Original Research Article

Evaluation of surgical Apgar score in predicting post-laparotomy complications

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ABSTRACT

Background: Surgical Apgar score is a simple, objective and economical ten point post-operative prognostic scoring system based on three readily recorded intra operative variables. Aim is to evaluate the applicability and accuracy of the surgical Apgar score in predicting post-operative complications and objectives are to identify patients at risk of developing post-operative complications based on intra-operative data, to study the incidence of post-operative complications and morbidity and mortality in patients undergoing elective and emergency laparotomy.
Methods: This was a prospective analytical study carried out at SSG Hospital from November 2018 to October 2019 and achieved sample size was 160 patients. Surgical Apgar score was calculated at the end of the operation from these three parameters: heart rate, mean arterial pressure and expected blood loss.
Results: Out of 160 patients, 77 patients were in group 0-5 and complications occurred in 45 patients (58.4%), 54 patients in group 6-7 in which 18 patients (33.3%) suffered a complication and 29 patients in 8-10 surgical Apgar score, rate of complications was 17.3% in category 8-10 Apgar score.
Conclusions: Complications are more in low Apgar score patients compared to high Apgar score and in emergency cases compared to elective surgeries, would require more intensive monitoring in the postoperative period.

Keywords: Surgical Apgar score, Post laparotomy complications, Heart rate, Mean arterial pressure, Expected blood loss

INTRODUCTION

In 1953, Virginia Apgar introduced a 10-point scoring system for evaluation of the condition of newborns, which revolutionized obstetric care.[1] The surgical Apgar score (SAS) proved simple to use; effective at providing clinicians with clear, graded feedback on how delivery had gone for the child; and predictive of 28-day survival. As a result, it enabled more consistent identification of newborns at high risk for death, prompted development of better methods to treat them, and provided a clear measure for testing clinical innovations. The Apgar score became an indispensable tool in achieving the remarkable safety of modern child delivery. Similar to obstetrics in 1953, surgery today is without a routine and reliable gauge of overall patient condition after surgical procedures to guide clinical practice. Surgical teams rely mainly on subjective assessment of the patient and delayed feedback from 30-day outcomes. Peri-operative risk stratification of mortality and morbidity is important in the provision of health care to ensure appropriate resource allocation and informed decision making. Many risk-scoring systems are not easily calculated at the bedside; requiring numerous data elements including laboratory data. Thus, surgical teams do not apply them routinely for their patients. Among currently available systems for surgical patients, SAS stands out as holding promise for routine application in low resource settings. SAS is a simple, objective and economical ten points post-operative prognostic scoring system based on three readily recorded intra operative

variables. Following development by Gawande et al in 2007 the score shows a strong correlation with the occurrence of major complication or death within 30 days of surgery.[2] A lower score on scale of 0 to 10 predicts poor prognosis. In this study we compared the major complication rate/death in low SAS (0-5), medium SAS (6-7) and high SAS (8-10).[3] Thus formulated the utility of the SAS in predicting post-operative outcome.The scoring was also further validated by Regenbogen et al who systematically sampled 4119 general and vascular surgery patients at Massachusetts General Hospital to evaluate the relationship between SAS and intra-operative performance.[4] Only 5% (72 patients) of the patients with a score of 9 to 10 (total 1441 out of 4119) developed major complications, including a death rate of 0.1% (2 patients). In comparison, 56.3% of the patients (72 patients) with a score less than or equal to 4 (total 128 out of 4119) developed major complications, with death rate being 19.5% (25 patients). This study showed that these three variables had significant statistical relation with postoperative complications and death. Wuerz et al conducted a retrospective study on 3511 patients from their electronic records in order to evaluate the significance of SAS in hip and knee arthroplasty.[5] They found that each 1-point decrease in the score was associated with a 34.0% increase (95% confidence interval, 0.66-0.84) in the odds of a complication. Haynes et al conducted a study to determine the validation of SAS in 8 countries.[6] They collected the components of SAS at the time of operation for 5.909 adult patients undergoing non-cardiac operative procedures under general anaesthesia at 8 hospitals in diverse international settings and evaluated the relationship between patients' scores and the incidence of inpatient postoperative morbidity and mortality. They concluded from their study that SAS is easily calculated, predictive, and moderately discriminative for major complications among adults undergoing inpatient non-cardiac operative procedures. Such a score could provide target for quality improvement efforts, particularly in resource-limited settings. Thorn et al conducted a prospective cohort study of 223 general, vascular and orthopaedic surgical cases in order to find the utility of the SAS in district general hospital.[7] And they found that discrimination achieved significance in general and vascular cases (p=0.0002) but not in orthopaedic cases (p=0.15). Subgroup analysis of high (SAS <7) and low risk (SAS≥7) groups demonstrated utility of the score in general surgery and vascular cases overall (p<0.0001), and in the emergency (p=0.004) but not elective (p=0.12) subgroups. Assifi et al conducted a study over 553 patients to evaluate the predictability of SAS in affecting peri-

operative morbidity in patients undergoing pancreatico-duodenectomy (PD) at a high-volume centre.[8] They found that SAS was a significant predictor of grade 2 or higher complications (p<0.0001), major morbidity (p=0.01), and pancreatic fistula (p=0.04) but not mortality (p=0.20). Thus, concluding that SAS is a significant of peri-operative morbidity for patients undergoing PD. Ziewacz et al performed a cohort study for validation of the SAS in a neurosurgical patient population in 918 patients. In their study 15.8% developed complication and 2.6% had mortality.[9] They found that SAS were significantly associated with the likelihood of postoperative complications (p<0.001) and death (p=0.002); scores varied inversely with postoperative complication and mortality risk in a multivariate analysis. Sobol et al performed a retrospective cohort study to find the association of SAS with ICU admission after high risk intra-abdominal surgery.[10]

METHODS

This was a prospective analytical study carried out at Sir Sayajirao General Hospital, from 03 November 2018 to 02 November 2019 and achieved sample size of 160 patients.

Inclusion criteria

Patients over 15 years undergoing emergency or elective laparotomy.

Exclusion criteria

Patients declining participation, undergoing concurrent major procedures on other body regions within 30 days, established metastatic and unresectable tumors and laparoscopic procedures.

SAS was calculated at the end of the operation from these three parameters: heart rate (HR), mean arterial pressure (MAP) and estimated blood loss (EBL). Individuals' score of these parameters are added to calculate SAS (Table 1).

Risk group

High risk- Apgar score 0-5, medium risk- Apgar score 6-7 and low risk - Apgar score 8-10. Study end point (major complication) patients were followed up for 30 days after surgery, following conditions are considered as complications: anastomotic leakage, wound dehiscence, renal dysfunction, superficial surgical site infection, deep surgical site infection, respiratory infection and death.

Table 1: Computed surgical Apgar score.

Surgical Apgar score	No. of points				
Variables	0	1	2	3	4
Estimated blood loss (ml)	>1000	600-1000	101-600	<100	-
Lowest mean arterial pressure (mmHg)	<40	40-54	55-69	>70	-
Lowest heart rate/min	>85	76-85	66-75	56-65	<55

Statistical analysis

P value generated using T test, Chi square test for comparison of proportions and analysis of variance (ANOVA). Values of $p<0.05$ were considered statistically significant.

RESULTS

A prospective analytical study was carried out at Sir Sayajirao General Hospital, from 03 November 2018 to 02 November 2019 and achieved sample size was 160 patients. Males accounted for 78.7% (126) of the patients in the present study.

Apgar score and out of 160 patients: low Apgar score- 77 patients, medium Apgar score- 54 patients, high Apgar score- 29 patients.

Test of significance applied is chi square test. More than 43% patients were observed in the age group 15 to 40 years. 57% patients were observed in more than 40 years study age group. As p value is 0.5484, so age is not considered a predictor of post-operative complications (Table 2). Test applied was chi square test. 85% surgery were in the emergency group while only 15% were in

elective. Complications were more in emergency surgeries which were statistically significant as p value was 0.0002 (Table 3).

In 57.5% (92 patients) there were no complications. There was overlapping of complications, many patients had more than one complication. Most common complication was superficial surgical site infection (SSI) 26.8%, while least common was anastomotic leakage 3.75% (Table 4).

Test of significance applied is chi square test and chi squared value is 17.435 and significance level p value is 0.0002. There is a significant difference ($p<0.05$) in incidence of complications in different groups so in low SAS there are higher chances of complications and in high SAS lower chances of complications (Table 5).

In elective surgeries most of the case were in low risk SAS group. Occurrence of complications among elective surgeries was not statistically significant in these SAS study groups as p value was 0.3872 (Table 6).

In emergency surgeries most of the case were in high risk SAS group. Occurrence of complications among emergency surgeries was statistically significant in these SAS study groups as p value was 0.01 (Table 7).

Table 2: Age groupwise distribution of patients.

Age group (in years)	No. of patients	Percentage (%)	Complications		P value
			Yes	No	
15-40	69	43.2	31	38	0.5484
40-49	29	18.1	12	17	
50-59	33	20.6	14	19	
>60	29	18.1	11	18	
Total	160	100	68	92	

Table 3: Distribution of surgeries into elective and emergency laparotomy.

Type of surgery	No. of cases (%)	No. of cases with complications	No. of cases without complications
Emergency	136 (85)	66	70
Elective	24 (15)	2	22
Total	160	68	92

Table 4: Frequency and percentage of post-operative complications.

Complications	Frequency (out of 160)	Percentage
No complications	92	57.5
Anastomotic leakage	6	3.75
Renal dysfunction	21	13.1
Superficial surgical site infection	43	26.8
Deep surgical site infection	34	21.2
Respiratory infection	33	20.6
Wound dehiscence	11	6.87
Death	18	11.2

Table 5: SAS groups and complications.

SAS	Total no. of cases	No. of cases with complications or death	No. of cases without complications	Percentage (%)	P value
0-5	77	45	32	58.4	0.0002
6-7	54	18	36	33.3	
8-10	29	5	24	17.3	

Table 6: Outcomes for elective surgery in relation to SAS.

SAS	Total no. of cases	No. of cases with complications or death	No. of cases without complications	Percentage (%)	P value
0-5	1	0	1	00	0.3872
6-7	3	1	2	33.3	
8-10	20	1	19	5	
Total	24	2	22	8.3	

Table 7: Outcomes for emergency surgery in relation to SAS.

SAS	Total no. of cases	No. of cases with complications or death	No. of cases without complications	Percentage (%)	P value
0-5	76	45	31	59.2	0.01
6-7	51	17	34	33.3	
8-10	9	4	5	44.4	
Total	136	66	70	48.5	

There is no significant difference (p value -0.8303) in occurrence of complications in male and female. In 42% male there was complication and in 44.1% female complications was present (Table 8).

In 57.5% patients there were no complications. Most common complication was superficial SSI (26.8%) and least common complication was anastomotic leakage (3.75%). Some patients had more than one complications (Table 9).

Table 8: Gender distribution and development of complications.

Sex	Total no. of cases	No. of cases with complications or death	No. of cases without complications	Percentage (%)	P value
Male	126	53	73	42.0	0.8303
Female	34	15	19	44.1	
Total	160	68	92	42.5	

Table 9: Risk groups and development of complications.

Complications	High risk (SAS 0-5)	Medium risk (SAS 6-7)	Low risk (SAS 8-10)	Total
No complications	32	36	24	92
Anastomotic leakage	5	1	-	6
Renal dysfunction	17	4	-	21
Superficial surgical site infection	29	10	4	43
Deep surgical site infection	28	5	1	34
Respiratory infection	26	5	2	33
Wound dehiscence	10	1	-	11
Death	14	4	-	18

DISCUSSION

A simple surgical score, based on blood loss during a surgery, lowest heart rate and lowest mean arterial pressure, provides a meaningful and useful estimate of a patient's condition and the risk of major complications or death after surgery. All 160 cases admitted in the department of general surgery were evaluated as described earlier in the patients and methodology. All the patients were appropriately assessed and posted for laparotomy.

Gender

In this study, mean age was 35.18 years with 15-84 years range with skewed gender distribution with 78.7% of the patients in our study were male patients. Most of the studies on this scoring system by Gawande et al and Scott et al show a female preponderance of 56% to 65% in various study cohorts. Kotera et al involved 81.4% females and in study by Santoshsing et al females were 42% in their respective studies.[11,12] A study by Dullo et al in Kitui District Hospital and School of Medicine, University of Nairobi, included 75% male and there was significant difference in male and female in occurrence of complications.[10] Percentage of occurrence of complications in present study male was 42% and in female 44.1%. However, no association has been noted between gender, the Apgar score and the postoperative prognosis in this study.

Age

56.8% of the patients were in the age group of over 40 years. 43.2% patients belonged to the below 40 years age group. Earlier studies have shown an average age distribution of 55.3 years to 63.6 years. About 55.1% of patients (16 patients of 29) in the age group >60 years had a low Apgar score (0-5). Whereas, in the younger age group of <40 years, 44.9% (31 patients of 69) had a low score of (0-5).

Nature of surgery (elective/emergency)

15% of the surgeries in this study were elective in nature and 85% were emergency procedures. A study by Dullo et al in Kitui District Hospital and School of Medicine, University of Nairobi, included 87% emergency case.

Occurrence of complications

The incidence of complications in elective surgeries was 8.33%, but statistically not significant (p value 0.3872) in all 3 study groups and there was no mortality in elective surgeries. While in emergency surgeries, the complication rate was 48.5%, statistically significant (p value 0.01) in all 3 study groups and the mortality being 13.2% in emergency surgeries.

Comparison of mortality in different study

Of the 160 patients in present study, there was 11.2% 30 days mortality rate, with the rate of complications being 42.5%. A study by Dullo et al in Kitui District Hospital and School of Medicine, University of Nairobi, thirty-day mortality was 7.9%.

Total 18 deaths were noted in my study, 14 deaths (77.8% of total deaths) in low Apgar score group (0-5), 4 deaths (22.2% of total deaths) in Apgar score 6-7 group while no death was noted in 8-10 Apgar score group, which is statistically significant.

Comparison of complications in different study

No complication was noted in 57.5% of the patients' studied.[15]

Table 10: Comparison of complications between a study by Dullo et al and present study.

Complications	Dullo et al study (n=152)	Present study (n=160)
SAS	Percentage of 30 day complications (%)	Percentage of 30 day complications (%)
High risk	58.3	58.4
Medium risk	35.6	33.3
Low risk	16.6	17.3
P value	0.004	0.0002

In present study mean surgical Apgar score was 5.575. The difference in surgical outcome between patients in different score groups was also statistically significant. Among the 77 (48.1%) patients with an Apgar low score (0-5), complications occurred in 45 patients (58.4%). Among 54 patients (33.8%) with a score of 6-7, 18 patients (33.3%) suffered a complication. In contrast, rate of complications was 17.3% in category 8-10 Apgar score, total number of patients in this group was 29 comprising 18.1% of total patients.

There is a significant difference (p value <0.05) in incidence of complications in different groups so in low Apgar score there are higher chances of complications and in high Apgar score lower chances of complications.

It was also noted that in every Apgar score category, the incidence of both complications and death was significantly greater than that of patients in the next higher category.

The relative risk of predicting a complication was significantly higher in all the subgroups of the Apgar score for emergency surgeries as compared to elective surgeries.

Among the complications superficial surgical site infection (SSI) (26.8%) was most common and anastomotic leakage (3.75%) was least common and some patient have more than one complication.

CONCLUSION

More than 43% patients accounted in <40 year and 57% patients in >40 years age group but not statistically significant in occurrence of complications. Total number of male patients were 126 comprising 78.7% of present study and emergency surgeries were 85% while elective surgeries were only 15%. Complications are more in low Apgar score patients compared to high Apgar score (p value =0.0002) and in emergency cases compared to elective surgeries (p value =0.0002), would require more intensive monitoring in the postoperative period. Mortality was also statistically significant (p value <0.05) in SAS groups and present only in emergency surgeries as compared to elective cases. No association has been noted between gender, age, the Apgar score and the postoperative prognosis in this study. Superficial SSI was most common complication while anastomotic leakage was least common complication. The 10 point Apgar scoring system despite using simple and readily available intra-operative parameters, is adequate in stratification of post-operative risk of major complications following laparatomy in our setting and demonstrates a good level of accuracy and easily applicable to predict post-operative morbidity and mortality, to identify patient at risk of developing post-operative complications, to study incidence of post-operative complications and is important in the provision of health care to ensure appropriate resource allocation and informed decision making. The surgical Apgar score has proved to be an important in predicting post-operative morbidity and mortality and promising as a prognostic measure and a clinical decision-making tool.

ACKNOWLEDGEMENTS

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