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Evaluation of POSSUM and P-POSSUM as a tool for prediction of surgical outcomes in the Indian population

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RESEARCH

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Abstract

Background

Increased scrutiny and the need to institute a truly patient centered approach to surgical care has motivated the growing interest in measuring the quality of surgical care through comparative surgical audit. This study aimed to assess the validity of the POSSUM (Physiological and Operative Severity Score for enumeration of Mortality and Morbidity) and P-POSSUM (Portsmouth-POSSUM) score in predicting the risk of morbidity and mortality respectively in general surgical patients presenting with conditions of various operative severities at a tertiary care centre in Haryana, a northern state of India.

Method

A prospective study was performed in 100 general surgical patients including an equal number of patients in each of the four groups of operative severity i.e. minor, moderate, major, major plus. The risks of mortality and morbidity were calculated by using the POSSUM equation for morbidity and the P-POSSUM equation for mortality in each patient. The predicted risks were compared with the observed risks of mortality and morbidity and statistically analysed.

Results

The difference in p value of predicted risk of morbidity by POSSUM equation and observed morbidity; calculated by chi square test was 0.756 which was not statistically significant. The difference in p value of predicted mortality by P-POSSUM equation and observed mortality; calculated by chi square test was 0.472 which was also not statistically significant.

Conclusion

POSSUM and P-POSSUM appear to be good and valid indices for use in the risk prediction of morbidity and mortality in the north Indian population.

Key Words

POSSUM, P-POSSUM, Surgical outcome

Background

Health professionals, especially surgeons, are increasingly being made accountable for their actions not only to their own professional organisation through revalidation to health authority managers, but also to the government, the media and above all to the population whom they serve. In this culture of increased scrutiny, surgeons must be able to clearly and accurately demonstrate how they perform, through comparative audit of their surgical outcomes. The need to institute a truly patient centered approach to surgical care has motivated interest in measuring the quality of surgical care. Surgical audit consists of critical assessment of surgical outcomes and results. Crude rates of morbidity and mortality are clearly misleading because these do not account for the physiological condition of the patient at the time of surgery and the age and general health of the patient population.[1] For meaningful comparison to be undertaken, some form of risk-adjusted analysis needs to be performed.[2]

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 recognised 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.[3]

POSSUM was first described by Copeland et al in 1991, as a method for normalising patient data so that direct comparisons of patient outcome could be made despite varying patterns of referral and demographic characteristics.[4] It was found that POSSUM over-predicted death. In an effort to counteract the perceived shortcomings of POSSUM, Whiteley 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]

There are very few studies involving the north Indian population,[5-7] therefore this study was planned to assess the value of POSSUM in predicting the morbidity rate and the value of P-POSSUM in predicting the mortality rate in general surgical patients of India.

Method

This study was carried out after institutional ethical clearance. Potential study participants were patients admitted to the Department of General Surgery at Pt. B.D. Sharma P.G.I.M.S., Rohtak, Haryana, India a tertiary care centre to which patients are referred from different regions of north India. A total of 100 patients undergoing elective or emergency surgery and requiring in-patient care for at least 24 hours were included in this study consecutively. Twenty-five patients from each of four different groups of surgeries, i.e. minor, moderate, major and major plus, were included in this prospective study (Table 1).[1,4]

All patients were scored before the operation using a physiological score and postoperatively using an operative severity score (Tables 2 and 3).[4,5,8,9] POSSUM morbidity and P-POSSUM mortality were calculated by allocating a physiological score based on 12 physiological variables (age, Glasgow score, respiratory rate, urea level, pulse rate, haemoglobin, WBC count, ECG, cardiac signs, Na, K level, systolic blood pressure) measured at the time of admission and then allocating a second score to the severity of operative procedure that the patient undergoes based on six operative variables: operative severity, multiple procedures, total blood loss amount, peritoneal soiling, cancer, mode of surgery. Each of these 18 variables was assessed by a four grade exponential score: 1, 2, 4 and 8. If a particular variable was not available, a score of 1 was allocated.[9,10] Comparison between predicted risk of morbidity by POSSUM morbidity equation and observed morbidity was performed and analysed (Table 6). Similarly a comparison between predicted risk of mortality by P-POSSUM mortality equation and observed mortality was performed and analysed. Morbidities were assessed by clinical observation. Confirmatory bacteriological and radiological tests were carried out only where clinical doubts existed. Morbidities were defined as described in the original paper by Copeland.[4] Values of serum Na^+ and K^+ were measured in milliequivalent instead of millimol as is reported in our institution. Morbidities and mortality within 30 days of operation were recorded on a prospective basis.[4,9] Various surgical procedures performed and associated morbidities and mortalities are shown in Table 4. Once physiological and operative scores were known, it was possible to estimate the predicted risk of morbidity and mortality using POSSUM equations. Morbidities were calculated using POSSUM equation for morbidity and mortalities were calculated using P-POSSUM equation for mortality given below.[1,4,5,11]

POSSUM equation for morbidity:

In [R / (1-R)]= -5.91 + (0.16 x physiological score) + (0.19 x operative severity score), where R is the predicted risk of morbidity.

P-POSSUM equation for mortality:

In [R / (1-R)] = -9.37 + (0.19 x physiological score) + (0.15 x operative severity score)

Where R is the predicted risk of mortality.

In our study, we had calculated the POSSUM score for morbidity and the P-POSSUM score for mortality by submitting values in a form provided at the URL: www.riskprediction.org.uk for calculating these scores.

Method of analysis:

The predicted mortality and morbidity rates were subsequently compared with the observed rates. Chi square test and Fisher's exact test were used to determine the statistical significance. P value (<0.05) was considered statistically significant.

Results

Various surgical outcomes were recorded in all patients within 30 days of operation showing that among 100 patients, 51 complications and 6 deaths occurred (Tables 4 & 5). The difference between observed and predicted morbidity (Table 6) was not significant (chi2= 1.393, df= 4, p= 0.845). The number of deaths predicted by P-POSSUM and observed number of deaths for different predicted risk grouping is shown in Table 7. The mortality rate predicted by P-POSSUM was not significantly different from the observed rate using Fisher's exact test (p=0.622). Patients in the risk group > 80 to ≤100 were at the highest risk of morbidity. Similarly patients in the mortality risk group ≥50 were at the highest risk of death as depicted in Figures 1 and 2. There was a close fit with observed morbidity by POSSUM morbidity equation and mortality by P-POSSUM mortality equation in all risk groups and no statistical difference was observed on comparison. However POSSUM and P-POSSUM predicted morbidity and mortality better for high-risk groups than low risk.

Discussion

Whiteley et al[1] and Copeland et al[4] observed the use of POSSUM for predicting mortality and morbidity and this method also helped in both retrospective and prospective analysis. However, Prytherch et al[3] and Kumar et al[12] reported that POSSUM over-predicted mortality more than twofold.[3] This is why we did not use it for mortality prediction. The POSSUM scoring system with the modified P-POSSUM predictor equation for mortality was also found applicable in Malaysia, a developing country, for risk-adjusted surgical audit.[11] Therefore the study was conducted on the north Indian population to confirm its applicability in a population of a state of a developing country.

Values of chi square test calculated in our study shows that POSSUM and P-POSSUM stand up well in predicting surgical outcomes. The study confirmed that both of these equations are valuable in assessing the patient outcome after a surgical procedure. This had a clear advantage over crude mortality and crude morbidity rates. The study shows that as the risk of morbidity increases, the patient is at more risk of an adverse surgical outcome.

POSSUM predicts morbidity closely to observed morbidity; better in high-risk than low-risk groups (Table 6). Whereas, P-POSSUM slightly over-predicted death in very low-risk groups but it was a close fit for high-risk groups (Table 7). Overall the P-POSSUM equation for mortality predicted death closely so this can be used reliably. Similar to our observation Mohil et al in 2004 observed that POSSUM was a good predictor of both morbidity and mortality whereas P-POSSUM predicted mortality well in patients undergoing emergency laparotomy.[6] Ramesh et al in 2008 reported that P-POSSUM was highly accurate in predicting mortality but POSSUM was not useful for the same in neurosurgical patients.[7]

Conclusion

POSSUM and P-POSSUM appear to be good and valid indices for use in risk prediction of morbidity and mortality respectively (surgical outcome) in the Indian population. Also they are better predictors in high-risk groups than in low risk-groups.

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PEER REVIEW

CONFLICTS OF INTEREST

None Declared

Table 1: Operative severity

Minor	Moderate	Major	Major Plus
Excision and biopsy of fibroadenoma;	Appendicectomy;	Any laparotomy;	Any aortic procedure;
eversion of sac in hydrocele;	cholecystectomy	peripheral bowel resection cholecystectomy with choledochotomy;	abdominoperineal resection;
varicocelectomy;	mastectomy;	vascular procedure; or	pancreatic or liver resection;
meshplasty in inguinal hernia.	Prostatectomy.	major amputation.	oesophagogastrectomy.

Table 2: Physiological severity score

Parameters	Score			
	1	2	4	8
Age (years)	≤60	61–70	≥71	
Cardiac signs	No failure	Diuretic, Digoxin, Anti-anginal or hypertensive therapy	Peripheral oedema, Warfarin therapy,	Raised JVP
Chest radiograph	Normal	–	Borderline cardiomegaly	Cardiomegaly
Respiratory history	No dyspnoea	Dyspnoea on exertion	Limiting dyspnoea (one flight)	Dyspnoea at rest (rate≥30/min)
Chest radiograph	Normal	Mild COAD	Moderate COAD	Fibrosis or Consolidation
Blood Pressure Systolic (mmHg)	110–130	131–170 or 100–109	≥171 or 90–99	≤89
Pulse (beats/min.)	50–80	81–100 40–49	101–120	≥121 ≤39
Glasgow Coma Score	15	12-14	9-11	≤8
Haemoglobin (g/100ml)	13–16	11.5–12.9 or 16.1–17.0	10.0–11.4 or 17.1–18.0	≤9.9 or ≥18.1
WBC count ($x10^{12}$/l)	4.0–10	10.1–20.0 or 3.1–4.0	≥20.1 or ≤3.0	
Blood Urea (mmol/l)	≤ 7.5	7.6–10.0	10.1–15.0	≥15.1
Sodium (mmol/l)	>136	131–135	126–130	≤125
Potassium (mmol/l)	3.5–5.0	3.2–3.4 5.1–5.3	2.9–3.1 5.4–5.9	≤2.8 ≥6.0
ECG	Normal	–	Atrial fibrillation (rate 60-90)	Any other abnormal rhythm or ≥5 ectopic/min, Q wave or ST/T wave changes

Table 3: Operative severity score

	Score 1	2	4	8
Operative severity	Minor	Moderate	Major	Major plus
Multiple procedures	0	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 metastases	Distant metastases
Mode of Surgery	Elective	–	Emergency resuscitation of >2h. possible, Operation < 24h after admission	Emergency * (immediate Surgery <2h. needed)

* Emergency resuscitation <2h indicates that resuscitation is possible even if this period is not actually used [4].

Table 4: Mortalities and morbidities in various operative procedures

Minor Procedures	No.	Morbidity	Mortality	Major Procedures	No.	Morbidity	Mortality
Hernia repair	7	3	0	Exploratory laparotomy with GI repair	24	19	2
Varico-celectomy	4	1	0	Cholecystectomy with choledocho-duodenostomy	1	0	0
Excision biopsy	8	3	0	Major Plus Procedures	No.	Morbidity	Mortality
Fistulectomy	2	0	0	Colectomy	7	7	2
Hydrocele surgery	4	2	0	Hartman's procedure	3	1	1
Moderate Procedures	No.	Morbidity	Mortality	Sternotomy + exploratorylaparotomy for hydatid cyst	1	1	0
Modified radical mastectomy	3	0	0	Abdomino-perineal resection	3	0	0
Urinary tract calculus surgery	3	0	0	Anterior resection	1	0	0
Appendectomy	7	3	0	Low anterior resection	3	3	0
Chole-cystectomy	7	1	0	Resection of mesenteric growth	1	1	1
Prostatectomy	3	1	0	esophagectomy	1	1	0
Colostomy closure	1	0	0	Whipple's procedure	2	1	0
Thyroid lobectomy	1	0	0	Resection of retroperitoneal tumor	1	1	0

				Wertheim's hysterectomy	1	1	0
				Radical cystectomy	1	1	0
Total	50	14	0	Total	50	37	6

Total Morbidity = 51 & Total Mortality = 6

Table 5: Various morbidities

Morbidity	No.	Morbidity	No.	Morbidity	No.
None	49	Wound haemorrhage	1	Wound Infection	14
Superficial wound dehiscence	3	Deep wound dehiscence	9	Anastomotic leak	6
Chest infection	7	Anastomotic leak	6	Cardiac failure	1
Hypotension	3	Respiratory failure	1	Renal failure	3
Others	3			Total	51

Table 6: Observed and predicted morbidity

Risk of Morbidity (%)	No. of Cases	Predicted	Observed	O/P Ratio *
>0 to ≤20	42	5	7	1.4
>20 to ≤40	11	3	5	1.7
>40 to ≤60	9	5	4	0.8
>60 to ≤80	19	14	15	1.1
>80 to ≤100	19	18	20	1.1
Total	100	45	51	1.13

* O/P = observed / predicted

Table 7: Observed and predicted mortality

Risk of Mortality (%)	No. of Cases	Predicted	Observed	O/P Ratio *
0 to ≤50	96	6	3	0.5
>50 to ≤100	4	3	3	1
Total	100	9	6	1.5

* O/P = observed / predicted

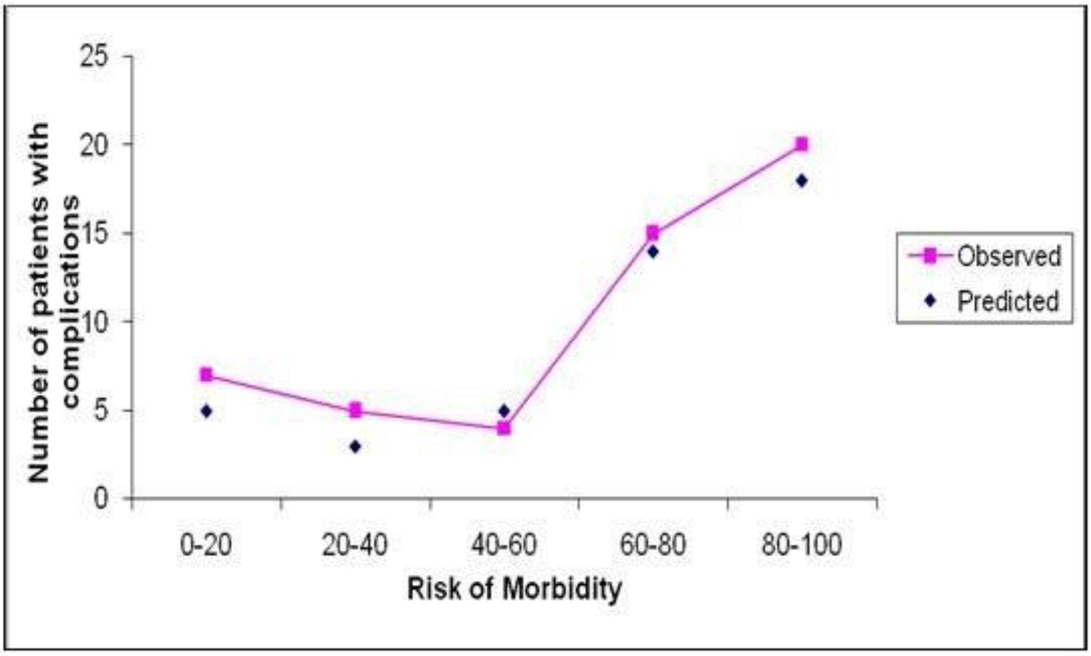

Figure 1: Observed complications closely follow the predicted morbidity

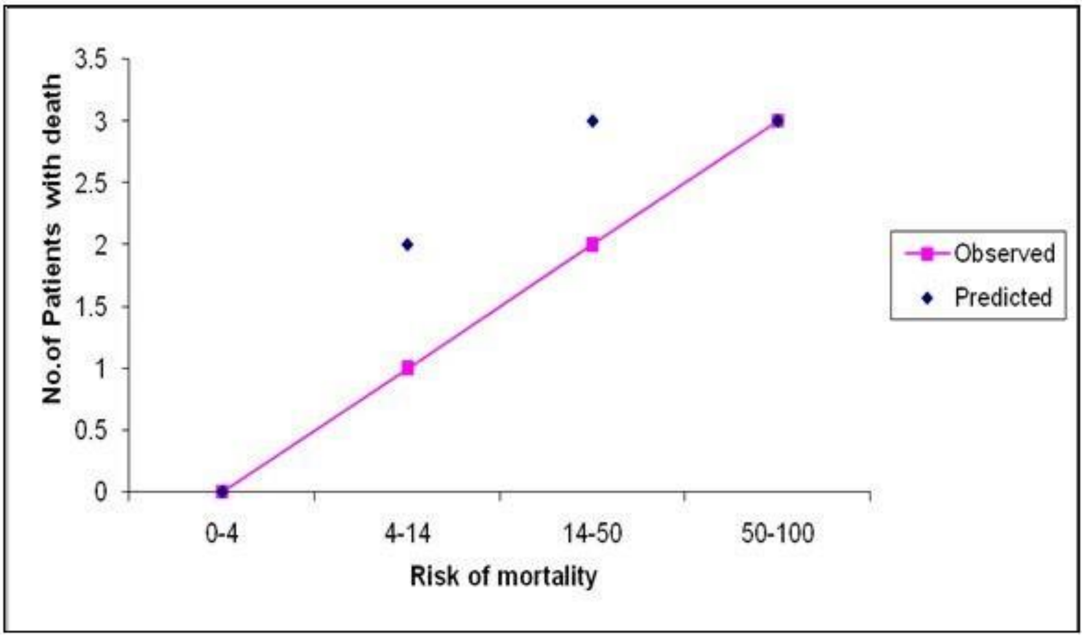

Figure 2: Observed deaths closely follow the predicted mortality