Original Article

The Relationship between Postoperative Complications and Outcomes after Hip Fracture Surgery

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Abstract

Introduction: We studied the prevalence of postoperative complications in a series of consecutive patients who received surgery for hip fractures in a major public hospital in Singapore. We also studied the predictors for the occurrence of complications and the impact of these complications on patient outcomes. Materials and Methods: A retrospective chart review of patients admitted with hip fracture, from March to November 2001, was carried out. Patients were classified as having postoperative complications if they developed any of the following conditions after surgery: dislocation of prosthesis, deep vein thrombosis, postoperative confusion, foot drop, stroke, cardiac arrhythmias or acute myocardial infarctions, urinary retention, urinary tract infection, pneumonia, wound infection and incident pressure sores. Results: Of the 180 patients studied, 60 developed postoperative complications. Significant predictors of complications after logistic regression included being of female gender [odds ratio (OR), 2.79; 95% confidence interval (CI), 1.13 to 6.89] and pre-fracture mobility status (OR for independent ambulators 0.45; 95% CI, 0.23 to 0.87), but not the age of the patients. Postoperative complications significantly affected the length of stay within the acute hospital (beta coefficient, 6.42; 95% CI, 2.55 to 10.29), but were not associated with a decline in mobility status at 3 months post-fracture, eventual discharge destination or readmission within 1 year. Conclusion: Postoperative complications are common after surgery for hip fractures and result in significantly longer hospitalisation periods. Significant predictors for such complications include being of female gender and pre-fracture mobility. Age, in itself, does not result in a higher risk of complications and should not preclude older hip fracture patients from surgical management.

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Introduction

Hip fractures constitute a major health concern for older persons and are associated with significant morbidity and mortality, with 1-year mortality rates ranging from 14% to 36% in spite of advancements in anaesthesia, surgical techniques and nursing care.[1,2] In addition, epidemiological studies have shown that the incidence of hip fractures has risen significantly amongst Asian countries and is anticipated to rise further with the rapid ageing of populations in these countries.[3] In Singapore alone, the absolute numbers of hip fractures have shown a 40% increase within an 8-year period from 1991 to 1998. It is estimated that there may be a 2- to 3-fold increase in the number of hip fractures here by the year 2025.[4]

It is known that 1-year mortality rates after hip fractures are increased when patients suffer from postoperative complications.[1] Indeed, Sexson and Lehner have shown that patients with postoperative complications had a 3-fold increase in 1-year mortality rates when compared with those without such complications.[5] Further to this, a previous study conducted in an acute hospital in Singapore showed that postoperative complications accounted for a significant proportion of costs incurred for the management of hip fractures.[6]

The aims of this study were 3-fold: first, to determine the prevalence of postoperative complications in a series of

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consecutive patients admitted for hip fractures; second, to study the predictors of such complications; and lastly, to investigate the impact of postoperative complications on patient outcomes.

Materials and Methods

The study was conducted in a 1100-bedded university-affiliated general hospital with a well-established hip fracture care path. Consecutive patients admitted to the hospital from March 2001 to November 2001 for closed hip fractures, and who were managed surgically, were included in a retrospective chart review that allowed the systematic extraction of relevant data. The study was approved by the institution's medical research ethics committee.

Apart from basic demographic data, information collected were drawn from data that are routinely collected as part of the hospital's care path and included the number and type of comorbid conditions, type of fracture (based on radiological reports), pre-fracture residence and mobility status, history of dementia, presence of confusion on admission, haemoglobin on admission, date of surgery, number and types of postoperative complications (if any) and the date of discharge.

The presence or absence of comorbid conditions was based on medical history obtained from the patients or their next-of-kin and included diabetes mellitus, hypertension, stroke, ischaemic heart disease, atrial fibrillation, Parkinson's disease, asthma and chronic obstructive lung disease. Patients were categorised as having 0 to 2 comorbidities, or 3 or more comorbidities. Patients were deemed to have dementia if they had been previously diagnosed to have the cognitive syndrome, while the presence of confusion (delirium) was based on the confusion assessment method (CAM) criteria.[7] The diagnosis of delirium was not dependent on pre-existent medical conditions (i.e., patients with a history of dementia who did not fulfill the CAM criteria on admission were not regarded as having delirium). Patients were deemed to be anaemic on admission if their haemoglobin level was below 13 g/dL for males or below 12.0 g/dL for females.[8]

Accordingly, possible predictors of postoperative complications that were considered in our study included the following dichotomous variables: gender, mobility status (defined as independent without aid versus assistance required), comorbidity status, known history of dementia, presence of confusion on admission and the presence or absence of anaemia on admission (using the definition as stated previously). In addition, patients' age and time to surgery were considered as possible predictors.

Postoperative complications were classified dichotomously (present/absent) and included dislocation of prosthesis, deep vein thrombosis (based on clinical diagnosis, with confirmation by ultrasound duplex scans when clinically suspected), postoperative confusion, foot drop, stroke, cardiac arrhythmias or acute myocardial infarctions, urinary retention, urinary tract infection, pneumonia, wound infection and incident pressure sores.

Patient outcomes that were studied included a decline in mobility status at 3 months post-fracture as compared to pre-fracture mobility status, decline in residential status at 3 months post-fracture, readmission to the same hospital within 1 year and the length of stay in the acute hospital.

Patients were deemed to have had postoperative complications if any of the complications mentioned previously were annotated in their medical records. Possible predictors of postoperative complications were based on previous literature and included the variables that were cited above. Odds ratios (OR) and 95% confidence intervals (CI) were calculated for all possible predictors. For the section on patient outcomes, exploratory analysis using contingency tables methods were applied for categorical/ordinal data, while linear regression was used for scale data. Finally, multiple regression analyses were applied to determine the simultaneous effects of possible confounding variables. All analyses were done using SPSS version 10.0 for Windows™.

Results

A total of 180 patients were admitted and underwent surgery for hip fracture between March 2001 and November 2001. Of these, 95 (52.8%) suffered neck of femur fractures while 85 (47.2%) suffered inter-trochanteric fractures. The gender distribution was such that there were 140 females (77.8%) and 40 males (22.2%). There was no significant difference (P = 0.53) in the age distribution between the female (79 ± 8.9 years) and the male (80 ± 9.2 years) patients (Table 1).

Prevalence of Postoperative Complications

Sixty (33.3%) of the 180 patients suffered from at least 1 postoperative complication, with postoperative delirium being the commonest (affecting 18 patients). Urinary tract infections and pneumonias were the next commonest complications, being found in 15 (8.3%) patients and 9 (5%) patients, respectively. Thirteen (7.2%) patients suffered from more than one postoperative complication.

Two patients died during their hospitalisation for hip fractures, with 1 succumbing to pulmonary embolism and the other to a stroke that developed in the postoperative period.

Predictors of Postoperative Complications

In our study, univariate analysis showed that female patients and patients with dementia had greater odds of

Table 1. Characteristics of Patients

Variable	Male	Female
Number of patients	40	140
Age (y)	80 ± 9.2	79 ± 8.9
Type of fracture		
Neck of femur fracture	37.5%	57.1%
Inter-trochanteric fracture	62.5%	42.9%
Premorbid mobility status		
Independent without assistance		
Walking aid or physical	60.0%	50.7%
assistance required	40.0%	49.3%
Number of comorbidities		
≤2	80.0%	75.0%
≥3	20.0%	25.0%
Pre-fracture functional status		
Totally independent in ADLs and IADLs	60.0%	54.3%
Assistance required in ADLs or IADLs	40.0%	45.7%

ADLs: Activities of Daily Living; IADLs: Instrumental Activities of Daily Living

suffering postoperative complications (Fig. 1). Similarly, increasing age, increased dependency in mobility and increasing number of comorbidities were significantly associated with an increased risk of developing postoperative complications. When individual chronic medical illnesses were considered (i.e., diabetes mellitus, hypertension, stroke, ischaemic heart disease, atrial fibrillation, Parkinson's disease, asthma and chronic obstructive lung disease), there was a non-significant trend for patients suffering from any of these conditions to develop postoperative complications when compared to patients who were not similarly disposed. The presence of anaemia on admission, confusion on admission and time to surgery were not significantly associated with the development of complications after surgery. On logistic regression to control for the effects of age and possible interaction between the various variables, the 2 variables that remained as significant predictors for the development of postoperative complications were gender (OR for female patients, 2.79; 95% CI, 1.13 to 6.89) and mobility status (OR for independent ambulators, 0.45; 95% CI, 0.23 to 0.87).

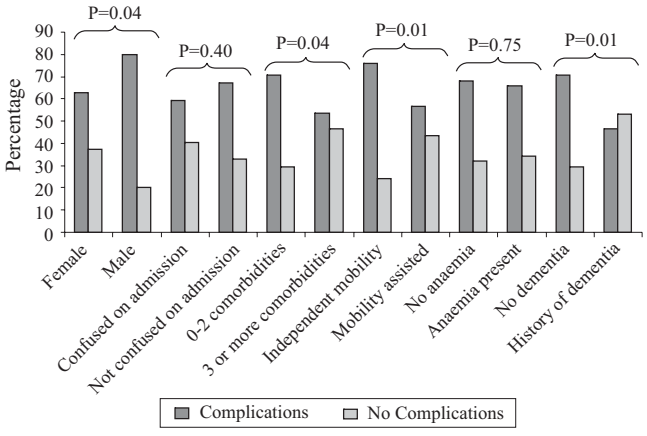

Fig. 1. Possible risk factors for postoperative complications.

Impact of Postoperative Complications on Patient Outcomes

Forty-six (25.6%) patients had a decline in their mobility status when they were reviewed 3 months after their fractures. While patients who had suffered postoperative complications were more likely to have become more dependent in their mobility status, this trend was not statistically significant ($P = 0.11$).

Twenty-three (12.8%) patients had to move to a new residence subsequent to their fractures, with 12 (6.7%) who had previously lived independently moving into nursing homes and the rest moving into new residences that allowed for assistance with activities of daily living (e.g., from their own homes to their children's homes). The presence of postoperative complications did not impact significantly on the need for a change in residential arrangements ($P = 0.8$).

Fifty-seven (31.7%) patients were readmitted to the same acute hospital within 1 year of their fractures, of which 24 had recurrent admissions. Fifteen patients had at least 1 admission for pneumonia, while 13 had admissions precipitated by urinary tract infections. Twelve patients had suffered recurrent falls with resultant injuries that necessitated admission, while 4 patients developed deep vein thrombosis within a year of their fractures. Univariate analysis suggested that the presence of postoperative complications was significantly associated with such an occurrence ($P = 0.04$). However, after logistic regression to control for other possible variables (age, gender, time to surgery, comorbidity status, history of dementia, type of fracture, anaemia on admission and confusion on admission), the presence of postoperative complications was no longer found to be a significant predictor.

Our patients had a mean length of stay (LOS) of 18.7 ± 13.5. As the distribution for LOS was highly skewed, a logarithmic transformation was done to achieve a normal distribution. The development of postoperative complications had a significant impact on the LOS (beta coefficient, 6.42; 95% CI, 2.55 to 10.29), even after adjusting for other potential confounders. Other variables that impacted significantly on the LOS included the time to surgery and the pre-fracture functional dependence.

Discussion

Hip fractures are an important consequence of osteoporosis and are associated with tremendous economic and social costs for the sufferers, their caregivers, as well as healthcare systems.[9] In Singapore, the average cost of acute hospitalisation for a hip fracture is approximately S$7400 (US$4600), and it has been shown that complications arising after surgery account for a significant portion of preventable costs.[6]

In this study, we sought to ascertain the prevalence of postoperative complications related to hip fractures in Tan Tock Seng Hospital (TTSH), a major public general hospital that provides medical coverage for the central zone of Singapore. Our institution was the first hospital in Singapore to set in place a care path for hip fractures, whereby patients admitted with hip fractures are routinely reviewed by a geriatrician. We have chosen to use a broad definition of postoperative complications that encompasses both surgical and medical complications commonly associated with major surgery (dislocation of prosthesis, deep venous thrombosis, postoperative confusion, foot drop, stroke, cardiac arrhythmias or acute myocardial infarctions, urinary retention, urinary tract infection, pneumonia, wound infection and incident pressure sores) because these clinical events reflect the situations that clinicians are likely to encounter and would, thus, be more representative of the true burden associated with caring for patients with hip fractures. Accordingly, our finding that postoperative complications are encountered in 33.3% of our patients is consistent with other reports that have chosen to use a similarly broad definition for complications after hip fractures,[10] and exceeds the 14% to 20% complication rate reported in studies that focused solely on medical complications.[6,11] Further to this, the finding that postoperative confusion and urinary tract infections were the commonest complications encountered in the postoperative period concurred with that reported by Bhandari et al.[12] Both postoperative confusion and urinary tract infections have been identified as common occurrences after orthopaedic surgeries.[12-14] While little is known of the causes of postoperative confusion in the elderly and the true impact of its occurrence on outcomes, the wealth of information available on the clinical significance of delirium in older persons (e.g., as atypical presentations for sepsis or cardiovascular disorders), and the availability of effective management strategies for some of these conditions,[15] support the case for close scrutiny for the occurrence of this complication in all elderly hip fracture patients. Similarly, urinary tract infections are common after hip surgery and it has been shown that simple measures, such as the early removal of indwelling catheters or the use of intermittent catheterisation, may result in a reduction in the occurrence of this complication.

In studying the possible predictors for the development of postoperative complications, our findings are largely consistent with current literature. While it is known that pre-surgical anaemia is associated with higher mortality 6 months and 12 months after surgery, Gruson et al[16] and Carson et al[17,18] showed that the presence of anaemia did not impact significantly on the incidence of postoperative complications in hip fracture patients. This ties in with our results which showed that anaemia was not significantly associated with postoperative complications. Similarly, our finding that age and time to surgery were not associated with increased odds for the development of post-surgical complications concurred with previous reports by Shah et al,[11] Orosz et al[19] and Zuckerman et al.[20] In our study, the finding of significant relationships between postoperative complications and the number of comorbid conditions, as well as the premorbid ambulatory status on univariate analysis, and the retention of ambulatory status as a significant predictor on logistic regression to control for age, comorbidities and dementia are of interest as we had postulated that both of these variables (i.e., number of comorbidities and pre-fracture mobility status) could serve as surrogate markers for frailty. Our findings are in consonance with the report by Young and Gibbs[21] that demonstrated the importance of pre-fracture mobility as a predictor of post-surgical outcomes. In this context, we wish to suggest that advanced age, by itself, should not be considered a contraindication for surgical intervention, and that the overall state of health (or frailty) of older hip fracture patients be taken into consideration when planning the management strategy. Such planning should include the proper timing of surgery to take into account the need to stabilise concurrent medical conditions before surgery. The exclusion of comorbid status on logistic regression may be due to the fact that we had chosen to focus on the number of comorbid conditions and had not taken into account the severity of illness, which is more likely to impact on outcomes after surgery.

The patient outcomes examined in this study are limited by the retrospective nature of the data extraction. Nonetheless, we feel that the outcomes studied (decline in mobility status, change in residence, readmissions within 1 year of fracture and length of hospitalisation for hip fracture) are of clinical significance both to the healthcare provider and the patients.

Of the patients studied, 25.6% failed to return to their usual mobility status prior to their fracture. This outcome compares favourably to figures quoted by van Balen et al[22] and Formiga et al,[23] that range from 38% to 58%. In terms of a change in residence at 3 months post-fracture, we found that 12.8% of our patients had moved to new

residences that provided higher levels of care, with only 6.7% patients moving into nursing homes. This compares very favourably with nursing home admission rates related to hip fractures that have been reported in most Western countries.[22,24,25] Our finding that only a small percentage of our patients moved into nursing homes after their fractures is not surprising, given the cultural expectations of filial piety that is commonly encountered in Asian countries, and the ease of employing domestic helpers who are able to help with the provision of care in Singapore. Fifty-seven (31.7%) patients required readmission to our hospital within 1 year of their fractures. Of these patients, 24 had recurrent admissions. Twenty-seven (47.4%) patients had at least 1 admission for conditions that may be associated with immobility (pneumonia, urinary tract infections and deep vein thrombosis), while 12 (21.1%) patients presented with injuries arising from recurrent falls. The readmission rate is consistent with reported results, which range from 16.7% to 32%.[26,27] The mean LOS in our patients was 18.7 days. This accounted only for the duration of time spent within the acute hospital setting. In Singapore, community hospitals provide post-acute rehabilitation services for the great majority of our patients. These hospitals are run by voluntary welfare organisations and are funded differently from the 5 public general hospitals, of which TTSH is the second largest. As such, patients moving from public hospitals (where medical care is heavily subsidised) to the community hospitals for "step-down" care may be required to pay a different rate, depending on their eligibility for subsidies (patients accessing "step-down" care in Singapore are means-tested to determine their eligibility for subsidies). Such a system of differential funding, coupled with the aforementioned ease of employing domestic helpers, means that not all patients requiring rehabilitation are transferred to community hospitals.

In our study, the development of postoperative complications did not impact significantly on any of the outcomes studied, with the exception of the length of acute hospitalisation. While this may appear counter-intuitive, we believe that the results stem from the fact that we had chosen to adopt a broad definition of the term "postoperative complications" and had not restricted ourselves to specific conditions that might individually affect the outcomes mentioned, such as postoperative strokes or myocardial infarctions. While we accept that our decision to use a broad definition of postoperative complications may be perceived as a limitation to our study, we wish to point out that previous studies of a similar nature have not shown the presence of postoperative complications to be a significant predictor of the outcomes that have been discussed thus far (i.e., decline in mobility, change in residence and readmissions).[22-27] Rather, the predictors that have been consistently identified include, inter alia, age, gender and premorbid functional status. With regards to LOS, our results showed the presence of postoperative complications to be a significant predictor after adjusting for the effects of age, gender and comorbid status. Other variables found to be significant after multiple linear regression included the time to surgery and pre-fracture functional dependence. This finding is consistent with previous studies.[12-14,21] Another limitation that we wish to highlight is the fact that the data presented are based on retrospective chart reviews. This has limited our ability to study all the variables that may be of relevance, and has also limited our ability to ensure the accuracy of some of the diagnoses that have been studied (e.g., dementia). We have endeavoured to minimise the impact of this limitation by basing our study on data that are routinely collected within our hip fracture care path and, where possible, have verified the data by cross-referencing daily casenote entries and treatment orders.

Conclusion

We have shown that postoperative complications are common after surgery for hip fractures, with postoperative confusion and urinary tract infections being the most commonly encountered. The development of postoperative complications can significantly increase the length of hospitalisation and result in increased costs of care. Whilst hip fractures are more commonly encountered in older persons, age per se does not appear to increase the risk of developing complications related to surgery. Rather, our results suggest that the general state of frailty, as reflected by pre-fracture mobility status, is more predictive of the increased odds of developing such problems. Clinicians involved in the care of older persons presenting with hip fractures should consider the patients' general state of health in determining the suitability and timing for surgery, and should maintain a close scrutiny for the development of complications after surgery. Age, in itself, should not preclude hip fracture patients from undergoing surgical repair.

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