Section: Miscellaneous

Original Research Article

UTILITY OF SURGICAL APGAR SCORE IN PREDICTING THE MORBIDITY AND MORTALITY OF PATIENTS UNDERGOING SURGERY

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Received *: 01/01/2025*
Received in revised form *: 20/02/2025*
Accepted *: 10/03/2025*

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DOI: 10.70034/ijmedph.2025.2.258

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (2); 1432-1436

ABSTRACT

Background: The need for surgical procedures is immensely high worldwide. But there is lack of accurate measuring tool to estimate the post-surgical outcomes. To provide surgeons with a simple, objective, and direct method of rating, a ten-point Surgical Apgar Score was developed. In this study the efficacy of the surgical APGAR score in predicting the post-operative mortality and major complications was evaluated.

Materials and Methods: A longitudinal follow up study was conducted at a tertiary care apex government hospital in the state of Telangana. A total of 100 patients undergoing general surgical procedures were selected randomly for inclusion in the study. The estimated morbidity and mortality for 30 days after surgery was calculated using the individual surgical Apgar scores. Descriptive statistics and chi – square analytical tests were used to analyzed the statistical significance.

Results: The study estimated that the surgical patients with low score APGAR had developed major post – operative complications (p = 0.000018). Those patients with co – morbidities had significant association with the APGAR score (p= 0.00205).

Conclusion: In this study, surgical Apgar score has proven to be an important tool in early prediction of development of post-operative major complications including 30 days mortality. Those who had lower Apgar score developed major post – operative complications and those with co - morbidities were found to be significant pre - operative factors associated with higher chances of post-operative complications.

Keywords: Surgical APGAR score, post – operative complications, co – morbidities.

INTRODUCTION

Globally the need for surgical procedures is estimated at 321.5 million per annum. The current in hospital mortality and morbidity rates for patients undergoing surgeries is not as high as it was in the pre – anaesthetic, prescientific and pre – antiseptic times, yet there exists a subset of patients for whom the risk is substantial. In light of this, it is highly valuable that the operating surgical team objectively and accurately predict the morbidity and 30 days in hospital mortality risk after any surgery and also communicate the same in clear and effective terms to the family members.[1]

Accurate estimates of postoperative complication risks are undoubtedly important to patients, caregivers, and clinicians. However, there is no risk estimation tool currently available that covers nearly all surgeries across multiple subspecialties. The differences in the post-operative outcomes of patients with similar risk factor profiles undergoing the same surgery arise due to the intra operative

differences in the vital parameters such as heart rate, blood pressure and body temperature and the varying physiological response of different bodies to the same degree of surgical stress.

The existing risk scores are - POSSUM – Physiological operative severity scoring for the enumeration of morbidity and mortality, NSQIP – National surgical quality improvement program, SORT – Surgical outcome risk tool, ASA – American society of anesthesiologists' physical status, SAPS 2 – Simplified acute physiology score, French association of surgery colorectal scale, APACHE 4 – Acute physiology and chronic health evaluation score, MODS – multiple organ dysfunction score, Cleveland Clinic Foundation, Colorectal Cancer Model, TRIOS – three day recalibrated ICU outcome score.[2]

These existing scoring systems are difficult to be calculated bedside by paramedical workers and nurses to assess the outcomes. Thus, there is a need for a good easily calculated bedside tool to evaluate for the post-operative risk.

Prevailing methods of surgical quality assessment, such as the American College of Surgeons' National Surgical Quality Improvement Program (NSQIP), evaluate surgical performance indirectly, i.e., by assessing the multiple preoperative risk factors and in addition attributes disparities between observed and expected complication rates to the treatment provided. ACS-NSQIP is the generally accepted program for risk adjustment to monitor and improve the surgical outcomes, it has also been validated as an excellent quality improvement tool by accounting for the influence of patient risk on outcomes from surgery and allowing hospitals to compare their outcomes with the outcomes of their peers. The ACS-NSQIP risk calculator uses 21 patient predictors to predict the chance that patients will have any of the nine outcomes within 30 days of the surgery. The NSQIP also has a reliable post discharge mortality predictor (PMP). The PMP is an accurate, simple, effective and clinically meaningful tool to calculate the risk of perioperative death using only preoperative variables. The PMP is a 30 points bedside preoperative mortality predictor scoring system.[3]

The practice of ambulatory surgery is on rise all over the world, but in patient surgery is still the need of the hour for the sicker patients and more complex surgical procedures. In patient status contributes indirectly to the mortality of post-operative patients by exposing them to hospital acquired infections. Advanced age also is an independent predictor of death and major complications post-surgery. Other independent predictors of mortality are as follows – poor functional status, do-not-resuscitate directives, cirrhosis, and renal failure, medical comorbidities like – cardiac problems, pulmonary dysfunction, and bleeding disorders. The presence of disseminated cancer also independently predicted death. Surgical complexity was only minimally predictive and only in very complex procedures, such as Pancreatectomy. In the operating room, the gut feeling of the surgeon is relied more upon than the objective assessment of the intraoperative course of the patient to assess and predict the post-operative course of the patient. Thereby causing differences in the quality of care being given post operatively and the post-operative course of the patient.

All the above stated predictive models and scoring systems for assessing the perioperative risk of death and complications are based on the patient characteristics and preoperative risk factor profile and furthermore these complex prediction systems are difficult to be made use by the paramedical and nursing staff for bedside use. Thus, the need for a simple scoring system that is not cumbersome to calculate or doesn't require too many lab parameters to calculate.[4]

To provide surgeons with a simple, objective, and direct method of rating, a ten-point Surgical Apgar Score was determined by Atul Gawande et al.5 It was discovered that three intraoperative variables remained independent predictors of major postoperative complications and death. They were - Lowest heart rate, lowest mean arterial pressure, and estimated blood loss. A score built from these three predictors has proved to be useful in categorizing the post-operative patients into 3 sub-groups and predict the risk of major post-operative complications and post-operative mortality in patients undergoing emergency general surgical procedures.

In this study the efficacy of the surgical APGAR score in predicting the post-operative mortality and major complications in the form of wound dehiscence, deep incisional surgical site infection, pneumonia, venous thromboembolism, proximal DVT, Acute renal failure, stroke, myocardial infarction and systemic sepsis in patients undergoing emergency general surgical procedures in a tertiary care hospital was evaluated. The study aimed to evaluate the significance of the Surgical Apgar score in post-operative outcome in the form of major post-operative complications (morbidity) and 30 days mortality in patients undergoing general surgical procedures in a tertiary care hospital in Hyderabad. It also aimed to assess the relationship between pre – operative co – morbidity and Surgical Apgar score in the surgical patients

MATERIALS AND METHODS

Study design and study procedure

A longitudinal follow up study was conducted at a tertiary care apex government hospital in the state of Telangana for a period of three years. A total of 100 patients undergoing general surgical procedures were selected randomly for inclusion in the study. Patients undergoing emergency and/or elective general surgical procedures under general, spinal or epidural anaesthesia were included in the study. Patients undergoing general surgical procedures

under local anaesthesia, patients of age less than 13 years and patients participating in any other concurrent studies at the same given time were excluded from the study.

Various determinants such as age, sex, comorbid conditions, presenting disease(s), procedure executed, surgical APGAR score[5], post-operative morbidity including complications till 30 days, 30 days mortality were analysed.

The data for lowest mean arterial pressure, lowest heart rate and estimated blood loss during the operative procedure were recorded and tabulated. The cumulative surgical Apgar score for each individual patient was calculated.

The cumulative scores were separated into 3 categories as described below –

Category 1 – surgical Apgar score of 0 to 4

Category 2 – surgical Apgar score of 5 to 7

Category 3 – surgical Apgar score of 8 to 10.

The estimated morbidity and mortality for 30 days after surgery was calculated using the individual surgical Apgar scores and then the patient was asked to come for follow up from the day of discharge from hospital, every weekly till first 5 weeks. These follow ups were performed in the OPD.

The follow up visits were recorded as follows–

1. Day 7 after index surgery
2. Day 14 +/-2 days after index surgery
3. Day 21 +/-2 days after index surgery
4. Day 28+/-2 days after index surgery
5. Day 30 after index surgery

Statistical Analysis

Data were compiled using Microsoft Excel and statistical analyses were performed using Jamovi 2.3.28. Socio – demographics, pre-operative co – morbidities, post – operative complications and APGAR scores have been expressed as proportions. Chi square test was used to evaluate the relationship between the Surgical APGAR score and the incidence of post-operative outcomes in the form of major post-operative complications including 30 days mortality patients undergoing elective and emergency surgeries. A p -value of < 0.05 was considered to be statistically significant.

Ethical Considerations

This study was approved by the Institutional Ethics Committee of Osmania Medical College (ECR/300/Inst/AP/2013/RR-16). Written informed consent was obtained from all study participants before participation.

RESULTS

The age group having maximum percentage of patients was 21 to 30 years age group, comprising 23% of patients. Out of the 100 cases, 77 patients were male and rest 23 were female patients. A total of 68 patients underwent emergency general surgical procedures and 32 patients underwent elective surgical procedures. The most commonly seen pre-operative comorbidity was type 2 Diabetes mellitus affecting 37% of the study population, closely followed by systemic hypertension affecting 29% of cases.

Of the 32 elective procedures, 04 cases (12.5% of cases) had 30 days major complications excluding mortality, whereas out of 68 emergency admissions and surgeries 30 patients (44.11% of cases) had 30 days major complications excluding mortality. The major complications seen in the elective surgeries group include – acute renal failure, stroke, wound disruption and deep organ space infection. Thus, in our current study at a tertiary care center, it was noted that the rates of post-operative complications in patients undergoing emergency surgeries were exceeding that of elective surgeries by almost 4 times. This can be attributed to the patient factors in emergency admissions in the form of delayed presentation of the patient in advanced stages of the disease and surgical factors in the form of higher complication rates of the emergency surgeries like resection and anastomosis of bowel in a patient with no prior bowel preparation and presence of intra-abdominal contamination in the form of focal and generalized peritonitis.

Patients in the age group of 51-60 years constituted the majority in APGAR low score category. 77% of the patients belonging to the low score category developed major post-operative complications. Thus, it can be safely concluded that the percentage of patients developing post-operative complications was highest in the Low score category followed by Moderate and Good score categories in the descending order. The patients belonging to the Low score category had the highest rates of preoperative comorbidities i.e. 90.9% of patients in the low score category had one or the other preoperative comorbidity. The least percentage rates of preoperative comorbidities were seen in the good score category.

POST OPERATIVE SURGICAL OUTCOME VS SURGICAL APGAR SCORE

The value of Chi-square for the dependence between the post-operative surgical outcome vs surgical Apgar score for this study is 21.7996, with a degree of freedom 2. Any value of chi square > 5.991 are considered to be significant. The p-value for the above-mentioned data set and the above mentioned two categorical variables is $p = 0.000018$. Any p value of < 0.005 is considered to be statistically significant with a confidence interval of 95%.

Thus, the null hypothesis can be rejected in this study and the alternate hypothesis holds true. The post-operative surgical outcome of the patient is dependent on the Surgical APGAR score category into which the patient falls.

PRE-OPERATIVE COMORBIDITIES VS SURGICAL APGAR SCORE

The value of Chi-square for the dependence between the presence and absence of pre-operative comorbidities vs surgical Apgar score for this study is 12.3799, with a degree of freedom of 2. Any value of Chi-square > 5.991 are considered to be

significant. The p-value for the above-mentioned data set and the above mentioned two categorical variables is p= 0.00205. Any p-value of < 0.005 is considered to be statistically significant with a confidence interval of 95%. This study observed that patients with pre – operative co – morbidities tend to have a lower surgical APGAR score.

Table 1: Characteristics of the patients

Characteristics	Frequency	Percentage
Age		
Less than 20 years	15	15
21 to 30 years	23	23
31 to 40 years	21	21
41 to 50 years	17	17
51 to 60 years	19	19
61 to 70 years	04	04
71 to 80 years	01	01
Gender		
Male	77	77
Female	23	23
Type of surgery		
Elective	32	32
Emergency	68	68
Pre – operative co – morbidities		
Obesity (BMI>25)	08	8
Hypertension	29	29
Pulmonary disease	4	4
Cardiovascular Disease	05	5
Diabetes mellitus	37	37
CVA/ TIA	2	2
Smoking	31	31
APGAR score		
Low score (<4)	22	22
Moderate score (5 to 7)	26	26
Good score (8 to 10)	52	52

Table 2: APGAR score distribution

Characteristics	APGAR score categories		
Age of the patients	Low score (n = 22)	Moderate score (n = 26)	Good score (n = 52)
< 20 years	01	03	11
21-30 years	01	04	18
31-40 years	02	07	12
41 – 50 years	04	06	07
51 – 60 years	10	05	04
61 – 70 years	03	01	0
71 to 80 years	01	0	0
Pre operative co – morbidities	20 (90.9%)	19 (73.07%)	26 (50%)
Post operative complications	17 (77%)	12 (46%)	02 (3.84%)

DISCUSSIONS

A simple surgical score based on estimated blood loss, lowest HR, and lowest MAP during an operation provides a meaningful estimate of patient's condition and rate of major complications and death after surgery. All 100 cases admitted in the department of general surgery at Osmania General Hospital were evaluated as described earlier in the methods and methodology. All the patients were appropriately assessed and managed according to standard guidelines for the respective disease.

77% of the surgical cases in our study were male patients. Most of the studies on the Surgical APGAR score by Gawande et al and Scott et al show a female preponderance of cases of 56% to 65% in different cohort of study.[6] However there has been no association between gender, the score and the prognosis in these studies. More than 20% of the patients were in the age group of 21 – 30 years (table 1). 59% of patients belonged to age< 40 years. The age distribution with an average of 55.3 years to 63.6 years has been noted in previous studies.[6]

Majority of the complications were noted in the age group > 50 years. 43.4% of patients (18 patients out of 41) in the age group of >40 years had low Apgar scores, whereas only 6.77% of patients (4 out of 59 patients) in the age group of <40 years had low Apgar score. 69% of patients (41 out of 59 patients) in <40 years age group had good Apgar scores. A study by Gawande et al showed significantly high rates of major complications of 16% with a mean age of 64.2 years.[7]

Hypertension, diabetes mellitus, pulmonary disease, cardiac disease, tobacco smoking and sepsis were associated with major postoperative complications in this study. Other studies show similar comorbid

conditions associated with poor prognosis.8 Some of the additional risk factors noted are ASA class> 3, underweight (BMI<18.5), open wound, weight loss > 10% in 6 months, ascites and gangrene.[7]

68% of the surgeries performed in this study were emergency in nature. 32% of the surgeries were elective in nature accounting to only 1/3th of total cases (table 3). A study on the emergency surgical admissions by Cape well et al showed that 46% to 57% of all surgical admissions are emergency in nature.[9]

The difference in surgical outcome between patients in different score groups was also statistically significant. Among the 22 patients with surgical Apgar score of <4, major complications occurred in 77% (17 out of 22 patients) and a 30 days mortality of 6% was seen. In contrast, among 52 patients with surgical Apgar score of 8-10, only 3.84% suffered from major post-operative complications. Thereby it can be safely deduced from the tabulated data that of this study that the rate of occurrence of major post-operative complications in emergency and elective general patients are higher in patients belonging to the low (<4) surgical Apgar score category as compared to those belonging to the good (8 to 10) surgical Apgar score category. Further this Surgical Apgar score is proven to be statistically significant in predicting the poor post –operative outcomes (p= 0.000018). A result with a relative risk of major complication amongst low scored operations was 16.1(95% CI, 7.7-34.0,p<0.0001), compared with those in the high scored operation was noted in the study by Atul A Gawande et al.[7]

The relative risk of predicting a major complication was significantly higher in all the subgroups of the Apgar score for emergency surgeries as compared to its elective surgeries where the statistical power was limited by the lowest scores. Study by Atul Gawande et al, showed a statistically significant result with an odds ratio of 4.8(95% CI, 2.41-9.57) for emergency procedures.[7] Other studies have shown complication rates of 43% and a mortality of 4% in emergency GIprocedures.[10]

In this regard, even the P-POSSUM has no morbidity prediction equation, as a result of the original authors' lack of confidence in the reporting of perioperative complications.[11] Subsequent studies have shown P-POSSUM to both over-predict and under-predict mortality,[12,13,14] in different settings.

The present study indicated that the older age groups had low Apgar score and hence the increased incidence of a major complication or 30 days mortality than younger population with similar low Apgar score. It was seen in that comorbidities like Hypertension, diabetes mellitus, pulmonary disease, cardiac disease, chronic renal failure smoking and sepsis were significantly associated (p< 0.001) with postoperative complications and 30 days mortality. It was evident in this study that the major complications and 30 days mortality were seen to be higher in emergency surgical groups compared with the elective surgical groups with respect to all the subcategories of Apgar score. Further study needs to be conducted on the emergency subgroups, in particular for it to be validated.

CONCLUSION

In this study, surgical Apgar score has proven to be an important tool in early prediction of development of post-operative major complications including 30 days mortality. Those who had lower Apgar score developed major post – operative complications. Patients more than 50 years and those with co - morbidities were found to be significant pre - operative factors associated with higher chances of post-operative complications.

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