

Hip Fractures in the Elderly: The Impact of Comorbid Illnesses on Hospitalisation Costs

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Abstract

Introduction: Hip fractures in the elderly are associated with multiple comorbidities. **Materials and Methods:** We prospectively surveyed and went through all relevant medical records of 70 consecutive patients admitted to Singapore General Hospital following either a cervical or intertrochanteric femoral fracture from late February to May 2004. The total hospitalisation cost for each patient was calculated based on the costs of inpatient care up to the point of discharge. Regression modeling was performed on the 7 commonest age-related conditions (based on our data), to determine the impact of each comorbidity on total costs. **Results:** The average age of the cohort was 77.24 years. The median length of stay was 13.6 days. In patients without comorbidities, the mean hospitalisation cost was S\$9347.5 ± 1719.6. With the presence of comorbidities, the mean cost increased to S\$11,502.3 ± 6024.3. In univariate modeling, dementia added the largest amount to total costs [S\$5398; 95% confidence interval (CI), S\$1273 to S\$9523; *P* < 0.05]. The presence of diabetes (S\$758; 95% CI, S\$2051 to S\$3566), hypertension (S\$644; 95% CI, S\$1986 to S\$3274) and osteoarthritis (S\$915; 95% CI, S\$3721 to S\$1891) did not significantly add to total costs. When controlled for multiple comorbidities, dementia retained its significance in adding to total costs (S\$6178; 95% CI, S\$1795 to S\$10,562; *P* = 0.006). **Conclusion and Discussion:** Hip fracture patients with comorbidities incurred higher hospitalisation costs. Cost-containment strategies in hip fracture patients should not only examine the number of comorbidities but also the type of disease.

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Key words: Costs, Comorbidities, Elderly, Hip Fractures, Length of stay

Introduction

Management of hip fractures is costly and continues to generate significant costs throughout the one-year period after discharge.¹ They demand considerable resources from a country's health care system.^{2,3} Hip fractures are the commonest cause for admission in the acute orthopaedics setting in the elderly.⁴ As a result of an ageing population, the incidence of hip fractures is rising.⁵

Hip fractures in the elderly are also commonly associated with the presence of multiple comorbidities.⁶ There have been no recent studies relating to the cost of hip fractures.⁷ We sought to examine the impact of comorbidities on costs of care in hip fracture patients with the intent of devising key strategies to contain the costs in these patients. We analysed the cost patterns of key age-related comorbidities and their interaction with hip fractures as a primary cause of morbidity.

Material and Methods

We prospectively studied 70 consecutive patients aged 55 and above. Patients had been admitted to the Singapore General Hospital following either a cervical (neck) or trochanteric femoral fracture.

The study was conducted from late February to May 2004 over a 3-month period. Informed consent was obtained. The orthopaedics department and hospital authorities granted permission to carry out this study. Patients or their family members were interviewed to obtain baseline demographic information about comorbid illnesses, as well as information pertaining to the fracture during their admission.

Data such as the length of stay and billing information were collected to determine the cost each patient incurred from point of admission till discharge. Cost included the

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costs of surgery, surgical implants, radiological and laboratory investigation, medication prescribed, rehabilitative services utilised and inpatient ward charges. Costs calculated were before the input of governmental subsidies or subvention and were adjusted to reflect 2004 Singapore dollar values.

The mean and standard deviations were determined for demographic and casemix continuous variables. Correlation between mean length of stay and total hospitalisation costs was determined using regression coefficient modelling. Univariate and multivariate regression modelling were used to determine factors associated with increased hospitalisation costs and to determine the impact of each comorbidity on total costs. Significance was determined at $P < 0.05$. Statistical analyses were done using SAS V9.0 (SAS Inc, Cary NC).

In patients with comorbidities, the 7 commonest age-related conditions (based on our data), were: hypertension ($n = 37, 53.7\%$), diabetes mellitus ($n = 3, 23.9\%$), dementia ($n = 7, 9.3\%$), arthritis ($n = 11, 20.8\%$), chronic obstructive lung disease ($n = 2, 2.9\%$), cardiovascular disease ($n = 23, 32.9\%$) and renal failure ($n = 12, 17.1\%$). These conditions were analysed to determine their influence on the costs of hospitalisation.

Results

Patient Characteristics

The average age of our patients was 77.24 [(70) $n = 5407$] years. It is comparable to the normal average age of 78 years.⁸ The average age of our male patients was 77.20 [(25) $n = 1930$] and that of females was 77.27 years [(45) $n = 3477$]. There were 45 females and 25 males. The majority of our patients were Chinese (91.4%), followed by Indians (4.3%), Caucasians (2.9%) and Malays (1.4%).

Characteristics of Hip Fracture and Intervention Received

Most of our patients suffered from femoral neck fractures (68.6%) as compared to intertrochanteric fracture (31.4%). Out of 70 patients, 69 (98.6%) were scheduled for surgery. However, 2 patients had their surgeries postponed due to renal problems and died before treatment.

Hence, with the exception of very advanced disease, patients with multiple comorbidities were still being operated on. Bipolar surgeries, which involved replacing the femoral head with a prosthesis, made up 60% of the total number of surgeries. Dynamic hip screws made up 30% of the total number of surgeries. They are used for internal fixation of fractures of the femoral neck and intertrochanteric region. Weight-bearing causes the femoral head to become impacted on the femoral neck, producing dynamic compression of the fracture. The shaft of the lag screw slides down the sleeve, maintaining reduction of the

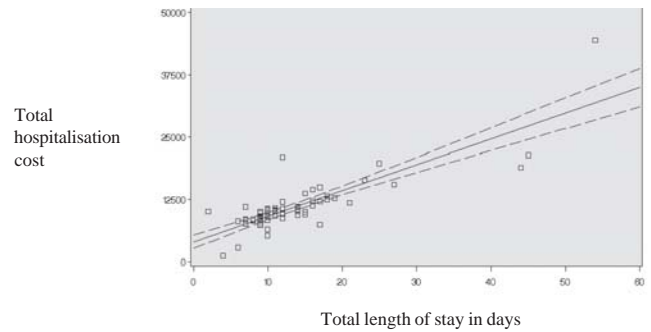


Fig. 1. Correlation between mean total hospitalisation cost and length of stay.

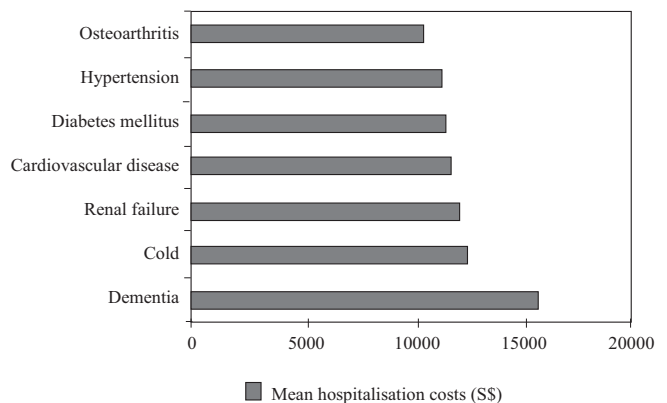


Fig. 2. Mean total hospitalisation cost stratified to comorbid illness type.

fracture as compression occurs. Cancellous screws, which aid in interfragmentary compression of the fractured bone, accounted for 7% of the total number of surgeries, and intermedullary rods, 3%.

Comorbidities and their Impact on Hospitalisation Costs

The average total hospitalisation cost for hip fractures was S\$10,995.27 (S\$5397.73). The median length of hospital stay was 13.6 days. For every 1 day increase in the length of stay (Fig. 1), hospitalisation cost increased by S\$516.04.

Patients without comorbidities stayed an average of 10.6 ± 4.4 days whereas those with comorbidities stayed on average of 14.3 ± 9.4 days. The former group paid an average sum of S\$9348 \pm 1720 whereas the latter paid an average of S\$11,502 \pm 6024 for total hospitalisation costs. Hence, comorbid illness affects hospital costs relating to hip fractures.⁹ The mean total hospitalisation cost stratified to comorbid illness type is shown in Figure 2.

Fifty-seven patients had comorbidities (81.4%), compared to 13 who had no comorbidities at all (18.6%). Fifteen patients had 1 concomitant comorbidity (26.3%). Twenty had 2 concomitant comorbidities (35.1%) and 22 patients had 3 or more concomitant comorbidities (38.6%). The mean hospitalisation costs increased with the number of comorbid diseases. However, it is crucial to note that the

Table 1. Simple Linear Regression Modelling of the Type of Comorbid Illness on Mean Costs

Type of comorbid illness	Point estimate	95% CI	P value
Dementia	5398.1	1273.0, 9523.1	0.01
Cold	1525.4	-6258.9, 9309.8	0.69
Renal failure	1251.5	-2311.1, 4814.2	0.49
Cardiovascular disease	1178.2	-1589.9, 3946.3	0.40
Diabetes	757.8	-2050.7, 3566.3	0.60
Hypertension	644.1	-1985.8, 3274.0	0.63
Osteoarthritis	-915.2	-3720.8, 1890.5	0.52

95% CI: 95% confidence interval

Table 2. Multivariable Regression Modelling of the Type of Comorbid Illness on Mean Costs

Type of comorbid illness	Point estimate	95% CI	P value
Dementia	6178.4	1795.2, 10562.0	0.006
Cold	879.4	-7288.9, 9047.6	0.83
Renal failure	385.1	-3363.9, 4134.1	0.84
Cardiovascular disease	1632.4	-1264.5, 4529.3	0.26
Diabetes	1449.2	-1626.0, 4524.4	0.35
Hypertension	630.2	-2076.8, 3337.2	0.64
Osteoarthritis	-969.8	-3882.0, 1942.4	0.51

95% CI: 95% confidence interval

P value was >0.05, suggesting that the type of illness contributed more significantly to hospitalisation costs than the number of comorbidities.

In univariate modelling (Table 1), the presence of dementia added the largest amount to the total costs (S\$5398.1; 95% CI, S\$1273 to S\$9523.1; *P* < 0.05). The presence of diabetes (S\$757.8; 95% CI, S\$2050.7 to S\$3566.3), hypertension (S\$644.1; 95% CI, S\$1985.8 to S\$3274) and osteoarthritis (S\$915.2; 95% CI, S\$3720.8 to S\$1890.5) did not significantly add to total costs.

When controlled for the presence of multiple comorbidities in multivariate modelling (Table 2), the presence of dementia retained its significance in adding to the total costs (S\$6178.4; 95% CI, S\$1795.2 to S\$10,562; *P* = 0.006). The presence of the other 6 comorbidities did not significantly add to total costs.

Discussion and Conclusion

Hip fractures in Singapore are costly. The mean cost of acute hospital care stands at \$10,995.27 (at a standardised rate of 164 per 100,000 per year). Although our cost is lower than that of the US (US\$33,000), France (€8048 to €8727),¹⁰ the UK (£12,163),¹¹ Belgium (Belgian francs 9534)¹² and Finland (€14,410),¹³ the standard of living is

higher in these countries than in Singapore. The average total hospitalisation cost is higher than the year 2002, where total costs for hip fractures averaged S\$7367.⁷

The median length of hospital stay of 13.6 days is much shorter as compared to the year 2002, with a mean stay of 17 days,⁷ and the UK, where the mean stay is 23 days.¹¹ However, it is much longer than the 9.21 days (2.13 days in ICU) in Brazil's private practice.¹⁴ As expected, the longer the stay, the higher the cost¹⁵ (Fig. 1). In the graph $r^2 = 0.7$, which signifies that 70% of the total costs can be accounted for by increasing length of stay whereas the remaining 30% can be attributed to factors like comorbid illnesses. These results emphasise the growing economic impact arising from the inpatient treatment hip fractures, most of which relate to length of hospital stay.¹¹

It is crucial to note that the cost burden is disproportionate to the nature of the disease – which is highly treatable and rehabilitative. Hence, based on our study results, it is of utmost importance to try to devise cost-containment strategies to bring the cost of hip fractures down. We can attempt to achieve this by i) reducing the length of hospitalisation; ii) better managing hip fracture patients' comorbid diseases, especially by examining the type, rather than the number of comorbidities a patient has; iii) screening the elderly for those at risk of osteoporosis and fractures;¹⁶ iv) using hip protectors in the elderly^{17,18} or treating osteoporosis early with drugs such as bisphosphonate¹⁹ or calcium and vitamin D supplements²⁰ to prevent hip fractures from taking place; v) educating the elderly about fall prevention strategies;¹⁷ vi) having proper risk assessment and treatment of hip fractures in the elderly by doctors, especially for subsequent fractures, to reduce risk;¹⁷ vii) scheduling hip surgery early especially in pre-morbidly fit patients;²¹ viii) having patients work closely with medical social workers;⁷ and iv) employing intensive physiotherapy or provision of outpatient therapy facilities for hip fractures.¹⁸

Cost data closely correlated with the length of hospital stay. The longer the stay, the higher the cost. Hospitalisation costs increased by S\$516 per day. This relationship is also influenced by the presence of comorbid illnesses, which significantly increases cost of care. A possible solution may be reducing the length of stay for hip fracture patients, by examining ways to have them undergo surgery earlier, (perhaps within 24 hours of sustaining a hip fracture). Early surgery, preferably within 24 hours, may even bring about a decrease in mortality rates.²²

Hip fracture patients with comorbidities incurred higher hospitalisation costs (the highest being patients with dementia). Although not significant for trend, the number of comorbid illnesses appears to have an impact on total hospitalisation costs. It seems that the type of illnesses contributes more significantly to hospitalisation costs rather

than the number of comorbidities. By addressing comorbidities from this angle, we may be able to lower costs by better managing comorbidities that have the greatest impact on hospitalisation costs.

Stratification and regression modelling by comorbid illness type suggested that the presence of dementia added the largest amount to the total costs. The presence of comorbid dementia significantly raises cost both as a single illness and in combination with other comorbid illnesses. Patients with dementia are at increased risk for hip fractures because they may have defective neuromuscular regulation, gait apraxia, use more antidepressants, and have a lower body mass index.²³ Dementia not only affects costs, it has also been found to affect post-fracture ambulatory status²⁴ and increase the risk of death following hip fractures.²⁵ We should examine in detail how dementia prolongs hospital stay and how it contributes so much to costs, so as to properly tackle its impact.

Patients with comorbidities more amenable to ambulatory care incurred lower costs. Hence, cost-containment strategies in hip fracture patients should examine the number and type of comorbidities (as mentioned). To reduce cost, we must re-examine our subsidy for hip fracture patients. Perhaps it is time we readjust subvention for hip fractures to cater for number of comorbid illness and specific illness types e.g., should patients with dementia get higher subventions?

A limitation of this study is that the size of patient pool is small. In addition, these patients were admitted to a single tertiary hospital, which limits its external validity. However, this is a prospective study with complete follow-up and can serve as a model for later studies. The contributions of specific acute hospital cost components have not been analysed and there are no data on post-discharge chronic care costs (although comparable studies have been done in Europe) and estimate costs up to 1 year from discharge.

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