



Received: 10-09-2026  
Accepted: 20-10-2026

## International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

### Predictive Accuracy of the Surgical Apgar Score for Outcomes After Emergency Surgery at Yirol Hospital South Sudan: A Retrospective One Year Observational Study

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DOI: <https://doi.org/10.62225/2583049X.2026.6.6.7100>

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#### Abstract

**Introduction:** Emergency surgery at Yirol Hospital appears to constitute a critical component of the local healthcare infrastructure, serving a patient population frequently presenting with life-threatening pathologies that require urgent intervention.

The present study seeks to validate the predictive performance of the Surgical Apgar Score in identifying postoperative morbidity and mortality secondary to emergency within the specific patient population at Yirol Hospital.

**Methodology:** This study employs a retrospective observational study design, analyzing data from patients who underwent emergency surgical procedures at Yirol Hospital over a 12-month period, covering 1 May 2025 to 1 May 2026 and encompassing a diverse cohort presenting with acute trauma and life-threatening surgical emergencies. Eligibility was restricted to adult patients who underwent non-elective operations during the designated time-frame;

patients with incomplete intraoperative physiological records were excluded. The primary outcome is the incidence of surgical site infection, with mortality within 30 days as the secondary outcome. To evaluate the scoring system's predictive accuracy, receiver operating characteristic curves will be constructed for both major morbidity and mortality.

**Results:** The area under the receiver operating characteristic curve was calculated as 0.67 with confidence interval 95% (0.40-.94) and a p-value of 0.22 (Handley McNeil) statistically significant.

**Conclusion:** The Surgical Apgar Score demonstrates a modest trend toward identifying patients at risk for postoperative morbidity at Yirol Hospital, yet it currently lacks the statistical precision required for robust clinical triage.

**Keywords:** Surgical Apgar Score (SAS), AUC, Sudan

#### Introduction

Emergency surgery at Yirol Hospital appears to constitute a critical component of the local healthcare infrastructure, serving a patient population frequently presenting with life-threatening pathologies that require urgent intervention.

To address this, the Surgical Apgar Score may serve as a relatively simple, objective instrument for stratifying patients according to their risk of major complications or mortality following surgery <sup>[1]</sup>. Despite its clinical utility in diverse settings, this study aims to evaluate the predictive performance of the Surgical Apgar Score in identifying postoperative complications and mortality rates among the emergency surgical population at this institution. By utilizing three easily measurable intraoperative parameters, this assessment seeks to determine whether the score may provide a reliable prognostic indicator for patient recovery in this specific clinical environment <sup>[2]</sup>. By systematically quantifying clinical risk, this research may provide a framework for optimizing resource allocation and clinical decision-making for high-acuity patients <sup>[3]</sup>. Integrating the Surgical Apgar Score into routine practice could provide a standardized metric for identifying patients at high risk of adverse events, ultimately guiding targeted postoperative interventions <sup>[4]</sup>.

Although established as a predictive metric in various global contexts, the score's discriminatory capacity in resource-limited emergency environments often requires rigorous assessment to ensure its clinical relevance <sup>[5]</sup>. Furthermore, local adaptation of risk models may be necessary, as prior validation studies have suggested the tool's effectiveness in predicting in-hospital

mortality and major complications in comparable tertiary environments [6]. By establishing the specific efficacy of this scoring system within the local context, this research intends to offer a robust data-driven foundation for refining triage and postoperative monitoring protocols [7]. By synthesizing these findings, this research seeks to bridge the information gap regarding routine surgical surveillance in low-resource environments [8], thereby supporting evidence-based improvements in local surgical care. This effort may be particularly important given the unique challenges of delivering surgical care in chronic conflict settings, where limited resources and personnel may necessitate efficient, objective triage mechanisms [9]. The study systematically evaluates whether these intraoperative physiological markers demonstrate a reliable discriminatory capacity for patient outcomes within this facility. Because the Surgical Apgar Score may predict adverse outcomes without sufficiently distinguishing individual risk, its performance at Yirol Hospital should be assessed as a potential aid to—not a substitute for—clinical judgment [5].

The present study seeks to validate the predictive performance of the Surgical Apgar Score in identifying postoperative morbidity and mortality within the specific patient population at Yirol Hospital.

### Methodology and Study Design

This study employs a retrospective observational study design, analyzing data from patients who underwent emergency surgical procedures at Yirol Hospital over a 12-month period, covering 1 May 2025 to 1 May 2026 and encompassing a diverse cohort presenting with acute trauma and life-threatening surgical emergencies. Eligibility was restricted to adult patients who underwent non-elective operations during the designated time-frame; patients with incomplete intraoperative physiological records were excluded.

The study population includes all adult patients admitted for urgent surgical intervention, encompassing acute trauma cases as well as patients presenting with complications from infectious pathologies or surgical emergencies. The Surgical Apgar Score is calculated by assigning points based on the lowest mean arterial pressure, lowest heart rate, and estimated intraoperative blood loss [10]. Outcomes defined as the occurrence of major postoperative complications or in-hospital mortality are assessed alongside 30-day postoperative follow-up in the surgical outpatient clinic. SAS scores of 0–4, 5–6, and 7–10 indicate high-, intermediate-, and low-risk patients, respectively [11], for postoperative complications classified according to the Clavien-Dindo scale [12] to ensure a standardized severity assessment. The primary outcome is the incidence of surgical site infection, with mortality within 30 days as the secondary outcome.

To evaluate the scoring system's predictive accuracy, receiver operating characteristic curves will be constructed for both major morbidity and mortality.

Calibration plots will additionally assess the agreement between observed complication rates and predicted probabilities, a procedure that may indicate whether the tool's risk stratification is clinically robust across the spectrum of patient acuity.

By integrating these statistical metrics, the research may provide a framework for evaluating whether the Surgical Apgar Score (SAS) serves as a reliable prognostic

instrument amid st the operational constraints of a low-resource emergency department. These statistical assessments may help clarify the score's clinical utility as a stratification tool for resource allocation in acute care environments.

Ethical approval for this study was granted by the local hospital Institutional Review Board through the medical director.

Furthermore, all analytical procedures were conducted in strict accordance with the Declaration of Helsinki to maintain the integrity and privacy of vulnerable patient records throughout the study duration. Given the absence of missing data, the statistical analysis utilizes the complete patient cohort to may increase the power of tests examining associations between individual score components and the primary study endpoints.

The absence of missing data may support an evaluation of the score's discriminatory performance in an environment where resource scarcity necessitates precise clinical decision-making.

Sensitivity and specificity thresholds will be calculated to estimate potentially useful cut-off points for clinical decision support, facilitating proactive rather than reactive postoperative care.

Finally, diagnostic performance indices—including positive and negative predictive values—will be assessed to determine the clinical threshold at which the score most effectively informs surgical triage and resource distribution. These diagnostic metrics may elucidate the potential for the SAS to serve as a reliable, objective adjunct to clinical intuition when managing high-acuity patients in resource-constrained settings [13]. Ultimately, these insights may clarify whether the SAS can function as a pragmatic tool for enhancing surgical safety and prioritizing postoperative care in the challenging environment of Yirol Hospital.

### Results

#### These results are reported according to strobe checklist for reporting observational studies

The cohort comprised 17 patients, characterized by a mean age of 25.9 years in those without complications and 30.1 years in those with complications.

Distribution of the Surgical Apgar Scores suggested a median value of 6.6 in those without complications and a mean score of 5.9 in those with complications (See Fig 2 and 3).

The mean arterial pressure without complications was 77.6 mmHg, while patients experiencing postoperative complications appeared to exhibit a lower mean arterial pressure of 76 mmHg.

The mean estimated blood loss was 36 mL among patients without subsequent morbidity, whereas those who developed complications had an estimated blood loss of 246.4 mL. Furthermore, the lowest heart rate in patients without complications averaged 84 bpm, compared to 87 bpm for those who encountered adverse postoperative events.

Patients exhibiting SAS values between 5 and 6 appeared to have a 50% postoperative complication rate compared to their higher-scoring counterparts. Conversely, scores of 7–10 had a complication rate of 28.6% (See Fig 2 and 3).

The surgical score appears to show the expected direction with a complication rate of 60% at a Surgical Apgar Score of 5 in comparison with the 0% complication rate observed

among patients scoring 8 or higher. Collectively, however, the limited sample size necessitates cautious interpretation. The area under the receiver operating characteristic curve was calculated as 0.67 with confidence interval 95% (0.40-.94) and a p-value of 0.22 (Handley McNeil) statistically significant (See Fig 1). These findings suggest that while the Surgical Apgar Score demonstrates a trend toward risk stratification, it fails to achieve statistical significance for predicting adverse surgical outcomes in this specific clinical population. The observed lack of predictive power likely stems from the small study cohort, which may lack the sensitivity to distinguish between low-risk and high-risk surgical profiles. Future investigations involving larger, multi-center datasets are required to definitively establish the utility of the Surgical Apgar Score in similar low-resource settings. Such findings underscore the complexity of adapting standardized scoring systems to emergency contexts where fluctuating intraoperative variables and clinical heterogeneity may obscure prognostic clarity.

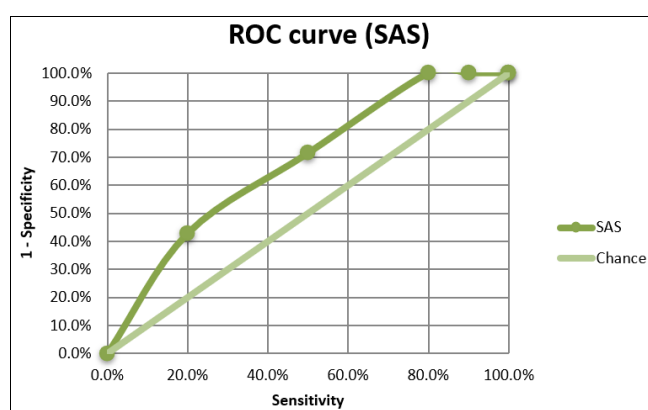


Fig 1: Receiver operating characteristic curve

Table 1: SAS risk bands vs sensitivity and specificity tests

| Cutoff (SAS ≤) | TP | FP | TN | FN | Sensitivity | Specificity | 1 - Specificity | Youden J |
|----------------|----|----|----|----|-------------|-------------|-----------------|----------|
| 4              | 0  | 0  | 10 | 7  | 0.0%        | 100.0%      | 0.0%            | 0.00     |
| 5              | 3  | 2  | 8  | 4  | 42.9%       | 80.0%       | 20.0%           | 0.23     |
| 6              | 5  | 5  | 5  | 2  | 71.4%       | 50.0%       | 50.0%           | 0.21     |
| 7              | 7  | 8  | 2  | 0  | 100.0%      | 20.0%       | 80.0%           | 0.20     |
| 8              | 7  | 9  | 1  | 0  | 100.0%      | 10.0%       | 90.0%           | 0.10     |
| 9              | 7  | 10 | 0  | 0  | 100.0%      | 0.0%        | 100.0%          | 0.00     |
| 10             | 7  | 10 | 0  | 0  | 100.0%      | 0.0%        | 100.0%          | 0.00     |

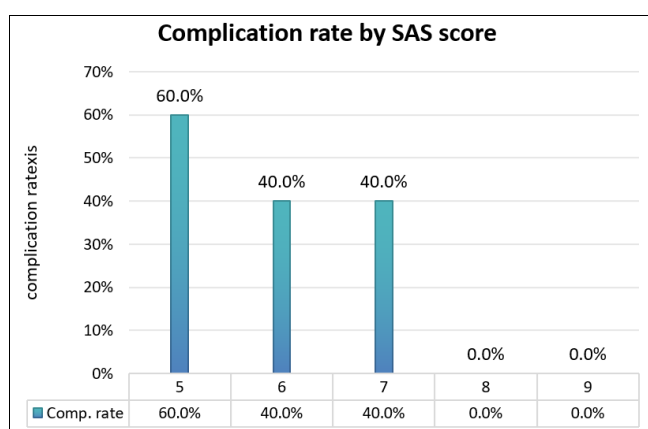


Fig 2: Complication rate by SAS Score

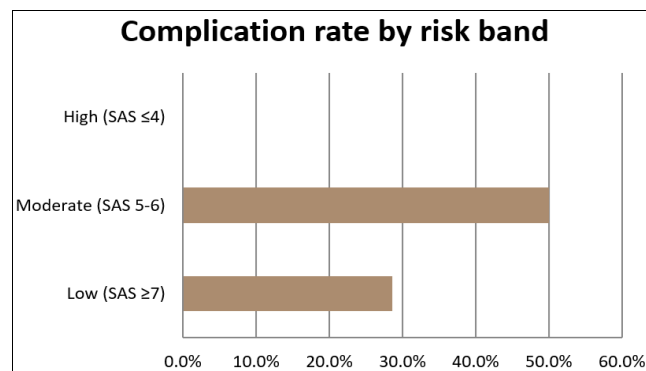


Fig 3: Complication rate by risk band

## Discussion

The current analysis indicates that the Surgical Apgar Score exhibits limited discriminatory capability for predicting postoperative morbidity at Yiol Hospital, suggesting that its application as a standalone triage instrument is premature in this setting. Its performance is almost close to using chance, mirroring recent meta-analytic findings that characterize the score's accuracy as highly context-dependent with AUC values typically ranging between 0.6 and 0.7. This observed performance discrepancy likely reflects the influence of confounding factors inherent to the local emergency environment, which are not captured by standardized physiological variables [14, 15].

Moreover, the modest sample size may have introduced a high risk of type II errors, potentially obscuring meaningful associations between low SAS values and severe outcomes. Furthermore, the heterogeneity of emergency surgical conditions often leads to inconsistent physiological markers, which complicates the standardization of the score's predictive thresholds [16, 17]. Consequently, while the Surgical Apgar Score remains a straightforward, cost-effective framework for intraoperative monitoring, its clinical utility at Yiol Hospital is constrained by these systemic limitations [18, 19]. Future integration of this metric into larger, prospective studies is warranted to determine whether it can effectively complement clinical judgment in resource-limited environments, particularly as a tool for auditing quality of care [20, 21]. Addressing these constraints will require a multi-center, prospective design that controls for extraneous clinical variables, such as patient comorbidities and systemic health care limitations [1, 22]. Establishing a robust, stepped-wedge cluster design for future interventions could help determine if a decisive, score-guided approach truly translates into superior postoperative outcomes [23]. Additionally, exploring the combination of the Surgical Apgar Score with other clinical parameters—such as the American Society of Anesthesiologists classification—may enhance predictive accuracy, as recent evidence suggests that composite models often outperform isolated physiological scoring systems in resource-limited settings [24].

## Conclusion

The Surgical Apgar Score demonstrates a modest trend toward identifying patients at risk for postoperative morbidity at Yiol Hospital, yet it currently lacks the statistical precision required for robust clinical triage.

Given these limitations, the score should not yet be utilized as a definitive prognostic indicator, but rather as a supplementary metric for tracking surgical quality and systemic performance. Future clinical efforts should prioritize the development of localized prognostic algorithms that integrate regional physiological baselines with existing risk stratification frameworks.

### Conflict of Interest

The author has no conflict of interest to disclose.

### Funding

The author received no funding from any non governmental organization of government nor from the surgery department.

### Data Availability

The will avail the raw data for individual statistical analysis upon request through the email address list above.

### Consent for Publication

Since there was no patient identity involving analysis the data, consent to publish is not required for this manuscript.

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