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Original Research Article

Comparison of P-POSSUM and E-POSSUM in defining prognosis in acute abdomen cases

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ABSTRACT

Background: The study attempts to define prognosis in acute abdomen cases using elderly modification (E-POSSUM) and compares its performance with physiological and operative severity score for the enumeration of mortality and morbidity (POSSUM) and Portsmouth modification- (P-POSSUM).
Methods: A non-randomized, prospective study was conducted between January 2016-November 2018 in 260 patients, aged ≥60 years old, undergoing elective and emergency general surgeries. Baseline characteristics, PS at the time of admission, surgery and OS at the moment of the patient's discharge was obtained after formal ethical consent. The follow up period was 30 days post-surgery, and complications if any, were noted.
Results: When exponential analysis was applied, POSSUM over predicted morbidity in low risk group (<30%), and though, it accurately predicted morbidity in higher risk strata, it was not statistically significant. Similarly, E-POSSUM accurately predicted morbidity for risk strata 60 -100 however, it was not significant when chi-square test was applied. However, when compared to POSSUM morbidity equation, E-POSSUM showed significant difference for risk strata 40-100 and 50-100. When exponential analysis was applied, E-POSSUM accurately predicted post-operative mortality similar to P-POSSUM. However, based on observed and expected ratio, E-POSSUM outperforms P-POSSUM in prediction of mortality.
Conclusions: Exponential analysis of E-POSSUM better predicts morbidity and post-operative mortality risk in various acute abdomen cases when compared to POSSUM morbidity and P-POSSUM mortality equation. Hence, E-POSSUM is a valid scoring system for predicting morbidity and mortality risk in elderly patients undergoing elective and emergency surgery for acute abdomen.

Keywords: Acute abdomen, Elective surgery, Emergency surgery, E-POSSUM, POSSUM, P-POSSUM

INTRODUCTION

Acute Abdomen is any sudden, critical intra-abdominal condition with an onset of less than 1 week.[1,2] Is not a single disease entity, but a blanket term for a symptom complex that constitutes a life-threatening abdominal condition, presented with pain, tenderness, and muscular rigidity.[3] Hence, the term 'acute abdomen' is used to describe a patient's condition until a final etiological explanation can be given and a diagnosis made.[4] Whether, presented in a noticeable or subtle manner, it must always be recognized as untreated condition may result in sepsis, necrosis or even death. The etiology classification for acute abdomen is infection, inflammation, obstruction, vascular, urologic, obstetric and gynecologic.[5] and its regional cause is given by Ansari.[6,7] Except for few cases with Acute Abdomen, which can be conservatively managed, most of the

conditions demands surgical intervention, such as laparotomy.[5,8-10] Hence, it is important to predict mortality and morbidity using severity scores which helps in risk prediction, identification of patients with unexpected outcomes, improve clinical decisions, helps in conducting risk-adjusted audit and finally, in assessing the quality of patient care by hospitals.[11,12] Such scoring systems should consider patient's physiological status, grade of disease, requirement for surgical intervention, nature of the operation along with pre and post-operative support instead of just assessing surgeon's abilities.

Understanding its importance, several scoring systems has been developed since 1941. Of which Physiological and Operative Severity Score for the enumeration of Mortality and morbidity (POSSUM) proposed in 1991 is well validated scoring systems for predicting post-operative morbidity and Portsmouth modification (P-POSSUM) is well validated scoring systems for predicting 30-day post-operative mortality risk in patients undergoing general and emergency surgery.[13-15] A table, representing physiological and operative score for POSSUM and P-POSSUM can be found in Banu et al.[16] According to Banu et al, both POSSUM and P-POSSUM scoring systems is based on same Physiological and Operative measures, use a four grade, twelve significant and independent Physiological factors which evaluate the physiological status of the patient at the time of surgery.[16] The values obtained for the physiological score (PS) can be between 12 and 88. The Operative Severity Score (OSS) is evaluated based on six factors of the severity of procedure, which is classified into Minor, Moderate, Major, Major Plus based on the mode of surgery, duration of surgery, number of surgical procedures, blood loss during surgery, peritoneal contamination and presence of metastases.[16] Since, the scoring system consider both pre- and intraoperative physiological parameters, it is easy to use and scored after decision to operate is made and not during admission.[17]

Since the original publication of POSSUM, the score has been modified and validated for numerous subtypes of surgeries and clinical scenarios, of which Elderly POSSUM (E-POSSUM) proposed and validated by Tran Ba Loc et al. in 2009, use the World Health Organisation (WHO) age classification for predicting morbidity and mortality in elderly patients aged ≥65 years.[17,18]

In developing countries like India, increased life expectancy, delayed diagnosis and resource limited settings affect surgical outcome despite adequate medical care. Therefore, to avoid such adverse outcomes, it is important to validate scoring systems for different acute abdomen cases.

Hence, the present study aims to validate the use of POSSUM, P-POSSUM and E-POSSUM in predicting morbidity and mortality risk in elderly patients undergoing elective and emergency surgery.

METHODS

Our study was based on non-randomised, prospective analysis conducted between January 2016 and November 2018 on 260 consecutive patients undergoing elective and emergency surgeries requiring in-patient care for ≥ 24 hours in General surgical wing of Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research located in Tamil Nadu, India. Patients aged <60 years of age, pregnant, cancer patients, those who died before surgery, re-exploration, surgery related to organ transplant, emergency laparotomy for vascular surgery such as ruptured aortic anonyrym (AAA), penetration injuries to the abdomen such as blunt injury, gunshot or stabbing were excluded from the study. After obtaining formal ethical consent, patient's baseline characteristics, the grade or stage of disease, PS at the time of admission, surgery and OS at the moment of the patient's discharge were recorded. The influence of patient's physiological status and grade of disease on the postoperative outcome was assessed. The follow up period was 30 days post-surgery, and complications if any, were noted depending upon the criteria as defined in POSSUM, P-POSSUM and E-POSSUM scoring system.[19]

The Clavien-Dindo classification was used for the stratification of postoperative morbidity events Jia et al.[20] The equation for predicting morbidity and mortality using POSSUM, P-POSSUM is: Log (R1/(1-R1) =-5.91 + (0.16 × PS) + (0.19 × OSS) and Log (S1/1-S1) = -9.37 + (0.19 × PS) + (0.15 × OSS) respectively, where R1 stands for predicted risk of morbidity and S1 denotes predicted risk of mortality.

The equation for predicting morbidity and mortality using E-POSSUM is: Log (T1/1-T1) = −3·3526 + (0·0779 × PS) + (0·0949 × OS) and Log (U1 / 1-U1) = -7·6942 + (0·1399 × PS) + (0·1126 × OS) where TI represents predicted risk of morbidity and U1 denotes predicted risk of mortality. For calculating PS, E-POSSUM use WHO age classification (65–74, 75–84 and 85 years or older). In order to maintain the same weights as in POSSUM, the coefficients for the 75–84-year-age group were rounded to 4 and for the group aged ≥85 years were rounded to 8.

Finally, based on the study outcome, the percentage difference between observed and expected outcome i.e., Observed and Expected ratio (O:E) was calculated. O:E = 1.00 indicates performance as expected, O:E <1.00 indicates low predictability and ratio >1.00 indicates overestimates than expected.[21]

Statistical analysis

The statistical analysis used is percentage analysis for the demographic variable namely gender and descriptive statistics for mean age. Exponential analysis is used to find out the over predicts E-Possum and P-Possum mortality score. $p<0.05$ is considered as statistical significant.

RESULTS

The number of patients included for POSSUM and P-POSSUM scoring system was 260 (60 years and above) (Table 1).

Table 1: Patient baseline characteristics.

Baseline characteristics	
Age (years)	**N (%)**
60	18 (6.9)
61-62	22 (8.5)
63-64	20 (7.7)
65-66	36 (13.8)
67-68	20 (7.7)
69-70	40 (15.4)
71-72	24 (9.2)
73-74	15 (5.8)
75-76	15 (5.8)
77-78	12 (4.6)
79-80	12 (4.6)
81-82	10 (3.8)
83-84	8 (3.1)
≥85	8 (3.1)
Mean age (range) in years	70
Gender	
Male	162 (62.3)
Female	98 (37.7)

From Table 1, of total 260 patients included for POSSUM and P-POSSUM scoring system, the mean age of patients was 70 years with 62.3% male and 15.4% of total patients were 69-70 years.

For comparison of E-POSSUM with POSSUM and P-POSSUM scoring systems the total number of cases included was 200 (65 years and above) (Table 2). From Table 2, of total 200 patients included for E-POSSUM, POSSUM and P-POSSUM comparison.

The mean age (range) in years for POSSUM and P-POSSUM was 75 years and for E-POSSUM was 75 years. The total percentage of male for POSSUM and P-POSSUM was 62.5% and that for E-POSSUM was 66%. The operative score (OS) remains same for all POSSUMs.

The most common indications for elective and emergency surgery identified in both 260 cases and 200 cases was acute appendicitis, followed by peptic ulcer perforation, duodenal perforation, SI and LI obstruction, diverticulitis, gastric perforation, acute pancreatitis, obstructed hernia and acute cholecystitis.

Post-operative complications and death observed during 30 days post-surgery in-hospital or during follow-up visit to out-patient department (OPD) is given in Figure 1.

Table 2: Baseline characteristics of patients included for E-POSSUM, POSSUM and P-POSSUM comparison.

E-POSSUM (200 cases)		POSSUM & P-POSSUM (200 cases)	
Age (years)	**N (%)**	**Age** (years)	**N (%)**
65-66	36 (13.8)	65-66	36 (13.8)
67-68	20 (7.7)	67-68	20 (7.7)
69-70	40 (15.4)	69-70	40 (15.4)
71-72	24 (9.2)	71-72	24 (9.2)
73-74	15 (5.8)	73-74	15 (5.8)
75-76	15 (5.8)	75-76	15 (5.8)
77-78	12 (4.6)	77-78	12 (4.6)
79-80	12 (4.6)	79-80	12 (4.6)
81-82	10 (3.8)	81-82	10 (3.8)
83-84	8 (3.1)	83-84	8 (3.1)
≥85	8 (3.1)	≥85	8 (3.1)
Mean age (range) in years 75 years		**Mean age (range) in years 75 year**	
Gender		**Gender**	
Male	132 (66.0)	Male	125 (62.5)
Female	68 (34.0)	Female	75 (37.5)

From Figure 1, 215 patients (82.69%) from age group 60 years and 163 patients (81.5%) from age group 65 years and above (200 cases) suffered from various post-operative morbid conditions. Similarly, the incidence of morbid conditions in 200 cases for POSSUM and P-POSSUM was 79.5%.

The post-surgery complications according to Clavien-Dindo classification in study population is given in Figure 2. From above Figure 2, in all cases, the most common complications were wound infection, bleeding, bowel obstruction, pelvic abscess, haemorrhage and DVT. 2 MOF and 5 deaths were observed in all cases.

The expected POSSUM morbidity score with the observed morbidity is given in Table 3.

Using exponential analysis, POSSUM Morbidity equation could predict morbidity accurately for risk strata 60-100 where chi square test applied and was not significant, but showed significant difference for risk strata 50-100 showing that POSSUM Morbidity equation over predicts morbidity especially in low risk group (<60%).

The expected E-POSSUM morbidity score with the observed morbidity is given in Table 4. Minimum expected morbidity using E-POSSUM risk calculation is 6.07%.

Using exponential analysis, E-POSSUM Morbidity equation could predict morbidity accurately for risk strata 60-100 where chi square test applied showed not

significant, but showed significant difference for risk strata 40-100 and 50-100 showing that E-POSSUM. Morbidity equation correctly predicts morbidity in low (<60%) and high risk group.

The expected POSSUM morbidity score with the observed morbidity for 200 cases is given in Table 5. Minimum expected morbidity using POSSUM risk calculation is 6.27%. NS- Not Significant.

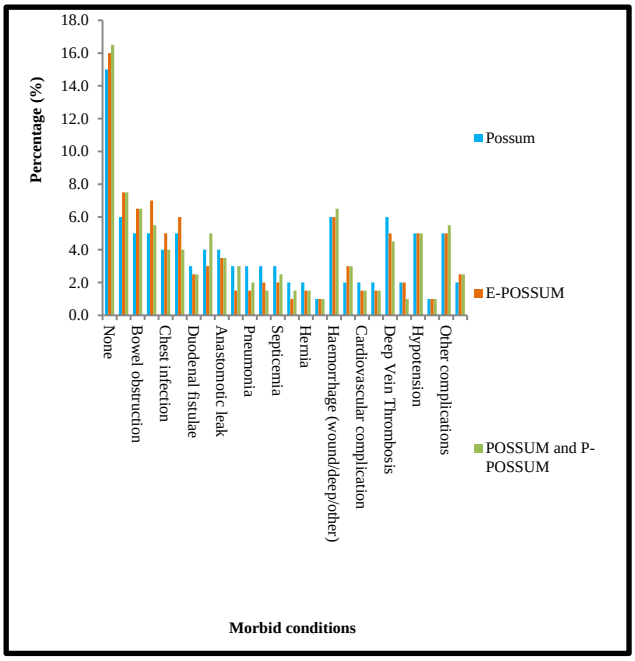

Figure 1: Post-surgery observed morbidity and mortality.

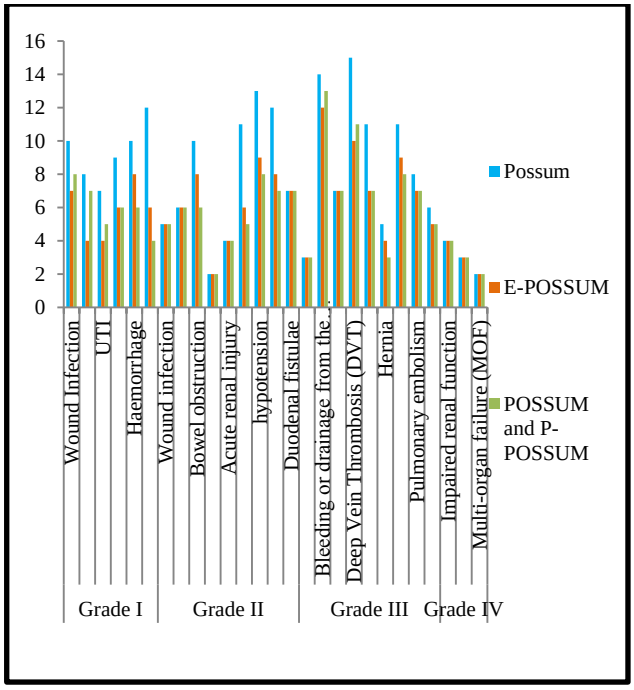

Figure 2: Post-surgery complications according to Clavien-Dindo classification.

Using exponential analysis, POSSUM Morbidity equation could predict morbidity accurately for risk strata 60-100 where chi square test applied and was not significant, but showed significant difference for risk strata 40-100 and 50-100 showing that POSSUM Morbidity equation over predicts morbidity especially in low risk group (<30%).

Table 3: Comparison of expected and observed morbidity using POSSUM morbidity equation and Clavien-Dindo classification.

Risk group (expected morbidity-%)	No. of patients (n)	Mean predicted risk of morbidity (%)	No. of expected cases (E)[a]	No. of observed cases (O)	Clavien -Dindo classification of complications (n)	O/E Ratio	P-Value[b]
I (6.27*-20)	28	18.2	27.95	26	Grade I: 26	0.93	0.000
II (20-30)	55	25.2	55	49	Grade I: 7 Grade II: 28 Grade III: 14	0.89	0.124 (NS)
III (30-40)	79	33.2	72.11	75	Grade I: 7 Grade II: 30 Grade III: 38	1.04	0.456
IV (40-100)	53	44.8	45.54	46	Grade I: 6 Grade II: 12 Grade III: 28	1.01	0.002
Total (6.27-100)	215	30.4	200.60	196	Grade I: 46 Grade II: 70 Grade III: 80	0.97	0.001

*Minimum expected morbidity using POSSUM risk calculation is 6.27%. NS- Not Significant.

Table 4: Comparison of expected and observed morbidity using E-POSSUM morbidity equation and Clavien-Dindo classification.

Risk group (expected morbitidy-%)	No. of patients (n)	Mean predicted risk of morbidity (%)	No. of expected cases (E)[a]	No. of observed cases (O)	Clavien-Dindo classification of complications (n)	O/E Ratio	P-Value[b]
I (6.07*-20)	22	19	22	20	Grade I: 20	0.90	0.158
II (20-30)	27	25.3	22.81	24	Grade I: 4 Grade II: 15 Grade III: 5	1.05	0.125
III (30-40)	61	35.8	57	58	Grade I: 6 Grade II: 23 Grade III: 29	1.01	0.415
IV (40-100)	53	41.9	53	52	Grade I: 5 Grade II: 17 Grade III: 30	0.98	0.001
Total (6.07-100)	163	29.7	154.81	154	Grade I: 35 Grade II: 55 Grade III: 64	0.99	0.032

Table 5: Comparison of expected and observed morbidity for 200 cases using POSSUM morbidity equation and Clavien-Dindo classification.

Risk group (expected morbitidy-%)	No. of patients (n)	Mean predicted risk of morbidity (%)	No. of expected cases (E)[a]	No. of observed cases (O)	Clavien -Dindo classification of complications (n)	O/E Ratio	P-Value[b]
I (5.47*-20)	26	18.5	26.31	20	Grade I: 20	0.76	0.145 (NS)
II (20-30)	28	21.5	27.90	24	Grade I: 6 Grade II: 14 Grade III: 4	0.86	0.125
III (30-40)	63	36.8	44.62	54	Grade I: 8 Grade II: 20 Grade III: 26	1.21	0.120
IV (40-100)	59	42.9	48.14	52	Grade I: 2 Grade II: 16 Grade III: 34	1.08	0.000
Total (5.47-100)	159	31.5	146.97	150	Grade I: 36 Grade II: 50 Grade III: 64	1.02	0.014

Table 6: Exponential analysis of expected and observed mortality using E-POSSUM mortality equation.

Risk group (expected mortality -%)	No. of patients (n)	Mean predicted risk of mortality (%)	No. of expected cases (E)[a]	No. of observed cases (O)	O/E Ratio	P-Value[b]
0-39	110	35.42	1	0	0.00	Not Applicable
10-39	88	38.12	1	0	0.00	Not Applicable
20-39	83	37.12	1	0	0.00	Not Applicable
30-39	61	32.15	0	0	0.00	Not Applicable
40-100	90	52.18	5	5	1.00	0.458 (NS)
50-100	64	72.15	3	3	1.00	0.326 (NS)
60-100	22	80.15	2	2	1.00	0.522 (NS)
70-100	7	89.12	1	1	1.00	0.126 (NS)
80-100	0	0	0	0	0.00	0.228 (NS)
90-100	200		6	5	0.83	0.325 (NS)

Table 7: Exponential analysis of expected and observed mortality using P-POSSUM mortality equation.

Risk group (expected mortality-%)	No. of patients (n)	Mean predicted risk of mortality (%)	No. of expected cases (E)[a]	No. of observed cases (O)	O/E Ratio	P-Value[b]
0-39	162	35.18	2	0	0.00	Not applicable
10-39	134	36.12	2	0	0.00	Not applicable
20-39	107	38.12	2	0	0.00	Not applicable
30-39	79	38.7	0	0	0.00	Not applicable
40-100	98	76.12	5	5	1.00	0.245 (NS)
50-100	88	78.15	4	5	1.25	0.120 (NS)
60-100	62	75.62	3	3	1.00	0.132 (NS)
70-100	28	82.15	2	2	1.00	0.112 (NS)
80-100	8	88.12	1	1	1.00	0.158 (NS)
90-100	0	0	0	0	0.00	0.245 (NS)
0-100	260		7	5	0.71	0.268 (NS)

Table 8: Exponential analysis of expected and observed mortality using P-POSSUM mortality equation for 200 cases.

Risk group (expected mortality -%)	No. of patients (n)	Mean predicted risk of mortality (%)	No. of expected cases (E)[a]	No. of observed cases (E)	O/E Ratio	P-Value[b]
0-39	117	35.89	1	0	0.00	Not applicable
10-39	91	38.18	1	0	0.00	Not applicable
20-39	89	38.15	1	0	0.00	Not applicable
30-39	63	34.15	0	0	0.00	Not applicable
40-100	83	52.18	6	5	0.83	0.256 (NS)
50-100	61	72.48	4	3	0.75	0.123 (NS)
60-100	19	80.78	2	2	1.00	0.236 (NS)
70-100	6	89.8	1	1	1.00	0.528 (NS)
80-100	0	0	0	0	0.00	0.456 (NS)
90-100	200		7	5	0.71	0.563 (NS)

The expected P-POSSUM mortality score with the observed mortality is given in Table 6.

The expected E-POSSUM mortality score with the observed mortality is given in Table 7.

The expected P-POSSUM mortality score for 200 cases with the observed mortality is given in Table 8.

DISCUSSION

Though POSSUM and P-POSSUM proposed in 1941 and 1991, is a well validated scoring system for predicting 30 days post-operative morbidity and mortality risk in patients undergoing general and emergency surgery.[22] There is a need to develop an updated scoring system based on WHO's updated age classification as people above the age of 65 years are increasing globally due to better quality of life and life expectancy. Also, it is important to note that mortality and morbidity risk of this age group is higher than age group less than 65 years. Therefore, to address this problem.[18] developed a scoring system for elderly patients, E-POSSUM to predict mortality and morbidity risk in elderly patients undergoing major colorectal surgery.

The present study, attempts to compare and validate E-POSSUM with that of POSSUM's morbidity and P-POSSUM's mortality risk prediction for acute abdomen cases undergoing elective or emergency surgery. For purpose of the study, 260 patients undergoing general and emergency surgery between January 2016 and November 2018 in General Surgical wing of teaching hospital in Tamil Nadu, India was included.

For calculating physiological score (PS), E-POSSUM used WHO age classification (65–74, 75–84 and 85 years or older) instead of POSSUMs and P-POSSUMs age classification (≤60, 61-70 and ≥71 years or older). In order to maintain the same weights as POSSUMs, the coefficients for E-POSSUMs age classification (65–74, 75–84 and 85 years or older) was same as POSSUMs age classification (≤60, 61-70 and ≥71 years or older) i.e., 1, 2, 4 and 8 respectively.

The most common indications for elective and emergency surgery in our study was Acute Appendicitis and our findings are in line with.[23-26]. Similarly, peptic ulcer perforation, duodenal perforation, SI and LI obstruction was found to be other common causes of surgical emergency which was also reported in studies by.[27-29]

The most common post-operative complications was wound infection, bleeding, bowel obstruction, pelvic abscess, haemorrhage and DVT which was also reported in studies by.[30,31] 2 patients developed MOF and 5 deaths was observed in both 260 and 200 cases respectively. This was higher than those reported by.[32] were no organ failure was reported and only one death observed (n=110).[31,33]

Exponential analysis of expected morbidity for POSSUM was compared with observed 30 days morbidity, the percentage difference between O:E was 0.97. 83 patients (38.60%) had an estimated morbidity lower than 30%. 2 groups had O:E ratio <1 meaning POSSUM over predicted morbidity in 260 cases. Our results are in line with several studies.[34,15]

Which have demonstrated that exponential analysis of expected morbidity by POSSUM overestimates morbidity, especially in low-risk groups. When exponential analysis was used to predict morbidity for E-POSSUM which was compared with observed 30 days morbidity, the percentage difference between O:E was 0.99. 49 patients (30.06%) had an estimated morbidity lower than 30%. 1 group had O:E ratio of 0.90. From analysis it is evident that E-POSSUM did not over predict morbidity in both low and high risk groups. Similarly, O:E ratio of morbidity risk prediction using POSSUM among 200 cases was found to be 1.02, with 2 groups having O:E <1 which represents POSSUM over-predicts morbidity in low-risk groups. Also, when O:E ratio of POSSUM and E-POSSUM was compared for 200 cases, it was found that E-POSSUM (0.99) better predicted morbidity than POSSUM (1.02) especially in low risk groups.

As POSSUM is not a good predictor for mortality (over-estimates).[14,35-37] P-POSSUM was used as it better predicts the risk of postoperative mortality through exponential analysis. When exponential analysis of expected mortality for P-POSSUM was compared with observed 30 days mortality, the percentage difference between O:E was 0.71 for 260 cases. 4 groups had O:E ratio equal to 1 meaning P-POSSUM better predicted mortality in 260 cases. Our findings are in line with.[38,14] were it was reported that P-POSSUMs mortality prediction in low risk groups improves when exponential analysis is applied.

When exponential analysis was used to predict mortality for E-POSSUM which was compared with observed 30 days morbidity, the percentage difference between O:E was 0.83. Similar to P-POSSUM, 4 groups in E-POSSUM had O:E ratio equal to 1 which indicates, that E-POSSUM better predicted mortality. However, on comparing the O:E ratio of P-POSSUM and E-POSSUM, it is evident that E-POSSUM better predicts mortality (0.83) than P-POSSUM (0.71). Studies have highlighted that linear analysis of P-POSSUM is not validated to estimate morbidity and it is likely to underestimate 30 days mortality in the elderly and in emergency procedure.[32]

CONCLUSION

The study concludes that E-POSSUM better predicts morbidity risk in various acute abdomen cases when compared to POSSUM which can reasonably predict morbidity only in high risk groups. Similarly, the mortality risk prediction of E-POSSUM is comparable to that of P-POSSUM. Hence, E-POSSUM is a valid scoring system for predicting morbidity and mortality risk in patients undergoing elective and emergency surgery for acute abdomen cases. However, our findings should be further assessed by larger, multi-center, studies to validate elderly POSSUM (E-POSSUM) scoring system.

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