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Impact of the American Society of Anesthesiologists (ASA) classification on hip fracture surgery outcomes: insights from a retrospective analysis

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Abstract

Background The American Society of Anesthesiologists (ASA) classification is the most used system to assess patient health status before surgery, ranging from I to V levels. This study aims to explore the impact of different ASA risk classes (ASA II [mild risk] and ASA III [severe risk]) on clinical outcomes following hip fracture surgery, including all-cause mortality and postoperative complications.

Methods A retrospective analysis from 2019 to 2021 across three Jordanian centers was conducted. The study included patients aged 65 and above who underwent hip fracture repair surgeries. Preoperative measures, intraoperative management protocols, and postoperative care were collected. Clinical data were extracted from electronic medical records, including demographics, fracture type, intraoperative data, and postoperative outcomes.

Results The analysis included 1033 patients, with 501 (48.5%) in the mild anesthetic risk group (ASA I-II) and 532 (51.5%) in the severe anesthetic risk group (ASA III-V). The mean age was 73 years, with a higher prevalence of males in the severe risk group. Patients in the severe risk group had more comorbidities, higher ICU admissions (15.23% vs. 6.18%), longer hospital stays (median 7 vs. 6 days), and higher rates of postoperative thromboembolic complications (3.39% vs. 1.39%) compared to the mild risk group. Additionally, the severe risk group showed higher mortality rates both in-hospital mortality (3.38% vs. 1.39%) and all-cause mortality (16.92% vs. 10.36%). Multivariate analysis identified higher ASA score as independent risk factors for increased all-cause mortality (HR = 1.64 95%CI 1.51–2.34) and thromboembolic complications (OR = 2.85 95%CI 1.16-7). Length of hospital stay was significantly associated with higher ASA score (OR = 1.04 95%CI 0.96–1.11).

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Conclusion The study underscores the significant impact of anesthetic risk on the outcomes of hip fracture surgeries. Patients with higher ASA scores associated with severe systemic diseases may have at increased risk of adverse outcomes.

Keywords Hip fracture surgery, Anesthetic risk, ASA classification, Outcome disparities, Elderly population, Postoperative complications, Risk assessment

Introduction

Hip fractures pose a significant health concern, especially among the elderly population, leading to substantial morbidity, mortality, and increased healthcare expenditures [1]. Hip fractures amongst the elderly usually indicate the beginning of multiple health conditions and problems for the remainder of their lives, as hip fractures can reduce the life expectancy of an elderly patient by 25% compared to the general population [2]. The management of hip fractures typically involves surgical intervention, often necessitating general or locoregional anesthesia [3].

The American Society of Anesthesiologists (ASA) physical status classification is the most used system [4] serves as a widely utilized tool for evaluating patients' preoperative health status, ranging from ASA I (healthy patient) to ASA V (moribund patient) [4]. Patients undergoing hip fracture surgery often exhibit diverse health conditions within this classification system, influenced by factors such as age, comorbidities, and the severity of the fracture [4]. [3].

The prevalence of hip fractures is high among elderly patients [5] that very often present with multiple comorbidities, such as cardiovascular diseases, diabetes, and osteoporosis, which can complicate both the anesthetic and surgical management [5], significantly determining the patient's anesthetic risk, as considered in the ASA classification [4].

The outcome disparities in hip fracture surgeries have been previously assessed based on surgical complications, length of hospital stay, postoperative recovery, and mortality rates [6]. Previous studies have indicated that higher ASA scores were associated with increased risk of postoperative complications and mortality [7]. Although the relationship between anesthetic risk and postoperative outcomes in hip fracture surgeries is complex and not fully elucidated [8], patients with severe anesthetic risk (ASA IV) may require careful and intensive intraoperative monitoring and postoperative care [9]. Indeed, they are also more likely to experience complications as postoperative delirium, prolonged hospitalization, and difficulties in rehabilitation [9], while patients with mild anesthetic risk (ASA II) generally have better surgical outcomes and a smoother recovery process [9]. Nevertheless, even in this group, the risk of complications exists, and understanding the factors that contribute to these disparities is crucial [10].

This study hypothesizes that higher American Society of Anesthesiologists (ASA) classification scores are associated with increased mortality and postoperative complication rates in patients undergoing hip fracture surgery. The primary objective of this study is to explore the association between ASA anesthetic risk and all-cause mortality in hip fracture surgeries. Additionally, we aim to assess the association between ASA status and major postoperative complications.

Methods

Study design and participant selection

A retrospective analysis was conducted across multiple centers, focusing on patients who underwent hip fracture repair surgeries from January 2019 to January 2021 that included cases from three centers in Jordan: the Jordan University Hospital (JUH) in Amman, Jordan, and the King Abdullah University Hospital in Irbid, Jordan, and Ministry of Health hospitals, Amman, Jordan. The study received ethical approval from the Yarmouk University Institutional Review Board in Irbid, Jordan (IRB Reference: IRB/2023/643) and adhere to the principles of Good Clinical Practice and the Declaration of Helsinki guidelines [11]. Informed consent has been waived by the Yarmouk University IRB ethics committee due to the retrospective nature of the study.

Inclusion and exclusion criteria

Participants aged 65 and above, diagnosed with femur or hip fractures from a standing height fall, and those who had hip fracture surgeries at the mentioned institutions were included. Exclusions were made for non-surgical cases, surgeries performed elsewhere, or when medical records were unavailable.

Preoperative procedures

Preoperative management involved administering 1 L of Normal Saline prior to spinal anesthesia and 500mL before general anesthesia. Patients on anticoagulants received subcutaneous calcium heparin after 12 h of admission. Oral anticoagulant therapies were discontinued (Low Molecular Weight Heparin 24 h prior, Aspirin 7 days prior, and Plavix 14 days prior to the surgery).

Intraoperative management

Standard intraoperative monitoring, including electrocardiographic monitoring, pulse oximetry, and non-invasive blood pressure monitoring was conducted. Spinal anesthesia was performed with patient in lateral position, using a 22/25-gauge Quincke point needle at L3-L4, with 10 mg Bupivacaine + 25 μg Fentanyl. General anesthesia, consisting of 100 mg Propofol + 100 μg Fentanyl, was administered intravenously, followed by tracheal intubation and muscle relaxation with Rocuronium. Sevoflurane was used based on hemodynamic parameters.

Postoperative care

For pain management post-surgery, 5 mg Morphine Sulfate was administered. Deep vein thrombosis (DVT) prophylaxis involved administering 40 mg Apixaban for 14 days, with an extension to 35 days for high-risk patients. Vigilant monitoring for complications such as cardiovascular events, blood transfusions, and mortality on the first postoperative day was paramount.

Data compilation and definitions

Clinical data were extracted from electronic medical records, encompassing demographics, preoperative details, fracture type, intraoperative data, and postoperative outcomes, including ICU admissions, hemoglobin levels, blood transfusions, and mortality rates up to 12 months post-surgery. All-cause mortality encompassed deaths from any cause post-surgery until the final follow-up.

Thromboembolic complications included a composite outcome with deep vein thrombosis and pulmonary embolism.

Statistical analysis

Given the retrospective nature of the study, a formal sample size calculation was not conducted, with the analysis encompassing every patient who underwent hip fracture repair during a two-year period. To assess the normality of variables, histograms, or quantile-quantile plots, in conjunction with Kolmogorov-Smirnov and Shapiro-Wilk tests, were employed. For normally distributed continuous variables, means and standard deviations were calculated, while the median and Interquartile Range (IQR) were utilized to express not normally distributed continuous variables. Categorical variables were described using frequencies and percentages. The Mann-Whitney test was employed for comparing not normally distributed continuous variables, and student t-test was used for normally distributed continuous variables. The chi-square test was used for categorical variables.

Logistic regression was performed to assess the risk factors associated with a higher ASA. All potential risk factors were transformed into dichotomous variables and entered in the univariate analysis, encompassing age, gender, smoking status, comorbidities, the need for preoperative and postoperative ICU care, as well as blood transfusion. In addition to the occurrence of DVT/PE, length of hospital stays, the need for readmission within one-month post-operation.

The impact of different ASA status and the outcome variables were analyzed using the multivariable logistic regression analysis. Significant variables were further analyzed using Cox hazard regression.

To assess the impact of ASA classification on hip fracture surgery outcomes, we performed a forward stepwise multivariable logistic regression analysis. This approach was chosen to identify the most significant predictors among the variables studied, allowing us to control potential confounders and better understand the relationship between ASA classification and different outcomes.

Data analysis was carried out using Stata version 17 software (Stata Corp. 2021). A two-sided p-value of less than 0.05 was considered statistically significant.

Results

Patients and treatments

This retrospective study comprised a total of 1033 patients who underwent hip fracture surgery, with 501 patients (48.5%) categorized into the mild anesthetic group and 532 patients (51.5%) into the severe anesthetic risk group. The mean age of the patients was 73 years (IQR 73–83), with 44.3% males. The most prevalent comorbidity was hypertension (68.76%), followed by diabetes mellitus (48.94%), cardiovascular disease (30.46%), and other minor conditions (refer to Table 1). Patients in the mild risk and severe risk groups had similar age. The proportion of males was higher in the severe risk group compared to the mild disease group (47.56% vs. 41.12%, $p = 0.037$). Patients in the severe risk group had significantly more comorbidities than those in the mild disease group, including more diabetes mellitus, hypertension, cardiovascular disease, cerebrovascular accident, pulmonary disease, thyroid disease, renal failure, Parkinson, Alzheimer, but similar rates of dementia and osteoporosis than patients with mild anesthetic risk, as reported in Table 1.

Regarding medication usage, patients in the mild disease group were treated significantly less frequently with Aspirin ($p < 0.001$), Clopidogrel ($p < 0.001$), as well as other anticoagulants ($p < 0.001$). Moreover, there was significantly less treatment with steroids in the mild risk group compared to the severe risk group. (1.39% vs. 3.95%, $p = 0.011$).

Patients in the severe risk group was admitted more to the ICU (15.23% vs. 6.18%, $p < 0.001$), experienced more thromboembolic complications (3.39% vs. 1.39, $p = 0.037$), stayed in hospital for longer (7 vs. 6 days, $p = 0.0002$), and were more frequently readmitted to

Table 1 Demographics and clinical characteristics of patients undergoing hip fracture repair

	Total	Mild systemic disease	Severe systemic disease	*p*-value
Age	73 (83 – 73)	78 (83 – 72)	78 (83 – 73)	0.7769
Gender				**0.037**
Male	459 (44.3%)	206 (41.12%)	253 (47.56%)	
Female	574 (55.57%)	295 (58.88%)	279 (52.44%)	
Smoking Status				**0.028**
Smoker	271 (26.21%)	116 (23.11%)	155 (29.14%)	
Non-Smoker	763 (73.79%)	386 (76.89%)	377 (70.86%)	
Comorbidities				
Diabetes Mellitus	506 (48.94%)	207 (41.24%)	299 (56.2%)	**< 0.001**
Hypertension	711 (68.76%)	294 (58.57%)	417 (78.38%)	**< 0.001**
Cardiovascular diseases	315 (30.46%)	0 (0%)	315 (59.21%)	**< 0.001**
Cerebrovascular Accidents	194 (18.78%)	0 (0%)	194 (36.47%)	**< 0.001**
Pulmonary diseases	43 (4.16%)	9 (1.79%)	34 (6.39%)	**< 0.001**
Thyroid diseases	46 (4.45%)	9 (1.79%)	37 (6.95%)	**< 0.001**
Renal failure	78 (7.54%)	1 (0.2%)	77 (14.47%)	**< 0.001**
Parkinson's Disease	35 (3.38%)	7 (1.39%)	28 (5.26%)	**0.001**
Dementia	11 (1.06%)	3 (0.6%)	8 (1.5%)	0.156
Alzheimer's Disease	28 (2.71%)	2 (0.4%)	26 (4.89%)	**< 0.001**
Osteoporosis	119 (11.51%)	63 (12.55%)	56 (10.53%)	0.308
Medications Used				
Aspirin	468 (45.26%)	135 (26.94%)	333 (62.59%)	**< 0.001**
Clopidogrel (Plavix)	78 (7.54%)	2 (0.4%)	76 (14.29%)	**< 0.001**
Other anticoagulants	73 (7.06%)	3 (0.6%)	70 (13.16%)	**< 0.001**
Steroids	28 (2.71%)	7 (1.39%)	21 (3.95%)	**0.011**
Bisphosphonates	22 (2.13%)	15 (2.99%)	7 (1.32%)	0.063
Days from admission to surgery; Median (IQR)	2 (4 – 1)	2 (4 – 1)	2 (4 – 1)	0.34

Table 2 Preoperative variables of patients undergoing hip fracture repair

	Total	Mild systemic disease	Severe systemic disease	*p*-value
Hemoglobin (g/dl)	11.98 ± 1.86	12.06 ± 1.87	11.92 ± 1.85	0.227
ICU admission	28 (2.71%)	7 (1.39%)	21 (3.95%)	**0.011**
Analgesia used				
Paracetamol	1020 (98.65%)	495 (98.61%)	525 (98.68%)	0.913
NSAIDs	9 (0.87%)	6 (1.2%)	3 (0.56%)	0.275
Opioids	416 (40.23%)	179 (35.66%)	237 (44.55%)	**0.004**
Antibiotic				
Cefuroxime or cefazolin	811 (78.43%)	408 (81.27%)	403 (75.75%)	**0.031**
Vancomycin	23 (2.22%)	12 (2.39%)	11 (2.07%)	0.725
Cefuroxime and Vancomycin	133 (12.86%)	47 (9.36%)	86 (16.17%)	**0.001**
Ceftriaxone	19 (1.84%)	7 (1.39%)	12 (2.26%)	0.303
Other antibiotics	5 (0.48%)	3 (0.6%)	2 (0.38%)	0.608

the hospital at 1 month (12.22% vs. 8.57%, $p=0.055$) than patients with mild risk score (Table 1). Severe risk score died more in hospital and for all-cause than mild risk score (Hospital mortality: 3.38% vs. 1.39%, $p=0.037$; overall-cause: 16.92% vs. 10.36%, $p=0.002$).

Preoperative care

Preoperative variables of patients undergoing hip fracture repair are presented in Table 2. The number of patients admitted to the ICU preoperatively in the mild risk group was significantly lower compared to the severe risk group (1.39% vs. 3.95%, $p=0.011$). Furthermore, patients in the mild risk group received significantly fewer opioids than in the severe risk group (35.66% vs. 44.55%, $p=0.004$). Additionally, there was a significantly lower number of patients receiving preoperative cefuroxime and vancomycin in the mild risk group compared to the severe risk group (9.36% vs. 16.17%, $p=0.001$. Conversely, there was a significantly higher percentage of patients receiving preoperative cefuroxime or cefazolin in the mild risk group compared to the severe risk group (81.27% vs.

Table 3 Intraoperative variables of patients undergoing hip fracture repair

	Total	Mild systemic disease	Severe systemic	*p*-value
Anesthesia Type				0.974
Spinal Anesthesia	637 (61.61%)	309 (61.55%)	328 (61.65%)	
General Anesthesia	397 (38.39%)	193 (38.45%)	204 (38.35%)	
Fracture type				
Stable femoral neck fracture	49 (4.74%)	19 (3.78%)	30 (5.64%)	0.161
Unstable femoral neck fracture	283 (27.37%)	138 (27.49%)	145 (27.26%)	0.933
Stable intertrochanteric fracture	214 (20.70%)	112 (22.31%)	102 (19.17%)	0.213
Unstable intertrochanteric fracture	477 (46.13%)	227 (45.22%)	250 (46.99%)	0.568
Subtrochanteric fracture	11 (1.06%)	6 (1.2%)	5 (0.94%)	0.689
Fixation type				
Dynamic Hip Screw	65 (6.29%)	35 (6.97%)	30 (5.64%)	0.377
Intramedullary Nailing	664 (64.22%)	317 (63.15%)	347 (65.23%)	0.486
Hip Hemiarthroplasty	296 (28.635)	145 (28.88%)	151 (28.38%)	0.829
Total Hip Replacement	2 (0.19%)	2 (0.4%)	0 (0%)	0.145
Cannulated screws	7 (0.68%)	3 (0.6%)	4 (0.75%)	0.762
Cement status				0.996
Cemented	221 (74.16%)	109 (74.15%)	112 (74.17%)	
Cementless	77 (25.84%)	38 (25.85%)	39 (25.83%)	
Hemiarthroplasty type				0.391
Unipolar	42 (14.19%)	18 (12.41%)	24 (15.85%)	
Bipolar	254 (85.81%)	127 (87.59%)	127 (84.11%)	

Table 4 Postoperative variables of patients undergoing hip fracture repair

	Total	Mild systemic disease	Severe systemic	*p*-value
ICU admission	112 (10.83%)	31 (6.18%)	81 (15.23%)	**< 0.001**
Blood Transfusion	370 (35.78%)	169 (33.67%)	201 (37.78%)	0.168
Analgesia used				
Paracetamol	1025 (99.13%)	499 (99.4%)	526 (98.87%)	0.359
Nonsteroidal Anti-Inflammatory Drugs	12 (1.16%)	5 (1%)	7 (1.32%)	0.631
Opioids	622 (60.15%)	285 (56.77%)	337 (63.35%)	**0.031**
Hemoglobin (g/dl)	10.3 (11.4–9.2)	10.3 (11.4–9.2)	10.4 (11.4–9.3)	0.7753
Deep Vein Thrombosis/ Pulmonary Embolism	25 (2.42%)	7 (1.39%)	18 (3.39%)	**0.037**
Duration of hospital stay (days)	6 (9 – 5)	6 (8 – 4)	7 (9 – 5)	0.0002
Readmission at one month	108 (10.44%)	43 (8.57%)	65 (12.22%)	0.055
Cause of Readmission				0.156
Medical Issue	83 (76.85%)	30 (69.77%)	53 (81.54%)	
Fracture/Operation Related	25 (23.15%)	13 (30.23%)	12 (18.46%)	
Revision for same operation	27 (2.61%)	13 (2.59%)	14 (2.63%)	0.9660
Cause of revision				0.183
Metal failure	13 (50%)	5 (41.67%)	8 (57.14%)	
Dislocation	4 (15.38%)	3 (25%)	1 (7.14%)	
Infection	7 (26.92%)	2 (16.67%)	5 (35.71%)	
Periprosthetic fracture	2 (7.69%)	2 (16.67%)	0 (0%)	

75.75%, $p=0.031$). Hemoglobin levels, as well as other administered drugs, were comparable between groups.

Intraoperative care

Intraoperative variables of patients undergoing hip fracture repair are presented in Table 3. The variables discussed include type of anesthesia used, type of fracture operated, fixation type, status of cement, as well as type of hemiarthroplasty (HEMI). All mentioned intraoperative variables were comparable between both severity groups, with no statistical significance observed.

Postoperative care

Postoperative variables of patients undergoing hip fracture repair are summarized in Table 4. Postoperative ICU admissions were significantly lower in the mild risk group compared to the severe risk group (6.18% vs. 15.23%, $p<0.001$). Additionally, there was a significantly lower number of patients receiving postoperative opioid in the mild risk group compared to the severe risk group (56.77% vs. 63.35%, $p=0.031$). Other postoperative variables, including blood transfusion, other types of analgesia used, and hemoglobin levels were comparable between both severity risk groups.

Factors associated with higher ASA score

At univariate analysis, factors associated with a higher ASA are reported in Additional file 1: S1. In the multivariable model, independent risk factors for higher ASA were age (OR=1.09 95% CI 1.05–1.14, $p<0.001$), pulmonary diseases (OR=30.78 95% CI 10.57–89.66, $p<0.001$), thyroid diseases (OR=19.94 95% CI 6.27–63.36, $p<0.001$), and renal failure (OR=918.71 95% CI 111.70–7556.52, $p<0.001$).

Effect of ASA score on all-cause mortality

According to multivariate COX regression model, higher ASA scores as well as higher age were independently associated with higher risk of all-cause mortality in comparison with lower ASA scores (ASA: HR=1.64 95%CI 1.15–2.34, $p=0.006$; age: HR=1.04 95%CI 1.02–1.06, $p<0.001$). Pulmonary diseases, thyroid diseases, and renal failure were not independently associated with all-cause mortality (pulmonary diseases: HR=1.66 95%CI 0.83–3.29, $p=0.15$; thyroid diseases: HR=0.71 95%CI 0.29–1.75, $p=0.46$; renal failure: HR=0.31 95%CI 0.57–1.84, $p=0.95$) (Additional file 1: S2).

Effect of ASA score on postoperative complications

At multivariate logistic regression model, a higher ASA score was independently associated with thromboembolic complications, with a threefold increased risk as compared with mild ASA group (OR=2.85 95% CI 1.16-7.00, $p=0.022$). Higher age, pulmonary diseases, thyroid diseases, and renal failure were not independently associated with thromboembolic complications (age: OR=1 95% CI 0.95–1.06, $p=0.78$; renal failure: OR=0.74 95% CI 0.17–3.32, $p=0.70$) (Additional file 1: S3).

Higher ASA scores were independently associated with increased risk for readmission at 1 month as compared with lower ASA scores (OR=1.53 95% CI 1.00-2.33, $p=0.05$). Higher age, pulmonary diseases, thyroid diseases, and renal failure were not independently associated with readmissions at 1 month (age: OR=0.99 95% CI 0.96–1.02, $p=0.45$; pulmonary diseases: OR=0.77 95% CI 0.27–2.21, $p=0.62$; thyroid diseases: OR=0.93 95% CI 0.36–2.42, $p=0.88$; renal failure: OR=0.93 95% CI 0.44–1.97, $p=0.85$) (Additional file 1: S4).

Higher ASA scores were not independently associated with increased risk for revision for the same operation as compared with lower ASA scores (OR=0.87 95% CI 0.38–1.99, $p=0.75$). Higher age, pulmonary diseases, thyroid diseases, and renal failure were also not independently associated with revisions for the same operation (age: OR=0.97 95% CI 0.91–1.02, $p=0.23$; pulmonary diseases: OR=3.00 95% CI 0.84–10.71, $p=0.09$; thyroid diseases: OR=2.92 95% CI 0.82–10.35, $p=0.1$; renal failure: OR=0.97 95% CI 0.21–4.44, $p=0.97$) (Additional file 1: S5).

Higher ASA scores were independently associated with a 1.04-fold longer hospital stay (OR=1.04 95%CI 0.40–1.67, $p=0.001$). Higher age, pulmonary diseases, thyroid diseases, and renal failure were not independently associated with revisions for the same operation (age: OR=0.03 95%CI -0.0.1–0.07, $p=0.19$; pulmonary diseases: OR=0.28 95%CI -1.24-1.8, $p=0.72$; thyroid diseases: OR=-0.88 95%CI -2.35-0.58, $p=0.24$; renal failure: OR=-0.23 95%CI -1.42-0.95, $p=0.70$) (Additional file 1: S6).

Discussion

This research investigated the clinical features and outcomes of individuals who underwent surgery for hip fracture repair at a tertiary care hospital in Jordan. Our results show that [1] among our study population, 48.5% of patients were classified as having a mild anesthetic risk, while 51.5% were classified as having severe risk. [2] Higher ASA scores were independently associated with higher all-cause mortality compared to those with a mild anesthetic risk. [3] Patients with a higher ASA score experienced a nearly threefold increase in thrombotic risk, higher readmission rates at one month, and 1.04-fold longer hospital stay when compared to those with lower ASA scores. [4] Moreover, age, pulmonary diseases, thyroid diseases, and renal failure were identified as independent risk factors contributing to higher ASA scores.

The main strength of this study lies in its detailed description of patients undergoing surgery following hip fractures and the investigation between ASA status and clinical outcomes. We acknowledge that a higher ASA score correlates with increased comorbidities, medication use, and hospitalization duration. What sets our study apart is its finding that ASA class in surgical patients undergoing hip fracture repair may independently correlate with severe complications and death.

This underscores the need to reevaluate the rationale for surgery and anesthesia in this patient group and to design a perioperative path that is suitable for the level of risk. Moreover, our study provides comprehensive information on preoperative factors, intraoperative variables, and postoperative outcomes concerning the severity of a patient's systemic disease, as classified by the ASA clinical status. Such data is essential for understanding risk factors, surgery-related variables, their association with the patient's physical status, and evaluating mortality risk

[12]. Notably, previous studies in Jordan have touched on this topic, but none have specifically investigated the relationship between disease severity in elderly patients and its influence on postoperative complications and outcomes [13–16].

Our study, involving 1033 patients undergoing hip fracture surgery, revealed significant differences in clinical outcomes between patients with mild and severe anesthetic risk scores. In the severe category, there was a predominance of males and smokers, while females were more common in the mild category, consistent with previous research [17, 18]. As predictable according to the design of ASA classification, fewer comorbidities were noted among patients with milder disease, whereas higher ASA scores had increased prevalence of conditions like diabetes, hypertension [2, 19, 20] and cardiovascular disorders [2, 17, 19]. Moreover, patients in the mild disease group were treated less frequently with different anticoagulant/ antiaggregant drugs. This contrasts with previous studies, as Sidhu et al. where aspirin or enoxaparin were used more frequently in ASA II patients (59.17%) compared to ASA III and ASA IV patients combined (56.83%) [21]. This can be due to the difference practices across countries about preventive or therapeutic use of anticoagulant/ antiaggregant medications.

This study revealed significant disparities in disease severity based on gender and smoking status, with a higher proportion of males and smokers in the severe category and more females in the mild category, consistent with previous research. Endo et al. also observed variations in post-operative outcomes between men and women undergoing hip fracture surgery. Men tended to have more severe systemic diseases and higher ASA scores, and they were more likely to experience postoperative medical complications. Additionally, male gender was associated with higher mortality rates, even after adjusting for ASA score, suggesting that other factors, such as gender, should be considered alongside ASA score in predicting mortality [22].

A higher ASA score was independently associated with increased all-cause mortality. Additionally, the study's findings on mortality and risk factors for mortality, particularly the role of ASA score and age, contribute to the ongoing debate on the ethics and practicalities of surgical interventions in elderly and high-risk populations [23]. They underscore the need for a balanced approach that weighs the potential benefits of surgery against the risks, especially in light of the significant mortality rates observed [23]. This is in concordance with the literature, as Yeoh et al. found increasing mortality with higher ASA scores [19]. Chen et al. also found that the mortality rate within 12 months post discharge for patients with ASA grade III was 8.1%, compared to patients with ASA grade II, which was only 3.1% [17]. Johansen et al. also found that mortality rates in-hospital were 1.8% for patients graded as ASA I or ASA II, compared to 16.5% in patients graded as ASA IV [24]. Ji et al. found similar results regarding in-hospital mortality as well [25].

Furthermore, higher ASA scores were independently linked to an elevated risk of thromboembolic complications and prolonged hospital stays. These findings prompt a discussion on the multifaceted nature of surgical patient risk. Firstly, the distinct outcome disparities based on ASA scores emphasize the importance of integrating such scoring systems into preoperative planning. Beyond its prognostic value, the ASA score could guide resource allocation, such as intensive care units and specialized postoperative monitoring, toward those with greater needs. The association between higher ASA scores and thromboembolic complications was supported by Singh et al. [26] contrasting with other studies that found no significant link between ASA scores and venous thromboembolism (VTE) risk [26–28]. These differing results underscore the need for a deeper understanding of patient-specific factors influencing this relationship, warranting further investigation. Notably, while certain comorbidities like pulmonary diseases, thyroid diseases, and renal failure elevate ASA scores, they do not independently predict thromboembolic events or readmission rates. This dissonance highlights the ASA score's value as a comprehensive measure of patient risk, encompassing the combined impact of various health conditions on surgical outcomes. Our analysis suggests that higher ASA scores may also predict a higher probability of hospital readmission within a month following hip surgery, consistent with Meyer et al.'s findings on ASA scores as predictors of hospital readmissions, although the exact timeframe for readmission post-surgery was not specified [29]. Additionally, our research contributes to the discussion on healthcare resource utilization, as evidenced by longer hospital stays associated with higher ASA scores. This finding is supported by Ahmad et al., who observed a mean hospital stay extension of 1.7 days for patients classified under ASA III compared to those under ASA II [30].

A study by Paul et al. investigated the effect of concomitant femoral fractures on the outcomes of patients with traumatic brain injuries (TBI) [31]. It showed that patients with both TBI and femoral fractures had higher in-hospital mortality rates and worse outcomes at discharge compared to those with isolated TBI. Moreover, the presence of a femoral fracture led to prolonged ICU and hospital stays and increased the risk of complications during the hospital stay, such as multi-organ failure, sepsis, and thromboembolic events. These findings highlight the need for special attention and tailored treatment strategies for TBI patients with concomitant femoral fractures, given the substantial impact on their overall prognosis and recovery trajectory.

Giusti et al. prospectively evaluated 236 hip-fractured older adults and found a higher rate of both single and multiple post-operative readmissions with higher Cumulative Illness Rating Scale (CIRS) scores. Most readmissions were due to non-surgical causes, including heart failure, stroke, and pneumonia, indicating that disease severity predicts post-operative readmissions [32]. Palm et al. implemented the Hvidovre algorithm for patients undergoing hip fracture surgery, predicting that ASA scores III-IV are associated with a higher risk of reoperation within 1 year [33].

Furthermore, the study suggests reconsidering management strategies for patients with high comorbidity burdens. Given the increased risks associated with severe anesthetic risk scores, there may be a need for more aggressive preoperative optimization of medical conditions, enhanced intraoperative monitoring, and vigilant postoperative care. This could include more tailored pharmacological interventions, considering the significant differences in medication usage observed between the mild and severe risk groups [30]. Wolters et al. found that multiple intraoperative and postoperative factors, including blood loss during the operation, ICU stay duration, post-op ventilation, and cardiac and pulmonary complications, increased with higher ASA scores, supporting the need to plan and direct management based on patients' physical status, focusing on delivering ventilation and circulatory support to those with higher ASA scores [34].

Patients with severe anesthetic risk encounter more adverse outcomes compared to their mild-risk counterparts. This is evident in the higher prevalence of comorbidities, increased medication usage, notably aspirin, clopidogrel, and other anticoagulants, as well as steroids, and higher rates of ICU admissions and thromboembolic events. Ji et al. found that 47.6% of patients in the ASA II group, 80% of the ASA III group, and 100% of the ASA IV group required ICU care [25]. Shahrokni et al. also found similar results, as the 30-day ICU admission rate was merely 3.1% for ASA II patients, 5% for ASA III patients, and 11.5% for ASA IV patients [35]. Moreover, these patients experienced longer hospital stays and elevated readmission and mortality rates. Such outcomes spotlight the critical role of comprehensive preoperative assessment in identifying high-risk patients and tailoring perioperative care to mitigate risks [32].

Intraoperative variables were comparable between severity groups. This raises intriguing theoretical considerations, suggesting that while the intraoperative phase might not differentially impact the two groups, the preoperative and postoperative care strategies play a pivotal role in determining patient outcomes. This insight emphasizes the importance of a holistic, continuum-of-care approach that extends beyond the surgical procedure itself. Additionally, Newman et al. studied the relationship between allogenic blood transfusions and reoperations due to suspected infection Following Total Knee and Total Hip Arthroplasty, and even allogeneic exposure alone did increase rates of reoperation, additional factors including an ASA score larger than II as well as the number of transfused units did cause a significant increase in these rates [36].

We propose that ASA scores encompass a wide range of patient vulnerabilities, from inherent physiological risks to the complexities of postoperative recovery and healthcare system interactions. This viewpoint calls for a reassessment of how ASA scores are incorporated into clinical decision-making, advocating for a comprehensive approach that considers both measurable health metrics and the nuanced realities of patient care [20, 30]. Regarding long-term outcomes, the findings of Michel et al. were consistent with existing literature regarding ASA's predictive value for mortality. However, analysis of postoperative functional outcomes, including mobility recovery and quality of daily activities, did not show statistically significant differences across severity groups. Predictors of functional outcomes included older age, frequent hospitalizations, and longer hospital stays, but ASA scores were not predictive of these outcomes nor statistically correlated with functional recovery [20]. Furthermore, Kastanis et al. prospectively analyzed 198 elderly patients following hip fracture surgery. Patients with ASA score II was associated with less severe postoperative complications, such as urinary tract infections. However, patients with higher ASA scores suffered additional complications including cutaneous ulcers, congestive heart failure, pneumonia, and pulmonary embolism. It is worth noting that the most common complications reported in all patients were hypertension and fluid-electrolyte disorders, meaning that the ASA scoring system can be a useful predictive tool for cardiopulmonary complications as well as cutaneous ulcers [2].

In summary, this study not only provides valuable empirical insights into the disparities in clinical outcomes among hip fracture surgery patients but also lays the groundwork for theoretical advancements in perioperative care. It highlights the importance of comprehensive risk assessment, underscores the potential of the ASA score as a predictive tool, and calls for a nuanced understanding of patient management strategies. As healthcare continues to evolve, such research underscores the imperative of tailoring surgical and perioperative care to the unique risks and needs of individual patients, thereby enhancing outcomes and optimizing resource allocation.

Limitations

This paper has multiple limitations to address. First, conditions like osteoporosis, which have risk factors including multiparity, racial background, menopause, and family history were not reported in patients' records. Additionally, we have no information on the incidence and mechanism of individual fractures, nor on factors that may have influenced them, including drugs or vitamin D deficiency. Furthermore, no data was available on any patients who were not managed surgically, nor the reason for their choice of management. Results may also contain a level of bias due to lack of information regarding patients' certain pre-existing diseases like coagulopathies.

Specific data on which medications, including which type of steroids, opioids, anticoagulants, or antibiotics were used, is also unavailable. Moreover, there was insufficient data from previous studies correlating different perioperative factors with disease severity. Many studies which did include ASA severity scoring were not specific enough to differentiate between mild and severe systemic disease and did not categorize different ASA grades individually. Additional larger randomized controlled trials (RCTs) are required and should take these factors into account when designing clinical trials.

Conclusion

This retrospective study highlights the significant impact of anesthetic risk, as categorized by the ASA Physical Status Classification System, on the outcomes of hip fracture surgeries. Key findings demonstrate that patients with higher ASA scores, indicating more severe systemic disease, face increased risks of adverse outcomes, including longer hospital stays, higher ICU admissions, and increased mortality rates. These risks are compounded by the presence of comorbidities and the use of specific medications, such as certain anticoagulants and steroids.

Despite similar intraoperative care across different ASA categories, the study reveals that pre-existing health conditions significantly influence postoperative outcomes. This underscores the importance of tailored preoperative preparation and postoperative management for patients based on their individual health profiles and anesthetic risks. The findings advocate for more detailed research in this area to further refine and improve patient care strategies for those undergoing hip fracture surgeries.

Abbreviations

ASA American Society of Anesthesiologists
IRB Institutional Review Board
ICU Intensive Care Unit
DVT Deep Vein Thrombosis
PE Pulmonary Embolism
IQR Interquartile Range
HEMI Hemiarthroplasty
OR Odds Ratio
CI Confidence Interval
HR Hazard Ratio
RCTs Randomized Controlled Trials

Supplementary Information

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Supplementary Material 1

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Author contributions

Conceptualization was carried out by LA-H and SA. Formal analysis was conducted by SAS and LAH. Methodology and data collection were managed by MA, ZAM, ARB, AH, SG, and AA. LA-H was responsible for supervision. The original draft was written by AB, AAz, SDR, and DB, while review and editing were undertaken by LA-H, SA, SDR, and DB.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study received ethical approval from the Yarmouk University Institutional Review Board in Irbid, Jordan (IRB Reference: IRB/2023/643) and adhere to the principles of Good Clinical Practice and the Declaration of Helsinki guidelines.

Consent for publication

The requirement for informed consent was waived by the Institutional Review Board of Yarmouk University because the work involves existing retrospective data.

Competing interests

The authors declare no competing interests.

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