

## Original Research Article


# Utility of surgical APGAR score in predicting post-operative morbidity and mortality in patients undergoing laparotomy – A prospective study

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## Abstract

**Background:** The best model to determine the postoperative complications must be simple and easily applicable to the majority of surgical patients. The complications and their incidence should be precisely defined and estimated. The model should also have a low threshold to identify them. The ASA classification was initially intended as a means to stratify a patient's systemic illness but not post-operative risk. Although the ASA classification has proved to be a predictive pre-operative risk factor in mortality models, its subjective nature and inconsistent scoring between providers make it less than ideal for performing evidence-based post-operative risk calculation.

**Aim of the study:** The aim of the study was to determine the applicability of the Surgical Apgar Score in post-operative risk stratification for morbidity and mortality during the 30 days post-laparotomy.

**Materials and methods:** In this study, 152 in-patient Visiting Government Stanley Medical College General Hospital from March 2017 to April 2018 had been studied. Patients undergone laparotomy at Department of General Surgery, Government Stanley Medical College were managed by a tier of doctors from anesthetic technicians, medical officer interns, medical officers, postgraduates in general surgery and anesthesiology and their consultants. Interns and postgraduates in general surgery provided the pre and postoperative care and participate in general surgical procedures whenever indicated. Anesthesiologists apart from providing anesthesia during surgery extended their care in the intensive care unit.

**Results:** 132 patients were operated as an emergency and only 20 patients were operated selectively. 86.8% of the surgeries were emergency laparotomies and only 13.2% of the surgeries were elective. This showed our efficient functioning and round the clock services of our emergency theatres. The most common causes in descending order include penetrating injury, intestinal obstruction, peritonitis, perforated duodenal ulcer, blunt injury abdomen, intra-abdominal abscess, hydatid cyst, obstructed hernia, mesenteric ischemia, cholecystitis. A significantly higher complication was noted among female patients at 63.2% compared to male patients at 33.3%. 43.9% of the postoperative complications occurred in emergency setting whereas only 20% of the complications occurred in the elective setting. When the complications were compared with the duration of surgery, those surgeries that lasted more than 120 minutes had a higher complication rate of 68.6% whereas surgeries with a shorter duration only had a complication rate of 26.7%.

**Conclusion:** Surgical Apgar Score is very effective in identifying high-risk patients who are capable of developing significant complications following laparotomy within the first 30 postoperative days. This identification of high-risk patients helps us in the judicious use of healthcare resources towards the proper monitoring and follow up of these patients.

## Key words

Surgical Apgar Score, Wound Complications, Obstructed Hernia, Cholecystitis.

## Introduction

There are many factors that alter the patient's condition during the surgery including extremes in blood pressure (hyper or hypotension), hypothermia, bradycardia/ tachycardia and the quantity of blood lost during the surgery [1]. It has been noticed that patients with intraoperative mean arterial pressure less than 70 mmHg have an increased risk of complications. Bradycardia and hypotension are also independently linked to poor outcomes in the recovery period. It has also been found that higher wound class and ASA class have a direct proportionate to the postoperative mortality and morbidity [2]. A higher wound class and ASA class have a higher rate of postoperative complications. There is no definitive method available to directly evaluate the performance and safety during a surgery using these variables [3]. Each and every component should be independently and collectively contribute to predicting the outcome for a score to be a clinically useful predictor of postoperative mortality and morbidity. During the surgery, the surgeon mostly relies on his "gut feeling" rather than an objective assessment to predict the postoperative happenings [4]. The intraoperative management plays an important role in determining the overall outcome of the

patient even though there is no quantitative measure of the operative care provider available [5]. This ten point Surgical Apgar Score also known as the SAS score predicts the postoperative mortality and morbidity and can be used in all specialties of surgery. 28 parameters were collected during the surgery and analyzed. Of these 28 parameters, only three intraoperative variables remained independent predictors of major catastrophe following surgery [6]. The three important variables that were derived and formulated into the Surgical Apgar Score are the lowest heart rate, the lowest mean arterial pressure and estimated blood loss during the surgery [7]. The SAS score provides an easy, quick and an objective mean of estimating and communicating the patient outcome following surgery, using data that are routinely available even in low resource settings [8]. The score can be very useful in choosing patients at the higher- and lower-than-average likelihood of severe complications post-surgery and may be helpful for guiding interventions to avoid poor outcomes. The parameters of the score highlight the patient's overall condition [9]. The degree of surgical insult and the efficacy of the surgical team to respond to and control hemodynamic changes during the operation. Blood pressure and

heart rate alterations represent both the physiological status of the patient and the adequacy of anesthetic management. The difficulty of the surgery and the efficacy of the surgeon can be predicted by blood lost during the surgery [10].

## Materials and methods

In this study, 152 in-patients Visiting Government Stanley Medical College General Hospital from March 2017 to April 2018 had been studied. Patients undergone laparotomy at Department of General Surgery, Government Stanley Medical College were managed by a tier of doctors from anesthetic technicians, medical officer interns, medical officers, postgraduates in general surgery and anesthesiology and their consultants. Interns and postgraduates in general surgery provided the pre and postoperative care and participate in general surgical procedures whenever indicated. Anesthesiologists apart from providing anesthesia during surgery extended their care in the intensive care unit.

**Inclusion criteria:** All Patients above 13 years of age, Scheduled for emergency or elective laparotomy.

**Exclusion criteria:** Patients undergoing concurrent major procedures on other body regions during or within 30 days of the laparotomy under study, patients with established metastatic and unresectable tumors, patients undergoing mini-laparotomy and laparoscopic procedures.

The primary researcher and a trained assistant recorded the required variables in the data collecting sheet. Data was collected after the surgery (within 24 hours) in the operating theatre, recovery area, ICU/HDU or in the ward admitted. Anesthetic notes were used to collect blood pressure, heart rate parameters during the surgery. Blood pressure and heart rate were monitored every fifteen minutes from induction to the reversal of general anesthesia. MAP was calculated by using a formula  $[\text{diastolic pressure} + (\text{a systolic pressure} - \text{diastolic pressure})/3]$ .

Pre- and Post-operative hematocrit and hemoglobin levels to calculate blood loss were obtained from the patient's pre and post-surgery full hemogram results. Post-operative follow up rounds and notes both as inpatient and outpatient for the next thirty days after surgery was used to determine the occurrence of any major post-operative complications. Data was collected using a standard questionnaire administered by the principal researcher and a trained assistant.

## Statistical analysis

Data collected was entered and analyzed with the help of statistician and statistic software. P value was generated using the t-test for means, Chi-square ( $\chi^2$ ) for comparison of proportions, analysis of variance (ANOVA) and where applicable Fischer's exact test. Value of  $p < 0.05$  was considered significant.

## Results

One hundred and fifty-four patients who matched with the inclusion criteria were adopted in the study after taking due consent from the patients. Of the 154 patients, two patients did not turn up to the hospital during the regular weekly periodic follow-up. This left us with a total of 152 patients. These 152 patients were available to monitor the outcome. All the patients taken up for the study were between the age group of 14 and 80 years.

**Table - 1** shows the distribution of diagnoses that necessitated laparotomy in a simplified manner. The most common causes in descending order include penetrating injury, intestinal obstruction, peritonitis, perforated duodenal ulcer, blunt injury abdomen, intra-abdominal abscess, hydatid cyst, obstructed hernia, mesenteric ischemia, cholecystitis, and other causes.

Duration of the laparotomies that were performed varied from about 1 hour to about 5 hours that is from about 60 minutes to about 300 minutes. The mean duration was 131.05 minutes and the median duration of the surgeries was 120

minutes. The standard deviation observed was 63.589. Observing the study, it has to be noted that out of the 152 patients, 12 patients died within 30 days of the laparotomy procedure. This makes it a mortality rate of 7.9%. Most of the deaths occurred within the first 16 days post-surgery from the 1<sup>st</sup> to 16<sup>th</sup> postoperative day. It is also worthwhile mentioning that most of the postoperative mortality in the study occurred in the first postoperative day (**Graph – 1**).

**Table – 1:** Diagnosis and no. of patients.

Diagnosis	Count %	Count (No)
Cholecystitis	1.9	3
Mesenteric ischemia	1.3	2
Hernia	2.6	4
Hydatid cyst	0.6	1
Intra-abdominal abscess	9.2	14
Blunt injury	10.5	16
Perforation	11.8	18
Peritonitis	15.1	23
Intestinal obstruction	15.1	23
Penetrating injury	19.7	30
Others	11.8	18

**Table – 2:** Frequency of complications.

Complications	Frequency	%
No complications	90	59.2
Anastomotic leakage	12	7.9
Renal dysfunction	4	2.6
Death	12	7.9
Superficial wound infection	11	7.2
Deep wound infection	14	9.2
Respiratory infection	1	0.7
Wound dehiscence	8	5.3
<b>Total</b>	<b>152</b>	<b>100</b>

Deep wound infection was the most common complication (**Table – 2**). The second to it comes to the anastomotic leakage. The next common complication was found to be a superficial wound infection. The other complication that was commonly noted were wound dehiscence, renal dysfunction, and respiratory infection. 90 patients of a total of 152 patients did not suffer

from any complications within the first 30 postoperative days. This is a 59.2% complication free patients amongst the total patients in the study.

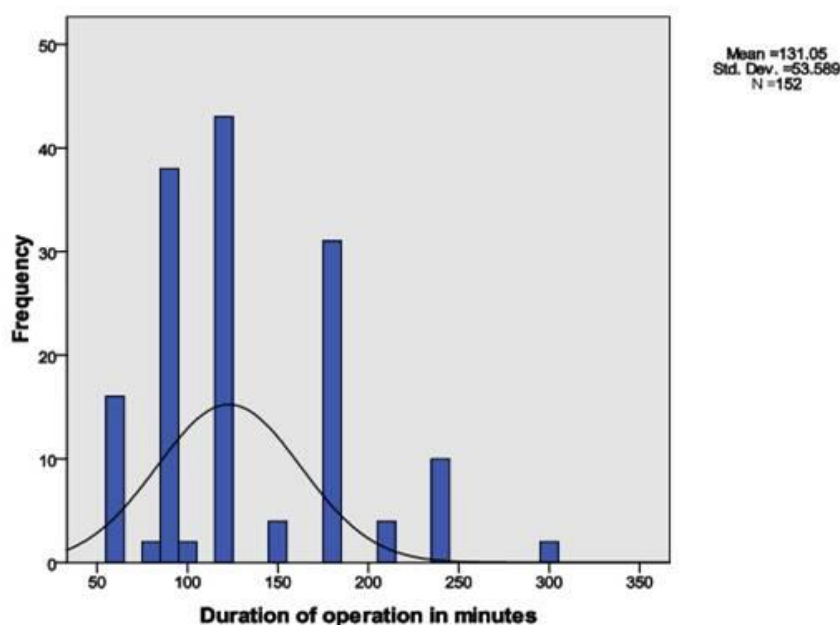
A significantly higher complication was noted among female patients at 63.2% compared to male patients at 33.3% (**Graph – 2**). 43.9% of the postoperative complications occurred in emergency setting whereas only 20% of the complications occurred in the elective setting. When the complications were compared with the duration of surgery, those surgeries that lasted more than 120 minutes had a higher complication rate of 68.6% whereas surgeries with a shorter duration only had a complication rate of 26.7%.

Surgeries lasting for less than 2 hours presented with fewer complications compared to surgeries lasting more than 2 hours (**Graph – 3**). 26.7% of patients who underwent surgeries for less than 2 hours developed complications whereas 68.6% of patients who underwent surgeries for more than 2 hours developed complications. In other words, 27 of total 101 surgeries that lasted less than 2 hours developed complications compared to 35 of total 51 surgeries that lasted more than 2 hours developed complications. In our study, the Surgical Apgar Score that was computed for all the patients ranged from 1 to 9. The mean was 5.03 and the median was 5. The mean SAS for males was 5.28 while for females it was 4.26. This was statistically significant ( $p=0.001$ ).

The comparison of the mean SAS between different patient groups based on the duration of surgery, gender, age group and occurrence of complications. P values were generated using ANOVA (**Graph – 4**).

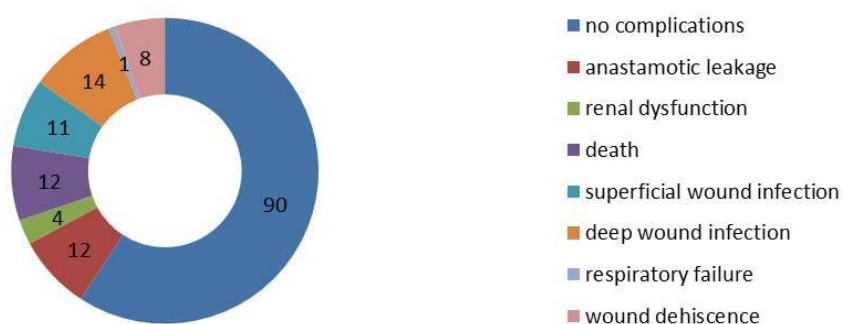
The major complications were more common in patients with peritonitis, intra-abdominal abscess and penetrating abdominal injury (**Graph – 5**). Complications were almost nil in straightforward surgeries which were easier and takes less duration such as obstructed hernia, cholelithiasis, and hydatid cysts.

**Graph – 1:** Different surgery duration.



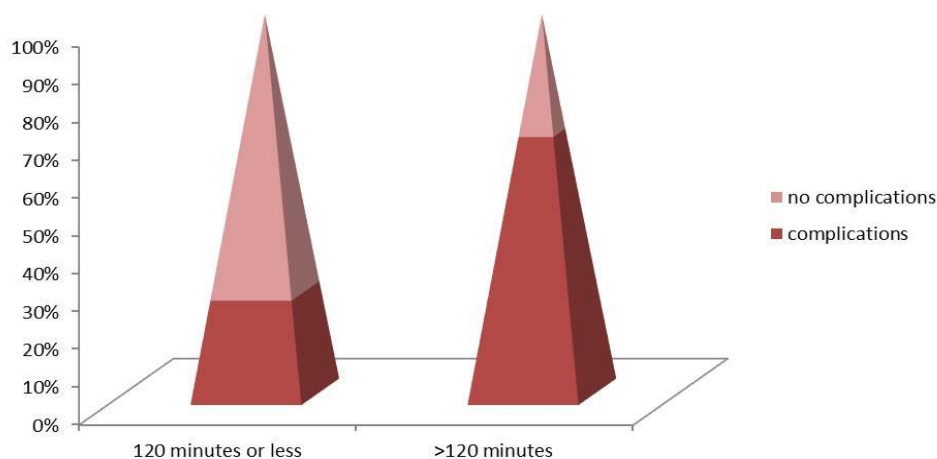
**Graph – 2:** Post-operative mortality and morbidity.

### POSTOPERATIVE MORTALITY AND MORBIDITY

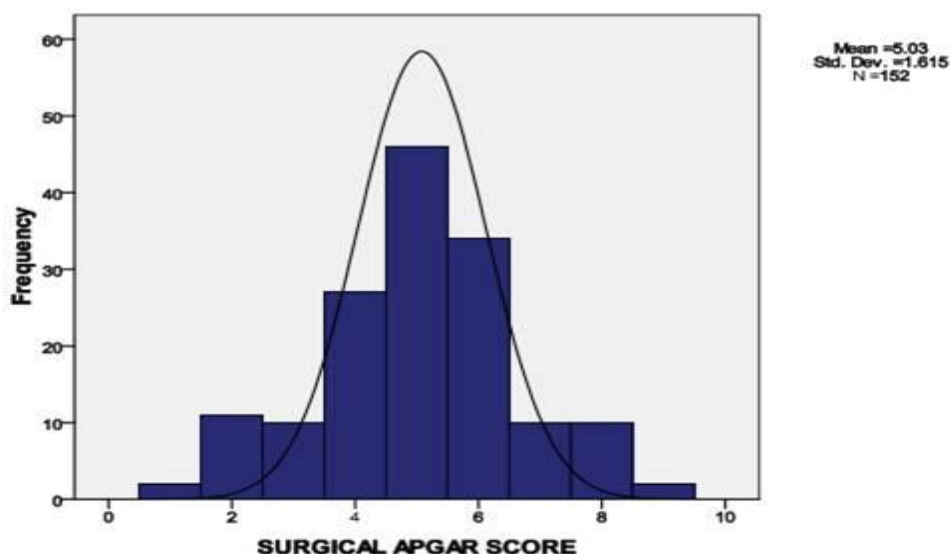


**Graph – 3:** Duration of complication.

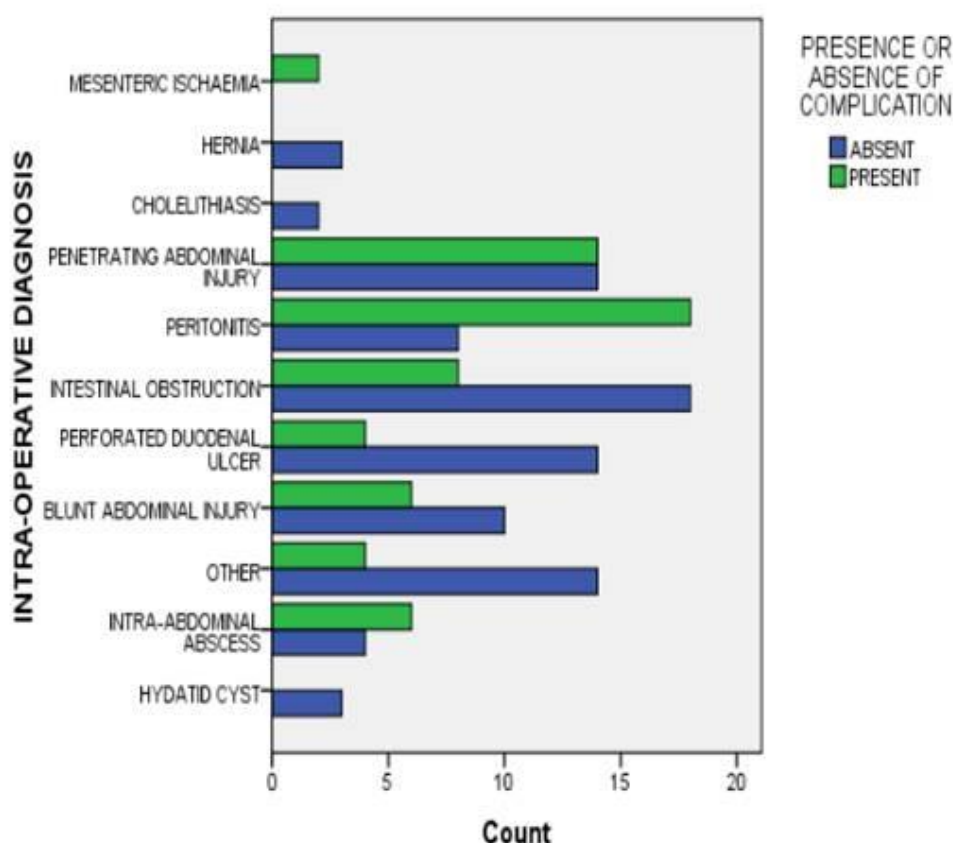
### DURATION & COMPLICATION



**Graph – 4:** Various SAS.



**Graph - 5:** Intraoperative diagnosis and complications.



## Discussion

Laparotomy is the most common surgery performed in the General Surgery department of

this hospital. 152 patients were studied in detail in this prospective study. The mean age in this study was 35.18 years [11]. This study had



skewed distribution of gender with 75% of patients being male. In our study conducted at our hospital, the most common reason for laparotomy is penetrating abdominal injury [12]. This is 18.4% of the overall cause of laparotomy. The second and third common cause of laparotomy in our study was peritonitis and intestinal obstruction. Both contributed to 17.1% each [13]. The efficacy and the talent of the surgeon and his team are mainly compared by the surgical mortality of the patients they are operating upon. The surgical mortality acts as a surrogate marker in assessing their performance [14]. In our study, it could be seen that emergency laparotomy is the major cause of the development of major postoperative complications when compared to elective laparotomies [15]. Female sex, 40 years or lesser age and surgery time more than 2 hours are other noted factors in our study that was found to be associated with a significantly higher rate of complications. Even in our study, significantly lower SAS was seen in the female gender. This correlates with a higher complication rate observed in the female gender [16]. Most of the studies on Surgical Apgar Score have established the long duration of surgery as one of the major important factors in the development of significant postoperative complications [17]. This might be due to the complexity of the surgery necessitated by possibly extensive disease. But it can also be observed in our study that, long duration of surgery and a low mean Surgical Apgar Score is having a strong association. Young patients were associated with a significantly higher rate of complications in our study. This can be explained by a lower mean Surgical Apgar Score in patients less than 40 years of age in our study [18].

## Conclusion

Surgical Apgar Score is very effective in identifying high-risk patients who are capable of developing significant complications following laparotomy within the first 30 postoperative days. This identification of high-risk patients helps us in the judicious use of healthcare

resources towards the proper monitoring and follow up of these patients. The Surgical Apgar Score was calculated from the lowest heart rate, lowest mean arterial pressure and the amount of blood lost during the surgery from the anesthetic notes. From the Surgical Apgar Score calculated, patients are stratified into high-risk, moderate-risk and low-risk. The patients belonging to various risk groups were monitored for 30 days postoperatively for the development of major complications.

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