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# The Comparison of American Society of Anesthesiologists (ASA) Scoring and Practical Scoring System of Mortality In Patients With Perforated Peptic Ulcer (POMPP) Scoring to Predict Mortality on Gaster Perforated Patients With Percutaneous Lavage

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***Abstract***
***Background****: Perforated peptic ulcer is the most common indication of emergency gastric surgery with high mortality rate. Scoring system was developed to predict the prognosis of perforated peptic ulcer patient. American Society Anesthesiology (ASA) score is a well-known scoring system to predict the mortality in perforated peptic ulcer patient. Practical Scoring System of Mortality in Patients with Perforated Peptic Ulcer (POMPP) is a scoring system which is more specific in predicting patient mortality with perforated peptic ulcer.*
***Objective****: The purpose of this study was to validate the predictive value of ASA and POMPP scores on the mortality of patients with gastric perforation who were subjected to percutaneous lavage at Saiful Anwar Hospital Malang.*
***Method****: This study is cohort retrospective research. The study samples are medical record of patient which had been diagnosed as perforated peptic ulcer in Saiful Anwar Hospital Malang during 1 January 2018 until 1 January 2019. The data was analyzed using Receiver Operating Characteristic (ROC) to determine Area Under Curve (AUC) in each score.*
***Result****: The AUC values using ROC in ASA and POMPP were 65.9% and 54.4%, respecively. The POMPP score has a lower sensitivity (37.5%) than ASA (87.5%). While the specificity of the POMPP score has a higher value (63.64%) than ASA (36.36%). In terms of accuracy, the ASA score has higher accuracy than the POMPP score (71.43% vs 45.71%).*
***Conclusion*** *: ASA has a better accuracy than POMPP score as predictive mortality score in perforated peptic ulcer patients at Saiful Anwar Hospital Malang..*
***Keywords:*** *Comparison, ASA, POMPP, Gastric Perforation*

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## I. Introduction

Perforated peptic ulcer is the most frequent indication of emergency gastric surgery and is often associated with potentially life-threatening complications. Perforation occurs in about 2-10% of the incidence of peptic ulcers. The mortality and morbidity resulting from this gastric perforation is extremely important, with the proportion of the risk of mortality reported to be 20-50% in several population-based studies.[1] Perforation itself is the cause of death in 70% of patients with peptic ulcer and the risk of mortality from this disease had 10-fold increase, compared to the other acute abdominal diseases such as acute appendicitis and acute cholecystitis.[2]

In Indonesia, there is a tendency for people to use traditional medicines and medicinal plants (jamu). These medicines are chosen by the community, especially the middle to lower class, because there is an opinion that traditional medicines are relatively safer than chemical/ synthetic based drugs. However, in fact, many of these traditional medicines have been added with chemicals and other drugs into them so they have side effects for their users. Based on the results of supervision of traditional medicines through sampling and laboratory testing in 2007, the Indonesian Food and Drug Administration (BPOM) stated that 54 kinds of traditional medicinal products had been mixed with chemicals and strong drugs such as Metampirone, Sibutramin

Hydrochloride, Sildenafil Citrate, Ciproheptadine, Phenylbutazone, Mefenamic acid, Prednisone, Theophylline and Paracetamol. Banureah reported that of the 10 types of herbal medicine studied, all contained the drug Metampirone which was consumed excessively and for a long time.[3]

The management of gastric perforations varies widely. Currently, Non-Operative Management therapy can be done in some cases. If a laparoscopic procedure is required, simple closure is sufficient in most cases, and definitive peptic ulcer surgery is no longer required for these patients.[4] In the past few decades, several minimally invasive techniques, angiographic interventions, and drugs have been discovered anti-secretory drugs such as histamine 2 receptor blockers and proton pump inhibitors, so that the management of gastric perforation on a non-laparotomy basis has begun to be considered, because it brings good outcomes, especially for high-risk patients.[5] One of these minimally invasive techniques is percutaneous lavage, the act of inserting a drain through the skin with local anesthesia with the aim of reducing fluid hyperacidity and controlling sepsis.[6] This technique is followed by the administration of a proton pump inhibitor and control of nutritional status. This technique became known after several case reports mentioned results equivalent to the open laparotomy technique in high-risk patients.[5]

Mortality and morbidity due to gastric perforation is very large, and mortality rates ranging from 25-30% have been reported in several studies.[7] Thus, several scoring systems have been developed to predict the prognosis of patients with perforated peptic ulcer, which have been reported in various studies. However, neither of these scoring systems was able to demonstrate superiority to the other.[8] The aim of the scoring system was to facilitate adequate management of patients with gastric perforations and reduce mortality and morbidity. Furthermore, the identification of patients with gastric perforations who are at high risk of worsening of the condition after surgery is important for clinical decision making. Early and accurate identification of high-risk patients can help stratify the level of risk and is very useful in triage, such as time and duration of preoperative stabilization of respiratory and circulatory functions, postoperative intensive care unit (ICU) and level and length of observation.[9]

Many scoring systems are used to assess the prognosis of mortality and morbidity in peptic ulcer perforation. All scoring systems such as the Boeysscore, Mannheim Peritonitis Index (MPI), American society of Anesthesiologist score, Acute Physiology and Chronic Health Evaluation (APACHE II) and Boey score, have been used to predict the mortality rate of peptic ulcer perforation. The scoring system used must be simple and can optimally predict outcomes, can be measured objectively, and can be applied to these patients to determine prognosis.[4]

The most well-known scoring systems for predicting mortality in patients with gastric perforation are the Boey score and ASA.[10] These Boey and ASA scores are frequently used because of their simplicity and high predictive value for mortality in patients with perforated peptic ulcer. However, the accuracy of this score for predicting morbidity is still questionable.[9] In the study of Møller MH, et al, showed the accuracy of the Boey Score score was 0.70, and the American Society Anesthesiology (ASA) score was 0.78 in predicting mortality and in case of perforated peptic ulcer.[10],[11] In the study of Nichakankitti, et al., The accuracy of Boey's score was 0.728, ASA score was 0.776.12. Møller introducing for the first time the POMPP (Practical scoring system of mortality in patients with perforated peptic ulcer) scoring system aimed specifically at predicting mortality in patients with surgical gastric perforation. The POMPP score looks more practical, but it is more complex and has not been validated other than the cohort method.[12],[13]

Area Under Receiver Operating Characteristic Curve (AUC) is a verification system that can be measured based on the value of errors that occur and can also be measured by how successful the recognition of a system is (specificity). Where the AUC value is always between 0 to 1. If the AUC value is above 0.90 then the system performance is classified as "Excellent", if the AUC value is between 0.08 and 0.09 then the system performance is "Good".[14]

Based on these data, we interested in conducting a study on the diagnostic validation of the POMPP score in predicting mortality in patients with gastric perforation who are undergoing percutaneous lavage at Saiful Anwar Hospital, Malang. Because as far as we know, this score has never been applied in Indonesia. With differences in the population age groups of patients with peptic ulcer perforation, differences in socio-economic backgrounds, understanding of health, especially peptic ulcers and the use of herbs or traditional medicines, this can provide a difference in the risk of postoperative mortality. This is expected to have a positive impact, especially regarding early identification and facilitating the stratification of high-risk patients, adequate preoperative and postoperative management.

## II. Methods

This study was a retrospective cohort design by measuring ASA and POMPP scores and the mortality of patients diagnosed with gastric perforation who underwent percutaneous lavage. The research was conducted at Saiful Anwar Malang Hospital during the period January 1 January 2018 - January 1 2019.

The study population was all patients with a diagnosis of gastric perforation who underwent percutaneous

lavage at Saiful Anwar Hospital Malang. The research sample was the entire population during the period January 1, 2018 - January 1, 2019.

The study inclusion criteria included:

1. Patients with diagnosis of gastric perforation who underwent percutaneous lavage at Saiful Anwar Hospital Malang during the period January 1, 2018 - January 1, 2019.
2. The patient was diagnosed with gastric perforation with the following signs: sudden abdominal pain with abdominal distension. The patient also vomit, had no appetite, and decreased activity. On physical examination, there was found tenderness in all areas of the abdomen, with the use of noise that decreased or even disappeared. From abdominal x-ray, you can find free air in both LLD and ½ sitting position.
3. Patient baseline data, physical examination, investigations, and therapy on clear and complete patient status.
4. ASA score ≥ 3

The study exclusion criteria included: Age of the patient <18 years and patients with a diagnosis of gastric perforation who underwent exploratory laparotomy at Saiful Anwar Malang Hospital during the period January 1, 2018 - January 1, 2019. The sampling technique was the total sampling method, where all existing subjects who meet the eligibility criteria are included in the study until the required number of samples is met. Data processing was performed using the statistical software SPSS program. Statistical analysis will use Receiver Operating Characteristic (ROC) and determine the amount of Area Under Curve (AUC) for each score.

## III. Results

**Characteristic of the Research Sample**

This research was conducted on 35 cases of gastric perforation under surgery obtained through medical records January 1, 2018 - January 1, 2019. From all respondents, the description of the characteristics of the respondents observed was age, gender, length of stay, mortality, location of perforation, surgery, ASA score and POMPP.

**Tabel 1.** Characteritic of the research sample

| Characteristic | Frequency (n) | Percentage (%) |
|---|---|---|
| Average Age (Min, Max) | 61.94 (26, 86) | |
| Gender | | |
| ● *Female* | 7 | 20.00 |
| ● *Male* | 28 | 80.00 |
| ASA Score | | |
| ● *3E* | 7 | 20.0 |
| ● *4E* | 25 | 71.4 |
| ● *5E* | 3 | 8.6 |
| POMPP Score | | |
| ● *0* | 7 | 20.0 |
| ● *1* | 15 | 42.9 |
| ● *2* | 9 | 25.7 |
| ● *3* | 4 | 11.4 |
| Mortality | | |
| ● *Yes* | 24 | 68.6 |
| ● *No* | 11 | 31.4 |

In terms of age, the average age of perforated peptic ulcer patients was 61.94 years with the youngest age 20 years and the oldest age 86 years (Table. 1). In terms of gender, this study showed the number of patients with gastric perforation with female gender was 7 people (20.0%) and male was 28 people (80%) (Table.1).

Based on the results of the ASA score, 8.6% had an ASA 5E score, 20.0% had an ASA 3E score, and the majority of 25 people (71.4%) had an ASA 4E score. Based on the results of the POMPP score in this study, 7 people (20.0%) got a POMPP score of 0. 15 people (42.9%) get a POMPP score 1, 9 people (25.7%) get a POMPP score 2 and 4 people (11.4%) get a POMPP score 3 (Table 1).

Table 1 shows the mortality of patients with gastric perforation. There were 11 patients (31.4%) who received outpatient treatment after peritoneal lavage, and 24 patients (68.6%) who died.

POMPP score accuracy

The analysis using the ROC test showed that the POMPP score had an area of under curve (AUC) of 0.544, with a 95% confidence interval between 0.331 to 0.756. Meanwhile, the analysis using the ROC test showed that ASA had an undercurve area (AUC) of 0.659, with a 95% confidence interval between 0.463 and 0.855.

**Table 2.** AUC based on mortality

| Variable | AUC | Asymp. Sig | IK 95% | | Cut of point |
|---|---|---|---|---|---|
| | | | Lower | Upper | |
| ASA | 0,659 | 0,136 | 0,463 | 0,855 | 3,50 |
| POMPP score | 0,544 | 0,683 | 0,331 | 0,756 | 1,50 |

Based on the ROC curve for the POMPP score, the AUC diagnostic value was 0.544, and the curve was above the 50% line. The AUC value obtained from the ROC method for the POMPP score was 54.4% (95% CI: 33.1% -75.6%, with p = 0.683). Because the significance value of AUC> 0.05, it can be interpreted that the AUC value for the POMPP score to predict mortality of patients who died and who lived had no significant difference with the AUC value of 50%. However, statistically, the AUC score of the POMPP score of 54.4% is still classified as very weak. Then, the AUC score of the POMPP score was 54.4%, meaning that if the POMPP score (cut off with ROC) was used to predict mortality of patients who died and those who lived in 100 patients, then the correct conclusion would be obtained in 54 patients. this means that the POMPP score shows poor results as a predictive score for mortality in patients with perforated peptic ulcer.

Based on the ROC curve for ASA, the AUC diagnostic value was 0.659 and the curve was above the 50% line. The AUC value obtained from the ROC method for ASA was 65.9% (95% CI: 46.8% -86.1%, with p = 0.122). Because the significance value of AUC> 0.05, it means that the AUC value for ASA to predict mortality of patients who died and who lived there was no significant difference with the AUC value of 50%. However, statistically, the AUC ASA value of 65.9% is still classified as weak. Then, the AUC value of ASA was 65.9%, meaning that if ASA (cut off with ROC) was used to predict mortality of dead and living patients in 100 patients, then the correct conclusion would be obtained in 66 patients. The magnitude of the prediction accuracy for predicting the likelihood that the subject will die or stay alive when using the ASA score was 40.0%.

Table 3. Diagnostic values

| **Variable** | **Kat.** | **Mortality** | | **Sens.** | **Spe.** | **NDP** | **NDN** | **Acc.** |
|---|---|---|---|---|---|---|---|---|
| | | **+** | **–** | **(%)** | **(%)** | **(%)** | **(%)** | **(%)** |
| | >3.5 | 21 | 7 | 87.5 | 36.36 | 75.0 | 57.14 | 71.43 |
| | <3.5 | 3 | 4 | | | | | |
| POMPP | >1.5 | 9 | 4 | 37.5 | 63.64 | 69.23 | 31.82 | 45.71 |
| Score | <1.5 | 15 | 7 | | | | | |

ASA

Abbrevation: Sens = sensitivity; Spe = specificity; NDP = positive predictive value; NDN = negative predictive value; Acc = accuracy

**Determination of the threshold (cutoff point) with the Receiver Operating Curve**

The use of a continuous scale score as a diagnostic tool is strongly influenced by the threshold value used to distinguish “patients who died” and “patients who are still alive”. In this study, the ASA score threshold and the POMPP score were determined using the Receiver Operating Curve (ROC) analysis. The ROC analysis graphs the sensitivity on the y-axis and 1-specivisity (false negative) on the x-axis at various threshold values. A diagnostic tool is considered perfect if the curves are close to the upper vertical and horizontal axes, which represent high sensitivity and low false negative (1-specificity) or high specificity.

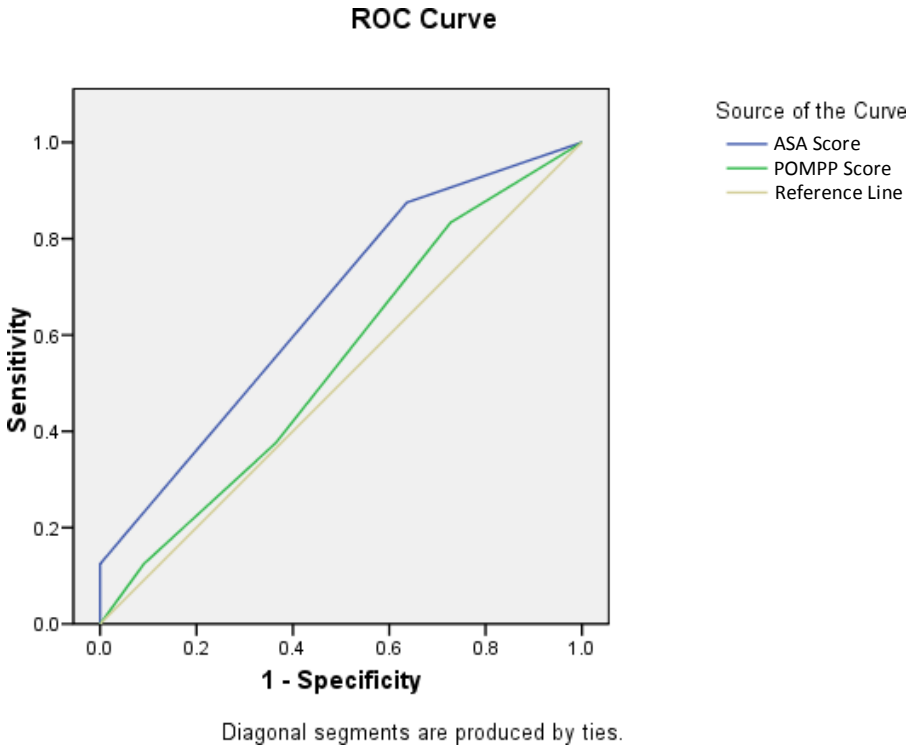


**Figure 1.** ROC ASA and POMPP Score

Then it can be concluded that clinically, the AUC score for ASA and the POMPP score, is not yet satisfactory to be used as a predictor of patient mortality (life and death), because it has a weak diagnostic value.

Besides the graph, the ROC analysis also produces a table showing the sensitivity and 1-specificity values at various cutoff values. To make it easier for the table to be converted into a sensitivity and specificity table (table 3).

**Table 4.** Sensitivity and Specificity at Various Threshold Values

| Score | Threshold value | Sensitivity | Specificity |
|---|---|---|---|
| POMPP | -1 | 1 | 0,000 |
| | 0,5 | 0,8333 | 0,273 |
| | 1,5* | 37,5% | 63,6% |
| | 2,5 | 0,125 | 0,909 |
| | 4 | 0 | 1,000 |
| ASA | 2 | 1 | 0,000 |
| | 3,5* | 87,5% | 36,3% |
| | 4,5 | 0,125 | 1,000 |
| | 6 | 0 | 1,000 |
| | -1 | 1 | 0,000 |
| | 0,5 | 0,8333 | 0,273 |

* threshold = cut of point

Determination of the optimal threshold point depends on the purpose of the diagnostic tool. If the tool is more emphasized as a screening, high sensitivity values are prioritized. If the tool is for definite diagnosis, then the specificity is prioritized. In this case, the POMPP score is intended as a diagnostic tool so that a threshold value of 1.5 was set, and for ASA a threshold value of 3.5 was set, because at this threshold value the optimum value for sensitivity and specificity is obtained.

**Diagnostic Test Results**

The analysis of the accuracy of the diagnostic value for ASA and the POMPP score to predict patient

mortality was calculated by calculating the sensitivity, specificity, likelihood ratio and predictive value using the patient mortality category (life and death). In table 5.5. can be seen the following diagnostic test results.

**Table 5.** Diagnostic Test Results

| Score | Sensitivity % | Spesificity % | LR | PPV % | NPV % |
|---|---|---|---|---|---|
| ASA | 87.5 | 36.36 | 1.375 | 75.00 | 57.14 |
| POMPP | 37.5 | 63.64 | 1.031 | 69.23 | 31.82 |

LR: Likelihood Ratio; PPV: Positive Predictive Value; NPV: Negative Predictive Value

The results of the accuracy analysis from the crosstabs table the cut off point results from the ROC showed that the POMPP score has a smaller sensitivity than ASA, which was 37.5%. As for the specificity test results, it shows that the marker with the POMPP score had a greater specificity value than ASA, which was 63.64%. This sensitivity value shows that 37.5 out of 100 patients whose POMPP score is increasing also increases the mortality rate after laparotomy exploration. Meanwhile, this specificity value indicates that 64 out of 100 patients were completely cured after laparotomy exploration.

The value of the likelihood ratio (LR) of the subjects who had a likelihood of dying would get a positive diagnostic test result using the two markers in sequence, the largest was owned by the ASA marker, which was 1.375.

It can also be seen that there was a high probability that the subject will have mortality (+) if the diagnostic test result is positive, called the positive predictive value (PPV) in sequence is the largest by markers with ASA, which is 75%, followed by PPV from the POMPP score of 69.23%. PPV The POMPP score is 69.23%, meaning that 70 out of 100 patients who died did have a score> 1.5. Meanwhile, the negative predictive value (NPV) is the high probability that the subject will have mortality (-) if the diagnostic test result is negative. With the NPV POMPP score of 31.82%, it means that 32 out of 100 patients who recover did have a score> 3.5. The ASA score with a PPV of 75% means that the ASA score can predict a mortality rate of 75% and predict a negative (live) mortality rate of 57.14%.

## IV. Discussion

Peptic ulcers annually affect 4 million people worldwide (Di Saverio et al, 2014). Peptic ulcer complications can occur, like bleeding, perforation, and obstruction. Perforation is the second complication after bleeding.[7] In ten to twenty percent (10-20%) of patients with peptic ulcer complications occur and 2% - 14% of them develop perforated peptic ulcer. Gastric perforation is the most frequent indication of emergency gastric surgery and is often associated with potentially life-threatening complications. Perforation occurs in about 2-10% of the incidence of peptic ulcers. The mortality and morbidity resulting from gastric perforation is of great importance, with the proportion of the risk of mortality reported to be 20-50% in several population-based studies.[1]

The mean age according to data from various studies varies widely. Research data by Nichakankitti et. A., shows that the mean age of patients with gastric perforations is 40.5 years.[15] In our study, the mean age of patients with gastric perforations was 61.94 years with the youngest 21 years and the oldest 86 years.

According to gender, this study showed the number of perforated peptic ulcer patients with female sex was 80% and male as much as 20%. This is in line with several previous studies which stated that there were more male peptic ulcer perforation patients than women. Research data by Nichakankitti et al. (2016) showed that 82.1% of the sample were male.[15]

In our study, 11 patients (31.44%) lived after peritoneal lavage, and the mortality rate was 24 (68.6%). This is higher than previous studies by Nichakankitti et. al.who obtained a 30-day mortality rate of 3.57%.[15] Other studies have shown a 30-day mortality rate of 9%.[9],[13] The mortality rate that is getting lower over time is one of the impacts of development. intensive care today. In the center where the study by Lohsiriwat (2009) was conducted, high-risk patients were treated and resuscitated first in the intensive care room before surgery.[16] The mortality rate of patients with peptic ulcer perforation can be reduced by improving the quality of patient care, such as grouping patients by risk groups high risk and low risk, then perform management according to the risk group.[9]

The majority of the research sample had a POMPP 1 score of 15 people (42.9%). At a score of 0 there are 7 people (20%), 2 as many as 9 people (25.7%) and a minority has a score of 3, namely 4 people each (11.4%). As with the study by Menekse (2015), with a total of patients who had a POMPP score of 0 and 1 had the largest number of samples and patients who had a score of 3 had the lowest sample.[2]

Analysis with the ROC test showed that the ASA score in this study had an area under the ROC (AUC) of 0.659 with a 95% confidence interval between 0.463 and 0.855. In this study, it was found that the sensitivity value of the ASA score at dr. Saiful Anwar Hospital Malang is 87.5%, with a specificity of 36.36%, a positive

predictive value (PPV) of 75%, and a negative predictive value (NPV) of 57.14%. That is, the ASA score predicts a mortality rate of 75% and predicts a cure (recovery / life) rate of 57.4%.

The analysis with the ROC test shows that the PMPP score in studies that have areas below the ROC (AUC) is 0.544 with a 95% confidence interval between 0.331 to 0.756. In this study, it was found that the sensitivity value of the ASA score at dr. Saiful Anwar Malang is 37.5%, with a specificity of 63.64%, a positive predictive value (PPV) of 69.23%, a negative predictive value (NPV) of 31.82%. That is, the POMPP score predicts a mortality rate of 69.23% and predicts a cure rate (recovery / life) of 31.82%. Research by Park et al., (2004) states that an acceptable AUC score is 0.7-0.8, a perfect score is 0.8-0.9, while more than 0.9 the score is very perfect.[17] In this study, the low AUC score was thought to be due to the small number of samples.

The results of this study are supported by Møller, et al. (2012) found that the ASA score in their study had an AUC of 0.78 with a 95% Confidence Interval between 0.76 to 0.80, meaning that the ASA score was included in the moderate category as a predictive score for mortality in patients with perforated peptic ulcer. in the study by Thorsen, et al. (2014) who found the AUC ASA score in their study was 0.79 (Table 4) meaning that this ASA score was included in the moderate category as a predictive score for mortality in patients with peptic ulcer perforation.[18] In another study, Saafan, et al. (2019) found an AUC ASA score of 0.69 with a 95% Confidence Interval between 0.55 and 0.83 (Figure .1), meaning that the ASA score was included in the moderate category as a predictive score for mortality in patients with peptic ulcer perforation. Both the ASA score and the POMPP score can be used to predict mortality in gastric perforated patients because all these scores have an AUC above 0.5 with varying power of predictive accuracy. When compared with the POMPP score, the ASA score has variability between examiners because the ASA score is not an objective score.[18] Thus, a more objective score such as the POMPP score is needed.

According to several previous studies, the POMPP score compared to other scores has the same predictive power and is good for mortality in PPU patients. Neither of the previously described scoring systems is widely accepted in clinical practice. Reasons can be complexity, non-specificity or confusion and subjective points in the doctor's mind such as the definition of preoperative shock, duration of perforation and severity of medical illness. It is believed that the three very clear parameters (age, albumin, and BUN) could easily be adopted in clinical practice to predict mortality in patients with PPU who underwent surgery. Respiratory support, circulatory stabilization, preoperative and postoperative care in the ICU, routine monitoring and perioperative care protocols can be added to high-risk patients with PPU. Therefore, a system that can be implemented simply and easily in predicting mortality for PPU patients can reduce the mortality rate.[2]

Our study has several limitation. Future studies are expected to use a cohort design (prospective study), develop research based on available data, and compare the POMPP score with other predictive scores. This has not been done in this study.

## V. Conclusions

According to this research result, it could be concluced that:

1. From the 35 samples of the study, the mean age of the sample was 61.94 years, the majority were male (80%), the majority of the study sample had a POMPP score of 1 (42.9%) at dr. Saiful Anwar Hospital Malang.
2. Mortality rate of patients suffering from perforated peptic ulcer at dr. Saiful Anwar Malang who received peritoneal lavage therapy was 68.6%.
3. ASA score shows better accuracy than the POMPP score as a predictive score for mortality in patients with perforated peptic ulcer at dr. Saiful Anwar Hospital Malang.
4. ASA score has a better AUC score than the POMPP score, but the two scores are not good enough to predict mortality.
5. ASA score has a greater sensitivity value, but the POMPP score has greater specificity. The ASA score has a sensitivity of 87.5% and a specificity of 36.36%. The POMPP score has a sensitivity of 37.5% and a specificity of 63.64%.

**Ethical Clearance**

The Ethical Clearance from Health Research Ethics Commission of Saiful Anwar Hospital, Malang number : 400/104/K.3/302/2020 on April 6th 2020.

**Conflict of Interest**

There is no conflict of interest.

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**Author Contribution**

All authors are contributed to conceived and design the analysis, cellected the data; contributed data and analysis tools; performed analysis and wrote the paper.

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