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Prognostic Study

Surgical Treatment of Intertrochanteric Fractures in Elderly Patients: Comparing the Effect of Age vs. Physical Status on Patient Outcomes

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Abstract

Purpose: The purpose of this study was to compare the impact of age and physical status on short term (≤ 30 days) outcomes of intertrochanteric fracture (ITF) in elderly patients. The primary outcome of our study was mortality. Secondary outcomes included short term complications.

Methods: This retrospective cohort study includes patients from the American College of Surgeons National Quality Improvement Program (ACS NSQIP) from January 2016 to December 2018. All patients with ITF treated with intramedullary nail (IMN) fixation were included in the study. Patients were divided into two age cohorts: 65-75 and 76-89 years-old. Patients' physical status was assessed by the American Society of Anesthesiologists (ASA) Classification System.

Results: A total of 14278 patients met the inclusion criteria: 3811 patients were between 65-75 years, and 10467 patients were 76-89 years-old. Overall, the mortality rate was 1.9%. After adjusting for gender, body mass index (BMI), functional status, and ASA class, age 76-89 years were not associated with mortality (OR = 1.2, P = 0.24). However, age 76-89 years were significantly associated with higher rates of blood transfusion (OR = 1.36, P < 0.001), myocardial infarction (OR = 1.76, P < 0.001), and urinary tract infection (OR = 1.24, P = 0.05). The adjusted odds ratio of mortality for patients with ASA class III and ASA Class IV/V was 2.86 (P < 0.001) and 10.51 (P < 0.001), respectively. Similarly, patients with ASA Class 4/5 had a significantly higher rate of transfusion (OR = 2.1, P = 0.00), pneumonia (OR = 3.43, P < 0.001), stroke (OR = 2.31, P = 0.01), myocardial infarction (OR = 2.96, P < 0.001), urinary tract infection (OR = 1.66, P < 0.001), renal failure/insufficiency (OR = 8.7, P < 0.001), sepsis (OR = 2.4, P < 0.001), surgical site infections (OR = 3.82, P < 0.001), readmission (OR = 2.73, P < 0.001) and revision surgery (OR = 1.94, P < 0.001).

Conclusion: This study has shown that patients aged 76-89 years had no increased risk of 30-day mortality compared with the 65-75 years-old age group. Data showed that in intertrochanteric fractures patients' physical status was a more reliable predictor of adverse outcomes than age.

Keywords

Hip fractures, Geriatrics, Age, Physical status, Comorbidities

Introduction

The United States has the highest annual rate of hip fractures globally, with an estimated incidence of over 300,000 admissions per year [1,2]. Although hip fractures can occur at any age, the vast majority of them involve geriatric patients and the most common fracture observed in this population involves the intertrochanteric region [3,4]. Given the unique anatomic and mechanical characteristics of ITF, surgical treatment is preferred to restore the pre injury functional level of independence within the shortest time possible [5]. However, surgical management carries additional risks for the geriatric population. Previous studies on hip fractures demonstrated that almost 50% of patients would experience at least one short-term complication following surgical repair, and approximately one-fifth of patients will die in the year following surgery [6,7].

Age and poorly controlled systemic diseases are among the important factors associated with worse patient outcomes [8,9]. Previous studies have found that a relatively higher annual mortality rate is associated with increasing age and comorbidities, but much of the literature considers elderly patients a homogenous group [10,11]. Also, relevant published studies commonly pool all types of hip fractures and surgical procedures into one study group. However, substantial differences are seen among fracture types as well as the type of surgical implant used [12,13]. Because of the potential negative clinical ramifications of increased age and comorbidities, it is valuable for surgeons to understand the risks pertaining to treating ITFs in such patients and counsel them correspondingly.

To this end, we sought to evaluate short-term (≤ 30 days) mortality and complications of ITFs treated by IMN in elderly patients. The purpose of this study was to investigate if patient age and physical status significantly affect postoperative outcomes. We hypothesized that; 1) mortality and complications in elderly patients are not affected by age, and 2) patients' physical status has a more significant influence on patient outcomes than age.

Methods

Study population

The data for this study were retrospectively collected from the American College of Surgeons National Quality Improvement Program (ACS NSQIP) from January 1, 2016, to December 31, 2018. The ACS NSQIP is a nationally validated, risk-adjusted, outcomes-based program to assess and enhance surgical care quality [14]. The program collects data on more than 150 variables, including preoperative risk factors, intra-operative variables, and 30-day postoperative outcomes for patients undergoing major surgical procedures [15].

The study subjects included patients aged 65 to 89 years with ITFs and were identified using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10 CM) diagnosis codes (S72.14). Only patients treated with IMN were included, and these patients were identified using the Current Procedural Terminology code (27245). Patients with missing variables on age and ASA classification were excluded from the study. The population was dichotomized into two groups: 65-75 years and 76-89 years. The American Society of Anesthesiologists (ASA) classification system was used to assess patients' physical status (Table 1). The ASA classification system assesses patient comorbidities that can help predict perioperative risks [16]. Studies have shown that ASA classification has a strong, independent association

Table 1: American Society of Anesthesiologists (ASA) physical status classification system [16].

ASA Class	Definition	Adult Examples, Including, but not Limited to:
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled DM/HTN, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥ 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks, history (> 3 months) of MI, CVA, TIA, or CAD/stents.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): Recent (< 3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): Ruptured abdominal/ thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

Abbreviations: BMI: Body Mass Index; DM: Diabetes Mellitus; HTN: Hypertension; COPD: Chronic Obstructive Pulmonary Diseases; ESRD: End-Stage Renal Disease; PCA: Post Conceptual Age; MI: Myocardial Infarction; CVA: Cerebrovascular Accident; TIA: Transient Ischemic Attach; CAR: Coronary Artery Disease; DIC: Disseminated Intravascular Coagulation; ARD: Advanced Renal Disease with postoperative outcomes across procedures [17]. In this study, ASA classes were combined into three groups: Patients with no or mild systemic disease (Class I/II), patients with severe systemic diseases (Class III), and patients with life-threatening systemic diseases or being moribund (Class IV/V). The institutional review board exempted the study and waived the patient's written informed consent because the data were deidentified. The study was performed according to the strengthening the reporting of observational studies in epidemiology (STROBE) guidelines [18].

Definition of variables and outcomes

Patients' preoperative variables included age, gender, race, BMI, functional status, and ASA Classification. Outcomes were defined as adverse events within the first 30 days after the surgical procedure. The primary outcome analyzed was mortality. Secondary outcomes assessed included blood transfusion, pneumonia, stroke, myocardial infarction, deep vein thrombosis, pulmonary embolism, urinary tract infection, renal failure/insufficiency, sepsis, surgical site infections, readmission, revision surgery, and postoperative length of stay.

Statistical analysis

Descriptive statistics were reported as frequencies and percentages for categorical variables. Postoperative length of stay was reported both as mean ± standard deviation as well as a median and inter quartile range due to its abnormal distribution.

We performed univariate analysis to investigate the difference in patient characteristics and postoperative outcomes with age groups. The Chi-square test was used for categorical data, and the Mann-Whitney U test was used for the postoperative length of stay. The statistically significant ($P < 0.05$) and clinically significant variables were included in the multivariable model. After adjusting for gender, BMI, functional status, and ASA class, a multivariable regression model was developed to evaluate whether the age group was a potential predictor of postoperative adverse events. Similarly, after controlling for age, gender, BMI, and functional status, multivariable regression analysis was used to determine the effect of patients' physical status, based on the ASA class, on postoperative outcomes. Odds ratios (ORs) with corresponding 95% confidence interval (CI) were used to report the results of multivariable regression. The threshold for statistical significance was $P < 0.05$, and all reported P values are 2-tailed. All analyses were performed with IBM SPSS Statistics 25.0 (Armonk, NY: IBM Corp.).

Results

Descriptive statistics

Table 2: Patient characteristics and outcomes.

Variables	**N = 14278, n (%)**
Age	
65-74	3811 (26.7)
75-89	10467 (73.3)
Gender	
Male	4310 (30.2)
Female	9968 (69.8)
Race	
White	11162 (78.2)
African American	452 (3.2)
Others	386 (2.7)
Unknow	2278 (16)
Body mass index[a]	
< 18.5	1658/13663 (12.1)
18.5-24.9	5922/13663 (43.3)
25-29.9	3719/13663 (27.2)
≥ 30	2364/13663 (17.3)
Functional status[a]	
Independent	11451/14228 (80.5)
Partially Dependent	2324/14228 (16.3)
Totally Dependent	453/14228 (3.2)
ASA class	
ASA I and II	2316 (16.2)
ASA III	9131 (64)
ASA IV and V	2831 (19.8)
Transfusion	4353 (30.5)
Pneumonia	536 (3.7)
Stroke	119 (0.8)
Myocardial infarction	271 (1.9)
Deep vein thrombosis	172 (1.2)
Pulmonary embolism	98 (0.7)
Urinary tract infections	554 (3.8)
Renal Failure/Insufficiency	120 (0.8)
Sepsis	146 (1)
Surgical site infections	100 (0.7)
Readmission	1170 (8.2)
Revision surgery	256 (1.8)
Postoperative LOS, Median (IQR), Mean (SD)	4 (3-6), 4.52 (8.56)
Mortality	289 (1.9)

[a] Results are reported based on available data.

Abbreviations: ASA: American Society of Anesthesiologists; LOS: Length of Stay.

Among 14278 patients who met the inclusion criteria, 3811 patients were between 65-75 years, and 10467 patients were 76 to 89 years-old. 69.8% of the patients were female, and 78.2% were white. Almost two-thirds

(64%) of the patients had severe systemic diseases (ASA class III), and 19.8% had life-threatening systemic diseases or were moribund (Class IV/V). Overall, 8.2% had unplanned readmission to the hospital, and the mortality rate was 1.9% (Table 2).

Univariate analysis

Table 3 shows patients' characteristics and outcomes by age groups. Patient preoperative variables, including gender, race, BMI, functional status, and ASA class,

Table 3: Patient characteristics and outcomes by age groups.

	Age (65-74) N = 3811, n (%)	**Age (75-89) N = 10467, n (%)**	**P value**
Gender			
Male	1358 (35.6)	2952 (28.2)	**< 0.001**
Female	2453 (64.4)	7515 (71.8)	
Race			
White	3013 (79)	8149 (77.9)	**< 0.001**
African American	170 (4.5)	282 (2.7)	
Others	93 (2.5)	293 (2.8)	
Unknow	535 (14)	1743 (16.6)	
Body mass index[a]			
< 18.5	430/3695 (11.6)	1228/9968 (12.3)	**< 0.001**
18.5-24.9	1396/3695 (37.8)	4526/9968 (45.4)	
25-29.9	993/3695 (26.9)	2726/9968 (27.3)	
≥ 30, N	876/3695 (23.7)	1488/9968 (14.9)	
Functional status[a]			
Independent	3304/3801 (86.9)	8147/10428 (78.1)	**< 0.001**
Partially Dependent	428/3801 (11.3)	1896/10428 (18.2)	
Totally Dependent	69/3801 (1.8)	384/10428 (3.7)	
ASA class			
ASA I and II	841 (22.1)	1475 (14.1)	**< 0.001**
ASA III	2326 (61)	6805 (65)	
ASA IV and V	644 (16.9)	2187 (20.9)	
Transfusion	917 (23.9)	3461 (32.9)	**< 0.001**
Pneumonia	130 (3.4)	406 (3.9)	0.19
Stroke	23 (0.6)	96 (0.9)	0.07
Myocardial infarction	48 (1.3)	223 (2.1)	**< 0.001**
Deep vein thrombosis	36 (0.9)	138 (1.3)	0.07
Pulmonary embolism	20 (0.5)	79 (0.8)	0.14
Urinary tract infarctions	123 (3.2)	431 (4.1)	**0.01**
Renal failure/insufficiency	38 (1)	82 (0.8)	0.22
Sepsis	38 (1)	112 (1.1)	0.7
Surgical site infections	30 (0.8)	70 (0.7)	0.45
Readmission	285 (11.6)	885 (12.6)	0.16
Revision surgery	70 (1.8)	198 (1.9)	0.83
Mortality	65 (1.7)	224 (2.1)	0.1

Abbreviations: ASA: American Society of Anesthesiologists.

[a]Results are reported based on available data.

Table 4: Postoperative length of stay by age groups.

Age groups	N	Median (IQR)	Mean (SD)
Age (65-75)	3811	4 (3-5)	4.33 (7.64)
Age (76-89)	10467	4 (3-6)	4.59 (8.87)

A nonparametric Mann-Whitney U Test (because of the skewed distributions) revealed that difference in postoperative length of stay between the two age groups is significant (P = 0.001). However, after adjusting for Gender, BMI, Functional status and ASA class, general linear model showed no significance (P = 0.63).

Table 5: Multivariable analysis based on age groups*^ .

Outcomes	Age (76-89)^		
	OR	95% CI	P value
Transfusion	1.361	1.25-1.49	**< 0.001**
Pneumonia	1.05	0.85-1.3	0.65
Stroke	1.44	0.9-2.32	0.13
Myocardial infarction	1.76	1.26-2.46	**< 0.001**
Deep vein thrombosis	1.46	0.99-2.46	0.06
Pulmonary embolism	1.4	0.84-2.33	0.2
Urinary tract infection	1.24	1-1.54	**0.05**
Renal Failure/Insufficiency	0.79	0.53-1.18	0.25
Sepsis	1	0.67-1.45	0.96
Surgical site infections	0.91	0.57-1.43	0.67
Readmission	1.06	0.91-1.23	0.43
Revision surgery	1.09	0.82-1.47	0.54
Mortality	1.2	0.89-1.63	0.24

*Adjusted for Gender, BMI, Functional Status and ASA class.

^Age (65-75) is considered the reference group.

were significantly different between the age groups (P < 0.001). Mortality was not found to significantly different between the age groups (2.1% vs. 1.7%, P = 0.1). However, compared to the age 65-75 years, the older age group demonstrated a higher rate of blood transfusion (32.9% vs. 23.9%, P < 0.001), myocardial infarction (2.1% vs. 1.3, P < 0.001) and urinary tract infection (4.1% vs. 3.2%, P = 0.01). Notably, those in the76-89 age group were found to be associated with a statistically significant longer postoperative length to stay (4.33 ± 7.64 vs. 4.59 ± 8.87 days, P = 0.001) (Table 4). However, this difference cannot be considered clinically significant. There was no other difference in the 30-day postoperative adverse events between the two groups.

Multivariable analysis by age groups

By multivariate regression analysis and after adjusting for gender, BMI, functional status and ASA class, age of 76-89 years was not an independent predictor of 30-day mortality (OR = 1.2, 95% CI = 0.89-1.63, P = 0.24). However, this group showed significantly higher rates of blood transfusion (OR = 1.36, 95% CI = 1.25-1.49, P = 0.00), myocardial infarction (OR = 1.76, 95% CI = 1.26-2.46, P = 0.00), and urinary tract infection (OR = 1.24, 95% CI = 1-1.54, P = 0.05) (Table 5).

Multivariable analysis by ASA classification

After adjusting for age, gender, BMI and functional status, multivariable regression analysis showed that compared to ASA class I/II, the adjusted odds ratio of mortality was 2.86 (95% CI = 1.43-1.8, P < 0.001), and 10.51 (95% CI = 1.81-2.36, P < 0.001) for patients with ASA class III and ASA Class IV/V, respectively. Patients with ASA class III had an odds ratio of 1.6 for transfusion (95% CI = 0.43-1.8, P < 0.001), 1.79 for pneumonia (95% CI = 1.27-2.52, P < 0.001), 1.41 for UTI (95% CI = 1.27-2.52, P = 0.01), 2.74 for renal failure/insufficiency (95% CI = 1.09-6.89, P = 0.03), 2.6 for surgical site infections (95% CI = 1.11-6.05, P = 0.02), and 1.68 for hospital readmission (95% CI = 1.35-2.08, P < 0.001). Similarly, patients with ASA Class IV/V demonstrated significantly a higher rate of transfusion (OR = 2.1, 95% CI = 1.81-2.36, P < 0.001), pneumonia (OR = 3.43, 95% CI = 2.4-4.92, P < 0.001), stroke (OR = 2.31, 95% CI = 1.16-4.58, P = 0.01), myocardial infarction (OR = 2.96, 95% CI = 1.88-4.68 P < 0.001), urinary tract infection (OR = 1.66, 95% CI = 1.2-2.3, P < 0.001), renal failure/insufficiency (OR = 8.7, 95% CI = 3.44-22.16, P < 0.001), sepsis (OR = 2.4, 95% CI = 1.32-4.68, P < 0.001), surgical site infections (OR = 3.82, 95% CI = 1.55-9.43, P < 0.001), readmission (OR = 2.73, CI = 2.15-3.47, P < 0.001) and revision surgery

Table 6: Multivariable analysis based on ASA classification*.

Outcomes	ASA III			ASA IV and V		
	OR	CI	P value	OR	CI	P value
Transfusion	1.6	1.43-1.8	**< 0.001**	2.1	1.81-2.36	**< 0.001**
Pneumonia	1.79	1.27-2.52	**< 0.001**	3.43	2.4-4.92	**< 0.001**
Stroke	1.57	0.84-2.92	0.15	2.31	1.16-4.58	**0.01**
MI	1.32	0.85-2.03	0.21	2.96	1.88-4.68	**< 0.001**
Deep vein thrombosis	1.04	0.67-1.61	0.85	1.18	0.7-2	0.53
Pulmonary embolism	1.55	0.81-2.7	0.18	1.6	0.74-3.4	0.23
UTI	1.41	1.06-1.87	**0.01**	1.66	1.2-2.3	**< 0.001**
Renal Failure/Insufficiency	2.74	1.09-6.89	**0.03**	8.7	3.44-22.16	**< 0.001**
Sepsis	1.46	0.81-2.25	0.21	2.4	1.32-4.68	**< 0.001**
Surgical site infections	2.6	1.11-6.05	**0.02**	3.82	1.55-9.43	**< 0.001**
Readmission	1.68	1.35-2.08	**< 0.001**	2.73	2.15-3.47	**< 0.001**
Revision surgery	1.36	0.91-2.03	0.14	1.94	1.24-3.04	**< 0.001**
Mortality	2.86	1.44-5.66	**< 0.001**	10.51	5.3-20.83	**< 0.001**

*ASA I and II is considered the reference group.

(OR = 1.94, CI = 1.24-3.04, P < 0.001) when compared to patients with ASA Class I/II (Table 6).

Discussion

This was an observational retrospective study of 14278 patients with ITF who underwent IMN surgery. The present study reported similar mortality rates between patient's age 75 or less and over 75 years. However, age over 75 was associated with significantly more blood transfusions, myocardial infarctions, and urinary tract infections. No other differences were identified between the two age groups in terms of 30-day postoperative complications. Interestingly, the study demonstrated that patients' physical status, as assessed by ASA classification, was found to be a reliable predictor of postoperative adverse events and mortality.

Increased patient age has frequently been associated as a critical indicator of higher mortality rates following hip fracture [11,19]. Studies have shown that age was among the strongest predictors of early mortality (< 30 days) following hip fracture repair [20,21]. A meta-analysis also illustrated that the absolute risk for death and the excess all-cause mortality in patients with hip fracture are largely dependent on age [11]. However, our study did not show a statistically significant difference in the 30-day mortality rate between patients age 75 or less and over 75 years. Additionally, the mortality rate recorded in this study (1.8%) is lower than the reported range of 7.1%-50.6% in the previous studies [20,21]. This may have contributed to the lack of difference in mortality between the two age groups in our study. Furthermore, previous studies assessed mortality after pooling all types of hip fractures compared to only intertrochanteric fracture in this study.

Following intertrochanteric hip fractures, there are critical postoperative complications that are well described in the literature. Our study identified three postoperative outcomes of ITFs that were significantly associated with increased patient age: Blood transfusion, myocardial ischemia, and urinary tract infections (UTIs). However, there is a literature gap in understanding how these complications are associated with older age. A possible explanation would be that the elderly population generally has a higher prevalence of anemia; thus, it is more likely to require blood transfusion during or after surgery [6]. Additionally, the use of anticoagulation medications are relatively more prevalent in the elderly population and are likely a contributor to increased intra-operative bleeding [6,22]. Of note, prior studies demonstrated a higher rate of myocardial infarction associated with increasing age, and this is in line with the finding of this study [23,24]. Finally, increased risk of urinary tract infection may be attributed to immobility and use of a foley catheter for an extended period following hip fracture surgery in the elderly population [25].

Patient comorbidities have been shown to profoundly affect the course of patient outcomes following hip fractures [26,27]. Our study used the ASA classification system to rank patients based on their comorbid physical status. We found that mortality was significantly higher in ASA class III (OR = 2.86, P < 0.001) and ASA class IV/V (OR = 10.51, P < 0.001) compared with those in ASA class I/II. This finding is consistent with a systematic review by Xu, et al., in which 8 out of 9 papers showed a greater mortality rate with higher ASA grades [28]. Both ASA class III and ASA class IV/V were associated with significantly increased rates of complications, but specific adverse outcomes such as stroke, myocardial infection, sepsis, and revision surgery were only statistically significant in patients with ASA class IV/V. This suggests that it is not only the presence of comorbidity that impacts outcomes but also the severity. The severity of complications in ASA class IV/V is also the likely cause of increased mortality in this group.

Approximately one-third of patients with a hip fracture will die in the year following injury, and many more will experience debilitating adverse outcomes [7]. Thus, it should be highlighted that, especially for elderly patients, regaining pre-fracture functional status is critical. Interestingly, in our study, most patients that underwent IMN for ITF were either in ASA class III (63.38%) or class IV/V (19.9%) groups. Our study found that patients in these groups had significantly higher mortality rates and complications. The higher complication rate in patients with higher ASA class warrants medical optimization prior to surgery [29]. While medical optimization of high-risk patients may delay surgery, operating on a stable patient can lower risks of readmission and revision surgery [30].

This was a pragmatic study and thus should be interpreted in the context of observational research and its limitations inherent to its design. First, our study's nonrandomized nature limits the generalizability of our results due to potential selection bias. Second, retrospective chart reviews have the disadvantage that questions are asked in a non-uniform way across different patients and providers. Also, besides patients' physical status, adjusting for patients' physiological status before surgery would have been helpful, but the ACS-NSQIP database does not report such variables.

Conclusion

This study investigated the association of age and physical status with mortality and complications in patients with intertrochanteric fractures treated with IMN fixation. We found that 30-day mortality was not significantly different in patients aged 76-89 years compared to 65-75 years. However, patients aged 76-89 years presented more frequently with the need for blood transfusions, myocardial infarctions, and urinary tract infections. The results suggest that patients' physical status per ASA Classification is a more reliable predictor of mortality and morbidity than age.

Conflicts of Interest Statement

All authors have no conflicts of interest to disclose.

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Author Contributions

Conception and design: Saadat and Bokhari; Acquisition of data: Saadat; Statistical analysis of data: Saadat Interpretation of data: All authors; Drafting of the manuscript: Saadat, Karasavvidis, Alsoof and Rebic; Critical revision of the manuscript for important intellectual content: Lycans, Starr and Bokhari; Final revision of the version to be published: All authors; Administrative, technical, or material support: Bokhari; Supervision: Bokharis

References

1. Dhanwal DK, Dennison EM, Harvey NC, et al. (2011) Epidemiology of hip fracture: Worldwide geographic variation. Indian J Orthop 45: 15-22.
2. HCUPnet. HCUPnet.
3. Ettinger B, Black DM, Dawson-Hughes B, et al. (2010) Updated fracture incidence rates for the US version of FRAX. Osteoporos Int 21: 25-33.
4. Verettas D-AJ, Ifantidis P, Chatzipapas CN, et al. (2010) Systematic effects of surgical treatment of hip fractures: Gliding screw-plating vs intramedullary nailing. Injury 41: 279-284.
5. Lu Y, Uppal HS (2019) Hip Fractures: Relevant Anatomy, Classification, and Biomechanics of Fracture and Fixation. Geriatr Orthop Surg Rehabil.
6. Zanker J, Duque G (2017) Rapid Geriatric Assessment of Hip Fracture. Clin Geriatr Med 33: 369-382.
7. Downey C, Kelly M, Quinlan JF (2019) Changing trends in the mortality rate at 1-year post hip fracture - a systematic review. World J Orthop 10: 166-175.
8. Zuckerman JD (2009) Hip Fracture. N Eng J Med 334: 1519-1525.
9. Penrod JD, Litke A, Hawkes WG, et al. (2008) The association of race, gender, and comorbidity with mortality and function after hip fracture. J Gerontol A Biol Sci Med Sci 63: 867-872.
10. Katsoulis M, Benetou V, Karapetyan T, et al. (2017) Excess mortality after hip fracture in elderly persons from Europe and the USA: the CHANCES project. Journal of Internal 281: 300-310.
11. Haentjens P, Magaziner J, Colón-Emeric CS, et al. (2010) Meta-analysis: Excess Mortality after Hip Fracture Among Older Women and Men. Ann Intern Med 152: 380-390.
12. Cornwall R, Gilbert MS, Koval KJ, et al. (2004) Functional Outcomes and Mortality Vary among Different Types of Hip Fractures. Clin Orthop Relat Res 425: 64-71.
13. Sun D, Wang C, Chen Y, et al. (2019) A meta-analysis comparing intramedullary with extramedullary fixations for unstable femoral intertrochanteric fractures. Medicine (Baltimore) 98: e17010.
14. American College of Surgeons (2020) ACS National Surgical Quality Improvement.
15. (2018) nsqip_puf_userguide_2018.pdf.

16. ASA Physical Status Classification System.

17. Hackett NJ, De Oliveira GS, Jain UK, et al. (2015) ASA class is a reliable independent predictor of medical complications and mortality following surgery. International Journal of Surgery 18: 184-190.

18. von Elm E, Altman DG, Egger M, et al. (2007) Strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. BMJ 335: 806-808.

19. Groff H, Kheir MM, George J, et al. (2019) Causes of in-hospital mortality after hip fractures in the elderly: HIP International.

20. Nijmeijer WS, Folbert EC, Vermeer M, et al. (2016) Prediction of early mortality following hip fracture surgery in frail elderly: The Almelo Hip Fracture Score (AHFS). Injury 47: 2138-2143.

21. Karres J, Kieviet N, Eerenberg J-P, et al. (2018) Predicting Early Mortality After Hip Fracture Surgery: The Hip Fracture Estimator of Mortality Amsterdam. J Orthop Trauma 32: 27-33.

22. Ringen AH, Gaski IA, Rustad H, et al. (2019) Improvement in geriatric trauma outcomes in an evolving trauma system. Trauma Surg Acute Care Open 4: e000282.

23. Moghadamyeghaneh Z, Mills SD, Carmichael JC, et al. (2015) Risk factors of postoperative myocardial infarction after colorectal surgeries. Am Surg 81: 358-364.

24. Kytö V, Sipilä J, Rautava P (2014) Gender, age and risk of ST segment elevation myocardial infarction. Eur J Clin Invest 44: 902-909.

25. Malik AT, Quatman-Yates C, Phieffer LS, et al. (2019) Factors Associated With Inability to Bear Weight Following Hip Fracture Surgery: An Analysis of the ACS-NSQIP Hip Fracture Procedure Targeted Database.

26. Cher EWL, Allen JC, Howe TS, et al. (2019) Comorbidity as the dominant predictor of mortality after hip fracture surgeries. Osteoporos Int 30: 2477-2483.

27. Haentjens P, Autier P, Barette M, et al. (2007) Survival and functional outcome according to hip fracture type: A one-year prospective cohort study in elderly women with an intertrochanteric or femoral neck fracture. Bone 41: 958-964.

28. Xu BY, Yan S, Low LL, et al. (2019) Predictors of poor functional outcomes and mortality in patients with hip fracture: A systematic review. BMC Musculoskeletal Disorders 20: 568.

29. Bernstein DN, Liu TC, Winegar AL, et al. (2018) Evaluation of a Preoperative Optimization Protocol for Primary Hip and Knee Arthroplasty Patients. The Journal of Arthroplasty 33: 3642-3648.

30. Mitchell SM, Chung AS, Walker JB, et al. (2018) Delay in Hip Fracture Surgery Prolongs Postoperative Hospital Length of Stay but Does Not Adversely Affect Outcomes at 30 Days. J Orthop Trauma 32: 629-633.