Original Article

Evaluation of POSSUM and P-POSSUM Diagnostic Tests as Mortality Predictors In Emergency Laparotomy Patients at Dr. Zainoel Abidin Regional General Hospital Banda Aceh

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Abstract

Introduction: *Laparotomy is a frequent surgical procedure carried out in emergency settings due to various indications and related to a considerable amount of postoperative mortality rate. POSSUM and P-POSSUM are known as two of the most favorable methods to calculate the likelihood of postoperative mortality, so that optimization of patient management can be achieved. The purpose of this research is to assess the predictive power of POSSUM and P-POSSUM scoring systems for emergency laparotomy patients in terms of accuracy, sensitivity, specificity, and Area Under the Curve (AUC) value.*
Method: *This study uses an observational analytical method with a prospective cohort approach, and was performed at Dr. Zainoel Abidin Regional General Hospital Banda Aceh since January until May 2024. Mortality status was observed for 30 days after surgery. The accuracy of POSSUM and P-POSSUM was assessed based on sensitivity, specificity, and AUC values obtained from the Receiver Operating Characteristic (ROC) curve.*
Results: *A total of 13 subjects experienced mortality within 30 days after surgery out of 29 subjects involved in this study. Analysis based on the ROC curve shows that POSSUM and P-POSSUM equally have 100% sensitivity and 75% specificity. The AUC values obtained were 0.851 and 0.837 respectively.*
Conclusion: *POSSUM and P-POSSUM scoring systems have good accuracy as mortality predictors in emergency laparotomy patients.*

Keywords: *POSSUM, P-POSSUM, Mortality Predictor, Emergency Laparotomy*

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Evaluasi Uji Diagnostik POSSUM Dan P-POSSUM Sebagai Prediktor Mortalitas Pada Pasien Laparotomi Emergensi Di Rumah Sakit Umum Daerah Dr. Zainoel Abidin Banda Aceh

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Abstrak

Pendahuluan: *Laparotomi merupakan tindakan pembedahan yang sering dilakukan atas berbagai indikasi dalam keadaan emergensi dan berhubungan dengan tingginya angka mortalitas pasca operasi. Sistem skoring POSSUM dan P-POSSUM disebut sebagai salah satu metode prediktor terbaik terhadap risiko mortalitas pasca operasi, sehingga optimalisasi tatalaksana pasien dapat tercapai. Tujuan studi ini adalah untuk mengetahui akurasi, sensitivitas, spesifisitas, dan nilai Area Under the Curve (AUC) skoring POSSUM dan P-POSSUM dalam memprediksi mortalitas pada pasien laparotomi emergensi.*
Metode: *Penelitian ini merupakan studi analitik observasional dengan pendekatan kohort prospektif yang dilakukan di Rumah Sakit Umum Daerah Dr. Zainoel Abidin Banda Aceh pada bulan Januari hingga Mei 2024. Status mortalitas diobservasi selama 30 hari pasca operasi. Akurasi skoring POSSUM dan P-POSSUM didasarkan pada nilai sensitivitas, spesifisitas, dan luas AUC yang didapatkan melalui kurva Receiver Operating Characteristic (ROC).*
Hasil: *Sebanyak 13 subjek penelitian mengalami mortalitas dalam 30 hari pasca operasi dari total 29 subjek yang terlibat dalam penelitian ini. Analisis melalui kurva ROC menunjukkan skoring POSSUM memiliki sensitivitas 100%, spesifisitas 75%, dan nilai AUC 0,851. Skoring P-POSSUM memiliki sensitivitas 100%, spesifisitas 75%, dan nilai AUC 0,837.*
Kesimpulan: *Skoring POSSUM dan P-POSSUM memiliki akurasi yang baik dalam memprediksi mortalitas pada pasien laparotomi emergensi.*

Kata kunci: *POSSUM, P-POSSUM, Prediktor Mortalitas, Laparotomi Emergensi*

Introduction

Laparotomy is included as the most frequent surgical procedure carried out in emergency settings, as known as emergency laparotomy. In United States, emergency laparotomies are performed at least 175,000 times a year for various indications. Each year, 30,000 to 50,000 laparotomies are performed in United Kingdom, and are associated with high postoperative mortality rates.[1–3] National tabulation data from the Indonesian Ministry of Health in 2019 states that surgical procedures were number 11 out of 50 overall disease patterns in all hospitals in Indonesia. Surgical procedures were performed on around 1.2 million people (12.8%) per year, of which 32% were laparotomies.[4] The number of laparotomies based on medical records in 2020 at Meuraxa District Hospital in Banda Aceh reached 10.2% of all surgical procedures, and increased to 16.2% in 2021.[5]

Adapted from Greek, 'laparotomy' consists of 'lapara' which means flank, and 'otomy' which means to cut. Laparotomy is described as a procedure that includes an abdominal incision to approach the abdominal cavity.[6,7] Laparotomy emergency is often carried out as a life-saving procedure, both for trauma and non-trauma indications. Most patients present in poor general conditions and with serious pathological conditions, so the indication for emergency laparotomy must be decided appropriately.[2,3,8,9]

Various studies show that emergency laparotomy results in a much greater mortality rate than elective laparotomy. Globally, reported death rates after emergency laparotomies range between 13 to 18% within 30 days, and increase to 25% within 24 months,

up to 5 times higher than elective laparotomy. According to a report from the Emergency Laparotomy Network (ELN), the death rate of emergency laparotomy in England reached 14.9% within 30 days, and could increase to 24.4% in patients aged over 80 years.[2,3,10,11]

Previously, a number of scoring systems, including Acute Physiology and Chronic Health Evaluation II (APACHE II) and The American Society of Anesthesiologists (ASA), were frequently used to estimate mortality after surgery. Unfortunately, these various methods are considered too complicated or too simple to be applied to all patients. Physiological and Operative Severity for the Enumeration of Mortality and Morbidity (POSSUM) is known to have a better ability to predict surgical outcomes than the other scoring systems.[12,13]

Copeland, et al[13] initially introduced the POSSUM scoring system in 1991 which predicted mortality and morbidity rates for 30 days after surgery with multivariate discriminant analysis techniques. POSSUM is designed to be an easy and fast scoring system and can be widely used in elective or emergency operations.[13–15] In 1996, Whiteley, et al[17] revealed that the POSSUM formula could not be used in Portsmouth because POSSUM produced an overprediction of mortality rates in 1485 subjects. The POSSUM scoring system is still used, but the regression formula must be updated. This new regression formula is called as Portsmouth-POSSUM (P-POSSUM) scoring system. In contrast to POSSUM which uses exponential analysis, P-POSSUM uses linear analysis which produces more reliable post-operative mortality prediction rates.[16,17]

POSSUM and P-POSSUM evaluation as mortality predictors after emergency laparotomy needs to be carried out in Indonesia, especially in Banda Aceh, because there is no adequate data so far on this case. The wide variety of emergency cases leads to various post-operative prognoses, so an effective and easy-to-use scoring system is needed as a prognosis predictor. In support of this, the authors conducted this research which aims to assess the predictive power of POSSUM and P-POSSUM for emergency laparotomy patients in terms of accuracy, sensitivity, specificity, and Area Under the Curve (AUC) value.

Method

This study uses an observational analytical method with a prospective cohort approach, and was performed at dr. Zainoel Abidin Regional General Hospital Banda Aceh since January until May 2024 after gaining ethical approval from the Ethics Committee of Health Research, Dr. Zainoel Abidin Regional General Hospital, Banda Aceh, with No. 013/ETIK-RSUDZA/2024. Mortality status was observed for 30 days after surgery. The accuracy of POSSUM and P-POSSUM was assessed depend on the sensitivity, specificity, and AUC values obtained from the Receiver Operating Characteristic (ROC) curve.

The study population was patients who underwent emergency laparotomy procedures at dr. Zainoel Abidin Regional General Hospital Banda Aceh, received standard pre-operative and post-operative care, signed the informed consent form, and agreed to be evaluated for 30 days after surgery. The exclusion criteria in this study are patients who are less than 18 years old, there are variables in the physiological score or surgical severity score that cannot be assessed due to lack of data, or if there is difficulty in making contact during 30 days evaluation after surgery.

This study included 29 subjects which was obtained using the sample size calculation formula for the validity test research design with AUC output. A consecutive method was used as the sampling technique, that is, all subjects who come sequentially during the research period and meet the research criteria will be included as research samples until the required sample size is fulfilled.[18–20]

Basic characteristic data was collected consisting of age, sex, diagnosis, surgical procedure, surgical duration, and peri-operative hemodynamic status. Before the emergency laparotomy procedure was carried out, the following 12 physiological scores were calculated: (Table 1).

The physiological score was assessed based on clinical conditions, physical examinations, chest X-rays, blood tests, and electrocardiogram (ECG) results, as listed in Table 1. With a minimum total score of 12 and a maximum of 88, the physiological score results will be used in the POSSUM and P-POSSUM equations.[14]

After the emergency laparotomy procedure was done, 6 scores of surgery severity were calculated: (Table 2).

As the name suggests, the operative severity score consists of 6 variables which can be seen in Table 2, based on the surgery that had been performed. With a minimum value of 6 and a maximum of 48, the operative severity score was used in conjunction

Table 1. POSSUM and P-POSSUM Physiological Score[14]

No.	Variable	1	2	4	8
1.	Age (years)	< 60	61 – 70	> 71	-
2.	Cardiac indicators	No abnormality	Diuretic drugs; Digoxin; Anti-anginal; Anti-hypertensive; Steroid	Peripheral swelling; Warfarin	Elevated JVP
	Chest radiography	No abnormality		Borderline cardiac enlargement	Cardiac enlargement
3	Respiratory indicators	No abnormality	Dyspnea on exertion	Limiting dyspnea (one flight of stairs)	Dyspnea at rest
	Chest radiography	No abnormality	Mild COPD	Moderate COPD	Fibrosis; Consolidation
4.	Systolic blood pressure (mmHg)	110 - 130	131 - 170 or 100 - 109	> 170 or 90 – 99	< 90
5.	Pulse (beats/min)	50 – 80	81 - 100 40-49	101 – 120	> 120 < 40
6.	GCS	15	12-14	9-11	< 9
7.	Urea (mmol/l)	<7,5	7,6-10	10,1-15	> 15
8.	Sodium (mmol/l)	>136	131-135	126-130	<125
9.	Potassium (mmol/l)	3,5-5	3,2-3,4 5,1-5,3	2,9-3,1 5,4-5,9	<2,8 >6
10.	Hemoglobin (gr/dl)	13-16	11,5-12,9 16,1-17	10-11,4 17,1-18	<9,9 >18,1
11.	WBC (x1012/mm3)	4-10	10,1-20 3,1-3,9	>20,1 <3	-
12.	ECV	Normal	-	AF (60 - 90)	Any other abnormalities

Legend: Physiological score calculation for POSSUM and P-POSSUM scoring system. JVP = jugular venous pressure, COPD = chronic obstructive pulmonary disease, mmHg = millimeters of mercury, beats/min = beats per minute, GCS = Glasgow coma scale, mmol/l = millimoles per liter, gr/dl = grams per deciliter, WBC = white blood cell, ECG = electrocardiogram, AF = atrial fibrillation.

Table 2. POSSUM and P-POSSUM Operative Severity Score[14]

No.	Variable	1	2	4	8
1.	Surgery Scale	Minor	Intermediate	Major	Major +
2.	Number of surgery	1		2	> 2
3.	Total blood loss (ml)	<100	101-500	501-999	>1000
4.	Peritoneal soiling	None	Serous	Local pus	Free bowel content, pus, blood
5.	Malignancy	None	Primary only	Nodal metastasis	Distant metastasis
6.	Time of surgery	Elective		Urgent, emergency resuscitation, or > 2 hours possible operation within 24 hours after admission	Emergency, immediate surgery <2 hours needed

Legend: Operative severity score calculation for POSSUM and P-POSSUM scoring system. ml = milliliter.

with the physiological score in the equations of POSSUM and P-POSSUM.[14]

The equations of POSSUM and P-POSSUM were calculated to obtain the predicted mortality risk number. To shorten the calculation time, the author used the MD App application which is known to provide the same results as manual calculations on several initial samples.[14]

The estimated mortality risk of POSSUM scoring system was calculated using the following equation (R indicates the risk of mortality) :

$$Log\frac{R}{(1-R)} = -7{,}04 + (0{,}13 \times Physiological\ Score) + (0{,}16 \times Operative\ Severity\ Score)$$

The estimated P-POSSUM mortality risk was calculated using the equation below (R indicates the risk of mortality):

$$Log\frac{R}{(1-R)} = -9{,}065 + (0{,}1692 \times Physiological\ Score) + (0{,}155 \times Operative\ Severity\ Score)$$

After the mortality risk numbers were calculated through the equations above, then all subjects were evaluated to record any incidence of mortality. The evaluation of mortality events was carried out in the ward after surgery, then continued as an outpatient through polyclinic visits or by phone calls until 30 days after surgery. A subject who was alive at the 30th day was counted as the 'mortality(-)' group. If a death was reported within 30 days after surgery, then counted as the 'mortality (+)' group. All data obtained in this study were analyzed statistically with Statistical Package for Social Sciences (SPSS) software.

Results

The distribution data listed in Table 3 above is based on gender, age, and various variables assessed in the physiological score and surgical severity score. There were more males than females, with the largest age group of <60 years in this study. A total of 12 samples had cardiac enlargement, 4 had lung consolidation, 19 had abnormal blood pressure, and 2 had decreased consciousness.

Along with data collection, it was discovered that a number of research subjects had comorbid factors that were known to be associated with mortality after emergency laparotomy in previous studies. According to those studies, the factors included hypertension, heart failure, impaired kidney function, anemia, and lung infections.[21,22] The comorbid factors found in this study can be seen in Table 4. It is known that chronic kidney failure is the most common comorbid condition found in this study, followed by heart failure, hypertension, anemia and pneumonia as the least.

The POSSUM accuracy as a mortality predictor in emergency laparotomy patients was assessed by determining sensitivity, specificity, and AUC value. The AUC value of POSSUM is determined to be 0.851 based on the ROC curve depicted in Figure 1(a). According to the ROC curve shown in Figure 1(b), the AUC value of P-POSSUM scoring system is known to be 0.837.

After the ROC curve was obtained, a cut-off point was established by calculating the Youden Index at each coordinate point in the curve with the formula: Youden Index = Sensitivity + Specificity -1. A coordinate point with the highest Youden Index was determined as the cut-off point.[23] The cut-off point of POSSUM was found to be 23.28 in this study, and the cut-off point of P-POSSUM scoring system was determined at 7.44 using the same method.

Based on the cut-off point, a 2x2 table referred to as Table 5 was created to assess the sensitivity and specificity of POSSUM scoring system as a mortality predictor in emergency laparotomy patients.

As seen in Table 5, calculations were carried out using the sensitivity and specificity equations. In this study, it was found that POSSUM and P-POSSUM scoring systems have good accuracy in predicting mortality of emergency laparotomy patients, considering that the sensitivity was 100% and the specificity was 75% for both scoring systems, and the AUC value was 0.851 and 0.837 respectively.

Discussion

In this study, the data was analyzed by creating ROC curves, where the area under the curve or what is known as AUC can describe the accuracy of POSSUM scoring. A good diagnostic test will show an AUC value close to 1. Meanwhile, a value close to 0.5 describes a poor diagnostic test. An AUC value >0.9 is classified as high or very good accuracy. An AUC value of 0.7-0.9 has moderate or good accuracy. Meanwhile, the AUC value of 0.5-0.7 indicates low accuracy. In this study, the AUC values of POSSUM and P-POSSUM scoring system as mortality predictors in emergency laparotomy patients are 0.851 and 0,837.[23,24]

The accuracy measured in this study is also assessed based on the level of sensitivity and specificity. After calculation, sensitivity values of 100% and specificity values of 75% were obtained for both scoring systems.

Table 3. General and Scoring Parameter Distribution

Variable	Number (n)	Percentage (%)
Sex		
Male	20	69,0
Female	9	31,0
Age		
< 60	23	79,3
61 – 70	2	6,9
> 71	4	13,8
Cardiac Indicators		
No abnormality	17	58,6
Diuretic, digoxin, anti-anginal, anti-hypertensive, steroid	0	0
Peripheral swelling, warfarin, borderline cardiac enlargement	4	13,8
Elevated JVP, cardiac enlargement	8	27,6
Respiratory Indicators		
No abnormality	25	86,2
Dyspnea on exertion, mild COPD	0	0
Limiting dyspnea (one flight of stairs), moderate COPD	0	0
Dyspnea at rest, fibrosis, consolidation	4	13,8
Systolic Blood Pressure (mmHg)		
110 – 130	10	34,5
131 – 170 or 100 – 109	14	48,3
> 171 or 90 – 99	3	10,3
< 89	2	6,9
Pulse (beats/min)		
50 – 80	6	20,7
81 – 100 or 40 – 49	10	34,5
101 – 120	10	34,5
> 121 or < 39	3	10,3
GCS		
15	27	93,1
12 – 14	2	6,9
9 – 11	0	0
< 9	0	0
Blood Urea Nitrogen (mmol/l)		
< 7,5	10	34,5
7,6 – 10	9	31,0
10,1 – 15	4	13,8
> 15,1	6	20,7
Sodium (mmol/l)		
> 136	17	58,6
131 – 135	9	31,0
126 – 130	3	10,3
< 125	0	0

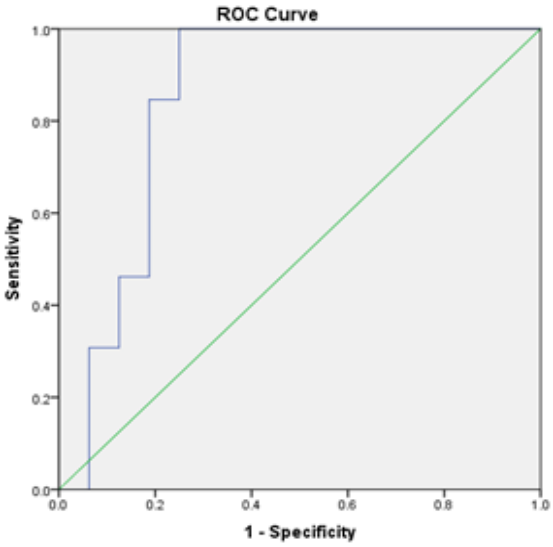
Table 3. General and Scoring Parameter Distribution

Variable	Number (n)	Percentage (%)
Potassium (mmol/l)		
3,5 – 5	23	79,3
3,2 – 3,4 or 5,1 – 5,3	3	10,3
2,9 – 3,1 or 5,4 – 5,9	3	10,3
< 2,8 or > 6	0	0
Hemoglobin (gr/dl)		
13 – 16	12	41,4
11,5 – 12,9 or 16,1 – 17	11	37,9
10 – 11,4 or 17,1 – 18	3	10,3
< 9,9 or > 18,1	3	10,3
White Blood Cells (/mm3)		
4.000 – 10.000	11	37,9
10.100 – 20.000 or 3.100 – 3.900	12	41,4
> 20.100 or < 3.000	6	20,7
ECG		
No abnormality	28	96,6
Atrial fibrillation (60 – 90 beats/min)	0	0
Other abnormalities	1	3,4
Operative Scale		
Minor	0	0
Intermediate	1	3,4
Major	28	96,6
Major +	0	0
Number of Surgery (30 Days)		
1	25	86,2
2	4	13,8
> 2	0	0
Total Blood Loss (ml)		
< 100	19	65,5
101 – 500	9	31,0
501 – 999	0	0
> 1000	1	3,4
Peritoneal Soiling		
None	0	0
Serous	4	13,8
Local pus	4	13,8
Free bowel content, pus, blood	21	72,4
Malignancy		
None	24	82,8
Primary only	5	17,2
Nodal metastasis	0	0
Distant metastasis	0	0
Time of Surgery		
Elective	0	0
Urgent (< 24 hours)	29	100
Emergency (< 2 hours)	0	0

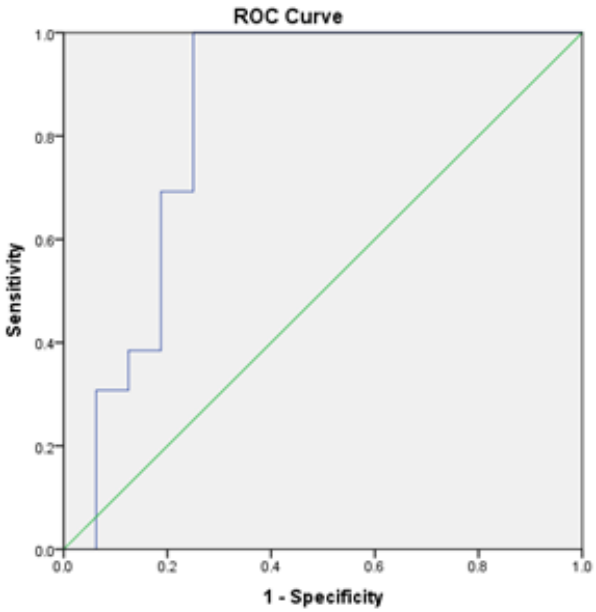
Distribution of scoring parameters. JVP = jugular venous pressure, COPD = chronic obstructive pulmonary disease, mmHg = millimeters of mercury, beats/min = beats per minute, GCS = Glasgow coma scale, mmol/l = millimoles per liter, gr/dl = grams per deciliter, mm3 = cubic millimeter, ECG = electrocardiogram, ml = milliliter.

Table 4. Distribution of Comorbidities

Comorbidity	Mortality (+)	Mortality (-)	Total
	n (%)	n (%)	
Hypertension	6 (60)	4 (40)	10
Heart disease	9 (75)	3 (25)	12
Chronic kidney disease	11 (58)	8 (42)	19
Anemia	4 (31)	9 (69)	13
Pneumonia	2 (50)	2 (50)	4



(a)



(b)

Figure 1(a). ROC Curve of POSSUM Score in Predicting Mortality.
1(b). ROC Curve of P-POSSUM Score in Predicting Mortality.

Table 5. POSSUM and P-POSSUM Scoring System and Observed Mortality

Cut-off Point	Mortality (+)		Mortality (-)	
	Number (n)	Percentage (%)	Number (n)	Percentage (%)
POSSUM score				
>23,28	13	44,8	4	13,8
<23,28	0	0	12	41,4
P-POSSUM score				
>7,44	13	44,8	4	13,8
<7,44	0	0	12	41,4

According to AUC, sensitivity, and specificity values obtained in this study, it was concluded that POSSUM and P-POSSUM scoring systems have good accuracy in predicting mortality in emergency laparotomy patients.

POSSUM and P-POSSUM scoring systems can be widely used in various cases of general surgery, orthopedic surgery, vascular surgery, gastroenterology surgery, pancreatic surgery, colorectal surgery, and to more specialized areas like bariatric surgery and lung resection. These systems are also reliable to be used in both emergency and elective surgery. A surgical audit carried out in 2002 at Warrington Hospital, England, measured the ratio of observed to expected number (O/E ratio) of morbidity after vascular surgery (1.03), hepatobiliary surgery (0.96), colorectal surgery (0.99), gastrointestinal surgery (1.03), and urology surgery (1.02), which showed promising morbidity prediction rates. However, in line with various other studies, POS-

SUM often shows overprediction of mortality rates. Meanwhile, P-POSSUM shows more accurate mortality rates. Therefore, the concurrent use of POSSUM as morbidity predictor and P-POSSUM as mortality predictor in patients undergoing various types of surgery can provide better results.[14,26,27]

The results of this study are similar to previous research by Pooja Batra, et al. in 2016 which showed 100% sensitivity and 72.29% specificity of POSSUM scoring system in predicting mortality.[25] Other research by Nithya S, et al. in 2023 also showed good POSSUM accuracy in predicting mortality after emergency abdominal surgery, with an AUC value of 0.818.[26]

Another previous study by Mohil, et al. in 2004 also gave similar results to this study. In that study, it was discovered that POSSUM and P-POSSUM had equally good accuracy in predicting mortality (O:E ratio 0.62 and 0.66).[27]

As mentioned above, this study shows that POSSUM and P-POSSUM have the same accuracy in predicting mortality, with the same sensitivity and specificity, only the AUC value of POSSUM is slightly higher than P-POSSUM. In contrast to the results of this study, a previous study by Kumar S, et al. in 2011 showed results that P-POSSUM had better accuracy than POSSUM (O:E ratio 0.85 and 0.47) in predicting mortality, as the POSSUM prediction rate was too high.[28] What was obtained in that study is in accordance with the aim of creating P-POSSUM scoring from the start, where POSSUM scoring often overpredicted mortality.[14] The result differences could occur because there is a significant difference in the study duration (4 months and 5 years), as well as the unequal number of samples and locations consisting of different patient characteristics. Additionally, this study assessed accuracy based on sensitivity, specificity, and AUC values. Meanwhile, research by Kumar S, et al. assess based on the O/E ratio.[28]

High mortality rate in this study (44.8%) can be explained by several reasons. First, the long gap between the onset and time of surgery. An extensive region of Aceh province and limited surgical facilities in remote areas make it difficult to carry out emergency surgeries. Many patients came from outside Banda Aceh and were referred to RSUDZA Banda Aceh with hours of referral times, so the operation time was delayed. This factor has been proven by studies conducted by Murray V, et al. in 2021 which showed that delayed surgery in patients with gastrointestinal ischemia or perforation was associated with a high post-surgical mortality rate.[29] Delay in surgery in patients with indications for emergency laparotomy can cause sepsis and even death.[30]

Another factor that is likely to play the most role is the comorbid conditions. Research in 2015 by Ambarish et al. showed good POSSUM accuracy in predicting mortality after emergency laparotomy with O : E ratio of 1.005, sensitivity of 95%, and specificity of 100%. In that study, it was also found that comorbid factors including hypertension, diabetes mellitus, liver disorders, and chronic kidney disease were significantly correlated with mortality rates ($p<0.05$).[31] It is necessary to do further analysis and data collection in this study to determine comorbid factors which are significantly related to mortality in emergency laparotomy patients.

With an average age of 47.34 + 3.15 years, the subjects of this research overall were between the ages of 18 and 77. In several studies, it is known that the maximum functional capacity of various organ systems decreases with age and is unable to meet the increased demands resulting from surgery. A study by Irene A, et al. in 2009 showed that post-surgical mortality and morbidity were affected by increasing age.[32,33]

By assessing the physiological score, it was discovered that 17 samples (58.6%) did not have signs and symptoms of heart problems, 8 (27.6%) experienced cardiomegaly, and 4 (13.8%) experienced borderline cardiomegaly based on chest x-ray. Research by Benjamin J, et al. found that symptomatic or asymptomatic heart failure was related to mortality rates 90 days after surgery, where the increase in mortality rate was proportional to the decrease in systolic function.[34]

Preoperative blood pressure is one of the factors that influences surgical outcomes and is associated with post-surgical mortality rates. Several studies have proven that low blood pressure before surgery is a predictor of intraoperative hypotension which can lead to post-surgical mortality.[35] A meta-analysis study in 2004 found a relationship between preoperative hypertension and increased postoperative heart problems, which can result in mortality.[36] In this study, 14 subjects (48.3%) were in the systolic blood pressure category between 131-170 mmHg or 100-109 mmHg. A total of 10 subjects (34.5%) had systolic blood pressure of 110-130 mmHg. Three subjects (10.3%) were in the systolic blood pressure category >171 mmHg or 90-99 mmHg. The remaining 2 people (6.9%) had systolic blood pressure <89 mmHg.

Based on cardiovascular physiology, heart rate is one of the keys to balancing the oxygen supply and demand of the myocardium. Increased heart rate at rest is one indicator of decreased heart pumping function.[37] In this study, 10 subjects (34.5%) had heart rate of 101-120 times/minute, and 3 subjects (10.3%) had heart rate >121 times/minute. Research in 2018 by Ladha KS, et al. proved that an increase in preoperative heart rate is associated with myocardial injury and postoperative mortality.[38]

High Blood Urea Nitrogen (BUN) levels are significantly related to mortality, as it is an indicator of poor prognosis of heart and kidney function.[39] Meanwhile, low BUN levels can be an indicator of lack protein intake which will result in poor nutritional status and hinder the patient's recovery.[40] In this study, 10 subjects (34.5%) had BUN levels <7.5 mmol/l, 9 subjects (31%) with BUN levels 7.6-10 mmol/l, 4 subjects (13.8%) with levels 10.1-15 mmol/l, and 6 subjects (20.7%) with BUN levels >15.1 mmol/l.

Preoperative anemia occurs in 30 - 40% of major surgery patients, and has been recognized as one among numbers of risk factors of mortality after surgery.[41] A study by Khaled MM, et al. in 2011 showed that anemia was associated with elevated death rate in 30 days after surgery than those without anemia. Those incidents were discovered in mild, moderate, and severe anemia.[42] In this study, 12 subjects (41.4%) were not having anemia with hemoglobin levels between 13-16 gr/dl, 11 subjects (37.9%) had hemoglobin levels of 11.5-12.9 gr/dl or 16, 1-17 gr/dl, 3 subjects (10.3%) with levels of 10-11.4 gr/dl or 17.1-18 gr/dl, and 3 other subjects (10.3%) had hemoglobin levels <9 .9 gr/dl.

Based on the results of this study, the good accuracy of POSSUM and P-POSSUM is the basis for using this scoring system in daily clinical applications in surgical patients. In hospitals with limited facilities, knowing the mortality prognosis can help prepare appropriate and optimal management that can be carried out to reduce the possibility of death, including by improving the quality of the referral system from distant hospitals. Mortality prediction can also help in determining the priority sequence of patients to be operated on based on the expected prognosis. After all, patient care at home after surgery can also be optimized based on predicted mortality rates. Limitation of this study was that observation of morbidity events within 30 days after surgery was not carried out due to the difficulty of collecting morbidity data which requires objective examination, whereas many patients live far outside the city of Banda Aceh and it was not possible to come immediately when symptoms appeared.

The authors suggest further research regarding the evaluation of POSSUM and P-POSSUM scoring systems as post-operative morbidity predictors with more comprehensive comorbidity data records. An evaluation of these scoring systems as post-operative mortality and morbidity predictors in many different surgical fields is also needed to enhance their reliability.

Conclusion

POSSUM and P-POSSUM have good accuracy as scoring systems to predict mortality in emergency laparotomy patients with equal results of 100% sensitivity and 75% specificity. The AUC values obtained were 0.851 and 0.837 respectively.

Conflicts of Interest

For this work, the authors have disclosed no conflicts of interest. This research has obtained approval from the Ethics Committee of Health Research, Dr. Zainoel Abidin Regional General Hospital, Banda Aceh, with No. 013/ETIK-RSUDZA/2024.

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