ORIGINAL ARTICLE

"SURGICAL APGAR SCORE: UTILITY IN PREDICTING POSTOPERATIVE OUTCOME IN CASES OF EXPLORATORY LAPAROTOMY"

ABSTRACT

AIMS AND OBJECTIVE: The aim of this study is to correlate SURGICAL APGAR score in predicting post-operative mortality and morbidity.

MATERIALS AND METHOD: This was a prospective study. All patients fulfilling the inclusion criteria in Krishna institute of medical sciences karad were included in the study which was conducted from December 2019 to July 2021. All patients undergoing exploratory laparotomy were scored according to surgical Apgar scoring system and their score was correlated with post-operative outcome.

RESULT: In our study, the mean surgical Apgar score among study subjects was 4.68 ±1.67. Majority of the study subjects had surgical APGAR score between 5 to 6 (51.43%), followed by 3 to 4 (28.57%). The p<0.0001 is highly significant in our study. Statistically significant results were seen in the score groups, with score groups of 0-2 showing 7.14%, 3-4 with 2.85%, 5-6 with 1.42%, 7-10 with 0% mortality.

CONCLUSION: From the study it was concluded that SURGICAL APGAR score is an excellent predictor of post operative outcomes in regard to complications and mortality

KEYWORDS: APGAR, EXPLORATORY LAPAROTOMY, MORBIDITY, MORTALITY

INTRODUCTION

The prediction of complications is an essential part of risk management in surgical practice .Surgeons and health care units consistently make efforts to lower the occurrence of any complications to a patient undergoing any procedure. Early recognition of patients at high risk of developing postoperative outcomes will substantially post-operative management of patients. Variability in outcome due to difference in preoperative risk factors is inevitable but intraoperative response of the body in terms of vital parameters like heart rate, blood pressure, blood loss, tissue perfusion, etc. have a major influence on post-operative outcome [2]. Therefore the ideal model to predict complications in surgical patients should be simple, readily available and it should properly define the complications, accurately estimate their incidence and have a low threshold to detect them.

With evolution of monitoring techniques there is wide range of scoring systems available like Acute Physiology Age Chronic Health Evaluation II (APACHE score) or Physiological and operative severity score for predicting Mortality and Morbidity(POSSUM) or TRIOS(Three days Recalibrated ICU Outcome Score). However those require a huge amount of data collection and rely on laboratories which makes them more vulnerable to errors.[4][6]

A ten point Surgical APGAR score provides surgeons with a simple, objective and readily available data to predict post operative outcomes. Surgical APGAR Score (SAS) uses 3 parameters lowest heart rate, lowest mean arterial pressure and Estimated blood loss.
A score built from those three parameters has proved to be a strong predictor of postoperative outcomes of the patient and due to its availability, inexpensively collectable data and low reliance on technological capacity and resource of the health care centre it is a simple and powerful tool, for assessing risk of post-operative outcomes. Since its introduction capability of surgical apgar score in predicting post operative outcomes after different kinds of surgeries and even in predicting outcomes after ICU admissions has been correlated, most of the studies found surgical apgar score to be a strong predictor of the outcomes.[1,2,8,9,10]
 In this study we will study the ability of Surgical APGAR score in predicting post-operative outcome in cases of exploratory laparotomy, without any other additional expenditure for the

patient. It is bedside clinical scoring system as far as surgical outcome of the patient is concerned.

MATERIALS AND METHODS

SOURCE OF DATA

This is a prospective study. All patients fulfilled inclusion criteria undergoing elective and emergency exploratory laparotomy in Krishna Hospital & Medical Research Centre, Karad will be included in the study between December 2019 to June 2021.

METHOD OF COLLECTION OF DATA

Inclusion Criteria

- Patients undergoing exploratory laparotomy under General, Spinal &Epidural Anesthesia will be included in this study.
- both emergency and elective cases are included
- age>16 years and <70years

Exclusion criteria:

1. Age less than 16 years and more than 70 years

2. Endoscopic procedures converted to open.

3. Surgeries under local anesthesia not requiring intensive monitoring and regular follow-ups

.

SAMPLE SIZE

Sample size n= Z^2Pq/L

70 Patients with inclusion criteria operated at department of surgery will be studied from DECEMER 2019 to JUNE 2021 (18Months)

METHODS OF COLLECTION OF DATA

70 randomly selected patients undergoing either emergency or elective exploratory laparotomy admitted in surgical ward in Krishna institute of medical sciences karad

Using LOWEST MEAN ARTERIAL PRESSURE, ESTIMATED BLOOD LOSS and LOWEST HEART RATE during the surgical procedure, the surgical Apgar score is calculated.

The 10-point surgical Apgar score will be as follows:

	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

(Any bradyarrhythmia which includes sinus arrest, atrio-ventricular block or dissociation, junctional and asystole, also receives 0 points for lowest heart rate)

Score is categorized into 0-2,3-4,5-6,7-8,9-10 for simplicity data such as lowest heart rate and lowest mean arterial pressures are noted intra operatively and collected from the anesthesiologists records(manual /electronic).

Estimated blood loss is calculated using the formulae 5

$$BLn = [(EBV \times (Hi - Hf)) / ((Hi + Hf)/2)] + (500 \times Tu)$$

Where:

(1) Estimated blood volume (EBV) is assumed to be 70 cm3/kg;

(2)   Hi and Hf represent pre and post-operative hemoglobin

Tu is the sum of autologous whole blood (AWB), packed red blood cells (PRBC), and cell saver (CS) units (FFP, cryoprecipitate) transfused.
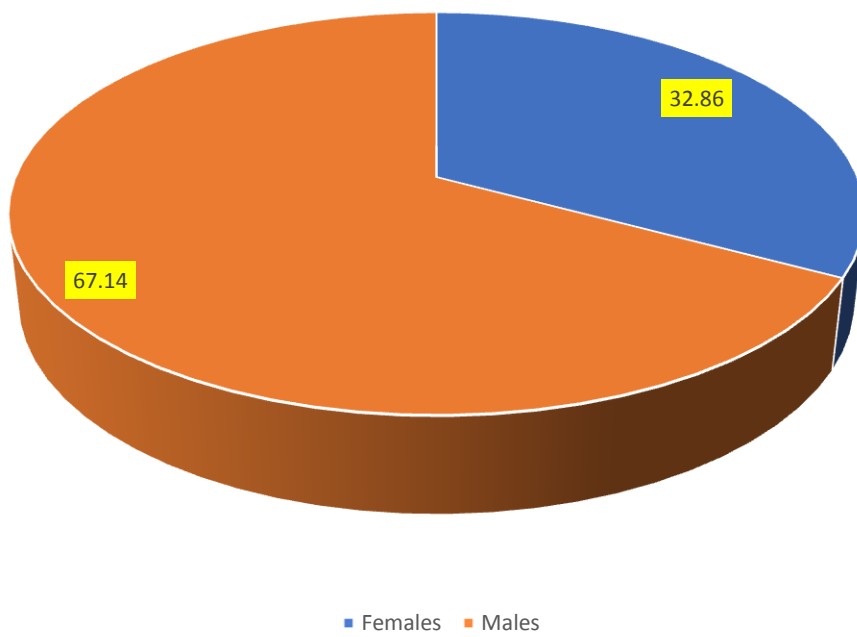
RESULTS

Gender distribution

In the present study we assessed the gender wise distribution among the study subjects. We observed that majority of the study subjects were males (67.14%). The male: female ration in the current study was Table 1.

Gender distribution	Number of subjects	Percentage
Females	23	32.86
Males	47	67.14
Total	70	100.00

figure 1.Genderwise distribution

32.86

67.14

■ Females ■ Males

Age distribution

In the present study we assessed the Age distribution among the study subjects. We observed that majority of the subjects belonged to the age group of 56 to 65 years (25.71%), followed by 26 to 35 years (21.43%). The mean age of the study subjects was 47.34 ± 14.86 years.

Table 2.

Age distribution	Number of subjects	Percentage
Less than 25 years	5	7.14
26 to 35 years	15	21.43
36 to 45 years	13	18.57
46 to 55 years	12	17.14
56 to 65 years	18	25.71
More than 65 years	7	10.00
Total	70	100.00

figure 2.Age distribution
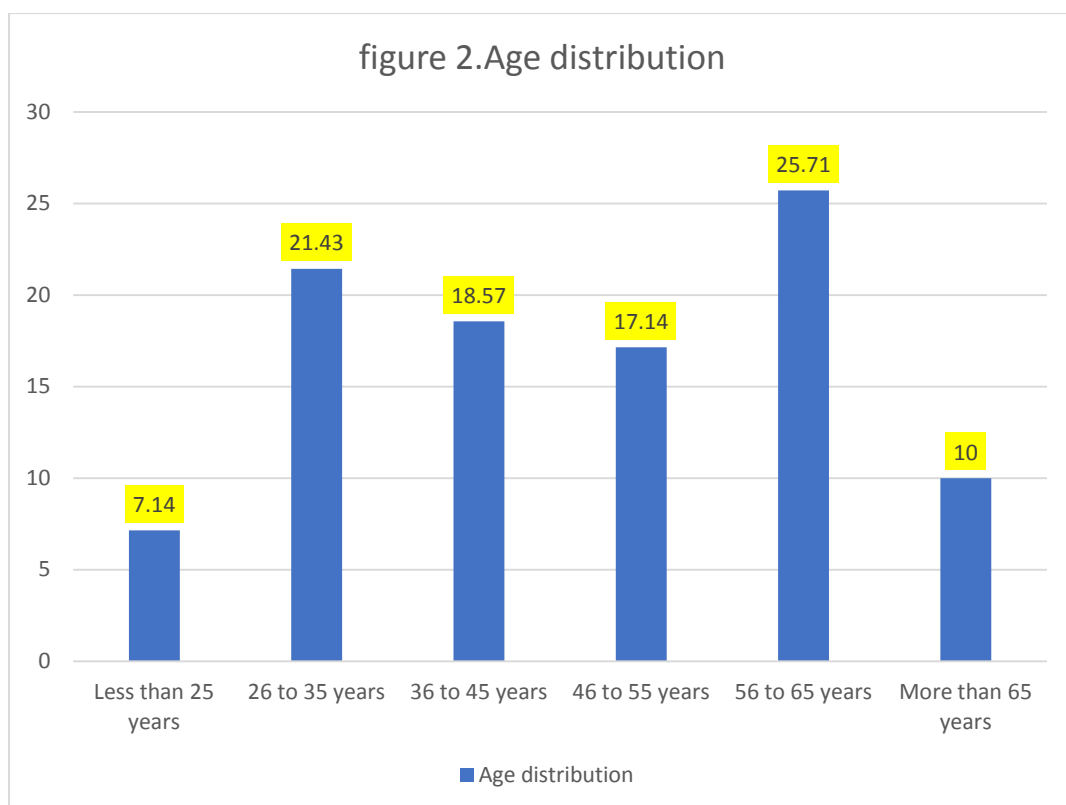
Previous history of Hypertension

In the present study we assessed the previous history of Hypertension among the study subjects. We observed that 15.71% subjects had previous history of Hypertension.

Table 3

Previous history of Hypertension	Number of subjects	Percentage
No	59	84.29
Yes	11	15.71
Total	70	100.00

Previous history of DM

In the present study we assessed the previous history of DM among the study subjects. We observed that 15.71% subjects had previous history of DM.

Table 4

Previous history of DM	Number of subjects	Percentage
No	59	84.29
Yes	11	15.71
Total	70	100.00

Previous history of CARDIAC DISEASE

In the present study we assessed the previous history of CARDIAC DISEASE among the study subjects. We observed that 1.43% subjects had previous history of CARDIAC DISEASE
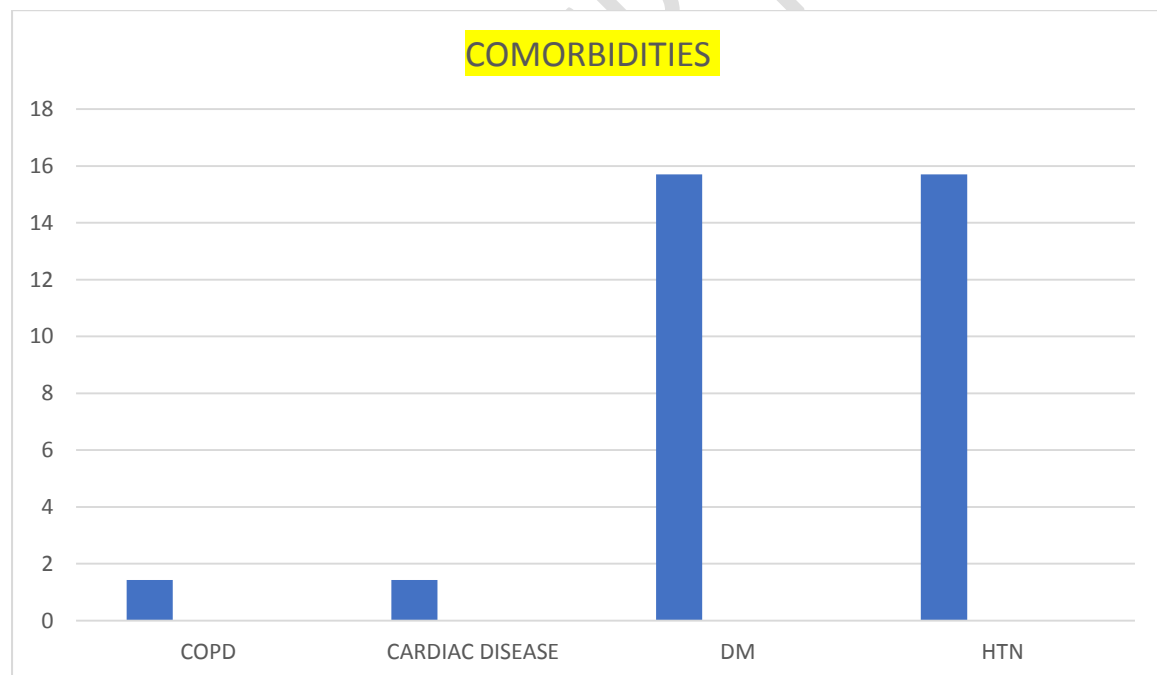
Table 5

Previous history of CARDIAC DISEASE	Number of subjects	Percentage
No	69	98.57
Yes	1	1.43
Total	70	100.00

Previous history of COPD

In the present study we assessed the previous history of COPD among the study subjects. We observed that 1.43% subjects had previous history of COPD

Table 6

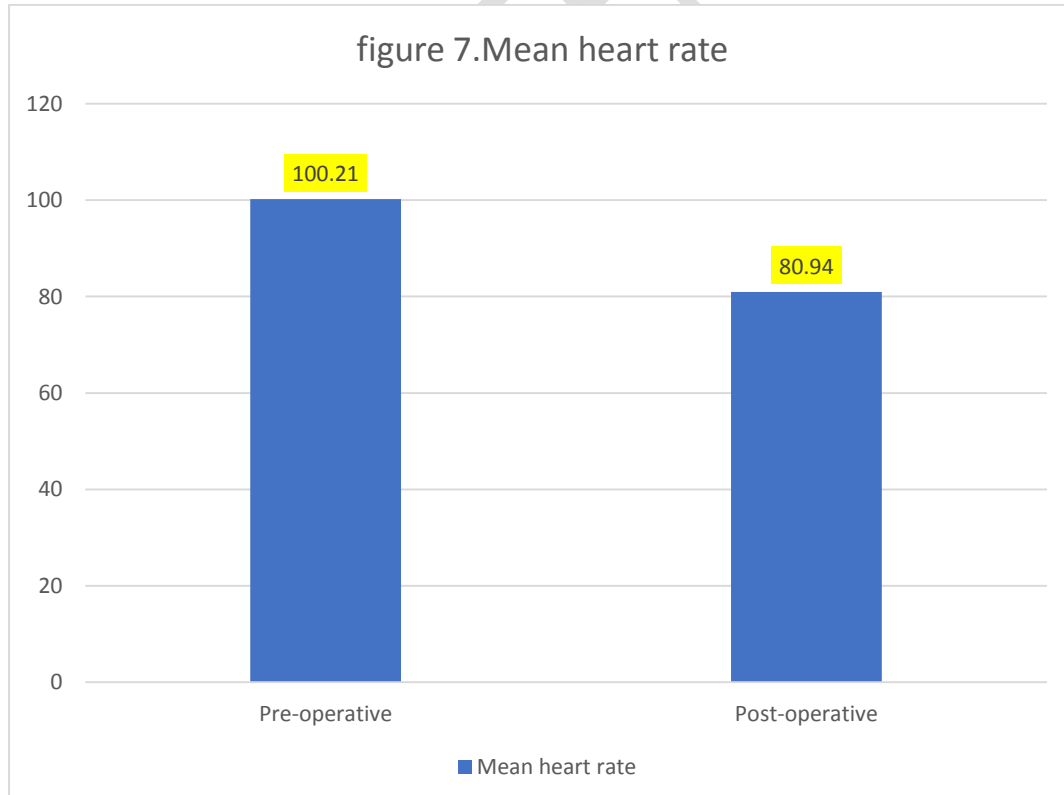| Previous history of COPD	Number of subjects	Percentage
No	69	98.57
Yes	1	1.43
Total	70	100.00

Heart rate

In the present study we assessed the heart rate among the study subjects. We observed that the mean Pre-operative heart rate was 100.21 ±7.14 per minute, Mean Post-operative heart rate was 80.94 ± 7.15 per minute.

Table 7

| Heart rate	Mean	SD	Median
Pre-operative	100.21	7.14	100
Post-operative	80.94	7.15	80

figure 7.Mean heart rate

Heart rate score

In the present study we assessed the HR score among the study subjects. We observed that majority of the study subjects had HR score of 1 (61.43%), followed by score 0 (24.29%)

Table 8

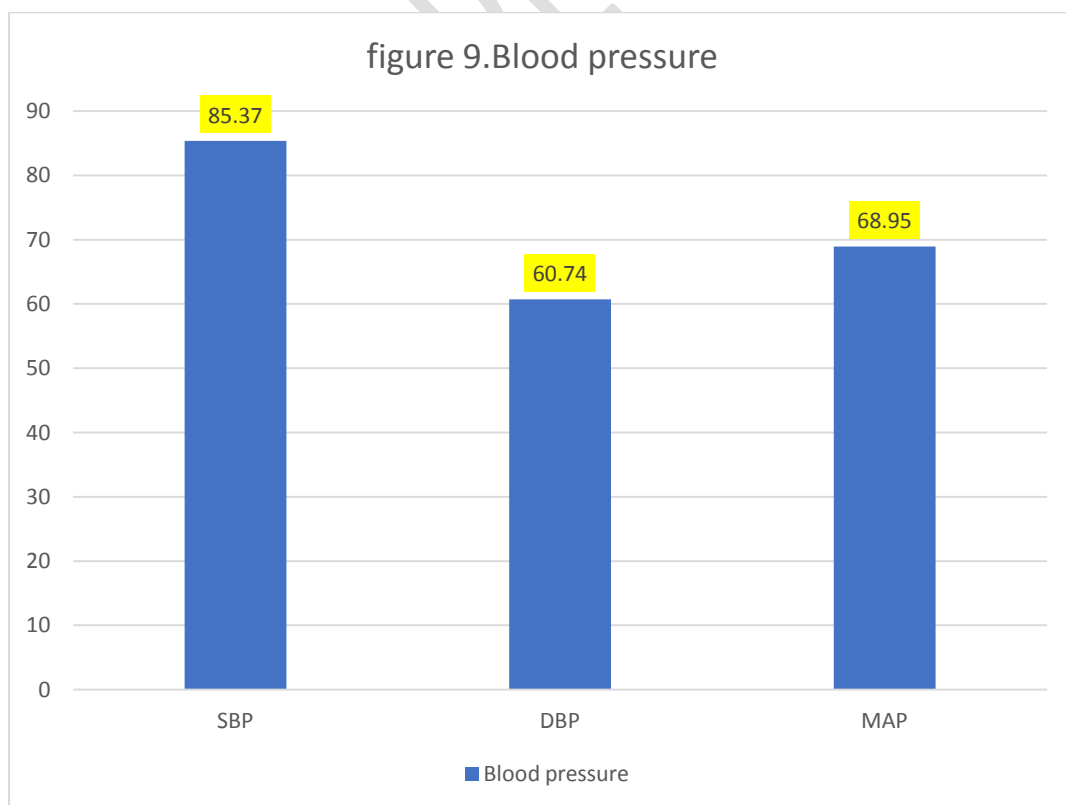| score HR	Number of subjects	Percentage
0	17	24.29
1	43	61.43
2	9	12.86
4	1	1.43
Total	70	100.00

figure 8.Heart rate score
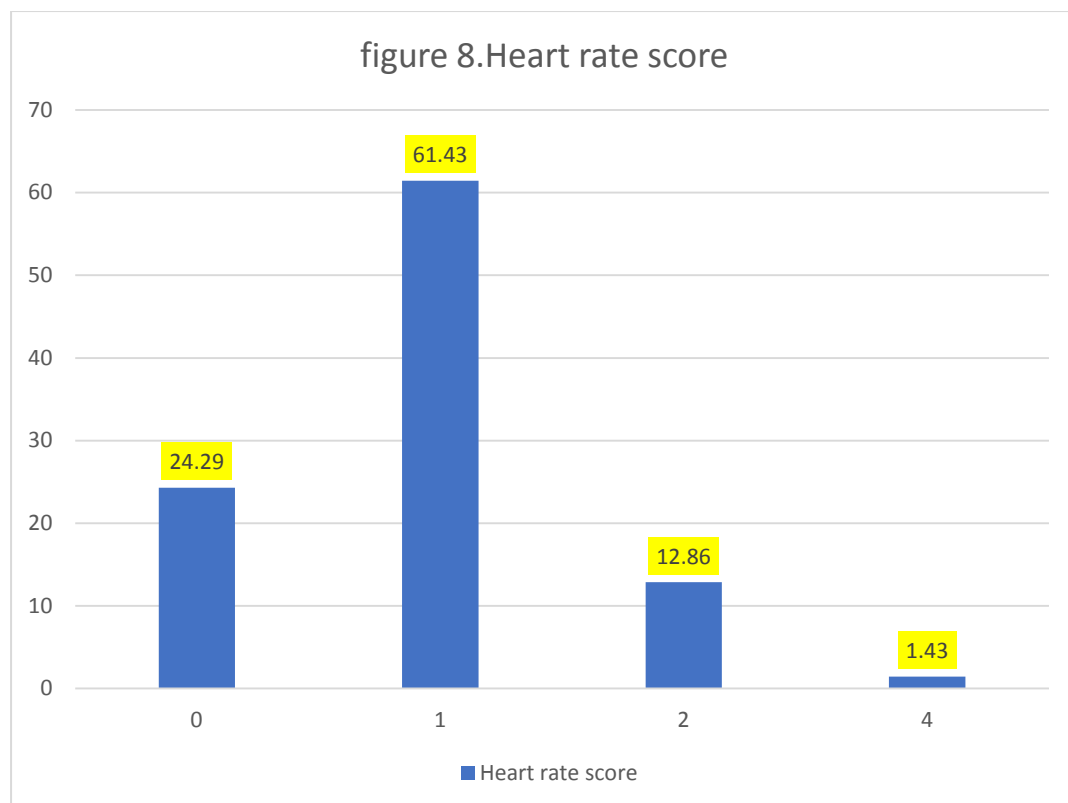
Blood pressure

In the present study we assessed the Blood pressure among the study subjects. We observed that the mean SBP was 85.37 ± 10.37 mmHg, Mean DBP was 60.74 ± 9.28 mmHg, and Mean MAP was 68.95 ± 9.46 mmHg.

Table 9

| Blood pressure	Mean	SD	Median
SBP	85.37	10.37	94
DBP	60.74	9.28	60
MAP	68.95	9.46	68.66

figure 9.Blood pressure

MAP score

In the present study we assessed the MAP score among the study subjects. We observed that majority of the subjects had MAP score of 3 (45.71%), followed by score 2 (42.86%)

Table 10

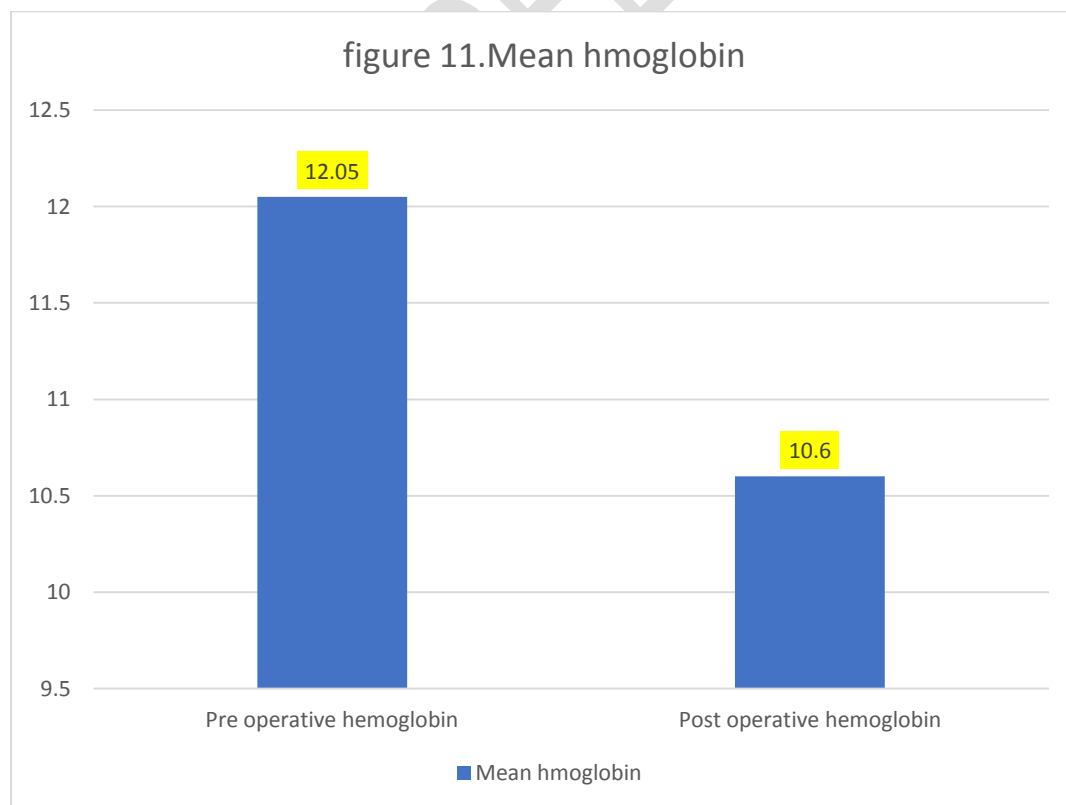| MAP score	Number of subjects	Percentage
1	8	11.43
2	30	42.86
3	32	45.71
Total	70	100.00

figure 10.MAP score
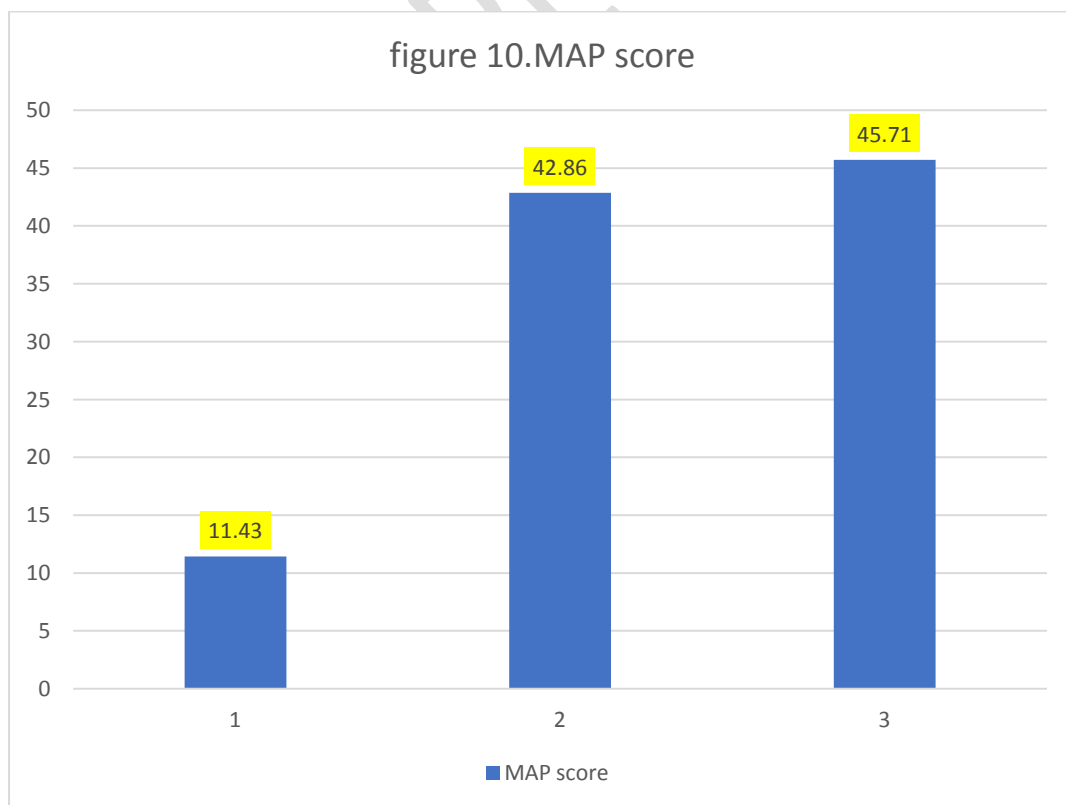
Mean hemoglobin levels

In the present study we assessed the mean blood loss and Mean hemoglobin levels among the study subjects. We observed that mean Pre operative hemoglobin level was 12.05 ± 2.13 g/dl, Mean Post-operative hemoglobin level was 2.73 ±10.9 g/dl, and Mean amount of Blood loss was 893.55 ±1039.03 ml.

Table 11

| Parameters	Mean	SD	Median
Pre operative hemoglobin	12.05	2.13	12.2
Post operative hemoglobin	10.6	2.73	10.9
Blood loss	893.55	1039.03	411.42

figure 11.Mean hmoglobin

EMERGENCY

In the present study we observed that 92.86% study subjects presented as a medical emergency at emergency department.

Table 12

EMERGENCY	Number of subjects	Percentage
No	5	7.14
Yes	65	92.86
Total	70	100.00

figure 12.Emergency
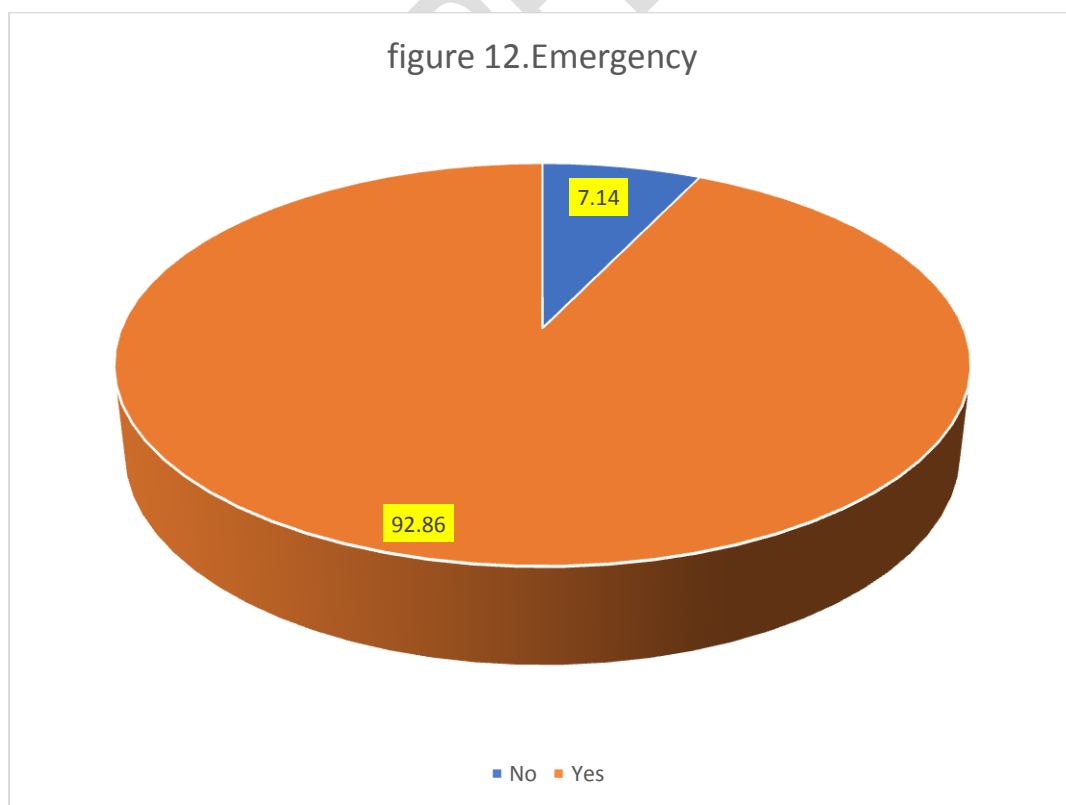
Blood loss score (Table 13)

Blood loss score	Number of subjects	Percentage
0	21	30.00
1	6	8.57
2	36	51.43
3	7	10.00
Total	70	100.00

In the present study we assessed the Blood loss score among the study subjects. We observed that majority of the study subjects had score of 2 (51.43%), followed by score 0 (30%).
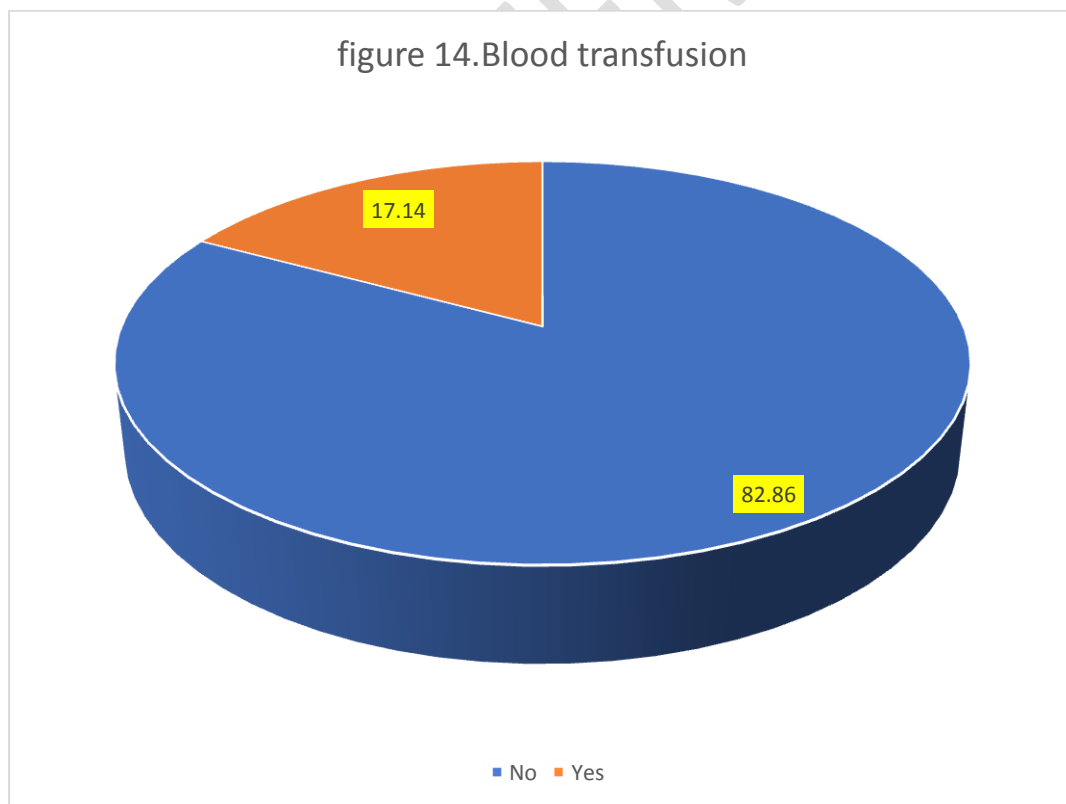
figure 13.Blood loss score
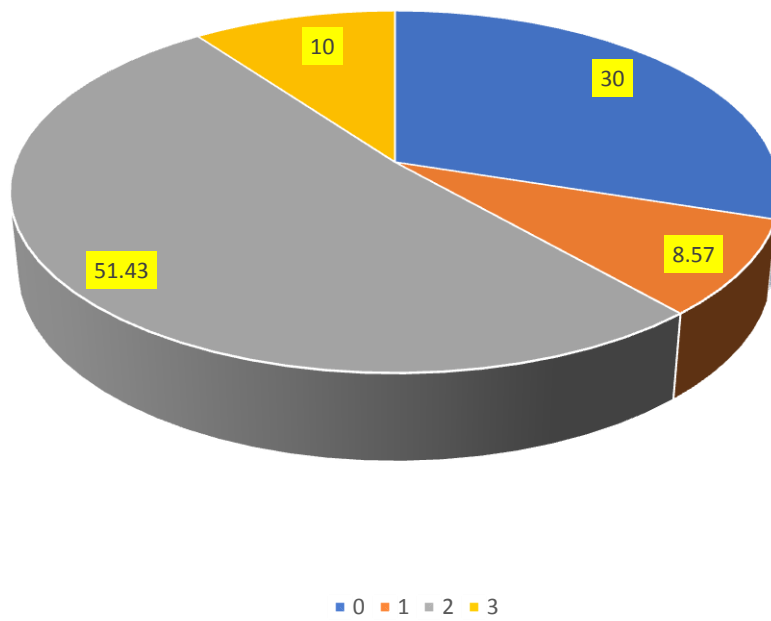
Blood transfusion

In the present study we assessed the Blood transfusion among the study subjects. We observed that blood transfusion was required among 17.14% subjects.

Table 14

Blood transfusion	Number of subjects	Percentage
No	58	82.86
Yes	12	17.14
Total	70	100.00

figure 14.Blood transfusion

Surgical APGAR score

In the present study we assessed the Surgical APGAR score among the study subjects. We observed that majority of the study subjects had surgical APGAR score between 5 to 6 (51.43%), followed by 3 to 4 (28.57%). The mean surgical APGAR score among study subjects was 4.68 ±1.67. (Table 15)
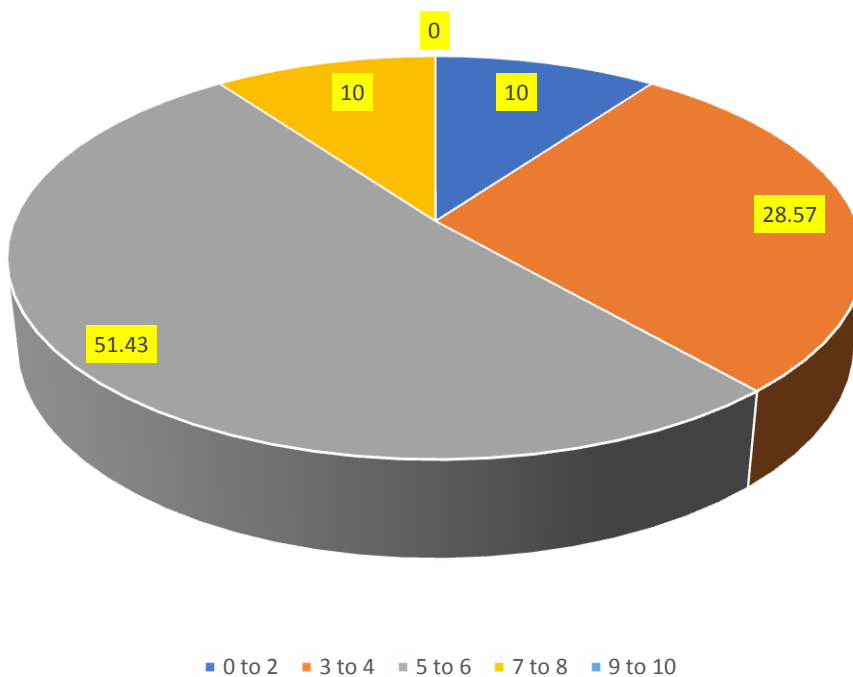
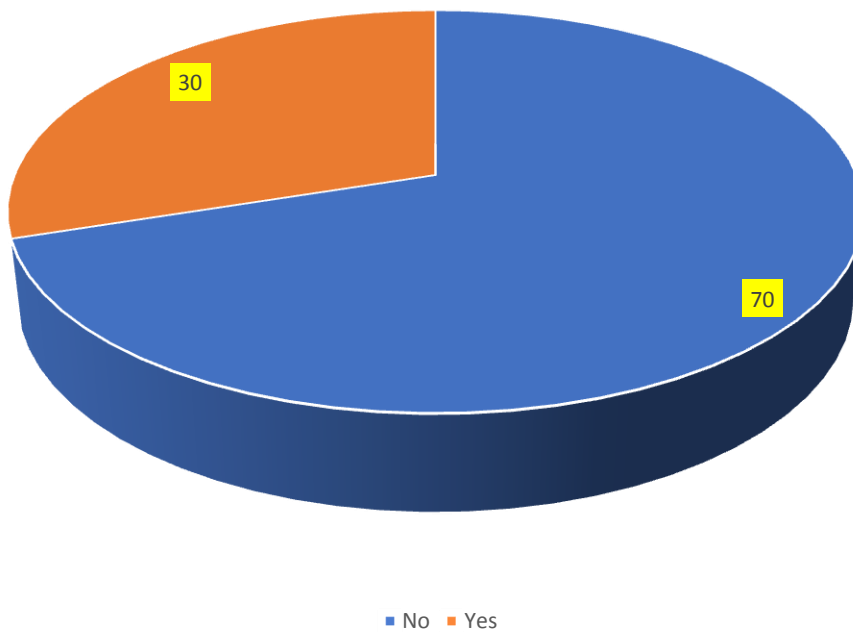| APGAR score	Number of subjects	Percentage
0 to 2	7	10.00
3 to 4	20	28.57
5 to 6	36	51.43
7 to 8	7	10.00
9 to 10	0	0.00
Total	70	100.00

figure 15.Surgical APGAR score

MORBIDITY

In the present study we assessed the morbidity among the study subjects. We observed that various forms of morbidity was observed among 30% study subjects.

Table 16

| MORBIDITY	Number of subjects	Percentage
No	49	70.00
Yes	21	30.00
Total	70	100.00

figure 16.Morbidity

MORTALITY

In the present study we assessed the mortality among the study subjects. We observed that the mortality was observed among 11.43% subjects. 88.57% subjects were cured and discharged.

Table 17

| MORTALITY	Number of subjects	Percentage
No	62	88.57
Yes	8	11.43
Total	70	100.00

figure 17.Mortality
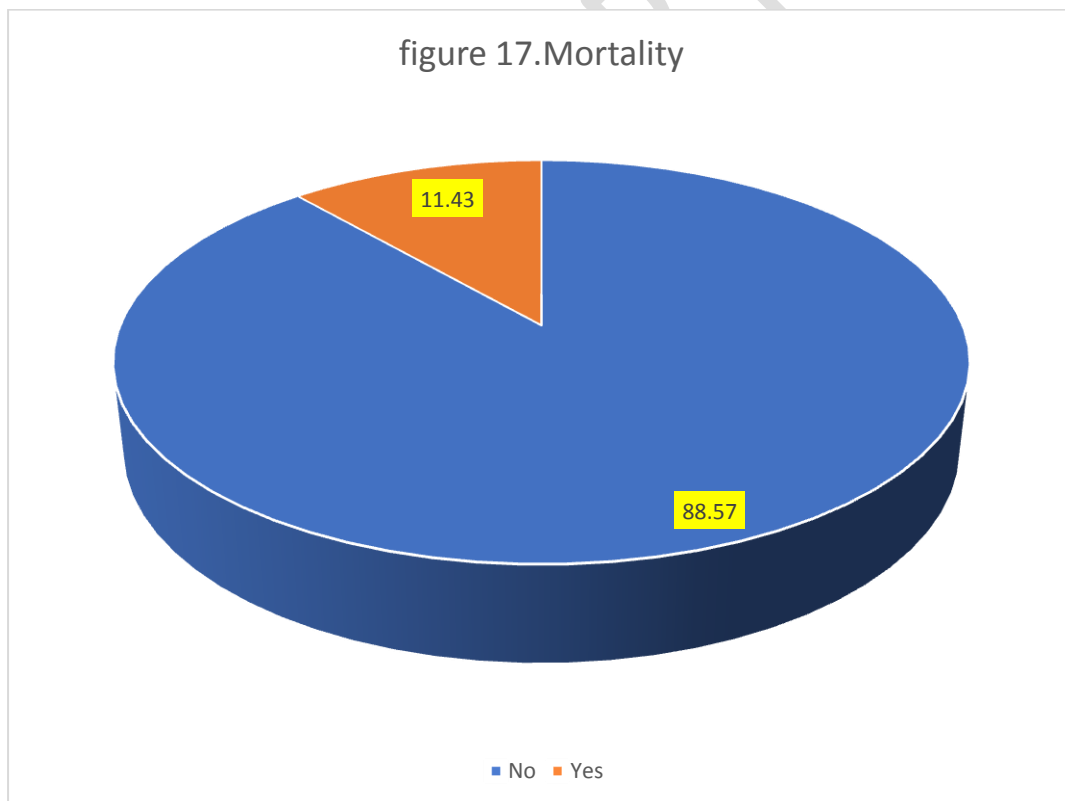
Comparison of surgical APGAR score with outcome

In the present study we assessed the Comparison of surgical APGAR score with outcome among the study subjects. We observed that mortality was associated with lesser surgical APGAR score, as compared to those subjects who were cured and discharged. The observations were found to be statistically significant. (The chi-square statistic is 25.1069. The p-value is < 0.00001. The result is significant at p < .05.)

Table 18

Surgical APGAR score	Morbidity		Mortality		No complications	
	Number of subjects	%	Number of subjects	Percentage	Number of subjects	Percentage
0 to 2	1	1.42	5	7.14	1	1.42
3 to 4	7	10	2	2.85	11	15.71
5 to 6	7	10	1	1.42	28	40
7 to 8	1	1.42	0	0.00	6	8.57
9 to 10	0	0	0	0.00	0	0
Total	16	22.85	8	11.42	46	65.71
Significance			The chi-square statistic is 31.87. The p-value is < 0.00001. The result is significant at p < .05.			

figure 18.Comparison of surgical APGAR score with outcome
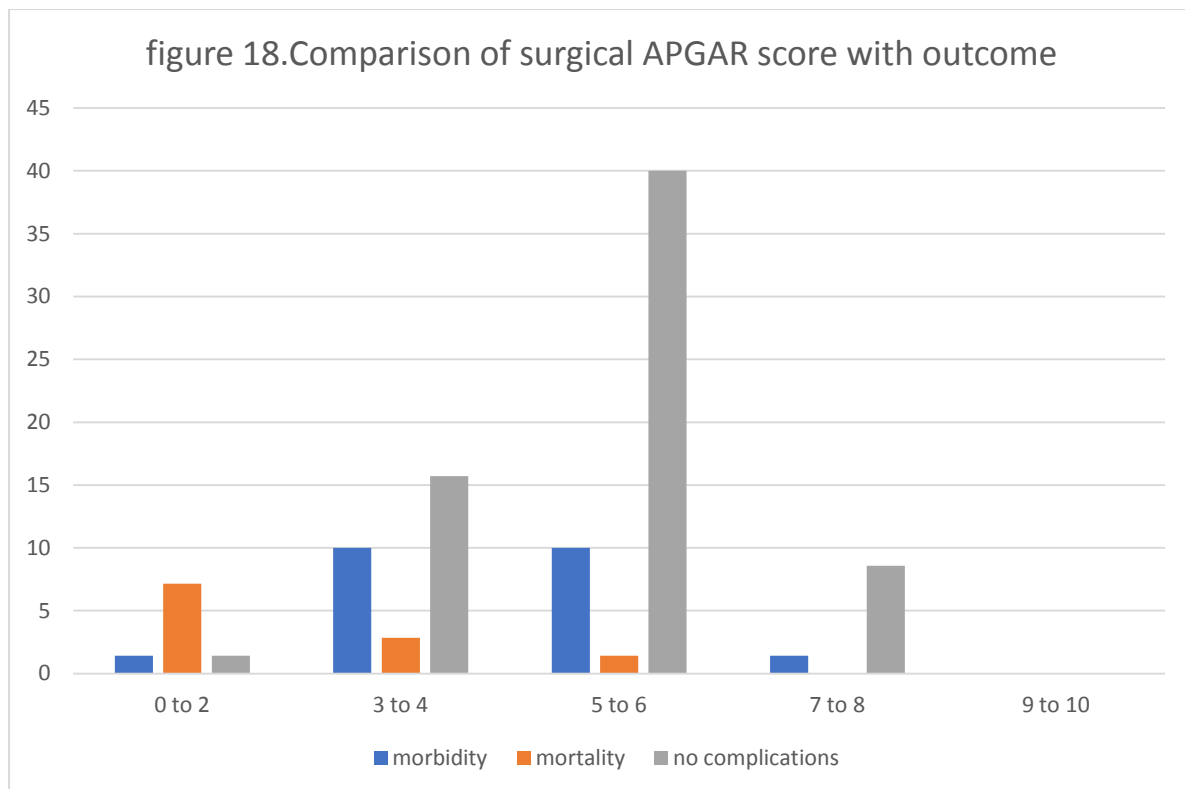
DISCUSSION

A 10 point Surgical APGAR score is a simple scoring system which is based on easily available and recordable parameters like lowest mean arterial pressure, lowest heart rate and blood loss during a surgery, which provides precise estimate of patient's post-operative outcome.

All 70 patients were admitted and treated and evaluated in department of general surgery KIM's karad with methods as described earlier.

Previous studies on surgical apgar score by scott et al and Gawande et al show a female preponderance of 56% to 65% in different cohort studies. In our study there was male preponderance of 67.14% with male to female ratio of 2.04:1. No significant associations were noted between gender and apgar score. This is comparable to the study by Mwangi et al that had a male preponderance of 67%

64.2% of the patients were above 40 years with mean age of the study subject's 47.34±14.86 years. Study by Regenbogen et al (2009), the mean age was 64.2 years. Gawande et al (2007) had a patient population with a mean age of 63.6 years

About 57.8% patients in the age group above 55 had postoperative complications and 21% had mortality whereas in younger age group of below 40 years had 16% complications and 8% mortality.

A study by Capewell et al on emergency admissions in surgery showed that between 46 % to 57 % of all surgical admissions are emergency in nature. In this study 92 %(65) of the cases were emergency laparotomies and only 7 %(5) were elective. A study done by scott et al showed incidence of complications 4.8% out of 21.3% of minor and major surgeries, in this study all the surgeries were major, 2 out of 5 elective cases had complications with 0 mortality while the emergency cases had 21.5%(14) morbidity and 12.3%(8) mortality. A statistically significant result with an odds ratio of 4.8 % was obtained in a study by Gawande et al for emergency procedures.13 Other studies have shown complication rates of 43 % and a mortality rate of 4 % in emergency GI procedures.

15.7% patients were known case of hypertension out which 27% had complications and 27% had mortality, 15.7% patients had diabetes mellitus out which 45% had complications and 27% had mortality. No previous studies compared comorbidities with complications or mortality but in this this study relation between hypertension and diabetes mellitus was found to be significant with post-operative outcome. Other comorbidities like COPD, asthma and cardiac disorders were not found to be significant.

12 out of 70 patients required intra-op blood transfusion of which 16.6% had complications and 33.3% had mortality. Inclusion of intra-op blood transfusion in scoring has been attempted but was not found to be significant predictor in study done by Hayashi et al, while study by Kristine et al found Msas(modified surgical apgar score) as significant predictor with p<.03 and p<.15 for Sas.

- **Yusufali TS et.al.**
  Majority 116 (56%) of the patients developed one or more major complications during the thirty day postoperative period while 85 (41.1%) did not. The mean SAS score for patients without complications was 7.04 (±0.29) while that for patients with complications was 4.80 (±0.30) (p < 0.001)

- **Scott e. Regenbogen et. al.**
  Of 1441 patients with scores of 9 to 10, 72 (5.0%) developed major complications within 30 days, including 2 deaths (0.1%). By comparison, among 128 patients with

scores of 4 or less, 72 developed major complications (56.3%; relative risk, 11.3; 95% confidence interval, 8.6-14.8; $P < .001$), of whom 25 died (19.5%; relative risk, 140.7; 95% confidence interval, 33.7-587.4; $P < .001$). The 3-variable score achieves C statistics of 0.73 for major complications and 0.81 for deaths.

- **Atul Gawande et.al.**

In patients with scores of 9 or 10 (29% of sample) had a <4% incidence of major comlications, and no deaths. In contrast, those with scores of $\leq$ 4 had a >50% risk of major complications, including a 14% mortality rate. Despite the relatively low prevalence of scores $\leq$ 4 %(4% of the sample size), the c-statistic of 0.75 suggests that the score has good overall discriminative ability.

- In our study, the mean surgical apgar score among study subjects was 4.68 ±1.67. Majority of the study subjects had surgical APGAR score between 5 to 6 (51.43%), followed by 3 to 4 (28.57%). The p<0.0001 is highly significant in our study.

- Out of 27 patients who had score of less than 4 29.6% had complications and 25.9% patients had mortality whereas 43 patients had score of above 4 out of which 18.6% had complications and 2%(1) had mortality.

- Statistically significant results were seen in the score groups, with score groups of 0-2 showing 7.14%, 3-4 with 2.85%, 5-6 with 1.42%, 7-10 with 0% mortality.

- Morbidity percentage was higher in score groups of 3-4 and 5-6 with both being 10%.

SUMMARY

70 patients who underwent exploratory laparotomy either on elective or emergency basis were included in the study. Mean age group of the study was 47.34±14.86 years with 64.2% of the patients above 40 years, there was male preponderance in the study but with no significant association. 57.8% patients above 55 years of age had complications and only 16% had complications in younger age group.

15.7% patients had diabetes mellitus and hypertension and the study found that hypertension was significantly related to postoperative complications and mortality.

Blood transfusion was given in 12 patients out which 33% had mortality which gives the scope for studying Modified surgical APGAR score where blood transfusion is included in the scoring system.

Mean surgical APGAR score of the study was 4.68 ±1.67 with majority of them being in group of 5-6. Patients who had score of less than 4 had higher rate of post-op complications and mortality than patients with score 0f 6 and above.

Study was statistically significant and showed that Surgical APGAR score is an excellent predictor of post operative outcomes in regard to complications and mortality and can be an efficient tool in monitoring and taking decisions in resource poor hospital setups and countries.

CONCLUSIONS

- The male: female ration in the current study was 2.04:1
- The mean age of the study subjects was 47.34 ± 14.86 years.
- We observed mortality among 11.43% subjects. 88.57% subjects were cured and discharged.
- The mean surgical APGAR score among study subjects was 4.68 ±1.67.
- Intraoperative hemodynamics and blood loss may affect postoperative transfer to the ICU and that the surgical APGAR score is strongly associated with postoperative ICU admission in patients undergoing all types of surgeries.
- The surgical APGAR score remains a powerful tool that can be used to facilitate clinical decision making with regard to the immediate transfer of patients to the ICU after surgery.

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