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Cost-effectiveness of surgical treatment for hip fractures among the elderly in Brazil☆

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ABSTRACT

Objectives: To estimate the cost per quality-adjusted life-year (QALY) focusing on the length of time between trauma and surgery.
Methods: A retrospective cohort with systematic sampling was conducted among all the patients who were admitted to the study hospital through the Brazilian National Health System (SUS) over a three-year period. Two treatment strategies were compared: early treatment, if the patient was operated up to the fourth day; and late treatment, if this was done after the fourth day. The cost was the direct medical cost from the point of view of SUS, which was gathered from the management system, from the SUS table of procedures, medications and implant material costs (SIGTAP), to account for the costs associated with the hospital, medical fees and implants used. The outcome of usefulness was measured indirectly by means of EuroQOL-5D, which is an instrument used worldwide, and these measurements were transformed into usefulness by means of the standard rules of the Regional Planning and Development Center of Minas Gerais (CEDEPLAR) of 2013.
Results: The sample included 110 patients: 27 in the early group and 83 in the late group. The confounding variables of age, gender, anesthetic risk (ASA), fracture type and surgery type were controlled for. The samples were shown to be homogenous with regard to these variables. The cost per QALY of the early strategy was R$ 5,129.42 and the cost of the late strategy was R$ 8,444.50.
Conclusion: The early strategy was highly favorable in relation to the late strategy in this study.

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Custo-efetividade do tratamento cirúrgico da fratura do quadril em idosos no Brasil

Palavras-chave:
Análise Econômica em Saúde
Fratura do quadril
Idoso

RESUMO

Objetivos: estimar o custo por ano de vida ajustado por qualidade (QALY) com foco no tempo entre o trauma e a cirurgia.
Métodos: foi feita uma coorte retrospectiva com amostra sistemática com todos os pacientes internados no hospital do estudo pelo Sistema Único de Saúde (SUS) durante três anos. Compararam-se duas estratégias de tratamento, uma precoce, se o paciente fosse operado até o quarto dia, e outra tardia, se após o quarto dia. O custo foi o direto médico do ponto de vista do SUS, colhido diretamente do Sistema de Gerenciamento da Tabela de Procedimentos, Medicamentos e Custos de Materiais de Implantes (OPM) do SUS (Sigtap), para contagem dos custos associados ao hospital, aos honorários médicos e aos implantes usados, e o desfecho utilidade foi medido indiretamente por meio do EuroQOL-5D, instrumento mundialmente usado e transformado em utilidade pela normativa do Centro de Desenvolvimento e Planejamento Regional de Minas Gerais (Cedeplar) de 2013.
Resultados: a amostra contou com 110 pacientes, 27 no grupo precoce e 83 no tardio. Variáveis confundidoras foram controladas, idade, gênero, risco anestésico (ASA) e tipo de fratura e de cirurgia. As amostras se revelaram homogêneas quanto a essas variáveis. O custo por QALY da estratégia precoce foi de R$ 5.129,42 e da estratégia tardia, de R$ 8.444,50.
Conclusão: a estratégia precoce demonstra dominância em relação à tardia neste estudo.

Introduction

Fractures of the proximal femur have extremely serious repercussions among elderly patients: high morbidity and mortality, high rates of postoperative incapacity and higher costs both for the family and for society, with poor results from the treatment. They are considered to be one of the biggest public health problems worldwide.[1,2]

In the United Kingdom, the guidelines recommend that the ideal interval between injury and surgery is 24 h, except in cases in which the patient's condition necessitate more time for clinical improvement.[3] Some authors have taken the view that adherence to this ideal time constitutes a quality criterion for the service in question.[4]

The time between injury and surgery is lengthy in Brazil, and this may cause worsening of the clinical results and of quality of life, as well as increasing the costs in a healthcare system that is under development, like the Brazilian system.[5–7]

The direct medical costs relating to treatment of hip fractures among elderly people have been studied in Brazil since 2001, and they vary significantly, particularly because of the differences in data-gathering or survey methodologies, from R$ 1,700.00[8] to R$ 24,000.00.[9]

Effectiveness can be measured as quality of life, such that the result is named "usefulness". This is a measurement method in which a cardinal number ranging from zero to one represents a possible extract of the quality of life. Death is represented as "zero" and perfect quality of life is represented as "one". This outcome can be gathered directly or indirectly by means of questionnaires.

Indirect data-gathering methods are easier and cheaper.[10] Use of these instruments depends on the transformation norms that ideally should be created among the local target population.[11]

Independent of whether the investment is of public or private type, healthcare expenditure has been increasing around the world, either through advances in hard technology or through the sum of technologies, which is a characteristic of the healthcare sector. This makes allocative efficiency and treatment efficiency even more important.[12] This knowledge is something that orthopedists should have an interest in.

Economic analysis on "hip fractures among the elderly" constitutes an effort to comprehend the problem better, along with its details, and enable adequate planning to deal with it. Its main characteristic is the collective point of view instead of the individual point of view, which better translates the dimension of the question in our eyes and in those of healthcare managers.

The aim of this study was to analyze the relationship between cost, from the perspective of the Brazilian National Health System (SUS), and the effectiveness of surgical treatment for hip fractures among elderly people in Brazil, focusing on the time that elapses between injury and surgery.

Methods

A retrospective cohort was studied, formed by a systematic sample of all patients with hip fractures who were admitted to the hospital of this study between January 1, 2009, and December 31, 2011. An economic analysis on healthcare was conducted from the perspective of the payer, i.e. SUS. It took

into consideration the direct medical costs associated with the various possible techniques for treating hip fractures among elderly people. The time span considered was one year and no corrections were applied to the table of reimbursements for hospitals working with SUS patients during this period (which was the setting for this study), since none were applicable.

From this cohort, data were gathered on the direct medical costs, time elapsed between the injury and the surgery, number of deaths at the hospital, length of hospital stay and usefulness, by means of the EuroQOL-5D (EQ-5D) questionnaire,[13] an instrument that had previously been used in Brazil, with transformation norms available for this country.[14] These were considered to be the final outcomes or dependent variables.

The independent variables were taken to be age, gender, type of fracture, type of treatment and ASA anesthetic risk.[15]

The costs associated with the treatments were surveyed directly through the management system of the SUS table of procedures, medications and orthoses, prostheses and special materials (OPM) (SIGTAP), in accordance with the following codes of the International Classification of Diseases (ICD-10):[16] S72-0, which corresponds to fractures of the femoral neck; and S72-1, which corresponds to transtrochanteric fractures.

These were divided into hospital costs, medical fees, implant material costs and total costs.

Two groups were created focusing on the time that elapsed between the injury and the surgery: "early surgery" (≤4 days) and "late surgery" (>4 days). This cutoff point was based on the observations of Fernandes et al.[17] in which the early group would have disappeared if the cutoff point had been lower, and Moroni et al.[18] who proved that mortality increased after this cutoff point.

The groups were compared in relation to age by means of Student's *t* test and with the other independent variables dichotomously by means of the chi-square test.

The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) 20.0 and the decision tree was generated using the Treeage Pro software 2011.

The study was approved by the Ethics Committee through Consolidated Report No. 126,931, dated October 9, 2012.

Results

Four treatment codes and six types of OPM and their various costs were found, as shown in Tables 1–3.

The real cost paid by SUS was applied to the spreadsheet thus created from the 115 patients of the cohort studied. From this, the mean cost per treatment per patient, of R$ 1933.79 (standard deviation, SD, R$ 686.26), was found. The mean hospital cost among the sample was R$ 813.92 (SD, R$ 210.92), corresponding to 42.09% of the total, the mean medical fee cost was R$ 252.73 (SD, R$ 12.13), corresponding to 13.17% of the total cost, and mean OPMs of R$ 867.13 (SD, R$ 473.52), corresponding to 44.84% of the total cost.

Table 1 – Codes for procedures.

Code	Name of the procedure
040805063-2	Surgical treatment of transtrochanteric fracture
040805048-9	Surgical treatment of femoral neck fracture with fixation
040804005-0	Partial hip arthroplasty
040804008-4	Cemented total hip arthroplasty

Table 2 – Hospital and medical costs associated with the codes.

Code	Hospital cost	Medical cost
040805063-2	R$ 725.17	R$ 247.80
040805048-9	R$ 715.22	R$ 246.63
040804005-0	R$ 1292.50	R$ 278.16
040804008-4	R$ 1343.75	R$ 291.52

Table 3 – Cost of implants.

Implant	Cost
Sliding screw, 135°	R$ 764.34
Sliding screw, 95°	R$ 678.73
Cannulated screw, each	R$ 90.29 (usually 3)
Proximal intramedullary nail	R$ 936.58
Bipolar prosthesis	R$ 1886.30
Cemented total prosthesis	R$ 1867.37

The two groups were compared according to the independent variables. The results are presented in Table 4.

It was considered that the groups were homogenous and that the costs for both strategies, from the perspective of SUS, were the same. The strategies could then be compared.

Regarding deaths at the hospital, the proportion of deaths in the early group was 7.41% versus 16.86% in the late surgery group. Although this result was not statistically significant (odds ratio, OR: 0.394; 95% confidence interval, CI: 0.084–1.859; $p = 0.226$), it was clinically significant.

With the same costs, considering the two strategies, for every thousand patients undergoing the early-surgery strategy, in comparison with the late-surgery strategy, 94 lives would be saved.

The length of hospital stay was statistically significantly different between the two groups, with a mean of 7.22 days

Table 4 – Comparison between groups.

Variable	Early	Late	*p* value
n	27 patients	83 patients	
Age	78.78 years (SD: 11.38)	76.75 years (SD: 11.01)	0.411
Gender	77.8% ♂ × 22.2% ♀	62.6% ♂ × 37.4% ♀	0.148
ASA grade	55.5% low risk vs. 44.5% high risk	50.6% low risk vs. 49.4% high risk	0.655
Fracture	44.4% neck vs. 55.6% transtrochanteric	27.7% neck vs. 62.3% transtrochanteric	0.105
Treatment	22.2% replacement vs. 77.8% synthesis	14.5% replacement vs. 85.5% synthesis	0.263

Table 5 – Analysis on the outcome of usefulness.

	Early mean vs. late mean	*p* value
Usefulness	0.592 vs. 0.523	0.566
EVA	0.650 vs. 0.637	0.911

of stay (SD, 3.43 days) for the patients undergoing the early-surgery strategy, versus 15.90 days of stay (SD, 6.81 days) for those with late surgery ($p < 0.001$).

Patients undergoing the early-surgery strategy would each generate a daily cost for the hospital of R$ 267.84, while those undergoing the late-surgery strategy would generate a daily cost of R$ 121.62.

With regard to studying usefulness, by means of EQ-5D, the differences found were not statistically significant, as shown in Table 5.

Decision analysis generated by means of a decision tree showed a notable result in terms of cost per quality-adjusted life year (QALY). Fig. 1 shows these results.

The strategies shown through the decision analysis model demonstrate the poorness of the results, combined with low usefulness for both strategies. On the other hand, an advantage for allocation of resources to the early-surgery strategy was demonstrated: this cost R$ 5129.42 according to QALY, versus R$ 8444.50 according to QALY for the late surgery. The first strategy was thus shown to be superior.

Discussion

The sample of the present study resembled previous samples in the Brazilian and foreign literature regarding proportionality, predominance of females and a peak at around the age of 75 years.[19,20] This information demonstrates the capacity for extrapolation of this study.

Transtrochanteric fractures predominated, as previously recognized by Castro da Rocha and Ribeiro.[21] The treatments typical of transtrochanteric fractures, with predominance of fixation in the present study, had also been seen in other studies.[21,22]

The mean costs per patient per treatment, of R$ 1993.79 (SD, R$ 686.26), were very close to those found by Krauss Silva in a partial economic analysis, in which only the costs were taken into consideration.[8]

The time that elapsed between the injury and the surgery was lengthy, as too have the times reported in other Brazilian studies.[5–7] This differs from studies in other countries, which have shown early attendance.[23,24]

The time that elapses between injury and surgery has been correlated with delay in preparing the patient and with the availability of a preoperative theater, in studies in other countries.[24] In the present study, there was a strong component associated with delay in transferring the patient from the emergency hospital to one equipped to deal with the complexity level of the case. After this delay, the procedures continued more smoothly.

The preoperative hospital stay was longer than the postoperative stay. The transfer time alone, i.e. the length of time between issuance of the authorization for hospitalization and arrival at the destination hospital, was 3.57 days (SD, 4.57 days) and the transfer time had a direct influence on the time that elapsed until surgery and on the entire stay.

The preoperative hospital stay was responsible for 64.3% of the entire stay, which confirms the observation that difficulties exist in relation to transferring and/or preparing the patient for the procedure.

In this sample, there was a high death rate at the hospital, with a mean of 13.04%, thus differing from the findings of the meta-analysis by Sakaki et al.[20] in which the rate was 5.5%. Their lower value may have resulted from using studies from other countries in their meta-analysis, and it resembled the results from the early-surgery group, which had a death rate at the hospital of 7.14%.

It can be assumed that the early treatment provided in other countries is the gold standard and that if the treatment provided in Brazil were similar, the results would resemble those of other countries.

Despite the clinical importance of the number of deaths, there was no statistically significant relationship with the time that elapsed until surgery, as seen in other studies already cited.

The mean hospital stay of our sample (13.4 days) was similar to that of other studies conducted in Brazil and elsewhere.[20,25,26]

The outcome of usefulness measured by means of the EQ-5D confirmed the poor results relating to this treatment, as previously shown through clinical and quality-of-life results.[27]

Through using a decision tree as the means of analyzing the decision-making, the present study becomes noteworthy

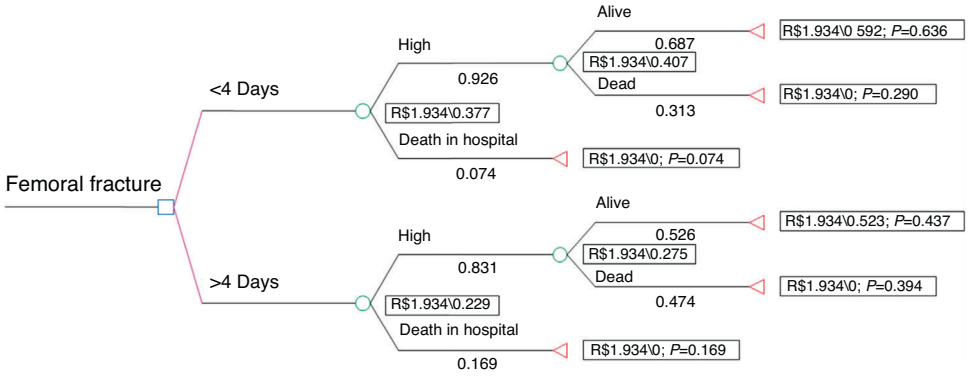

Fig. 1 – Cost-usefulness decision tree for hip fractures.

given that its design clearly demonstrates the cost and usefulness results relating to the strategies used.

The small number of comparable studies shows the scarcity of this type of study in the literature and thus the present study cannot be compared with other studies conducted in Brazil or in other countries. There have been many clinical evaluations focusing on the time period between injury and surgery, but few cost-effectiveness assessments.

At this point, it should be emphasized that there is an ethical limit on this and other studies focusing on the time elapsed between injury and surgery, with regard to random allocation of patients. In such situations, observational studies like the present one are the type that brings the best evidence.

Cost-effectiveness analysis performed on a model produces QALY values. In the present study, early surgery generated a cost of R$ 5129.42 according to QALY, versus R$ 8444.50 according to QALY for late surgery.

Conclusion

After controlling for the confounding variables of age, gender, type of fracture, type of treatment and ASA anesthesia risk, the cost-usefulness ratio of the early-surgery strategy (<4 days) was shown to be superior to the late-surgery strategy (>4 days).

The economic analysis conducted here provides backing for determining that early surgery should be the ideal for guidelines within Brazilian realities and for allocation of resources to seek this objective.

Conflicts of interest

The authors declare no conflicts of interest.

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