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Original Article

Efficacy of early surgery and causes of surgical delay in patients with hip fracture

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ARTICLE INFO

Article history:

Received 13 October 2014

Accepted 4 January 2015

Available online 28 February 2015

Keywords:

Hip fracture

Surgical delay

Mortality

ABSTRACT

Background: Whether early surgery for hip fractures is effective remains controversial. The current Japanese medical system poses some constraints on conducting early surgery. We examined the usefulness of early surgery and factors that delay surgery in patients with hip fractures treated at our hospital.

Methods: Among 314 patients aged ≥ 60 years treated for hip fractures since January 2006, 270 patients (55 men, 215 women; mean age 84.1 years; femoral neck fracture in 111, trochanteric fracture in 159) who underwent surgery were studied. They were divided into an early surgery group (surgery up to 1 day after admission) and a delayed surgery group (later than 1 day). Clinical parameters analyzed included age, gender, pre-injury residence, pre-injury ambulatory ability, admission during public holiday, fracture site, fracture type, blood tests and urinalysis at admission, chest radiography, electrocardiography, number of systemic chronic diseases, dementia, surgical modality, blood transfusion, length of hospital stay, ambulatory ability at discharge, and hospital death. After performing univariate analysis between two groups, the parameters that were identified as significant were further tested by multivariate analysis.

Results: Among 270 patients treated for hip fracture, 112 patients (41.5%) received early surgery. Multivariate analysis identified admission during public holiday, electrocardiographic abnormalities, femoral head replacement, and length of hospital stay as significant independent factors.

Conclusion: The causes of surgical delay were admission during public holiday, electrocardiographic abnormalities, and femoral head replacement. Although length of hospital stay was shorter in patients with early surgery, there was no difference in outcome.

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<http://dx.doi.org/10.1016/j.jor.2015.01.013>

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1. Introduction

The functional outcome of hip fracture has improved over the years. Nevertheless, only approximately 50% of the patients regain motor functions to the same extent as before injury.¹ In elderly patients, mortality increases with aging and the prognosis is poor.² A national survey in Japan showed that 94% of the patients with hip fracture undergo surgical treatment.³ However, whether surgery conducted early after admission is beneficial and the factors causing surgical delay remain controversial. Some investigators observed a positive effect of early operation on the mortality rate,^{4–10} whereas others reported a higher mortality rate for operations conducted within 24 h¹¹ and 72 h.¹² Many more do not find any effect of early surgery on the mortality rate.^{13–20} In addition, the current Japanese medical system poses some constraints on conducting early surgery to the same extent as in European and American countries. Moreover, our search of literature found almost no detailed report on the factors that delay surgery.²¹ In the present study, we investigated patients with hip fractures treated at our hospital, and examined the usefulness of early surgery as well as the causes of surgical delay.

2. Patients and methods

We performed a retrospective analysis of data from the surgical database at our hospital. Among 314 patients aged 60 years or above who were treated for hip fractures at our hospital between January 2006 and June 2012, 270 patients who underwent surgery were enrolled in this study. Our hospital is a self-contained regional hospital with an orthopedic department and an in-hospital rehabilitation facility, which provides care for patients with acute injury. However, we do not have an affiliated rehabilitation or a long-term care facility.

The subjects comprised 55 men (20.4%) and 215 women (79.6%). The ages at injury ranged from 60 to 101 years (mean 84.1 years). The fracture type was femoral neck fracture in 111 patients (41.1%) and trochanteric fracture in 159 patients (58.9%). Our treatment strategy for hip fracture is to perform surgery as early as possible. In principle, osteosynthesis is conducted for undisplaced femoral neck fracture, femoral head replacement for displaced femoral neck fracture, Twin Hook system²² or compression hip screw for stable trochanteric fracture, and osteosynthesis using short femoral nail for unstable trochanteric fracture. The 270 patients underwent surgeries comprising femoral head replacement in 50 and open reduction and fixation in 220. The internal fixation devices used were the compression hip screw (for osteosynthesis) in 5 patients, Twin Hook in 122, Hansson pin in 59, Gamma Nail in 31, and cannulated cancellous hip screw in 3.

The subjects were divided into an early surgery group in which surgery was conducted on the same day or on the next day of admission (day 0–1), and a delayed surgery group in which surgery was conducted later (day 2 or later). We selected surgery up to day 1 after admission as early surgery because in most studies, early intervention is defined as surgery performed within 24 h after admission or injury.¹³

Next, we analyzed 23 parameters as potential factors that delay surgery or affect postsurgical outcome: age at admission, gender, pre-injury residence, pre-injury ambulatory ability, day of admission (admission during weekend/public holiday), fracture site (femoral neck fracture or trochanteric fracture), fracture type (stable or unstable type), results of blood tests and urinalysis at admission, chest radiographic abnormalities, electrocardiographic abnormalities, number of systemic chronic diseases,²³ status of dementia, surgical modality (osteosynthesis or femoral head replacement), status of blood transfusion, postoperative complication (requiring treatment by specialists other than orthopedic surgeon), length of hospital stay, ambulatory ability at discharge, and hospital death (Table 1).

First a univariate analysis on the above clinical factors was conducted to identify factors that differ significantly between the early surgery and delayed surgery groups. Then multivariate analysis by logistic regression was conducted using the parameters showing significant difference ($p < 0.05$) in univariate analysis as independent variables. Statistical analyses were conducted using StatView 5.0. A p value less than 0.05 was considered statistically significant.

3. Results

Among 270 patients who underwent surgery for hip fracture, 112 patients (41.5%) had early surgery and the largest number (69 patients) had surgery on day 1 after admission (Fig. 1).

Univariate analysis showed significant differences between early surgery and delayed surgery groups in 12 parameters: pre-injury residence, pre-injury ambulatory ability, admission during weekend or public holiday, fracture site, fracture type, anemia, electrolyte abnormalities, electrocardiographic abnormalities, surgical modality, length of hospital stay, and ambulatory ability at discharge (Table 2).

Multivariate analysis identified admission during weekend or public holiday [odds ratio (OR) = 5.51797, $p = 0.00005$], electrocardiographic abnormalities (OR = 4.34595, $P = 0.00003$), surgical mode (femoral head replacement: OR = 21.4482, $P = 0.00065$), length of hospital stay (OR = 1.02911, $P = 0.00435$) as significant independent factors for delayed surgery (Table 3).

4. Discussion

Whether surgery conducted early after admission is effective for hip fracture remains controversial.^{21,24} A recent systematic review and meta-analysis conducted by Simunovic et al²⁵ showed that earlier surgery was associated with a lower risk of death and lower rates of postoperative pneumonia and pressure sores among elderly patients with hip fracture. These results suggest that reducing delays may reduce mortality and complications. Moja et al²⁶ also concluded that surgical delay is associated with a significant increase in the risk of death and pressure sores. Furthermore, the systematic review of Khan et al²⁷ also led to a conclusion that early surgery (within 48 h of admission) after a hip fracture reduces hospital stay and may also reduce complications and

Table 1 – Parameters analyzed.

1	Age	
2	Gender	Male
3	Residence before injury	Nursing home/hospital or own home
4	Ambulatory ability before injury	Can walk unaided/with cane
5	Day of admission	Weekend/public holiday
6	Fracture site	Femoral neck or trochanteric fracture
7	Fracture type	Stable or unstable
8	Anemia	Hemoglobin 12 g/dl or lower for men, 11 g/dl or lower for women
9	Liver function	GOT 40 IU/l or above, GPT 35 IU/l or above
10	Renal function	BUN 20 mg/dl or above
11	Electrolyte abnormality	Abnormalities in Na, K and Cl levels
12	Inflammation status	C-reactive protein 0.5 mg/dl or above
13	Urinary glucose	Positive
14	Lung function	Abnormal chest X ray and with a medical diagnosis
15	Heart function	Abnormal ECG (arrhythmia, ischemic changes, etc.)
16	Chronic systemic disease ^a	Presence or absence of diabetes, congestive heart failure, ischemic heart disease, etc.
17	Dementia	Present
18	Surgical modality	Osteosynthesis or femoral head replacement
19	Blood transfusion	With or without
20	Postoperative complication	Transfer to other specialties due to severe pneumonia, etc.
21	Length of hospital stay	
22	Ambulatory ability at discharge	Can walk unaided/with cane
23	In-hospital death	

GOT: glutamate oxaloacetate transaminase; GPT: glutamate pyruvate transaminase; BUN: blood urea nitrogen; ECG: electrocardiogram.

^a Eleven diseases as described previously.²³

mortality. In Japan, the Clinical Practice Guidelines for Femoral Neck/Trochanteric Fractures (2nd edition) recommends surgery as early as possible, with the following comment. An increasing number of studies have shown that although emergency surgery within 24 h is not required, surgery should be conducted as early as possible, except in the case that surgery is delayed by medical complications. In Japan, the effectiveness of early surgery has also been reported, but the current Japanese medical system poses some constraints on conducting early surgery to the same extent as

in European and American countries.²⁸ A recent analysis in Japan using the Japanese Diagnosis Procedure Combination Database reported that surgical delays of 5 days or more were significantly associated with higher rates of in-hospital mortality.²⁹ The above findings thus indicate that for operable patients, surgery should be conducted as early as possible without waiting. However, in the present study, although the length of hospital stay was significantly shorter in the early surgery group, there were no significant differences in post-operative complications, ambulatory ability at discharge, and in-hospital mortality between the early surgery and delayed surgery groups, indicating no difference in postsurgical outcome between two groups. Some possible explanations for this result are that the study was a single-center study and that no post-discharge follow-up was conducted.

Vidan et al²¹ investigated the reasons for surgical delays longer than 48 h, and reported that the most frequent causes for delay were lack of an available operating room for programmed surgery (60.7%) and acute medical reasons (33.1%) including the need to interrupt antiplatelet treatment, need for echocardiography or other examinations, and clinical instability. Consistent with their finding that need for echocardiography was a cause, we found that electrocardiographic abnormality was a factor of surgical delay. These findings thus indicate a possibility that impaired cardiac function is a cause of surgical delay. However, this is a factor of the patient's side and cannot be controlled.

The present study identified admission during public holiday and femoral head replacement as independent risk factors of surgical delay. On the other hand, Daugaard et al³⁰ reported that the mortality rate for patients admitted during weekends or public holidays, or at night, was similar to that

Fig. 1 – Duration from admission to surgery.

Table 2 – Results of univariate analysis.^a

	Early surgery (n = 112)		Delayed surgery (n = 158)		p
	n	(%)	n	(%)	
Mean age (yrs)	86.5 ± 7.9		82.4 ± 8.4		0.00002
Males	17	15.2	38	24.1	0.07452
Residence before injury (institution/hospital)	42	37.5	33	20.9	0.00267
Can walk unaided/with cane before injury	97	86.6	149	94.3	0.02856
Admission in weekend/public holiday	13	11.6	48	30.4	0.00028
Femoral neck fracture	26	23.2	85	53.8	<0.00001
Unstable fracture	34	30.4	80	50.6	0.00089
Anemia	61	54.5	57	36.1	0.00269
Liver dysfunction	17	15.2	25	15.8	0.88558
Renal dysfunction	45	40.2	49	31.0	0.11931
Electrolyte abnormalities	59	52.7	58	36.7	0.00908
Presence of inflammatory finding	65	58.0	98	62.0	0.50904
Positive urine glucose test	22	19.6	26	16.5	0.49975
Presence of pulmonary disease	14	12.5	21	13.3	0.84878
Cardioelectrographic abnormalities	55	49.1	103	65.2	0.00823
Number of systemic chronic diseases	1.9 ± 1.6		1.8 ± 1.4		0.39961
Presence of dementia	52	46.4	58	36.7	0.10927
Surgery mode: femoral head replacement	2	1.8	48	30.4	<0.00001
Received blood transfusion	19	17.0	24	15.2	0.69463
Postoperative complications	7	6.3	3	1.9	0.09850
Length of hospital stay (days)	27.5 ± 17.3		39.7 ± 19.9		<0.00001
Walking unaided/with cane at discharge	27	24.1	76	48.1	0.00006
Hospital death	2	1.8	2	1.3	0.72755

^a Mann–Whitney's U test, Chi-square for independence test, Fisher's exact probability test.

Table 3 – Results of multivariate analysis by logistic regression.

Factor	Adjusted odds ratio	95% confidence interval		p
		Lower	Upper	
Age	0.95972	0.91955	1.001	0.05955
Pre-injury residence	1.17401	0.52218	2.639	0.69793
Ambulatory before injury	0.64642	0.20489	2.039	0.45671
Admission during weekend or holiday	5.51797	2.42212	12.57	0.00005
Femoral neck fracture	0.62619	0.28701	1.366	0.23958
Unstable fracture	1.03267	0.49525	2.153	0.93167
Anemia	1.45505	0.75451	2.806	0.26302
Electrolyte abnormalities	1.91823	0.99671	3.691	0.05116
Electrocardiographic abnormalities	4.34595	2.18354	8.649	0.00003
Femoral head replacement	21.4482	3.68456	124.8	0.00065
Length of hospital stay	1.02911	1.00901	1.049	0.00435
Ambulatory at discharge	1.19902	0.54084	2.658	0.65499

found for those admitted during working days. Admission during public holiday and selection of the surgical option of femoral head replacement are factors of the medical care provider's side, and may be factors specific to the Japan. These findings suggest a need to reflect on the current practice. In the future, reform of the hospital system to remove factors of the medical care provider's side may improve outcome of patients undergoing surgery for hip fracture. Reform of the medical system has to be addressed.

The weaknesses of this study include the retrospective design and that only short-term outcome was examined. Another issue is that this study only examined the duration from admission to surgery, and did not consider the duration

from injury to admission. More comprehensive studies investigating also long-term outcomes are required.

Ethical standards

The study was authorized by the Ethical Committee of our hospital. The Ethical Committee endorsed that individual patient consent was not required due to full anonymity of the patients included in the study and the retrospective study design. The study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki as revised in 2000.

Conflicts of interest

All authors have none to declare.

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