

Predicting Major Complications following Emergency Laparotomy for Gastrointestinal Conditions using Surgical Apgar score

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ABSTRACT

Background: Emergency laparotomy is a common surgical operation, and is associated with high postoperative morbidity and mortality. The mortality within 30 days following emergency laparotomy ranged from 13% to 18%. Surgical Apgar Score (SAS) is a simple, inexpensive, and easily utilizable tool for predicting postoperative complications using only three intraoperative parameters, and has good predictive accuracy. This study aimed to determine the ability of SAS in predicting major complications following laparotomy for gastrointestinal conditions. **Patients and Method:** This is a prospective observational study conducted in Aminu Kano Teaching Hospital, where adult patients who consented and met the indication for emergency laparotomy were enrolled for 1 year. Patients' demographic and clinical characteristics were obtained using a proforma. The patients were categorized into high-risk, moderate risk, and low risk based on the surgical Apgar score, and followed up for 30 days. Patients' data were analyzed, Receiver Operating Characteristics (ROC) curve generated and Area under the Curve (AUC) calculated. **Results:** Fifty seven adult patients were studied. The rate of major postoperative complications was 50.88% and 30-day postoperative mortality of 10.53%. The mortality rate was 25.00% in the high-risk group, while in moderate risk group was 15.38%, and no mortality recorded in low risk group. The AUC of 0.72 (95% CI: 0.58- 0.85; p< 0.01) was obtained from the study. **Conclusions:** Surgical Apgar score has good predictive accuracy in predicting major complications following emergency laparotomy for gastrointestinal conditions.

Keywords: Emergency Laparotomy, Surgical Apgar score, Major Postoperative Complications

INTRODUCTION

Emergency laparotomy is a common surgical procedure done to gain access into the abdominal cavity to address emergency surgical

conditions. Data from the National Emergency Laparotomy Audit (NELA) Project 2015 Report in the United Kingdom showed over 30,000 adult



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patients had emergency laparotomy yearly in UK. ^[1] Postoperative major complications are common following laparotomy especially when performed in an emergency setting. ^[2, 3] They negatively affect the health system as well as the individual patient socioeconomically; by increasing hospital stay, increased hospital bills, and extending time to return to work or normal activity. ^[3, 4] The reported mortality after emergency laparotomy internationally ranged from 13% to 18% within 30 days and rose to around 25% within 2 years. ^[5] Vishwani *et al* in India conducted a study on patients who had laparotomy for peritonitis and observed a postoperative complications rate of 48.31% and a mortality rate of 6.75%. ^[6] Similarly, in a study conducted in Kenya by Dullo *et al*, they reported postoperative complications rate of 40.8% and mortality rate of 7.9% following laparotomy. ^[7] In a study conducted in Southeastern Nigeria by Ugochukwu and his colleagues, they observed postoperative mortality of 18.6% following emergency laparotomy for typhoid ileal perforation. ^[8]

A postoperative complication is defined as any negative outcomes of surgery as perceived by the surgeons or the patients. ^[9] A major postoperative complication is defined according to the National Surgical Quality Improvement Program (NSQIP) of America College of Surgeons (ACS); when any of the following occurred postoperatively: "Acute renal failure, bleeding requiring ≥ 4 units red cell transfusion within 72 hours after an operation, cardiac arrest requiring cardiopulmonary resuscitation, coma for 24 hours or longer, deep venous thrombosis, septic shock, myocardial infarction, unplanned intubations, ventilator use for 48 hours or longer, pneumonia, pulmonary embolism, stroke, wound disruption, deep or organ space surgical site infection, sepsis, systemic inflammatory response syndrome, and vascular graft failure". ^[10, 11] Additionally, postoperative complications were classified into 5 grades by Dindo *et al* ^[12], this grading was based on the interventions needed to address the complications and the presence of organ dysfunction or death. ^[12]

The interventions could be pharmacological, radiological, endoscopic, or surgical, and could be under general or local anesthesia. ^[12]

Many complications follow laparotomy, they include but not limited to wound infections, wound dehiscence, urinary tract infection, septic shock, anastomotic leak, enterocutaneous fistula, and adhesive intestinal obstruction. ^[7] According to previous studies, the most common major postoperative complication following laparotomy was wound infection. ^{[7][8]}

Several risk stratification tools are used for predicting postoperative complications in many surgical procedures. They include POSSUM, APACHE, ASA, and SAS. Most of these tools are comprised of many variables and some require laboratory investigations. ^[5] Surgical Apgar score was developed in 2007 by Gawande and colleagues in Boston United States of America. ^[10] It is a simple and inexpensive tool that consists of only three intraoperative parameters and has a total of 10-points like the Apgar score in obstetrics. ^[10, 11] The tool was developed from the variables obtained from 303 patients who had colectomy at Brigham and Women Hospital Boston. ^[10] The intraoperative parameters are: lowest heart rate, lowest mean arterial pressure, and estimated blood loss. These variables were found to be more sensitive than other variables in predicting postoperative morbidity and mortality. ^[10] The parameters are allocated points based on the value obtained from the patient intraoperatively as in Table 1. Patients are then stratified based on the scores into high risk (0-4), moderate risk (5-7), and low risk (8-10) for developing postoperative complications. ^[10]

Many studies were done validating SAS for use in several surgical operations. It was originally validated in general and vascular surgical operations by Gawande *et al* and also in 4119 patients in Massachusetts General Hospital in a retrospective study by Regenbogen and his colleagues. ^[10, 13] The tool was also validated in several other surgical specialties like gynecology, orthopedics, neurosurgery, and urology. ^[11] Moreover, the surgical Apgar score was validated

for use in low and medium-income countries like India, Tanzania, Philippines, and Rwanda.^[14]

Surgical Apgar score was used in predicting postoperative outcomes following open abdominal operations in a study conducted by Priyank *et al* in India.^[15] In a study conducted by Singh and colleagues to detect major complications and death following emergency abdominal surgery using SAS; they found that SAS has moderate accuracy in predicting major complications and death.^[16] Similarly, in the Kenyan study, it was found that surgical Apgar score has good accuracy in predicting major complications after laparotomy and it was also an adequate postoperative risk stratification tool.^[7] Chitra and colleagues in their study in India demonstrated that lower SAS has a better prediction for postoperative morbidity and mortality.^[17] The objective of this study was to determine the ability of SAS to predict major complications following emergency laparotomy for gastrointestinal conditions in a tertiary health institution in Northwestern Nigeria.

PATIENTS AND METHODS

This study was a prospective observational study conducted in Aminu Kano Teaching Hospital, Kano, Kano State, Northwestern Nigeria between June 2018 and May 2019. Adult patients who required emergency laparotomy for gastrointestinal conditions and consented were enrolled. Ethical approval was obtained from the Research and Ethics committee of Aminu Kano Teaching Hospital based on the principle of Helsinki declarations. The patients excluded from the study included multiply injured patients, patients with advanced intrabdominal malignancy, and those with bleeding diathesis.

The patients' data were obtained using a proforma; patients' demographics and clinical characteristics were documented. The intraoperative lowest heart, lowest mean arterial pressure, and estimated blood loss were obtained and documented. The intraoperative blood loss was estimated using gravimetric method. The patients were then scored points based on the value observed as depicted in Table 1. They were categorized as high risk, moderate risk, and low risk for developing major complications. Patients were then followed up for 30-days post-operatively looking for major postoperative complications as defined by the American College of Surgeons National Surgical Quality Improve program (NSQIP-ACS).^[10]

The data were analyzed using SPSS version 22. Quantitative variables like age was summarized using mean, standard deviation and histogram, while qualitative variables like sex and postoperative complications were summarized using table, chart, ratio and proportion. ROC curve was generated and the area under the curve was calculated to determine the predictive accuracy of the SAS.

RESULTS

Fifty-seven patients were studied with ages ranging from 18years to 86years, and a mean age of 37.30 ± 17.70years. The majority of the patients were young adults, between the ages of 20 and 29years, and constituted 38.60% of the patients studied as shown in Figure 1. Male patients were the majority as displayed in Figure 2, and represented a male-female ratio of 1.5:1. The operative diagnosis of the patients that had emergency laparotomy is shown in table 2.

Table 1: Displaying Scoring of Points of the SAS Parameters.^[10]

Points	0	1	2	3	4
Estimated Blood Loss (mls)	>1000	601-1000	101-600	≤100	
Lowest Mean Arterial Pressure (mmHg)	<40	40-54	55-69	≥70	
Lowest Heart rate (beats/ mins)	>85	76-85	66-75	56-65	≤55

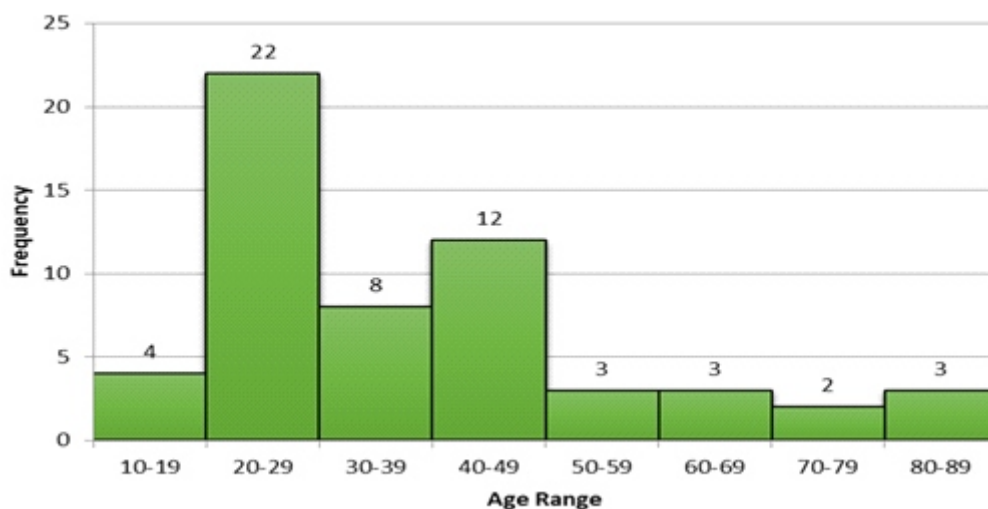


Figure 1: A Histogram Summarizing Age Distribution of the patients

Diagnosis	No. (%)
Peritonitis	23(40.35)
Ruptured Appendix	15(26.32)
Perforated Peptic Ulcer Disease	4(7.02)
Typhoid Ileal perforation	4(7.02)
Intestinal Obstruction	13(22.81)
Colonic Tumour	6(10.53)
Adhesive	3(5.26)
Hernia	2(3.51)
Others	2(3.51)
Trauma	12(21.05)
Others	9(15.79)

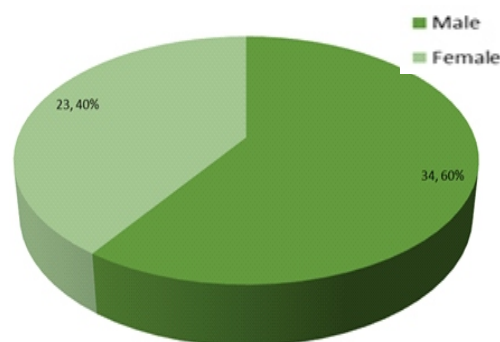


Figure 2: Pie-chart Displaying Sex Distribution of the Patients

Major postoperative complications rate recorded was 50.88%, and 6 deaths were recorded with 30day mortality rate of 10.53%.

Table 3: Showing Major Complications and Deaths

Major postoperative complications	Number of patients (%)
Wound Infections	16(28.07)
Wound Dehiscence	3(5.26)
Enterocutaneous Fistula	2(3.51)
Septic Shock	2(3.51)
Others	6(10.53)
Total	29 (50.88)

Table 4: Showing complication and mortality among Risk Groups

Risk Group	Number of patients (%)	Major Complication (%)	Death (%)
High Risk	21(36.84)	16(76.19)	4(25.00)
SAS (0-4)			
Moderate Risk	34(59.65)	13(38.24)	2(15.38)
SAS (5-7)			
Low Risk	2(3.51)	0(0.00)	0(0.00)
SAS (8-10)			

The ROC curve was shown in the Figure 3, and the area under the curve (AUC) obtained which signifies a moderate predictive accuracy as in Table 5.

Table 5: Showing Area under the Curve (AUC)

AUC	P-Value	Lower Bound 95% CI	Upper Bound 95% CI
0.72	0.005	0.58	0.85

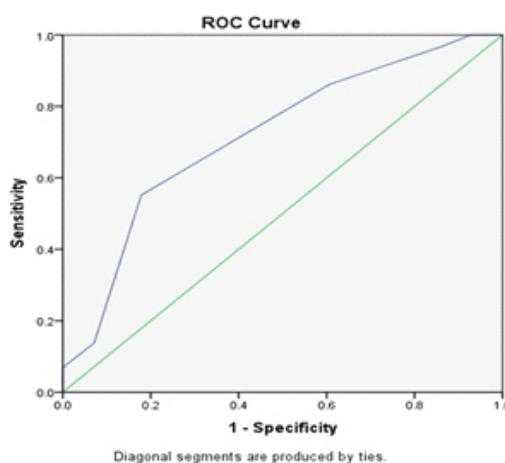


Figure 3: Showing a Receiver Operating Characteristic (ROC) Curve

DISCUSSION

This study sought to determine the ability of surgical Apgar score in predicting major postoperative complications following emergency laparotomy for gastrointestinal conditions. Fifty-seven patients were studied, and the majority of the patients were young adults with a mean age of 37.30 years and males were more with a male-female ratio of 1.5:1 as shown in Figures 1 and 2. These findings were in concordance with what was obtained in the Indian study by Chitra et al who reported mean age of 47.8 years and the majority of the patients studied were men.^[17]

Emergency laparotomy is associated with high morbidity and mortality rate, in this study the rate of a major complication and 30-day mortality was high as well; the rate of major complication was 50.88%, and the 30-day mortality rate of 10.53%. These findings were closely similar to what reported internationally, in which mortality in patients who underwent emergency laparotomy ranged from 13% to 18% within 30 days.^[5] The Kenyan study found a postoperative major complication rate of 40.8% and a mortality rate of 7.9%.^[7] These findings were from all the patients who had laparotomy irrespective of the urgency of the procedure. The major postoperative complications rate following emergency laparotomy from the study was 43.9%, compared to the 20% in elective group.^[7]

Moreover, the major postoperative complications and 30-day mortality were higher in the high-risk group based on the SAS.^[2,7] Similarly in this current study postoperative complications and mortality were found to be higher in the high-risk group than in other risk groups; this could be due to the worsen intraoperative parameters (Blood loss, Mean Arterial Pressure and Heart rate) in them, which are sensitive predictive factors for major postoperative complications.^[10] These findings are in concordance with findings in the literature.^[2, 7] Major postoperative complication rate was higher in the high-risk group in the Kenyan study also.^[7] They recorded postoperative complication rates of

58.3% in high risk, 35.6% in the moderate-risk group, and 16.6% in low-risk group.^[7] In another similar study conducted in India by Santoshsingh and colleagues, there were no complications and death in those patients with the low-risk group, however, they recorded 50.0% and 10.3% postoperative complication rate and mortality rate respectively in high risk group.^[2]

SAS was found to have moderate accuracy in predicting major complications from this study; the AUC of 0.72 (95% CI: 0.58-0.84; P<0.01) was obtained as shown in Table 5. This finding is similar to what was recorded by Singh et al in their study; they found an AUC of 0.71 (95% CI; 0.68-0.73, p<0.01).^[16] Although their study was retrospective in design, they still found very similar findings with this current study which is prospective in design. Similarly, another study also found SAS to have good accuracy in predicting postoperative complications following laparotomy; AUC of 0.79 was obtained in their study.^[7] Their study involved both emergency and elective laparotomy, unlike in this current study which only included emergency laparotomy. Also in the study conducted by Chitra et al in India assessing the utility of SAS in predicting postoperative complications in patients who had laparotomy, they concluded that SAS has a better prediction for postoperative morbidity and mortality in high-risk group.^[17] They also recruited patients who had elective or emergency laparotomy.

The majority of these studies were conducted in the low and medium-income countries (LMICs) and have shown that SAS could be used in predicting morbidity and mortality following laparotomy.^[7,16]

^[17] This can help in planning and utilization of health facilities such intensive care units to achieve better outcome in the health care delivery. More so, it has been shown that SAS has good accuracy in predicting major complications and death after laparotomy, as suggested by this current study in emergency laparotomy.

CONCLUSION

This study revealed that the Surgical Apgar score has moderate accuracy in predicting major complications following emergency laparotomy for gastrointestinal conditions. Therefore, SAS could be used to risk stratify and triage postoperative patients for better utilization of health care resources such as in intensive care units especially in low and medium income countries.

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