Original Article

Portsmouth Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity scoring system in general surgical practice and identifying risk factors for poor outcome

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Abstract

Background: Estimation of the outcome is paramount in disease stratification and subsequent management in severely ill surgical patients. Risk scoring helps us quantify the prospects of adverse outcome in a patient. Portsmouth-Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (P-POSSUM) the world over has proved itself as a worthy scoring system and the present study was done to evaluate the feasibility of P-POSSUM as a risk scoring system as a tool in efficacious prediction of mortality and morbidity in our demographic profile. **Materials and Methods:** Validity of P-POSSUM was assessed prospectively in fifty major general surgeries performed at our hospital from May 2011 to October 2012. Data were collected to obtain P-POSSUM score, and statistical analysis was performed. **Results:** Majority (72%) of patients was male and mean age was 40.24 ± 18.6 years. Seventy-eight percentage procedures were emergency laparotomies commonly performed for perforation peritonitis. Mean physiological score was 17.56 ± 7.6, and operative score was 17.76 ± 4.5 (total score = 35.3 ± 10.4). The ratio of observed to expected mortality rate was 0.86 and morbidity rate was 0.78. **Discussion:** P-POSSUM accurately predicted both mortality and morbidity in patients who underwent major surgical procedures in our setup. Thus, it helped us in identifying patients who required preferential attention and aggressive management. Widespread application of this tool can result in better distribution of care among high-risk surgical patients.

Key words: Portsmouth-Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity, risk scoring, surgical audit

INTRODUCTION

Each surgical procedure brings forth inherent risks, and surgical safety is of foremost concern. Using only crude mortality rates to say surgeon A is better than surgeon B, can be extremely misleading as other factors such as patient factors, facilities in surgical setup, and pre- and post-operative care also play a role.[1] Thence arise the need of risk scoring which may help in the

Access this article online	
Quick Response Code:	Website: www.jnsbm.org
	DOI: 10.4103/0976-9668.198342

How to cite this article: Tyagi A, Nagpal N, Sidhu DS, Singh A, Tyagi A. Portsmouth Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity scoring system in general surgical practice and identifying risk factors for poor outcome. J Nat Sc Biol Med 2017;8:22-5.

accurate prediction of outcome. An ideal risk scoring system should accurately quantify a patient's risk of adverse outcome early, should be easy to use, fast, and comparable across different patient groups. The simplest and oldest classification being used is the American Society of Anaesthesiologists Physical Status (ASA-PS) classification but has limitations in describing individual risk of complication in postoperative period.[2,3] Various other scoring system is available but fail to incorporate surgical factors. Copeland *et al.* developed Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) scoring system in hope of providing a retrospective and prospective analysis of surgical mortality and morbidity.[1] They initially analyzed 62 parameters and ultimately improvised to the final set of 12 physiological and six operative factors. The score derived was subjected to multivariate discriminate analysis to get outcome.[1,4] Whitely MS from Portsmouth University demonstrated an over prediction of by a factor of two and suggested use of linear regression analysis to derive a better equation.[5] Thus, Portsmouth-POSSUM (P-POSSUM) is a modification of the POSSUM, which uses same variable and grading system, but a different equation to provide better results. In our center where, malnourishment is a common problem, presentation frequently delayed, and resources limited. This study was carried out to assess the validity of P-POSSUM scoring in our hospital.

MATERIALS AND METHODS

After getting approval from institutional ethical and research committee this study was conducted prospectively on the patients undergoing elective and emergency major surgery as defined by POSSUM scoring system. Data were collected prospectively between May 2011 to October 2012 to include fifty consecutive patients excluding those who did not meet the 30 days follow-up criteria or were aged <12 years.

Detailed history, investigations as deemed necessary for the standard procedure were recorded in Performa. Each parameter was given a 4 grade exponential score (1, 2, 4, 8). Findings of clinical examination, biochemical and hematologic tests, and an electrocardiographic assessment were studied obtain score for each of the 12 physiologic parameters (age, cardiac signs including chest radiograph findings, respiratory history, blood pressure, pulse, Glasgow coma score, hemoglobin, white cell count, blood urea, serum sodium, serum potassium, and findings on electrocardiogram) and sum of score of 12 parameters was done to obtain physiologic score (PS). Similarly, six operative parameters (operative severity, multiple procedures, total blood loss, peritoneal soiling, the presence of malignancy, and mode of surgery) were recorded at the time of completion of surgery to obtain an operative score (OS). The two parameters thus obtained were entered into following logistic regression equation to derive percentage risk of mortality and morbidity.

For mortality it is,

$$\text{Log}_e [R/1 - R] = (0.1692 \times PS) + (0.155 \times OS) - 9.065.$$

Where R = Risk of mortality.

For morbidity it is,

$$\text{Log}_e [R/1 - R] = -5.91 + (0.16 \times \text{physiological score}) + (0.19 \times \text{operative score}).$$

Where R = risk of morbidity.

The expected mortality rate was compared with observed and observed: Expected ratio was calculated. Using SPSS 17 (IBM) Chi-square test was then applied to obtain the *P* value to note any significant difference between the predicted mortality rate and the actual outcome. Individual parameters were analyzed for morbidity and mortality and Chi-square test was applied to obtain *P* value to see statistical correlation between mortality and different risk factors.

RESULTS

A total of 50 patients admitted for emergency/elective major surgery in surgical ward were studied. Mean age was 40.24 ± 18.6 years. 72% of patients were male and M:F ratio was 2.57:1. Majority (78%) procedures were emergency surgeries while 22% elective. Perforation peritonitis was the most common indication for surgery and per operatively most common site of perforation found was in Ileum followed by duodenum, appendix, and cecum. Other indications included intestinal obstruction, penetrating abdominal trauma. Among elective procedures, indications were gastrointestinal malignancy, common bile duct calculi, and others. Various indications of surgery are represented in Table 1.

Table 1: Indication for surgery

Indications	Number of patients	Percentage
Perforation peritonitis	26	52
Intestinal obstruction	9	18
Penetrating abdominal trauma	3	6
Gastrointestinal malignancy	4	8
Cholelithiasis with common bile duct stone	4	8
Others	3	6

The mean physiological score was 17.56 ± 7.6 with a range of 12–42 while mean operative score was 17.76 ± 4.5 with a range from 9 to 26. Total P-POSSUM score was in the range of 21–61 with mean of 35.3 ± 10.4 of the fifty procedures six were associated with death, thus crude mortality rate was 12.00%. Based on P-POSSUM expected mortality rate of 14% was obtained in this study. The ratio of observed to expected mortality rate was 0.86 (× 2 = 00.258, 4 df, $P = 0.992$). Comparison of observed and P-POSSUM predicted mortality rates was done using linear analysis as in Table 2 across various risk bands. Postoperative complications encountered during the 30 days follow-up period following the surgery are listed in Table 3. Based on P-POSSUM expected morbidity rate of 54% was obtained in the present study while observed morbidity was 42%. The ratio of observed to expected morbidity rate was 0.78. The comparison is illustrated in Table 4. On analysis of individual risk factors nine of the 18 risk factors were found to have significant association with mortality namely cardiorespiratory status ($P = 0.00$), Pulse rate ($P = 0.01$), Glasgow Coma Scale ($P = 0.03$), hemoglobin ($P = 0.05$), electrocardiograph changes ($P = 0.00$), blood urea ($P = 0.00$), serum sodium ($P = 0.03$), serum potassium ($P = 0.02$), blood loss ($P = 0.02$), while P value for other nine risk factors was >0.05.

Table 2: Comparison of observed mortality with predicted mortality

Predicted mortality rate (%)	Number of patients	Observed	Expected	Observed: expected ratio
<10	39	1	2	0.50
>10-<20	5	1	1	1.00
>20-<30	1	0	0	0.00
>30-<40	1	0	0	0.00
>40-<50	-	-	-	-
>50-<60	1	1	1	1.00
>60-<70	1	1	1	1.00
>70-<80	2	2	2	1.00
>80-<90	-	-	-	-
>90-<100	-	-	-	-
Total	50	6	7	0.86

Table 3: Postoperative complications

Type	Number of cases	Percentage
Wound dehiscence (superficial)	9	18
Wound infection	8	16
Chest infection	5	10
Septicemia	3	6
Respiratory failure	2	4
Wound dehiscence (deep)	2	4
Renal dysfunction	2	4
Pulmonary embolism	1	2

Table 4: Comparison of observed morbidity with predicted morbidity

Predicted morbidity rate (%)	Number of patients	Complications observed	Expected	Observed: Expected ratio
<10	4	0	0	0.00
>10-<20	6	0	1	0.00
>20-<30	3	0	1	0.00
>30-<40	1	0	0	0.00
>40-<50	10	4	5	0.80
>50-<60	7	2	4	0.50
>60-<70	4	1	3	0.33
>70-<80	4	3	3	1.00
>80-<90	6	6	5	1.20
>90-<100	5	5	5	1.00
Total	50	21	27	0.78

DISCUSSION

Despite advancement in surgical technique and critical care facilities, high-risk surgical procedures are associated with substantial mortality.[3] As per WHO global estimates, approximately 1–5 million postoperative deaths occur per year, and postoperative morbidity is expected to be 5–10 times this rate.[6] Herein comes role of surgical audit as it is only by comparing the occurrence of an adverse outcome we can assess the safety and efficacy of a particular procedure.[7] Risk scoring measurement can help in standardization and evolution of more effective treatment regimens. Simple scoring system using fewer variables and simple equation often compromises accuracy, whereas a complex system with many variables and complex equation, may achieve precision but compromises ease of use. Thus, in an ideal system, there should balance between ease of use and accuracy. Numerous scoring systems are available such as ASA-PS,[8] goldman's index,[9] charlson's score,[10] acute physiology and chronic health evaluation, surgical risk scoring[11] but each has its own pros and cons.

POSSUM, in essence, is a surgeons scoring system as it includes parameters accounting for operative severity. Use of exponential analysis in POSSUM was criticized.[12] Since inception numerous modifications have been proposed and the most significant being P-POSSUM. It helped counter the shortcoming of POSSUM in overestimating mortality, especially in low-risk patients.[13] In this study, finding of an observed to expected mortality of 0.87 and morbidity of 0.78, validated P-POSSUM in our setup. Prytherch *et al*.[14] observed over prediction of the mortality rate by a factor of two by POSSUM, rectified it by application of P-POSSUM. Menon *et al*.[15] evaluated P-POSSUM in patients with or without methicillin-resistant *Staphylococcus aureus* infection, suggested P-POSSUM as means of standardizing patient data among a diverse group of patients. The worthiness of P-POSSUM has been proven across surgical setups,

in various geographical locations like Midwinter *et al.* and Treharne *et al.*[16] patients undergoing vascular surgery, Yii and Ng[17] general surgery in Malaysia, Zafirellis *et al.*[18] undergoing esophagectomy. Stonelake *et al.*[19] observed high efficacy of P-POSSUM as compared to other scoring systems. Ying *et al.*[20] suggested some drawbacks of POSSUM like different definitions of postoperative complications result in different settings, issue of missing data, difficulty in establishing the classification of electrocardiography abnormalities and the exact operative blood loss. Furthermore, noninclusion of liver function, blood glucose, nutritional status which are often detrimental in outcome after surgery.[21]

CONCLUSION

P-POSSUM has shown tremendous efficacy in the prediction of 30 days mortality and morbidity following major surgery at in our setup and authors recommend their routine use in high-risk patients. Small sample size was a limitation. Both POSSUM and P-POSSUM are available as online calculators and have dedicated applications in android and iOS platform their availability on smartphone's or tablets can speed up the calculation process making them extremely easy to use, can encourage further widespread application. P-POSSUM risk scoring system helps in appropriate clinical decision making and a useful audit tool for surgical procedures to improve the quality of surgical care.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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