Surgical Apgar Score Predicts Post-Laparatomy Complications

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Abstract

Introduction: The Surgical Apgar score (SAS) presents a simple, immediate and an objective means of determining surgical outcomes. The score has not been widely validated in low resource settings where it would be most valuable. This study aimed to evaluate its accuracy and applicability for patients undergoing laparatomy at Kenyatta National Hospital (KNH), Nairobi.

Methodology: Using intra-operative records, we calculated Surgical Apgar Scores for 152 patients during a 6-month study between March 2011 and August 2011. Our main outcome measures were the incidence of major postoperative complications and/or death within 30 days of surgery.

Results: The mean age of the patients evaluated was 35.18 years, range of 14 to 80 years. Most laparatomies were emergency procedures (86.8%) with mean duration for surgery of 131 minutes. The overall rate for major complications and mortality was 40.8% and 7.9% respectively. Common morbidities were superficial and deep wound infection, anastomotic leakage and wound dehiscence. The mean SAS for patients with complications was lower (4.0) compared to those without (5.73) ($p<0.001$). Patients categorised as high risk had a 58.3% complication rate compared to low risk patients with 16.6 % ($p=0.04$). These outcomes compare favourably with other studies. The SAS demonstrated good predictive accuracy for post-operative morbidity (ROC area under the curve of 0.796, CI 0.727-0.865).

Conclusion: This study confirms the SAS as adequate in stratification of post-operative risk of major complications following laparatomy in our setting with good predictive accuracy.

Introduction

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 (1). Many risk-scoring systems are not easily calculated at the bedside; requiring numerous data elements including laboratory data(2).Thus, surgical teams do not apply them routinely for their patients(2).

Among currently available systems for surgical patients, the SAS stands out as holding promise for routine application in low resource settings(1). Modeled after the Apgar score in obstetrics, this ten-point model entered surgical practice in 2007(3). It is a simple, immediate and an objective means of determining surgical outcomes, using data available in most settings. The score is effective in predicting the risk of major postoperative complications thus prompting preventive counteractions. The score's components capture elements of the overall patient condition, extent of the surgical insult and ability of the team to respond to and control hemodynamic changes during a procedure(4) (Table 1).

Table 1: Surgical Apgar Score

	0 points	1 point	2 points	3 points	4 points
Estimated blood loss (ml)	>1,000	601-1,000	101-600	≤ 100	-
Lowest mean arterial pressure (mmHg)	<40	40-54	55-69	≥ 70	-
Lowest heart rate (beats/min)	>85	76-85	66-75	56-65	≤ 55

Criticism of this scoring system is that operative blood loss can be subjective although the wide categories utilised allow for reasonably accurate estimation (5,6).

Though validated for many procedures and in several countries in the west, few studies have been conducted in Africa where patient demographics and the clinical environment are different (7). The aim of this study is to evaluate the applicability and accuracy of the SAS in stratifying post-operative risk in patients undergoing laparatomy at the Kenyatta National Hospital (KNH).

Material & Methods

This was a 6 month, hospital based, single centre observational study at KNH, Nairobi, from March 2011 to August 2011. All admitted patients over 13 years of age undergoing laparatomy under general anaesthesia were eligible. Exclusion criteria included patients declining participation, undergoing concurrent major procedures on other body regions within 30 days, established metastatic and un-resectable tumours, mini-laparatomy and laparoscopic procedures.

Data collected included patient demographics, intra-operative diagnosis, duration of surgery, data relevant to the SAS calculation as above and development of major complications. The primary end-points were major complications and death within 30 days of surgery as per definitions given by Copeland et al(9). Patients were subsequently grouped into three categories based on their SAS for purposes of assessing risk stratification.

We performed all analyses using the SPSS Statistics, version 17.0.1(IBM Armonk, New York, USA). P values were generated using T test for means, Chi square test for comparison of proportions, analysis of variance (ANOVA) and where applicable Fischer's exact test. P values < 0.05 were considered statistically significant. As a measure of discrimination, we constructed receiver operating characteristic curve and calculated the area under the curve for the SAS. Area under the ROC is interpreted thus; .50-.75 = fair, .75-.92 = good, .92-.97 = very good and .97-1.0 = excellent.

Results

We recruited a hundred and fifty four patients into the study. Two patients absconded and were lost to follow leaving 152 patients for assessment. There were 114 (75%) males giving a male: female ratio of 3:1. Age range was 14 to 80 years with a median of 31 years. The average age for males was 36.16 years compared to 32.24 years for females (p=0.163).

Emergency laparatomies constituted 86.8% and elective procedures 13.2%, (p=0.579). The commonest reason for laparatomy was penetrating abdominal injury (18.42%). Intestinal obstruction and peritonitis constituted (17.11%) each, perforated peptic ulcer (11.84) and other causes (11.84%). Others included renal calculi, stomach cancer, liver abscess, liver cyst and colonic cancer. Mean duration of surgery was 131.1 min (Range 60 to 300 minutes). Fifty patients suffered major complications during follow up (40.8%). Commonest complication was deep wound infection followed by anastomotic leakage and superficial wound infection (Table 2).

Table 2: Occurrence of complications

COMPLICATION	Frequency	Percentage
No Complication	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	.7
Wound Dehiscence	8	5.3
TOTAL	152	100.0

Females had more complications than males (63.2% versus 33.3%). Emergency laparatomies suffered more complications compared to elective cases, 43.9% versus 20%. Surgery of more than 120 minutes resulted in 68.6% complication rate compared to 26.7% for shorter procedures (Table 3). Twelve patients died (7.9%).

The relationships between occurrence of complications and gender, setting of laparatomy, age and duration of surgery were all statistically significant(Table 3).

Table 3. Distribution of postoperative complications

		PRESENCE OR ABSENCE OF COMPLICATION		Total	p value
		Number Absent (%)	Number Present (%)		
GENDER	MALE	76 (66.7)	38(33.3)	114	0.001
	FEMALE	14(36.8)	24(63.2)	38	
SETTING	EMERGENCY	74(56.1)	58(43.9)	132	0.042
	ELECTIVE	16(80)	4(20)	20	
AGE GROUP	<40 YRS	54(51.4)	51(48.6)	105	0.004
	>=40	36(76.6)	11(23.4)	47	
DURATION GROUP	<=120 MINUTES	74(73.3)	27(26.7)	101	<0.001
	>120 MINUTES	16(31.4)	35(68.6)	51	
Total		90(59.2)	62(40.8)	152	

Table 4. Mean SAS compared with various parameters

Duration of laparatomy	Mean SAS	P
120 minutes or less >120 minutes	5.52 4.04	<0.001
Gender	Mean SAS	P
Male	5.28	
Female	4.26	0.001
Age group	Mean SAS	P
<40 yrs	4.80	
40 and above	5.53	0.009
Presence or absence of complication	Mean SAS	P
Absent	5.73	
Present	4.00	<0.0001

The SAS ranged from one to nine with a mean of 5.03 (median 5). Mean SAS for males was 5.28 and females 4.26 (p=0.001). Based on SAS, 31.6% of patients fell under the high-risk category, 59.2% medium and 9.2% low-risk.

The distribution of complications within the different risk categories is illustrated in Table 5. With few exceptions, complications are more common in the high and medium risk groups, (Table 5) (P=0.004). The mean SAS for patients with complications was significantly lower compared to those without (p<0.001) (Table 6). The complication rate within the high-risk group was 58.3% compared to 35.6% in the medium and 16.6% in the low risk group (p=0.004). The area under ROC curve for the SAS was 0.796. The ROC curve analysis showed a good predictive capability of morbidity.

Table 5. Risk groups and development of complications

		RISK GROUP			Total
		HIGH RISK (score <5)	MEDIUM RISK (score 6-7)	LOW RISK (score 8-10)	
No complications	Count	20	58	12	90
Anastomotic leakage	Count (%)	8(16.7)	4(4.4)	0(0)	12(7.9)
Renal dysfunction	Count(%)	0(0)	2(2.2)	2(14.3)	4(2.6)
Death	Count	4(8.3)	8(8.9)	0(0)	12(7.9)
Superficial wound infection	Count	5(10.4)	6(6.7)	0(0)	11(7.2)
Deep wound infection	Count	6(12.5)	8(8.9)	0(0)	14(9.2)
Pyrexia of unknown origin	Count	1(2.1)	0(0)	0(0)	1(0.7)
Wound dehiscence	Count	4(8.3)	4(4.4)	0(0)	8(5.3)
Total	Count	48	90	14	152

Table 6. Comparison of SAS and complication rate.

		PRESENCE OR ABSENCE OF COMPLICATION		Total	x2/F	p value
		ABSENT	PRESENT			
RISK GROUP	HIGH RISK	20(41.7%)	28(58.3%)	48		
	MEDIUM RISK	58(64.4%)	32(35.6%)	90	X2=11.2	0.04
	LOW RISK	12(85.7%)	21(16.6%)	14		
Total		90(59.2%)	62(40.8%)	152		
MEAN SURGICAL APGAR SCORE		5.73	4.00		F=58.336	0.00

Discussion

In this study, mean age was 35.18 years with a skewed gender distribution, males accounting for the majority of patients. This distribution is comparable to a previous study in this institution(9). Our demographics vary from western studies where the average patient undergoing laparatomy is much older averaging the seventh decade (3,10).

Thirty day mortality was 7.9%, this is higher than that previously observed (4.8%) at this hospital. Similar studies internationally have reported mortality ranges from 1.2% to 9.2% (3,7,11). Mortality is a useful comparison index between surgeons and units. To be accurate however confounding factors like case mix and other variables need to be considered.

Factors associated with higher complications were female gender, age younger than 40 years and duration of surgery more than 120 minutes. Long duration surgery was also associated with a lower mean SAS in our study. Long duration has been established as a factor in most studies assessing SAS(3,8). This may be a reflection of complexity possibly due to extensive disease.

Increasing age has a direct impact on surgical outcome. For abdominal surgery, complications and mortality peak at 27.9% and a 16.7% respectively by age 90 years(12). This is not due to chronological age per se, but more a result of co-morbidities(14). Therefore, our average younger age alone will not account for our high morbidity compared to western figures.

In our study, patients with SAS of 0-4 (high-risk group) had complication rates of 58.3% compared to those with scores of 8-10 (low risk group) at 16.6%. These complication rates compare favourably with those published by Regenbogen et al (14). This demonstrates the reproducibility of the SAS in identifying the risk of major post-operative complications.

In a developing country like Kenya, a simple tool like the SAS would find use in routine post-operative risk stratification. This would facilitate easier identification of high-risk patients and initiation of appropriate interventions.

Despite its reproducibility, the SAS does have its limitations apart from that mentioned earlier. Firstly; it is only a reflection of intra-operative management. Intra-operative management is directly dependent on the level of skill of the operator. Skilled surgeons are better able to control intra-operative situations compared with non-experienced surgeons. Paediatric and adult physiological parameters vary. Case mix differences also affect the outcome score. Proportionately, junior surgeons conducted more emergency operations in this study. Another factor is manipulation of physiological parameters by pharmacological agents. All these may be significant biases in SAS results.

Given that, the SAS reflects both intra-operative anaesthetic and surgical performance, serial monitoring of SAS within a unit may serve as an audit tool for improving these. However, more studies on this aspect are required to confirm this role.

Conclusion

The SAS, 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 in predicting morbidity in post-laparatomy.

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