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Research Article

Predictors of Adverse Postoperative Outcomes Following Emergency Laparotomy: A Prospective Observational Study

Vakamudi prakash[1], Tandri shyam sundar[2*]
[1]Associate Professor in the Department of General surgery, Narayana Medical College, Nellore.
[2*]Associate professor in the Department of General surgery, Narayana Medical College, Nellore.
Correspondence Author: Dr. Tandri shyam sundar
Associate Professor, Dept. of General surgery, Narayana Medical College & Hospital, Nellore, Andhra Pradesh 524003, India.
Email: anandendreddy@gmail.com
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ABSTRACT
Background: Emergency laparotomy remains one of the most frequently performed procedures in general surgery and is associated with significant postoperative morbidity and mortality. Identifying clinical and biochemical predictors of adverse outcomes may help in early risk stratification and improved perioperative management. This study aimed to evaluate predictors of postoperative morbidity and mortality in patients undergoing emergency laparotomy.
Methods: This prospective observational study was conducted over a period of 18 months in a tertiary care hospital and included 150 patients undergoing emergency laparotomy. Patients aged >18 years undergoing surgery for acute abdominal conditions were included. Demographic variables, comorbidities, preoperative laboratory parameters, operative findings, and perioperative variables were recorded. Postoperative outcomes including complications and mortality within 30 days were analyzed. Statistical analysis was performed using Chi-square test, Student's t-test, and multivariate logistic regression analysis. A p value <0.05 was considered statistically significant.
Results: A total of 150 patients underwent emergency laparotomy (mean age 48.6 ± 16.3 years; 62.7% males). The main indications were perforation peritonitis (46.7%), intestinal obstruction (30.0%), and trauma (14.0%). Overall morbidity occurred in 63 patients (42.0%), while 30-day mortality was 12.0% (n = 18). Common complications included surgical site infection (18.0%), respiratory complications (10.0%), intra-abdominal sepsis (7.3%), and anastomotic leak (6.7%).Univariate analysis showed significant associations between morbidity and age >60 years (x^2 = 8.41, p = 0.003), albumin <3.5 g/dL (x^2 = 10.72, p = 0.001), ASA ≥III (x^2 = 12.36, p <0.001), delay to surgery >24 h (x^2 = 6.18, p = 0.013), and operative duration >2 h (t = 2.64, p = 0.009). Multivariate analysis identified ASA ≥III (OR 4.08) and hypoalbuminemia (OR 3.21) as independent predictors. Mortality correlated with age >60 years (p = 0.007), preoperative sepsis (p = 0.003), and albumin <3.0 g/dL (p = 0.001). Albumin predicted mortality (ROC AUC 0.78; sensitivity 72%, specificity 74%).
Conclusion: Emergency laparotomy is associated with considerable postoperative morbidity and mortality. Advanced age, higher ASA score, hypoalbuminemia, delayed surgical intervention, and preoperative sepsis significantly increase the risk of adverse outcomes. Early identification and optimization of these risk factors may help improve surgical outcomes in patients undergoing emergency laparotomy.

Keywords: Emergency Laparotomy, Postoperative Complications, Mortality, Predictors, Risk Factors.

INTRODUCTION

Emergency laparotomy remains one of the most critical and frequently performed life-saving procedures in general surgery, indicated in conditions such as perforation peritonitis, intestinal obstruction, intra-abdominal sepsis, and abdominal trauma. Despite significant advancements in surgical techniques, anaesthesia, and perioperative critical care, outcomes following emergency laparotomy remain suboptimal, with considerably higher morbidity and mortality compared to elective abdominal procedures. [1,2] This reflects the urgent nature of presentation and the compromised physiological status of patients requiring such interventions.

Globally, emergency laparotomy is associated with substantial postoperative risk. Large cohort studies and international audits have reported complication rates ranging from 30% to 50% and mortality rates between 10% and 20%, with even higher rates observed in elderly

and frail populations. [2, 3, 4] Variations in outcomes across healthcare systems further highlight disparities in access to timely intervention, perioperative optimization, and critical care support. [5]

The determinants of postoperative outcomes following emergency laparotomy are multifactorial, involving a complex interaction of patient-related, disease-related, and healthcare system factors. Patient characteristics such as advanced age, frailty, and pre-existing comorbidities significantly influence surgical risk and postoperative recovery. [3, 6] In addition, disease severity at presentation, including the presence of sepsis, peritonitis, and organ dysfunction, has been consistently associated with adverse outcomes. [7]

Risk stratification has therefore emerged as an essential component of perioperative management in emergency surgery. Several predictive models and scoring systems, including the Emergency Surgery Score, Surgical Apgar Score, and National Emergency Laparotomy Audit (NELA) risk model, have been developed to identify high-risk patients. [8, 9] However, the applicability of these models may vary across different populations, emphasizing the need for simple and reliable predictors that can be easily utilized in routine clinical practice, particularly in resource-constrained settings. [10]

Among the clinical predictors, factors such as higher American Society of Anaesthesiologists (ASA) score, delayed surgical intervention, preoperative hypotension, and septic status have demonstrated strong associations with increased postoperative morbidity and mortality. [6, 7, 11] These variables reflect both the physiological reserve of the patient and the urgency and severity of the underlying pathology, thereby influencing perioperative outcomes.

Biochemical markers have also gained prominence as predictors of adverse surgical outcomes. Serum albumin, a well-established marker of nutritional status and systemic inflammatory response, has been extensively studied in this context. Hypoalbuminemia has been linked to impaired wound healing, increased risk of infection, prolonged hospital stay, and higher mortality rates. Several recent studies have confirmed that low preoperative serum albumin is an independent predictor of poor outcomes following emergency abdominal surgery. [12, 13]

In addition to patient and disease factors, perioperative variables play a crucial role in determining surgical outcomes. Factors such as duration of surgery, intraoperative blood loss, need for vasopressor support, and delay between hospital admission and operative intervention significantly impact morbidity and mortality. Early surgical intervention combined with adequate resuscitation and optimization of physiological parameters has been shown to improve survival outcomes in critically ill patients. [5, 14]

Given the persistently high burden of postoperative complications and mortality associated with emergency laparotomy, identifying reliable and easily measurable predictors remains essential for improving patient outcomes. A comprehensive understanding of these predictors can aid in early risk stratification, guide clinical decision-making, and facilitate targeted perioperative interventions. Therefore, the present study was undertaken to evaluate the clinical and biochemical predictors of postoperative morbidity and mortality in patients undergoing emergency laparotomy in a tertiary care centre. [15]

METHODOLOGY

Study Design and Setting

This prospective observational study was conducted in the Department of General Surgery at a tertiary care teaching hospital over a period of 18 months from September 2024 to march 2026. The study aimed to evaluate predictors of postoperative morbidity and mortality in patients undergoing emergency laparotomy.

Study Population

All adult patients presenting to the emergency department and undergoing emergency laparotomy for acute abdominal conditions during the study period were considered eligible for inclusion in the study.

Inclusion Criteria

Patients fulfilling the following criteria were included in the study:

1. All patients aged ≥18 years undergoing emergency laparotomy for acute abdominal conditions.
2. Patients presenting with perforation peritonitis, intestinal obstruction, abdominal trauma, mesenteric ischemia, or intra-abdominal sepsis requiring emergency surgical intervention.
3. Patients who underwent midline exploratory laparotomy within the same admission.

4. Patients with radiological or clinical evidence of acute abdomen requiring operative management.
5. Patients who provided written informed consent to participate in the study.
6. Patients who were hemodynamically stabilized and underwent definitive surgical management.
7. Patients available for postoperative follow-up during the hospital stay and up to 30 days after surgery.

Exclusion Criteria

Patients fulfilling any of the following criteria were excluded from the study:

1. Patients undergoing elective laparotomy.
2. Patients undergoing re-laparotomy for complications following previous abdominal surgery.
3. Patients with gynaecological causes of acute abdomen such as ruptured ectopic pregnancy or ovarian torsion.
4. Patients with isolated urological emergencies not requiring exploratory laparotomy.
5. Patients who died before surgical intervention or before completion of evaluation.
6. Patients managed conservatively without surgical intervention.
7. Patients with incomplete clinical or laboratory data required for analysis.
8. Patients who refused consent to participate in the study.
9. Patients lost to follow-up within the 30-day postoperative period.
10. Pregnant patients, due to altered physiological parameters influencing outcomes.

Sample Size Calculation

The sample size was calculated using the formula for estimation of proportion:

$$n=Z^2\times p\times q/d2$$

Where:

- n = required sample size
- Z = standard normal deviate at 95% confidence level (1.96)
- p = expected proportion of postoperative morbidity in emergency laparotomy (taken as 40% based on previous studies)
- q = 1 − p
- d = allowable error (8%)

Substituting the values:

$$n= (1.96)^2\times0.40\times0.60/(0.08)^2$$

$$n=3.84\times0.24/0.0064$$

$$n\approx144$$

Thus, the minimum required sample size was 144 patients. Considering possible dropouts and incomplete data, a total of 150 patients were included in the study.

Data Collection

A structured data collection proforma was used to record patient details. The following parameters were documented:

Study Variables

The following variables were recorded and analysed in the study.

Demographic Variables

- Age (years)
- Gender (male/female)

Clinical Variables

- Presenting symptoms and duration
- Comorbidities (diabetes mellitus, hypertension, chronic kidney disease, cardiac disease)
- Hemodynamic status at admission
- American Society of Anaesthesiologists (ASA) physical status classification

Laboratory Variables

- Haemoglobin level (g/dL)
- Total leukocyte count (cells/mm³)
- Serum albumin (g/dL)
- Serum creatinine (mg/dL)

Operative Variables

- Indication for emergency laparotomy
- Time interval between hospital admission and surgery
- Intraoperative findings
- Type of surgical procedure performed
- Duration of surgery (minutes)
- Estimated intraoperative blood loss

Postoperative Variables

- Postoperative complications
- Requirement of ICU admission
- Duration of hospital stay (days)
- 30-day postoperative mortality

Operational Definitions

To maintain uniformity in data interpretation, the following operational definitions were used:

Emergency laparotomy

A non-elective surgical procedure involving opening of the abdominal cavity performed within the same hospital admission to treat life-threatening intra-abdominal conditions.

Delay to Surgery
Time interval greater than 24 hours between hospital admission and operative intervention.
Hypoalbuminemia
Preoperative serum albumin level <3.5 g/dL.
Postoperative Morbidity
Any complication occurring within 30 days after surgery.
Postoperative Mortality
Death occurring within 30 days of surgery or during the same hospital admission following emergency laparotomy.
Prolonged Operative Duration
Surgical duration exceeding 120 minutes.

Prolonged Hospital Stay
Hospitalization exceeding 10 days after surgery.
Definition of Postoperative Complications

Surgical Site Infection (SSI)
Infection occurring within 30 days after surgery involving the incision or deep tissues, characterized by purulent discharge, positive culture, or clinical signs of infection.
Respiratory Complications
Conditions such as pneumonia, respiratory failure, or need for mechanical ventilation after surgery.
Intra-Abdominal Sepsis
Presence of postoperative intra-abdominal infection confirmed clinically, radiologically, or surgically.
Anastomotic leak
Leakage from a surgically created intestinal anastomosis confirmed clinically or radiologically.
Severity Grading of Complications
Postoperative complications were graded according to the Clavien–Dindo classification system:
Grade I:
Minor deviation from normal postoperative course without need for pharmacological treatment or surgical intervention.
Grade II:
Complications requiring pharmacological treatment such as antibiotics, blood transfusion, or parenteral nutrition.
Grade III:
Complications requiring surgical, endoscopic, or radiological intervention.
Grade IV:
Life-threatening complications requiring intensive care unit management.
Grade V:
Death of the patient.
Statistical Analysis
Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 25.0.
Descriptive statistics were used to summarize demographic and clinical variables. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages.Association between categorical variables was analysed using the Chi-square test or Fisher's exact test when appropriate. Continuous variables were compared using the Student's t-test.
Variables with $p < 0.05$ in univariate analysis were included in multivariate logistic regression analysis to identify independent predictors of postoperative morbidity and mortality. Results were expressed as odds ratios (OR) with 95% confidence intervals (CI).The predictive ability of significant biochemical parameters was further evaluated using Receiver Operating Characteristic (ROC) curve analysis, and the area under the curve (AUC) was calculated to determine diagnostic accuracy.
A p value <0.05 was considered statistically significant.

Ethical Considerations
The study protocol was reviewed and approved by the Institutional Ethics Committee of the hospital. Written informed consent was obtained from all participants before enrolment. Confidentiality of patient data was maintained throughout the study.

RESULTS
A total of 150 patients who underwent emergency laparotomy were included in the study. The demographic profile of the study population is summarized in Table 1. The mean age of the patients was 48.6 ± 16.3 years, with the majority belonging to the 41–60-year age group. Males constituted 94 patients (62.7%), while 56 patients (37.3%) were females.
The distribution of indications for emergency laparotomy is presented in Table 2. Perforation peritonitis was the most common indication, accounting for 70 cases (46.7%), followed by intestinal obstruction in 45 patients (30.0%) and abdominal trauma in 21 patients (14.0%). Other indications such as mesenteric ischemia and intra-abdominal abscess were observed in 14 patients (9.3%).
Postoperative complications observed in the study population are shown in Table 3. Overall postoperative morbidity occurred in 63 patients (42.0%), whereas 87 patients (58.0%) had an

uncomplicated postoperative course. The most common complication was surgical site infection (18.0%), followed by respiratory complications (10.0%), intra-abdominal sepsis (7.3%), and anastomotic leak (6.7%).

The association between patient-related factors and postoperative morbidity is summarized in Table 4. Patients aged >60 years had significantly higher complication rates compared with younger patients ($\chi^2 = 8.41$, $p = 0.003$). Hypoalbuminemia (<3.5 g/dL) was strongly associated with postoperative morbidity ($\chi^2 = 10.72$, $p = 0.001$). Similarly, patients with ASA score ≥III showed significantly increased complications ($\chi^2 = 12.36$, $p < 0.001$). Delay in surgery of more than 24 hours was also associated with increased morbidity ($\chi^2 = 6.18$, $p = 0.013$).

Operative factors influencing postoperative complications are described in Table 5. Patients with operative duration greater than 2 hours had a significantly higher incidence of postoperative complications compared with those with shorter operative time ($t = 2.64$, $p = 0.009$).

The predictors of postoperative morbidity identified through multivariate logistic regression analysis are shown in Table 6. ASA score ≥III (OR 4.08, 95% CI: 1.86–8.93, $p < 0.001$) and hypoalbuminemia (OR 3.21, 95% CI: 1.52–6.74, $p = 0.002$) were found to be independent predictors of postoperative complications.

Mortality-related factors are summarized in Table 7. The overall 30-day mortality rate was 12.0% (18 patients). Mortality was significantly associated with age >60 years ($\chi^2 = 7.15$, $p = 0.007$), preoperative sepsis ($\chi^2 = 9.04$, $p = 0.003$), and serum albumin <3.0 g/dL ($\chi^2 = 11.62$, $p = 0.001$).

Receiver operating characteristic (ROC) curve analysis evaluating the predictive value of serum albumin for mortality is presented in Table 8. Serum albumin demonstrated good predictive ability with an area under the curve (AUC) of 0.78 (95% CI: 0.69–0.87, $p < 0.001$). A cut-off value of 3.1 g/dL showed 72% sensitivity and 74% specificity in predicting postoperative mortality.

Table 1. Demographic Characteristics of the Study Population (n = 150)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
18–40	40	26.7
41–60	65	43.3
>60	45	30.0
Gender		
Male	94	62.7
Female	56	37.3
Mean age (years)	48.6 ± 16.3	—

Values expressed as mean ± standard deviation or frequency (%).

Table 2. Indications for Emergency Laparotomy

Indication	Number (n)	Percentage (%)
Perforation peritonitis	70	46.7
Intestinal obstruction	45	30.0
Abdominal trauma	21	14.0
Mesenteric ischemia	8	5.3
Intra-abdominal abscess	6	4.0

Table 3. Postoperative Complications

Complication	Number (n)	Percentage (%)
Surgical site infection	27	18.0
Respiratory complications	15	10.0
Intra-abdominal sepsis	11	7.3
Anastomotic leak	10	6.7
No complications	87	58.0

Table 4. Association between Clinical Factors and Postoperative Morbidity

Variable	Morbidity	Morbidity	χ^2 value	p value

	Present n (%)	**Absent n (%)**		
Age >60 years	28 (62.2)	17 (37.8)	8.41	0.003*
Albumin <3.5 g/dL	35 (58.3)	25 (41.7)	10.72	0.001*
ASA ≥III	31 (63.3)	18 (36.7)	12.36	<0.001**
Delay to surgery >24h	22 (57.9)	16 (42.1)	6.18	0.013*

Table 5. Operative Factors Associated with Postoperative Morbidity

Variable	Morbidity Mean ± SD	No Morbidity Mean ± SD	t value	p value
Operative duration (minutes)	135 ± 32	112 ± 28	2.64	0.009*

Table 6. Multivariate Logistic Regression Analysis for Postoperative Morbidity

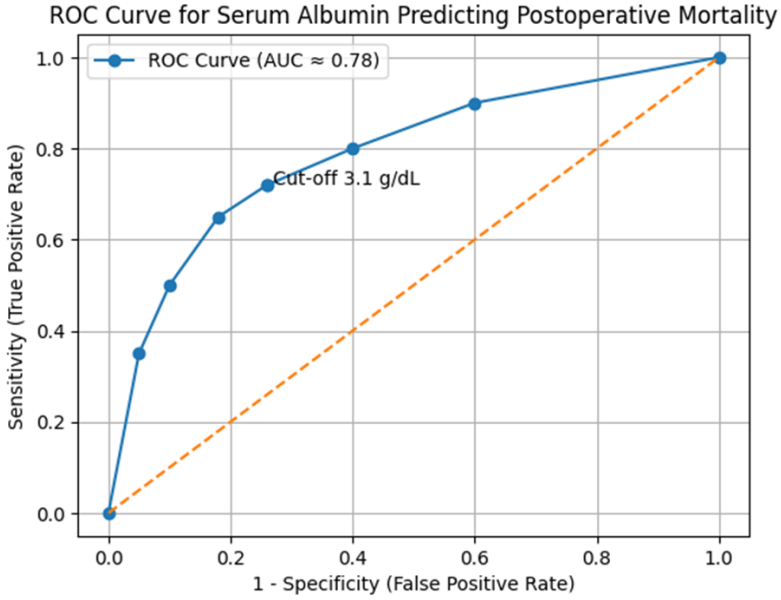
Variable	**Adjusted OR**	**95% CI**	**p value**
ASA ≥III	4.08	1.86 – 8.93	<0.001**
Albumin <3.5 g/dL	3.21	1.52 – 6.74	0.002*
Age >60 years	1.89	0.92 – 3.88	0.08

Table 7. Factors Associated with Postoperative Mortality

Variable	Mortality Present n (%)	Mortality Absent n (%)	χ^2 value	p value
Age >60 years	10 (22.2)	35 (77.8)	7.15	0.007*
Preoperative sepsis	9 (27.3)	24 (72.7)	9.04	0.003*
Albumin <3.0 g/dL	11 (28.2)	28 (71.8)	11.62	0.001*

Table 8. ROC Analysis of Serum Albumin for Predicting Postoperative Mortality

Parameter	**AUC**	**Standard Error**	**95% CI**	**p value**	**Cut-off**	**Sensitivity**	**Specificity**
Serum Albumin	0.78	0.046	0.69 – 0.87	<0.001**	3.1 g/dL	72%	74%



DISCUSSION

Emergency laparotomy continues to be associated with substantial postoperative morbidity and mortality despite advances in perioperative care. In the present study, postoperative morbidity was 42% and 30-day mortality was 12%, which are comparable with global data reported in large observational studies (Nepogodiev et al., 2021; Dessalegn et al., 2024).[19] [2] These findings reinforce the persistent burden of adverse outcomes

associated with emergency abdominal surgery across diverse healthcare settings.

Advanced age was found to be a significant predictor of both morbidity and mortality, with patients aged >60 years demonstrating worse outcomes. This observation is consistent with previous studies showing that advancing age and frailty significantly influence surgical outcomes (Isand et al., 2024; Kagimu et al., 2025).[4] [8] The increased vulnerability in elderly patients may be attributed to reduced physiological reserve, higher comorbidity burden, and impaired immune response.

The ASA physical status classification emerged as a strong independent predictor of postoperative morbidity in the present study, with ASA ≥III showing significantly increased risk (OR 4.08). This finding aligns with prior studies demonstrating the predictive value of ASA score in assessing perioperative risk (Rai et al., 2022; Hewitt et al., 2024).[9] [18] The ASA classification remains a simple, reliable, and widely applicable tool for risk stratification in emergency surgical practice.

Preoperative hypoalbuminemia was another important predictor identified in this study. Patients with serum albumin <3.5 g/dL had significantly higher morbidity, while levels <3.0 g/dL were strongly associated with mortality. Serum albumin reflects both nutritional status and systemic inflammatory response, and its deficiency contributes to impaired wound healing, increased susceptibility to infection, and delayed recovery. Similar findings have been reported in recent studies evaluating biochemical predictors (Giudici et al., 2025; Gilan et al., 2025).[11] [10]

Delay in surgical intervention beyond 24 hours was significantly associated with increased postoperative complications. Delayed intervention allows progression of peritonitis, worsening sepsis, and further physiological deterioration. Previous studies have emphasized that timely surgical management is crucial in improving outcomes (Al-Shelleh et al., 2025; Teka et al., 2025).[5] [7]

Operative duration was also found to significantly influence postoperative morbidity, with procedures exceeding two hours associated with higher complication rates. Prolonged operative time may reflect increased disease severity, technical complexity, or extensive intra-abdominal contamination. Similar observations have been reported in global outcome studies (Bath et al., 2025).[6]

Preoperative sepsis was identified as a significant predictor of mortality in this study. Sepsis results in systemic inflammatory response, hemodynamic instability, and multi-organ dysfunction, thereby increasing perioperative risk. This finding is consistent with studies demonstrating increased mortality in septic patients undergoing emergency abdominal surgery (Raufudin et al., 2025; Amati et al., 2025).[17] [13]

The ROC curve analysis demonstrated that serum albumin has good predictive ability for postoperative mortality (AUC = 0.78), with a cut-off value of 3.1 g/dL showing reasonable sensitivity (72%) and specificity (74%). This supports its role as a simple, cost-effective, and reliable biomarker for preoperative risk stratification, consistent with existing literature.[11]

Overall, the present study demonstrates that postoperative outcomes following emergency laparotomy are influenced by a combination of patient-related, biochemical, and perioperative factors. Advanced age, higher ASA score, hypoalbuminemia, delayed surgical intervention, prolonged operative duration, and preoperative sepsis were identified as key predictors of adverse outcomes. These findings are consistent with contemporary literature and emphasize the importance of early risk stratification and targeted perioperative optimization strategies.

From a clinical perspective, incorporation of simple predictors such as ASA score and serum albumin into routine preoperative assessment can aid in identifying high-risk patients. Early aggressive resuscitation, timely surgical intervention, and appropriate postoperative monitoring—including intensive care support when required—may significantly reduce morbidity and mortality.

Strengths of the Study

Prospective Study Design

The prospective observational design allowed systematic data collection and minimized recall bias.

Comprehensive Evaluation of Predictors

The study evaluated multiple demographic, clinical, laboratory, and operative variables, providing a broad assessment of factors influencing postoperative outcomes.

Use of Multivariate Analysis

Multivariate logistic regression enabled identification of independent predictors of morbidity, improving the reliability of the findings.

Objective Outcome Measures

Standard definitions for complications and mortality were used, and postoperative

complications were graded using the Clavien–Dindo classification, enhancing reproducibility.

Use of ROC Analysis

Evaluation of serum albumin using ROC curve analysis provided additional insight into its diagnostic and prognostic value in predicting postoperative mortality.

Limitations of the Study

Single-Centre Study

The study was conducted at a single tertiary care institution, which may limit the generalizability of the findings to other healthcare settings.

Moderate Sample Size

Although adequate for statistical analysis, the sample size of 150 patients may limit the ability to detect less common predictors.

Short Follow-Up Period: Outcomes were assessed only up to 30 days postoperatively, and long-term outcomes such as quality of life or late complications were not evaluated.

Heterogeneous Surgical Pathologies

Emergency laparotomy was performed for various indications, including perforation peritonitis, intestinal obstruction, and trauma, which may introduce heterogeneity in outcomes.

Limited Evaluation of Physiological Scoring Systems

Established risk prediction tools such as APACHE II, POSSUM, or NELA scores were not included, which might have provided additional insights into risk stratification.

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