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Acceptable time of surgical delay for hip fracture surgery in elderly patients: comparison between American Society of Anaesthesiologists physical status classes I–II versus classes III–IIV

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ABSTRACT

Background: Elderly patients with high American Society of Anaesthesiologists (ASA) physical status (classes III–IV) have higher reported postoperative mortality for hip fracture. Whether the acceptable time of surgical delay among patients with high ASA scores (classes III–IV) and those with low ASA scores (classes I–II) is different has not been clearly investigated.
Methods: A retrospective cohort study was conducted on 2,035 patients aged ≥60 years who underwent hip fracture surgery between January 2005 and December 2020. The 1-year mortality rate was compared between patients with waiting times beyond the indexed day versus those within the indexed day of 1 to 5. The least time point detecting a significant difference was considered the acceptable time of surgical delay.
Results: There were 1,099 cases (54.0%) in the high ASA group. In the low ASA group, the 1-year mortality rate was significantly lower than the high ASA group (3.5% versus 6.5%, p=0.003), and patients with a waiting time >4 days had a higher mortality rate than those receiving surgery ≤4 days (5.4% vs. 1.8%, OR 2.98, 95%CI 1.40–6.34, p=0.003). For the high ASA group, patients with a waiting time >2 days had a higher mortality rate than those receiving surgery ≤2 days (7.2% versus 3.1%, OR 2.31, 95% CI 1.01–5.25, p=0.036).
Conclusions: The elderly with hip fractures in ASA classes I–II could wait for surgery up to 4 days and 2 days in ASA classes III–IV without a significantly increased 1-year mortality.

Keywords: Surgical delay, Hip fracture, Elderly, ASA physical status

INTRODUCTION

Hip fractures in elderly patients are serious problems that can lead to immobility, permanent dependence, deteriorating quality of life, and a financial burden for the health care system.[1] Surgery is the treatment of choice for these patients and should be performed as soon as possible to reduce post-injury mortality. However, surgical delays frequently occur, and reasons for these include the time taken to improve the medical condition before the operation, the lack of available resources, and organizational-administrative problems.[2,3] The impact of the timing of surgery for hip fractures in the elderly has been widely studied, but the association between the delay to surgery and postoperative mortality remains controversial. There is disagreement on the maximum amount of time that can pass before surgery, after which the mortality rate significantly increases. Some systematic reviews and meta-analyses reported lower mortality rates when surgery was carried out within 2 days.[1,4] Others failed to find a negative association between a delay of surgery more than 2 days and mortality.[5,6] Likewise, several studies showed that there was no increased mortality rate when the surgery was delayed up to 3 days, 4 days, 5 days, or even 7 days.[2,7-14]

The American Society of Anaesthesiologists (ASA) physical status is a tool commonly used to classify a patient's physical fitness preoperatively and is regarded as a scale to predict risk.[15] It categorizes patients into 5 classes: I, normally healthy patient; II, patient with mild systemic disease; III, patient with severe systemic disease; IV, patient with severe systemic disease that is a constant threat to life; and V, moribund patient.[16] Patients with high ASA scores (ASA classes III–IV) have higher reported mortality after surgery for hip fracture.[2,14,17-19] However, whether the acceptable waiting time to surgery among patients with high ASA scores (ASA classes III–IV) and those with low ASA scores (classes I–II) is different has not been clearly investigated. A nationwide Swedish cohort study revealed an increase in 4-month mortality for patients who waited more than 24 hours for surgery only among patients with ASA classes III–IV.[18] There was no association between waiting time longer than 24 hours and mortality for healthier patients (ASA classes I–II) with hip fracture. A strict waiting time applied to all patients may not be the best rationale.[18] We hypothesize that patients with ASA classes I–II should have a longer acceptable waiting time than those with ASA classes III–IV. This study aimed to determine the acceptable time of surgical delay among elderly patients with hip fractures in ASA classes I–II and those in ASA classes III–IV.

METHODS

A retrospective cohort study was conducted on the patients aged ≥60 years old with hip fractures who underwent surgery between January 2005 and December 2020 at Lampang Hospital, a tertiary referral hospital in northern Thailand. The exclusion criteria were patients with metastatic cancer or multiple injuries. The medical charts were reviewed. Demographic data included age, gender, ASA class, co-morbidities, type of fracture (intra- or extracapsular), and type of operation (fixation or replacement). The waiting time for surgery was calculated from the time of admission to the time of operation. This time period was divided into 6 groups: 1 day (0–24 hours), 2 days (25–48 hours), 3 days (49–72 hours), 4 days (73–96 hours), 5 days (97–120 hours), and ≥ 5 days (≥120 hours).

The primary outcome was 1-year mortality. The patient's death was confirmed in the database of the National Health Security Office. The secondary outcome was 30-day postoperative complications, including cardiac complications (myocardial infarction and congestive heart failure), pneumonia, urinary tract infection, pressure sore, and venous thromboembolism. The data were analyzed using descriptive statistics. Demographic data, postoperative complications, and the 1-year mortality rate were compared between the low ASA group (classes I–II) and the high ASA group (classes III–IV) using the t-test, Mann-Whitney U test, and Fisher's exact test. To verify the acceptable waiting time for surgery, the 1-year mortality rate was compared between patients with waiting times greater than 1 day and those with waiting times within 1 day (>1 day versus ≤1 day) using Fisher's exact test and univariate logistic regression analysis. This analysis was repeated for the longer time points as follows: >2 days versus ≤2 days, >3 days versus ≤3 days, >4 days versus ≤4 days, and >5 days versus ≤5 days. The least time point detecting a statistically significant difference was considered the acceptable waiting time for surgery. The level of significance was set at p <0.05. All statistical analyses were performed using STATA version 13.0 (Stata Corp LLC, College Station, USA).

The sample size calculation aimed to estimate the 1-year mortality rate as the infinite population proportion. According to our pilot study during 2019–2020, the 1-year mortality rate after hip fracture surgery was 5%. We considered the maximum tolerated error determined by a researcher to be 1% (0.01). Using the formula for estimating the infinite population proportion, with a type I error level of 0.05, the sample size was 1,825 cases.[20]

RESULTS

Between January 2005 and December 2020, there were 2,136 elderly patients with hip fractures receiving surgery at our hospital. Seventy-five cases of multiple fractures and 26 cases of pathologic fractures were excluded. Thus, 2,035 patients were enrolled in the study. The mean age was 75.2±8.9 years, and 1,410 cases (69.3%) were female. There were 936 cases (46.0%) classified in the low ASA group and 1,099 cases (54.0%) in the high ASA group (Table 1). The overall 30-day postoperative complication rate was 4.6% (94 cases), and the 1-year mortality rate was 5.1% (104 cases).

The mean age in the low ASA group (71.8±8.5 years, range 60–95) was less than the high ASA group (78.1±8.2 years, range 60–106, p<0.001). The low ASA group had a lower proportion of females than the high ASA group (66.0% vs. 72.1%, p=0.003), as well as lower co-morbidities, including DM, COPD, and coronary artery disease (p<0.001). The median waiting time for surgery in the high ASA group was 4 days (IQR 3, 7) and that of the high ASA group was 5 days (IQR 3, 7) (p=0.008). Most hip fractures in the low ASA group were intracapsular fractures (64.6%), and in the high ASA group they were extracapsular fractures (81.0%, p<0.001). Most patients in the low ASA group underwent hip replacement surgery (58.2%), and in the high ASA group, they underwent internal fixation (84.9%, p<0.001) (Table 2). All patients with 30-day postoperative complications had a waiting time of ≥ 9 days. The 30-day postoperative complications were not different between the two groups, except for the pressure sore, which was found in 1.0% of the patients in the low ASA group and 0.2% of the patients in the high ASA group (p=0.029). The 1-year mortality rate was significantly lower in the low ASA group than the high ASA group (3.5% versus 6.5%, p=0.003). When analyzing the acceptable waiting time in the low ASA group, the mortality rate was not different in the comparison of >1 day versus ≤1 day,>2 days versus ≤2 days, and >3 days versus ≤3 days (p=0.788, 0.398, and 0.066 respectively). However, patients with waiting time over 4 days had a higher mortality rate than those receiving surgery within 4 days (5.4% versus 1.8%, OR 2.98, 95% CI 1.40–6.34, p=0.003), similarly with waiting time over 5 days (5.7% versus 2.1%, OR 2.69, 95% CI 1.34–5.40, p=0.005) (Table 3). Thus, the least time point for detecting a statistically significant difference was 4 days, which was considered the acceptable waiting time in the ASA classes' I–II group. For the high ASA group, patients with waiting time over 2 days had a higher mortality rate than those receiving surgery within 2 days (7.2% versus 3.1%, OR 2.31, 95% CI 1.01–5.25, p=0.036), similarly with waiting time over 3 days (8.0% versus 3.3%, OR 2.39, 95% CI 1.30–4.40, p=0.003), 4 days (8.9% versus 3.7%, OR 2.43, 95% CI 1.46–4.06, p<0.001), and 5 days (8.6% versus 4.9%, OR 1.77, 95% CI 1.13–2.79, p=0.013) (Table 4). Regarding the least time point with a significant difference, 2 days was considered the acceptable waiting time for surgery in the ASA classes III–IV group.

Table 1: Demographic data and postoperative outcomes among 6 different waiting times for surgery (N=2,035).

Data	Waiting time to surgery (hours)						Total
	≤24	25-48	49-72	73-96	97-120	≥121	
Number of patients N (%)	190 (9.3)	210 (10.3)	313 (15.4)	298 (14.7)	192 (9.4)	832 (40.9)	2,035 (100)
Age (year) mean±SD	72.4±9.1	77.4±8.3	75.8±9.1	75.3±8.9	76.6±8.6	74.7±9.0	75.2±8.9
Female N (%)	121 (63.7)	157 (74.8)	212 (67.7)	212 (71.1)	139 (72.4)	569 (68.4)	1,410 (69.3)
Co-morbidities N (%)							
DM	9 (4.7)	13 (6.2)	27 (8.6)	34 (11.4)	18 (9.4)	129 (15.5)	230 (11.3)
Dementia	5 (2.6)	4 (1.9)	7 (2.2)	13 (4.4)	5 (2.6)	28 (3.4)	62 (3.1)
COPD	7 (3.7)	5 (2.4)	16 (5.1)	10 (3.4)	7 (3.6)	31 (3.7)	76 (3.7)
Coronary artery disease	6 (3.2)	6 (2.9)	4 (1.3)	6 (2.0)	6 (3.1)	45 (5.4)	73 (3.6)
ASA classes I-II N (%)	115 (60.5)	92 (43.8)	146 (46.6)	141 (47.3)	73 (38.0)	369 (44.4)	936 (46.0)
Extracapsular Fx N (%)	79 (41.6)	149 (71.0)	206 (65.8)	187 (62.8)	130 (67.7)	470 (56.5)	1,221 (60.0)
Hip replacement N (%)	81 (42.6)	48 (22.9)	91 (29.1)	96 (32.2)	56 (29.2)	339 (40.7)	711 (34.9)
30-day complication N (%)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	94 (11.3)	94 (4.6)
1-year mortality N (%)	6 (3.2)	5 (2.4)	8 (2.6)	9 (3.0)	15 (7.8)	61 (7.3)	104 (5.1)

Table 2: Demographic data and postoperative outcomes comparison between the ASA classes I–II group and the classes III–IV group.

Data	ASA classes I-II (N=936)	ASA classes III-IV (N=1,099)	P value
Age (year) mean±SD	71.8 ± 8.5	78.1 ± 8.2	<0.001
Female N (%)	618 (66.0)	792 (72.1)	0.003
Co-morbidities N (%)			
DM	77 (8.2)	153 (13.9)	<0.001
Dementia	32 (3.4)	30 (2.7)	0.369
COPD	12 (1.3)	64 (5.8)	<0.001
Coronary artery disease	7 (0.7)	66 (6.0)	<0.001
Waiting time to surgery, median (IQR)	4 (3,7)	5 (3,7)	0.008
Extracapsular fracture N (%)	331 (35.4)	890 (81.0)	<0.001
Hip replacement N (%)	545 (58.2)	166 (15.1)	<0.001
30-day complication N (%)	44 (4.7)	50 (4.5)	1.212
Pressure sore	9 (1.0)	2 (0.2)	0.029
Pneumonia	18 (1.9)	17 (1.5)	0.609
Cardiac complications	0 (0)	2 (0.2)	0.503
Urinary tract infection	16 (1.7)	27 (2.5)	0.280
Venous thrombo-embolism	1 (0.1)	2 (0.2)	1.000
1-year mortality N (%)	33 (3.5)	71 (6.5)	0.003

Table 3: Postoperative 1-year mortality rate of elderly patients in the ASA classes I–II group, comparison between surgery beyond versus surgery within the indexed 5-day waiting time period (N=936).

Comparative waiting time	1-year mortality, N (%)	Adjusted odds ratio	95% CI	P value
>1 day versus ≤1 day	30/821 (3.7%) versus 3/115 (2.6%)	1.40	0.43 – 4.51	0.788
>2 days versus ≤2 days	28/729 (3.8%) versus 5/207 (2.4%)	1.59	0.62 – 4.07	0.398
>3 days versus ≤3 days	26/583 (4.5%) versus 7/353 (2.0%)	2.24	0.99 – 5.13	0.066
>4 days versus ≤4 days	24/442 (5.4%) versus 9/494 (1.8%)	2.98	1.40 – 6.34	0.003
>5 days versus ≤5 days	21/369 (5.7%) versus 12/567 (2.1%)	2.69	1.34 – 5.40	0.005

Table 4: Postoperative 1-year mortality rate of elderly patients in the ASA classes III–IV group, comparison between surgery beyond versus surgery within the indexed 5-day waiting time period (N=1,099).

Comparative waiting time	1-year mortality, N (%)	Adjusted odds ratio	95% CI	P value
>1 day versus ≤1 day	68/1024 (6.6%) versus 3/75 (4.0%)	1.66	0.53 – 5.15	0.472
>2 days versus ≤2 days	65/906 (7.2%) versus 6/193 (3.1%)	2.31	1.01 – 5.25	0.036
>3 days versus ≤3 days	59/739 (8.0%) versus 12/360 (3.3%)	2.39	1.30 – 4.40	0.003
>4 days versus ≤4 days	52/582 (8.9%) versus 19/517 (3.7%)	2.43	1.46 – 4.06	0.001
>5 days versus ≤5 days	40/463 (8.6%) versus 31/636 (4.9%)	1.77	1.13 – 2.79	0.013

DISCUSSION

This study demonstrated that elderly hip fracture patients in the ASA classes I–II group had longer acceptable waiting times for surgery than those in the ASA classes III–IV. Surgery could be delayed by up to 4 days for patients with ASA physical status classes I–II without significantly increasing the 1-year mortality rate. However, ASA classes III–IIV patients should not put off surgery for longer than two days in order to prevent an increase in 1-year postoperative mortality. It is possible that the effects of surgical postponement may vary between healthy and ill patients.

As surgery is frequently delayed due to the time needed to clear patients for the procedure, it is probable that the higher mortality rate associated with surgical delays is caused by the causes of the delay rather than the delay itself. Delaying surgery is less difficult for healthy, independent patients than for those with comorbidities. However, comorbid patients could be given priority and undergo early surgery if staff and operating room availability are limited, provided they do not have any obvious surgical contraindications.

Our results in elderly patients with ASA classes I–II were in agreement with a number of previous studies. Lizaur-Utrilla et al's prospective research of 628 patients found no correlation between postponing surgery by up to 4 days and a higher 1-year mortality rate.[9] Of these, 343 cases (55%) were classified as ASA I–II, and the primary factor in the postponement of surgery was an ongoing medical condition that was co-managed by medical internists and surgeons. According to a prospective study by Moran et al that included 2,660 patients, the 1-year mortality rate was not increased when surgery was delayed by up to 4 days for patients who were healthy enough for hip fracture surgery and were generally believed to be in the low ASA group.[8] In a retrospective study by Kim and colleagues, 317 cases (63%) of 506 elderly patients fell into ASA classes I–II.[4] They proved that postponing surgery by more than seven days had no relation to 30-day postoperative mortality or complications. Although patients from ASA classes I to IV were included in the study populations in these three literatures, patients with ASA classes I–II who were fit enough for surgery or had few co-morbid conditions made up the majority. To our knowledge, there are no publications in which patients in ASA classes I–II make up the whole population. This provided evidence that delaying surgery by four days can reduce postoperative mortality.

Among patients with ASA classes III–IV, our study revealed that a 2-day waiting period before surgery was acceptable. This was in accordance with a retrospective analysis of 841 cases by Bennett et al.[17]

630 of these (or 75%) were ASA classes III–IV. They discovered that postponing surgery by more than two days was associated with a significant increase in intrahospital mortality. Similarly, a recent systematic review and meta-analysis discovered that patients with waiting times of less than two days significantly reduced their risk of 1-year mortality.[1] However, it was not made clear how many patients were in ASA classes III–IV.

On the other hand, Muhm et al carried out prospective research with 138 patients, 88% of whom were in ASA classes III–IV.[21] They showed that a two-day delay in surgery has no impact on mortality after one year. Additionally, they performed retrospective research on 136 patients, 117 of whom (86%) were in ASA classes III–IV.[22] They found that a delay in surgery of up to 7 days has no adverse effects on 1-year mortality. Likewise, in a prospective study by Al-Ani et al, 63% of the 740 patients had ASA classes III–V.[23] They showed that a surgery waiting period of more than two days does not raise mortality at four months.

The overall 1-year postoperative mortality rate of in this study was 5.1%, which was comparable to studies conducted in Bangkok, Thailand (6.1%) and Chiang Mai, Thailand (10%), as well as 5.5% in Japan and 9.5% in South Korea.[24-27] It was nevertheless less than the 16.8% recorded rate in Taiwan and Hong Kong.[28,29] Whereas in the Western population, postoperative mortality rates ranged from 8% to 30%.[9,10,13,30-32] The reason for this mortality disparity is unclear. Racial differences may be the cause of these variations, as evidenced by the fact that Western patients have a higher rate of cardiac morbidity than Thai or Asian patients.[14]

The overall 30-day postoperative complication rate in this study was 4.6%, whereas earlier studies reported a 30-day complication rate of 10.8–39.5%.[9,13,14,17,30,33] With a waiting period of 1 to 8 days, we did not find any postoperative complications in any patient.

We adopted the rigorous criteria that the condition must first manifest after surgery, which may account for the low complication rate. Myocardial infarction, congestive heart failure, pneumonia, and urinary tract infections were among the disease problems identified and treated before surgery but were not included in our study as postoperative complications.

Limitation

This study had some limitations. First, it was a retrospective design and therefore could not cover all aspects of complications. The core outcomes set for clinical evaluation of patients with a hip fracture, such as pain score, activities of daily living, mobility score, and health-related quality of life, were not assessed.[34] Second, we did not collect the 30-day postoperative mortality data because its rate is low (1%) in the Thai population.[24] We assessed only one year because this is the maximum follow-up period mostly used in previous studies under the presumption that mortality after this time is comparable to that of the general population of a similar age and not due to fracture.[1] However, to the best of our knowledge, this study followed up on the largest cohort of elderly individuals in Thailand who had hip fracture surgeries. It is also the first study to compare the 1-year postoperative mortality of patients with high ASA classes against patients with low ASA classes. Our results do not devalue the standard practice that older patients with hip fractures should undergo surgery as soon as they are well enough. However, the decision should not be made solely based on a strict reference point for the scheduling of surgery but rather on an adequate evaluation and the patient's medical readiness. It seems advisable to postpone surgery for the optimization of a medical illness.

CONCLUSION

The elderly with hip fractures in ASA classes I–II could wait for surgery up to 4 days and 2 days in ASA classes III–IV without a significantly higher death rate within 1 year. In the event of surgical and operating room management limitations, ASA classes III–IV should take precedence over ASA classes I–II.

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