ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 8, Issue – 1, January - 2025, Page No. : 126 – 139

The Utility of Surgical Apgar score in Predicting Postoperative Morbidity and Mortality in Exploratory Laparotomy Surgery

[1]Dr. Anil S Degaonkar, Associate Professor and HOD, Department of General Surgery, Dr S C GMCH, Nanded

[2]Dr Abdul R Tamboli, Assistant Professor, Department of General Surgery, Dr S C GMCH, Nanded

[3]Dr. Dipesh P Rajpal, Post Graduate, Resident, Department of General Surgery, Dr S C GMCH, Nanded

Corresponding Author: Dr. Dipesh P Rajpal, Post Graduate Resident, Department of General surgery, Dr S C GMCH, Nanded

How to citation this article: Dr. Anil S Degaonkar, Dr Abdul R Tamboli, Dr. Dipesh P Rajpal, "The Utility of Surgical Apgar Score in Predicting Postoperative Morbidity and Mortality in Exploratory Laparotomy Surgery", IJMACR- January - 2025, Volume – 8, Issue - 1, P. No. 126 – 139.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: The Surgical Apgar Score (SAS) is a simple rating system using readily available intraoperative information predicting the patient's risk for a major complication. It was derived from the intraoperative data to predict morbidity and mortality outcomes after general surgery.

Aims and Objective: To determine the applicability of the Surgical Apgar Score (SAS) in post-operative risk stratification for morbidity and mortality

Primary objectives: To assess the utility of the score in predicting post-operative mortality and morbidity in Elective and Emergency Laparotomy Procedures.

Secondary objective: To assess the use of the surgical Apgar score in postoperative care.

Material and Methods

Study Design: A Prospective observational study.

Study Site: The study will be conducted in the surgery ward in a tertiary health care centre.

Study Population: This study consists of the patient admitted to the surgical ward at the tertiary care Centre to be operated on for elective and emergency exploratory laparotomy.

Study Duration: The study was done between 1st January 2023 to 31st June 2024.

Sampling Method: The sample size is determined by the Complete Enumeration method.

Sample Size: The sample size of 100 patients were included in the study.

Result: 100 patients were operated as an emergency and 66% of the patients are male and 34% are female. SAS scores in this range underwent emergency surgery. This suggests that patients requiring urgent, unplanned

surgical interventions are more likely to experience poorer intraoperative physiological conditions.

Discussion: Purpose of this work is to establish the usage of the Surgical Apgar Score in the stratification of the post-operative risks for patients undergoing laparotomy.

Keywords: Blood Loss, Laparotomy, Peritonitis, Surgical Apgar Score, Surgical Practice.

Introduction

Exploratory laparotomy is a major surgical procedure with inherent risks of postoperative morbidity and mortality. Identifying patients at risk for these complications is crucial for optimizing patient care and allocating resources effectively. The Surgical Apgar Score (SAS) has emerged as a simple and readily available tool to predict postoperative outcomes in various surgical procedures, including exploratory laparotomy. This score objectively assesses 3 key physiological parameters at the end of surgery: lowest heart rate measured intraoperatively, lowest mean arterial pressure measured intraoperatively and estimated blood loss at the end of surgery.

Overall, research on the utility of the Surgical Apgar Score in exploratory laparotomy surgery has significant clinical and research potential. It holds the promise to improve patient care, advance surgical practice, and optimize resource allocation in the healthcare system.

Aims and Objectives

To determine the applicability of the Surgical Apgar Score (SAS) in post-operative risk stratification for morbidity and mortality

Primary objectives

To assess the utility of the score in predicting post-operative mortality and morbidity in Elective and Emergency Laparotomy Procedures.

Secondary objective

To assess the use of the surgical Apgar score in postoperative care.

Material and Methods

Study Design: A Prospective observational study.

Study Site: The study will be conducted in the surgery ward in a tertiary health care centre.

Study Population: This study consists of the patient admitted to the surgical ward at the tertiary care Centre to be operated on for elective and emergency exploratory laparotomy.

Study Duration: The study was done between 1st January 2023 to 31st June 2024.

Sampling Method: The sample size is determined by the Complete Enumeration method.

Sample Size

$N = [Z^2_{1-\alpha/2} P (1-P)/d^2]$

Where $\alpha = 0.05$, $P=0.07$ AND $d = 5\%$

P is the prevalence of Complication. (Ref Rajat Chaudhary)

$q = 1 - P$

$= 1 - 0.07$

$= 0.93$

$d = 5\%$ Absolute Precision

$n = 4 \times 0.07 \times 0.93 / (0.025)$

$= 104.0$

The sample size is equal to 104.0 and a round off of 100 patients were included in the study.

Study Tool: All the cases available during the study period are considered and studied with consideration of exclusion and inclusion criteria, All the relevant information will be recorded in case record form (CRF).

Inclusion Criteria

1. All adult (aged >18 years) patients presenting to the department of general surgery and undergoing both

elective and emergency Laparotomy surgeries were included in the study after taking adequate informed consent.

2. Patients undergoing surgery under general anaesthesia or spinal anaesthesia were included.

Exclusion Criteria

1. Patients with polytrauma requiring any other surgical procedure apart from or in addition to Exploratory laparotomy.
2. Patients undergoing surgery under local anaesthesia or peripheral nerve blocks.
3. Patients discharged against medical advice.
4. Patients who refused to give consent.
5. Patients whose 30-day follow-up could not be completed.

Statistical analysis:

- Data will be recorded in a predesigned case record form compiled in Microsoft Excel version 2018 and analysed.
- Descriptive statistics for quantitative variables will be represented as mean +/- SD.
- Qualitative variables will be represented as frequency & percentages.
- Fisher test or Chi-square test will be used to test the association of columns and rows in tabular data, in the case of qualitative, categorical data.
- Pearson or Spearman correlation will be done, depending on the normality of the distribution, to evaluate the correlation of any variable.
- Graphical representations will be done wherever applicable. The level of significance will be considered as $P < 0.05$.

Result

Table 1: Age-wise distribution of patients

Sn.	Age Groups	Frequency (N=100)	Percentage (%)
1	<50	56	56
2	>50	44	44
	Total	100	100.0

Table 1 shows that 56 (56%) patients were from the age group of <50 years, while 44 (44%) were from the age of >50 years. The median age of all patients was 45 years the minimum and maximum ages were 18 and 80 years and the standard deviation was ±15.73.

Figure 1: Age-wise distribution of patients.

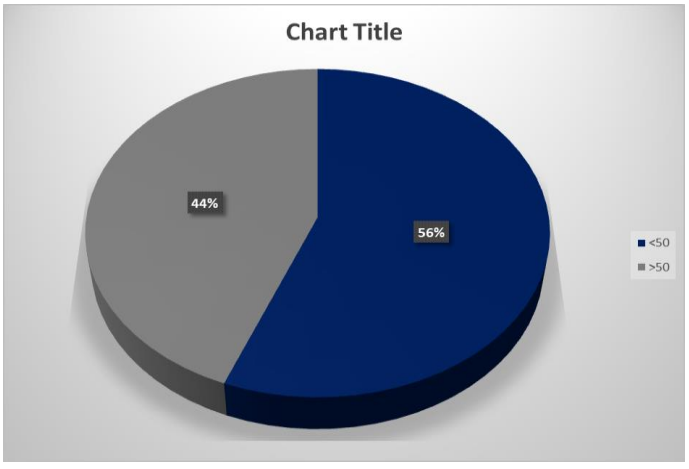


Table 2: Gender-wise distribution of patients

Sr No	Education	Frequency (N=100)	Percentage (%)
1	Male	66	66%
2	Female	34	34%
	Total	100	100%

This table shows the distribution of patients by gender. There are a total of 100 patients in the sample. 66% of the patients are male and 34% are female. The table also shows the frequency and percentage of patients for each gender.

Figure 2: Gender-wise distribution of patients

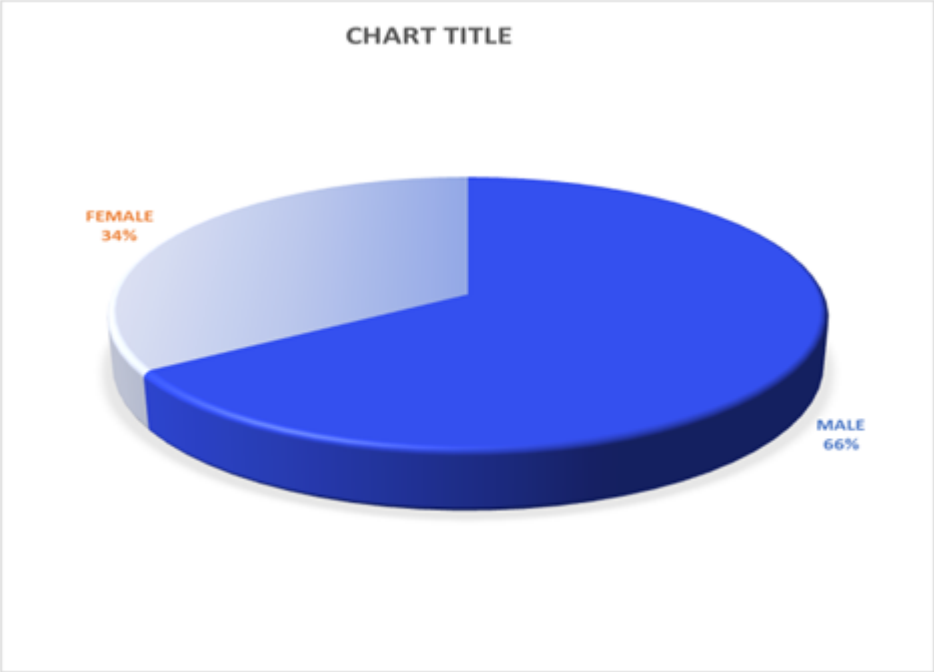


Table 3: Operative baseline characteristics for the study population

Characteristics	Mean	Median	Standard deviation	Minimum	Maximum
Lowest Heart Rate	75	78	7.4	60	88
Lowest Mean Arterial Pressure	81	80.8	10.7	53	96
Estimated Blood Loss	232	200	240	50	1500

This table summarizes the baseline characteristics of the study population undergoing surgery, focusing on 3 key parameters: lowest intraoperative heart rate, lowest intraoperative mean arterial pressure and Estimated blood loss.

Figure 3: Comparison of patient characteristics

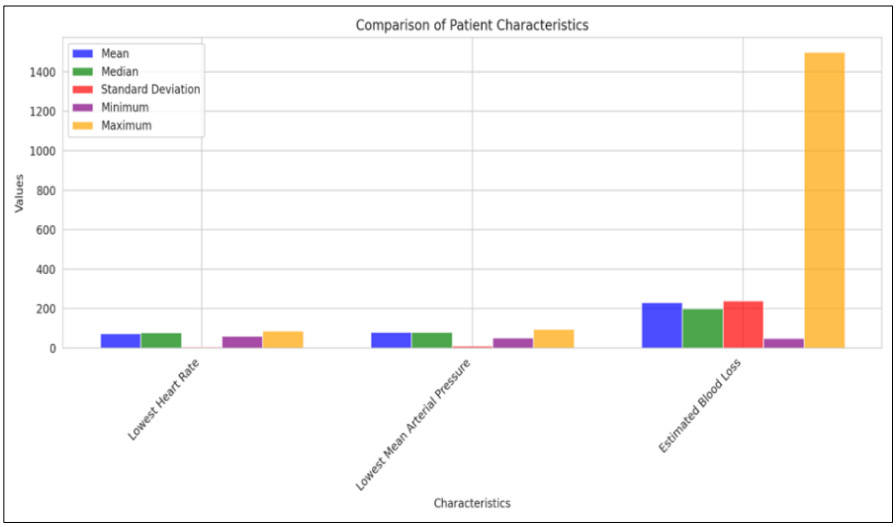


Table 4: Comparison of Surgical Apgar Score with Post-operative complications (Mortality and morbidity)

SAS	Complications		Total	P-Value
	Present	Absent		
0-4	9	0	9	<0.0001
5-8	28	51	79	
9-10	1	11	12	
Total	38	62	100	

This table shows the association between the Surgical Apgar Score (SAS) and the presence of post-operative complications, including both mortality and morbidity, in the study population.

Figure 4: Comparison of Surgical Apgar Score with Post-Operative Complications.

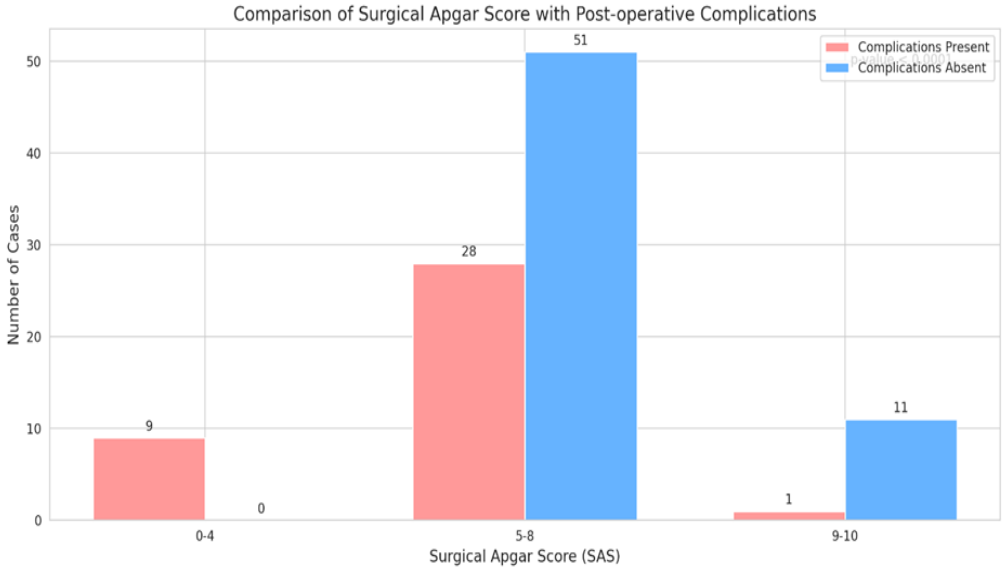


Table 5: Comparison of Surgical Apgar Score with type of surgical procedure (Elective/ Emergency)

SAS	Type of Procedure		Total	P-Value
	Elective	Emergency		
0-4	1	8	9	>0.05
5-8	22	57	79	
9-10	03	09	12	
Total	26	74	100	

Chi-Square value: 1.183, df: 2

Figure 5: Surgical Apgar Score with type of surgical procedure:

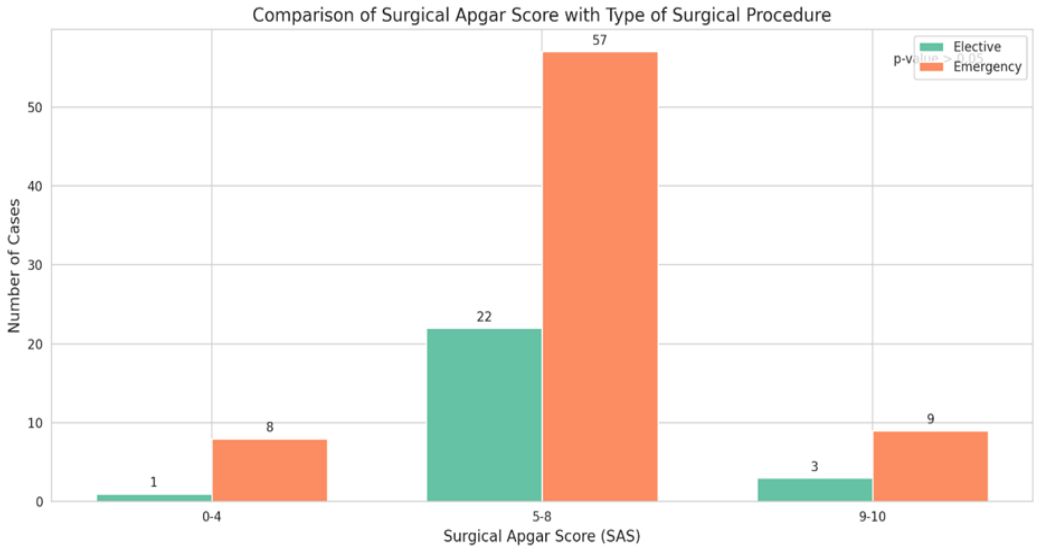


Table 6: Distribution of patients with diabetic mellites status

Sn.	Diabetes Mellites	Frequency (N=100)	Percentage (%)
1	Present	20	20%
2	Absent	80	80%
	Total	100	100%

This table shows the distribution of patients based on their diabetic mellitus status. There are a total of 100 patients in the sample. 20% of the patients have diabetic mellites and 80% do not. The table also shows the frequency and percentage of patients for each diabetic mellitus status.

Figure 6: Distribution of patients with diabetic mellites status

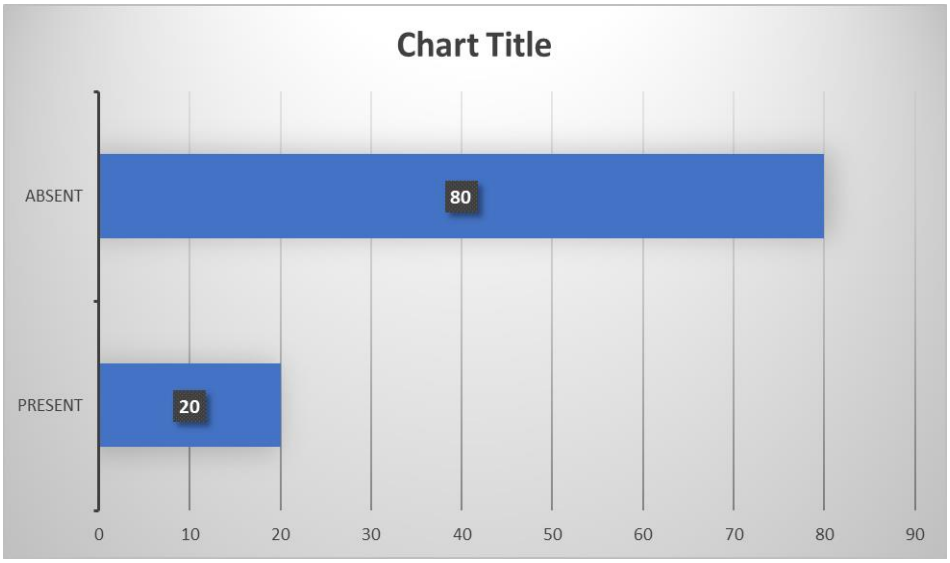


Table 7: Distribution of patients with Alcohol consumption status

Sn.	Alcohol consumption status	Frequency (N=100)	Percentage (%)
1	Present	11	11%
2	Absent	89	89%
	Total	100	100%

This table shows the distribution of patients in the sample based on their alcohol consumption status. There are a total of 100 patients, and: 11% of the patients consume alcohol. 89% of the patients do not consume alcohol.

The table also provides the frequency and percentage of patients for each alcohol consumption status category. This makes it easier to visually compare the distribution and see that the vast majority of patients do not consume alcohol.

Figure 7: Distribution of patients with Alcohol consumption status

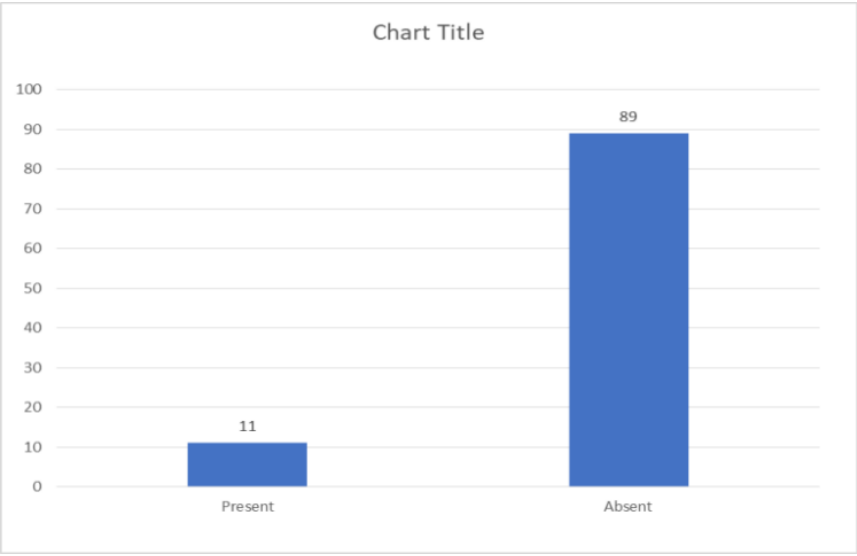


Table 8: Distribution of patients with drug abuse status

Sn.	Drug Abuse status	Frequency(N=100)	Percentage (%)
1	Present	04	4
2	Absent	96	96
	Total	100	100.0

This table shows the distribution of patients in the sample based on their drug abuse status. There are a total of 100 patients, and: 4% of the patients have drug abuse. 96% of the patients do not have drug abuse. The table also provides the frequency and percentage of patients for each drug abuse status category. This makes it easier to visually compare the distribution and see that the vast majority of patients do not have drug abuse.

Figure 8: Distribution of patients with drug abuse status.

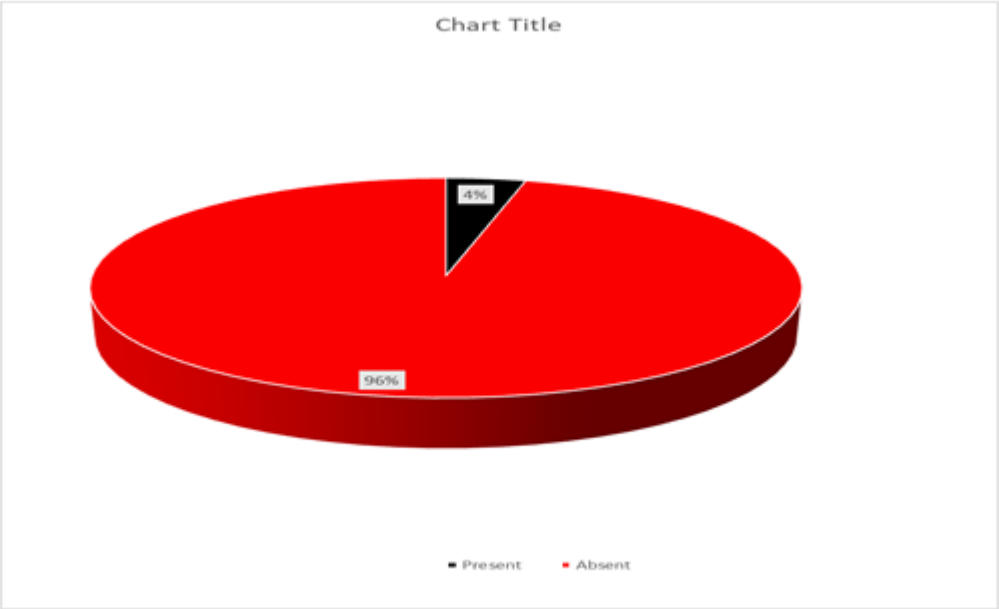


Table 9: Distribution of patients done with previous surgery.

Sr No	H/ o Previous Surgery	Frequency (N=100)	Percentage (%)
1	Present	20	20
2	Absent	80	80
	Total	100	100.0

This table shows the distribution of patients based on whether they have undergone any previous surgery. There are a total of 100 patients in the sample. 20% of the patients have had a previous surgery, while 80% have not. The table also provides the frequency and percentage of patients for each category of previous surgery history.

Figure 9: Distribution of patients with H/o previous surgery.

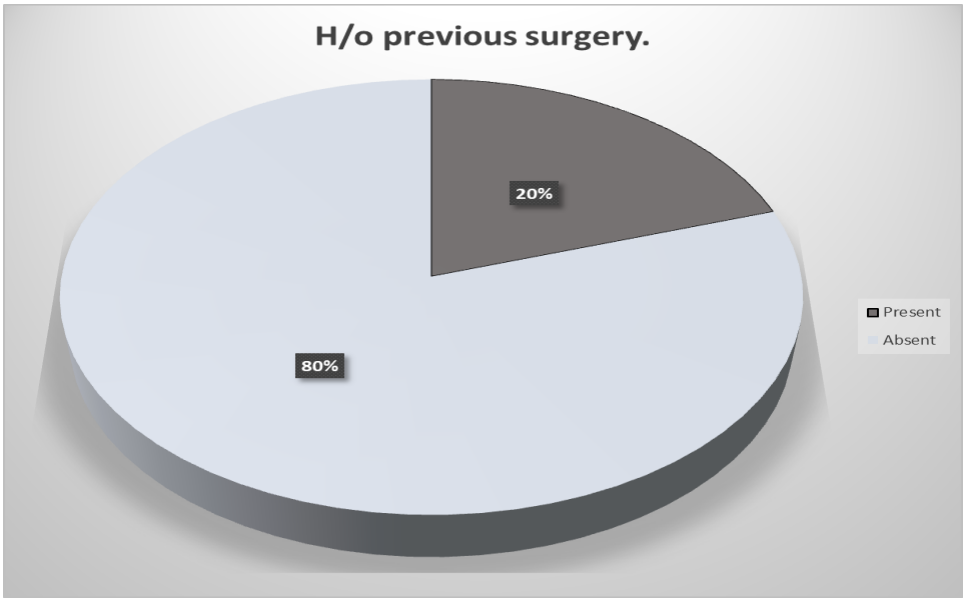


Table 10: Distribution of patients with Complications

Sn.	Complications	Frequency (N=100)	Percentage (%)
1	Present	38	38%
2	Absent	62	62%
	Total	100	100%

This table shows the distribution of patients based on whether they have any complications. There are a total of 100 patients in the sample. 38% of the patients have complications, while 62% do not. The table also provides the frequency and percentage of patients for each category of complications presence.

Figure 10: Distribution of patients with Complications

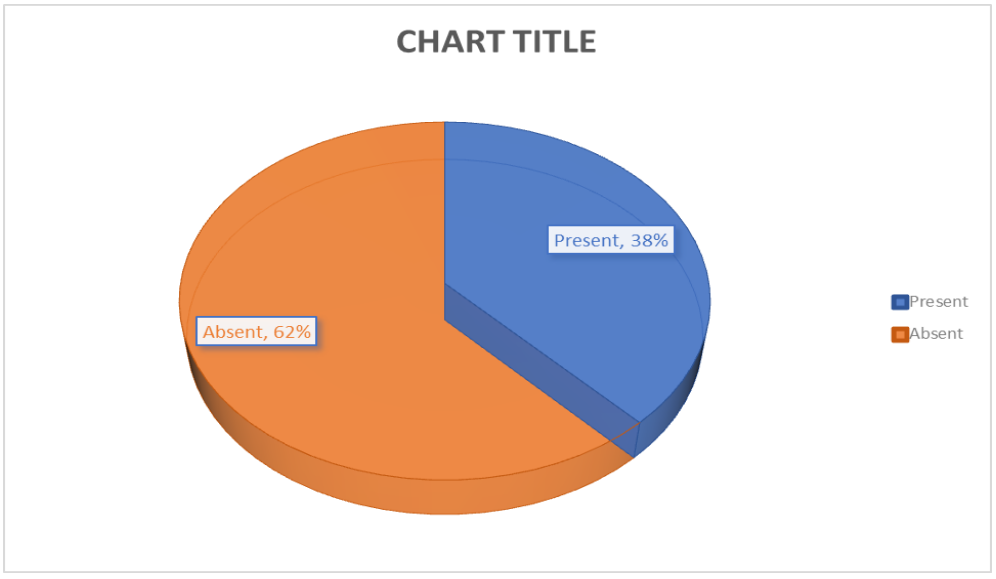


Table 11: Population baseline characteristics Show the presence or absence of comorbidities among the study samples.

Comorbidities	Total sample size=100		Post-Operative Complication rate	P- Value
	No of patients	percentage		
Diabetes Mellites	20	20%	12 (60%)	<0.05
Hypertension	25	25%	11 (44%)	>0.05
IHD	4	4%	02 (50%)	>0.05
Stroke	1	1%	0	>0.05
TB	2	2%	0	>0.05
Asthma	1	1%	0	>0.05
COPD	2	2%	02 (100%)	<0.05
Smoking	13	13%	07 (54%)	<0.05
Alcohol	11	11%	05 (45%)	<0.05
Drug Abuse	4	4%	01 (25%)	>0.05
Hypothyroidism	3	3%	01 (33%)	>0.05
Prev Surgery	20	20%	08 (40%)	>0.05
Renal Failure	2	2%	01 (50%)	>0.05

Figure 11: Comorbidities in study population

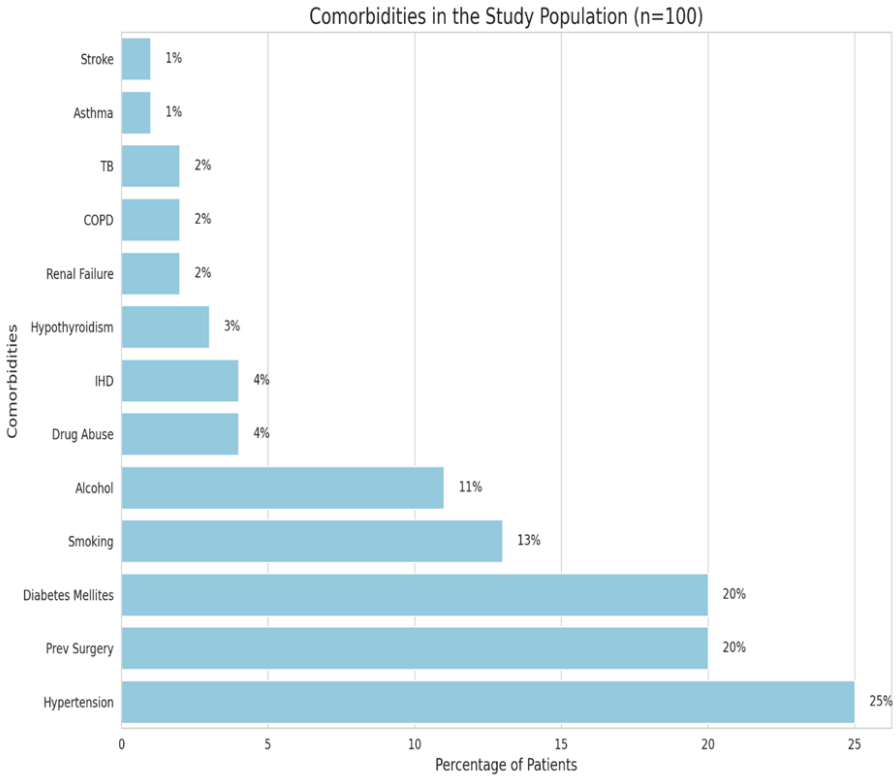
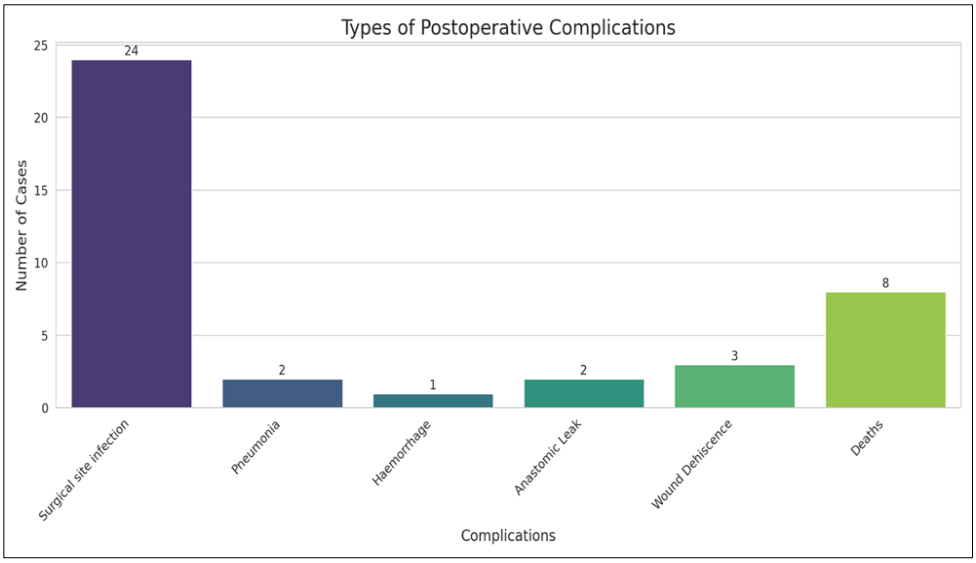


Table 12: Types of Postoperative Complications

Sn.	Complications	In Number
1	Surgical site infection	24
2	Pneumonia	2
3	Haemorrhage	1
4	Anastomotic Leak	2
5	Wound Dehiscence	3
6	Deaths	8

This table provides a breakdown of the different types of postoperative complications experienced by the study population. It lists each complication and the number of patients who encountered it.

Figure 12: Types of Postoperative Complications



Discussion

The key purpose of this work is to establish the usage of the Surgical Apgar Score in the stratification of the post-operative risks for patients undergoing laparotomy.

A predominantly young patient population was observed, with 56% of participants under 50 years old. This aligns with similar findings from previous studies where the majority of patients fell within the same age range.

The standard deviation of 15.73 years indicates some within-group variability, consistent with findings that reported a similar degree of variation in the young patient population studied.

In our study the most common reason for laparotomy is perforation peritonitis. This is 16% of the overall cause of laparotomy. The second and third common cause of laparotomy in our study was Intestinal obstruction (13%) and penetrating abdominal injury (12%).

This study investigated the association between pre-existing comorbidities and post-operative complications in 100 patients undergoing exploratory laparotomy. While several comorbidities were present, statistically significant associations with complications were observed only for DM, smoking, alcohol consumption, and COPD.

In a healthcare setting where only limited resources are available, SAS score would guide us in planning and managing the limited resources towards the postsurgical management, monitoring and follow up of deserving high risk patients. This would thereby prevent the wastage of resources in monitoring of low-risk patients where it is actually not needed.

Conclusion

- The analysis reveals a strong association between low SAS scores (0-4) and the presence of postoperative complications, suggesting its potential as a predictor for patients with poor intraoperative physiological conditions.
- A significant but lower association between moderate SAS scores (5-8) and complications highlights the increased risk even in apparently "moderate" cases.
- A minimal no. of complications in patients with high SAS scores (9-10) indicates a low risk associated with excellent intraoperative physiological state.
- This trend underscores the potential value of SAS as a risk stratification tool, allowing for tailored postoperative care and monitoring strategies to improve outcomes and patient safety.
- High-risk SAS scores (0-4) are exclusively associated with emergency procedures, suggesting poorer intraoperative conditions in urgent, unplanned surgeries. The data reveals a strong and statistically significant association between low SAS with emergency surgeries but no statistically significant association between SAS and procedure type due to a smaller number of elective cases compared to emergency surgeries.

References

1. Gawande AA, Studdert DM, Orav EJ, Brennan TA. The Surgical Apgar score: a simple, objective tool to improve operating room performance. J Am Coll Surg. 2003;196(1):10-5.
2. Srivastava N, Bagawan MB. Surgical Apgar Score: Utility in Predicting Postoperative Outcome in Cases of Exploratory Laparotomy. J Pharm Res Int. 2022;34(16A):50-64.
3. Gupta S, Saxena A, Singh G, Sharma P. Surg APGAR Scores Predict Complications After Emergency General Surgery Laparotomy. Indian J Surg. 2019;81(Supply 2):524-528.
4. Gupta A, Gupta A, Singh G. The Reliability of Surgical Apgar Score in Predicting Immediate and Late Postoperative Morbidity and Mortality: A Narrative Review. Cureus. 2018;10(2): e2027.
5. Hannan MA, Shahab A, Khan N, Khan AM. The utility of surgical Apgar score in predicting postoperative morbidity and mortality in general surgery. Cureus. 2022;14(6): e25720.
6. Wong CJ, Ho CM, Ng SS, et al. Surgical Apgar score and its predictive value of postoperative complications in colorectal surgery: a prospective observational study. World J Surg. 2009;33(5):987-92.
7. Khuri SF, Daley J, Henderson WG, et al. A prospective evaluation of the surgical Apgar score in patients undergoing vascular surgery. J Vasc Surg. 2009;49(2):498-504.
8. Koller MT, Caputo TA, Ferraris VA, et al. Validation of the surgical Apgar score in cardiac surgery patients. Ann Thorax Surg. 2007;84(3):894-900.

9. Edwards MJ, Gupta RL, Mayer G, et al. Revised surgical Apgar score for prediction of postoperative outcomes in general surgical patients. Ann Surg. 2010;252(1):15-20.
10. van der Worp HB, van der Voort PH, Kalkman CJ, et al. The modified surgical Apgar score predicts postoperative complications after major open abdominal surgery: a prospective observational cohort study. Ann Surg. 2011;253(5):834-41.
11. Gentilello LM, Jurkovich GJ, Rivara FP, MacKenzie EJ. The trauma score: a re-evaluation. J Trauma. 1995;38(5):709-14.
12. Choudhari R, Bhat R, Prasad K, Vyas B, Rao H, Bhat S. The utility of surgical Apgar score in predicting postoperative morbidity and mortality in general surgery. Turkish Journal of Surgery. 2022 Sep;38(3):266.
13. Ernst L, Kümmecke AM, Zieglowski L, Liu W, Schulz M, Czigany Z, Tolba RH. Implementation of the Surgical Apgar Score in Laboratory Animal Science: A Showcase Pilot Study in a Porcine Model and a Review of the Literature. European Surgical Research. 2023 Mar 23;64(1):54-64.
14. Hino H, Hagihira S, Maru N, Utsumi T, Matsui H, Taniguchi Y, Saito T, Murakawa T. The surgical Apgar score predicts postoperative complications and survival in lung cancer patients. Surgery Today. 2023 Mar 24:1-9.
15. Nagoya A, Kanzaki R, Kimura K, Fukui E, Kanou T, Ose N, Funaki S, Minami M, Fujii M, Shintani Y. Utility of the surgical Apgar score for predicting the short-and long-term outcomes in non-small-cell lung cancer patients who undergo surgery. Interactive Cardiovascular and Thoracic Surgery. 2022 Aug 1;35(2): ivac150.
16. Sugimoto A, Fukuoka T, Nagahara H, Shibutani M, Iseki Y, Sasaki M, Okazaki Y, Maeda K, Ohira M. The impact of the surgical Apgar score on oncological outcomes in patients with colorectal cancer: a propensity score-matched study. World Journal of Surgical Oncology. 2022 Mar 10;20(1):75.
17. Shibao, Y., Miura, K., Koda, M., Asada, T., Sato, K., Eto, F., Kono, M., Mataki, K., Kumagai, H., Nagashima, K. and Noguchi, H., 2022. Surgical Apgar score is significantly useful as a predictor of major complications after thoracic spinal surgery: a retrospective cohort study.
18. Muhammad S, Sheshe AA, Naaya HU, Suleiman IE, Bello UM. Predicting Major Complications Following Laparotomy for Gastrointestinal Conditions Using Surgical Apgar Score: A Prospective Analysis in a Nigerian Population. J West Afr Coll Surg. 2022 Jul-Sep;12(3):24-29. doi: 10.4103/jwas.jwas_92_22. Epub 2022 Oct 6. PMID: 36388736; PMCID: PMC9641734.
19. Onen BC, Semulimi AW, Bongomin F, Olum R, Kurigamba G, Mbiine R, Kituuka O. Surgical Apgar score as a predictor of outcomes in patients following laparotomy at Mulago National Referral Hospital, Uganda: a prospective cohort study. BMC surgery. 2022 Dec;22(1):1-2.
20. Yakar MN, Polat C, Akkılıç M, Yeşildal K, Yakar ND, Turgut N. Use of a modified surgical APGAR score for prediction of postoperative complications in emergency surgery: An observational retrospective study. Turkish Journal of Trauma & Emergency Surgery/Ulusal Travma ve Acil Cerrahi Dergisi. 2022 May 1;28(5).

21. Sehgal S, Ravishankar N, Raghupathi DS, Kotekar N. Can the surgical Apgar score predict morbidity and mortality in general surgery? International Surgery Journal. 2019 Apr 29;6(5):1481-6.
22. Singh K, Hariharan S. Detecting major complications and death after emergency abdominal surgery using the surgical Apgar score: A retrospective analysis in a Caribbean setting. Turkish Journal of Anaesthesiology and Reanimation. 2019 Apr;47(2):128.
23. Cho YW, Park SE, Shin YJ, Lee JM, Han IS, Lee HK, Huh IY. The relationship between the surgical Apgar score and postoperative complications in patients admitted to an intensive care unit after surgery. Anaesthesia and Pain Medicine. 2019 Jul 31;14(3):356-63.
24. Rajgopal V, Kulkarni SV. Efficacy of the surgical Apgar score in predicting post-operative morbidity and mortality in patients undergoing laparotomy. International Surgery Journal. 2019 Jul 25;6(8):2791-6.
25. Goel N, Manstein SM, Ward WH, DeMora L, Smaldone MC, Farma JM, Uzzo RG, Esnaola NF. Does the Surgical Apgar Score predict serious complications after elective major cancer surgery? Journal of Surgical Research. 2018 Nov 1; 231:242-7.
26. Giugliano DN, Morgan A, Palazzo F, Leiby BE, Evans NR, Rosato EL, Berger AC. Surgical Apgar score (SAS) predicts perioperative morbidity, mortality, and length of stay in patients undergoing esophagectomy at a high-volume centre. Journal of Surgical Oncology. 2017 Sep;116(3):359-64.
27. Masi A, Amodeo S, Hatzaras I, Pinna A, Rosman AS, Cohen S, Saunders JK, Berman R, Newman E, Ballantyne GH, Pachter LH. Use of the surgical Apgar score to enhance Veterans Affairs Surgical Quality Improvement Program surgical risk assessment in veterans undergoing major intra-abdominal surgery. The American Journal of Surgery. 2017 Apr 1;213(4):696-705.
28. Ngarambe C, Smart BJ, Nagarajan N, Rickard J. Validation of the Surgical Apgar Score after laparotomy at a tertiary referral hospital in Rwanda. World Journal of Surgery. 2017 Jul; 41:1734-42.
29. Clark RM, Lee MS, Rauh-Hain JA, Hall T, Boruta DM, Del Carmen MG, Goodman A, Schorge JO, Growdon WB. Surgical Apgar Score and prediction of morbidity in women undergoing hysterectomy for malignancy. Gynaecologic oncology. 2015 Mar 1;136(3):516-20.
30. Baltazar GA, Darnauer T, Akella K, Kanitsch S, Shafey A, Chandrasekhar A. Surgical Apgar Score Predicts Postoperative Length of Stay Better Than American Society of Anaesthesiologists Classification. The Internet Journal of Surgery. 2014;32(1).
31. Varadkar PS, Neal KR, Jones DR, et al. (2005). Prevalence and outcome of previous surgery in patients undergoing emergency laparotomy. Br J Surg 92(12):1506-1510.
32. Devereaux PJ, Yang H, Kellum JA, et al. (2013). Acute kidney injury after abdominal surgery: a contemporary meta-analysis. Crit Care Med 41(10):2605-2615.
33. Afsar N, Uçkun H, Özcan A, et al. (2015). Prevalence and predictors of postoperative acute kidney injury following major abdominal surgery. World J Emerg Surg 10:5.