

The Relationship Between Systemic Immuno-Inflammation Index/Albumin Ratio and C-Reactive Protein/Albumin Ratio and In-Hospital Mortality in Geriatric Hip Fracture Patients: A Retrospective Cohort Study

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Research Article

Keywords: Hip Fractures, systemic immune-inflammation index, critically ill elderly patients, C-reactive protein, albumin, prognostic value, in-hospital mortality

Posted Date: April 19th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9227029/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background

Geriatric hip fractures are one of the leading causes of morbidity and mortality. The systemic inflammatory response following hip fracture and the accompanying malnutrition are influential in prognosis. The aim of this study is to investigate the relationship between the systemic immune inflammation index/albumin (SII/Alb) ratio and the C-reactive protein/albumin (CRP/Alb) ratio at admission and in-hospital mortality in patients who underwent surgery for geriatric hip fracture and were followed up in the intensive care unit (ICU) in the postoperative period.

Methods

This retrospective observational study, conducted at a tertiary hospital between January 2023 and January 2025, included patients who underwent surgery for hip fracture and were followed in the ICU postoperatively. Demographic data, comorbidities, ICU scores, and routine laboratory results at admission were recorded. SII/Alb and CRP/Alb ratios were calculated. The primary endpoint was defined as in-hospital mortality. Multivariate logistic regression was used to identify independent predictors, and receiver operating characteristic (ROC) analyses were used to assess prognostic performance.

Results

A total of 233 patients were included in the study. The in-hospital mortality rate was 7.7%. Age and male sex were significantly higher in the mortality group ($p = 0.042$ and $p = 0.024$, respectively). Median SII (4464 vs. 2253, $p = 0.001$), SII/Alb (1767 vs. 745, $p < 0.001$), and CRP/Alb (21.7 vs. 6.2, $p = 0.001$) values were significantly higher in the mortality group. In multivariate regression analysis, SII/Alb (OR = 1.003; $p = 0.019$), CRP/Alb (OR = 1.077; $p = 0.010$), and the acute physiology and chronic health evaluation-II (APACHE-II) score (OR = 1.225; $p < 0.001$) were identified as independent predictors of in-hospital mortality. ROC analysis showed that the area under the curve (AUC) was 0.873 for APACHE-II, 0.794 for SII/Alb, 0.736 for SII, and 0.727 for the CRP/Alb ratio.

Conclusions

In critically ill geriatric patients with hip fractures, the SII/Alb and CRP/Alb ratios at admission are effective and easily accessible biomarkers for predicting in-hospital

mortality. These biomarkers may be useful for early risk stratification and clinical decision-making.

Introduction

Geriatric hip fractures are among the leading causes of trauma-related morbidity and mortality in older adults. Despite advances in surgical techniques and perioperative care, early complications and the risk of death remain major challenges in clinical practice. Although a decline in mortality rates has been observed with the development of modern medicine, the 1-year mortality rate after hip fracture is still reported to be 17–25% [1–3]. In critically ill geriatric patients, a multisystem clinical condition emerges in which the fracture-triggered systemic stress response, inflammation, immobilization, and comorbidity burden converge. Therefore, early risk stratification using rapid and low-cost biomarkers capable of predicting short-term outcomes such as in-hospital mortality is of critical importance. This approach is also beneficial for anticipating the need for intensive care, perioperative optimization, and healthcare resource planning [4].

The systemic inflammatory response following hip fracture and the accompanying tendency toward malnutrition and sarcopenia are among the main determinants of prognosis. The C-reactive protein/albumin ratio (CRP/Alb), which can be derived from routine blood tests, has gained increasing attention because it combines an inflammatory marker (CRP) with a nutritional/reserve indicator (albumin) in a single measurement. In the geriatric population, the CRP/Alb ratio has been reported to have both short- and long-term prognostic value [5,6]. In geriatric patients undergoing hemiarthroplasty for hip fracture, the CRP/Alb ratio has been shown to be an independent predictor of 1-year mortality [6]. On the other hand, the systemic immune-inflammation index (SII; platelet $\times$ neutrophil / lymphocyte), calculated from complete blood count parameters, is a useful index reflecting both inflammatory activity and suppression of the immune response. SII has been suggested to have prognostic value in critically injured trauma patients and in patients with hip fractures [7,8].

In critically ill geriatric patients with hip fractures, nutritional status is also known to have prognostic value [9]. Based on this, a single inflammatory marker may be insufficient to determine prognosis in elderly patients with hip fractures; therefore, it is considered that calculating SII in relation to albumin (SII/Alb), which integrates both inflammation and nutritional status, may provide a more comprehensive assessment [10]. Although only a limited number of studies have investigated the prognostic value of the SII/Alb ratio, there is a lack of sufficient evidence regarding its prognostic significance specifically in geriatric patients with hip fractures. Given the prominent role of both inflammation and the high prevalence of malnutrition in this population, we hypothesized that the SII/Alb ratio could influence postoperative outcomes in geriatric patients with hip fractures. Accordingly, the

aim of this retrospective observational study was to evaluate the prognostic value of the admission SII/Alb and CRP/Alb ratios for in-hospital mortality in geriatric patients who underwent surgery for hip fracture and were subsequently followed in the intensive care unit (ICU) during the postoperative period.

Methods

Patients and Study Design

This retrospective observational study was initiated after obtaining approval from the institutional ethics committee (date: 25.06.2025, KAEK/2025.06.162). The study was conducted in accordance with the principles of the Declaration of Helsinki. Patients who underwent surgery for hip fracture and were followed in the ICU during the postoperative period between January 2023 and January 2025 at the University of Health Sciences, İstanbul Kanuni Sultan Süleyman Training and Research Hospital were included in the study. Patient data were obtained from the hospital information system and medical records.

The inclusion criteria were: (1) age ≥ 65 years; (2) undergoing surgery for hip fracture and being monitored in the ICU during the postoperative period.

The exclusion criteria were: (1) trauma at a site other than the hip fracture; (2) chronic kidney disease requiring dialysis; (3) severe liver disease; (4) malignancy; (5) use of medications that may cause bone marrow suppression; (6) cardiovascular depression or cardiac arrest during the perioperative period; (7) a history of viral or bacterial infection within the previous two weeks; and (8) missing data.

Data Collection

Demographic data, American Society of Anesthesiologist (ASA) physical status, comorbidities, admission Glasgow Coma Scale (GCS) score, acute physiology and chronic health evaluation-II (APACHE-II) score, routine laboratory parameters, and in-hospital mortality were recorded for geriatric patients who underwent hemiarthroplasty or proximal femoral nailing for hip fracture and were followed in the ICU during the postoperative period. Patients were classified into survivor and mortality groups, and the data were compared between these groups.

Systemic immune-inflammatory index / Albumin ratio

The SII/Alb ratio combines the SII, which reflects systemic inflammatory burden, with serum albumin levels, which are inversely related to inflammation, thereby providing a more comprehensive prognostic biomarker than indicators of inflammation or nutritional status alone. In traumatic orthopedic conditions such as geriatric hip fractures, the

interaction between the systemic inflammatory response and malnutrition plays a critical role in clinical outcomes, further enhancing the prognostic relevance of the SII/albumin ratio [11].

SII was calculated using complete blood count parameters obtained at ICU admission in the postoperative period as follows: $SII = (\text{platelet count} \times \text{neutrophil count}) / \text{lymphocyte count}$.

Subsequently, the SII/Alb ratio was calculated by dividing the SII value by the serum albumin level measured at the same time point: $SII/Alb = SII / Alb \text{ (g/dL)}$.

By integrating the systemic inflammatory and immune response burden reflected by SII with the nutritional/reserve status and inflammation-related negative acute-phase response represented by albumin, the SII/Alb ratio aims to provide a more holistic prognostic biomarker approach compared with inflammatory indices alone.

C-Reactive Protein/Albumin ratio

The CRP/Alb ratio integrates CRP, a positive marker of the acute-phase response, with albumin, a negative acute-phase reactant that decreases during inflammation, thereby reflecting the severity of systemic inflammation and the patient's biological reserve more comprehensively than CRP alone. In traumatic orthopedic conditions such as hip fractures, increased inflammatory response accompanied by hypoalbuminemia is closely associated with mortality and postoperative complications; therefore, the CRP/Alb ratio is used as a meaningful prognostic biomarker in this patient population (5). Similarly, CRP/Alb ratios were calculated at ICU admission using routine laboratory parameters according to the following formula:

$$CRP/Alb = CRP \text{ (mg/L)} / Alb \text{ (g/dL)}.$$

The primary endpoint of the study was defined as in-hospital mortality. Patients were classified into survivor and mortality groups according to in-hospital mortality. In this context, sample size calculation was performed using the G*Power 3.1 software. For t-tests, assuming $p < 0.05$, an effect size of 0.5, and a study power of 80%, a total of 128 patients were required to be included in the study. In this retrospective observational study, all patients who were followed during the 2-year period between the specified dates were included.

Statistical analysis

Statistical analysis was performed using SPSS software (SPSS Inc., Chicago, USA; version 26.0). The normality of data distribution was assessed using the Shapiro-Wilk test, histograms, and analysis of skewness and kurtosis values. Descriptive statistics were expressed as number of patients, percentage, mean $\pm$ standard deviation, or median

(interquartile range, IQR [Q1–Q3]) according to data distribution. For quantitative variables with normal distribution, the independent samples t-test was used, whereas the Mann–Whitney U test was applied for variables without normal distribution. Categorical variables were analyzed using the Pearson chi-square test or Fisher’s exact test, as appropriate. Multivariate logistic regression analysis was performed to identify independent predictors of mortality among variables that showed significant differences between the survivor and mortality groups. ROC curve analysis was conducted to determine the prognostic value of the SII/Alb and CRP/Alb ratios. A p-value <0.05 was considered statistically significant for all analyses.

Results

A total of 233 geriatric patients who were followed and treated in the ICU after hip fracture surgery between January 2023 and January 2025 were included in the study (Figure 1). The in-hospital mortality rate was 7.7% (n=18). The median age of the entire cohort was 81 (75–85) years, and 68.2% (n=159) were female. In the mortality group, median age (86 vs. 80 years, $p=0.042$) and the proportion of male patients (55.6% vs. 29.8%, $p=0.024$) were significantly higher. The proportion of patients with ASA physical status IV was significantly higher in the mortality group (33.3% vs. 5.1%, $p<0.001$), as was the median length of ICU stay (15 vs. 1 day, $p<0.001$). At ICU admission, median GCS scores were significantly lower (14 vs. 15, $p=0.003$), whereas APACHE-II scores were significantly higher (18 vs. 10, $p<0.001$) in the mortality group. The types of anesthesia administered to patients with hip fractures did not differ significantly between the groups (Table 1).

At ICU admission, routine laboratory results showed that mean hemoglobin (9.2 vs. 10.3 g/dL, $p=0.006$), mean albumin (2.5 vs. 3.0 g/dL, $p<0.001$), and median lymphocyte counts (1.1 vs. 1.4, $p=0.002$) were significantly lower in the mortality group. In contrast, median CRP (54.6 vs. 18.2 mg/L, $p=0.013$), creatinine (1.0 vs. 0.8 mg/dL, $p=0.017$), and base excess values (4.5 vs. 2.1, $p<0.001$) were significantly higher in the mortality group. Additionally, among inflammatory biomarkers, median SII (4464 vs. 2253, $p=0.001$), SII/Alb ratio (1767 vs. 745, $p<0.001$), and CRP/Alb ratio (21.7 vs. 6.2, $p=0.001$) were significantly higher in the mortality group (Table 1).

Hypertension was present in 69.1% (n=161) of the total population, neurocognitive disorders (stroke, Alzheimer’s disease, and Parkinson’s disease) in 40.3%, and diabetes mellitus in 34.3% (n=80). No significant differences in comorbid conditions were observed between the groups (Table 2).

Multivariate regression analysis was performed for biomarkers and scoring systems that showed significant differences between groups in ICU-treated hip fracture patients,

including the SII/Alb ratio, CRP/Alb ratio, SII, GCS, and APACHE-II scores. The Enter method was used in the multivariate regression analysis. SAR (OR=1.003, $p=0.019$), CAR (OR=1.077, $p=0.010$), and the APACHE-II score (OR=1.225, $p<0.001$) were identified as independent predictors of in-hospital mortality (Table 3).

When the prognostic values of the scores that differed significantly between groups were evaluated using ROC curve analysis, the cut-off value for SII/Alb ratio was $\geq 1,036$ with an area under the curve (AUC) of 0.794 (95% CI, 0.688–0.899); for CRP/Alb ratio, the cut-off value was ≥ 12 with an AUC of 0.727 (95% CI, 0.623–0.832); for SII, the cut-off value was $\geq 3,834$ with an AUC of 0.736 (95% CI, 0.617–0.854); for APACHE-II, the cut-off value was ≥ 16 with an AUC of 0.873 (95% CI, 0.784–0.961); and for the GCS score, the cut-off value was ≤ 13 with an AUC of 0.687 (95% CI, 0.198–0.428) (Table 4).

Discussion

In this study conducted at a tertiary hospital, we found that biomarkers reflecting both inflammatory and nutritional status at admission were strongly associated with in-hospital mortality in critically ill geriatric patients with hip fractures who were followed in the ICU during the postoperative period. In the mortality group, CRP, SII, CRP/albumin, and particularly the SII/albumin ratio were significantly higher, whereas albumin and lymphocyte levels were markedly lower, suggesting that the systemic inflammatory response following hip fracture, together with concomitant immune suppression and malnutrition, adversely affects prognosis. Moreover, the identification of the SII/Alb ratio and the CRP/Alb ratio as independent predictors of in-hospital mortality alongside the APACHE-II score in multivariate analysis indicates that these parameters reflect not only inflammatory burden but also physiological reserve, thereby contributing to early risk stratification. These findings support the notion that, in critically ill geriatric patients with hip fractures, the prediction of short-term mortality should not rely solely on clinical scoring systems but should also incorporate simple and readily available biomarkers that provide a holistic assessment of inflammation and nutritional status.

CRP is a fundamental acute-phase reactant that reflects the severity of the acute inflammatory response through interleukin-6-mediated hepatic synthesis and rises rapidly in the early period following trauma and surgery. Although CRP is one of the most widely used biomarkers reflecting the intensity of the acute inflammatory response after trauma and surgery, its prognostic power alone has been reported to be limited in the geriatric population due to age-related chronic inflammation, immunosenescence, and a high burden of comorbidities [12]. In geriatric patients with hip fractures, elevated CRP levels have been associated with the development of complications and increased mortality; however, chronic inflammation, comorbidity burden, and age-related immune dysfunction commonly observed in advanced age have been shown to limit the prognostic value of CRP

when used in isolation [13]. To overcome this limitation, the CRP/albumin ratio integrates the inflammatory burden with nutritional reserve into a single parameter, providing a stronger, more holistic prognostic assessment than CRP alone. Recent literature has demonstrated that CRP/albumin ratio is an independent predictor of both early and late mortality in geriatric patients with hip fractures and exhibits higher AUC values than CRP [13–15]. While cut-off values around 14 have been reported to significantly predict 30-day mortality in CRP/albumin ratio (12), other studies have reported a wide range of cut-off values, ranging from 11 to 29 [13–15]. This heterogeneity may be related to differences in patient populations and clinical severity. In our study, the ability of a CRP/albumin ratio cut-off value ≥ 12 to predict in-hospital mortality, along with the identification of CRP/albumin ratio as an independent predictor in multivariate analysis, indicates that CRP/albumin ratio is a strong and clinically applicable biomarker for determining short-term prognosis, particularly in critically ill geriatric patients with hip fractures admitted to the ICU. These findings highlight the inadequacy of traditional approaches relying solely on CRP and support the benefit of evaluating inflammation in conjunction with albumin levels in geriatric patients with hip fractures.

A substantial proportion of deaths following hip fracture have been shown to be related not to surgical technique but to early systemic complications and insufficient physiological reserve [16]. SII, which simultaneously reflects neutrophilia and thrombocytosis together with lymphopenia, provides an integrated assessment of inflammation and immune suppression and has recently been used for prognostic purposes in various patient populations [17,18]. In elderly patients, the acute inflammatory response triggered by fracture and surgical stress becomes more pronounced on a background of age-related immune dysfunction and chronic low-grade inflammation, thereby adversely affecting short-term prognosis [19]. Moreover, malnutrition and hypoalbuminemia, which are common in geriatric patients with hip fractures, are among the major factors that impair control of the inflammatory response and increase the risk of infection, organ dysfunction, and mortality [20]. Studies in geriatric patients with hip fractures have reported that elevated SII levels are associated with increased short- and long-term mortality [21]. Although the biological mechanisms linking SII to mortality have not been fully elucidated, they appear to be related to immune dysfunction and systemic inflammatory response. Following hip fracture, cytokine release increases, and neutrophil and macrophage accumulation occurs as a result of lymphocyte dysfunction. Injury, infection, or ischemia triggers a protective inflammatory response accompanied by thrombocytosis. In geriatric patients, reduced physiological reserve leads to an inadequate anti-inflammatory response against excessive proinflammatory cytokine release. This imbalance may result in prolonged systemic inflammation, organ dysfunction, and ultimately an increased risk of mortality. Thus, SII reflects not only the severity of inflammation but also the organism's capacity for immune homeostasis. However, considering the high prevalence of

hypoalbuminemia and malnutrition in the elderly population and their substantial impact on the intensity of the inflammatory response and clinical course, the prognostic sensitivity of SII when used alone may be limited. In this context, the significant association between the SII/albumin ratio and in-hospital mortality observed in our study highlights the importance of jointly evaluating the cellular inflammatory response and nutritional reserve.

In our study, the SII/Alb ratio demonstrated a higher discriminative ability for predicting in-hospital mortality compared with the CRP/Alb ratio (AUC: 0.794 vs. 0.727), suggesting that the combined evaluation of inflammatory response and nutritional reserve may be superior to unidimensional biomarkers. Although the CRP/Alb ratio reflects prognosis by integrating the acute-phase response with hypoalbuminemia, it is primarily based on an inflammation marker related to hepatic synthesis. In contrast, the SII/Alb ratio provides a more comprehensive biological profile by jointly assessing albumin with the cellular inflammatory response, which reflects neutrophil- and platelet-mediated innate immune activation and lymphocyte suppression. Recent studies in critically ill patients have reported that SII-based indices offer greater accuracy in predicting mortality than CRP-based ratios [22]. Particularly in the elderly population, the frequent presence of immunosenescence, lymphopenia, and hypoalbuminemia may limit the prognostic sensitivity of CRP/Alb, which relies solely on the acute-phase response. Contemporary cohort studies in trauma and orthopedic surgery patients have demonstrated that SII and its derivatives, which reflect cellular inflammation, predict short-term mortality more strongly than CRP-based biomarkers [23,24]. Although SII alone has been reported to be associated with mortality in geriatric patients with hip fractures [25,26], studies investigating the prognostic impact of the SII/Alb ratio (combining cellular inflammation with nutritional reserve) remain extremely limited. This scarcity of evidence renders the superior prognostic performance of the SII/Alb ratio over the CRP/Alb ratio in our study clinically and biologically meaningful. Considering the high prevalence of hypoalbuminemia, lymphopenia, and immunosenescence in elderly patients, the SII/Alb ratio may more accurately reflect mortality risk than the CRP/Alb ratio, which represents only the acute-phase response. Therefore, our findings support that the SII/Alb ratio may represent not merely an alternative but potentially a superior prognostic biomarker to the CRP/Alb ratio in critically ill geriatric patients with hip fractures and may be useful for early risk stratification.

This study has several limitations. First, the retrospective and single-center design limits the ability to establish causal relationships and reduces the generalizability of the findings. Second, the inclusion of only geriatric patients with hip fractures who were followed in the ICU during the postoperative period may have excluded patients with a milder clinical course, potentially introducing selection bias. Third, inflammatory biomarkers were evaluated using a single measurement obtained at ICU admission, and dynamic

perioperative changes could not be assessed through serial measurements. In addition, albumin levels may be influenced by factors such as acute inflammatory response, fluid therapy, and hemodilution, and therefore may not accurately reflect true nutritional status. The effects of comorbidity burden and perioperative complications (e.g., sepsis or multiple organ failure) on inflammatory biomarkers could not be fully standardized. Finally, functional outcomes and long-term survival data beyond in-hospital mortality were not evaluated. Consequently, the present findings should be validated by prospective, multicenter studies including larger patient populations.

Conclusion

In conclusion, in critically ill geriatric patients with hip fractures who were followed in the ICU during the postoperative period, the admission SII/Alb and CRP/Alb ratios are useful and independent biomarkers for predicting in-hospital mortality. Notably, the higher discriminative ability of the SII/Alb ratio compared with the CRP/Alb ratio suggests that the combined assessment of cellular inflammation and nutritional reserve may be clinically valuable for early risk stratification.

Abbreviations

SII: Systemic immune inflammation index, Alb: Albumin, C-reactive protein: CRP, ICU: Intensive care unit, ROC: Receiver operating characteristic, APACHE-II: Acute physiology and chronic health evaluation-II, AUC: Area under curve, ASA: American Society of Anesthesiologist, IQR: interquartile range, GCS: Glasgow Coma Scale.

Declarations

Ethics approval and consent to participate

This single-center retrospective observational study was approved by the Institutional Review Board at University of Health Sciences, Istanbul Kanuni Sultan Süleyman Training and Research Hospital (approval number: KAEK/2025.06.162, June 25, 2025) and the need for written informed consent was waived.

Clinical trial number: Not applicable

Funding Declaration: Not Applicable

Consent for publication: Not Applicable

Availability of Data and Materials

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

Competing interests

The authors declare no conflicts of interest.

Authors' contributions

KA and ASS helped to design and conduct the study. KA analysed the data and approved the final manuscript. KA and ASS helped to design and conduct the study. KA and ASS and handed in the final manuscript. The authors read and approved the final manuscript

Acknowledgements: Not Applicable

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Tables

Table 1. Patient clinical characteristics and laboratory data

Variable	All population (n=233)	Survivor group (n=215)	Mortality group (n=18)	p-value
Age (y)	81 (75-85)	80 (75-85)	86 (75-91)	0.042
Sex, n (%)				0.024
Female	159 (68.2)	151 (70.2)	8 (44.4)	
Male	74 (31.8)	64 (29.8)	10 (55.6)	
ASA status				<0.001
II	11 (4.7)	11 (5.1)	0	
III	205 (88)	193 (89.8)	12 (66.7)	
IV	17 (7.3)	11 (5.1)	6 (33.3)	
Duration of ICU (days)	1 (1-3)	1 (1-3)	15 (2-24)	<0.001
Laboratory parameters				
Hemoglobin (g/dL)	10.2±1.6	10.3±1.7	9.2±1.1	0.006
Albumin (g/dL)	3.0±0.4	3.0±0.4	2.5±0.5	<0.001
CRP (mg/L)	19 (7.9-53.9)	18.2 (6.9-50.3)	54.6 (13.9-66.1)	0.013
Lenfocyte (10 ⁹ /L)	1.3 (1.0-1.8)	1.4 (1.0-1.8)	1.1 (0.8-1.2)	0.002
SII	2384 (1440-3777)	2253 (1405-3579)	4464 (2484-6282)	0.001
SII/Albumin	771 (456-1307)	745 (440-1189)	1767 (115-2690)	<0.001
CRP/Albumin	6.3 (2.5-17.9)	6.2 (2.3-16.6)	21.7 (6.2-25.4)	0.001
Creatinine (mg/dL)	0.8 (0.6-1.2)	0.8 (0.6-1.2)	1.0 (0.9-1.8)	0.017
Neutrophil (10 ⁹ /L)	11.2 (8.6-14.9)	11.1 (8.5-14.8)	13.8 (9.6-17.7)	0.118
Platelets (10 ⁹ /L)	285±110	281±111	333±81	0.056
Lactate (mmol/L)	1.6 (1.2-	1.6 (1.2-	1.8 (1.2-3.1)	0.310

	2.3)	2.2)		
INR	1.11 (1.04-1.19)	1.11 (1.04-1.19)	1.21 (1.05-1.28)	0.058
Base deficit	2.4 (1.0-4.3)	2.1 (1.0-4.0)	4.5 (3.7-8.9)	<0.001
Urea	49.3±19.1	49.0±20.3	55.8±14.1	0.168
GFR (mL/dk/1.73 m²)	68.6±19.1	69.2±23.6	62.1±13.3	0.210
ALT (U/L)	15 (10-22)	14 (10-21)	25 (11-35)	0.06
AST (U/L)	24 (18-32)	23 (18-32)	25 (16-29)	0.461
Scores				
GCS	15 (13-15)	15 (14-15)	14 (12-14)	0.003
APACHE-II	10 (8-13)	10 (8-13)	18 (15-28)	<0.001
Anesthesia type				
Spinal anesthesia	54 (23.2)	49 (22.8)	5 (27.8)	0.574
Spinal anesthesia and peripheral nerve block*	148 (63.5)	140 (65.1)	8 (44.4)	0.08
Combined spinal-epidural anesthesia	9 (3.9)	7 (3.3)	2 (11.1)	0.147
General anesthesia and peripheral nerve block*	13 (5.6)	11 (5.1)	2 (11.1)	0.265

Data are expressed as number of patients, percentage, mean±standart deviation and median (interquartile range=Q1-Q3).

ASA: American society of anesthesiologist, **ICU:** Intensive care unit, **CRP:** C-Reactive Protein, **SII:** Systemic immün-inflammation index, **INR:** International normalized ratio, **GFR:** Glomerular filtration rate, **GCS:** Glasgow coma scale, **APACHE-II:** Acute Physiology and Chronic Health Assessment-II

Table 2. Comorbid diseases

Comorbidity, n (%)	Overall (n=226)	Survivor group (n=207)	Mortality group (n=19)	p-value
Hypertension	161 (69.1)	147 (68.4)	14 (77.8)	0.407
Stroke/Alzheimer/Parkinson	94 (40.3)	84 (39.1)	10 (55.6)	0.171
Diabetes	80 (34.3)	72 (33.5)	8 (44.4)	0.347
CVD/HF	75 (32.2)	71 (33.0)	4 (22.2)	0.346
Asthma /COPD	30 (12.9)	26 (12.1)	4 (22.2)	0.262

CVD/HF: Coronary vascular disease/heart failure, **COPD:** Chronic obstructive pulmonary disease

Table 3. Multivariate logistic regression analysis of mortality prediction

	Odds Ratio	95% CI (min-max)	p-value
SII/Alb	1.003	1.000-1.005	0.019
CRP/Alb	1.077	1.018-1.139	0.010
SII	0.999	0.998-1.000	0.051
APACHE-II	1.225	1.106-1.357	<0.001
GCS	1.003	0.638-1.577	0.989

CI: Confidence interval, **SII/Alb:** Systemic-immune inflammation index/albumin ratio, **CRP/Alb:** C-reactive protein/albumin ratio, **SII:** Systemic-immune inflammation index, **APACHE-II:** Acute Physiology and Chronic Health Assessment-II score, **GCS:** Glasgow coma scale score

Table 4. Prognostic performance of scores and biomarkers

	Cut-off	Sensitivity	Specificity	AUC (95% CI)
SII/Alb	1036	0.833	0.693	0.794 (0.688-0.899)
CRP/Alb	12	0.722	0.674	0.727 (0.623-0.832)
SII	3834	0.667	0.791	0.736 (0.617-0.854)
APACHE-II	16	0.778	0.912	0.873 (0.784-0.961)
GCS	13	0.556	0.242	0.687 (0.198-0.428)

AUC: Area under curve, **SII/Alb:** Systemic-immune inflammation index/albumin ratio, **CRP/Alb:** C-reactive protein/albumin ratio, **APACHE-II:** Acute Physiology and Chronic Health Assessment-II, **GCS:** Glasgow coma scale

Figures

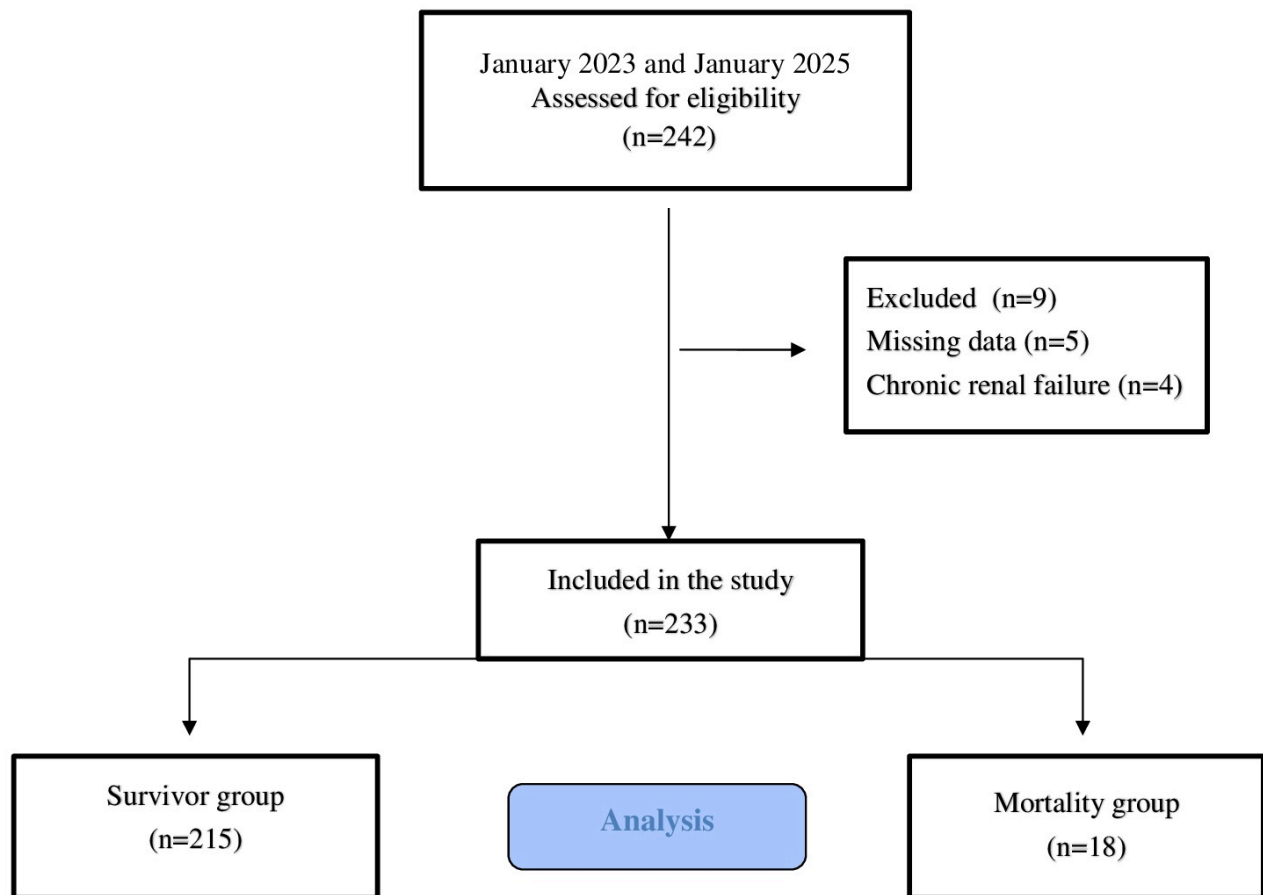


Figure 1

Legend not included with this version.

