

Surgical outcome of daytime and out-of-hours surgery for elderly patients with hip fracture

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ABSTRACT

Introduction: Surgery for hip fracture may be performed out-of-hours to avoid surgical delay. There is, however, a perception that this may constitute less-than-ideal conditions and result in a poorer outcome. The aim of this study was to evaluate the surgical outcome of elderly patients with hip fracture who underwent daytime versus out-of-hours surgery in Hong Kong. This will help make decisions about whether to operate out-of-hours or to delay surgery until the following day.

Methods: This retrospective study included all elderly patients with hip fracture who were operated on and discharged from the Prince of Wales Hospital in 2014. Patients were divided into groups according to the time of surgical incision. Records were examined for 30-day mortality and postoperative surgical complications, and their potential associations with surgeon characteristics.

Results: Overall, 367 patients were selected in this study with 242 patients in the daytime group and 125 in the out-of-hours group. Demographic characteristics were comparable between the two groups. The overall 30-day mortality rate was 2.0% and the surgical complication rate was 24.2%. Compared

with the daytime group, there was no increase in 30-day mortality or surgical complications for out-of-hours group. Fewer surgeons were involved in out-of-hours surgery but the number of surgeons and their qualifications did not affect the outcomes.

Conclusions: The two groups were homogeneous in terms of demographic characteristics. Outcomes for 30-day mortality and postoperative surgical complications were comparable between the two groups. Surgeons' qualifications and number of surgeons involved were also not associated with the outcomes. Out-of-hours surgery remains a viable option in order to facilitate early surgery.

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New knowledge added by this study

- Time of surgery for hip fracture did not affect the outcome.
- Surgeon's qualification was not associated with postoperative outcomes.

Implications for clinical practice or policy

- Out-of-hours repair of hip fracture is safe.
- Hip operations by junior surgeons are practical.

Introduction

With the ageing population in Hong Kong, the number of elderly people aged 65 years or above is projected to rise most rapidly in the next 20 years, with a projected increase from 15% in 2014 to 30% in 2034.¹ With this surge in the elderly population, and as one of the most common injuries in the elderly, hip fracture is also projected to double its numbers in 20 years.² This places a huge financial burden on health care resources. The sum of HK\$310 million allocated to elderly patients with hip fracture in 2011 will rise in the next few years.²

Early surgical repair is a key element both for pain management and restoration of bone integrity after hip fracture.³⁻⁵ Systematic reviews show that

surgery beyond 48 hours significantly increases 30-day and 1-year mortality and complication rates.⁶⁻⁹ Early surgical stabilisation and mobilisation has become the standard of care. As a result, and due to congested operating theatre schedules, non-life-threatening orthopaedic surgery may be performed at night. However, there is a perception that out-of-hours surgery may result in poorer outcomes due to insufficient technical support and surgeon fatigue or inexperience.

Studies that investigated the effect of out-of-hours surgery in different specialties have shown increased morbidity and mortality risk.¹⁰⁻¹² Scant literature on the effect of time of the day of operation on hip surgery outcome shows controversial results.

A German study in 2003¹³ and a study by Chacko et al¹⁴ in 2011 showed no significant differences in mortality or complication rate 6 months after surgery when it was performed at night. Other studies, however, have shown that night-time surgeries for hip fracture may be associated with increased operating time and surgical complication rate.^{15,16}

Owing to the controversial outcomes of these limited studies, this retrospective study aimed to evaluate the surgical outcome of elderly patients with hip fracture who underwent surgery in Hong Kong during the day or out-of-hours. It was hypothesised that surgical outcomes of out-of-hours surgery would not differ significantly to those of daytime surgery. It was hoped that findings of this study would help surgeons in making a decision about whether to operate out-of-hours or to delay surgery until the following day.

Methods

The Hospital Authority (HA) in Hong Kong manages all public hospitals serving more than 90% of the population. The Clinical Data Analysis and Reporting System (CDARS) includes in-patient data from all hospitals and forms a huge database. The Clinical Management System (CMS) is another computerised system that records all aspects of clinical management in the HA.

Using these two systems, a retrospective case series study was conducted to review individual records of patients in the Prince of Wales Hospital (PWH) in Hong Kong. This study was approved by the New Territories East Cluster Ethics Committee (reference number: 2015.665). Preliminary screening was performed using CDARS. All patients discharged in 2014 with a diagnosis of hip fracture (ICD-9 code: 820.00-820.03, 820.09, 820.20-820.23, 820.8, 821.00 and 905.3) and who underwent surgical intervention (ICD-9 code: 79.15(0)-79.15(5), 79.15(7)-79.15(10)) were selected from CDARS. Records were also reviewed through the CMS for verification. Patients aged 65 years or older with an isolated hip fracture who underwent surgical intervention were included in the study. Those with high-energy trauma, peri-prosthetic fracture, bilateral hip fracture, or multiple lower limb fractures were excluded as well as those with a fracture as a result of primary or metastatic bone tumours.

Records of patients who fulfilled the criteria were divided into two groups based on the time of surgical incision. The daytime group included those with an operation between 08:00 and 16:59 (group 1). The out-of-hours group comprised patients of whom the procedure was commenced between 17:00 and 07:59. This group was further split into those having surgery before (group 2) or after midnight (group 3) to enable more detailed analysis.

Operation procedure was defined as either

髖部骨折老年患者在日間和非日間接受手術的術後結果

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引言：為避免手術延遲，髖部骨折手術或可於非日間時間內進行。然而，這種情況會被視為不太理想，認為這會導致較差的手術結果。本研究旨在評估在香港接受日間及非日間手術的老年髖部骨折患者的手術結果。研究結果將有助決定是否應在非日間時間內進行手術或應否延遲手術至翌日。

方法：研究對象包括2014年內所有於香港威爾斯親王醫院接受手術並已出院的髖部骨折老年患者。根據開刀時間把病人分組。找出病人的30天死亡率和術後併發症，以及與外科醫生特徵的潛在關係。

結果：367名患者中，日間組有242例，非日間組有125例。兩組人口特徵相若。所有病人的30天死亡率為2.0%，手術併發症比率為24.2%。與日間組比較，非日間組的30天死亡率或手術併發症比率並沒有增加。非日間手術會有較少外科醫生參與，但醫生人數和其專業資格對手術結果沒有影響。

結論：兩組在人口特徵方面相若，他們的30天死亡率和併發症比率的結果相近。參與手術的醫生人數和其專業資格與手術結果無關。為儘早提供手術給予有需要的病人，非日間手術是一個可行的選擇。

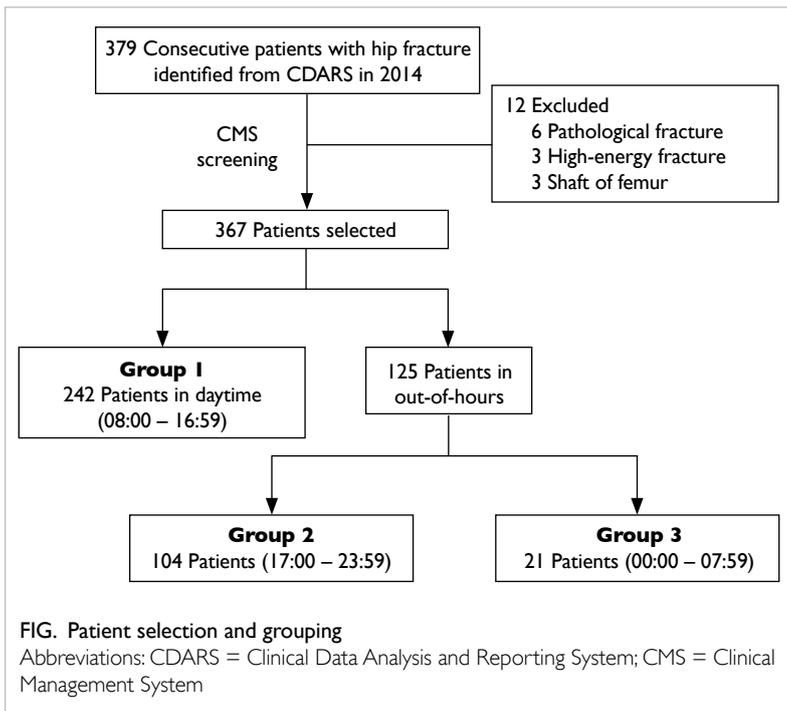
fixation or arthroplasty. Preoperative surgical risk was estimated by the American Society of Anesthesiologists (ASA) classification. Surgeon's qualification was defined according to the list of specialist registration in Orthopaedics and Traumatology in the Medical Council of Hong Kong. Surgeons who qualified as a specialist in or before 2014 were considered a specialist in this study. Surgery performed by a non-specialist but in the presence of a specialist was classified as 'non-specialist with supervision'.

Outcome measures were 30-day mortality and complications during hospital stay; 30-day mortality was chosen because a shorter period could include deaths directly related to the hip surgery. Surgical outcome was defined as complications related to surgical procedures only. General complications such as cardiovascular, respiratory, or cognitive complications were excluded.

Statistical analyses

Records were divided into groups based on the time of incision. The daytime group included patients operated on between 08:00 and 16:59 (group 1). The remaining patients were assigned to the out-of-hours group. More detailed comparison was performed with the out-of-hours group further split into those having surgery before (group 2: 17:00 to 23:59) or after midnight (group 3: 00:00 to 07:59).

For group comparisons, continuous variables



were presented as means and standard deviations. Comparison between groups was performed by one-way analysis of variance with post-hoc Bonferroni test. Categorical data such as demographic data as well as mortality and complication rates were expressed as proportion and were compared by Pearson's Chi squared test. Statistical analysis was performed using the SPSS (Windows version 20.0; IBM Corp, Armonk [NY], United States). The level of significance was set at $P < 0.05$.

Results

Using International Classification of Disease, 9th revision and identified from CDARS, there were 379 hip fracture patients operated on and discharged from PWH in 2014. Review of the related medical records in CMS led to elimination of 12 patients according to the inclusion and exclusion criteria. Of the remaining 367 patients, 242 patients were operated on between 08:00 and 16:59 (daytime group; group 1), and 125 patients were operated on during out-of-hours after 16:59 and before 08:00. Among these 125 patients, 104 were operated on before midnight (group 2: 17:00 to 23:59), and 21 were operated on after midnight (group 3: 00:00 to 07:59). Patient selection and grouping are shown in the Figure.

Demographic characteristics

Demographic equivalency was assessed by comparing

the daytime and out-of-hours group and revealed no difference in terms of age, sex, or type of fracture. Detailed comparison was performed with the out-of-hours group further divided into before and after midnight as shown in the Table. There remained no differences in terms of age, sex, or fracture type among the groups. The mean age of the three groups ranged from 83.2 to 84.3 years and there were more females than males in all groups, more intertrochanteric fractures in group 1 and group 2, and more femoral neck fractures in group 3.

Intra-operative variables

Intra-operative variables were compared between the daytime and out-of-hours groups and revealed no significant differences in ASA class, type of surgery performed, or surgeon's qualification. Again, a more complete comparison was made with the three groups.

The ASA class was comparable among the groups, with almost two thirds of the patients categorised as ASA class 3. Fixation was more common in all the groups but the number of fixation and arthroplasty cases was not statistically significant. There was no difference in surgeon's qualification among the groups, with most surgeries (>95%) performed in the presence of a specialist. Chi squared test revealed that significantly fewer surgeons were involved in the out-of-hours group, especially after midnight ($P = 0.02$).

Regarding surgical outcome, the 30-day mortality rate and postoperative complication rate during hospital stay were obtained. There were eight deaths among 367 patients, accounting for 2.2% of the study population. The cause of death included chest infection and cardiac arrest. The mortality rates were 2.1% and 2.4% in the daytime and out-of-hours groups, respectively ($P = 0.84$).

Surgical outcome was defined as complications related to surgical procedure only. The overall complication rate was 24.3% in the study population with a similar rate between daytime and out-of-hours groups. Comparable results were obtained when the out-of-hours group was further divided into two subgroups ($P = 0.53$). A total of 89 patients among all groups had postoperative complications. Fall in haemoglobin level in 89 patients required blood transfusion in 96.7% of cases. Wound infection or implant infection occurred in only four patients. Because all patients with implant infection had revision surgery, rate of revision surgery was the same as implant infection. No patient had fixation failure, prosthetic dislocation, or peri-prosthetic fracture.

Comparison of surgical time revealed no significant difference in surgical outcome, or in surgeon's qualification ($P = 0.21$). For type of surgery performed, the fixation group showed a significantly higher surgical complication rate than

TABLE. Comparison of demographic characteristics and intra-operative variables between groups

	Mean ± SD (range) or No. (%)			P value
	Group 1: daytime, 08:00 – 16:59 (n=242)	Group 2: out-of-hours, 17:00 – 23:59 (n=104)	Group 3: out-of-hours, 00:00 – 07:59 (n=21)	
Age at surgery (years)	83.5 ± 7.5 (66-108)	84.3 ± 6.4 (67-97)	83.2 ± 7.4 (74-100)	0.58
Sex				0.27
Male	72 (29.8)	33 (31.7)	3 (14.3)	
Female	170 (70.2)	71 (68.3)	18 (85.7)	
Fracture type				0.17
Neck of femur	118 (48.8)	41 (39.4)	12 (57.1)	
Trochanteric fracture	124 (51.2)	63 (60.6)	9 (42.9)	
Type of surgery				0.35
Arthroplasty	92 (38.0)	32 (30.8)	6 (28.6)	
Fixation	150 (62.0)	72 (69.2)	15 (71.4)	
ASA class				0.36
1	20 (8.3)	10 (9.6)	2 (9.5)	
2	69 (28.5)	24 (23.1)	4 (19.0)	
3	152 (62.8)	69 (66.3)	15 (71.4)	
4	1 (0.4)	1 (1.0)	0	
Surgeon's qualification				0.21
Non-specialist	6 (2.5)	1 (1.0)	1 (4.8)	
Non-specialist with supervision	36 (14.9)	7 (6.7)	4 (19.0)	
Specialist	200 (82.6)	96 (92.3)	16 (76.2)	
No. of surgeon(s)				0.02
1	85 (35.1)	47 (45.2)	10 (47.6)	
2	127 (52.5)	52 (50.0)	11 (52.4)	
3	26 (10.7)	5 (4.8)	0	
4	4 (1.7)	0	0	
Mortality at 30 days	5 (2.1)	3 (2.9)	0	0.84
Complication	61 (25.2)	25 (24.0)	3 (14.3)	0.53

Abbreviations: ASA = American Society of Anesthesiologists; SD = standard deviation

the arthroplasty group (P=0.03), although mortality rate was similar.

Discussion

Bone density insufficiency is the leading cause of major musculoskeletal trauma following a fall in the aged population.¹⁷ In 2000, the number of hip fractures worldwide was about 1.6 million. By 2050, the projected number will reach 4.5 million, and more than 50% of osteoporotic hip fractures will occur in Asia.¹⁸

Encouragement of early surgery after hip fracture will result in unavoidable out-of-hours surgery because of busy daytime operating room schedules. Safety of surgery performed outside routine daytime working hours, however, has long been a controversial issue. Surgery performed after-hours may be under less-ideal conditions

with consequent poorer outcomes. This study was designed to assess if surgical outcomes for out-of-hours surgery significantly differ to those of daytime surgery.

In this study, patients were grouped according to the time of surgical incision. The normal shift in the operating theatre is 08:00 to 17:00. Surgeries performed after 17:00 and before 08:00 were considered out-of-hours. The time period correlates with the typical working hours and allows analysis based on a surgeon's routine practice. Demographic characteristics were comparable among the groups.

Outcomes of daytime and out-of-hours surgery

Mortality and complication rates were comparable between the daytime and night-time groups. Even after midnight, when a surgeon is thought to be

most affected by fatigue, there was no significant increase in complication rate or mortality. This was supported by a study in 2013 that showed no significant difference in postoperative complication rate or mortality rate after reviewing 220 dynamic hip screw surgeries in terms of their operating time.¹⁹ It concluded that out-of-hours surgery offers the benefit of early fixation and mobilisation, and hence may shorten the length of stay and reduce cost of treatment.¹⁹ Chacko et al¹⁴ also reported similar findings in 171 hip fracture patients with surgical intervention where mortality rate within 1 month and complication rate were comparable between the daytime and night-time groups. Switzer et al²⁰ studied the relationship between surgical time of day and outcome after hip fracture fixation. They identified more than 1400 hip fracture patients with surgical intervention. Time of surgery was treated as a continuous variable and showed no association with complication rate at any time period. The authors concluded that there was no difference in 30-day mortality or complications based on the time of surgery and suggested that early operation after normal operating room hours was safe and reasonable.²⁰

In addition, complex cases are generally scheduled for surgery during the daytime when more support can be obtained when needed. This may help explain the similar surgical outcomes among the groups. The comparable results for daytime and out-of-hours surgery shown in this study are supported by the literature suggesting that out-of-hours surgery is safe.

Mortality rate

The overall 30-day mortality rate was 2.2% in this study, lower than the 3.5% to 10% reported in the UK,¹⁷ as well as the 4.96% in a 1997 local study.²¹ The lower mortality rate in this study may be attributed to advancements in surgical technique and design of prostheses. The introduction of an ortho-geriatrician in managing hip fracture patients has also been proven to decrease mortality and complication rates.²²

Postoperative complication rate

Postoperative complications included chest infection and acute coronary syndrome. The effect of surgeon aspects on outcomes, however, was the main factor under investigation in this study. Thus, surgical outcome was defined as complications related to surgical procedure only. General complications were excluded. For surgical outcome, fall in haemoglobin level with the need for blood transfusion, wound infection, and implant infection were analysed.

The overall surgical complication rate was 24.2% in this study compared with previous reports

of 5% to 32% in hip fracture fixation.^{15,19,20,23,24} Nonetheless, different analyses and definitions of complication rate were used in these studies. Some studies defined complications as medical complications or unplanned return to the operating room,^{15,24} whereas others reported only wound infection, urinary tract infection, and deep vein thrombosis.¹⁹ Thus direct comparison with these studies was not possible. Further comparison of blood transfusion rate with previous studies was performed, as it represented the most common complication. The blood transfusion rate was 23.4% in this study, similar to the results in previous studies where transfusion after hip fixation ranged from 19% to 69%.²⁵ This may be due to incomplete reporting in the CMS as blood transfusion was not always noted in the discharge summary. Despite the difficulties in direct comparison of the complication rate with previous study, we suggest that the rate in this study was reasonable.

Number and qualification of surgeons

Significantly fewer surgeons were involved in out-of-hours surgery. This may be because training of junior staff commonly occurs during the daytime. Although fewer surgeons were involved in out-of-hours surgeries, this may be compensated by the experience of the surgeon since a larger proportion of out-of-hours surgeries was performed by a specialist. Nonetheless, the difference was not significant.

Furthermore, the qualification of the surgeon had no association with surgical outcomes in this study. This may be because cases were screened prior to allocation. Difficult and more complex cases would likely be operated on by a more experienced surgeon. Holt et al²⁶ showed comparable results in their study of the Scottish Hip Fracture Audit Database published in 2008. They studied more than 18000 patients and concluded that grade of surgeon did not significantly affect surgical outcome.²⁶

Strengths and limitations

This is the first local study based in a major hospital in Hong Kong to analyse the effect of operating time on surgical outcome. The out-of-hours group was split into before and after midnight so as to focus on surgeon fatigue. Analysis of surgeon expertise revealed that surgical outcome was not compromised by surgeon's qualification.

There are several limitations in this study. First, this was a retrospective study with no functional outcomes. Information on complications was retrieved from the CMS only which might not have recorded all complications. A fracture registry or prospective study with more representative complications including prosthetic dislocation, peri-prosthetic fracture, implant loosening,

fixation failure, malreduction, malfixation, and implant malposition is suggested in future. Data collection was performed by the authors who were not blinded so this might have introduced bias. Blood transfusion, the most common complication reported, was believed to be related to the operative procedure. Fall in haemoglobin level due to other causes, however, could not be excluded simply from details in the CMS. Second, the overall population size and the relatively smaller number of cases in the after-midnight group might not have the statistical power to show any difference. Further study with a larger sample size is suggested. Finally, several potential confounders were not investigated, for example, fractures were not classified according to stability and time to surgery. These factors may be associated with poorer outcome.

Conclusion

This study demonstrates similar outcomes of elderly patients with hip fracture in terms of mortality and postoperative complications for daytime and out-of-hours surgery. Qualification and number of surgeons involved were not associated with outcome. To facilitate better outcome with early operation, out-of-hours surgery remains a safe option and the only means to overcome limited resources.

Declaration

All authors have disclosed no conflicts of interest.

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