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## FACTORS AFFECTING THE INCIDENCE OF SURGICAL SITE INFECTIONS AFTER GERIATRIC HIP FRACTURE SURGERY: A RETROSPECTIVE STUDY DURING 2017-2020

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### ABSTRACT

**INTRODUCTION.** Geriatric hip fracture are a common and disruptive public health problem worldwide. Surgical Site Infection (SSI) can be a devastating complication of this injury. By identifying these factors, the adverse outcomes of elderly hip fractures can be prevented. The objective of this study was to identify factors affecting the incidence of surgical site infection after geriatric hip fracture surgery.

**METHODS.** In this retrospective study, 440 patients (60 years or older) underwent hip surgery at Imam Khomeini Hospital Complex were selected based on census between April 2017 and March 2020. Demographics information, and additional comorbidities and operation-related variables were extracted and analyzed. Data analyses were performed by descriptive statistics and inferential statistics. SPSS-19 software was used in this study and P values less than 0.05 were considered significant.

**RESULTS.** The results of univariate analyzes showed that the type of surgery ( $p=0.005$ ), readmission ( $p=0.0001$ ) and level of self-care ( $p=0.001$ ) were significantly associated with Surgical Site Infection (SSI). The results of regression analysis showed that history of readmission and self-care at all levels on SSI.

**CONCLUSION.** The findings showed that the history of readmission and self-care at all levels is effective on SSI in the elderly with hip fractures. Therefore, it can be concluded that by identifying the factors affecting the SSI with hip fractures, fewer acute complications, reduced death and shorter length of hospital stay.

**Keywords:** *hip fracture, elderly, outcome, mortality, SSI*

### INTRODUCTION

Hip fracture is known as one of the most common and debilitating public health problems worldwide. Given its high mortality and morbidity rates, this disorder is also a major challenge facing health care systems and the society (1). In this sense, hip fracture is the most prevalent injury occurring in the elderly population in each society, affecting 350,000 people in the United States each year (2), and its prevalence rate has been estimated at 615,000 cases in Europe in 2010, and predicted to be 815,000 people in 2025. Of note, one year after a fracture, most patients undergo a sharp decline in their quality of life, and

the mortality rate in this group is 36% (3). No specific statistics have been thus far reported in this regard in Iran, however, the prevalence rate of hip fracture, according to a study conducted in 2006, has been 115.2 and 115.6 in men and women (per 100,000 people per year), respectively (4).

Identifying the common factors contributing to this injury, reflecting on the high costs associated with a prolonged hospital stay due to a hip fracture, as well as taking some measures to reduce them can thus help in minimizing health care expenditures, and consequently boost patient satisfaction (2).

Surgical site infections (SSIs), as the most common post-operative complications, are one of the significant

factors increasing the average length of hospital stay (ALOS), mortality rates, and health care costs in patients with hip fractures (5). Approximately 234 million surgeries to repair hip fractures are annually performed across the world, of which 3.16% are associated with complications, and SSIs are the most common ones. Orthopedic surgeries using appropriate prostheses are also known methods of pain reliefs in patients with joint disorders, are associated with 1.5% of the complications of SSIs (7), although the statistics obtained through telephone reports by patients after surgery are 6.7% (8).

More caution should be accordingly taken in comparing the prevalence rates of SSIs occurring in hospitals, due to the discrepancies in the number of patients, use of different hospital monitoring processes, sensitivity in finding the cases, medical methods adopted, etc. (7). In view of that, a fair comparison of the rates of SSIs in hospitals is required to provide hospital feedback and public reports (8), which may bring about a high-quality competition among hospitals. In this regard, SSI prevention and control is one of the most cost-effective interventions that can be performed in health care centers (9). In order to evaluate and investigate SSIs in patients after discharge, various methods, alone or in combination, such as telephone interviews, electronic charts, diagnostic codes, patient follow-ups, as well as reviews of pharmacy records have been so far utilized (10). In general, monitoring patients after discharge can have a significant effect on the occurrence of SSIs, so that most cases of severe infections have been observed during follow-ups after discharge (11).

Another factor highlighted as the significance of the present study is the population aging in most countries, particularly in Iran (12). According to the studies and estimates by the Statistical Center of Iran, the population in this country will become one of the oldest in the world by 2050 (13).

Given that hip fractures are more prevalent in the elderly population, identifying the effective factors during hospitalization, reflecting on mortality rates, and investigating SSIs can moderate the burdens on the health care system, and subsequently minimize the incidence of patient mortality. With regard to the review of domestic and global literature as well as scientific evidence, and considering the importance of ALOS, mortality rates, the approaches adopted by many developing countries in this field, and focusing more on nosocomial infections due to their high mortality and morbidity rates and associated complications (14), some emerging infectious diseases, such as the coronavirus disease 2109 (COVID-19) (15), or currently sexually transmitted diseases, such as hepatitis B (16), non-infectious diseases have been

ignored. On the other hand, no similar study had been so far conducted in Iran.

Therefore, the present study was to identify the common factors associated with SSIs in older adults with hip fractures referred to the hospitals affiliated to Tehran University of Medical Sciences (TUMS), Tehran, Iran, during 2017-2020, in order to reflect on these factors in cases with hip fractures undergoing surgeries and help prevent such complications.

## MATERIALS AND METHODS

This retrospective study was performed by the census sampling method to collect the data from the medical records of elderly patients with hip fractures, hospitalized between April 2017 and March 2020 in Imam Khomeini Complex Hospital (IKCH), Tehran, Iran. This complex is the largest educational and therapeutic center of the Tehran University of Medical Sciences (TUMS) which accommodates more than 1,300 hospital beds and includes three independent hospitals and a joint emergency department for those three hospitals.

The research samples were the medical records of older adults undergoing surgeries for hip, femoral, and intertrochanteric femoral fractures in 2017-2020 at IKHC, meeting the inclusion criteria, so that a total number of 440 cases were included in this study. Of note, the orthopedic ward of IKHC had 40 beds for orthopedic patients and an average of about 1,800 surgeries was being performed annually in this educational-medical center. The inclusion criteria were age over 60 based on previous studies, along with hip fracture diagnosis according to radiological findings, computerized tomography (CT) scan results, and specialist physicians' opinions, and full access to patients' information. On the other hand, the exclusion criteria included non-response by patients or their families to check the information, incomplete information in the medical records, and simultaneous fractures in more than one limb.

Upon receiving the ethics clearance from the Joint Institutional Ethics Committee of the School of Nursing, Midwifery, and Rehabilitation, affiliated to TUMS, Tehran, Iran, the permit was obtained to do sampling in the study setting. The research samples, i.e., the medical records containing patients' profiles, were thus entered into the study after reviewing the inclusion criteria or excluded. Then, the information registration forms, designed to collect the desired information, were further completed. After retrieving patients' information and contact numbers from their medical records, the researcher contacted their families to obtain information about them in order to investigate their mortality rates. The calls were made

to those who had been hospitalized and there was no information available about them in terms of being alive or dead. In addition, more information on the common factors that might have contributed to the outcomes in the patients with hip fractures, such as where the patient had been transferred after discharge, the cause of death, the date and place of death, and so on were provided through the medical records that were not accessible, but the patients' families were aware of them, were taken.

The data collection tool consisted of two researcher-made checklists, including a demographic information questionnaire and SSIs. The researcher designed the forms and their items for patients with hip fractures after reviewing the literature and the evidence-based studies as well as retrieving information from medical records. The content validity of the data collection tool was determined through the opinions of 10 experts and faculty members, including the professors of nursing, orthopedics, infectious and infection control specialist.

For this study, a list of the effective factors, based on various sources and reviews of the related literature (17-23), was prepared, and then a checklist of the factors shaping the common consequences of hip fractures was designed, using the information from medical records, and provided to the professors and specialists. The factors contributing to the common outcomes of hip fractures in patients included age, gender, type of surgery, place of living, history of infection, type of fracture, underlying diseases, place of transfer after discharge, ALOS, mortality, time of death, cause of death, readmission, admission to the intensive care unit (ICU), and receiving blood transfusion. The initial checklist consisted of 35 types of variables, designed after reviewing the opinions of the professors and specialists as well as medical records. The checklist used in the present study did not need to be examined for reliability because it was extracted from medical records. Using the SPSS Statistics Software (version 19), linear/logistic regressions were recruited to investigate the relationship between the study variables and the common outcomes of hip fractures in older adults.

## RESULTS

Most elderly population were males (52.3%) and married (67.02%). The average age of the studied patients was  $27.7 \pm 3.4$  years (range 60-87 year). Majority of the patients (95%) had insurance coverage and (91.1%) held private home. The most common fractures among these older adults were intertrochanteric femoral fractures (49.5%) and the most reported cause of fractures was falls (76.4%). Besides, the most frequent type of surgery was open

bone fracture repair (58.4%) and the most common type of anesthesia was spinal anesthesia (58.4%). The bulk of the elderly people with hip fractures had no history of infections (98.2%), and 42.3% of the cases had a history of hospitalization in ICUs.

The study results demonstrated that the type of surgery ( $p=0.005$ ), readmission ( $p=0.0001$ ), and the levels of self-care ( $p=0.001$ ) were significantly associated with SSIs. The elderly with total hip replacement (15.5%) also had experienced the highest incidence of SSIs compared with those undergoing hemiarthroplasty (10.4%) and open bone fracture repair (4.3%) ( $p=0.05$ ). The older adults with a history of readmission (51.1%) additionally had been subjected to higher rates of SSIs than those without a history of readmission (2.5%) ( $p=0.0001$ ). Moreover, the elderly with no self-care (28.6%) had undergone the highest incidence of SSIs compared with those with high (4.5%), moderate (6.6), and low (9.6%) levels of self-care ( $p=0.001$ ) (Table 1).

The logistic regression results showed the effect of the history of readmission and the levels of self-care on SSIs rates in older adults with hip fractures, thus the chances of SSIs in the elderly with no history of readmission were 99% lower than those who had been readmitted. The risks of SSIs in the elderly with high, moderate, and low levels of self-care were 95.67%, 96.66%, and 92% lower than the ones who had failed to take care of themselves (Table 2).

## DISCUSSION

This study, identifying the common factors associated with SSIs in older adults with hip fractures referred to the hospitals of TUMS, Tehran, Iran, during 2017-2020, demonstrated a significant relationship between the type of surgery, readmission, and the levels of self-care and SSIs.

The study results also revealed no association between gender and SSIs, as reported in the literature with conflicting results regarding such a relationship. In this respect, De jong et al. had reported that women could face a higher risk of SSIs than men (24), Zhao et al. had further found that men who had undergone hip fracture surgery could be exposed to a higher risk of developing SSIs than women (25), but Edwards et al. and Langelotz et al. had demonstrated no relationship between gender and SSIs (26, 27). As well, another study on all orthopedic surgeries had reported that men were more likely to develop SSIs after orthopedic surgeries (28). The discrepancy in the results of these studies and the present one, could be thus attributed to the sample size, monitoring and reporting systems of nosocomial infections in different countries, type of surgery, quality of surgery, surgeons, operating

Table 1. The absolute and relative frequency distribution of SSIs according to demographic characteristics and morbidity of older adults with hip fractures referred to the hospitals of TUMS, Tehran, Iran, during 2017-2020

Demographic characteristics and morbidity		SSIs				Chi-square (X <sup>2</sup> ) test results
		Yes (n=33)		No (n=407)		
		Frequency	Percentage	Frequency	Percentage	
Gender	Male	16	7	214	93	X <sup>2</sup> =0.205 df=1 p=0.65
	Female	17	8.1	193	91.9	
Level of education	Illiterate	10	8.1	113	91.9	X <sup>2</sup> =0.194 df=2 p=0.90
	Below High school diploma	13	6.9	176	93.1	
	High school diploma	10	7.8	118	92.2	
Housing	Rental and state-owned	4	11.1	32	88.9	X <sup>2</sup> =0.961 df=1 p=0.61
	Private	29	7.2	372	92.8	
Occupation	Retired	13	6.8	179	93.2	X <sup>2</sup> =0.445 df=2 p=0.801
	Homemaker	15	8.5	161	91.5	
	Other	5	6.9	67	93.1	
Insurance coverage	Yes	32	7.7	386	92.3	X <sup>2</sup> =0.291 df=1 p=0.58
	No	1	4.5	21	95.25	
Smoking	Yes	3	9.1	30	90.9	X <sup>2</sup> =0.130 df=1 p=0.71
	No	30	7.4	377	92.6	
Cause of fracture	Fall	23	6.8	313	93.2	X <sup>2</sup> =0.906 df=2 p=0.63
	Osteoporosis	2	10.5	17	89.5	
	Accident	8	9.4	77	90.6	
Type of fracture	Femur head	3	6	47	94	X <sup>2</sup> =1.878 df=3 p=0.59
	Femur neck	14	8.9	144	91.1	
	Intertrochanteric femoral	2	14.3	12	85.7	
	Hip fracture	14	6.4	204	93.6	
Type of surgery	Open bone fracture repair	11	4.3	246	95.7	X <sup>2</sup> =10.730 df=2 p=0.005
	Total hip replacement	9	15.5	49	84.5	
	Hemiarthroplasty	13	10.4	112	89.6	
Type of anesthesia	General anesthesia	9	7.8	107	92.2	X <sup>2</sup> =0.267 df=2 p=0.87
	Spinal anesthesia	20	7.8	237	92.2	
	Epidural anesthesia	4	6	63	94	
History of medication use	Yes	22	7.1	289	92.9	X <sup>2</sup> =0.278 df=1 p=0.59
	No	11	8.5	118	91.5	
History of admission to ICU	Yes	15	8.1	171	91.9	X <sup>2</sup> =0.023 df=1 p=0.87
	No	18	7.1	236	92.9	
History of blood transfusion	Yes	11	7.2	141	92.8	X <sup>2</sup> =0.194 df=1 p=0.90
	No	22	7.6	266	92.4	
Underlying diseases	Yes	24	7.4	301	92.6	X <sup>2</sup> =0.024 df=1 p=0.87
	No	9	7.8	106	92.2	

<b>Readmission</b>	Yes	23	51.1	22	48.9	$\chi^2=137.423$ df=1 p=0.0001
	No	10	2.5	385	97.5	
<b>Age</b>	Below 69	17	10.2	150	89.8	$\chi^2=0.228$ df=2 p=0.199
	70-79	10	6.8	136	93.2	
	Over 80	6	4.7	121	95.3	
<b>Level of self-care</b>	High	8	4.5	170	95.5	$\chi^2=16.600$ df=3 p=0.001
	Moderate	9	6.6	128	93.4	
	Low	10	9.6	94	90.4	
	No	6	28.6	15	71.4	

Table 2. The logistic regression results of the factors contributing to SSIs in older adults with hip fractures referred to the hospitals of TUMS, Tehran, Iran, during 2017-2020

<b>Demographic characteristics and morbidity</b>		<b>B</b>	<b>S.E</b>	<b>P</b>	<b>EXP(B)</b>	<b>95% CI Lower/upper limits</b>
<b>Type of surgery</b>	Open bone fracture repair	-0.907	0.584	0.098	0.404	0.138-1.83
	Total hip replacement	1.270	0.681	0.062	3.561	0.938-13.526
	Hemiarthroplasty	Reference category				
<b>Readmission</b>	No	-4.411	0.584	0.001	0.012	0.004-0.038
	Yes	Reference category				
<b>Level of self-care</b>	High	-3.147	0.823	0.001	0.043	0.009-0.216
	Moderate	-3.125	0.840	0.001	0.044	0.008-0.228
	Low	-2.475	0.813	0.002	0.084	0.017-0.414
	No	Reference category				

room equipment, and adherence to instructions for SSI prevention and control in operating rooms.

The study results also showed no relationship between the type of fracture and the causes of fracture and SSIs. However, Merer et al. (2015) SSI was diagnosed a median of 30 days after surgery (interquartile range, 21-41 days), 32% of these SSIs were superficial infections, and 68% were deep or organ-space infections that SSI after surgery for femoral neck fracture is severe (29). In another study by Zhao et al., the risk factors associated with SSIs in intertrochanteric femoral fractures included gender, time between admission and surgery, type of implants, and albumin levels (25). In spite of this, no association was established between the type of fracture and SSIs in the present study.

The logistic regression results in this study indicated that the levels of self-care and readmission were significantly associated with SSIs. Regarding the levels of self-care, studies had further shown that the given variable had not been directly evaluated, but a systematic review by Mark et al. had reported the incidence of complications after femoral and hip fracture surgeries, such as SSIs, in patients receiving complete care and self-care programs, were fewer than

those in cases who had received only routine care (30). In the present study, the older adults who were unable to take care of themselves or had low self-care ability were more likely to experience adverse outcomes. Most studies had further revealed that the level of self-care in the elderly could predict the disease conditions, quality of life, psychological conditions, and mortality (31, 32).

Of note, some common factors affecting hip fracture outcomes, such as diet, income, financial satisfaction, activity limitations before and after surgery, dressing, number of dressing changes per day and week, and type of dressing did not exist in the medical records here, and this information was not obtained even during telephone contacts with the patients' families, which was considered as one of the main limitations of this study.

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