Portsmouth Possum Scoring in General Surgery, identifying Risk Factors for low outcome And Predicting Post operative Mortality.

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Abstract:

Background and objectives: *The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) and its modification the Portsmouth POSSUM, have been proposed as a method for standardising patient data so that direct comparisons can be made in spite of differing patterns of referral and population. Application of the POSSUM scoring system in this country where the level of healthcare and resources differ, is limited. In this prospective study, the validity of P-POSSUM was tested in patients undergoing major surgery to predict their mortality rate and to compare its accuracy as well as to identify a cut off range in the score to predict a higher percentage of mortality in the cases*

Methods: *200 surgeries in minor, moderate and major+ categories as described by P POSSUM scoring were studied. Complications and death rates were noted. Accuracy of the mortality score of P POSSUM was determined by comparison of death rates by mann whitney test. Chi square test and fischers exact test were used to find out the significant risk factors contributing to mortality. ROC curve plotting was done and analysed to obtain a cut off range beyond which mortality can be predicted.*

Results: *mann whitney test was done to find out the accuracy of the predicted mortality by the scoring system. the mortality score was found to be significant statistically in predicting the observed death and complications.(p- 0.0004 for mortality). In all the risk factors studied, a positive correlation was found between higher possum score and mortality. A threshold score for predicting mortality was also calculated and a cut off was obtained.*

Interpretation and conclusion: *Portsmouth POSSUM scoring system serves as a good predictor of post operative mortality in major general surgical procedures and was applicable even in our setup and be used for comparing various treatment modalities and assessing the quality of care provided. A cut off range in the mortality score was also obtained to serve as a predictor of post operative mortality in the said cases.*

Keywords: *mortality scoring, POSSUM, Portsmouth POSSUM, surgical scoring, audit*

I. Introduction

Mortality and morbidity are important and objective ways of measuring results. However, its raw rates are inadequate to define the management of resources, monitor performance of medical care, as well as to assure quality medical service. The basic aim of any surgical procedure is to cause reduction in morbidity and mortality rates. By comparing the influence on adverse outcome; we can assess the efficiency of that particular procedure and assess the quality of care provided to the patient. Comparison using crude morbidity and mortality rates is fallacious, because of differences in general health of the local population and variable presentation of the patient's condition Risk scoring seeks to quantify a patient's risk of adverse outcome based on the severity of illness derived from data available at an early stage of the hospital stay [4]

The possible outcome of a surgical operation must be determined to cause evolution of more effective treatment regimens.

Therefore, there is a need for:

- Accurate risk adjusted scoring system that's specific to the patient.
- Should incorporate the influence of the disease diagnosed for which the surgery is planned
- Allow for assessment of variable presentation of each patient
- Assessment of the efficiency of the procedure being performed]
- Easy to use, fast and comparable among different patient groups.
- Comparison of quality of care provided and the efficacy of the procedure performed by comparing the expected to observed mortality rate.
- Predicting the individual patient's prognosis, influence treatment decisions and help in rationalizing regimens.
- Should help set a benchmark acceptable adverse outcome rate for a particular procedure, by comparing mortality rates among different surgeons.
- This would result in a better and more meaningful surgical audit that will help is better and faster adaptation of a new procedure by comparing the reduction in the observed to expected adverse outcome rate.

Different calibrated systems were developed to obtain mortality estimates for various classes of patients in hospital settings, including patients undergoing surgery. Among these systems is the Physiological and operative severity scoring system for the enumeration of morbidity and mortality(POSSUM), created by Copeland and collaborators as a statistical model to predict the surgery risk based on exponential analysis.

The Physiological and Operative Severity Scoring system for the enumeration of Morbidity and mortality (POSSUM) has been proposed as a risk adjusted scoring system to allow for direct comparison between the observed and expected adverse outcome rates[5, 6]. It has been called as a surgeon based scoring system.The Portsmouth POSSUM is a modification of the POSSUM scoring system, incorporating the same variables and grading system, but a different equation, which provides a better fit to the observed mortality rate, which is an important and objective measure of outcome [7] It has already found use in general [9], vascular[9-12], colorectal[13-15] oesophageal[16] and laparoscopic procedures but the studies mostly involved patients in developed countries, where the patient characteristics, presentation and available resources differ from indian setup[17].Hence, there is a need to test the validity of P-POSSUM scoring system in the Indian scenario where, malnourishment is a common problem, presentation frequently delayed and resources limited, all of which can influence the patient's complication rate, even with adequate quality of care provide.

The scoring system should be able to incorporate these factors to predict an accurate mortality rate.The P-POSSUM scoring system that includes both physiological and operative findings parameters recorded pre operatively, intra operatively, has been proposed to address these concerns.Therefore, there is a need to test whether the P-POSSUM scoring system is able to effectively address these concerns while arriving at the expected mortality rate in the indian scenario. Major surgeries (elective and emergency), as defined by the POSSUM scoring system, constitute the important high risk group of patients where, the comparison of observed to expected mortality rate would be expected to yield significant results and, determination of the possible causes for the adverse outcome in patients who succumb following the surgical procedure, would be more beneficial.This study was undertaken to assess the validity of P-POSSUM scoring system in patients undergoing surgeries in our setup and, to try to analyse the causes for low outcome in this high risk group

II. Objectives

1. To assess the validity of Portsmouth POSSUM scoring system in predicting anticipated mortality rate and to compare with the actual mortality rate in general surgical patients admitted for surgical procedures in JUSTICE K.S.HEGDE HOSPITAL, MANGALORE during the period of October 2014 to september 2016.
2. To assess validity of Portsmouth POSSUM scoring system in identifying risk factors for its adverse outcomes
3. To obtain a threshold cut off score of this scoring system beyond which patient mortality can be predicted pre operatively.

III. Methodology

- **Source of data:**
- This prospective study was carried out on patients undergoing major general surgical procedures admitted department of general surgery of JUSTICE K.S.HEGDE HOSPITAL, MANGALORE from October 2014 to september 2016.
- Sample size- 200
- Period of follow up- 30 days post surgery.

- **Method of collection of data:**

Patients admitted under general surgery and scheduled to undergo major surgical procedures were scored according to their physiological and operative findings using a proforma sheet (Annexure III). The p possum score was calculated using a possum calculator

- **Inclusion criteria:**

Patients undergoing any of the following surgical procedures as defined by the POSSUM scoring system
1. Any laparotomy
2. Bowel resection
3. Cholecystectomy , appendicectomy
4. Peripheral vascular procedure
5. Major amputation.
Neck surgeries
Hernia
Breast surgeries
Turp

And the surgeries mentioned in major, major +, moderate categories

- **Exclusion criteria:**

1. Age less than 12 years
2. Day care surgery
3. Follow up period criteria not met.

Patients were informed regarding the aims and objectives of study and a detailed informed written consent was taken prior to inclusion into the study (Annexure III). The study protocol was approved by the local ethical clearance committee of this hospital. During hospitalisation relevant history was collected and appropriate investigations as deemed necessary were done using standard procedures The patients were then scored depending on their physiological parameters and the intra operative findings were noted and a final expected mortality rate was calculated.

Portsmouth physiological and operative severity score for the enumeration of mortality and morbidity (p-possum).

Score	1	2	4	8
Age(years)	≤60	61 - 70	≥71	
Cardiac history Chest X-ray	Nil Normal	Drug treatment	Oedema/warfarin Borderline Cardiomegaly	Raised JVP Cardiomegaly
Respiratory history Chest X-ray	Normal	Dyspnoea on exertion Mild COPD	Limiting dyspnoea (on flight stairs) Moderate COPD	Dyspnoea at rest Fibrosis/consolidation
Systolic blood pressure (mmHg)	110 - 130	131 - 170 or 100 - 109	≥171 or 90 - 99	≤89
Pulse rate (b.p.m)	50 - 80	81 - 100 or 40 - 49	101 - 120	≤39 or ≥121
GCS	15	12 - 14	9 - 11	≤8
Urea (mmol/L)	≤7.5	7.6 - 10	10.1 - 15	≥15.1
Haemoglobin (g/L)	130 - 160	115 - 120 or 161 - 170	100 - 114 or 171 - 180	≤99 or ≥181
White cell count (×10^{12}/L)	4 - 10	10.1 - 20 or 3.14	≥ 20.1 or ≤ 3	
Sodium (mmol/L)	≥136	131 - 135	126 - 130	≤125
Potassium (mmol/L)	3.5 - 5	3.2 - 3.4 or 5.1 - 5.3	2.9-3.1 or 5.4-5.9	≤2.8 or ≥6
ECG	Normal		MI > 6 months ago; AF rate < 90	MI < 6 months ago; AF rate > 90/min

b.p.m., beats per minute; COPD, chronic obstructive pulmonary disease; GCS, Glascow coma score; JVP, jugular venous pressure; each of the 12 rows is scored according to patient factors. These scores are added to give a physiological score for the patient.

Table 1 physiological scoring

Operative Severity Score.

	1	2	4	8
Operative severity	Minor	Moderate	Major	Major⁻
Multiple Procedures	1		2	>2
Total blood loss (ml)	<100	101-500	501-999	>1000
Peritoneal soiling	None	Minor (serous fluid)	Local pus	Free bowel content, pus or blood
Presence of Malignancy	None	Primary only	Nodal metastasis	Distant Metastases
Mode of surgery	Elective		Emergency resuscitation of >2h possible <24h after admission	Emergency (immediate surgery <2h needed

Table 2 operative scoring

Physiological score (12-88), Operative score (9-44)

For mortality it is, score was calculated

Loge [R/1-R] = (0.1692 x PS) + (0.155 x OS) - 9.065.

Where R = risk of mortality[7].

The Portsmouth possum score for morbidity and mortality was calculated for each patient using a P POSSUM calculator software.Mortality and morbidity scores were calculated out of 100 using the calculator.The patients were then followed up for a period of 30 days following the surgical procedure and complications if any, were noted depending upon the following criteria as defined for POSSUM scoring system[5].

IV. Results

A total of 200 patients were analysed between September 2014 and September 2016 in K.S.Hegde medical academy, derlakatte, mangalore.They were followed up for a period of 30 days post operatively.No patients were lost for follow up.Patients underwent surgeries in the moderate, major and major+ categories.Majority of the patients (50%) had surgeries that were classed as major categories 5 13% patients underwent surgery in the major + category as described by Copeland et al 5

Mode of surgery: There were 63 emergency procedures performed during the study period.

Malignancy:

44% patients were operated for some sort of malignancy

36% had nodal metastases

7 % had distant metastases

Death rate: of the 200 patients studied, 36 of them were associated with death of the patient.

Crude death rate: 18% in the study population

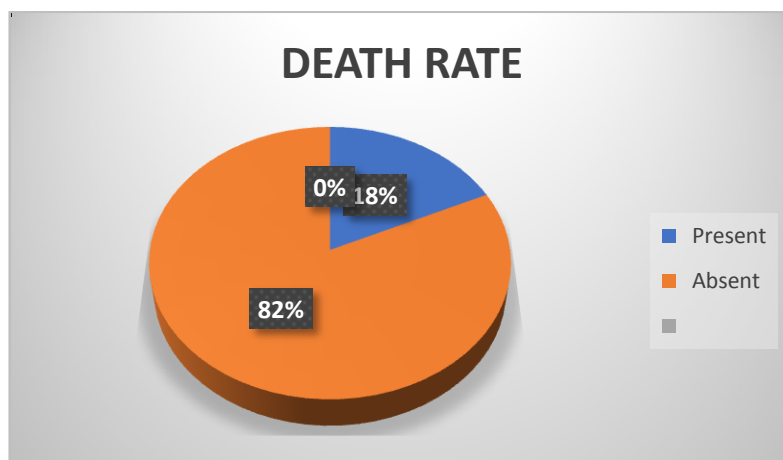|		Frequency	Percent
	Present	36	18.0
	Absent	164	82.0
	Total	200	100.0

Table 3- death rate

Figure 1

Most common complication observed was wound infection (59 cases, 24.5%), chest infection (42 cases, 18%). Sepsis was seen in 28 cases (11.6%) Anastomotic leak was seen in 21 out of the 240 cases. (9%)
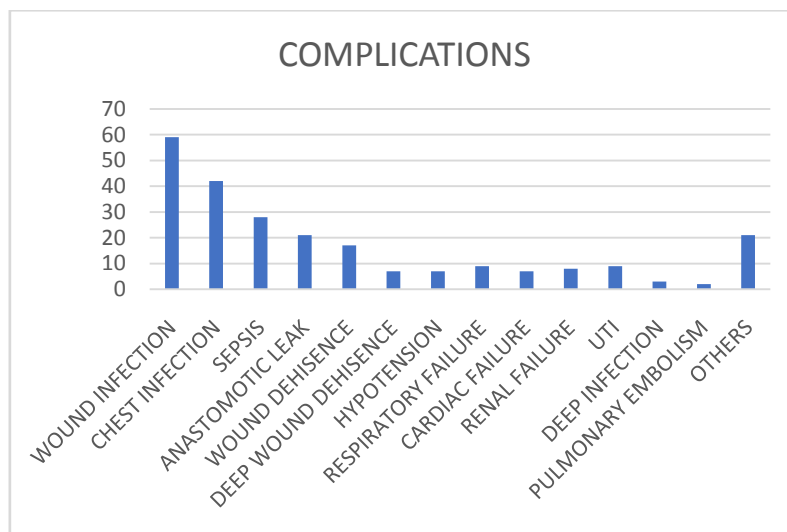
Figure 2

Based on the cross tabulation study, the parameters mentioned in Portsmouth possum scoring system were analysed as to how they contributed individually towards the mortality of the patients post operatively.The relation between the different scores allotted to a specific parameter among the 200 patients and their observed mortality post operatively was also analysed. Chi square test and fischers exact test was then used to identify the parameters in the scoring system that directly contributed in a significant way to the post operative death of the patient It was found that, all the 12 physiological and the 4 operative parameters had a significant bearing towards predicting the post operative mortality in the study group.All physiological parameters were found to be highly significant in predicting the post op mortality.Out of the operative parameters: operative severity, multiple procedures, operative blood loss, and peritoneal soiling were found to be highly significant.Mode of surgery, that is, whether the surgery was undertaken in an emergency setting or an elective setting was found to be only marginally significant.Presence or absence of malignancy in the patients pre operatively was found to be statistically insignificant in predicting the mortality of the patients in the study group.

|	chi square/Fishers exact test p	
age/sex	0.001	HS
cardiac	0.000	HS
Resp	0.000	HS
BP	0.000	HS
pulse	0.000	HS
Gcs	0.000	HS
Hb	0.000	HS
Wbc	0.000	HS
Urea	0.000	HS
sodium	0.000	HS
Potass	0.000	HS
Ecg	0.000	HS
operative severity	0.000	HS
multiple procedures	0.000	HS
total blood loss	0.000	HS
peritoneal soiling	0.005	HS
mode of surgery	0.018	sig
malignancy	0.080	NS

Table 4- evaluation of risk factors and association with outcome

Mean mortality rates depicted in observed deaths and cases that had no mortality

      36 deaths were observed in out of the 200 patients who underwent surgery.Crude death rate of the study was found to be 18 %. The mean mortality score as per the P POSSUM scoring system in the study was found to be 71.611 among the cases in whom actual mortality was observed. Mean mortality score in the remaining cases where there was no observed mortality was 19.54, significantly lower than the mortality group.

The median mortality rate among the observed deaths in the study was found to be 82.46. The score in the observed mortality group(n-36) ranged from 49.18 being the lowestto 94.32 being the highest score.In the group with no mortality, median score was a very low 2.42. After the mann whitney test, the z value was found to be 8.20 The p value of the test obtained when comparing the expected mortality score and the observed mortality along with the sore in the cases with no mortality post operatively in the study was 0.0004. This was found to be highly significant for this study Hence it is inferred that the mortality score predicted by the P POSSUM scoring system had a high level of accuracy and the scoring system can be used as a valid tool in predicting mortality in surgeries pre operatively.

mortality score

Death	N	Mean	Std. Deviation	Median(IQR)	Mannwhitney test Z value	p
Present	36	71.61194	29.528731	82.46(49.1825-94.325)	8.209	.000
Absent	164	11.89604	19.543045	2.42(1.2725-14.465)		HS

Table 5- p value of P POSSUM mortality score
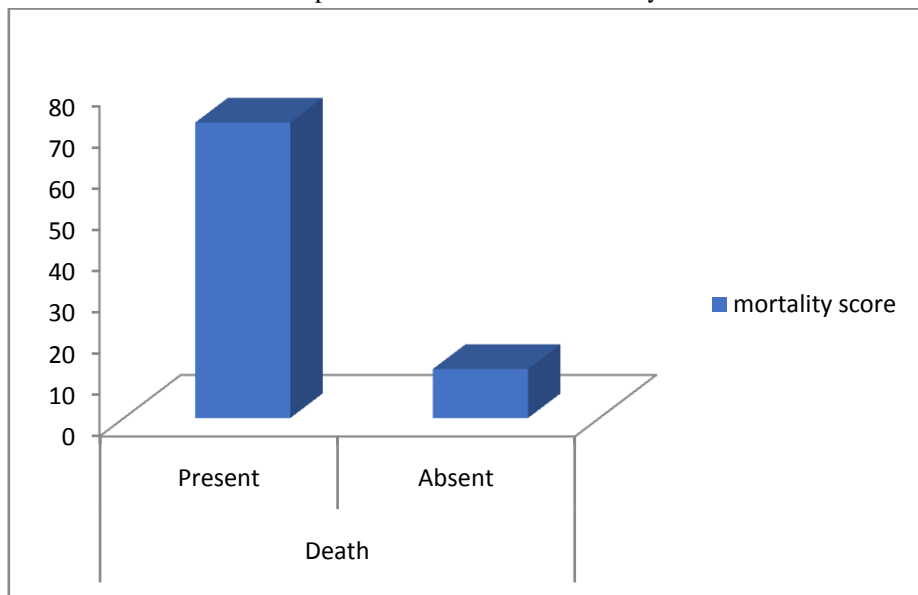
Figure 3

Obtaining the cut off threshold possum score to predict mortality

      Receiver operating characteristic of the study or ROC curve was plotted using the true positivity rate of the scoring system against the false positivity rate of the scoring system. Area under the curve obtained was significantly large indicating the high accuracy of the scoring system This statistical system was used to arrive at a value in the scoring system which had the potential to accurately predict the mortality in the patients based on the data in the study. The score with the highest sensitivity and specificity possible in this model was assessed and taken as threshold score.It was found that a possum mortality score between 18.64 and 22.03 had the highest sensitivity and specificity for predicting a mortality and had the potential to be determined as a cut off score beyond which observed mortality may be increased manifold. In other words, if pre operatively a mortality score of more than 18- 22 out of 100, there is a risk for actual death in the patient post operatively.Therefore, the parameters that contribute towards the score should be controlled in such a way that the score is achieved below 18 when predicting the mortality score using this scoring system, so that chance of post operative death can be reduced.
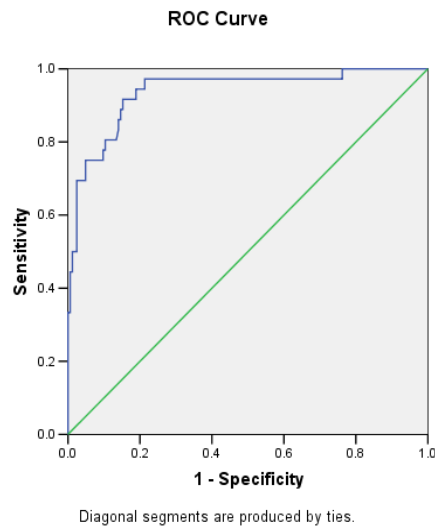
Figure 4

Area Under the Curve

Area	Std. Error(a)	Asymptotic Sig.(b)	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.937	.024	.000	.891	.984

V.   Discussion

The basic tenet in medical care has been to provide quality care to the patient to cause reduction in adverse outcome. It is by comparing the adverse outcome rates that we can assess the adequacy of care provided to the patient and evolve new treatment strategies. However, comparison using crude mortality rates can be misleading as it cannot adequately account for the patient's general condition and the disease process for which he was subjected to surgery. To overcome this shortcoming POSSUM, a risk adjusted scoring system was proposed5.P-POSSUM, a modification of POSSUM, has been proposed as a better scoring system as it better correlates with the observed mortality rate. But P-POSSUM has to be correlated to the general condition of the local population for it to be effective[7,8,14,15,19,21].This is especially true in patients in developing countries like India where the general health of the population is poor, malnutrition is a common problem and presentation frequently delayed.In our study, we assessed the validity of P POSSUM in 200 surgeries by comparing the mortality rate and morbidity rate with actual observed death and complications. 36 patients died (crude mortality of 18%). Tekkis et al obtained similar results (mortality rate of 11.1%). On analysis, the mean mortality score in patients with actual mortality was 71.6 (median 82.46). The P POSSUM scoring system was found to be an accurate predictor (p-0.0004) for mortality in this scenario.

On analyzing the risk factors, it was found that all physiological risk factors contributed towards mortality post operatively and were found to be highly significant towards predicting the mortality in the study. Of the operative parameters, all the parameters except mode of surgery(p- 0.018) and presence of malignancy (0.080) were found to be highly significant as risk factors towards mortality. Various factors like decreased immunity and cachexia resulting from malignancy, ischemia and impaired haemostasis resulting from blood loss, uraemia resulting in decreased healing rates, impaired immunity, leucocytosis correlating with the degree of inflammation, toxaemia, hyponatremia resulting into impaired physiological response could be attributed to the effect of these factors on post operative mortality rate.

Therefore adequate and prompt correction can definitely be expected to cause a decrease in adverse outcome rates.On analyzing morbidity, Tekkis and others found that total blood loss was not significant enough to alter their statistical analysis in their study but their study predominantly involved elective cases (66%) in a super speciality setting. Of the observed complications, wound infection was seen as the most common complication (59 cases, 24%). Chest infection (42 cases, 18%) and sepsis (28 cases, 11.6%) were the other two complications observed.

Anastomotic leak was seen in 21 patients (9% patients). 240 complications were observed in the cases studied.Similar results were obtained by Mohil RS (35% and 20% respectively).Wound infections could be attributed to the large number of patients who had gross peritoneal contamination resulting from hollow visceral perforation resulting in local contamination of the incision site. A raised diaphragm, upper abdominal incision and gross peritoneal contamination resulting into higher rates of chest infections in our study.An attempt was made to obtain a margin or a cut off value for the mortality score beyond which a post operative death or complication could be expected. Using the data in the study, it was determined that a post op mortality could be expected if the mortality score according to possum score was above the range of 18-22..

Hence the scores can be used effectively as a predictive tool to predict post operative mortality. Moreover, it can be used to identify the risk factors and the morbidity and mortality rates in a particular setting and help improve the death rate and complication rates.

VI. Conclusion

This study validates the Portsmouth possum scoring system in general surgery in an indian setup as a valid means of assessing the quality of care being provided. It is a scoring system tailored to assess patients undergoing surgeries and help in risk assessment of the patients with respect to both mortality and morbidity. Hence this can be used to improve the quality of care provided by focusing on improving the score by improving the said parameters for each patient. A fairly accurate prediction can also be made pre operatively with regards to the risk of mortality to the patient.

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