmente nos indivíduos mais idosos ( $p = 0,029$ ), com leucocitose ( $p < 0,001$ ), com necessidade de cuidados intensivos ( $p < 0,001$ ) e que não foram submetidos a cirurgia ( $p < 0,001$ ). A sobrevida média foi significativamente maior nos pacientes submetidos a cirurgia e inversamente nos pacientes que necessitaram da unidade de terapia intensiva.

**Conclusão:** As mulheres predominaram nas internações e o grau de leucocitose associado a idade avançada apresentou relação com a mortalidade, independentemente do tipo de lesão e procedimento cirúrgico. Ainda devem ser feitos mais estudos para avaliar outros fatores associados à mortalidade.

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## Introduction

The World Health Organization (WHO) classifies as elderly every individual aged 60 years or more.<sup>1</sup> This population sample presents an accelerated increasing percentage rate, generating an increase in the prevalence of chronic degenerative diseases.<sup>2</sup>

According to Monteiro, falls of the elderly – in addition to the injury itself – are also damaging the family, as they create a dependency due to the loss of autonomy after the trauma event, representing an important social, economic, and public health issue.<sup>3</sup> It is estimated that the number of hip fractures worldwide will reach 4.5 million cases in 2050.<sup>4</sup>

The main factors associated with mortality after fracture are age, comorbidities, cognitive status, time between fracture and surgery, and type of anesthesia used.<sup>5-8</sup> However, the association of time until surgery and risk of death is controversial. The literature indicates that there is a relationship between time until surgery and mortality.<sup>9</sup> Altered laboratory blood exams such as leukocyte levels, which may present as a associated factor with death, have also been widely addressed.<sup>10</sup>

From this perspective, the data presented herein is expected to lead to a better understanding of this problem and contribute to a better care of elderly patients with femoral fracture. Therefore, this study aimed to evaluate the associated factors with mortality in elderly patients with hip fracture during hospitalization.

## Material and methods

The present study was a retrospective cohort of 275 elderly patients who had femoral fractures from January 2008 to December 2013 and were admitted to a single-center, regional reference hospital.

For sample selection, the medical patient record of the institution was contacted in order to stratify individuals hospitalized with a diagnosis of femoral fracture (ICD-10 S72), who were older than or equal to 60 years in the proposed period.

The exclusion criteria comprised incomplete data on the medical charts, misdiagnosis at hospitalization, transfer to other hospitals, and re-admissions. The study was approved by the Research Ethics Committee under No. 34735814.2.0000.5369.

The following variables were collected: gender, age, comorbidities, type and side of fracture, type of fall, surgical treatment, type of surgery and time until surgery, hospital length of stay, need for intensive care treatment, hematocrit and leukocytes in the first week of hospitalization, and outcome, described as discharge or death.

An anatomical subdivision was used to classify femoral fracture regions. The proximal part of the femur comprises the intracapsular and extracapsular fractures; the joint capsule is used as a reference. In turn, the intermediate portion corresponds to the femoral shaft; the final subdivision consists of fractures of the distal part of the femur.<sup>11</sup>

Data were stored in an Excel spreadsheet and then transferred to the SPSS 20.0 software for analysis. Numerical variables were presented as central tendency and dispersion, and categorical variables as absolute frequencies and percentages.

Numerical variables were analyzed using the Kolmogorov–Smirnov normality test. To compare these variables with the outcome, Student's t-test ( $p < 0.05$ ) was used for data with normal distribution; for nonparametric variables, the Mann–Whitney test was used ( $p < 0.05$ ). For results with significant difference, accuracy was assessed through the area under the ROC curve.

For comparison among gender, ICU hospitalization, and performance of surgery, the chi-squared test was used ( $p < 0.05$ ). The relative risks of death, with their respective 95% confidence intervals, were calculated.

The survival rate of patients who required intensive care and underwent surgery was analyzed using Cox regression ( $p < 0.05$ ) and presented through Kaplan–Meier curves.

## Results

Initially, 275 individuals were selected. Of these, 80 were discarded due to incomplete or missing data in the medical

**Table 1 – Characteristics of the elderly patients hospitalized for hip fracture.**

Variables	n (%)
<b>Gender</b>	
Female	133 (68.2)
Male	62 (31.8)
Age <sup>a</sup> (years)	78.5 ± 9.6
<b>Types of fracture</b>	
Intracapsular	79 (40.5)
Extracapsular	96 (49.2)
Diaphysis	12 (6.1)
Distal femur	4 (2.1)
Not reported	4 (2.1)
<b>Side of the fracture</b>	
R	91 (46.7)
L	100 (51.3)
R and L	1 (0.5)
Not reported	3 (1.5)
<b>Type of fall</b>	
Low-energy	170 (87.2)
High-energy	7 (3.6)
Not reported	18 (9.2)
<b>Surgery</b>	
Yes	182 (96.3)
No	13 (6.7)
<b>Type of surgery</b>	
Osteosynthesis	95 (48.7)
Total arthroplasty	44 (22.6)
Partial arthroplasty	26 (13.3)
Others <sup>b</sup>	30 (15.4)
Waiting time until surgery	7.7 ± 4.2
Waiting time until surgery (days)	13.6 ± 7.5
Hematocrit at admission <sup>a</sup> (days)	33.5 ± 5.7
Leukocytes at admission <sup>a</sup> (mm <sup>2</sup> )	8922 ± 5972.6
<b>Comorbidities</b>	
Systemic hypertension	90 (46.2)
Diabetes mellitus	43 (23.6)
Cardiac diseases	41 (21.0)
Others	21 (9.2)
<b>Outcome</b>	
Death	28 (14.4)

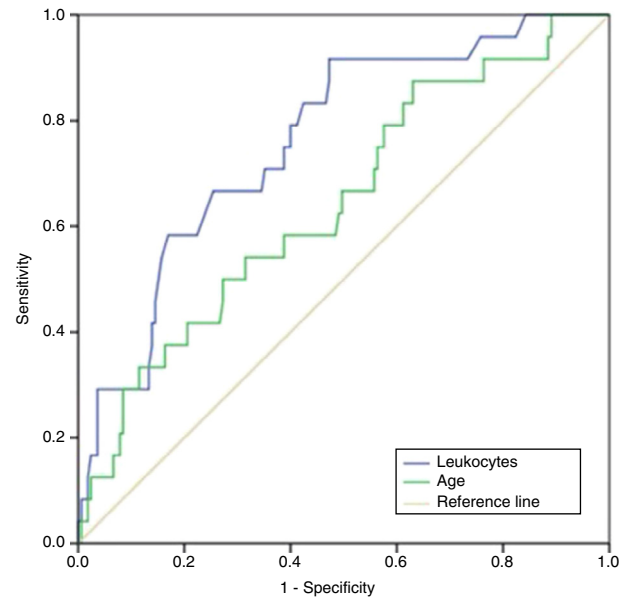
<sup>a</sup> Mean ± standard-deviation.

<sup>b</sup> Did not undergo surgery, type of procedure not reported, bipolar arthroplasty, Ilizarov. Heart failure, chronic renal failure, tumor, COPD, stroke, dementia, hypothyroidism, hearing loss, arthritis.

records, as well as admissions without actual fractures, with consequent discharge, transfers, or re-admissions. Therefore, a sample of 195 patients was obtained. Table 1 describes population characteristics.

Table 2 shows the comparison between time until surgery and hospitalization, and hematocrit and leukocyte count at admission, for both discharge and death groups. A significant difference was observed only regarding age and leukocyte count.

In the analysis of the numerical variables that presented significant difference between discharge and death from the perspective of the ROC curve, the accuracy for death prognosis obtained by the area under the curve was 0.761 (95%



**Fig. 1 – ROC curve of age, white blood cells, and death prognosis.**

CI: 0.664–0.859),  $p < 0.001$  for leukocytes, and 0.643 (95% CI: 0.525–0.762),  $p < 0.023$  for age (Fig. 1).

In the comparison of outcome and gender, no significant difference was observed: 16.2% males and 13.5% females ( $p < 0.630$ ). However, individuals requiring ICU admission presented a relative risk of 10 (95% CI: 4.1–24.4); non-performance of surgery showed a relative risk of 30.4 (95% CI: 7.6–120.6), both with statistical significance ( $p < 0.001$ ).

The mean survival of patients hospitalized in the ICU was 28.2 days (95% CI: 22.1–34.4); for those who did not require ICU admission, 47 days (95% CI: 36.5–57.5), with significant difference ( $p < 0.001$ ) (Fig. 2).

The mean survival of patients who did not receive surgery was 11.7 days (95% CI: 7.9–15.5); for those who underwent surgery, it was 45.8 days (95% CI: 37.9–53.8), with significant difference ( $p < 0.001$ ) (Fig. 3).

## Discussion

Regarding gender, the present study observed a higher number of women who had suffered femoral fracture. This finding is similar to that of a retrospective study in the Lazio region, with 6896 patients, in which 78% of the elderly patients admitted with femoral fracture were females.<sup>12</sup>

Regarding type of fractures, a higher incidence of extracapsular fractures was observed when compared with intracapsular fractures. This data is corroborated by a retrospective study of 1911 elderly patients with femoral fractures that observed similar prevalence.<sup>13</sup>

As for the dynamics of trauma, this study showed a high prevalence of low-energy trauma. This finding is justified by the characteristics of the sample, which was comprised primarily of elderly patients. Moraes et al.<sup>14</sup> stated that such findings are due to the many mechanisms of fall from patients' own height, which has a peak incidence between 60 and 70

**Table 2 – Comparison of the numerical variables according to the outcome of death.**

	Discharge n = 167 85.60%	Death n = 28 14.40%	p-Value
Age <sup>a</sup> (years)	78 ± 9.5	82.1 ± 9.8	0.029 <sup>c</sup>
Time until surgery <sup>a</sup> (days)	7.5 ± 4.0	9.44 ± 5.1	0.105
Hospital length of stay <sup>a</sup> (days)	13.6 ± 7.5	13.6 ± 7.7	0.811
Hematocrit <sup>b</sup> (%)	33.4 ± 5.7	31.2 ± 5.5	0.06
Leukocytes <sup>a</sup> (/mm <sup>2</sup> )	8323.3 ± 4645.9	13,037.9 ± 10,836.4	<0.001 <sup>c</sup>

<sup>a</sup> Mann-Whitney test.  
<sup>b</sup> Student's t-test.  
<sup>c</sup> p-Value < 0.05.

years and is most likely to occur in females, which would explain the greater exposure of women to femoral fractures.

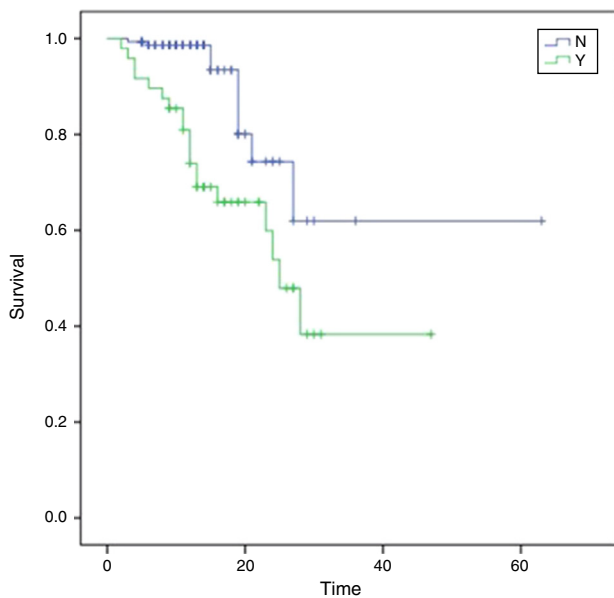
In the analysis of survival curve and comparison of individuals with or without surgical indication, a significant difference was observed between these groups; survival rate was significantly higher in individuals who underwent surgery. Roche et al.<sup>15</sup> concluded that the greatest risk factor for mortality was directly related to the presence of three or more comorbidities evaluated preoperatively. In contrast, another study showed that, for patients without clinical conditions for surgery, not performing surgery was the best choice, and there was no significant difference in functional outcome and mortality when compared with patients treated surgically.<sup>16</sup> Although the present study did not compare mortality with morbidities, it can be deduced that the early death observed is related to the number of comorbidities in these patients.

Regarding type of procedure, osteosynthesis and total or partial arthroplasty were the most frequent choices. However, surgical approach had no significant relationship with recovery time, nor with death. A Norwegian study of 4335 elderly patients compared osteosynthesis with arthroplasty in the treatment of femoral neck fracture and observed no

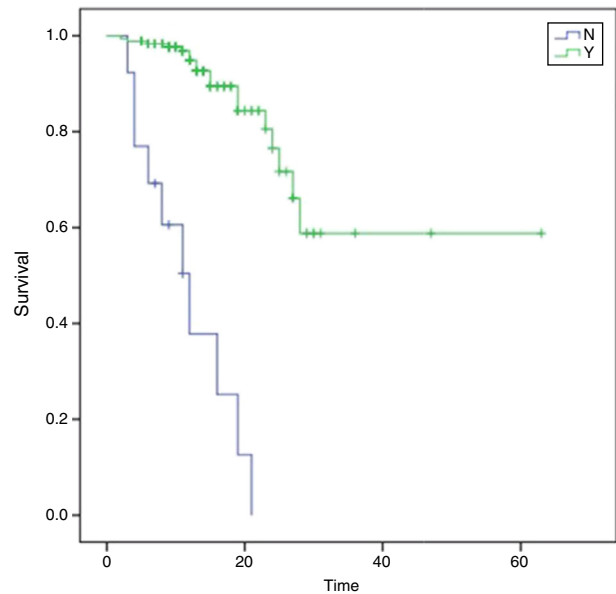
differences in mortality rates one year after surgery. This same study found that patients undergoing osteosynthesis reported higher pain levels, greater dissatisfaction with the results of surgery, and lower quality of life than the arthroplasty group.<sup>17</sup>

Regarding waiting time until surgery, there was no significant difference between discharge and death outcomes for these patients. Although the literature is quite controversial,<sup>9</sup> according to Grimes et al.,<sup>18</sup> time between trauma and surgery appears to influence mortality in elderly patients with femoral fractures. In a study of 8383 subjects, patients were divided into three groups: first group were operated within the first 24 hours after fracture; second group, after 24 hours of fracture, but without active disease; and third group was also operated after 24 hours, but with active pathology. Patients with active disease had their surgery postponed due to the presence of decompensated disease. At the end of the study, the mortality of the individuals operated within the first 24 hours was lower. However, when the groups were homogenized for presence of associated diseases, this difference disappeared.<sup>18</sup>

There are several possible explanations for this finding. The first possibility may be linked to the fact that the occurrence of many post-surgical complications in patients who died may



**Fig. 2 – Survival in patients who were or were not admitted to the ICU.**



**Fig. 3 – Survival in patients who did or did not undergo surgery.**

not necessarily be associated with waiting time. Secondly, during the collection phase, a marked pattern of postponement of surgical procedures was observed (although not described in the study), due to either lack of beds in the ICU or inadequate clinical conditions of patients, both of those who were discharged and those who died. However, an observational study of 2660 patients found that delaying surgery by up to four days did not affect mortality, while a delay of more than four days significantly increased mortality rates.<sup>19</sup> Nevertheless, a systematic review of 256,367 patients observed that a delay of more than 48 hours increases the risk of all-cause mortality at 30 days after surgery by up to 41%.<sup>20</sup>

Mean survival of patients who did not require ICU admission was higher than that of those who did. The main hypothesis was that the latter had a more unfavorable clinical picture, a greater number of comorbidities, and older age when compared with patients who did not require intensive care. However, Fuchs et al.,<sup>21</sup> with 7265 patients over 65 years, observed that the main reason for ICU admission was associated comorbidities. Old age should be considered as a risk factor, especially for patients older than 75 years admitted in these units.

Few studies have sought to analyze the prognostic impact of inflammatory cells in femur fractures. In this study, a significant difference was observed in the relationship between total leukocyte count during hospitalization and death. In this respect, according to the ROC curve analysis, leukocytes were shown to have a discriminative ability to identify those patients with femoral fracture who had a higher risk of death. White et al.<sup>10</sup> observed a prevalence of leukocytosis of 43.5%. However, the high leukocyte count was at the expense of increasing the number of neutrophils; this variable was not evaluated in the present study. This finding is relatively common in patients with hip fracture, indicating possible presence of a previous infection or an infection that developed after the fracture.<sup>10</sup> Thus, it is important to note that the cellular and humoral elements decrease with increasing age; the present study consisted of elderly patients with a mean 82.1 years in the higher mortality group, which may explain the higher mean total leukocyte count in patients who died. In addition, when analyzing the ROC curve, age also presented a discriminative ability to identify individuals at higher risk of death.

The overall mortality of 14.4% can be considered high, and is considerably different from the results found in international studies, where death rates were lower. In a retrospective study in Canada with 3981 patients, the hospital mortality rate was 6.3%.<sup>22</sup> In this context, another retrospective study in Italy with 6629 elderly patients presented an even lower rate of 5.4%.<sup>23</sup> Furthermore, at the national level, the results of this study were similar to a retrospective study that reported a mortality rate of 14.61%. The literature shows that overall mortality in relationship to these types of fracture has varied among services, depending on the existing hospital complex.<sup>24</sup>

This study was conducted in a single-center reference regional hospital. In this context, the literature indicates that in institutions with higher volume of hip surgeries, higher mortality rates are observed. Higher in-hospital mortality in these hospitals, when compared with lower-demand services,

was reflected in the present study.<sup>24</sup> In order to generalize data for elderly patients hospitalized for various types of hip fracture, the authors believe there is no reason for this to be different, which could explain the present findings regarding death rates. Moreover, another factor to be assessed is the perioperative mortality, which also contributes to overall mortality rate and is not associated with quality of the therapeutic approach offered, but rather to the clinical condition of these patients, which is usually high-risk due to their age and the presence of many associated comorbidities.

The association of the fracture site with mortality was not significant in the present study. However, in a systematic review with 544,733 patients, mortality was higher in patients with intracapsular fracture. That study also observed age over 85 years as a factor associated with mortality. This finding is similar to that of the present study, which had a similar mean age at death.<sup>25</sup>

The main limitation of the present study was the inability to collect data related to certain variables, due to lack of information in the medical charts, which may have underestimated the actual clinical condition of the patients. In addition, the present study was observational, so the associations found do not imply causality; the present findings should be confirmed by further studies.

## Conclusion

In the present study, it was observed that women comprised the majority of admissions, and that the degree of leukocytosis associated with advanced age was correlated with mortality, regardless of type of injury and surgical procedure. A higher mean survival rate of patients who did not require ICU admission was also observed. It is noteworthy that the waiting time for surgery and hospital stay were not associated with the in-hospital mortality outcome. These findings highlight the importance of developing protocols for better management of these patients. They also emphasize the importance of including the assessment of leukocytes rates into the clinical evaluation, as this variable presented an important ability to predict worse outcomes.

## Conflicts of interest

The authors declare no conflicts of interest.

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