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ORIGINAL ARTICLES

Utility of Surgical APGAR Score In Predicting Morbidity and Mortality In Patients Undergoing Laparotomy

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ABSTRACT

Perioperative healthcare teams continue to lack an accurate, objective tool predictive of postoperative complications. A 10-point Surgical APGAR Score (SAS), developed to identify patients at high risk of post laparotomy complications has been retrospectively validated in multiple surgical populations. We sought to prospectively evaluate the ability of this score to predict postoperative complications. This study was approved by the local research ethics board. Prospective observational study. Patients with a lower SAS (<4) had a higher risk of postoperative complications (sensitivity-94.87%, p=<0.001).In moderate risk group only 2% died and 60% were normal and 37% develop postoperative complications. If score is >8 patient, patient remained normal postoperatively. SAS score is able to find out the postoperative risk at higher sensitivity (though lack of specificity is a drawback in this), lower SAS score is much higher predictive for identifying mortality and morbidity(p<0.05) but medium SAS score indicates morbidity as well as risk of mortality, lower than the high risk score, Among the all parameters Estimated blood loss and Lowest MAP are sensitive indicators. But all the three are statistically significant (<0.05).

KEY WORDS : Chondrolipoma, Adipose tissue, Benign mesenchymal tumour, Hyaline cartilage, Excision and Biopsy

Introduction

Surgical teams lack A Routine, objective evaluation of patient condition after surgery to inform postoperative prognostication, guide clinical communication, and evaluate the efficacy of safety interventions in the operating room[1]. Instead, surgeons rely primarily on subjective assessment of available patient data[2].

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Complex models, such as the Acute Physiology and Chronic Health Evaluation score[3] and the Physiologic and Operative Severity Score for the Enumeration of Mortality[4], provide adequate predictions of a surgical patient's risk of complications. These scores have not come into standard use for surgical patients, because they are not easily calculated at the bedside, require numerous data elements that are not uniformly collected, and are often not well understood among the various members of a multidisciplinary care team[5]. Efforts to significantly reduce surgery's overall 3% major complication rate [6] have been hampered in part because surgical departments in most hospitals have no easily applied tool for routine measurement and monitoring of surgical results[1].

In 2007 under the leadership of prof. Dr. Atul A Gawande, a retrospective trial was done from the medical records and National Surgical Improvement programme data at Boston's Brigham and Women's hospital. Their target was to invent a novel scoring system that can be used intra operatively with simple manner without the help of any additional gadgets, but at the same time surgeons can accurately identify the risk patient may have following surgery in form of complications or death, thus make it easy to post-operative triaging or stratification. Atul et al described a scoring system that estimates three parameters that are intraoperative blood loss, lowest MAP, and lowest heart rate and give a single digit score 0 – 10 in all laparotomies which are associated with various complications. They identified 311 patients in the BWH-NSQIP database to form cohort 1 (for derivation of our score), 103 patients to form cohort 2 (for validation in colectomy patients), and 775 patients for cohort 3 (for validation in patients undergoing general or vascular surgery).

They studied retrospectively using the anesthetic and intraoperative documents regarding various factors. Subsequently they observed the 30 days follow up notes and correlated with the intraoperative changes of variables. So they found that lowest heart rate, estimated blood loss, and lowest mean arterial pressure (MAP) were each independent predictors of outcomes.

Three variables of Surgical Apgar Score was documented to be

1. Estimated blood loss (in ml)
2. Lowest Mean Arterial Pressure (in mmHg)
3. Lowest Heart rate (beats/min)

The 10-point surgical Apgar score is as follow [1]

components	0	1	2	3	4
Estimated blood loss(ml)	>1000	601-1000	101-600	<100	-
Lowest mean arterial pressure(mm of Hg)	<40	40-54	55-69	>70	-
Lowest heart rate(beats/min)	>85	76-85	66-75	56-65	<55

(Data such as lowest heart rate and lowest mean arterial pressures are noted intraoperatively and collected from the anesthesiologist's records (manual/electronic).

Estimated Blood Loss was counted using few other variables

Estimated blood volume (EBV) = body wt (kg) x average blood volume (ml3/kg) Pre and post-operative hematocrit, Final formula used to find out estimated blood loss was, Estimated Blood loss= [(EBV × (Hi – Hf) / (Hi +Hf)/2]

EBV=Estimated blood volume, Hi = Pre-operative hematocrit, Hf = post-operative haematocrit[3,10].

Following giving score individuals were segregated among three risk groups

Table No. 1:

Apgar score	Risk predicted
<4	high
5,6	medium
≥7	Low

Patients are followed up for 30 days to look for any complications. The following events are considered major complications:

Acute renal failure, Acute respiratory distress syndrome, sepsis, entero cuteneous fistula, anaemia, paralytic ileus, dyselectrolytemia, wound infection, wound gapping, abdominal

hypertension, systemic inflammatory response syndrome, Deep or organ- space surgical site infection, septic shock and deaths are assumed to include major complications[1].

Usefulness of This Scoring System

1. Simple surgical score using routinely available data either manually, or, derived from various easily available intraoperative datas.
2. Immediate graded feedback to the surgical team regarding the intra-operative patient status feedback.
3. Surgeons will be able to identify high risk group with probable post op complications.
4. Provide information to relatives regarding overall post op status of the patient. This score not only improves patients outcome also derives the possible ways to improve the available surgical settings.
6. With respect to better resources, intraoperative modern equipment's patients intraoperative status gets improved, it does not really compare between quality of two institutions or surgical team's skill.

Limitations of this Scoring System

1. This score was tested only at a single, large, teaching hospital.
2. This study was confined to only General surgery patients.
3. Although there is a strong association between surgical score and risk of major complications, the confidence intervals around the risk estimates for any individual score remain wide.
4. Only studied in subjects >13 year
5. Blood loss estimation can be similarly imprecise.

Materials and Methods

Study Justification

The SAS has been mainly validated in resource rich western settings and no published study in the Indian 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.

Aim of the Study

Applicability or utility of APGAR scoring system in patient undergoing laparotomy.

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-laparatomy at GRH, Madurai.

Secondary Objectives

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

Study Area

The setting of this study was at GRH. This is the largest referral hospital in the South India a 2000 bed inpatient public health facility. It is the main referral hospital in south India including Kerala and southern most Tamilnadu and serves as a teaching hospital for the Tamilnadu MGR University.

Patients undergoing laparatomy at GRH are managed by a tier of doctors from anesthetic technicians, medical officer interns, medical officers, senior house officers in general surgery and anesthesiology 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 laparatomy admitted to the general surgical wards or, trauma ward, intensive and high dependency units who met the eligibility criteria. Selection of patients was from the point first seen at GRH those admitted for emergency surgeries were selected from the Trauma ward. 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 January 2015 to December 2015.

Criteria For Subject Selection Inclusion Criteria

All patients above 13 years of age, scheduled for emergency or elective laparatomy at GRH 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 laparatomy under study,

-Patients undergoing mini-laparatomy and laparoscopic procedures,

Study Endpoint

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

Sampling Method

Using non-probability convenience sampling all patients 13 years and above admitted to Government Rajaji Hospital, Madurai and for whom laparatomy was scheduled and who met all inclusion and none of the exclusion criteria were recruited until the desired sample size of 80.

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. SAS derived from estimated blood loss, lowest recorded mean arterial pressure and lowest recorded pulse rate. Lowest mean arterial pressure and lowest heart rate were calculated and recorded intraoperatively. Estimated blood loss was calculated from conventional equation.
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 definations was according to Copeland et al, Patients were subsequently grouped into three categories based on their SAS for purposes of risk stratification. Thus;

Data Management and Analysis

Data was entered into and analyzed 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, x2 for comparison of proportions, analysis of variance (ANOVA) and where applicable Fischer's exact test.

Ethical Considerations

The Department of Surgery, Tamilnadu MGR University and GRH, Madurai Ethical committee reviewed the study protocol and granted approval prior to commencement. All patients recruited to take part in the study signed an informed consent administered by the principal researcher. We handled all the collected data confidentially.

Results

Patient Characteristics

Total eighty patients who met the inclusion criteria were recruited into the study. All patients were followed up for 1 month post operatively in review OPD weekly.

The age range was 14 to 80 years. The extreme age groups were the least in this study .The sample population had a mean age of 47.8

There were 63 (78.7 %) male patients and 17(21.3 %) female patients resulting in a male: female 3.70. Most patients underwent laparatomy in an emergency setting (64%) as compared to elective (36%) indications.

Age Distribution:

Maximum patients are above 20 yrs and only 1 patient was above 80 years, Mean age of laparotomy in GRH 47.8, Age distribution was symmetrical.

Emergency laparotomy carries around 63.75% of cases >250 ml blood loss is seen in 30 cases, which is 37.5% of total laparotomies. 62.5% cases showed blood loss less than 250ml.

Complications faced in post-operative period :

Post operatively total 11 cases died (13.75%) 42 patients did well post-operatively.most common morbidity observed post-operatively abdominal hypertension, paralytic ileus, sepsis, enteric fistula, wound gapping, wound infection, LRTI.

Table No. 2:

Score Vs. Death	Death	Morbidity	Nil
0 to 4 (21)	10(47.61%)	9(42.85%)	2(9.5%)
5 to 7 (46)	1(2.17%)	17(36.95%)	28(60.86%)
> 7 (13)	0	2(15.38%)	11(84.61%)
Total	11	28	41

Table.No. 3:

Figure.No. I: Demonstration of SAS Vs Morbidity and Mortality. PREDICTION CAPABILITY OF SURGICAL APGAR SCORE

APGAR SCORE	Death	Other compli-cations	Total subjects	P-value
≤4	10	9	21	<.001
5-6	1	17	46	<.001
≥7	0	2	13	<.001

Table.No. 4:

Significance of parameters for mortality and morbidity	p-value
Estimated blood loss (>250 ml)	.044
Lowest mean arterial pressure (<50 mmHg)	.031
Lowest Heart rate (>76 beats/min)	.924

Table 5:

	Morbidity & mortality	Ni Post op Event	
Score <7	37	30	67
Score ≥7	2	11	13
	39	41	80

Sensitivity 94.87

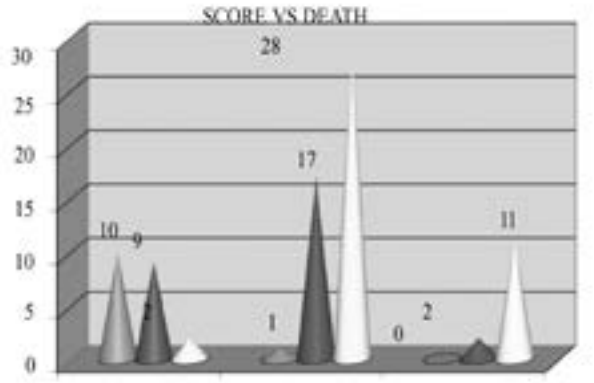
Specificity 26.83

PPV	55.22
NPV	84.61
Accuracy	60%

SAS score is highly sensitive with sensitivity around 95% .But in our study it did not show good specificity.

It had good positive and excellent negative predictive value.

Discussion



We studied the utility of the SAS in predicting outcome in 80 patients undergoing laparotomy at our hospital – a tertiary care teaching institute. The Surgical Apgar score since its inception by Gawande et al in 2007[1] has been validated in general and vascular surgery[1-12], colectomies[13-14], pancr eaticoduodenectomies[15],Cytoreduction for advanced ovarian cancers[16] and across diverse surgical sub-specialities[17]. The SAS has also been validated in diverse international settings across the world[18]. Validity of the Surgical Apgar Score is yet to be proven in Orthopaedic procedures[19] minimally invasive procedures and Paediatric age group. The limitations of the study by Gawande et al in their original article[1] have all been addressed at this point of time and SAS has also found its place in WHO guidelines for safe surgery.

We choose to study the SAS at our hospital in patients undergoing laparotomy because it represents the major bulk of operative procedures at our institute. Surgeries performed were both elective and emergency excluding patient <13years of the 80 patients enrolled in the study, twenty one patients in our series had a SAS of ≤ 4 and 13 patients had a score of 7 or more. The predictive value of Surgical Apgar Score to predict the complications was found to be <0.001 (significant). Thus, SAS was useful in predicting complications in the present series. We found amount of blood loss during the surgery and lowest MAP during the surgical procedure to be significantly related with post-operative complication (p =0.044) and (p=0.031) respectively. Lowest HR was not found a significant predictor of major complications. (p=0.924). Mean arterial pressure readings in our series were derived from hand written anesthesia records as well as electronic monitor readings taken at 5 min intervals intra-operatively. Fluctuations in arterial pressure in these 5 min intervals could probably have been better studied by more frequent vigilance. This could be possible by using a parameter that can give a more constant overview of tissue perfusion example– Intra-operative Lactic acid levels[21]. Occurrence of complication with EBL and lowest MAP on multivariate analysis, found to be Associated. The score may have use in several areas. For example, during the handoff process (the communication between physician services or physician and nursing team members) it can signal the provider taking over care to the overall risk the patient is facing and may indicate the need for additional care measures to minimize the risk[21]. Improving surgical mortality and morbidity is only speculative at this time. However the score provides an objective adjunct to facilitate discussions of the surgeon, anesthesiologist and the intensive care physician in determining the need for heightened postoperative care strategies that additional diagnostic testing (arterial

blood gases, serum lactate or hematocrit determinations), further resuscitation, one-on-one nursing, or more invasive monitoring is indicated[1,3,21]. The original model of Gawande et al was kept simple so that a human could compute the score. Although the simplicity of the original model is reasonable and in fact, a major point of the score, the broad adoption of automatic per-operative information systems could facilitate a more complex and improved model. The Surgical Apgar Score 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. The additional complexity would be acceptable because the score would then be computed in real time using the computer. The Surgical Apgar Score developed by Gawande et al is a simple, reproducible, accurate, objective scoring system available to all patients, in all settings. It serves a useful objective metric to supplement the subjective assessment of postoperative outcome of patients. Future work should be directed towards improving the surgical APGAR score for elective and minimally invasive surgeries and in pediatric population[21]. Its use can be examined in guiding intra-operative techniques and postoperative interventions, such as intensive care admissions or other escalations in diagnosis or therapy.

Conclusion

This study was carried out in (GRH) Govt. Rajaji Hospital, Madurai and conclusion was made are as follows

- SAS score is able to find out the post operative risk at higher sensitivity though lack of specificity is a drawback in this
- Lower SAS score is much higher predictive for identifying mortality and morbidity but medium SAS score indicates morbidity as well as risk of mortality lowers than the high risk score
- Among the all parameters estimated blood loss and Lowest MAP are most sensitive indicators.
- SAS score was proved to be a handy simple predictor system in tertiary care hospital like

GRH also in peripheral setup.

We conclude that the Surgical Apgar Score is simple, easily calculated and a reproducible objective metric for open abdominal surgeries in Indian settings.

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