Efficacy of Possum in Surgical Audit of Patient Undergoing Emergency Surgery at Nepalgunj Medical College

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ABSTRACT

Introduction: The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) has been proposed as a method for standardizing patient data so that direct comparisons can be made in spite of differing patterns of referral and population. **Aims and objectives:** To evaluate the efficacy of a scoring system for predicting the incidence of postoperative complications and mortality in patient undergoing Emergency Surgeries based on the Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM). **Material and Methods:** This is a hospital based cross sectional study of all the cases that had undergone Emergency Surgery at Nepalgunj Medical College Teaching Hospital from the period of July 2014 to June 2015. The period of follow up was 30 days following the surgical procedure. A total of 100 emergency surgeries, as defined by the POSSUM scoring system criteria were studied. Predicted mortality and morbidity rates were calculated using the POSSUM equation by exponential analysis method. It was then compared with the actual outcomes. Observed: Expected Ratio (O:E) was calculated and difference detected by chi-square test. The risk factors as scored in the POSSUM criteria were noted. **Results:** Applying exponential analysis, an observed to expected ratio (O:E) for mortality of 0.44 was obtained, indicating significant difference between the predicted and observed values (x^2=93.207, df 63, p=0.008). But, an observed to expected ratio (O:E) for morbidity of 1.01 was obtained and there was no significant difference between the predicted and observed values (x^2=76.295, df 71, p=0.312). It was found to be comparable to other studies. In all the risk factors studied, a positive correlation was found between deaths and post-operative complications with higher POSSUM scores. **Conclusion:** POSSUM scoring system could accurately predict overall morbidity while it over predicted the overall mortality. POSSUM scoring system serves as a good predictor of post-operative outcome 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.

Keywords: *Emergency Surgery, morbidity, mortality, POSSUM, surgical scoring*

INTRODUCTION

A scoring system quantifies a patient's risk of morbidity and mortality based on the severity of illness derived from data available at an early stage of hospital stay. The ideal scoring system for surgical audit purposes should assess mortality and morbidity and retrieval of surgical success, it should also allow comparison of these rates between institutions, teams and individual surgeons. The need to develop measures of health outcome for use in surgical audits was recognized and resulted in the development of the Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity (POSSUM) which is currently the appropriate system for assessing surgical outcomes by risk-adjusted analysis[1].

POSSUM was first described by Copeland et al in 1991, as a method for normalizing patient data so that direct comparisons of patient outcome could be made despite varying patterns of referral and demographic characteristics[2]. It was found that POSSUM over-predicted death. In an effort to counteract the perceived shortcomings of POSSUM, Prytherch et al, devised the Portsmouth predictor equation for mortality (P-POSSUM), which is thought to be a more accurate predictor of mortality. P-POSSUM also uses the same physiological and operative scoring methods as described by Copeland et al, but P-POSSUM uses linear analysis while POSSUM uses exponential analysis[1,3].

Surgeons are more aware of POSSUM than other scoring systems used by anesthetists for example who ASA for general risk prediction and APACHE for critically ill patients on ICU. ASA is too simplistic and highly subjective whilst APACHE is too complex for general use. POSSUM lies somewhere between these two systems, closer to APACHE and requires only 12 physiological and 6 operative parameters for its calculation. POSSUM can even be used in the pre-clerking clinic to give an estimate of risk providing those clinicians handling the data understand the implications.

Originally POSSUM was designed specifically for general surgical spectrum, both in elective and emergency settings. Later on POSSUM was successfully applied to specialist areas like colorectal surgery, laparoscopic cholecystectomy, vascular surgery, orthopedic surgery and cardiothoracic surgery, etc.

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POSSUM uses 12 physiologic and 6 operative variables to give a calculated risk of morbidity and mortality. Minimum score of 12, max score of 88. In order for perioperative risk to be calculated, the sum of the physiologic and operative variables is entered into 2 mathematical equations which are used to calculate the risk of morbidity and mortality. In this study an evaluation of the risk assessment with POSSUM scoring system will be done in our setup.

MATERIAL AND METHODS

This is a hospital based cross sectional study of all the cases that had undergone Emergency Surgery at Nepalgunj Medical College Teaching Hospital from the period of July 2014 to June 2015. The period of follow up was 30 days following the surgical procedure. Total of 100 cases were taken for final analysis. All the patients who had undergone Emergency Surgery on Outpatient Basis, Day care Surgery, Emergency Surgery in Specialized Units viz. Cardiothoracic Surgery, Urosurgery, Neurosurgery, were excluded in the study. A multipart structure sheet containing patient demography and variables from history, clinical examination, investigations, operation undergone and outcome were designed. Physiological data were entered at the time of induction of anesthesia. Operative scores were entered at the completion of operation. All completed sheets were gathered. Post operative Morbidity and Mortality were noted within 30 days of Emergency Operation. Data analysis was done by SPSS (SPSS, Chicago, Illinois, USA) version 20 software. Value of $p<0.05$ were taken to be significant.

RESULT

A total of one hundred emergency surgical operations were performed between July 2014 to June 2015. Out of 100 emergency surgeries, 74 were male patients and 26 were female patients.

Outcome of Surgery

Out of 100 emergency operations studied, 8 of them eventually died within 30 days after operation and 52 of them had developed some complications resulting in crude mortality rate as 8% and crude morbidity rate as 52%.

Observed: Expected Mortality Ratio

Comparison of observed and POSSUM predicted mortality rates was done using exponential analysis represented in Table No.II. An observed to expected ratio (O: E) of 0.44 was obtained and there was significant difference between the predicted and observed values (x^2=93.207, df 63, p=0.008). The null hypothesis was that the equation would be an adequate fit; it follows the large x^2 and correspondingly small p values are indicative of lack of fit.

Complications

The complications occurring during the 30 day follow up period following the surgeries are listed in table III.

Observed: Expected Morbidity Ratio

Comparison of observed and POSSUM predicted morbidity rates was done using exponential analysis represented in Table No. IV. An observed to expected ratio (O:E) of 1.01 was obtained and there was no significant difference between the predicted and observed values (x^2=76.295, df 71, p=0.312).

S.No.	Indications	No. of Patients
1.	Duodenal Perforation	19
2.	Acute Appendicitis	19
3.	Acute Intestinal Obstruction	11
4.	Obstructed/ Strangulated Hernia (Inguinal/ Femoral)	10
5.	Ileal Perforation	9
6.	Appendicular Perforation	9
7.	Peritoneal Breach Injuries (Bull Injuries & Stab Injuries)	4
8.	Chest Injuries (Pneumothorax, Hemothorax & Surgical Emphysema)	4
9.	Abscess	4
10.	Scrotal Injuries	3
11.	Blunt Trauma Abdomen with Splenic Lacerations	2
12.	Gastric Perforations	2
13.	Mesenteric Ischemia	2
14.	Compartment Syndrome	1
15.	Bleeding Hemorrhoids	1
	Total	**100**

Table No. I: Indications

Predicted Mortality Rate (%)	No. of Procedures	Mean Risk (%)	Observed No. of Death (O)	Expected No. of Death (E)	O:E
< 10	44	4.713	0	2	0
>10 to <20	30	15.153	0	5	0
>20 to <30	11	25.763	1	3	0.33
>30 to <40	3	34.7	0	1	0
>40 to <50	7	45.54	3	3	1
>50 to <60	0	0	0	0	0
>60 to <70	2	67.75	1	1	1
>70 to <80	2	75.2	2	2	1
>80 to <90	1	81.2	1	1	1
>90 to 100	0	0	0	0	0
Total	**100**	**17.34**	**8**	**18**	**0.44**

Table No. II: Comparison of Observed and Expected Mortality Ratio

S.No.	Complications	No. of Patients
1.	Wound Infections	26
2.	Chest Infections	20
3.	Wound Dehiscence	10
4.	Hypotension	3
5.	Anastomotic Leak	3
6.	Septicemia	3
7.	Impaired Renal Function	3
8.	Respiratory Failure	2
9.	Urinary Infection	1
	Total	**71**

Table No. III: Complications

Predicted Morbidity Rate (%)	No. of Procedures	Mean Risk (%)	Observed No. of Complications (O)	Expected No. of Complications (E)	O:E
< 10	1	9.3	0	0	0
>10 to <20	23	16.66	2	4	0.5
>20 to <30	4	24.3	0	1	0
>30 to <40	9	36.5	6	3	2
>40 to <50	8	43.68	2	3	0.66
>50 to <60	10	53.97	4	5	0.8
>60 to <70	18	64.92	13	12	1.08
>70 to <80	9	74.16	8	7	1.125
>80 to <90	10	83.19	9	8	1.125
>90 to 100	8	94.15	8	8	1
Total	**100**	**56.01**	**52**	**51**	**1.01**

Table No. IV: Comparison of Observed and Expected Morbidity Ratio

Risk Factors

1. Age: In our study there was significant correlation of age of patient for predicting mortality (x^2=7.975, df=2, p=0.019) but it was statistically insignificant for predicting morbidity (x^2=5.036, df=2, p=0.081).
2. Cardiac Signs: In our study there was significant correlation of cardiac signs of patient for predicting mortality (x^2=4.891, df=1, p=0.027) but it was statistically insignificant for predicting morbidity (x^2=1.884, df=1, p=0.170).
3. Respiratory Signs: In our study there was significant correlation of respiratory signs of patient for predicting mortality (x^2=24.776, df=2, p=0.000) as well as it was statistically significant for predicting morbidity (x^2=14.605, df=2, p=0.001).
4. Systolic Blood Pressure: In our study there was significant correlation of Systolic Blood Pressure of patient for predicting mortality (x^2=43.257, df=3, p=0.000) as well as it was statistically significant for predicting morbidity (x^2=12.302, df=3, p=0.006).
5. Pulse: In our study there was significant correlation of Pulse rate of patient for predicting mortality (x^2=34.078, df=3, p=0.000) as well as it was statistically significant for predicting morbidity (x^2=27.851, df=3, p=0.001).
6. Glasglow Coma Scale : In our study there was significant correlation of Glasglow Coma Scale of patient for predicting mortality (x^2=23.496, df=1, p=0.000) but it was statistically insignificant for predicting morbidity (x^2=1.884, df=1, p=0.170).
7. Urea : In our study there was significant correlation of BUN of patient for predicting mortality (x^2=8.398, df=3, p=0.038) as well as it was statistically significant for predicting morbidity (x^2=26.427, df=3, p=0.000).
8. Sodium: In our study there was significant correlation of Serum Sodium level of patient for predicting mortality (x^2=24.654, df=3, p=0.000) as well as it was statistically significant for predicting morbidity (x^2=8.483, df=3, p=0.037).
9. Potassium : In our study there was significant correlation of Serum Potassium level of patient for predicting mortality (x^2=48.123, df=3, p=0.000) as well as it was statistically significant for predicting morbidity (x^2=10.281, df=3, p=0.016).
10. Hemoglobin : In our study there was significant correlation of Hemoglobin level of patient for predicting mortality (x^2=13.788, df=3, p=0.003) as well as it was statistically significant for predicting morbidity (x^2=22.169, df=3, p=0.000).
11. White Cells Count (WCC) : In our study there was significant correlation of Hemoglobin level of patient for predicting mortality (x^2=9.263 df=2, p=0.010) as well as it was statistically significant for predicting morbidity (x^2=6.597, df=2, p=0.037).
12. Operative Magnitude : In our study there was no significant correlation of Operative Magnitude for predicting mortality (x^2=3.217 df=2, p=0.200) but it was statistically significant for predicting morbidity (x^2=25.325, df=2, p=0.000).
13. Total Blood Loss: In our study there was significant correlation of total blood loss during operation of patient for predicting mortality (x^2=12.388, df=3, p=0.006) but it was not statistically significant for predicting morbidity (x^2=2.762, df=3, p=0.430).
14. Peritoneal Contamination : In our study there was not significant correlation of peritoneal contamination during operation of patient for predicting mortality (x^2=0.865, df=3, p=0.834) as well as it was not statistically significant for predicting morbidity (x^2=5.518, df=3, p=0.138).
15. Malignancy : In our study there was no significant correlation of Malignancy for predicting mortality (x^2=0.177, df=1, p=0.674) as well as it was statistically insignificant for predicting morbidity (x^2=1.884, df=1, p=0.170).

DISCUSSION

Morbidity and mortality rates continue to be the main endpoints by which quality of care is judged in most institutions in developing countries such as Nepal. Patients undergoing emergency operations have diverse aetiologies and associated co-morbid conditions that can influence the outcome adversely. Patients seeking medical help in medical college and teaching hospital like this one mostly belong to low socioeconomic strata with very limited resources. Under such circumstances, measuring the quality of care using morbidity and mortality rates may be biased[4].

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.

So, POSSUM has been proposed as an accurate scoring system for auditing the outcome of patients who undergo surgery. It has the advantage of being simple and includes variables that are easy to collect. It takes into account both the admission physiology of the patient and the severity of the operation performed in predicting the rates of morbidity and mortality[5].

The POSSUM data set provides a good tool for monitoring the quality of care provided by a particular institution by making adequate risk adjustments. The validity of the POSSUM scoring systems has been verified over the past decade for use in general surgery and different subspecialties, including vascular, colorectal, gastroenterological, pulmonary and orthopaedic surgery. The variables required are assessed routinely in all patients undergoing emergency laparotomy and the

calculations are simple to perform. With practice it is possible to calculate the score in 90 seconds using a POSSUM Calculator Application in computers and mobile devices, and free packages are available on the internet to assist[4].

In our study, we assessed the validity of POSSUM in 100 emergency operations by comparing observed mortality with expected mortality and observed morbidity with expected morbidity. In total, 8 patient died (crude mortality rate being 8%) and 52 patient developed one or more complications in 30 days follow up period (crude morbidity being 52%).

In our study, observed: expected mortality ratio is less than 1 in total and low risk group suggesting over prediction except in high risk groups (>40% risk of mortality) where it is exactly 1. There is about 2.25 times over prediction in total and about 3 fold over prediction in low risk group. This result is in contrast to many studies where authors had showed no difference in observed mortality and expected mortality thus O: E ratio approaching around 1 in all risk groups[2,6]. Few authors had reported the similar over predictive tendency of the POSSUM scoring system especially in low risk groups. Prytherch et al. were the first one to report such observation in their study that POSSUM equation for mortality was found to be over predictive of the overall risk of death by more than two folds and the risk of death for patients at lowest risk (5% or less) by more than sevenfold[1].

But in other hand, observed: expected morbidity ratio is near about 1 suggesting good predictive value of test for assessing morbidity in patients. In lower risk groups, O: E ratio is below 1 but in higher risk groups it is above 1. Such result were seen in different studies that had showed no difference in observed and expected morbidity with O: E ratio around 1[2,6]. But this result is in contrast to numerous studies where expected to observed morbidity corresponds to each other[7,8].

On analyzing the risk factors, we found positive rate of increment with all the risk factors studied but it was found to be statistically significant with respect to Age (p=0.019), Cardiac Status (p=0.027), Respiratory Signs (p=0.000), Systolic Blood Pressure (p=0.000), Pulse (p=0.000), Glasglow Coma Scale (p=0.000), Urea (p=0.038), Sodium (p=0.000), Potassium (p=0.000), Hemoglobin (p=0.003), White Cell Count (p=0.010) and Total Blood Loss (p=0.006) in predicting mortality of patients.

And in predicting morbidity of patients, we found that the risk factors which were statistically significant were Respiratory Signs (p=0.001), Systolic Blood Pressure (p=0.006), Pulse (p=0.001), Urea (p=0.000), Sodium (p=0.037), Potassium (p=0.016), Hemoglobin (p=0.000), White Cell Count (p=0.037) and Operative Magnitude (p=0.000).

Various factors like decreased immunity resulting from increasing age, more post anaesthetic complications due to compromise in cardiac and respiratory systems, decreased cellular perfusions due to hypotension and bradycardia, uremia and hemoglobin levels resulting in decreased healing rates, toxemias, ischemia and impaired hemostasis resulting from blood loss and hyponatremia and hypokalemia resulting into impaired physiological response could be attributed to the effect of these factors on post-operative mortality and morbidity rates. Therefore, adequate and prompt correction can definitely be expected to cause a decrease in adverse outcome rates.

Wound infection (26 cases, 36%) and chest infections (20 cases, 28%) accounted for the majority of complications. Similar results were obtained by Mohil RS (35% and 20% respectively)[4]. 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 group.

It has been observed that application of a outcome scoring system to a population that is different from the original population in which the system was developed and calibrated, can only be done with absolute confidence if the composition of both populations is demonstrated to be similar, that is, if the baseline characteristics of their patients are comparable (same case mix)[9]. A Consensus Conference stated that "Mortality prediction models are almost always overspecific for the patient samples upon which they were developed, and thus performance usually deteriorates when models are applied to different population samples……, For this reason, we recommend that mortality prediction models always be tested in patient samples distinct from those in which the models were developed"[10]. In this study, mortality and morbidity prediction models of POSSUM were tested in patient samples distinct from in which the models were developed. This study showed that POSSUM is a good method of risk evaluation in predicting morbidity in emergency operations in our set up but not so satisfactory in predicting mortality rates. But, it gives us a rough picture of future morbidity and even mortality rates mostly in high risk groups and helps us to correct some of the risk factors and even makes the counselling of patients' relatives easier for surgeons before surgery. This scoring system can be applied in our set up for the surgical audit in emergency operations and even further research in needed to prove its efficacy in routine cases.

CONCLUSION

POSSUM scoring system could accurately predict overall morbidity and mortality in only high risk groups in general surgery patients who underwent emergency operations. However, there was significant over prediction of overall mortality in cases undergoing emergency operations.

Modifications of the POSSUM mortality and morbidity scoring systems by logistic regression analysis in larger patient setup is required to rectify its over prediction tendency in low risk group. Since POSSUM mortality and morbidity equations successfully predicted the overall morbidity rates and mortality rates in high risk groups in our setup, these scoring system can be used for audit purpose in emergency surgeries in general surgery department. POSSUM mortality and morbidity risk of an individual patient can be used for predicting outcomes, counselling and better resource utilization.

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