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Original Article

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Synergistic Use of Possum and P-Possum Scores in Predicting Laparotomy Outcomes

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ABSTRACT

Introduction: Scoring systems objectively guide towards providing quality of care as well as plays a significant role as far as outcomes of a particular procedure. In the present study a comparison is made between two well established scoring systems i.e, POSSUM & P- POSSUM and also importance is given to highlight synergistic usage of well established scoring systems to effectively gauge in anticipating the outcomes post laparotomy.

Objectives of the Study: To compare the accuracy of mortality prediction between the two scoring systems. To highlight the importance of synergistic use of scoring system in predicting morbidity and mortality. Usage of Clavien-Dindo scoring system to attain comparative objectivity of a surgical procedure.

Materials and Methods: It is the prospective observational study conducted for the period of 1 year. The data is collected from the inpatients after obtaining the written informed consent, undergoing laparotomy admitted under the Department of General Surgery, Ramaiah Hospitals, Bengaluru during the period of study.

Results: Among the 96 cases studied 60(62.5%) were males and 36(37.5%) were females. Emergency resuscitation, operation done within less than 24 hours is 49%. Elective cases were 47.9% and emergency immediate operation done within less than 2 hours is 3.1%. Mean physiological score calculated using POSSUM and P-POSSUM is 21.92% and 22.98% and the difference is not statistically significant. Mean operative score calculated using POSSUM and P-POSSUM is 15.13% and 17.16% and the mean difference is significant statistically. Mean mortality calculated using POSSUM and P-POSSUM is 20.44 and 12.46% and the difference is statistically significant. Mortality prediction was noted to be better with P-POSSUM scoring system, while POSSUM over predicted mortality by 1.5 times even in low risk cases. Complication following a procedure were graded using universally accepted CLAVEIN DINDO grading system so that comparative objectivity is maintained.

Conclusion: It was noted from the study that POSSUM scoring over predicted mortality in low-risk cases by 1.5 times, against other studies wherein the overestimation was noted to be between two to eight folds. P-POSSUM accurately predicted the operative severity and expectant management and was statistically significant parameter. It was noted from the study that morbidity estimation is as important as precise mortality estimation of a particular operative procedure. Hence we conclude highlighting the fact that synchronous usage of POSSUM and P-POSSUM is an essential guiding which will aid in expectant post procedural outcomes.

Key Words: *POSSUM score, P-POSSUM score, Laparotomy outcomes, Scoring systems, Morbidity and mortality prediction*

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INTRODUCTION

There is an impending need for scoring system as far as surgical audit is concerned in order to provide quality of care ,also to anticipate an untoward sequence of events that follow during the post operative period following any surgical procedure.

Scoring system also aids in better anticipation, patient preparedness as well as improved qualityof patient care when it comes to patient requiring intensive care. It may also prove worthwhile and helps avoid unintended anxious, impulsive decision making from both doctor as well as patients' perspective is concerned.

There have been various scoring systems in this regarding with the likes of Surgical APGAR score, SOFA and q-SOFA score, APACHE II etc, however in the present study we have utilized the resources of two well established scoring systems i.e POSSUM and P-POSSUM scores in assessing morbidity and mortality of a particular operative procedure,also highlight the significance of synchronous usage of these two scoring systems in anticipating better patient outcomes.

There have been various studies comparing the two scoring systems in terms of accuracy in predicting mortality

which showed variability from two folds to upto eight folds and P-POSSUM predicting mortality better than POSSUM.

In order to inspect this varied results study was conducted in order to establish the fact as to which scoring system predicted mortality better besides using similar parameters which the only difference being a constant which was introduced in P-POSSUM scoring system which aided in predicting mortality better.

OBJECTIVES OF THE STUDY

To compare the accuracy of mortality prediction between the two established scoring systems. To highlight the importance of synergistic use of scoring system in predicting morbidity and mortality. Usage of Clavien-Dindo scoring system to attain comparative objectivity of a surgical procedure.

MATERIALS AND METHODS

Source of Data:

The source of the data will be collected from the inpatients after obtaining the written informedconsent, undergoing laparotomy admitted under the Department of General Surgery, Ramaiah Hospitals, Bengaluru during the period of study.

Study design: Prospective Observational Study
Study Setting: Department Of General Surgery, Ramaiah Hospitals, Bengaluru
Sampling: Complete enumeration of all cases satisfying inclusion and exclusion criteria
Study Period: Jan 2021-august 2022
Sample Size: 96 cases

Justification for sample size:

A study carried out on "POSSUM and P-POSSUM for risk-adjusted audit of patients undergoing emergency laparotomy" [1], has revealed that 13.3% died within 30 days of surgery, 51.7% developed complications. Based on above findings of study with an absolute precisionof 7% for mortality and 10% for morbidity conditions with confidence level of 95% it is estimated a minimum of 96 cases need to be recruited for the study. Further, the above paper has also reported that the POSSUM and P-POSSUM scores prediction of mortality in terms ofO:E ratio to be 0.91 and 0.88 respectively by exponential analysis. Assuming a non-inferioritymargin of 0.082, with power of 80% and alpha error of 5%, it is estimated that 96 patients arerequired. Both the scales will be employed on the all the patients for comparison for predictingmorbidity and mortality in patients undergoing laparotomy. Thus, a sample size of 96 patientswill be recruited for the study.

Inclusion Criteria:

1) Patients undergoing laparotomy both elective and emergency

Exclusion criteria:

1) The data set excludes patients requiring laparotomy for trauma.

Method of collection of data (including sampling if any):

A total of 96 patients will be selected after applying the inclusion-exclusion criteria. Information is collected from the patients records which includes basic information based on physiological parameters and operative parameters which are routinely used.

Investigations: ECG, Chest X-Ray, Hemoglobin, BUN, sodium, potassium.

Data Collection:

Detailed history taking, clinical interpretation of Chest X-ray, ECG and blood investigations like Hemoglobin, Sodium, Potassium and below mentioned physiological and operative parameters will be taken into consideration.

Post operatively patient will be followed up over a period of 30 days and any morbidity, mortality is noted. With the data of the physiological and operative parameters Possum and P-Possum scores will be calculated and morbidity and mortality will be ascertained.

Physiological parameters	Operative parameters
Age	Operative severity
Cardiac signs	Number of procedures
Respiratory history	Estimated blood loss
Systolic blood pressure	Peritoneal Soiling
Pulse	Presence of malignancy
Glasgow coma scale	Mode of Surgery
Hemoglobin	

White cell count	
BUN	
Sodium	
Potassium	
ECG	

Informed Consent: Informed consent will be taken from the patients in their vernacular language.

STATISTICAL ANALYSIS

The Statistical software SPSS 19.0 was used for the analysis of the data and Microsoftword and Excel have been used to generate graphs, tables etc**.** Descriptive and Inferential statistical analysis has been carried out in the present study. Results on Continuous measurements are presented in Mean and Standard Deviation. Significance is assessed at 5 % level of significance. Un-paired t test was applied to compare means of all the variables acrosstwo score criteria.

RESULTS

The following parameters i.e, a total of 18 parameters were assessed which were to be common for both scoring systems. The gender distribution showed 62.5% comprised of males,while 37.5% comprised of female population. Most of the study population belonged to age of less than or equal to 60 which accounted to around 79.2%. Physiological age is as shown in table1.

Among the study population around 6.2% consisted of having cardiac co-morbidity for which the patients were on medications in the form of antiplatelets, anticoagulants and drugs to prevent cardiac re-modelling. As far as age is concerned 79.2% of the population belonged to less than or equal to 60 years accounting for majority of study population in this age group.Meanwhile 15.6 % belonged to 61-70 age group and 5.2% of the study population belonged to71 years or greater. Study population suffered from mild COPD, shortness of breath on exertion which accounted to 19.8%. Systolic blood pressure and heart rate is as shown in table2 and table 3. 27.1% of study population had tachycardia, mainly in patients who underwent laparotomy on emergency basis. Most of the study population had normal GCS which consisted of 96.9%. 3.1% of the patients had GCS between 9-14 which mainly included patient requiring relaparotomy i.e 3 out of 96 patients. 81.2% of patients had optimum hemoglobin levels required for Emergency as well as elective surgery, around 9.2% of patients had hemoglobin of less than 9.9g/dl. In the study population 51% of patients were noted to have abnormal total leukocyte count. 26% of patients were found to have raised blood urea nitrogen. 4.2% of patients were noted to have sodium levels required correction as patients had symptoms of drowsiness, fatigue and lassitude. Potassium values were normal in 62.5%, remaining 37.5% has abnormal values. ECG was shown to be normal in 94.2%, and abnormal in remaining 5.8% of patients for whom emergency cardiac evaluation was done before the procedure. Operative severity is shown is graph 1.Blood loss was noted to be proportionate to the duration of surgery and was seen to be more in major emergency surgeries in comparison to elective surgeries. About 30.2% of the patients underwent surgery for malignancy. Patients were stratified based on the mode of surgery into emergency and elective which accounted to 52.1% and 47.9% respectively.

INTERPRETATION

Physiological score-The mean was found to be higher in P-POSSUM when compared to POSSUM and the difference was found not statistically significant

Operative score-The mean was found to be higher in P-POSSUM when compared to POSSUM and the difference was found to be statistically significant ($p \leq 0.05$)

Mortality- The mean was found to be higher in POSSUM when compared to P-POSSUM and the difference was found to be statistically significant. ($p \leq 0.05$) as shown in table 5

Physiological score-The mean was found to be higher in EMERGENCY when compared to ELECTIVE and the difference was found to be statistically significant ($p \leq 0.05$)

Operative score-The mean was found to be higher in ELECTIVE when compared to EMERGENCY and the difference was not statistically significant

Mortality- The mean was found to be higher in EMERGENCY when compared to ELECTIVE and the difference was not statistically significant as shown in table 6.

Physiological score-The mean was found to be higher in EMERGENCY when compared to ELECTIVE and the difference was found to be statistically significant ($p \leq 0.05$)

Operative score-The mean was found to be higher in EMERGENCY when compared to ELECTIVE and the difference was found NOT to be statistically significant

Mortality- The mean was found to be higher in EMERGENCY when compared to ELECTIVE and the difference was found to be statistically significant. ($p \leq 0.05$) as shown in table 7.

Table 1: Physiological scoring: Age

	N	%
1(less than or equal to 60)	76	79.2
2(61-70)	15	15.6
4(greather than or equal to 71)	5	5.2
Total	96	100.0

Table 2: Systolic blood pressure

	N	%
1(110-130)	61	63.5
2(131-170 or 100-109)	16	16.7
4(greater than or equal to 171 or 90-99)	15	15.6
8(less than or equal to 89)	3	3.1
Total	96	100.0

Table 3: Heart rate

	N	%
1(50-80)	50	52
2(81-100 or 40-49)	20	20.8
4(101-120)	22	22.9
8 (greater than or equal to 121 or less than equal to 39)	4	4.2
Total	96	100.0

Table 4: Laparotomies for various conditions as mentioned above:

Type	Subtype	N (%)
Perforation	Appendicular Gall bladder Ileal Gastric Colon	4(4.16) 1(1.04) 6(6.25) 5(5.2) 1(1.04)
	Duodenal Total	3(3.125) 20(20.8)
Intestinal Obstruction	Benign Malignant Total	18(18.75) 8(8.3) 26(27)
Whipple's Surgery	Cholangiocarcinoma Periampullary CA Insulinoma Others Total	4(4.16) 8(8.3) 2(2.08) 2(2.08) 16(16.67)
Splenectomy	Hemolytic anemia refractory to treatment ITP Total	2 2 4(4.16)
Ventral Hernia		5(5.25)
Re-laparotomies	Anastomotic leak Intestinal obstruction Total	3(3.125) 1(1.04) 4(4.16)
Others		25(26.04))

Table 5: comparison of possum and p-possum scores

	Score	N	Mean	Std. Deviation	t	p
Physiological Score	POSSUM	96	21.92	6.13	1.1	0.2
	P-POSSUM	96	22.98	7.07		
Operative Score	POSSUM	96	15.13	5.09	2.7	**0.007***
	P-POSSUM	96	17.16	5.17		
Mortality	POSSUM	96	20.44	19.5	3.0	**0.003***
	P-POSSUM	96	12.46	16.6		

Table 6: Comparison based on type of surgery-possum

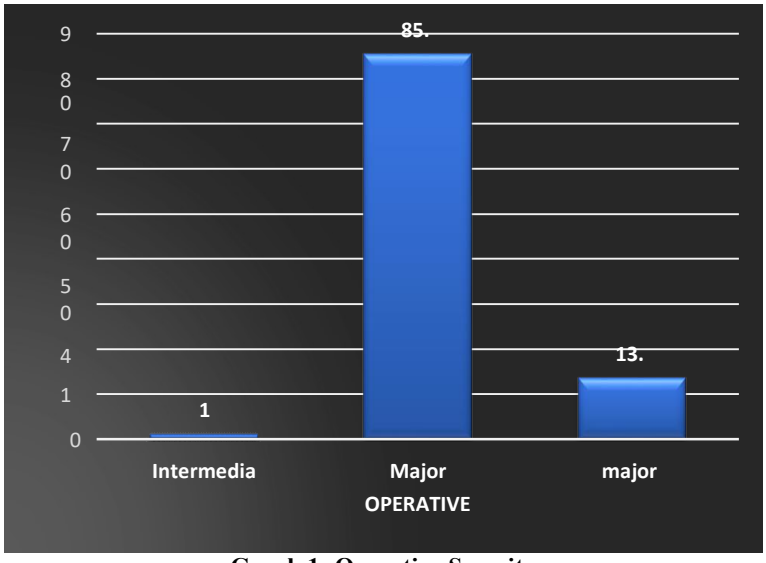
	TYPE OF SURGERY	N	Mean	Std. Deviation	T	p
Physiological Score	Elective	46	20.43	5.38	2.3	**0.02***
	Emergency	50	23.30	6.50		
Operative Score	Elective	46	14.76	4.31	0.6	0.4
	Emergency	50	15.48	5.74		
Mortality	Elective	46	16.72	16.60	1.8	0.07
	Emergency	50	23.86	21.52		

Table 7: Comparison based on type of surgery P-POSSUM

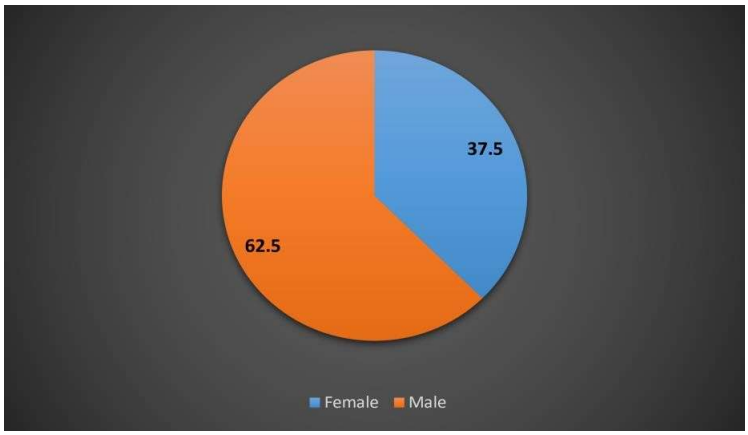
	TYPE OF SURGERY	N	Mean	Std. Deviation	T	p
Physiological Score	Elective	46	20.5000	6.30608	3.4	**0.001***
	Emergency	50	25.2800	7.03066		
Operative Score	Elective	46	16.4783	4.82926	1.2	0.2
	Emergency	50	17.8000	5.45108		
Mortality	Elective	46	8.5720	12.93806	2.2	**0.02***
	Emergency	50	16.0382	18.94097		

Table 8: Post operative stratification of operative complications

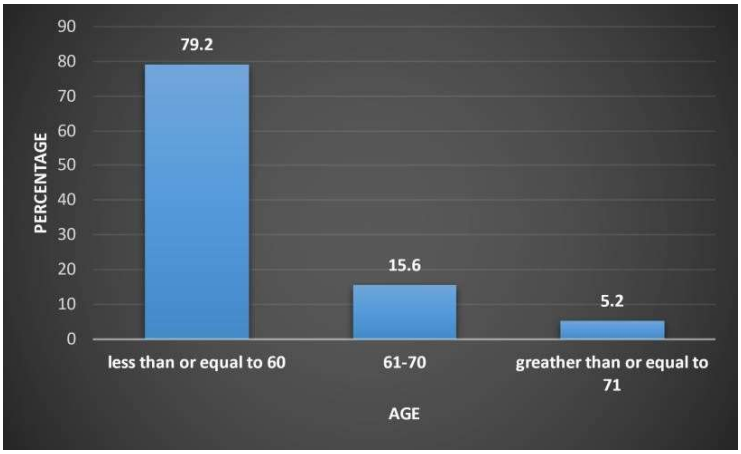
CLAVIN DINDO SCORE	N	%
1	56	58.3
2	7	7.3
3a	2	2.1
3b	3	3.1
4	25	26.0
5	3	3.1
Grand Total	96	100.0



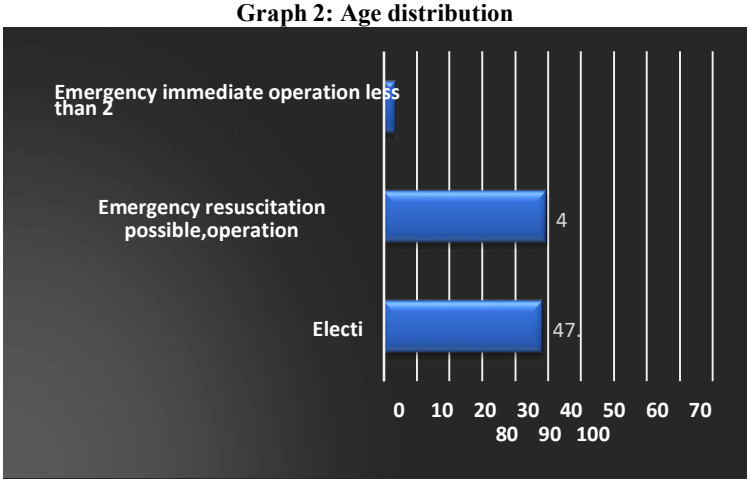
Graph 1: Operative Severity



Piechart 1: Genderwise distribution



Graph 2: Age distribution



Graph 3: Mode of surgery

DISCUSSION

Surgeons are required to audit the quality of the clinical care that they provide [2,3]. If a comparison of quality of care between individual surgeons or surgical units is to be valid, outcome measures must be standardized and the effect of non-surgical factors controlled [2]. The currently accepted measure of surgical outcome is 30 day postoperative mortality [2, 4 & 5]. The disadvantage of using mortality as an endpoint is that the majority of surgical procedures carry a low risk of death. Other quality measures, such as inpatient stay, patient satisfaction or need for readmission, might prove more appropriate for comparative audit in these low-risk patients [2, 6]. Inadvertent auditing leads to conserved approach towards operative management of a patient resulting in a hinderance towards patient care.

The ideal comparative audit tool should be independent of surgeon-related factors, compensate for factors outside the surgeons' influence and allow comparison of heterogeneous patient groups. It should not be specific to a procedure or disease process but encompass the entire spectrum of the surgeons' practice. POSSUM, P-POSSUM and SRS were developed with these ideals in mind. POSSUM and P-POSSUM have been validated for the prediction of postoperative mortality in a large number of studies [2,5]. POSSUM generally over predicts mortality, as in this study, particularly in lower-risk groups. The over prediction results from POSSUM predicting a mean mortality rate of 1·1 per cent in the lowest-risk patient group. In comparison, P-POSSUM, by using different coefficients and linear analysis, has a minimum predicted mortality rate of 0·2 per cent, still higher than one would reasonably expect for a low-risk patient [2].

Over prediction results in most surgeons appearing to perform favorably. Not only does POSSUM give the impression of favorable performance,it may fail to identify poor performance. Few surgeons would argue that the volume of blood lost during a procedure and the need for reoperation are beyond surgical influence. However, the POSSUM OSS includes blood loss and the need for repeat operation, thus removing two potentially important discriminant factors for comparative surgical audit. The PSS may be altered by 'optimization' of the patient's physiological state before surgery, a factor that is again often surgeon dependent [7].

Our study showed out of 96 cases 20(20.8%) cases had perforation among which duodenal perforation was seen in 3 (3.25%) cases, ileal perforation was seen in 6(6.25%) patients, 27% of cases had obstruction. Whipple's procedure was done in 16.7% cases. Splenectomy was done in 4.16% patients, ventral hernias accounted to 5.25% of patients, relaparotomy was done in 4.16% of cases, other operations was done in 21.87% of patients, there were 3 deaths. Where as MJ Brook et al showed Of 949 patients scored, 34·1 per cent underwent vascular procedures, 28·8 per cent colorectal procedures, 23·9 per cent general surgical procedures, 8·5 per cent upper gastrointestinal procedures, 3·0 per cent head and neck surgery, and 1·5 per cent urological procedures. Most general surgical procedures were operations for abdominal wall hernia repair, appendicectomy and varicose vein surgery. The actual in-hospital mortality rate was 8·4 per cent. There was one death after elective surgery [2].

PP tekkis et al showed the following distribution wherein out of 505 cases distributed amongst 4 operating surgeons, 311(61.58%) of cases were of malignancy, 33(6.5%) belonged to procedures done for inflammatory bowel disease, 67(13.26%) belonged to surgeries performed for diverticular disease, 94(18.61%) cases belonged to others. Elective procedures were 63(66.13%), emergency procedures 171(33.86%), colorectal resection accounted for 317(62.77%), upper GI procedures 138(27.32), small bowel resections 50(9.9%) [4].

A fundamental requirement of patient autonomy is the need for accurate consenting anddiscussion of the risk of any proposed treatment. Emphasis has been placed on the need for consent to be a process of informed, shared decision making. To accurately explain options and risks to the patient, surgeons need to have evaluated clinical and research evidence, In both emergency as well as elective surgical procedures.

Emergency surgery is often a life-saving procedure, which carries inherent risks of mortality and morbidity. Death may be a significant risk when either undergoing or refusing surgery, which should therefore be discussed during the consenting process. S. A. Hobson et al, compared these two well established scoring systems for surgical audit in patient undergoing on emergency surgeries [8], whereas in our present study the scoring system was utilized for both emergency as well as elective General Surgical and Oncological procedures.

One problem of using the POSSUM/P-POSSUM scoring systems in a clinical setting is the operative score. In many cases, this may not be accurately calculated pre-operatively as the nature of the necessary surgery, and indeed pathology, may not be fully established until the operation is underway.

The accuracy of prediction of mortality is difficult to interpret, and values are very much open to manipulation depending on the type of analysis used. In the study conducted by PP. Tekkis et al it was noted that on using exponential analysis there was over predicting in mortality by 2 times especially in low risk cases, the study findings were in relevance to the other studies [4].

Results are in agreement with the work produced by Whitely and his colleagues. There is no clear explanation as to why Copeland's POSSUM equation overestimates mortality. It was apparent in our study that POSSUM overpredicted mortality, particularly in the lower-risk group of patients, by a factor between one and a half times. Similar results were

published by Whiteley *et al.* and Midwinter and Ashley.

In our present study linear regression analysis was done in order to avoid over prediction, it was in concordance with the other studies performed wherein we noted that therewas over-prediction in mortality by 1.5 times by POSSUM when compared to P-POSSUM. In our study the post operative complications are also graded as per universally accepted Clavien-Dindo grading for comparative objectivity.

It was also noted from the study that POSSUM scoring system predicts both morbidity and mortality whereas P-POSSUM accurately predicted mortality in comparison to POSSUM, however P-POSSUM cannot predict the morbidity with respect to a particular procedure which is also important in terms of patient outcome.

CONCLUSION

From our study it was noted that P-POSSUM predicted mortality better than POSSUM in our study it was noted that POSSUM over predicted mortality by 1.5 times as compared to other studies wherein it varied from 2 fold to upto 8 fold.

In our study we applied these well-established scoring system in patients requiring laparotomy for varied reasons ranging from benign to malignant causes, post operative events were gradedusing an universally accepted Clavien Dindo Grading system so that comparative objectivity is maintained.

In our study 3 deaths were noted out of 96 study population who underwent laparotomy which were accurately predicted by P-POSSUM and mortality was under predicted by POSSUM especially in high risk cases. It was noted in certain low risk cases POSSUM over predicted the mortality, the established scoring systems were also statistically assessed to objectively evaluate its applicability in both elective as well as emergency setting, however the results showed that the overall outcome of applicability of POSSUM and P-POSSUM can be generalized irrespective of the scenario in which operative procedure was performed.

While P-POSSUM accurately predicted mortality, POSSUM score predicted both morbidity and mortality which is vital as far as burden estimation from an operative procedure. Hence theimportance of synergistic usage of both scoring systems is highlighted in this study.

In general these well-established scoring systems act as a guide towards objectively justifying acts towards management without clouding the clinical decision making of a treating medical professional. Therefore, meticulous application of these scoring systems in scenarios conducive for better outcomes must be encouraged and further stratification of these scoring systems and its applicability beyond demographics and its usage amongst various study populations and operative procedures should be time tested for further refinement.

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