

Surgical Evaluation of P-Possum and Cr-Possum Scores in Patient Undergoing Colorectal Cancer Operation

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Abstract

Background: "Portsmouth" modification of POSSUM (P-POSSUM) scoring system used to assess mortality in general surgical patients and "Colorectal" Cr-POSSUM scoring system used for mortality assessment for colorectal patient. **Objective:** The purpose of the present study was to estimate the validity of the P-POSSUM (Portsmouth-POSSUM) and Cr-POSSUM (Colorectal-POSSUM) score in predicting the risk of mortality in colorectal cancer patient. **Methodology:** This was single centre clinical trial was carried out in the Department of Surgery at Dhaka Medical College Hospital, Dhaka, Bangladesh from November 2013 to April 2014 for a period of six (06) months. Patients of both sex who got admitted in the surgery in-patient department for elective colorectal cancer operations were selected as study population. Both the P-POSSUM and Cr-POSSUM, physiological score, operative score, predicted mortality rate were calculated using an online POSSUM calculator. Based on both P-POSSUM and Cr-POSSUM Scoring, patients were categorized into three risk groups. Then a comparative analysis was performed between the observed and the predicted values as well as the Observed/Predicted ratio (O:P) in all the risk groups. **Results:** A total of 50 patients with the median age of 50 (ranging 20 to 72) years were studied. 30 days overall observed mortality was 3(6%) patients. The mean P-POSSUM and C-POSSUM physiological scores were 32.49±2.08 and 13.92±1.30 respectively. However, the operative score was 11.59±1.46 and 8.12±0.24 in P-POSSUM and C-POSSUM respectively. The overall mortality predicted by the P-POSSUM model was 5 patients (19.33±2.87) and mortality predicted by the Cr-POSSUM model was 4 patients (20.66±4.09). **Conclusion:** In conclusion both model accurately predicted the risk of postoperative death. Cr-POSSUM provided a better fit to observed results than P-POSSUM. [*Journal of National Institute of Neurosciences Bangladesh, July 2020;6(2): 118-123*]

Keywords: Surgical evaluation; P-Possum; Cr-Possum; scores; colorectal cancer

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Introduction

Colorectal cancer is the third most common cancer in the world. An estimated 1.24 million people worldwide are diagnosed with colorectal cancer. It is the fourth most

common cause of cancer death worldwide¹. Surgery is one of the important modality of treatment in colorectal cancer.

Outcomes after surgery are influenced by preoperative

physiological status, operative severity, the provision of appropriate care. Surgeons can minimize the deleterious effects of the surgical insult by careful preoperative planning, meticulous intraoperative technique and by accurate postoperative care. Preoperative physiological status and preoperative co-existing medical problems translate into increased operative risk and mortality². However, when comparing quality of care, mortality rates has obvious limitations and may give misleading results because they do not consider the physiologic condition of the patient at the time of surgery, the severity of the surgery, and the age and general health of the patient³. To give a more objective comparison for quality of care, various scoring systems have been introduced.

There are many scoring systems like American Society of Anesthetists (ASA) and Acute Physiology and Chronic Health Evaluation (APACHE II& III) that predict the risk of mortality with varying degrees of accuracy⁴. While all these scoring systems are used in generally sick patient, none is exclusively for surgical patients. One of the first scoring systems for predicting outcome in surgery is the physiological and operative severity score for the enumeration of mortality and morbidity (POSSUM), which has been designed for general surgery⁵. Since the original POSSUM system is introduced, several modifications have been suggested for the specific requirements of certain surgical subspecialties. Therefore, modifications of the original POSSUM score are created. The Portsmouth POSSUM (P-POSSUM) system was designed to overcome the problem of over predicting mortality in patients at low risk by using the original POSSUM score. P-POSSUM system is found to be more accurate in predicting mortality in general surgery⁶. The colorectal POSSUM (Cr-POSSUM) system has been created specifically for colorectal surgery. Even the P-POSSUM model still over predicts mortality in low-risk groups, but is a better 'fit' than POSSUM. Furthermore, there have been reports of over prediction in different surgical specialties. This has led some to produce specialty-specific POSSUM such as V-POSSUM for use in elective vascular surgery and Cr-POSSUM for colorectal surgery⁷. The purpose of the present study was to estimate the validity of the P-POSSUM (Portsmouth-POSSUM) and Cr-POSSUM (Colorectal-POSSUM) score in predicting the risk of mortality in colorectal cancer patient.

Methodology

Study Settings & Design: This study was designed as a prospective, single centre, non-comparative and

non-randomized clinical trial which was carried out in the Department of Surgery at Dhaka Medical College Hospital, Dhaka, Bangladesh from November 2013 to April 2014 for a period of six (06) months. Patients of both sex with the age of more than or equal to 18 years were selected who got admitted in the surgery in-patient department of Dhaka Medical College Hospital with the need of elective colorectal cancer operations. Patients of emergency colorectal cancer surgery patient and pediatric patients aged less than 14 years and the patients having lack of necessary investigations were excluded from the study. The physiological variables of all selected patients were collected just after admission by doing necessary investigations and operative variables were obtained from the records and by personal communication with the operating surgeon.

Study Procedure: Both the P-POSSUM and Cr-POSSUM, physiological score, operative score, predicted mortality rate were calculated using an online POSSUM calculator. The P-POSSUM predicted mortality risk scores of all patients were arranged serially ranging from 0.7 to 42 and Cr-POSSUM predicted mortality risk scores of all patients were arranged serially ranging from 0.95 to 49.92. Based on both P-POSSUM and Cr-POSSUM scoring, patients were categorized into three risk groups⁸. The groups were named as minor, moderate and major. Then a comparative analysis was performed between the observed and the predicted values as well as the Observed/Predicted ratio (O:P) in all the risk groups. Data was collected in a pre-designed data collection sheet. Physiological data of the patients were collected before operations at the time of admission and operative variables were collected at per-operative and postoperative period. All data gathered from data collection sheet was forwarded to computer software named P- POSSUM and Cr-POSSUM calculator V2 (Richard Muirhead, 2000) freeware or by online POSSUM calculator. POSSUM online calculator and formulated data was transferred to Microsoft Excel version Office 2007. P-POSSUM equation for mortality: $\text{Ln} [R / (1-R)] = -9.37 + (0.19 \times \text{physiological score}) + (0.15 \times \text{operative severity score})$; where R is the predicted risk of mortality. Cr-POSSUM equation for mortality: $\text{Ln} R/1-R = -9.167 + (0.338 \times \text{physiological score}) + (0.308 \times \text{operative severity score})$; where R = predicted risk of mortality. This calculation also can be made easily by computer software or through online risk score calculation program by using internet.

Statistical analysis: The data were processed and were

analyzed using computer software SPSS (Statistical Package for Social Sciences, version 22.0). Qualitative data were expressed as frequency and percent. The quantitative data were expressed as mean and standard deviation. The descriptive statistics of quantitative data were analyzed as median and mode.

Results

Over the 6 months of the study, 50 patients of age range 20 to 72 years, were selected preoperatively from different units of Department of Surgery at DMCH, Dhaka. The mean P-POSSUM physiological and operative scores of all patients were around 32 and 14 respectively; the mean Cr-POSSUM physiological and operative scores of all patients were around 12 and 8 respectively. Within one month of postoperative period, 6.0% mortality was reported. These terms like minor, moderate and major were used here only for the name of the groups to understand the severity of the predicted risk and they did not mean minor/major disease or operation. All patients (50) were arranged serially according to the post-operative individual P-POSSUM predicted mortality risk (0.7% to 42%) and Cr-POSSUM predicted mortality risk (0.95% to 49.92%) and number of the group was set from the personal interest according to the pre-study approved protocol. The entire patients could be grouped into any number in the same type of study. The mean with SD of predicted mortality score of P-POSSUM was

Table 1: Comparison of Predicted Mortality score between P-Poosum and Cr-Poosum among Risk Band

| Risk Band Group | Mortality Score (%) | | P value |
|-----------------|---------------------|------------|---------|
| | P-Poosum | Cr-Poosum | |
| Minor | 4.89±2.29 | 2.82±2.75 | 0.0009 |
| Moderate | 17.10±2.03 | 15.21±2.07 | 0.0002 |
| Major | 36.0 ±4.31 | 43.96±7.46 | 0.0001 |

Student t test was performed to see the level of significance

4.89±2.29, 17.10±2.03 and 36.0 ±4.31 in minor, moderate and major risk groups respectively. However, the mean with SD of predicted mortality score of P-POSSUM was 2.82±2.75, 15.21±2.07 and 43.96±7.46 in minor, moderate and major risk groups respectively (Table 1).

In this study the mean physiological score ranged from 25.47±4.15 to 38.0±1.50. The lowest mean score was seen in minor risk group which was 25.47±4.15 and the major risk group having the highest score 38±1.50. The moderate risk group physiological score was 34.0±1.04. The mean operative score ranged from 10.29±0.52 in group-1 (minor risk) to 13.0±2.44 in group-3 (major plus). Group-2 (moderate risk) operative score was 11.50±1.44 (Table 2).

In this study that it was clearly seen that the summation number of mean physiological and operative score was gradually raised from minor to major risk group. The minor group represented the summation number (9.20+7.05=16.25) which was seen as 27.25 (17.25+10) in major risk group. It was observed that the predicted P-POSSUM mortality in percentage which was 4.89±2.29 2 in number and observed death was 1 in number in group-1. The O/P ratio was 0.5(50%) in Minor (group-1). The O/P ratio of Moderate (Group-2) was 0.5=50% and major (Group-3) was 1=100%. Overall P-POSSUM mortality O/P ratio is 66 %. It was noted that Cr-POSSUM mortality O/P ratio is 100% in minor and moderate risk group. The O/P ratio 0.5=50% was seen in major risk group. Overall O/P ratio is 75.0%. In this study minor and moderate risk group the P-POSSUM mortality predictability were 50.0% and Cr-POSSUM predictability was 100%. But in major group P-POSSUM predictability was 100.0% in comparison to Cr-POSSUM. In total P-POSSUM predicted mortality 66.0% and Cr-POSSUM predicted mortality 75.0% (Table 3).

Table 2: Comparison of Physiological and Operative scores of P-POSSUM and Cr-POSSUM in three risk group

| Scores | Minor Group | | Moderate Group | | Major Group | |
|-----------------------------|-------------|-----------|----------------|-----------|-------------|-----------|
| | P-POSSUM | Cr-POSSUM | P-POSSUM | Cr-POSSUM | P-POSSUM | Cr-POSSUM |
| Physiological Scores | | | | | | |
| • Mean±SD | 25.5±4.15 | 9.2 ± 2.5 | 34.0±1.04 | 15.3±0.51 | 38.0±1.50 | 17.2±0.95 |
| • Median | 27 | 9 | 34 | 15,16 | 38 | 17.50 |
| • Mode | 27,29 | 9 | 34,35 | 15 | 37 | 18 |
| Operative Scores | | | | | | |
| • Mean±SD | 10.29±0.52 | 7.05±0.22 | 11.50±1.44 | 7.33±0.51 | 13±2.44 | 10.0±0 |
| • Median | 10 | 7,8 | 10,12 | 7.33 | 35.10 | 10 |
| • Mode | 10,11,12 | 7 | 11.50 | 7 | 31.8 | 10 |

Table 2: Comparison of Physiological and Operative scores of P-POSSUM and Cr-POSSUM in three risk group

| Scores | Minor Group | | Moderate Group | | Major Group | | Overall | |
|-------------------------------|-------------|-----------|----------------|-----------|-------------|-----------|-----------|-----------|
| | P-POSSUM | Cr-POSSUM | P-POSSUM | Cr-POSSUM | P-POSSUM | Cr-POSSUM | P-POSSUM | Cr-POSSUM |
| Predicted Mortality | 4.9±2.29 | 2.8±2.75 | 17.1±2.03 | 15.2±2.07 | 36.0±4.31 | 44.0±7.46 | 19.3±2.87 | 20.7±4.09 |
| Predicted Deaths | 2 | 1 | 2 | 1 | 1 | 2 | 5 | 4 |
| Observed Deaths | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 |
| O/P Ratio with Predictability | 50% | 100% | 50% | 100% | 100% | 50% | 66% | 75% |

Discussion

Surgical audit has increased in importance over the past few years, both as an educational process and as a means of assessing the quality of surgical care⁹. The ideal scoring system for surgical audit purposes should assess mortality and morbidity and should allow audit retrieval of the surgical success. It should be quick and easy to use and should be applicable to all general surgical procedures in both the emergency and elective settings. It should be of use in all types of hospital. There are many scoring systems that predict the risk of mortality with varying degrees of accuracy¹⁰. Many scores have been devised which are ideally suited to special types of surgical procedure or to assess particular types of complication. Some scores are ideal for assessing the risk of mortality and to a lesser extent morbidity in particular groups of surgical patients¹¹.

These scoring systems have not been evaluated in surgical patients in any hospitals in Bangladesh. It was tried to study prospectively the accuracy of P-POSSUM and Cr-POSSUM in predicting colorectal cancer patient mortality. Audit is an essential part of surgical practice. It is a tool for self-assessment and monitoring, and a complement to research and education. The Royal College of Surgeons of England has defined audit as the 'systematic appraisal of the implementation and outcome of any process in the context of prescribed targets and standards'¹². Sheldon defined clinical audit as 'A study of outcome of part of the structure, process and outcome of medical care carried out by those personally engaged in the activity concerned, to measure whether set objectives have been attained and thus assess the quality of care delivered'¹³.

POSSUM was designed originally as a postoperative, general surgical, audit tool. However, its use has since expanded into other surgical fields and preoperative assessment. In theory, P-POSSUM and Cr-POSSUM provide an attractive tool for surgical audit and triage. However, if it is to be used with confidence, Cr-POSSUM need to be validated for specific surgical

procedures like colorectal cancer surgery. Whiteley et al¹⁴ and Copeland et al¹⁵ observed the use of P-POSSUM for predicting mortality in both retrospective and prospective analysis. However, Prytherch et al¹⁶ reported that POSSUM over-predicted mortality more than twofold. In a study that compared P-POSSUM and CR-POSSUM, CR-POSSUM was found to be the most promising tool for colorectal surgery. This is why P-POSSUM and Cr-POSSUM equation was used in this study for mortality.

In this study, among 50 patients the median age was 47 years with the range of 20 years to 72 years. In the original POSSUM, the physiological data are collected close to the surgery, but here in this study data are collected following admission and/or resuscitation. Here the mean P-POSSUM physiological score is 32.49±2.23 and mean of operative score is 11.59±1.46 and Cr-POSSUM the mean physiological and operative score is 13.93±1.30 and 8.12±0.24 respectively. However, 3 patients are found to be dead within one month postoperatively.

In this study, preoperative physiological and post-operative parameters of all patients are calculated at P-POSSUM and Cr-POSSUM calculator. P-POSSUM predicted mortality (%) and Cr-POSSUM predicted mortality (%) are found individually of all patients from the online P-POSSUM and Cr-POSSUM calculator. The P-POSSUM predicted mortality risk scores of all patients are arranged serially ranging from 0.7 to 42. Based on P-POSSUM Scoring, patients are categorized into three risk groups, having 34 patients in minor, 12 patients in moderate, 4 patients in major. On other hand the Cr-POSSUM predicted mortality risk scores of all patients are arranged serially ranging from 0.95 to 49.92. Based on Cr-POSSUM scoring, patients are categorized into three risk groups, having 40 patients in minor group, 6 patients in moderate and 4 patients in major.

In this present study the mean P-POSSUM physiological score and operative score raise serially in consecutive risk group. The highest P-POSSUM

operative score seen in major risk group. Mean physiological and operative score may be different irrespective of risk group. The highest summation of the two scores (physiological + operative) was observed in major risk group 51(38+13). In this study the mean Cr-POSSUM physiological and operative severity score also raise serially in consecutive risk group. The highest summation of the two scores (physiological and operative) was observed in major risk group (27.25±0.95).

This study showed that in case of minor risk group there was 1 death occurred and the predicted mean P-POSSUM mortality was (4.89±2.29), the nearest whole of predicted death in number was 2. The observed and predicted ratio (O/P ratio) is 0.5(50%). It means that P-POSSUM is over predicted the death number in minor group. On the other hand Cr-POSSUM predicted risk mortality for group-1 is 2.82±2.75; the nearest whole of predicted death number is 1 and predicted death is 1. The O/P ratio for Cr-POSSUM equation is 1. The prediction is 100.0%. Here, for minor group, the better predictability for mortality was seen to be effective by Cr-POSSUM equation in comparison to P-POSSUM. In moderate risk group P-POSSUM predicted mortality rate was (17.10±2.03) 2 in number and observed death was 1(one) in number and O/P ratio was 0.5(50%) and Cr-POSSUM mortality O/P ratio was 1(one)100%. Here in this group Cr-POSSUM predict mortality accurately than P-POSSUM. Substantial differences in prediction of mortality based on P-POSSUM have been described when applying this score in different populations and health care systems¹⁶. Bennett-Guerrero et al¹⁷ compared P-POSSUM mortality rates after surgery between patients in the United States and the United Kingdom and found over prediction of mortality by a factor of 4 to 6 in the United States. Possible reasons for such over prediction may include differences in the organization of intensive care units.

In group-3(major group) the P-POSSUM predicted death in number is found 1 and observed death is also 1; therefore O/E ratio in this group is 1. In the same group Cr-POSSUM predicted mortality was 2 and observed mortality was 1, O/P ratio was 0.5(50%). It was found that P-POSSUM predict death accurately than Cr-POSSUM. It is due to P-POSSUM Predict mortality accurately in high risk group. In total number of 50 patients Cr-POSSUM predict mortality (20.66 4.09)% 4 in number and observed death 3 in number; therefore, O/P ratio is 0.75 (75%). Other hand P-POSSUM predict mortality(19.33±2.87)% 5 in

number and observed death 3 in number, so O/P ratio is 0.66(66%). This study has showed that Cr-POSSUM well predict mortality than P-POSSUM in colorectal cancer patient. Therefore, validity of this evaluation needs larger group of patients, and subsequently it may be used in all hospitals in Bangladesh near future. Specific scoring systems may be required to evaluate surgical outcomes in different specialties. The Cr-POSSUM system was created as a modification of an original POSSUM score to suit the specific needs of colorectal surgery¹. The results of our study demonstrate better accuracy of Cr-POSSUM compared with P-POSSUM in predicting mortality after surgery for colorectal cancer, which is in agreement with the results of another published study¹⁸. However, all scoring systems tend to optimize the fit of the data to the original population. Although during development, Cr-POSSUM fitted the data well in both the development and validation sets, it is important to cross-validate the scoring system externally by applying the model to a different population to assess its predictive power¹⁹.

There are some limitation of this study. The study was done on a very small sample size, may not represent the whole picture. No randomization or blinding method was employed in the current study. This might probably have given rise to sampling error and bias.

Conclusion

In conclusion both P-POSSUM and Cr-POSSUM are validated mortality accurately although Cr-POSSUM more accurate. Cr-POSSUM shows actual validity over P-POSSUM in prediction of colorectal cancer mortality as in different developed centers in the world. P-POSSUM and Cr-POSSUM equation is being used in different hospitals in the developed world as a surgical auditing and computerized monitoring system. Further study may be needed combining large sample size with long term evaluation and multicenter estimation should be in concern for more valid result.

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