

SURGICAL APGAR SCORE: APPLICABILITY IN PATIENTS
UNDERGOING LAPARATOMY AT KENYATTA NATIONAL
HOSPITAL

A PROSPECTIVE STUDY

*A DISSERTATION SUBMITTED IN PART FULFILMENT OF THE
REQUIREMENTS OF THE UNIVERSITY OF NAIROBI FOR AWARD OF THE
DEGREE OF MASTER OF MEDICINE IN GENERAL SURGERY*

By

DR. MICHAEL DULLO

MB ChB (Nairobi)

DECLARATION

This study is my original work, and has not been presented at any other university.

Signed.....Date.....Day of.....2011

Dr Michael Dullo

MBChB (Nairobi)

This dissertation has been submitted for consideration with my approval as the University supervisor

Signed.....Date.....Day of.....2011

Prof S.W.O Ogendo

Associate Professor, Consultant Thoracic and Cardiovascular Surgeon,

Department of Surgery,

University of Nairobi

Signed.....Date.....Day of.....2011

Dr. Elly O. Nyaim

Lecturer, Consultant General Surgeon,

Department of Surgery,

University of Nairobi

DEDICATION

To, my parents, for all the sacrifices made.

ACKNOWLEDGEMENT

I wish to acknowledge the role played by my supervisors Professor Stephen Oendo and Dr. Elly O. Nyaim. Their guidance in the conception, conduct and finalization of this project was invaluable.

This dissertation would not have been successful without the co-operation of the casualty department, general surgical wards, surgical outpatient clinics and the records department.

Finally, I would like to express my heartfelt gratitude to all patients who consented to be part of this project.

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LIST OF ABBREVIATIONS

SAS	Surgical Apgar Score
KNH	Kenyatta National Hospital
ASA	American Society of Anaesthesiologist
SRS	Surgical Risk Scale
APACHE	Acute Physiological and Chronic Health Evaluation
POSSUM	Physiological and Operative Severity Score for EnUmeration of Mortality and Morbidity
NSQUIP	National Surgical Quality Improvement Programme
WHO	World Health Organization

SUMMARY

This study was designed to assess the applicability of the Surgical Apgar Score in post-operative risk stratification for patients undergoing laparotomy at Kenyatta National Hospital. A prospective analysis of consecutive patients who underwent laparotomy and follow up at KHN between March 2011 and August 2011 was performed.

Data on age, gender, setting of laparotomy i.e. emergency/elective, duration of surgery, diagnosis, Surgical Apgar Score and occurrence of major complications during a 30 day follow up was collected using a pre-designed questionnaire. The data collected was entered and analysed using SPSS 17.0

Of the 154 recruited patients, all underwent laparotomy and 152 were evaluated for outcome while 2 were lost to follow up. The mean age was 35.18 years with a range of 14 to 80 years. Males comprised the majority in this study at 75%. Most of the laparotomies were done in an emergency setting (86.8%) with mean duration for surgery being 131 minutes.

The overall rate for major complications within 30 days post-laparotomy was 40.8% with a mortality rate of 7.9%. The common morbidities were superficial and deep wound infection, anastomotic leakage and wound dehiscence. The means SAS for patients with complications was significantly lower (4.0) compared to those without (5.73) ($p < 0.001$). Patients categorised as high risk (SAS=0 to 4) had complication rates of 58.3% compared to low risk patients (SAS= 8 to 10) with 16.6 % ($p=0.04$)

This study confirms the SAS as a simple tool that would be useful in post-operative risk stratification especially in our resource-limited setup.

INTRODUCTION

The Surgical Apgar Score (SAS) is a 10-point score based on a patient's estimated amount of blood loss, lowest heart rate, and lowest mean arterial pressure during the intra-operative period. It provides a simple, immediate, objective means of measuring and communicating patient outcomes in surgery, using data routinely available even in low resource settings. The score can be effective in identifying patients at higher- and lower-than-average likelihood of major complications after surgery and may be useful for guiding interventions to prevent poor outcomes.

The score's components capture elements of the patient's overall condition, the extent of the surgical insult and the ability of the team to respond to and control hemodynamic changes during the procedure. Alterations in the heart rate and blood pressure often represent both the physiological status of the patient and the adequacy of anaesthetic management. Blood loss is an indicator of the complexity of an operation and the performance of the surgeon. These components result in a score that gives feedback to clinicians on the relative success of their operation and the relative risks for complications or death.

Various risk-scoring systems currently exist for use in surgical patients. These scores are not easy to calculate at the bedside, require numerous data elements that rely on laboratory data not uniformly collected. The majority, as a result, are not routinely used for surgical patients¹. The SAS has been validated mainly in the west and no Kenyan studies are currently available.

Laparotomy is one of the commoner surgical procedures performed at Kenyatta National Hospital (KNH) and is associated with significant morbidity and mortality². The aim of this study was therefore, is to evaluate the applicability of the SAS in stratifying post-operative risk in patients undergoing laparotomy at KNH. This may ultimately provide local surgical teams with a simple and reliable score for stratifying post-operative risk in this group of patients.

TABLE 1: SURGICAL APGAR SCORE

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

Surgical Apgar score = Sum of the points for each category in the course of a procedure.

\dagger -Occurrence of pathologic bradyarrhythmia, including sinus arrest, atrioventricular block or dissociation, junctional or ventricular escape rhythms, and asystole also receive 0 pts for lowest heart rate.

α - The estimated blood loss used in the calculation should be the number entered in the official operation record. This is computed by the anaesthetist and confirmed by the surgeon.

β -The heart rate and blood pressure obtained from the anaesthesia record, as values recorded from the time of incision to the time of wound closure.

Ω - Mean arterial pressure is used to calculate the blood pressure score. When the systolic and diastolic blood pressures are recorded without mean arterial pressure, the lowest mean arterial pressure must be calculated by selecting the lowest diastolic pressure and using the formula: mean arterial pressure = diastolic pressure + (systolic pressure–diastolic pressure)/3.

Δ -In cases in which asystole or complete heart block occurs the score for heart rate should be zero.

LITERATURE REVIEW

Peri-operative risk stratification of mortality and morbidity is important in the provision of health care to ensure appropriate resource allocation and enable informed decision making by the recipient³. Ideally, risk-scoring systems should provide objectivity and mortality prediction enabling communication and understanding of severity of illness. Scores incorporating subjective factors allow clinicians to apply their experience and understanding of the situation to an individual but are not reproducible. Scores such as American Society of Anaesthesiologists (ASA) Score^{4,5,6} and Surgical Risk Scale (SRS)^{7,8} incorporate subjective measures and have been criticised for this. Limitations relating to obtaining variables, generalization in different patient categories and calculating predicted mortality and applicability are present in most systems¹.

Acute Physiological and Chronic Health Evaluation (APACHE)^{9,10,11,12,13}, and Physiological and Operative Severity Score for EnUmeration of Mortality and Morbidity (POSSUM)^{2,15,16,17,18} and their derivations are limited by their complexity, discouraging use in low resource settings. The same applies to the National Surgical Quality Improvement Programme (NSQIP) database used mainly in the West¹⁹.

The simplicity of the Apgar score in obstetric practice led to its worldwide uptake as an assessment tool. Gawande et al. set out to derive a similar surgical model, which they published in 2007. Using a retrospective dataset, they used multivariable logistic regression to derive intra-operative and pre-operative factors associated with surgical mortality and morbidity. The group then chose to use one of their models that relied solely on intra-operative factors, as these were independent predictors of outcome. The three factors used were estimated blood loss, lowest mean arterial pressure and lowest heart rate (or arrhythmias). This ten-point model was then prospectively validated²⁰. Several other studies have validated the score in patients undergoing various surgical procedures, indicating possible wide applicability and ability to identify patients likely to have postoperative mortality or morbidity even after uncomplicated discharges^{21, 22, 22, 23, 24, 25}.

In an effort to determine the feasibility of the SAS, the WHO conducted a pilot study in several sites worldwide²⁶. Patients with a score < 5 had a three times greater risk for a postoperative complication, while patients with scores of 9 or 10 had only one third the risk

of patients who had a score of 7. This study confirmed the score as a simple, reliable measure regardless of the setting.

Criticisms of this scoring system are that operative blood loss can be subjective although the wide categories utilised allow for reasonably accurate estimation^{27, 28}.

Among the currently available risk-scoring systems available for surgical patients, the SAS stands out as one holding promise for routine application in low resource settings¹. However, few published studies done in the third world are available.

STUDY JUSTIFICATION

The SAS has been mainly validated in resource rich western settings and no published study in the Kenyan population exists. Establishing its applicability would provide a simple, cost-effective tool for identifying patients requiring close post-operative monitoring in our resource-limited setting.

STUDY QUESTION

Is the SAS applicable in stratifying the risk of post-operative morbidity and mortality among patients undergoing laparotomy at KNH?

STUDY OBJECTIVES

PRIMARY OBJECTIVE

To determine the applicability of the SAS in post-operative risk stratification for major complications and mortality during the 30 days post-laparotomy at KNH.

SECONDARY OBJECTIVES

1. To determine the proportion of patients undergoing laparotomy who develop major complications during the 30-day post-operative period.
2. To determine a 30-day post-operative mortality of patients undergoing laparotomy.
3. To determine the relationship between the SAS and the occurrence of major complications and mortality during the 30- day post-operative period.

MATERIAL & METHOD

STUDY AREA

The setting of this study was at KNH. This is the largest referral hospital in the country being a 1400 bed inpatient public health facility. It is the main referral hospital in east and central Africa and serves as a teaching hospital for the University of Nairobi medical school.

Patients undergoing laparotomy at KNH are managed by a tier of doctors from anaesthetic technicians, medical officer interns, medical officers, senior house officers in general surgery and anaesthesiology and their consultants. The institution has a capacity to undertake major surgical procedures on round the clock basis.

STUDY POPULATION

The target population was patients undergoing laparotomy admitted to the general surgical wards, intensive and high dependency units who met the eligibility criteria. Selection of patients was from the point first seen at KNH. Those admitted for emergency surgery were selected from the accident and emergency department. Those to undergo elective surgery were recruited in the respective general surgery wards prior to their surgery.

STUDY DESIGN

This was a hospital based, single centre prospective observational study carried out from March 2011 to August 2011.

INCLUSION CRITERIA

All patients above 13 years of age, scheduled for emergency or elective laparotomy at KNH who consented to participate in the study.

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 tumours,
- Patients undergoing mini-laparotomy and laparoscopic procedures,

STUDY ENDPOINT

Patient follow up was up to the 30th post-operative day after laparotomy under investigation.

SAMPLE SIZE

Using the formula:

$$n = \frac{z^2 \times p(1-p)}{d^2}$$

Where z: score at 95% confidence interval (1.96)

p: 30 day mortality in laparotomy patients at KNH (4.8%)

d: margin of error (0.05%)

$$\text{Thus, } n = \frac{1.96^2 \times 0.048 \times 0.952}{0.05^2} = 70.21$$

We doubled this figure to account for the effect of clustering and allow for generalization of results.

With an adjustment of 10% to account for possible losses to follow up, the final figure was 154 patients.

SAMPLING METHOD

Using non-probability convenience sampling all patients 13 years and above admitted to Kenyatta National Hospital and for whom laparotomy was scheduled and who met all inclusion and none of the exclusion criteria were recruited until the desired sample size of 154.

DATA COLLECTION

Data was collected using a standard questionnaire administered by the principal researcher and a trained assistant.

Data collected included,

1. Age
2. Sex
3. Nature of operation-emergency vs. elective procedure
4. Diagnosis
5. Duration of procedure in minutes
6. SAS derived from estimated blood loss, lowest recorded mean arterial pressure and lowest recorded pulse rate. The anaesthetist and surgeon determined the estimated blood loss from the number of blood soaked gauze and measurement of the volume of sucked blood intra-operatively. This was record in the patients' anaesthetic chart.
7. The occurrence of major complications and mortality within 30 days postoperatively was based on follow-up data in admitting ward and surgical outpatient clinic notes. Major complications definitions was according to Copeland et al ¹⁵ (Appendix 3).

Patients were subsequently grouped into three categories based on their SAS for purposes of risk stratification. Thus;

Risk group	Surgical Apgar Score
High	0 to 4
Medium	5 to 7
Low	8 to 10

DATA MANAGEMENT AND ANALYSIS

Data was entered into and analysed using SPSS (SPSS, Chicago, Illinois, USA) version 17 software. Value of $p > 0.05$ was considered significant.

P values were generated using t test for means, χ^2 for comparison of proportions, analysis of variance (ANOVA) and where applicable Fischer's exact test.

ETHICAL CONSIDERATIONS

The Department of Surgery, University of Nairobi, and the KNH Ethics and Research Committee reviewed the study protocol and granted approval prior to commencement (Appendix 4).

All patients recruited to take part in the study signed an informed consent administered by the principal researcher (Appendix 2). We handled all the collected data confidentially.

RESULTS

PATIENT CHARACTERISTICS

One hundred and fifty-four patients who met the inclusion criteria were recruited into the study. Two patients were lost to follow up due to absconding from the wards leaving 152 patients available for assessment of outcome.

The age range was 14 to 80 years with a median of 31 years. The extreme age groups were the least in this study (Figure 1). The sample population had a mean of 35.18 with a SD of 14.9. The male group had a mean age of 36.16 years while the female had a mean age of 32.24 years. However this difference was not statistically significant ($p=0.163$).

There were 114 (75%) male patients and 38(25%) female patients resulting in a male: female ratio of 3:1(Table 2).

Most patients underwent laparotomy in an emergency setting (86.8%) as compared to elective (13.2%) indications. There was no statistically significant difference between the genders on the setting for laparotomy ($p=0.579$) (Table2).

FIGURE 1 :AGE DISTRIBUTION

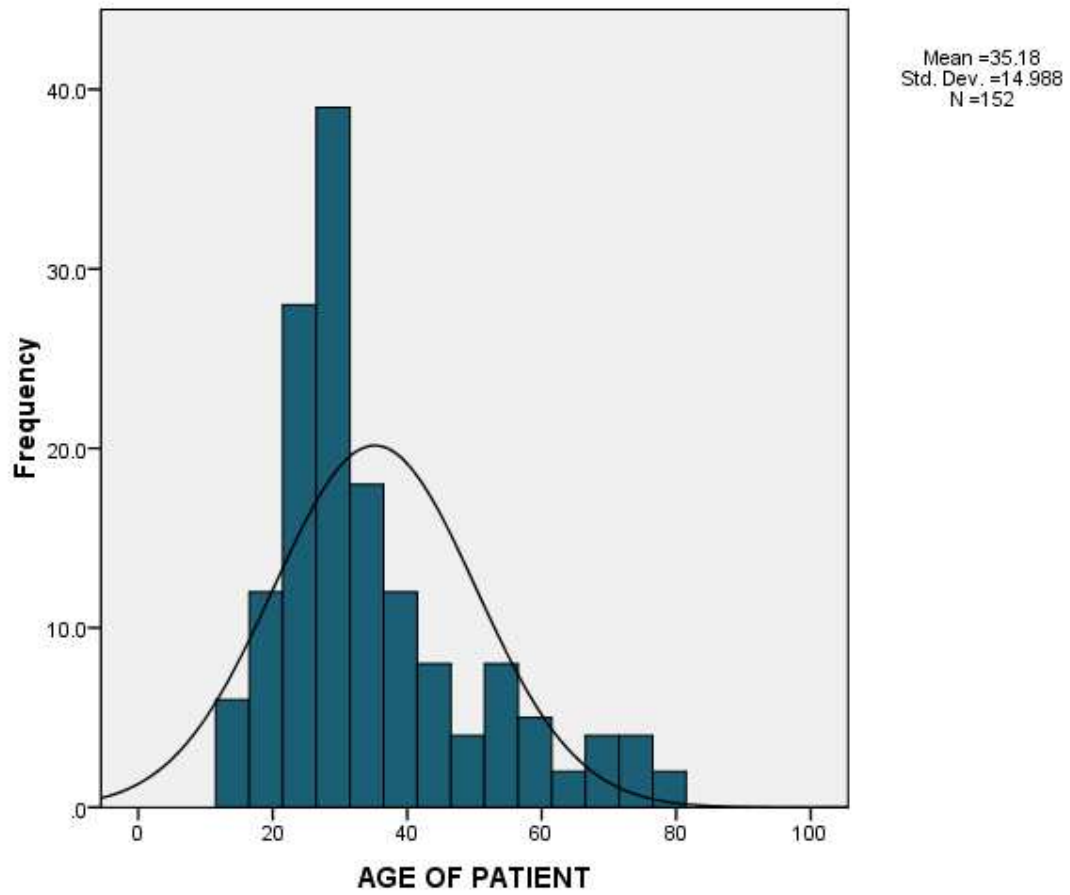


FIGURE 1 shows the distribution of patients by age. Most patients are below 40 years.

TABLE 2: GENDER AND SETTING OF LAPARATOMY

			GENDER		Total
			MALE	FEMALE	
SETTING OF LAPARATOMY	EMERGENCY	Count	100	32	132
		% of Total	65.8%	21.1%	86.8%
	ELECTIVE	Count	14	6	20
		% of Total	9.2%	3.9%	13.2%
Total		Count	114	38	152
		% of Total	75.0%	25.0%	100.0%

TABLE 2 shows the distribution of gender based on whether a laparotomy was an emergency or elective case. There was no significant difference between the genders ($\chi^2 = 0.307$, $p = 0.579$).

DIAGNOSES

The commonest reasons for laparotomy were penetrating abdominal injury (18.42%), intestinal obstruction (17.11%), peritonitis (17.11%), perforated peptic ulcer (11.84) and other causes (11.84%). Causes categorised as others included renal calculi, cancer of the stomach, liver abscess, liver cyst and colonic cancer. Figure 2

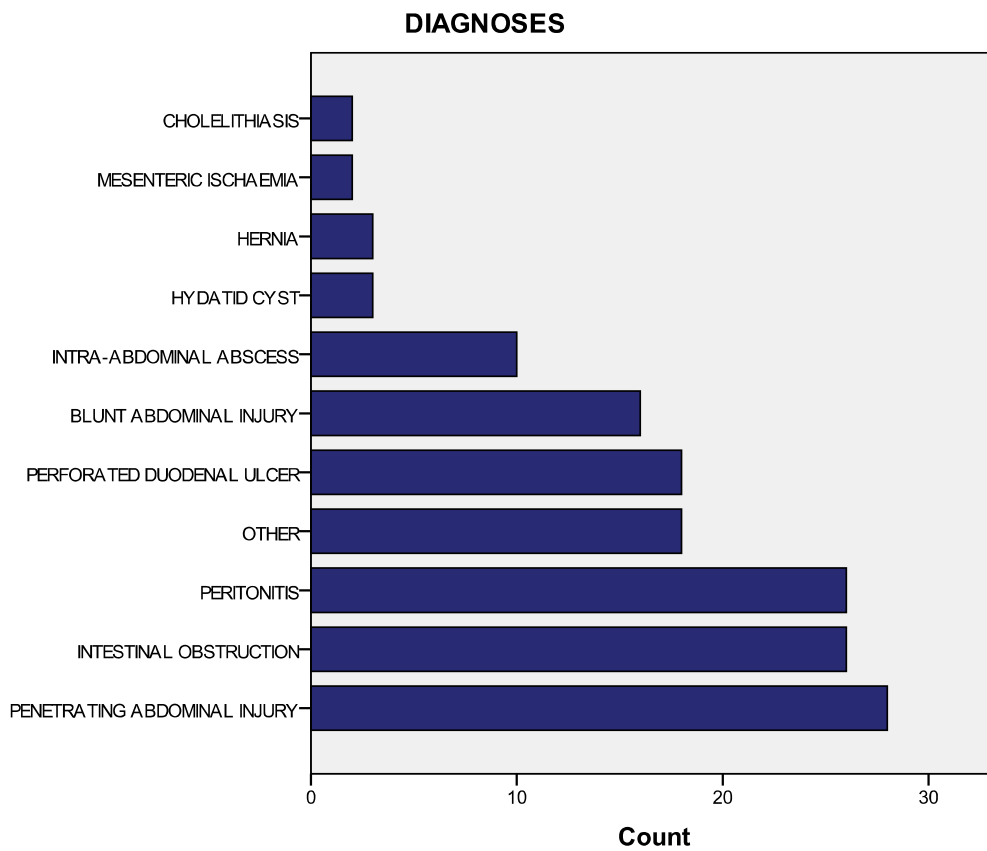


FIGURE 2: Distribution of various diagnoses that necessitated laparotomy.

DURATION OF LAPARATOMIES

Laparatomies studied varied in duration from 60 to 300 minutes. Mean duration was 131.05 minutes with a median of 120 minutes (Figure 3).

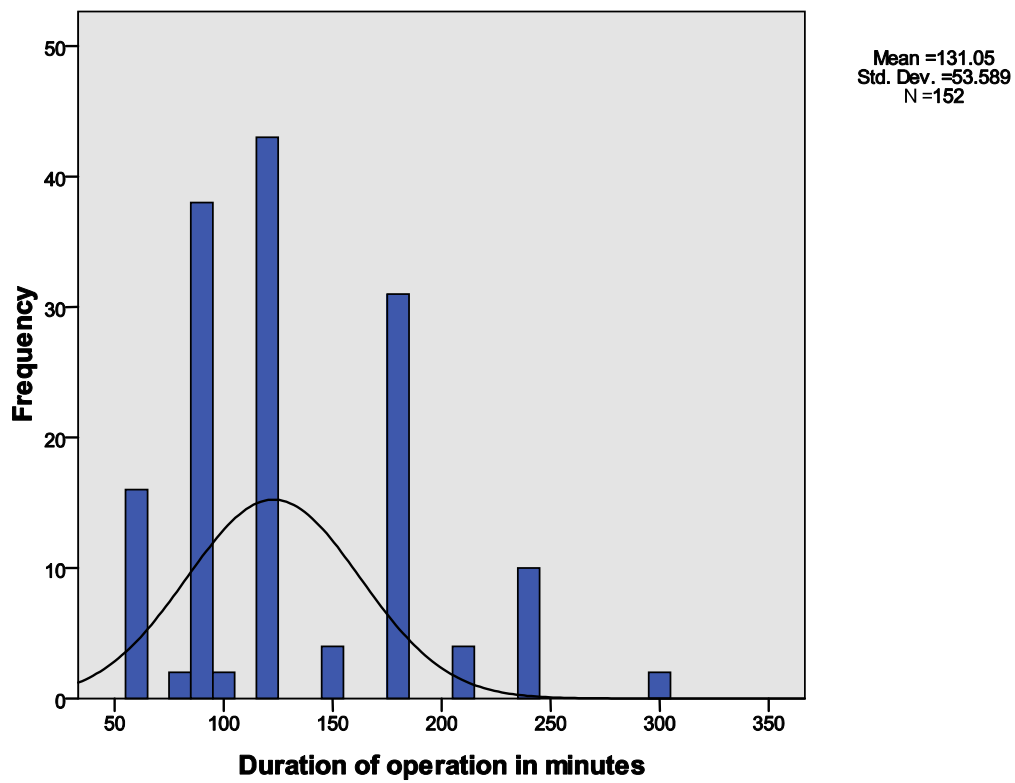


FIGURE 3: Distribution of duration of laparatomies

MORBIDITY AND MORTALITY

Twelve patients died within 30 days of laparotomy representing a 7.9% mortality rate. The timing of death ranged from the 1st to 16th post-operative day, with the 1st day being the commonest.

Fifty patients suffered major complications during the 30 days of follow up resulting in a rate of 40.8%. The commonest major complication was deep wound infection followed by anastomotic leakage and superficial wound infection (Table 3). There was a significantly higher complication rate among female patients at 63.2% compared to the males with 33.3%. Laparotomies done in emergency settings resulted in major complications in 43.9% of cases compared to 20% in elective cases. Duration of surgery more than 120 minutes resulted in complication rate of 68.6% compared to those that took a shorter time with 26.7% (Table 4).

COMPLICATION	FREQUENCY	PERCENT
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

TABLE 3: Distribution of post-operative complications

			PRESENCE OR ABSENCE OF COMPLICATION		Total	χ^2	<i>p value</i>
			ABSENT	PRESENT			
GENDER	MALE	Count % within GENDER	76 66.70%	38 33.30%	114 100.00%	10.497	0.001
	FEMALE	Count % within GENDER	14 36.80%	24 63.20%	38 100.00%		
SETTING OF LAPARATOMY	EMERGENCY	Count % within SETTING OF LAPARATOMY	74 56.10%	58 43.90%	132 100.00%	4.121	0.042
	ELECTIVE	Count % within SETTING OF LAPARATOMY	16 80.00%	4 20.00%	20 100.00%		
AGE GROUP	<40 YRS	Count % within AGE GROUP	54 51.40%	51 48.60%	105 100.00%	8.515	0.004
	40 AND ABOVE	Count % within AGE GROUP	36 76.60%	11 23.40%	47 100.00%		
DURATION GROUP	120 MINUTES OR LESS	Count % within DURATION GROUP	74 73.30%	27 26.70%	101 100.00%	24.628	<0.001
	>120 MINUTES	Count % within DURATION GROUP	16 31.40%	35 68.60%	51 100.00%		
Total		Count % within DURATION GROUP	90 59.20%	62 40.80%	152 100.00%		

TABLE 4 shows the relationship between occurrence of complications vs. gender, setting of laparotomy, age and duration of surgery. p values were generated using chi-square test.

SURGICAL APGAR SCORE

The calculated SAS ranged from one to nine with a mean of 5.03 and median of five (Figure3). The means SAS for males was 5.28 while for females it 4.26. This was statistically significant ($p=0.001$).

Stratification based on SAS resulted in 31.6% of patients falling under the high-risk category while 59.2% and 9.2% were medium and low-risk respectively.

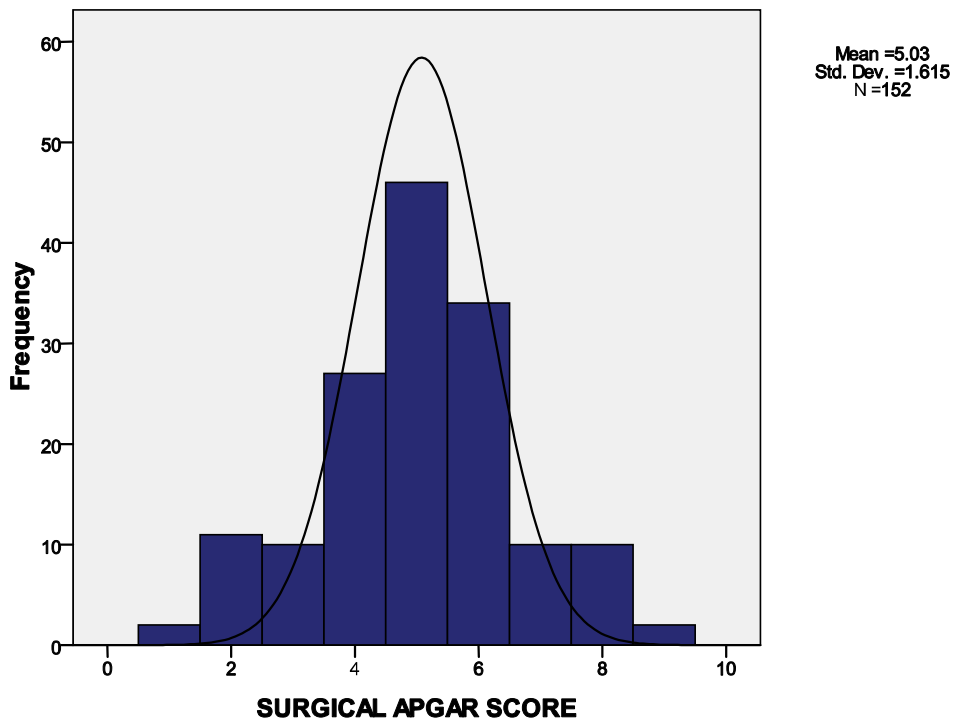


FIGURE 4 shows the mean, standard deviation and distribution of calculated SAS.

TABLE 5**SURGICAL APGAR SCORE**

DURATION OF LAPARATOMY	Mean	N	Std. Deviation	F	p
120 MINUTES OR LESS	5.52	101	1.432		
>120 MINUTES	4.04	51	1.509	35.153	<0.001
Total	5.03	152	1.615		

GENDER	Mean	N	Std. Deviation	F	p
MALE	5.28	114	1.549		
FEMALE	4.26	38	1.589	12.147	0.001
Total	5.03	152	1.615		

AGE GROUP	Mean	N	Std. Deviation	F	p
<40 YRS	4.80	105	1.608		
40 AND ABOVE	5.53	47	1.530	6.929	0.009
Total	5.03	152	1.615		

PRESENCE OR ABSENCE OF COMPLICATION	Mean	N	Std. Deviation	F	p
ABSENT	5.73	90	1.364		
PRESENT	4.00	62	1.391	58.336	<0.0001
Total	5.03	152	1.615		

Table 5 shows the comparison of the mean SAS between different patient groups based on duration of surgery, gender, age group and occurrence of complications. P values were generated using ANOVA tables.

TABLE 6: COMPLICATION TYPES IN DIFFERENT RISK GROUPS

		RISK GROUP			Total	
		HIGH RISK	MEDIUM RISK	LOW RISK		
TYPE OF COMPLICATION	Count	20	58	12	90	
	ANASTOMOTIC LEAKAGE	Count	8	4	0	12
		% within RISK GROUP	16.7%	4.4%	.0%	7.9%
	RENAL DYSFUNCTION	Count	0	2	2	4
		% within RISK GROUP	.0%	2.2%	14.3%	2.6%
	DEATH	Count	4	8	0	12
		% within RISK GROUP	8.3%	8.9%	.0%	7.9%
	SUPERFICIAL WOUND INFECTION	Count	5	6	0	11
		% within RISK GROUP	10.4%	6.7%	.0%	7.2%
	DEEP WOUND INFECTION	Count	6	8	0	14
		% within RISK GROUP	12.5%	8.9%	.0%	9.2%
	Pyrexia of unknown origin	Count	1	0	0	1
		% within RISK GROUP	2.1%	.0%	.0%	.7%
	WOUND DEHISCENCE	Count	4	4	0	8
		% within RISK GROUP	8.3%	4.4%	.0%	5.3%
	Total	Count	48	90	14	152
	% within RISK GROUP	100.0%	100.0%	100.0%	100.0%	

Table 6 shows the distribution of different complications within different risk groups. Most complications types apart from renal dysfunction are commoner in the high and medium risk groups.

FIGURE 5: DIAGNOSIS VS OCCURENCE OF COMPLICATIONS

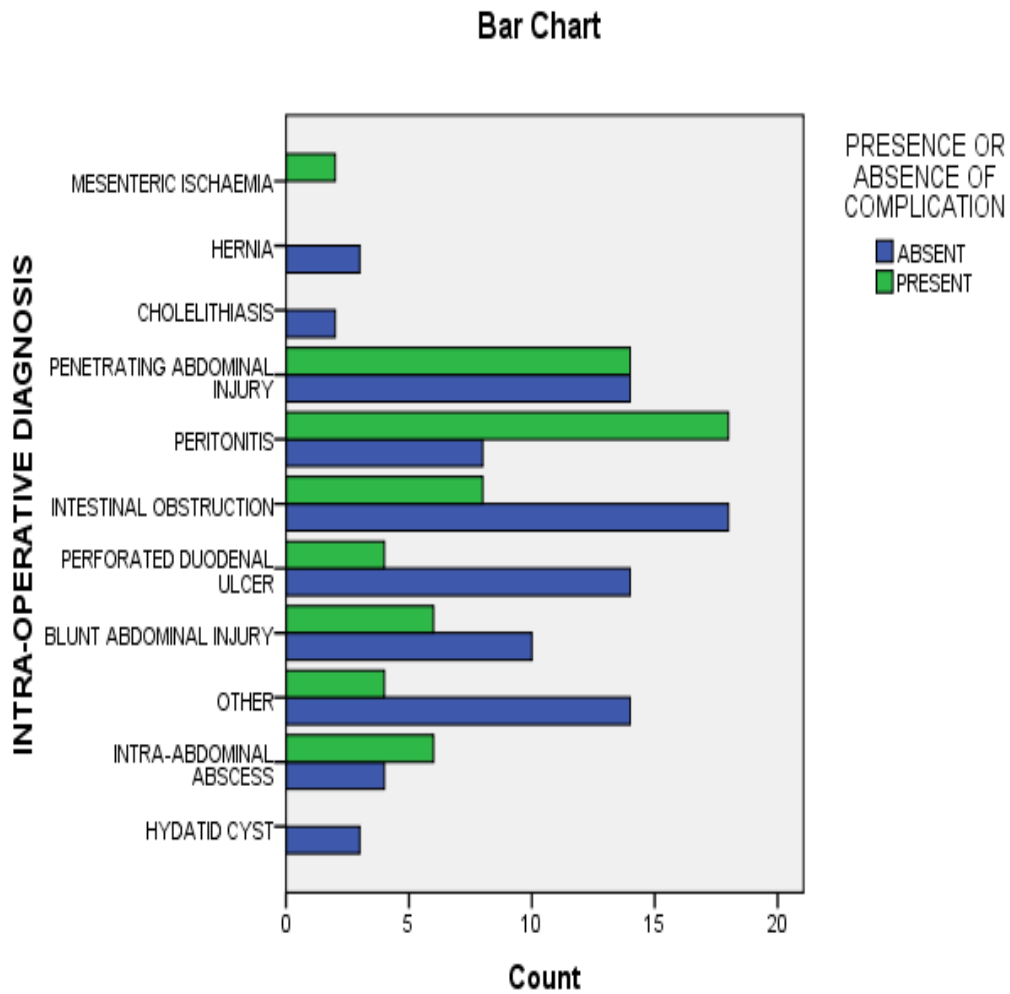


Figure 5 shows major complications were common in patients with peritonitis, intra-abdominal abscess and penetrating abdominal injury.

ASSOCIATION BETWEEN SAS, RISK CATEGORY AND OUTCOME

The mean SAS for patients with complications was significantly lower (4.00) compared to those without (5.73) (p=0.00) (Table 7).

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. This was statistically significant (p=0.04).

		PRESENCE OR ABSENCE OF COMPLICATION		Total	x2/F	p value
		ABSENT	PRESENT			
RISK GROUP	HIGH RISK	20(41.7%)	28(58.3%)	48	X2=11.2	0.04
	MEDIUM RISK	58(64.4%)	32(35.6%)	90		
	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
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TABLE 7 shows the relationship between occurrence of major complications with the mean SAS and risk category.

DISCUSSION

The purpose of this study was to establish the applicability of the SAS in post-operative risk stratification for patients undergoing laparotomy at KNH. The SAS was developed as a simple and objective tool that could identify patients at higher than average risk of post-operative complication. Laparotomy is one of the common surgeries at KNH and previous studies² have demonstrated the significant morbidity and mortality associated with this surgery.

In this prospective study, 152 patients were evaluated. The mean age was 35.18 years with a skewed gender distribution, males accounting for 75% of patients. This is comparable to the study by Mwangi et al² that had a male preponderance of 67% with a mean age of 34.8 years. This varies from studies done on the SAS in the west where the average patient undergoing laparotomy is much older. In the study by Regenbogen et al (2009)²¹, the mean age was 64.2 years. Gawande et al (2007)²⁰ had a patient population with a mean age of 63.6 years.

In this study, penetrating abdominal injury was the most common reason for laparotomy at 18.4% followed by peritonitis and intestinal obstruction both at 17.1%. Mwangi et al (2007)² found peritonitis, intestinal obstruction and appendicitis to be the commonest.

The observed 30-day mortality in our study was 7.9%. This is higher than that observed by Mwangi et al that was 4.8%. Yii and Ng (2002) in a study in Malaysia recorded a mortality of 6.1%. Similarly, in the study by Regenbogen (2010)²² in patients undergoing laparotomy for gastrectomy or colectomy the mortality was 5.2%. Gawande et al (2007)²⁰ observed a mortality rate of 4% in patients undergoing colectomy.

Surgical mortality is frequently used as a surrogate marker for performance to enable comparisons between individual surgeons and units. This can sometimes be misleading due to differences in case mix as can be seen in differences between patients in this study and that of Mwangi et al (2007)².

In this study, emergency laparatomies were the majority and were more likely to be associated with occurrence of major complications. This is similar to the findings by Mwangi et al (2007)². Other factors noted to be associated with significantly higher complication rates were female gender, age younger than 40 years and duration of surgery more than 120 minutes.

Regenbogen et al (2009)²¹ found a similar association between female gender and higher complication rates ($p < 0.001$). Gawande et al (2007)²⁰ found no significant difference ($p = 0.07$). In our study female gender was also associated with a significantly lower SAS and this may be the explanation for the higher complication rates.

Long duration of surgery as a factor in the occurrence of major complication as has been established in most studies on the SAS^{20, 21, 22, 23, 24}. This may be a reflection complexity of surgery necessitated by possibly extensive disease. However, long duration surgery was also associated with a lower mean SAS in our study.

Younger patients in this study were more likely to get complications. This is different from what Gawande et al (2007) and Regenbogen et al (2009) observed. This may be explained by the fact that in our study patients younger than 40 years had a lower mean SAS.

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) who had a rate of 16.6%. In the study by Regenbogen et al (2009) patients with scores between 0-4 had complication rates of 54-75% while those with scores of 7-10 had rates of 5-13%. This demonstrates the ability of the SAS in identifying patients at higher than average 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 facilitating easier identification of high-risk patients. This would allow for prudent allocation of our limited resources for post-operative monitoring and follow up.

Studies indicating a link between intra-operative anaesthetic and surgical performance and SAS suggest possibility of its use in surgical audit. Serial monitoring of SAS within a unit

may used as a tool for improving performance. However ,more studies on this aspect are required.

CONCLUSION

This study demonstrates that,

- i) In our setting laparotomy is still associated with significant morbidity and mortality and
- ii) The SAS, despite using simple and widely available intra-operative parameters, is adequate in stratification of post-operative risk of major complications following laparotomy.

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APPENDICES

APPENDIX 1:QUESTIONNAIRE

REF.NO

DATE;...../...../20...

THE SURGICAL APGAR SCORE: APPLICABILITY IN PATIENTS UNDERGOING LAPARATOMY AT KENYATTA NATIONAL HOSPITAL

A.INPATIENT FILE NUMBER

B. MOBILE NUMBER

C.AGE (YEARS)

D.SEX:

MALE

FEMALE

E.NATURE OF PROCEDURE;

EMERGENCY

ELECTIVE

G.INTRAOPERATIVE DIAGNOSIS

H.DURATION OF OPERATION (MINUTES)

I.SURGICAL APGAR SCORE

PARAMETER	RECORDED	SCORE
ESTIMATED BLOOD LOSS(ml)		
LOWEST MEAN ARTERIAL PRESSURE(mmHg)		
LOWEST PULSE RATE(beats/min)		

TOTAL SCORE (SAS) =

H.MAJOR COMPLICATIONS (source Copeland et al ¹⁵);

ABSENT

PRESENT

SPECIFY TYPE:

1. HAEMORRHAGE -SUPERFICIAL

-DEEP

2. INFECTION -SUPERFICIAL, WOUND

-DEEP, WOUND

-URINARY

-RESPIRATORY

-SEPTICAEMIA

3. PYREXIA OF UNKNOWN ORIGIN

4. WOUND DEHISCENCE

5. ANASTOMOTIC LEAKAGE

6. THROMBOSIS -DEEP VENOUS

-PULMONARY EMBOLISM

7. ORGAN DYSFUCTION- RENAL

-CARDIAC

-RESPIRATORY

8. HYPOTENSION

9. DEATH SPECIFY POST-OP DAY

9. OTHER

APPENDIX 2:STUDY CONSENT FORM IN ENGLISH

THE SURGICAL APGAR SCORE: APPLICABILITY IN PATIENTS UNDERGOING LAPARATOMY AT KENYATTA NATIONAL HOSPITAL

Study No

Hospital No

Purpose of the study

The purpose of this study is to investigate the usefulness of the Surgical Apgar Score in patients undergoing abdominal surgery at Kenyatta National Hospital. The Surgical Apgar Score is measured from patients' vital signs during operation. The information gathered will be useful in improving treatment of patients after operation.

Risks and benefits

There is no harm or risk to you for participating in this study. No additional tests outside the usual ones for treatment will be done and there will be no extra cost to you for participating in the study.

Voluntary participation

Participation in this study is out of your own free will. You will not be denied medical care in case you refuse to participate in the study. You may stop participating at any time with no consequences whatsoever.

Confidentiality

All information will be treated with confidentiality. Your identity will not be exposed to the public.

I, the undersigned have been explained to, understand the above, and voluntarily accept to participate in the study.

Signature/Thumb print:

(Patient/Parent/Guardian)

Telephone No (Patient/ Parent/Guardian)

Enquiries

For any enquiries or further clarification, please contact the following people

1. DR MICHAEL DULLO – *PRINCIPAL RESEARCHER*

Tel 0720 829196

2. DR. P. MUNGAI NGUGI- *CHAIRMAN,*

*KENYATTA NATIONAL HOSPITAL ETHICS & RESEARCH
COMMITTEE*

Tel 020-2726300

APPENDIX 3:STUDY CONSENT FORM IN SWAHILI

SURGICAL APGAR SCORE: MANUFAA KWA WAGONJWA WA UPASUAJI WA TUMBO KATIKA HOSPITALI YA TAIFA YA KENYATTA

Fomu ya idhini

Nambari ya utafiti

Nambari ya Hospitali

Lengo la utafiti

Lengo la utafiti huu ni kuchunguza manufaa ya Surgical Apgar Score kwa wagonjwa wa upasuaji wa tumbo katika Hospitali ya Taifa ya Kenyatta. Surgical Apgar Score inahesabiwa kutoka shinikizo la damu ya wagonjwa , kasi ya moyo na kiasi cha kupoteza damu wakati wa upasuaji.Matokeo ya utafiti itakuwa muhimu katika kuboresha kufuatiliwa kwa wagonjwa hawa baada ya upasuaji.

Hatari na faida

Hakuna madhara au hatari inayotarajiwa kwa kushiriki katika utafiti huu. Hakuna vipimo vya ziada nje ya yale kawaida kwa matibabu itafanywa, na hakuna gharama yeyote ya ziada utatokana kwa ajili ya kushiriki katika utafiti.

Ushiriki wa hiari

Kushiriki katika utafiti huu ni kwa hiari yako mwenyewe. Utapata huduma ya matibabu japo utakataa kushiriki katika utafiti. Unaweza kuondoa ushiriki wako wakati wowote na hakuna madhara utakayopata.

Usiri

Habari zozote utakazotoa zitawekwa kwa siri na jina lako halitachapishwa popote.

Mimi, niliyetia sahihi. nilielezewa, nimeelewa, na kwa hiari nakubali kushiriki katika utafiti.

Saini/Alama ya kidole:

(Mgonjwa / Mzazi / Mlinzi)

Nambari ya simu_(Mgonjwa / Mzazi / Mlinzi)

Maelezo ya ziada

Kwa maelezo ya ziada au ufafanuzi, tafadhali wasiliana na:

1. Dkt MICHAEL DULLO – *MTAFITI MKUU*

Nambari ya Simu. 0720 829196

2. Dkt. P. MUNGAI NGUGI- *MWENYEKITI,*

*KAMATI YA MAADILI NA UTAFITI YA HOSPITALI YA TAIFA
YA KENYATTA*

Nambari ya Simu. 020-2726300

APPENDIX4:DEFINITIONS OF MAJOR COMPLICATIONS **(COPELAND ET AL)**

Wound haemorrhage: local hematoma requiring evacuation

Deep haemorrhage: post-operative bleeding requiring re-exploration

Chest infection: production of purulent sputum with or without chest radiograph changes or pyrexia

Wound infection: wound cellulitis or discharge of purulent exudates

Deep infection: presence of intra-abdominal collection confirmed clinically or by imaging

Urinary infection: presence of positive urine cultures

Septicaemia: presence of positive blood cultures with clinical signs and symptoms

Pyrexia of unknown origin: any temperature above 37.5 °C for more than 24 hours occurring after the original fever following surgery has settled, for which no obvious cause could be found

Wound dehiscence: superficial or deep wound breakdown

Deep venous thrombosis and pulmonary embolus: confirmed by Doppler study

Cardiac failure: symptoms or signs of left ventricular or congestive cardiac failure

Impaired renal function: arbitrarily defined as an increase in blood urea of more than 5 mmol/l above pre-operative levels.

Hypotension: a fall of systolic blood pressure to less than 90 mmHg for more than 2 hours

Respiratory failure: respiratory difficulty requiring emergency ventilation and blood gas analysis findings.

Anastomotic leakage: discharge of bowel content via a drain, wound or abnormal orifice

APPENDIX 5: ETHICS COMMITTEE APPROVAL



Ref: KNH-ERC/ A/16

Dr. Michael Dullo
Dept. of Surgery
School of Medicine
University of Nairobi

Dear Dr. Dullo

**RESEARCH PROPOSAL: "SURGICAL APGAR SCORE: APPLICABILITY IN PATIENTS
UNDERGOING LAPARATOMY AT KENYATTA NATIONAL HOSPITAL" (P381/11/2010)**

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above revised research proposal for the period 10th February 2011 – 9th February 2012.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF A N GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The HOD, Records, KNH
The Dean, School of Medicine, UON
The Chairman, Dept.of Surgery, UON
Supervisors: Prof. W. O. Ogendo, Dept.of Surgery, UON
Dr. Elly O. Nyaim, Dept.of Surgery, UON

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi.
Email: KNHplan@Ken.Healthnet.org
10th February 2011