CLINICS

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Predictors of hip fracture mortality at a general hospital in South Brazil: an unacceptable surgical delay

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OBJECTIVE: Hip fractures have been associated with increased mortality in the elderly. Several risk factors such as the time between the insult and the surgical repair have been associated with hip fracture mortality. Nevertheless, the risk of delayed surgical repair remains controversial. Few studies have examined this issue in Brazil. The aim of this study was to study the risk factors for death one year after hip fracture and in-hospital stay at a tertiary hospital in South Brazil.

METHODS: A prospective cohort study was carried out from April 2005 to April 2011 at a tertiary university hospital at Santa Maria, Brazil. Subjects admitted for hip fracture who were 65 years of age or older were followed for one year. Information about fracture type, age, gender, clinical comorbidities, time to surgery, discharge, and American Society of Anesthesiologists score were recorded. Death was evaluated during the hospital stay and at one year.

RESULTS: Four hundred and eighteen subjects were included in the final analysis. Of these, 4.3% died in-hospital and 15.3% were dead at one year. Time to surgery, American Society of Anesthesiologists score, Ischemic Heart Disease, and in-hospital stay were associated with death at one year in the univariate analysis. The American Society of Anesthesiologists score and time to surgery were one-year mortality predictors in the final regression model. In-hospital death was associated with American Society of Anesthesiologists score and age.

CONCLUSION: Time to surgery is worryingly high at the South Brazil tertiary public health center studied here. Surgical delay is a risk factor that has the potential to be modified to improve mortality.

KEYWORDS: Hip Fractures; Risk Factors; Regression Analysis; Prospective Studies.

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INTRODUCTION

Hip fracture is one of the most common and serious injuries in the elderly. Moreover, the prevalence of this injury is increasing as the population ages. Hip fractures have been associated with increased mortality (1-9), and several risk factors are associated with elevated rates of this injury, such as male gender (10-15), ASA (American Society of Anesthesiologists) score (10,12,13,16-19), comorbidities (20), and increased age (13,14,16,19,21). Furthermore, the time between the insult and surgical repair has been associated with high mortality rates among hip fracture subjects (22,23). Nevertheless, surgical delay has not been determined as a risk factor for death by others (12,19,24).

Although the risk factors for death after a hip fracture have been studied worldwide, this issue has scarcely been addressed in South America (16,20,21). Brazilian subjects might not have the same risk factors after a hip fracture as people who live in other countries. Although ASA score and comorbidities were associated with death in some cross-sectional Brazilian studies, no association was found between mortality and time to surgery in these studies (16,20). Souza et al. found an odds ratio of 1.04 (CI 1.02, 1.11) of death in the 90 days following hip fracture in a

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retrospective Brazilian cohort (21). However, few studies evaluated the ability of the Brazilian health system to provide care for the elderly population. Time to surgery after hip fracture could be a useful tool to evaluate the ability of the system. Our hypothesis is that Brazilian people might share some but not all of the risk factors for death with the global population. To the best of our knowledge, this is the first prospective cohort study evaluating predictive factors for death in elderly subjects with hip fracture in South Brazil. The aim of this study was to access the risk factors for death within one year and during a hospital stay in people 65 years of age or older who had been admitted to a tertiary hospital in South Brazil after a hip fracture.

■ METHODS

A prospective cohort study was carried out at the University Hospital, Federal University of Santa Maria, Santa Maria (Parallel 37° South), Brazil. The research was approved by the University Ethics Committee (CAAE number 0151.0.243.000-08) and followed the ethical guidelines of the 1975 Declaration of Helsinki. All patients admitted for hip fracture who were 65 years of age or older and who had a surgical procedure to correct a hip fracture performed during an in-hospital stay were eligible for the study. Subjects were recruited from April 2005 to April 2011 and followed from April 2005 to April 2012. Data from 544 participants were screened; however, 94 subjects did not have their hip surgically repaired. Therefore, 450 patients were included in the present study.

Information about fracture type, date of birth, age, gender, clinical comorbidities (Systemic Arterial Hypertension, Ischemic Heart Disease, Diabetes, Stroke, Asthma, Chronic Obstructive Pulmonary Disease, and Chronic Renal Failure), date and type of surgery, discharge and in-hospital death, and patient health status [evaluated using the ASA (American Society of Anesthesiologists) score (25)] were recorded during hospital admission. Patient health status was grouped according to ASA score into one of two groups: Group one, ASA I (normal, healthy patients) and ASA II (patients with mild systemic diseases); and Group two, ASA III (patients with severe systemic diseases), ASA IV (patients with severe systemic disease that was a constant threat to their life), and ASA V (moribund patients who were not expected to live without an operation).

All subjects admitted for hip fracture had an appointment scheduled for one year after the surgery as a routine procedure at the Santa Maria University Hospital. For this study, all subjects who missed their appointment were contacted by mail (telegram) and by telephone call to their home address. Subjects who did not answer the mail or telephone contact were considered lost to the study.

Statistical analysis

The outcome variables were death at one year and death during the hospital stay. A univariate analysis was performed using Cox's proportional hazard regression for the one-year outcome and using logistic regression models for the in-hospital death. All variables with a p-value <0.10 were included in a Cox's proportional hazard regression model or in a logistic regression model, respectively. The best models were selected based on the likelihood ratio. Kaplan-Meier survival analyses and graphs were generated, and a Log Rank (Mantel-Cox) test was performed to evaluate possible differences among groups regarding survival time. An ANOVA test was used to verify age differences between genders and fracture types and to assess differences in time to surgery between genders and ASA groups. Differences were considered significant when the two-tailed p-value was <0.05. Statistical analysis was performed using the SPSS statistics package (SPSS Inc., IBM Corporation, Armonk, New York) for Windows version 18.0.

■ RESULTS

Of the 450 patients included in this study, 7.1% (n = 32) were lost to follow up; therefore, 418 subjects were included in the final analysis. Of these, 4.3% (18) died during hospitalization, and 15.3% (64) died at one year. The mean age at the time of fracture was 79.82 ± 7.26 years (mean $\pm$ standard deviation), range 65-97, [80 (IQR 75-85)] [median (interquartile range)]. The characteristics of this population are displayed in Table 1.

There were considerably more women than men in our cohort, and the mean age of the cohort was 80 ± 7 years, [81 (IQR 75-85)] for women and 78 ± 7 years, [78 (IQR 74-83)] for men ($p = 0.006$). The mean time from hospital admission to surgery was 7.1 ± 5.4 days [6 (IQR 3-9)], and no differences were observed in time to surgery between ASA groups ($p = 0.065$) and gender groups ($p = 0.505$); however, significant differences were observed between the presence or absence of comorbidities and between fracture types (data not shown). The most common surgery was trochanteric surgery using Dynamic Hip Screw (DHS) 162 (38.8%), followed by Hemiarthroplasty 128 (30.6%), transtrochanteric using Proximal Femoral Nail (PFN) 61 (14.6%), Total Hip Arthroplasty (THA) 25 (6%), and other types of surgery 42 (10%). Subjects who had transtrochanteric fracture were older (81 ± 7 years) [(mean $\pm$ SD) years]) than subjects who had femoral neck (79 ± 7 years) and subtrochanteric (77 ± 8 years) fractures, $p = 0.005$.

The crude Hazard Ratio (HR) of one-year mortality measured using Cox's regression analyses is shown in Table 3. Time to surgery, ASA score, ischemic heart disease, and in-hospital stay were statistically significant, as found using univariate Cox's analysis. The predictors of one-year mortality that remained in the final Cox's proportional hazard regression model were ASA scores (HR: 1.938) and time to surgery (HR 1.051). Time to surgery had a significant relationship with one-year mortality. Additionally, ASA was a strong predictor of death in this cohort (Table 2).

Survival was analyzed using Kaplan-Meier curves, yielding an overall survival of 330.3 ± 4.6 SE (Standard Error) (84.67%) days. A Log Rank (Mantel – Cox) test showed significant differences in survival between ASA groups one and two in these patients (Figure 1) and between patients with and without ischemic heart disease [$p = 0.008$ and χ^2 (chi-square) = 7.077]. No other significant differences were observed in the survival time between fracture type groups ($p = 0.384$), gender groups ($p = 0.076$), and the presence or absence of other comorbidities ($p = 0.224$).

The final model for in-hospital mortality and the corresponding odds ratio (OR) analyzed using Logistic Regression are shown in Table 3. Patients in ASA group two (ASA III– V) were six times more likely to die during the hospital stay (OR: 4.668). Additionally, each year of age older than 65 increased the probability of death occurring during the hospital stay by approximately 8% (OR 1.079).

Table 1 - Population characteristics.

Characteristic	Value
Mean (SD) Age (yr)	79.82 (7.26)
Gender (n,%)	
Male	100 (23.9)
Female	318 (76.1)
ASA (n,%)	
Group One (ASA I - II)	215 (51.4)
Group Two (ASA III - V)	203 (48.6)
Time to Surgery [days] [mean (SD), median (IQR)]	7.1 (5.4), 6 (3-9)
Intrahospital Stay [days] [mean (SD), median (IQR)]	12.2 (11.5), 10 (6-14)
Methods of Surgery (n, %)	
Total Hip Arthroplasty (THA)	25 (6)
Hemiarthroplasty	128 (30.6)
Transtrochanteric Surgery With Dynamic Hip Screw (DHS)	162 (38.8)
Transtrochanteric Surgery with Proximal Femoral Nail (PFN)	61 (14.6)
Other	42 (10)
Fracture Type (n, %)	
Neck Fracture	162 (38.8)
Transtrochanteric Fracture	237 (56.7)
Subtrochanteric Fracture	19 (4.5)
Comorbidity (n, %)	
Yes	366 (87.6)
No	52 (12.4)
Comorbidity (n, %)	
Systemic Arterial Hypertension	263 (62.9)
Ischemic Heart Disease	81 (19.4)
Diabetes	50 (12)
Ischemic Cerebrovascular Accident	30 (7.2)
Others *	67 (16)

* = Asthma, Chronic Obstructive Pulmonary Disease, and Chronic Renal Failure.

DISCUSSION

Time to surgery was associated with one-year mortality but not with in-hospital mortality in our study. Furthermore, for every day that the surgery was delayed, the one-year survival was shortened by nine days. An ASA score greater than two increased the odds of in-hospital death by six times and decreased the one-year survival rate by almost 50%.

The association between time to surgery and increased mortality has been debated since the mid-1990s (12,23,26). Most of the early studies were audits or retrospective or cross-sectional studies (10,14,16,20,23,27-29). Orosz et al. carried out a prospective cohort study at four hospitals at New York City in the U.S. and followed individuals aged 50 years or older with hip fracture for a maximum period of six months. No association was found between surgical delay and mortality in this study. Their result can be explained by the population studied (50 years and above, not just the elderly) and the short follow-up time. Another factor was that the mean time between fracture and surgery in the group that was classified as surgical delay was 40.6 hours. Simunovic et al. found in a systematic review published in October 2010 that surgical delay is a risk factor for mortality; however, this effect was not as large as expected, especially when the factors were adjusted. Most of the studies included in the review used a cutoff in the follow-up time that defined a delay to surgery of 24 hours, possibly explaining their findings. Another explanation for the poor association found in this review may be the fact that several studies included only one type of hip fracture (only neck fracture or only transtrochanteric fracture), and many of these studies had a follow-up time of less than one year. Furthermore, in the studies that found an effect of surgical delay on hip fracture mortality, the association was found for a delay of at least three to four days (22,23). In our study, the mean time between hip fracture and surgery was seven days. We consider this delay to surgery unacceptably high.

ASA grade has consistently been determined to be a risk factor for mortality (10,12,13,16-19). In our study, the presence or absence of comorbidities or the presence of a specific disease (systemic arterial hypertension, ischemic heart disease, diabetes, and stroke) were not found to be risk factors for death, unlike ASA. In our opinion, ASA grade is the best predictor of mortality because it evaluates not only comorbidity but also the functional status of the patient.

No association was found between gender, type of surgery, and mortality in our study. It is possible that the Brazilian population presents different risk factors for death after a hip fracture. Even so, most of the studies that found such associations did not adjust their models for comorbidities or ASA and time to surgery (34-37).

During the past 20 years, the Unified Health System (SUS) has increased access to healthcare for our population and has invested in the expansion of human resources and technology (38), creating health programs that have improved specific sectors of public health (39). However, these efforts have proven insufficient because SUS remains under-financed. The secondary care which was responsible for these kind of assistance (perform surgery in hip fracture) is neglected, and it has a little regulation in support of high-cost procedures (38,40). Additionally, no specific public healthcare policy addressing the elderly exists. Although the Statute of the Elderly was created in 2003, senior citizens wait long periods for hospitalization. When fractured, elderly people often remain in the hallways of our

Table 2 - One-year mortality predictors.

Covariates	Crude HR (95% CI)	Crude *p*-value	Adjusted HR (95% CI)	Adjusted *p*-value
Age	1.029 (0.994 - 1.065)	0.105	Refuted	Refuted
Gender				
Female	Reference			
Male	1.596 (0.947 - 2.689)	0.079	Refuted	Refuted
Time to Surgery	1.054 (1.018 - 1.092)	0.003	1.051 (1.014 - 1.089)	0.007
ASA Grade				
Group One	Reference			
Group Two	2.024 (1.215 - 3.374)	0.007	1.938 (1.161 - 3.233)	0.011
Comorbidity (Yes/No)	0.971 (0.921 - 1.024)	0.273	Refuted	Refuted
Comorbidity				
Systemic Arterial Hypertension	1.319 (0.778 - 2.238)	0.304	Refuted	Refuted
Ischemic Heart Disease	2.019 (1.19 - 3.426)	0.009	Refuted	Refuted
Diabetes	1.594 (0.833 - 3.052)	0.159	Refuted	Refuted
Ischemic Stroke	1.599 (0.729 - 3.505)	0.241	Refuted	Refuted
Others *	0.527 (0.277 - 1.222)	0.135	Refuted	Refuted
Intrahospital Stay	1.014 (1.003 - 1.024)	0.009	Refuted	Refuted
Fracture Type				
Trochanteric	Reference		Refuted	Refuted
Neck	0.533 (0.209 - 1.362)	0.189	Refuted	Refuted
Subtrochanteric	0.527 (0.201 - 1.382)	0.193	Refuted	Refuted

CI = Confidence Interval HR = Hazard Ratio.
*= Asthma, Chronic Obstructive Pulmonary Disease, and Chronic Renal Failure.

Brazilian public hospitals. One of the reasons for this is that the emergency services are overcrowded due to the lack of a government policy for elderly healthcare. These factors contributed to the increased time to surgery observed in our study.

Our study has some limitations due to the nature of the data collection and design. Comorbidities were evaluated as present or absent and for a few specific diseases. We did not evaluate other acute disorders, such as heart failure, coronary disease, hemorrhagic stroke, malnutrition, and acute diseases; in addition, we did not evaluate the cognitive status of the subjects. Although we used a single-center study, it is highly representative of the region because it is the reference center for two million people. Our study has several other strengths. To the best of our knowledge, this is the first prospective cohort to evaluate risk factors for in-hospital and one-year mortality in South Brazil and the first study to present important data concerning surgical delay in Brazil. Moreover, we performed an attentive follow-up, including clinical appointment and telephone-mail contact, which minimized lost follow-up bias.

In conclusion, surgical delay and ASA score are risk factors for one-year mortality in our cohort. Time to surgery was worryingly high in our study. Although it is not clear whether improving the clinical condition of patients and decreasing time to surgery would have a positive effect on the survival of these subjects, efforts should be made to

Table 3 - In-hospital mortality predictors.

Covariates	Crude OR (95% CI)	Crude *p*-value	Adjusted OR (95% CI)	Adjusted *p*-value
Gender				
Female	Reference			
Male	0.905 (0.291 - 2.814)	0.863	Refuted	Refuted
Age	1.096 (1.022 - 1.175)	0.010	1.079 (1.005 - 1.159)	0.035
Time to Surgery	1.034 (0.959 - 1.115)	0.379	Refuted	Refuted
ASA Grade				
Group One	Reference			
Group Two	5.638 (1.607 - 19.779)	0.007	4.668 (1.313 - 16.597)	0.017
Comorbidity (Yes/No)	2.484 (0.324 - 19.069)	0.382	Refuted	Refuted
Comorbidity				
Systemic Arterial Hypertension	1.187 (0.436 - 3.230)	0.737	Refuted	Refuted
Ischemic Heart Disease	2.167 (0.788 - 5.959)	0.134	Refuted	Refuted
Diabetes	2.199 (0.694 - 6.964)	0.180	Refuted	Refuted
Ischemic Cerebrovascular Accident	1.661 (0.363 - 7.588)	0.513	Refuted	Refuted
Others *	0.644 (0.145 - 2.869)	0.564	Refuted	Refuted
Intrahospital Stay	1.022 (0.999 - 1.045)	0.059	Refuted	Refuted
Fracture Type				
Trochanteric	Reference		Refuted	Refuted
Neck	1.045 (0.129 - 8.445)	0.967	Refuted	Refuted
Subtrochanteric	0.456 (0.048 - 4.302)	0.493	Refuted	Refuted

CI= Confidence Interval OR = Odds Ratio.
*= Asthma, Chronic Obstructive Pulmonary Disease and Chronic Renal Failure.

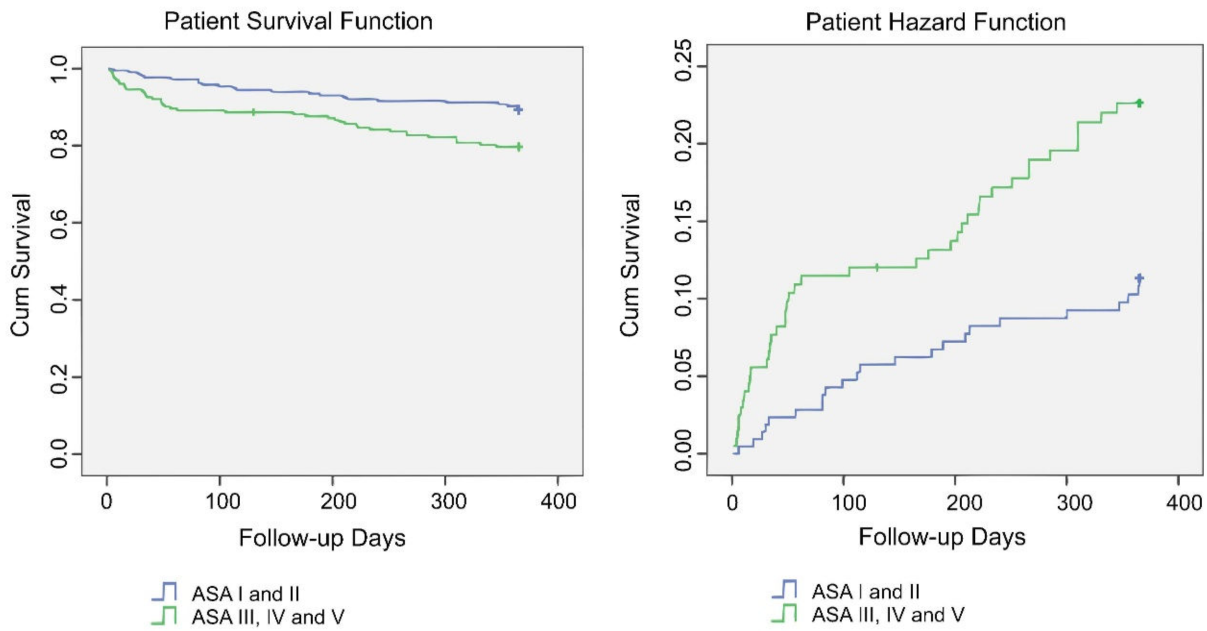

Figure 1 - Left side: Survival function of the study subjects stratified according to ASA score. The Log Rank (Mantel-Cox) test demonstrates a significance of $p = 0.006$ and a χ^2 (chi-square) of 7.643 between ASA groups. Group one: 342.94 ± 5.20 SE days (89.3%) and Group two 316.83 ± 7.66 SE days (79.75%). **Right side:** Hazard function of the study subject patients stratified according to ASA score. Group one 11.31% and Group two 22.62% risk of death in one year.

improve these variables. More studies are needed to evaluate whether programs that decrease time to surgery and ameliorate the clinical status of the patient would affect mortality after hip fracture.

AUTHOR CONTRIBUTIONS

Ribeiro TA, Premaor MO, Larangeira JA, and Monticielo OA conceived the design. Ribeiro TA, Brito LG, Luft M, and Guterres LW performed the data collection. Ribeiro TA and Premaor MO analyzed the data. Ribeiro TA, Premaor MO, Larangeira JA, Brito LG, Luft M, Guterres LW, and Monticielo OA interpreted the data and prepared the manuscript. All authors contributed to the writing of the manuscript.

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