The Relationship between the Lee Score and Postoperative Mortality in Patients with Proximal Femur Fractures*

A relação do escore de Lee com a mortalidade pós-operatória em pacientes com fraturas de fêmur proximal

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Abstract

Objective To verify the predictive value of the Lee score for mortality in a one-year period after proximal femur fracture surgery. The present study also evaluated the isolated predictive capacity of other variables.

Methods A sample of 422 patients with surgically-treated proximal femur fractures was evaluated. Data was collected through a review of medical records, appointments, and contact by telephone.

Results The Lee score was applied to 99.3% of the patients with proximal femur fractures submitted to surgical treatment. The mortality rate was of 22% of the sample, and the majority were classified as class I risk. The Lee score had no significant association with mortality ($p = 0.515$). High levels of serum creatinine ($p = 0.001$) and age ($p = 0.000$) were directly associated with death.

Conclusion The Lee score was not predictive of mortality in a one-year period after proximal femur fracture surgery; however, a statistical significance was observed between age and serum creatinine levels, considered separately, and death.

Keywords

- femoral fractures/ etiology
- femoral fractures/ surgery
- femoral fractures/ mortality
- postoperative complications

Resumo

Objetivo Verificar o valor preditivo do escore de Lee para a mortalidade no primeiro ano pós operatório de fraturas de fêmur proximal. O estudo também avaliou a capacidade preditiva isolada de outras variáveis.

Método Uma amostra de 422 pacientes com fraturas do fêmur proximal submetidos a cirurgia foi avaliada neste estudo. Os dados foram coletados por meio de revisão de prontuários, consultas presenciais e contatos telefônicos.

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Palavras-chave
- fraturas do fêmur/ etiologia
- fraturas do fêmur/ cirurgia
- fraturas do fêmur/ mortalidade
- complicações pós-operatórias

Resultados O escore de Lee foi aplicado em 99,3% dos pacientes com fraturas de fêmur proximal submetidos a tratamento cirúrgico. A taxa de mortalidade da amostra foi de 22%, a maioria classificada como classe I de risco. O escore de Lee não apresentou associação significativa com a mortalidade ($p = 0,515$). Os valores elevados de creatinina sérica ($p = 0,001$) e a idade ($p = 0,000$) estiveram diretamente associados com o desfecho de morte.

Conclusões O escore de Lee não é preditivo para a mortalidade em um período de um ano após cirurgia de fraturas de fêmur proximal; entretanto, observou-se significância estatística entre a idade e a dosagem sérica da creatinina, isoladamente, com o desfecho de morte.

Introduction

Proximal femur fractures correspond to a large percentage of hospitalizations due to orthopedic conditions, and are associated with high morbidity and mortality rates. It is estimated that the number of cases can reach up to 6.26 million by 2050, mostly because of the population pyramid inversion worldwide. The affected patients are usually older than 70 years of age, Caucasian, and postmenopausal females. The most common mechanism is low-energy trauma, and it is related to clinical conditions such as malnutrition, decreased visual acuity and reflexes, chronic use of medications, and, most importantly, the progressive decrease in bone mineral density. The high morbimortality rate and the need for rapid therapeutic intervention may hinder the initial management. About a third of the patients die within a year after surgical treatment, and half of them remain with functional limitations. A study with 8,930 patients reported a 30-day and 1-year postsurgical mortality rate of 4% and 16% respectively.[1,2] The treatment is predominantly surgical, and its goal is the early mobilization of the patient. Conservative measures are reserved only for specific cases, such as patients with poor clinical conditions for surgery and/or those who do not walk. Early surgery, within 24 hours of the trauma, may minimize the chance of complications secondary to bed restriction, such as pneumonia and venous thromboembolism. A delay in the treatment of more than 72 hours is associated with an increased mortality rate between 30 days and 1 year after surgery.[3] Therefore early surgical intervention is recommended for these patients.

Minimizing the gap between hospital admission and surgery requires reducing the time spent in the preoperative clinical evaluation. Most patients with proximal femoral fractures can't undergo more specific cardiac function tests, and usually present multiple comorbidities. Therefore, the creation of comprehensive preoperative evaluation methods that are reliable, easy to use and quick to implement is paramount. The revised cardiac risk index (RCRI), or Lee score, was created to facilitate presurgical assessments, and it is used worldwide to estimate the risk of myocardial events in the immediate peri- and postoperative periods. The objective of this study was to verify the predictive value of the Lee score for mortality up to 1 year after the surgical correction of proximal femoral fractures. In addition, the isolated predictive capacity pf other variables was analyzed.

Material and Methods

The present was a mixed retrospective cohort study with a population composed of patients with proximal femoral fractures submitted to surgery, aged ≥ 65 years, and admitted to a Southern Brazilian hospital under the care of the Orthopedics and Traumatology Service between June 2013 and June 2015. The study was approved by the Ethics in Research Committee under number 108356/2016 /CAAE 61120016.6.0000.5328.

The medical records of all patients with proximal femoral fractures at the Hospital's Medical and Statistical Archive Service (SAME, in the Portuguese acronym) were reviewed. The query was performed using the international code of diseases (ICD-10), which classifies all medical records. The postoperative follow-up was performed during medical consultations registered in the hospital's internal system, and through contact by telephone with patients and their relatives in order to minimize the loss at follow-up. If contact was not possible, the city's Health Department system was consulted to trace the outcome. Thus, the amount of sample losses was reduced.

The data was recorded in an Excel 2017 (Microsoft, Redmond, WA, US)spreadsheet, constituting a databank for further studies in our service. The final sample consisted of 422 patients, and the exclusion criteria were preoperative death and conservative treatment. The variables studied were: age, gender, Lee score, trauma mechanism, postoperative mortality, fracture laterality, bone exposure, fixation implant, postoperative infection, neurovascular injury, peripheral venous thrombosis, cardiorespiratory arrest, serum creatinine level, clinical comorbidities, alcoholism, smoking, systemic arterial hypertension (SAH), type-2 diabetes mellitus, renal insufficiency, HIV infection, hepatitis C, stroke, hypertensive heart failure, delirium, and ischemic heart disease.

In order to calculate the RCRI, one point is assigned to each of the following items: serum creatinine level > 2 mg/dL and history of congestive heart failure, coronary artery disease, brain vascular disease, and insulin-dependent diabetes mellitus.[4] One point is added to high risk surgery. Hip procedures

are considered intermediate-risk surgeries.[5] Therefore, no patient in the sample was classified as having the highest risk. The negative outcomes included acute myocardial infarction, pulmonary edema, ventricular arrhythmia, cardiac arrest, total heart block, and death.

The Fisher exact association test and the Mann-White non-parametric test were used for the statistical evaluation. The significance level adopted was of 5% ($p < 0.05$), and the analyses were performed using the Statistical Package for the Social Sciences (SPSS, SPSS, Inc., Chicago, Il, US), software, version 13.0.

Results

A total of 422 records were reviewed from June 2013 to June 2015, and the final sample consisted of 78% (329) of women and 22% (93) of men. The patients were divided into 3 age groups: 48.1% (203) aged > 80 years, 40.5% (171) between 70 and 80 years old, and 11.4% (48) younger than 70 years of age (►**Table 1**). The mean age was 79.8 years old.

The main trauma mechanism was fall from standing height, which represented 95.7% (404) of the cases. The topography of proximal femoral fractures according to the ICD-10 was: 54.2% (229) of transtrochanteric fractures, 34.6% (146) of femoral neck fractures, and 11.1% (47) of subtrochanteric fractures. The lesions occurred at the left side in 55% (232) of the cases, and at the right side in 45% (190) of the cases. It is worth mentioning that proximal femoral fractures with atypical patterns, such as multiple injuries, were not classified in the electronic records, being grouped under the "Other" category.

The most used implants were dynamic hip screws (DHS) in 32% (135) of the cases, and proximal femoral nails (PFN) in 28.9% (122) of the cases. Partial hip arthroplasty was the procedure of choice in 18% (76) of the cases, whereas total hip arthroplasties were performed in 13% (55) of the patients. Dynamic condylar screw (DCS) and dynamic compression plate (DCP) implants were used in 4.3% (18) and 2.8% (12) of the cases respectively. The remaining synthetic methods were grouped as "Other."

The contamination rate in the medical records and surgical descriptions was of 0.5% (2 cases). Deep venous thrombosis (DVT) occurred in 0.5% (2) of the cases, and cardiorespiratory arrest (CRP), in 2.1% (9) of the cases. There were no cases of neurovascular injury.

The Lee score was applied in 99.3% (419) of the patients with proximal femoral fractures submitted to a surgical procedure; 63.5% (268) of these patients were classified as class I, 26.5% (112), as class II, 8.5% (36), as class III, and 0.7% (3), as class IV. Unclassified patients were grouped as "Other." The mortality rate was of 18.7% (93) of the sample (►**Table 2**).

Table 1 Total sample number: gender and age

Variable	Response	Number of cases	%
Gender	Male	329	78.0
	Female	93	22.0
Age	< 70 years old	48	11.4
	70-80 years old	171	40.5
	> 80 years old	203	48.1

Table 2 Total deaths and patient classification according to the Lee score

Variable	Response	Number of cases	%
Death	No	343	81.3
	Yes	79	18.7
Lee score	I	268	63.5
	II	112	26.5
	III	36	8.5
	IV	3	0.7
	Other	3	0.7

The data analyzed showed that the Lee score had no significant association with patient mortality ($p = 0.515$), since a higher percentage of death outcomes (60.8%) was classified as low-risk in the RCRI. In addition, only 1.3% of all deaths belonged to the highest risk group (►**Table 3**). Another finding is that elevated serum creatinine levels ($p = 0.001$) and age ($p = 0.000$) were directly associated with fatal outcomes (►**Table 4**). Death was more common in individuals older than 80 years of age, which corresponded to 68.8% of the sample ($p = 0.023$) (►**Table 5**).

Discussion

The present study aimed to evaluate the efficacy of the Lee Score as a preoperative assessment tool to predict mortality within a year after surgery for proximal femoral fractures, and to analyze the individual variables for the correlation with fatal outcomes. The current literature disagrees about the quality of simple preoperative evaluative methods in various surgical areas,[6] including the Lee score. Previous works have shown that, in orthopedic procedures, the Lee score has limited ability to predict unfavorable outcomes. In a total sample of 227 patients submitted to elective orthopedic surgeries, Vetrugno et al[7] verified that most postoperative complications occurred in patients classified as low and intermediate (grades I and II) in the Lee score. In the same

Table 3 Relationship between the Lee score and mortality

Variable	Response	Death				*p*-value
		No		Yes		
		n	%	n	%	
Lee score	I	220	64.7	48	60.8	0.515
	II	91	26.8	21	26.6	
	III	27	7.9	9	11.4	
	IV	2	0.6	1	1.3	

Table 4 Relationship between creatinine levels and age with mortality

Variable	Death	n	Average	Standard deviation	*p*-value
Creatinine >	No	343	0.97	0.66	0.001
2 mg/dL	Yes	79	1.45	1.51	
Age	No	343	79.08	8.12	0.000
	Yes	79	83.10	7.84	

Table 5 Relationship between gender and age with mortality rates

Variable	Response	Death				*p*-value
		No		Yes		
		n	%	n	%	
Gender	Female	271	79.0	58	79.4	
	Male	72	21.0	21	26.6	
Age	< 70 years old	44	2.8	4	5.1	
	70-80 years old	144	42.0	27	34.2	0.23
	> 80 years old	155	45.2	48	60.8	

study, the authors compared the efficacy of the score with the pre- and postoperative B-type natriuretic peptide (BNP) dosages, and concluded that it presented a better predictive capacity for unfavorable outcomes. In another paper, Ackland et al[8] used a modified RCRI (mRCRI) including electrocardiogram changes, uncontrolled hypertension, and age > 70 years to evaluate the postoperative morbidity and mortality in a sample of 560 patients undergoing elective knee and hip replacement surgeries. As a result, the specificity improved. An American study by Waterman et al[9] also created a new and simple preoperative assessment tool to predict the risk of intra- and postoperative cardiac events in patients undergoing total knee and hip replacement surgeries. The so-called total joint arthroplasty cardiac risk index has only three variables: hypertension, age $\geq$ 80 years, and history of heart disease. In a large sample with 85,129 patients, this score predicted unfavorable outcomes more efficiently when directly compared with the Lee score. These articles reinforce the results obtained in our study, which indicate that some isolated factors are efficient in predicting the outcomes of orthopedic surgeries.

On the other hand, there are studies regarding non-orthopedic surgeries that report a higher precision of the preoperative evaluation with the Lee score compared to other methods. A survey involving aortic bypass surgery showed a significant relevance of the RCRI regarding the risk of postoperative mortality within 30 days and 1 year. However, this study did not consider factors such as surgical indication, emergency procedure, and age, which provided additional prognostic information.[10] Archan et al[11] considered the Lee Score a useful tool in the stratification of high-risk patients submitted to vascular repair procedures.

There are more specific methods to evaluate the patients' preoperative conditions, although most involve high costs and a certain level of technical difficulty regarding execution in the emergency department. It is well-known that most patients with proximal femoral fractures who are awaiting surgical procedures do not tolerate more objective measures of cardiorespiratory evaluation.[12] According to Canty et al,[13] preoperative transthoracic echocardiography may reduce mortality in patients with hip fractures without generating delays in the procedure. However, there are issues inherent to our reality, such as limited resources, which impose constraints on more advanced assessment methods.

The Lee score can be compared to another presurgical evaluation tools, such as the American Society of Anesthesiologists (ASA) score. A Brazilian study[14] has shown a correlation between this latter method and mortality after hip fracture surgical correction.[14] Both consider criteria which, isolated, are significant in the onset of fatalities. Cardiac insufficiency, for instance, is one of the cardiac conditions with the highest mortality rate in non-cardiological procedures, as well as aortic stenosis and pulmonary hypertension.[13] The RCRI may present a certain theoretical advantage because it includes acute myocardial infarction and stroke, which were the variables considered the main causes of death in a recent analysis.[14]

The level of creatinine is relevant in the perioperative period. It has already been shown that increases higher than 0.3 mg/dL in the baseline value may serve as a marker of infection in elderly patients with hip fracture.[15] Similarly, age has already been indicated as a predictor of negative outcome in other studies.[16–19] A higher number of more serious comorbidities, such as osteoporosis, atherosclerosis, heart disease, diabetes, and cerebral and renal failures are more commonly found in elderly patients. Our study is consistent with the literature, since serum creatinine levels and age individually showed a statistical correlation with mortality. It is worth mentioning that our sample had a significant number of elderly patients, which was higher than the statistical mean of the reviewed papers. Our sample included 203 patients in their eighth decade of life, corresponding to 48.1% of the total sample.

During the literature review on this subject, we observed that there are few studies regarding the death outcome predicted by the Lee score in non-cardiac surgeries performed due to traumatic causes.

The present work generated a vast database that can be used to create further studies in our service, and that instigate the creation of a new, more objective and simple preoperative evaluation tool. We also believe that we have contributed to the attention to conditions that pose greater risks to patients.

Conclusion

We conclude that the Lee score is not predictive of mortality within one year after surgical treatment of proximal femoral fractures. However, age and serum creatinine levels, isolatedly, were statistically associated with fatal outcomes. The remaining variables studied were not related with death.

Conflicts of Interest
The authors have none to declare.

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