

A Retrospective Study to Assess the Efficacy of Surgical APGAR Score

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Abstract: ***Introduction:** In today's era cost of health care is of growing importance and it is important to recognize patients at increased risk of post-operative morbidity and mortality and to find interventions to reduce the risk. Hence, there is a need of an objective prognostic tool to assess the post-operative outcome of patients. The Surgical APGAR score (SAS) is a simple score that uses intraoperative information on hemodynamics and blood loss of patient to predict post-operative morbidity and mortality. Score on a scale of 0-10 is calculated from three parameters collected during the operative procedure, lowest heart rate (HR), lowest mean arterial pressure (MAP), and estimated blood loss. **Materials and Methods:** A 12 months retrospective study was done in Dr Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation. Emergency and elective major cases were included in this study. SAS calculated based on intraoperative parameters lowest MAP, lowest HR, and amount of blood loss. **Results:** A total of 403 patients were studied, age ranged from 18 to 70 years. 246 elective and 157 emergency surgeries, the majority were gastrointestinal surgeries. SAS was significantly associated with post-operative morbidity and mortality within 30 days ($P < 0.001$). Of 403 patients, 121 had SAS 4 or less. Complications noted in 65 out of 121 patients. By comparison among 105 patients with SAS 8 - 10 nobody had complications. **Conclusion:** SAS is a simple prognostic tool for assessing post-operative outcome in general surgical patients.*

Keywords: Estimated blood loss, Mean arterial pressure, Surgical APGAR score

1. Introduction

Surgical risk scoring is important to predict the postoperative outcomes, plan the admission to intensive care unit, prognosticate the general condition of the surgical patient, and plan specific interventions postoperatively. Anaesthesiologists and surgeons anticipate the perioperative events involved after major surgeries on the basis of factors like age, associated comorbidities, surgical blood loss and surgery duration. An otherwise uneventful Intraoperative course does not predict the post operative course in patient.

The Surgical Apgar Score is a 10-point tally based on 3 readily obtained intraoperative parameters---the estimated intraoperative blood loss, the lowest heart rate, and the lowest mean arterial pressure ---which are assigned points and added to create a score from 1 to 10. The score is predictive of morbidity and mortality, even after controlling for preoperative patient factors.

2. Materials and Methods

This is a retrospective study was undertaken at Dr Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation over a period of 12 months, sample size 403 patients

Inclusion Criteria

- 1) Elective or emergency surgeries requiring intensive perioperative monitoring

Exclusion Criteria

- 1) Age >70 yrs or <10 yrs
- 2) Comorbid condition like ischemic heart disease, patients on beta blockers, etc.,
- 3) Surgeries under regional anaesthesia.

3. Results

A total of 403 patients studied, 169/females and 234/males, 246 were elective surgeries, and 157 were emergency. Most of the surgeries were abdominal surgeries; open/laparoscopic.

- a) A total of 85 complications were seen (12 deaths and 73 major complications)
- b) Out of 73 major complications, 61 were observed in patients operated on emergency basis while 12 were seen in an elective case
- c) Of the 73 major complications:
 - 37 had deep wound infection
 - 28 had pneumonia
 - 4 had sepsis
 - 4 on prolonged ventilator.

4. Discussion

In this study, 403 patients were included. Male predominance was seen. Majority were between 40 and 50 years of age (27%) mean age 42.8 years. Distribution of surgical APGAR score as shown in Table 1. In the study by Regenbogen et al. 2 (2009), the mean age was 64.2 years. Gawande et al.¹ (2007) had a patient population with a mean age of 63.6 years.

Table 1: SAS Distribution in Patients Studied

SAS	Gender		Total
	Female (%)	Male (%)	
0-4	40 (23.8)	81 (34.5)	121 (30)
5-7	77 (45.2)	100 (43.1)	177 (44)
8-10	52 (31)	53 (22.4)	105 (26)
TOTAL	169 (100)	234 (100)	403 (100)

Table 2: Post Operative Compliactions in Patients Studied

Post Operative Complication	Gender		Total (n=403)
	Female (n=169)	Male (n=234)	
Wound Infection	8 (4.8)	28 (12.1)	36 (9.5)
Pneumonia	20 (11.9)	12 (5.2)	32 (8.5)
Ventilator	0 (0)	4 (1.7)	4 (1)
Sepsis	0 (0)	4 (1.7)	4(1)
Uneventful	141 (83.3)	186 (79.3)	327 (80)
Total	169 (100)	234 (100)	403 (100)

In this study, 61% surgeries were elective and 39% surgeries were emergency. The most common indication for elective surgery was cholecystectomy (27%) while appendectomy (17%) was most common emergency procedure. The timing of most surgeries was elective. Most emergency surgeries were operated within 2 hrs of admission. A study by Capewell showed that 46-57% of all surgical admissions are emergency in nature.¹⁴ General anaesthesia was the most common form of anaesthesia.

Most common comorbidities seen were diabetes mellitus, hypertension and obesity

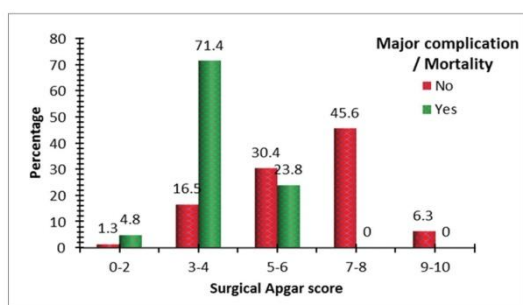
In this study, (18%) morbidity and (3%) 30 days mortality was noted, (79%) patient's recovery was uneventful. Wound infection was most frequent morbidity noted, followed by pneumonia. Similarly, in the study by Regenbogen et al.³ in

patients undergoing laparotomy for gastrectomy or colectomy the mortality was 5.2%. Gawande et al. observed a mortality rate of 4% in patients undergoing colectomy.

The majority of complications were noted in age group >60 years. 42% patients in age group >60 had low APGAR score of <4. Only 5.5% in the younger group of <50 years have low APGAR score of <4. Moreover, all patients with higher SAS (9-10) belong to <60 years group. Gawande et al.¹ study showed significantly high rate of major complications of 16% with a mean age of 64.2 years. Emergency surgery in aged patients carries a higher morbidity and mortality than elective surgery.¹⁵ In the study by Regenbogen et al.,^{2,3} patients with scores between 0 and 4 had higher complication rates of 54-75% while those with scores of 7-10 had lower rates of 5-13%. This demonstrates the SAS's ability to identify patients at higher than average risk of major postoperative complications.

Most common complication noted in this study (Table 2) was deep wound infection followed by pneumonia. Prolonged ventilator and sepsis were other complications. 12 mortality were noted. Out of 12, 7 deaths secondary to septic shock and 5 secondary to cardiopulmonary arrest. Of the 403 patients, there was (3%) 30 days mortality and (18%) major complications and (79%) no complication. The difference in surgical outcome between patients in different score group also showed statistical significance. Among the patient with SAS 0-4, major complications occurred in 50% and 30 days mortality in 10.3%. In contrast patients with SAS of >8 no major complications or mortality seen. Regenbogen et al.² study showed among major surgeries, patient with score of 4 or less were 6.5 times more likely to have major complications (95% confidence interval [CI], 4.7-8.9, P < 0.001).

It was also noted that in every 2 point score category the incidence of both major complications and death was significantly higher than that of patients in next category (Graph 1). A similar result with relative risk of major complications among low scored operations was 16.1 (95% CI, 7.7-34, P < 0.0001), compared with those in high scored operations was noted in a study by Gawande et al.¹



Graph 1: Surgical Apgar score in relation to major complications and mortality. P < 0.001, significant, Fisher exact test. As the surgical Apgar score decreases more complications and death seen

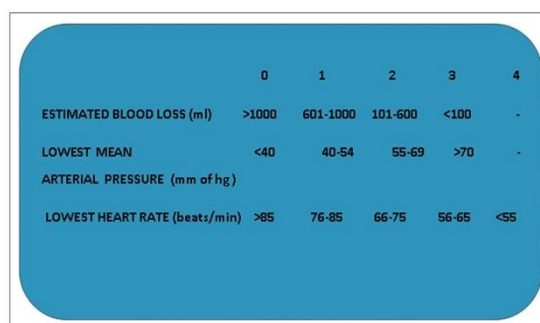


Figure 1: Surgical Apgar score

Surgical APGAR Score could potentially offer a similar resource for surgical care. Although further study is necessary to assess its use in clinical care, it may provide an objective assessment of risk for clinician decision making and could additionally serve as an instrument for

communication with team members about patient condition and a target for individual clinician and team improvement. The score could be used to help identify patients at increased risk of complication after operation and to ensure that this

risk is communicated appropriately to all clinicians caring for the patient.

Despite its simplicity, application of the Surgical Apgar Score may not be possible in every environment. To compute a meaningful score, the anesthetic record must include heart rate measurements and blood pressure at acceptable intervals, typically at least every 5 minutes. If such data are unavailable, the discriminative ability of the Surgical Apgar Score may be diminished or eliminated

Our study was limited to adult patients undergoing noncardiac operations under general anesthesia. In some sites, objective physiologic monitoring was limited or absent for patients undergoing operation under regional or local anesthesia, compromising our ability to understand the Surgical Apgar Score's relationship to complications in these cases, the Surgical Apgar Score provides an immediate quantification of patient risk for complications. Although it cannot replace more comprehensive outcome measurement methods, the score provides a simple, widely applicable, objective measure that is rapidly obtainable and predictive of postoperative complications, providing complimentary information to preoperative risk stratification

5. Conclusion

The SAS shows how intraoperative events affect post-operative outcomes. Calculating the SAS in the operating theatre gives immediate, reliable and real-time feedback information about post-operative risk. Strengths of the SAS include the ability to calculate the score quickly and objectively. The provider could then anticipate the need for further or more aggressive interventions. Ultimately, the score may also prove useful in guiding preventive measures like optimizing intraoperative HR or blood pressure. The SAS could be incorporated into electronic documentation packages for real-time calculation either during or at the end of surgery, providing an automated warning to clinicians. This prognostic value may alert the provider that additional diagnostic testing, further resuscitation, or more intensive monitoring is indicated.

- 1) The SAS is strongly associated with clinical decision making regarding immediate intensive care unit (ICU) admission after high-risk surgery.
- 2) Despite using simple and widely available intraoperative parameters, the SAS is adequate in post-operative risk stratification of major complications following major surgery.
- 3) For patients with scores ≥ 7 , very few complications were seen hence can consider usual care. The patients with a score of 6 or less had high risk for major complications, and patients with a score of 4 or less are very high risk and should be considered for high risk of decompensation and monitored very closely, often in an ICU setting. It may also be useful to make nursing staff aware of these patients who are particularly high risk, so the care team can be notified early of any signs of decompensation.
- 4) Patients with comorbidities such as diabetes mellitus, hypertension, and anaemia were found to have a high risk of complications.
- 5) Complication rates are higher in emergency surgeries.

- 6) Emergency surgery in elderly has a higher morbidity than elective surgery, elderly should be strongly motivated to undergo surgery electively rather than put off surgery until the disease worsens.

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