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Utility of Surgical APGAR Score in Risk Stratification for Emergency Gastrointestinal Procedures: A Prospective Analysis

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ABSTRACT

Background: Emergency gastrointestinal surgery is associated with significant morbidity and mortality. The Surgical APGAR Score (SAS), a simple 10-point scoring system based on intraoperative parameters, has shown promise in predicting postoperative complications. This study aimed to evaluate the utility of SAS in predicting outcomes following emergency gastrointestinal procedures.

Methods: A prospective cross-sectional study was conducted on 30 patients undergoing emergency gastrointestinal surgery under general anesthesia at Mamata Medical College, Khammam, from October 2019 to September 2021. SAS was calculated using lowest heart rate, lowest mean arterial pressure, and estimated blood loss. Patients were followed for 30 days to assess major complications and mortality. Statistical analysis included correlation between SAS scores, complications, and ASA grades.

Results: The mean age was 45.46 ± 16.05 years with slight female predominance (53.3%). Acute intestinal perforation was the most common diagnosis (30%). SAS distribution showed 40% high-risk (0-4), 53.3% medium-risk (5-7), and 6.7% low-risk (8-10) patients. Patients with complications had significantly lower mean SAS scores compared to those without complications (4.65 ± 1.78 vs 6.20 ± 1.22, p=0.001). A strong inverse correlation existed between ASA grade and SAS score (F=44.76, p<0.0001). The 30-day mortality rate was 6.7%. Major complications included prolonged ventilation (13.3%) and wound dehiscence (13.3%).

Conclusions: The Surgical APGAR Score effectively predicts postoperative complications in emergency gastrointestinal surgery. Its simplicity and immediate availability make it a valuable tool for risk stratification and clinical decision-making. Implementation of SAS can enhance patient safety and optimize resource allocation in emergency surgical settings.

Keywords: *Surgical, APGAR Score, Stratification for Emergency, Gastrointestinal Procedures.*

1. INTRODUCTION

Surgical complications remain an inevitable aspect of surgical practice and represent a significant challenge in contemporary healthcare delivery. The increasing complexity of surgical procedures, emergence of new surgical technologies, performance of operations in challenging patient populations, and rising numbers of emergency operations have made the prediction and prevention of postoperative complications more critical than ever[1]. The ability to accurately identify patients at high risk for developing complications contributes substantially to improving surgical quality and reducing healthcare costs. However, marked variability in postoperative outcomes is commonly observed due to differences in patient preoperative risk factors and intraoperative events[1].

In emergency surgical situations, the primary objective extends beyond the technical execution of the procedure to include adequate preparation and resuscitation of patients while addressing the underlying surgical pathology. Inadequate perioperative management represents a major contributory factor to increased morbidity and mortality in emergency surgery. Multiple intraoperative factors, including alterations in the patient's physiological condition such as heart rate fluctuations, blood pressure changes including hypotension, hypothermia, bradycardia, tachycardia, and significant blood loss, have been independently associated with adverse perioperative outcomes[2–4].

Current Risk Assessment Methods

The American Society of Anesthesiologists (ASA) physical status classification, widely utilized for preoperative risk assessment, is based primarily on subjective clinical evaluation and has demonstrated limited utility in predicting individual patient outcomes[5]. While this classification system provides a general framework for risk stratification, its subjective nature and lack of specificity limit its predictive accuracy for postoperative complications.

The evolution of sophisticated monitoring techniques and well-equipped laboratory facilities has led to the development of various surgical scoring systems, including the Simplified Acute Physiology Score (SAPS), Acute Physiology and Chronic Health Evaluation (APACHE), Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM), and Mortality Prediction Model (MPM)[6–9]. However, these scoring systems present significant limitations in clinical practice. They are not easily calculated at the bedside, require numerous data elements including extensive patient characteristics and laboratory data that are not uniformly available, and are prone to calculation errors due to their complexity. These factors compromise their reproducibility among various multidisciplinary teams involved in patient care[6–9].

The Need for a Simple Scoring System

An ideal predictive model for surgical complications should possess several key characteristics: simplicity, universal applicability to all surgical patients, immediate availability of required data, and ease of calculation. Such a system should provide reliable risk stratification without requiring extensive resources or complex calculations that may introduce errors or delays in patient care[10–12].

Development of the Surgical APGAR Score

In response to these limitations, Gawande and colleagues developed the Surgical APGAR Score (SAS), a 10-point scoring system based on three readily available intraoperative parameters: estimated blood loss, lowest heart rate, and lowest mean arterial pressure during the operative period[13]. This scoring system was inspired by the original APGAR score developed by Virginia Apgar in 1952 for evaluating newborns, which has proven successful in predicting neonatal outcomes and guiding immediate postnatal care[14].

The Surgical APGAR Score provides a simple, immediate, and objective method for measuring and communicating surgical outcomes using data that are routinely available in all surgical settings, regardless of resource limitations. The score ranges from 0 to 10 points, with lower scores indicating higher risk for postoperative complications. This system offers several advantages: it utilizes parameters that are universally monitored during surgery, requires no additional equipment or laboratory tests, can be calculated immediately upon completion of the procedure, and provides real-time feedback to the surgical team[13].

Clinical Utility and Validation

The SAS has demonstrated effectiveness in identifying patients with higher and lower than average likelihood of major complications following surgery and may prove useful for guiding interventions to prevent poor outcomes. The score enables surgical teams to make informed decisions regarding postoperative care intensity, including the need for intensive care unit admission, enhanced monitoring, or more frequent clinical assessments. This immediate risk stratification capability can significantly impact patient safety and resource allocation[13].

While the Surgical APGAR Score has undergone extensive validation primarily in Western healthcare systems, limited data are available from hospitals in developing countries, particularly in the Indian subcontinent. The applicability and performance of this scoring system in different healthcare settings, patient populations, and surgical subspecialties require further investigation to establish its universal utility.

Emergency Gastrointestinal Surgery

Emergency gastrointestinal surgery represents a particularly challenging subset of surgical practice, characterized by urgent clinical presentations, limited time for comprehensive preoperative optimization, and often complex intraoperative findings. Patients undergoing emergency abdominal procedures frequently present with conditions such as perforation, obstruction, bleeding, or trauma, which may compromise their physiological reserves and increase the risk of postoperative complications. The ability to rapidly and accurately assess the risk of complications in this population is crucial for optimizing patient outcomes and healthcare resource utilization.

Study Rationale

Given the limited validation of the Surgical APGAR Score in Indian healthcare settings and specifically in emergency gastrointestinal surgery, this study was designed to prospectively evaluate the utility of the SAS in predicting postoperative complications in patients undergoing emergency gastrointestinal procedures under general anesthesia. The investigation aims to determine whether this simple scoring system can effectively risk-stratify patients in our healthcare environment and potentially improve patient care through enhanced recognition of high-risk individuals who may benefit from intensified postoperative monitoring and management.

Understanding the predictive value of the Surgical APGAR Score in emergency gastrointestinal surgery could provide surgeons and healthcare teams with a valuable tool for immediate postoperative risk assessment, potentially leading to improved patient outcomes through targeted interventions and appropriate allocation of healthcare resources.

2. MATERIALS AND METHODS

Study Design and Setting

This prospective observational cross-sectional study was conducted at the Department of General Surgery, Mamata Medical College and Hospital, Khammam, Telangana, India, from October 2019 to September 2021. The study was designed to evaluate the utility of the Surgical APGAR Score (SAS) in predicting postoperative complications and outcomes in patients undergoing emergency gastrointestinal procedures under general anesthesia.

Ethical Considerations

Institutional Ethical Committee approval was obtained prior to the commencement of the study. Written informed consent was obtained from all participants or their legal guardians after explaining the study objectives, procedures, and potential risks. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines.

Study Population

Sample Size

A total of 30 patients who met the inclusion criteria were enrolled in the study during the study period.

Inclusion Criteria

Patients aged 16 years and above undergoing emergency abdominal surgeries under general anesthesia

Patients willing to participate in the study and providing informed consent

Exclusion Criteria

Elective gastrointestinal surgical procedures

Patients undergoing mini-laparotomy and laparoscopic procedures

Age less than 16 years

Patients lost to follow-up during the 30-day postoperative period

Patients with established metastatic and unresectable tumors

HIV-positive patients

Patients who did not consent to participate in the study

Data Collection

Preoperative Assessment

Detailed history and thorough physical examination were conducted for all patients. The following parameters were recorded:

Demographics: Name, age, sex, address, occupation

Comorbidities: Obesity (BMI >25 kg/m²), hypertension, pulmonary diseases, cardiovascular diseases, diabetes mellitus, renal failure, sepsis, cerebrovascular accident/transient ischemic attack, smoking history, malignancy, steroid therapy

American Society of Anesthesiologists (ASA) Classification: Patients were classified according to the ASA physical status classification system[15]

Laboratory investigations: Complete blood count, renal function tests, electrolyte levels, and other relevant investigations as clinically indicated

Imaging studies: Plain radiographs, ultrasonography, and computed tomography as appropriate

Intraoperative Data Collection

The following intraoperative variables were meticulously recorded for calculation of the Surgical APGAR Score:

Lowest heart rate (beats per minute) during the procedure

Lowest mean arterial pressure (mmHg) during the procedure

Estimated blood loss (milliliters) during the procedure

Surgical APGAR Score Calculation

The SAS was calculated using the scoring system developed by Gawande et al.[16] The score ranges from 0 to 10 points based on three intraoperative variables:

Table: Surgical APGAR Score Calculation

Parameter	0 Points	1 Point	2 Points	3 Points	4 Points
Estimated Blood Loss (ml)	>1000	601-1000	101-600	≤100	-
Lowest MAP (mmHg)	<40	40-54	55-69	≥70	-
Lowest Heart Rate (bpm)	>85	76-85	66-75	56-65	≤55

Patients were subsequently categorized into risk groups based on their SAS:

High risk: SAS 0-4

Medium risk: SAS 5-7

Low risk: SAS 8-10

Postoperative Follow-up

All patients were followed for 30 days postoperatively for the occurrence of major complications or death, which constituted the primary endpoints of the study.

Primary Endpoint (Major Complications)

Major complications were defined according to established criteria[17,18] and included:

Acute renal failure

Bleeding requiring transfusion of 4 or more units of red blood cells within 72 hours

Cardiac arrest requiring cardiopulmonary resuscitation

Deep vein thrombosis

Myocardial infarction

Unplanned intubation

Pneumonia

Pulmonary embolism

Stroke/cerebrovascular accident

Wound disruption/dehiscence

Deep or organ-space surgical site infection

Sepsis, septic shock, or systemic inflammatory response syndrome (SIRS)

Death within 30 days of surgery

Study Objectives

Primary Objective

To determine the applicability of the Surgical APGAR Score in postoperative risk stratification for major complications during the 30-day period following emergency gastrointestinal surgical procedures.

Secondary Objectives

To determine the proportion of patients undergoing emergency gastrointestinal surgical procedures who develop major complications during the 30-day postoperative period

To determine the 30-day postoperative mortality rate in patients undergoing emergency gastrointestinal surgical procedures

To correlate postoperative outcomes in terms of major complications within 30 days with:

Preoperative comorbid factors

Intraoperative pathological findings

Surgical APGAR Score

To correlate the Surgical APGAR Score with the American Society of Anesthesiologists score

Data Management and Quality Control

Data were collected using a standardized proforma and recorded in Microsoft Excel 2013. Regular monitoring was conducted to ensure data quality and completeness. Missing data were minimized through careful follow-up procedures.

Statistical Analysis

Statistical analysis was performed using SPSS version 16.0 (Statistical Package for Social Sciences). Descriptive statistics were used to summarize patient characteristics and outcomes. Qualitative data were expressed as frequencies and percentages, while quantitative data were presented as mean ± standard deviation.

The following statistical tests were employed:

Chi-square test: For association between categorical variables

Independent t-test: For comparison of means between two groups

Analysis of Variance (ANOVA): For comparison of means among multiple groups

Correlation analysis: To assess relationships between continuous variables

Statistical significance was set at p-value <0.05. Results were presented using appropriate graphical representations including bar charts and pie charts for better visualization of data.

Study Limitations

Single-center study with a relatively small sample size

Limited to emergency gastrointestinal procedures only

Potential for selection bias due to the specific inclusion criteria

Observer bias in recording intraoperative parameters

The study was conducted to provide evidence for the utility of the Surgical APGAR Score as a simple, reproducible tool for risk stratification in emergency gastrointestinal surgery, particularly in resource-limited settings where complex scoring systems may not be feasible[19],[20].

3. RESULTS

1. Age Distribution

The study included 30 patients who underwent emergency gastrointestinal surgeries. The majority of patients (26.7%) belonged to the age group of 51-60 years, followed by 23.3% in the 18-30 years group. The mean age of patients was 45.46 ± 16.05 years.

Table 1: Age Distribution of Study Participants

Age Group (Years)	Number of Patients (n=30)	Percentage
18-30	7	23.3%
31-40	6	20.0%
41-50	4	13.3%
51-60	8	26.7%
61-70	5	16.7%
Total	30	100%
Mean ± SD	45.46 ± 16.05	

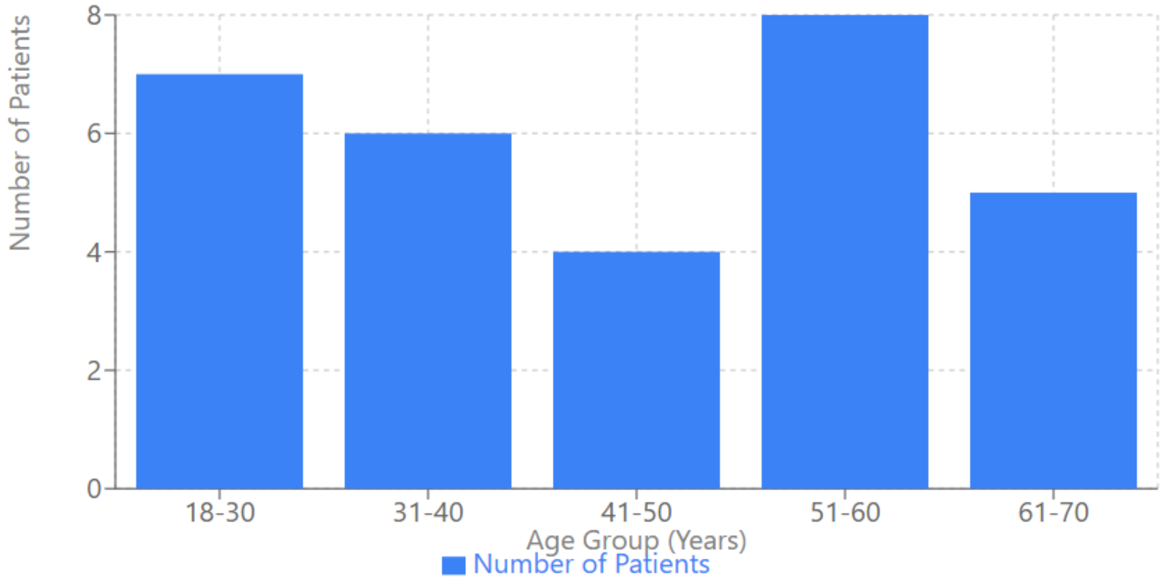

Fig 1: Bar chart showing age distribution

2. Gender Distribution

The study population showed a slight female predominance with 53.3% (n=16) female patients and 46.7% (n=14) male patients.

Table 2: Gender Distribution

Gender	Number of Patients (n=30)	Percentage
Male	14	46.7%
Female	16	53.3%
Total	30	100%

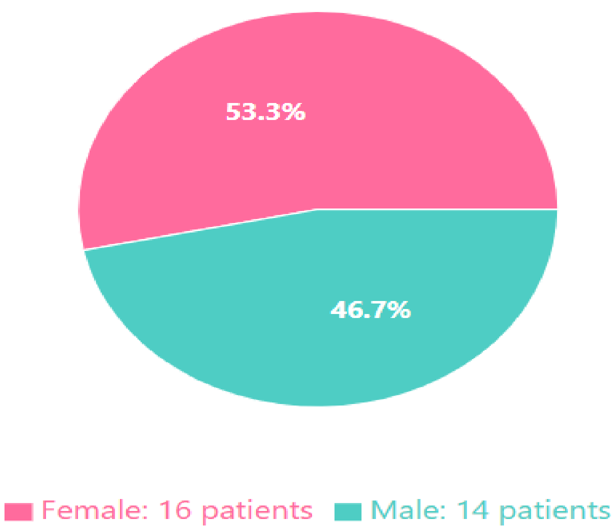

Fig 2 : Pie chart showing gender distribution

3. Comorbidities

Among the study participants, diabetes mellitus was the most common comorbidity affecting 26.7% (n=8) of patients, followed by hypertension in 16.7% (n=5) of patients. One patient (3.33%) had hypothyroidism, while 53.3% (n=16) had no documented comorbidities.

Table 3: Distribution of Comorbidities

Comorbidity	Number of Patients (n=30)	Percentage
Diabetes	8	26.7%
Hypertension	5	16.7%
Hypothyroidism	1	3.33%
None	16	53.3%
Total	30	100%

4. Preoperative Diagnosis

The most common preoperative diagnosis was hollow viscus perforation in 30% (n=9) of patients, followed by bowel obstruction in 43.3% (n=13) of patients.

Table 4: Preoperative Diagnosis Distribution

Diagnosis	Number of Patients (n=30)	Percentage
Hollow viscus perforation	9	30.0%
Bowel obstruction	13	43.3%
Blunt abdomen/hemoperitoneum	3	10.0%
Hernia - Strangulation	2	6.6%
Hernia - Obstruction	3	10.0%
Total	30	100%

5. Final Surgical Diagnosis

Acute intestinal perforation was the most common final diagnosis in 30% (n=9) of patients, followed by acute intestinal obstruction and intussusception, each accounting for 13.3% (n=4) of cases.

Table 5: Final Surgical Diagnosis

Diagnosis	Number of Patients (n=30)	Percentage
Acute intestinal perforation	9	30.0%
Acute intestinal obstruction	4	13.3%
Intussusception	4	13.3%
Blunt injury abdomen	3	10.0%
Obstructed ventral hernia	3	10.0%
Band with gangrene	2	6.7%
Strangulated inguinal hernia	2	6.7%
Sigmoid volvulus	2	6.7%
Intestinal tuberculosis	1	3.3%
Total	30	100%

6. ASA Grade Distribution

The majority of patients (53.4%, n=16) had ASA grade 2, while 23.3% (n=7) each had ASA grades 3 and 4. No patients had ASA grade 1 or 5.

Table 6: ASA Grade Distribution

ASA Grade	Number of Patients (n=30)	Percentage
ASA 2	16	53.4%
ASA 3	7	23.3%
ASA 4	7	23.3%
Total	30	100%

7. Surgical APGAR Score Components

Heart Rate

The majority of patients (40%, n=12) had a lowest intraoperative heart rate >85 beats/minute. The mean heart rate was 79.16 ± 12.41 beats/minute.

Table 7: Intraoperative Heart Rate Distribution

Heart Rate (bpm)	Number of Patients (n=30)	Percentage
>85	12	40.0%
76-85	6	20.0%
66-75	7	23.3%
56-65	4	13.3%
<55	1	3.3%
Total	30	100%
Mean ± SD	79.16 ± 12.41	

Mean Arterial Pressure

The largest group of patients (43.3%, n=13) had a lowest mean arterial pressure of 55-69 mmHg. The mean arterial pressure was 67.56 ± 13.35 mmHg.

Table 8: Intraoperative Mean Arterial Pressure Distribution

MAP (mmHg)	Number of Patients (n=30)	Percentage
<40	1	3.3%
40-54	4	13.3%
55-69	13	43.3%
>70	12	40.0%
Total	30	100%
Mean ± SD	67.56 ± 13.35	

Estimated Blood Loss

The vast majority of patients (86.7%, n=26) had estimated blood loss between 101-600 ml. The mean blood loss was 268.83 ± 169.04 ml.

Table 9: Estimated Blood Loss Distribution

Blood Loss (ml)	Number of Patients (n=30)	Percentage
<100	2	6.7%
101-600	26	86.7%
601-1000	2	6.7%
>1000	0	0%
Total	30	100%
Mean ± SD	268.83 ± 169.04	

8. Surgical APGAR Score Distribution

The majority of patients (53.3%, n=16) were classified as medium risk (SAS 5-7), followed by 40% (n=12) as high risk (SAS 0-4), and only 6.7% (n=2) as low risk (SAS 8-10).

Table 10: Surgical APGAR Score Risk Categories

Risk Category	SAS Score	Number of Patients (n=30)	Percentage
High Risk	0-4	12	40.0%
Medium Risk	5-7	16	53.3%
Low Risk	8-10	2	6.7%
Total		30	100%

9. Postoperative Complications

Various major complications were observed, with prolonged ventilation (>48 hours) and wound dehiscence being the most common, each affecting 13.3% (n=4) of patients.

Table 11: Major Postoperative Complications

Complication	Number of Patients	Percentage
Prolonged ventilation (>48h)	4	13.3%
Wound dehiscence	4	13.3%
Pneumonia	3	10.0%
Sepsis and shock	3	10.0%
Acute renal failure	2	6.7%
Blood transfusion >5 units	2	6.7%
Mortality	2	6.7%
Cardiac arrest	1	3.3%
Deep vein thrombosis	1	3.3%
Myocardial infarction	1	3.3%
Pulmonary embolism	1	3.3%
Stroke	1	3.3%

10. Mortality

The overall 30-day mortality rate was 6.7% (n=2), with 93.3% (n=28) of patients surviving the postoperative period.

Table 12: Mortality Outcomes

Outcome	Number of Patients (n=30)	Percentage
Survived	28	93.3%
Died	2	6.7%
Total	30	100%

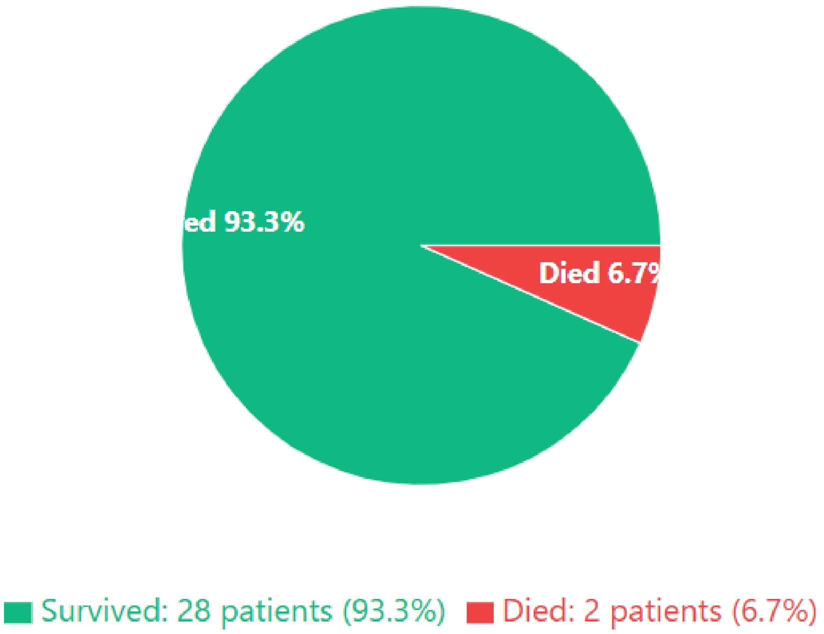

Fig : Pie chart depicting mortality outcomes

11. Correlation Between Surgical APGAR Score and Complications

Patients with complications had significantly lower mean SAS scores compared to those without complications (4.65 ± 1.78 vs 6.20 ± 1.22, p=0.001).

Table 13: SAS Score Correlation with Complications

Patient Group	Mean SAS Score	Standard Deviation
With complications	4.65	± 1.78
Without complications	6.20	± 1.22

Statistical significance: t=2.59, p=0.001

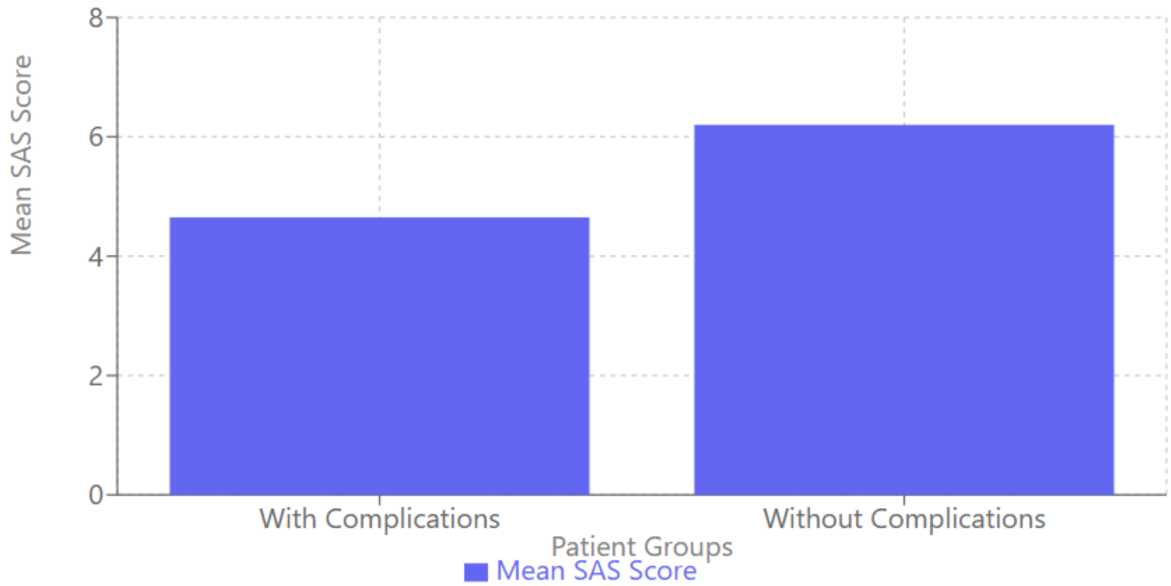

Fig: Bar chart comparing mean SAS scores between groups

12. Correlation Between Surgical APGAR Score and ASA Grade

There was a statistically significant inverse correlation between ASA grade and SAS score, with higher ASA grades associated with lower SAS scores (p<0.0001).

Table 14: SAS Score by ASA Grade

ASA Grade	Mean SAS Score	Standard Deviation
ASA 2	7.57	± 1.13
ASA 3	5.71	± 0.48
ASA 4	3.87	± 0.88

Statistical significance: F=44.76, p<0.0001

The results demonstrate that the Surgical APGAR Score effectively stratifies patients based on their risk for postoperative complications, with lower scores correlating significantly with increased morbidity and mortality in emergency gastrointestinal procedures.

4. DISCUSSION

The present study evaluated the utility of the Surgical APGAR Score in predicting postoperative complications among patients undergoing emergency gastrointestinal procedures. Our findings demonstrate that the SAS is an effective tool for risk stratification in this high-risk population, with significant correlations between lower SAS scores and increased complication rates.

Patient Demographics and Clinical Characteristics

The mean age of patients in our study was 45.46 ± 16.05 years, which is comparable to previous studies investigating the SAS in emergency surgery. Haddow et al. reported a mean age of 59.6 ± 18.3 years in their validation study[21], while Singh et al. found a median age of 62 years in their Caribbean cohort[22]. The slightly younger age in our population may reflect the demographic patterns of emergency gastrointestinal diseases in our region, particularly the higher incidence of infectious and inflammatory conditions in younger adults.

The gender distribution in our study showed a slight female predominance (53.3% vs 46.7% male), which aligns with findings from Lin et al. (58.5% female)[23] and contrasts with studies by Singh et al. (55% male) and Rajgopal et al. (66% male)[22,24]. This variation likely reflects differences in the types of emergency procedures included and regional disease patterns.

Comorbidity Profile and Risk Factors

The prevalence of diabetes mellitus (26.7%) and hypertension (16.7%) in our cohort represents a significant burden of comorbid conditions that influence surgical outcomes. Bhushanam et al. reported similar patterns of cardiovascular comorbidities in their Indian population[25], emphasizing the importance of optimizing perioperative management in patients with multiple risk factors. The high prevalence of these conditions in emergency settings limits the opportunity for preoperative optimization, making intraoperative risk assessment tools like the SAS particularly valuable[26].

Distribution of Surgical Diagnoses

Acute intestinal perforation was the most common diagnosis (30%), followed by intestinal obstruction (13.3%) and intussusception (13.3%). This distribution reflects the typical emergency gastrointestinal pathology encountered in tertiary care centers in developing countries. Singh et al. reported that 99% of their patients underwent open abdominal surgery, with 88.6% requiring exploratory laparotomy[22], highlighting the complexity and urgency of cases that benefit from immediate risk stratification using the SAS.

ASA Classification and Surgical Risk

The distribution of ASA grades in our study (53.4% ASA 2, 23.3% each ASA 3 and 4) indicates a population with moderate to high perioperative risk. This distribution is consistent with emergency surgical populations reported by Sobol et al. (61% ASA II, 28.6% ASA III)[27] and Haddow et al. (43% ASA II, 29% ASA III)[21]. The absence of ASA 1 patients in our cohort reflects the acuity of emergency gastrointestinal conditions requiring surgical intervention.

Surgical APGAR Score Distribution and Validation

Our study found that 40% of patients were classified as high risk (SAS 0-4), 53.3% as medium risk (SAS 5-7), and only 6.7% as low risk (SAS 8-10). This distribution differs from elective surgical populations and reflects the inherent risks associated with emergency procedures. Bhushanam et al. reported a similar distribution in their abdominal surgery cohort (21.9% high risk, 56.2% medium risk, 21.9% low risk)[25], though with a higher proportion of low-risk patients, likely due to the inclusion of elective cases.

The strong inverse correlation between ASA grade and SAS score ($F=44.76$, $p<0.0001$) in our study validates the complementary nature of these scoring systems. Patients with higher ASA grades consistently demonstrated lower SAS scores, indicating that preoperative risk factors are reflected in intraoperative physiological parameters captured by the SAS[28].

Intraoperative Parameters and Risk Assessment

The mean intraoperative heart rate (79.16 ± 12.41 bpm), mean arterial pressure (67.56 ± 13.35 mmHg), and estimated blood loss (268.83 ± 169.04 ml) in our study provide insights into the physiological stress associated with emergency gastrointestinal surgery. Haddow et al. reported similar values for heart rate (60.3 ± 10.7 bpm) and blood loss (375 ± 547 ml)[21], though their study included both emergency and elective procedures.

The predominance of patients with heart rates >85 bpm (40%) and mean arterial pressure 55-69 mmHg (43.3%) reflects the sympathetic stress response and potential hemodynamic instability common in emergency surgical scenarios[29]. These findings support the utility of the SAS in capturing real-time physiological data that may not be adequately reflected in preoperative scoring systems.

Complication Rates and Mortality

The overall complication rate in our study was substantial, with prolonged ventilation (13.3%) and wound dehiscence (13.3%) being the most common major complications. The 30-day mortality rate of 6.7% is within the range reported for emergency abdominal surgery but lower than some studies. Singh et al. reported a 24% mortality rate in their emergency surgery cohort[22], while Rajgopal et al. found mortality rates of 12.7% for elective and 31.1% for emergency procedures[24].

The lower mortality in our study may reflect differences in case mix, surgical techniques, or perioperative care protocols. However, the pattern of complications aligns with previous reports emphasizing respiratory, infectious, and wound-related morbidity as primary concerns in emergency gastrointestinal surgery[30].

Predictive Value of the Surgical APGAR Score

The significant difference in mean SAS scores between patients with and without complications (4.65 ± 1.78 vs 6.20 ± 1.22, $p=0.001$) demonstrates the discriminatory power of this scoring system. This finding is consistent with multiple validation studies. Regenbogen et al. reported that patients with SAS 0-4 had a 56.3% major complication rate compared to 5.0% in those with SAS 9-10[31].

Kenig et al. demonstrated that the SAS effectively predicted outcomes in both fit and frail elderly patients undergoing emergency abdominal surgery[32], while Gothwal et al. found that patients with low SAS (<4) had significantly higher complication rates and prolonged hospital stays[33]. Our results further validate these findings in the specific context of emergency gastrointestinal surgery.

Clinical Applications and Decision-Making

The immediate availability of SAS calculation at the conclusion of surgery makes it particularly valuable for clinical decision-making. Patients with low SAS scores can be identified for enhanced postoperative monitoring, earlier intensive care unit admission, or modified care pathways[34]. This is especially relevant in resource-limited settings where the simplicity and universal applicability of the SAS make it superior to more complex scoring systems requiring extensive laboratory data[35].

Lin et al. demonstrated that SAS was strongly associated with postoperative ICU admission, with odds ratios of 5.2, 2.26, and 1.73 for SAS 0-2, 3-4, and 5-6, respectively[36]. This supports the use of SAS for immediate postoperative triage decisions, particularly valuable in emergency settings where rapid risk assessment is crucial.

Comparison with Other Risk Scoring Systems

While traditional scoring systems like APACHE II, POSSUM, and SAPS II require multiple variables and complex calculations, the SAS offers comparable predictive ability with significantly greater simplicity[37,38]. Thorn et al. found that the SAS performed with an area under the curve (AUC) ranging from 0.62 to 0.73, with significant discrimination in general surgery and emergency cases[39].

The immediate availability of SAS data contrasts with systems requiring 24-48 hour observation periods or extensive laboratory workups. This temporal advantage is particularly relevant in emergency surgery, where early identification of high-risk patients can guide immediate postoperative management decisions[40].

Integration with Existing Care Pathways

Our findings support the integration of SAS into standardized emergency surgery care pathways. The strong correlation with ASA classification suggests that these tools can be used complementarily rather than in isolation. Preoperative ASA assessment combined with intraoperative SAS calculation provides a comprehensive risk profile that spans the entire perioperative period[41].

Padilla et al. demonstrated that SAS, when combined with other factors like BMI and surgery duration, significantly improved risk prediction in gastrointestinal cancer surgery[42]. This multimodal approach to risk assessment may be particularly valuable in emergency settings where single predictors may be insufficient.

Resource Allocation and Healthcare Economics

The ability to identify high-risk patients immediately after surgery has significant implications for resource allocation, particularly in healthcare systems with limited intensive care capacity. Ejaz et al. suggested that incorporating additional intraoperative variables, such as blood transfusion requirements, could further enhance the predictive ability of the SAS[43].

In developing healthcare systems, where complex monitoring and laboratory facilities may be limited, the SAS provides an accessible method for risk stratification that requires no additional equipment or personnel training beyond standard surgical monitoring[44].

Study Limitations

Several limitations should be acknowledged in interpreting our results. The single-center design and relatively small sample size limit the generalizability of findings. The study was conducted at a tertiary care center, which may have selected for more complex cases and influenced complication rates[45].

The subjective nature of estimated blood loss assessment introduces potential variability, though this limitation is inherent to the SAS methodology and has been addressed in previous validation studies[46]. Additionally, the 30-day follow-up period, while standard for surgical outcome studies, may not capture all relevant long-term complications.

Future Research Directions

Future studies should focus on validating the SAS in larger, multi-center cohorts and investigating its performance across different surgical subspecialties within emergency general surgery. The development of modified or enhanced versions of the SAS, incorporating additional readily available intraoperative parameters, warrants investigation[47].

Research into the cost-effectiveness of SAS-guided care pathways and their impact on overall healthcare utilization would provide valuable evidence for healthcare policy decisions. Additionally, studies examining the utility of SAS in guiding specific interventions, such as ICU admission criteria or enhanced recovery protocols, could further define its clinical role[48].

The integration of SAS with electronic health records and decision support systems represents another area for future development, potentially enabling real-time risk assessment and automated care pathway activation[49].

Implications for Clinical Practice

Our findings support the routine implementation of SAS calculation in emergency gastrointestinal surgery. The strong correlation with postoperative complications provides clinicians with an immediate, objective assessment of patient risk that can guide early postoperative management decisions[50].

The simplicity of the SAS makes it particularly suitable for implementation in varied healthcare settings, from tertiary care centers to district hospitals with limited resources. This universal applicability is crucial for improving surgical care quality across diverse healthcare systems.

In conclusion, our study validates the utility of the Surgical APGAR Score as an effective predictor of postoperative complications in emergency gastrointestinal surgery. The strong correlations with complication rates and mortality, combined with its simplicity and immediate availability, make the SAS a valuable tool for perioperative risk assessment and clinical decision-making in this high-risk population.

5. CONCLUSION

This prospective study successfully validates the utility of the Surgical APGAR Score as an effective predictor of postoperative complications in emergency gastrointestinal surgery. Our findings demonstrate several key conclusions:

Primary Findings

Strong Predictive Value: Patients with low SAS scores (0-4) showed significantly higher complication rates compared to those with higher scores, with mean SAS scores of 4.65 ± 1.78 in patients with complications versus 6.20 ± 1.22 in those without complications (p=0.001).

Excellent Correlation with ASA Classification: The strong inverse relationship between ASA grade and SAS score (F=44.76, p<0.0001) validates the complementary use of these scoring systems for comprehensive perioperative risk assessment.

Clinical Applicability: The 30-day mortality rate of 6.7% and substantial complication rates (73.3% overall) in our emergency surgery cohort underscore the importance of immediate postoperative risk stratification.

Clinical Implications

Immediate Risk Stratification: The SAS provides real-time assessment of surgical risk using readily available intraoperative data, enabling immediate clinical decision-making regarding postoperative care intensity.

Resource Optimization: High-risk patients (SAS 0-4) can be identified for enhanced monitoring, ICU admission, or specialized care pathways, optimizing resource allocation in emergency settings.

Universal Applicability: The simplicity of SAS calculation makes it particularly valuable in resource-limited settings where complex scoring systems are impractical.

Recommendations

Routine Implementation: We recommend routine calculation and documentation of SAS scores for all emergency gastrointestinal procedures.

Care Pathway Integration: SAS scores should be incorporated into standardized postoperative care protocols to guide monitoring intensity and resource allocation.

Quality Improvement: Serial monitoring of SAS scores can serve as a quality improvement tool for surgical units and outcome benchmarking.

Future Directions

Multi-center validation studies with larger sample sizes are needed to further establish the generalizability of these findings across diverse healthcare settings. Investigation of SAS-guided interventions and their impact on patient outcomes represents an important area for future research.

Final Statement

The Surgical APGAR Score represents a simple, cost-effective, and immediately available tool that significantly enhances our ability to predict and manage postoperative complications in emergency gastrointestinal surgery. Its implementation can contribute to improved patient outcomes through early identification of high-risk patients and appropriate allocation of healthcare resources. This study supports the widespread adoption of SAS as a standard component of perioperative care in emergency general surgery.

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