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The Relationship Between Mannheim Peritonitis Index and Mortality in Adult Secondary Peritonitis Patients at Dr. Saiful Anwar Malang Hospital

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Abstract:- Background: Peritonitis is still a frequent infection problem and has a high mortality rate, although the development of surgical techniques. The Mannheim Peritonitis Index (MPI) is a scoring system for assessing the prognosis of peritonitis patients with simpler variables than the SAPS and APACHE II scores. Aim: To determine the sensitivity and specificity of MPI in adult secondary peritonitis patients at RSSA Malang. Methods: This research is an observational study with a "Retrospective Cohort. Patients whose medical records incompletely included the MPI variable would be excluded from this study. Data were analyzed to determine the probability value (p) and the Relative Risk (RR) value of the patient's death. Results: In this study there were 71 patients with secondary peritonitis with an average age of 55.14 years (SD 14.08; range 19-80 years). There were significant differences in the variables of age (p=0.045), organ failure (p=0.000) and organ origin (p=0.001). MPI has a sensitivity of 76% and a specificity of 83% with a cut off point at a score of 25.5 and an AUC value of 0.856. Conclusion: MPI is a simple and effective score in assessing the prognosis of adult secondary peritonitis patients.

Keywords:- *Mannheim Peritonitis Index, Secondary Peritonitis.*

I. INTRODUCTION

Peritonitis is inflammation caused by infection or aseptic conditions in the lining of the abdominal organs (peritoneum). The peritoneum is a thin, clear membrane that covers the abdominal organs and the inner abdominal wall. Location of peritonitis can be localized or diffuse and history of acute or chronic. According to a survey by the World Health Organization (WHO), cases of peritonitis in the world are 5.9 million cases. Based on data from the Ministry of Health in 2008, the incidence of peritonitis in parts of Indonesia is still high. In Indonesia, the number of patients with peritonitis is around 7% of the total population in Indonesia, or around 179,000 people. 2 Peritonitis patients treated at RSSA Malang in the period January 2019 - December 2019 reached 225 cases with a mortality rate of 26.3%. The high mortality rate in cases of peritonitis encourages evaluation to reduce mortality in patients with peritonitis. One way is to determine an accurate and simple peritonitis score so that it can be used in hospitals that do not have a complete supporting examination. Assessment systems such as APACHE II, SAPS, MPI have been developed as an effort to evaluate and improve monitoring of health services [1]. The initial assessment using the Mannheim Peritonitis Index (MPI) aims to facilitate the evaluation of patients with peritonitis. MPI is one of the simplest scoring systems used by surgeons to make it easier to determine the risk during surgery and the patient's prognosis. Some of the parameters used by MPI include: age, sex, organ failure, presence of cancer, duration of peritonitis, colon involvement and degree of spread and character of peritoneal fluid. In a study conducted by Sharma et al. in India there were patients with a score of <21, a mortality rate of 0%; for a score of 21–27 is 27.28%; and for scores > 27 it was 100% (P < 0.001). For patients with a score <21, the morbidity rate was 13.33%; for a score of 21-27 65.71%; and for scores > 27 it was 100% (P < 0.001). So that MPI is a simple and effective tool to assess morbidity and mortality in patients with peritonitis. In Indonesia, HDI has been used in several hospital institutions, one of which was in the study of A. Mughni and I Riwanto at RSUP Dr. Kariadi Semarang said that HDI has a sensitivity of 72% in adult generalized peritonitis patients with a cut off point of 26 [2]. At Dr. Hospital Saiful Anwar MPI has never been used to evaluate patients with secondary peritonitis, so MPI can later be used to evaluate patients with peritonitis.

II. METHOD

This study was designed using an observational study with a retrospective cohort design. This study examined the relationship between the Mannheim Peritonitis Index (MPI) on mortality and patients returning to life in adult secondary peritonitis at RSUD dr. Saiful Anwar in September 2019 to September 2020. The inclusion criteria in this study were patients with secondary peritonitis aged 18-60 years at Dr. Saiful Anwar Malang whose medical records met the HDI variable and had definitive surgery performed. Exclusion criteria were secondary peritonitis patients at dr. Saiful Anwar whose medical record did not meet the HDI variable and did not undergo surgery. Hypothesis test in this study used discriminant analysis. Calculation process using the SPSS computer program.

III. RESULT

TABLE I. SENSITIVITY AND SPECIFICITY AT VARIOUS THRESHOLD VALUES

Biomarkers	Threshold Value	Sensitivity (ROC)	Specificity (ROC)
MPI	24.5	76.67%	82.93%

MPI: *Mannheim Peritonitis Index*

In this study score MPI can be used to predict patient outcomes (death and return to life), because at this threshold the optimum value for sensitivity and specificity is obtained. Furthermore, based on the threshold value of the ROC results, it can be used to divide the MPI score above into 2 categories, namely above and below the threshold, to then make a cross table with *outcome* patients (dead and home alive). The results of the cross table are as follows.

TABLE II. CROSSTABS OUTCOME HDI SCORE

		Outcomes				The p value of chi square	Odds ratio	95% Confidence Intervals	
		Dead		Alive				Lower	Upper
		n	%	n	%				
MPI (ROC cut off)	>24.5	12	37.5%	39	18.1%	0.000			
	<24.5	20	62.5%	176	81.9%		15,959	4,935	51,611

Remarks: tested with Chi square

For The MPI crosstabs and outcomes above show that of the 30 patients who died, there were 76.7% with MPI > 24.5 and 23.3% patients with MPI <24.5. As for the 41 people who returned alive, there were 17.1% patients with MPI > 24.5 and 82.9% patients with MPI <24.5. The test results obtained a p value of 0.000 (p <0.05), so it can be concluded that a high MPI score of or above 24.5 tends to indicate a patient at high risk of death, while a low MPI value of <11 tends to indicate a patient who has the opportunity to go home alive.

A. Sensitivity and Specificity of MPI score

Analysis of the accuracy of prognostic values for MPI *Sensitivity, specificity, likelihood ratio* and *predictive value* were calculated using the patient *outcome* (dead or alive). In table 2. can be seen the results of the diagnostic tests for all observed parameters, namely the calculation of the value *of Sensitivity, specificity, likelihood ratio* and *predictive value (PPV and NPV), as well as accuracy and odds ratio*, with a summary in the following table.

TABLE III. SUMMARY OF DIAGNOSTIC TEST RESULTS

	Sensitivity	specificity	Positive predictive value (PPV)	Negative predictive value (NPV)	Positive likelihood ratio (LR)	accuracy	Odds ratio	95% Confidence Intervals	
								Lower	Upper
MPI	76.7%	82.9%	76.7%	82.9%	4,490	80.3%	15,959	4,935	51,611

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

Based on the table above shows that MPI has a sensitivity of 76.7 %. This means that the MPI score with *a cut off* from the ROC results has the ability to predict patient *outcomes* (death and return to life), where with an MPI > 24.5 of all patients who are truly at high risk of dying with a prediction rate of 76.7 %.

Based on the table above it shows that MPI has a specificity of 82.9 %, meaning that the MPI score with *a cut off* from the ROC results has the ability to show patients with *a cut off* that is less than the threshold value 24.5 of all patients with true outcome came home alive, amounting to 82.9 %.

Based on the table above it shows that MPI has a specificity of 82.9 %, meaning that the MPI score with *a cut off* from the ROC results has the ability to show patients with *a cut off* that is less than the threshold value 24.5 of all patients with true outcome came home alive, amounting to 82.9 %.

Based on the table above, it shows that the HDI score has a positive predictive value (PPV) of 76.67%, meaning that the HDI score with a cut off from the ROC results, namely having the ability to show the proportion of patients with HDI > 24.5 with an outcome of death, is 76.67%.

Based on the table above, it shows that MPI has *a negative predictive value* (NPV**)** of 82.9 %, meaning that the MPI score has the ability to show the proportion of patients with MPI <24.5 with *an outcome* of going home alive at 82.9 %.

From the results of the calculations in the table above, it is obtained that the accuracy of the HDI score prediction for assessing patient prognosis can be predicted correctly where less than the 24.5 threshold will have a chance of returning to life, while those over the 24.5 threshold will be at risk of death, with a degree of accuracy. reached 80.3%.

Because the odds ratio for MPI is 15.96 (CI 85%: 4.935 – 51.61), the value is above 1 (OR> 1), it can be concluded that MPI with *cut off* from ROC results can be one of the factors for predicting patient *outcomes* (died and returned alive). Where if the MPI has a value higher than the threshold (ROC result) MPI > 24, then the probability of a patient with *an outcome* dying is 15.96 times compared to a patient with *an outcome* alive. Likewise for MPI that has a value lower than the threshold of MPI <24.5, then the probability of a patient with *the outcome* coming home alive is 15.96 times compared to patients with *the outcome* dying.

IV. DISCUSSION

B. Prevalence

In this study, we identified a prevalence of secondary peritonitis in adults (over 18 years) at RSSA Malang in 2021, which encompassed a total of 169 patients. Comparatively, according to the 2008 MOH data, the prevalence of peritonitis in Indonesia was reported to be 7%, equating to approximately 179,000 individuals. To ascertain the characteristics of our sample, we included 71 patients with an average age of 55.14 (SD 18.03; range 19-85). In contrast, a study conducted in Krakow, Poland, consisted of 168 patients with an average age of 48.45 and an SD ± 22.22. Similarly, a study in Madhya Pradesh, India, involved 100 patients, with a mean age of 37.96 and an SD ± 17.49 [3].

In our study, we observed a total of 47 male patients, among whom the mortality rate was 22.5%. Additionally, there were 23 female patients with a mortality rate of 18.3%. In comparison, a study conducted in Karnataka, India24 reported a higher mortality rate among female patients. This particular study consisted of 80 patients, with 13 female patients experiencing a mortality rate of 23%, while 67 male patients had a mortality rate of 8.9%. The variations in mortality rates can be attributed to differences in sample size and the inclusion of patients who met the research criteria [3].

C. Etiology and Mortality Rate

In this study, we identified the location of perforations based on the frequency, with the appendix, stomach, caecum, ileum, jejunum, recto-sigmoid, and colon being the most common sites, in descending order. Among these locations, the highest mortality rate was associated with colon perforations caused by colon tumors (100%) and recto-sigmoid perforations (83.3%). In contrast, a study conducted in Madhya Pradesh, India reported that the highest incidence of perforations occurred in the small intestine (duodenum, jejunum, and ileum) at 53%, followed by the stomach at 20% [3]. Another study in Karnataka, India, found the highest perforation rates in the duodenum and ileum, with the highest mortality rates observed in the jejunum (100%) and colorectal region (50%).

Colon perforation resulting from colon cancer carries a high mortality risk, primarily due to factors such as poor nutritional status, cancer spread to the peritoneal cavity upon perforation, and delayed treatment owing to the patient's overall condition [4]. Rectosigmoid perforation is frequently observed in clinical practice. This region is characterized by low stool fluidity, weak blood circulation, and an intraluminal diameter that is relatively narrow, leading to an increase in intraluminal pressure. Additionally, advanced age and the presence of co-morbidities contribute to increased mortality rates associated with rectosigmoid perforation [5]. In this study, patients with perforations in the rectosigmoid had advanced age and comorbid cancer.

D. HDI Variables

In our study, we observed a higher mortality rate among patients over the age of 50, specifically in males. Factors associated with increased mortality included the presence of organ failure, absence of malignancy, a duration of ≤ 24 hours, colonic organ origin, purulent fluid characteristics, and the presence of generalized peritonitis. In comparison, a study conducted in Karnataka, India, reported similar findings, where mortality rates were higher in patients aged > 50 years, those with organ failure, the presence of malignancy, a duration of ≥ 24 hours, colonic origin, and the characteristics of purulent and faecal discharge [6]. In relation to the organ failure variable, patients who experience organ failure are at a 5.53 times higher risk of mortality compared to those without organ failure. This increased risk can be attributed to the systemic inflammatory response triggered by peritoneal infection, which has the potential to progress to septic shock and subsequent organ failure. These complications pose a significant threat to patients with secondary peritonitis and can ultimately lead to death [7]. In terms of the organ origin variable, patients with perforations located in the colon face a 3.56 times higher risk of mortality compared to patients with perforations located outside the colon. The occurrence of colon perforation can result in increased intra-abdominal contamination, leading to sepsis in patients with secondary peritonitis. This heightened risk is attributed to the retroperitoneal space lacking a physiological barrier, thereby exposing numerous lymphatic channels. Consequently, fecal contamination can extend to the retroperitoneal region, intensifying the sepsis condition in patients with secondary peritonitis [8].

E. HDI Outcomes

Based on the MPI scoring, patients in this study were classified into three groups: 31 patients had a score <21, 23 patients had a score between 21-29, and 17 patients had a score >29. Among patients with a survival outcome, the largest proportion belonged to the <21 score group. Conversely, among patients with a fatal outcome, the largest proportion had a score >29. Patients with an MPI score <21 had a mortality proportion of 4.2%, while those with a score between 21-29 had a mortality proportion of 16.9%. Notably, patients with an MPI score >29 had the highest mortality proportion at 40.8%. The observational data from this study

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indicate that an increase in MPI score is associated with an increased risk of mortality in patients with secondary peritonitis. These findings align with previous studies that have explored the accuracy of MPI scoring in predicting outcomes in secondary peritonitis [9]. The observed increase in mortality in this study can be attributed to several risk factors among patients, including age over 50 years, the presence of organ failure, malignancy, and the presence of faecal exudates. Furthermore, complications arising from the disease, such as septic shock and multiple organ failure, contribute to the higher mortality rates.

F. Sensitivity and Specificity of MPI as a Mortality Predictor

Sensitivity refers to the test's ability to correctly identify individuals who are truly sick within the entire population. The table above shows that MPI has a sensitivity of 76.7%. This means that the MPI biomarker, with a cut-off derived from the ROC results, can predict patient outcomes (death and recovery) with a 76.7% accuracy. Specifically, an MPI score above 24.5 indicates a high risk of mortality in patients. Specificity, on the other hand, represents the test's ability to accurately identify individuals who are not sick among those who are actually not sick. According to the table, MPI exhibits a specificity of 82.9%. This indicates that an MPI score below the threshold value of 24.5 can correctly identify patients who will return home alive with an accuracy of 82.9%.

The positive predictive value (PPV) refers to the proportion of patients who test positive and truly have the disease. The table demonstrates that MPI has a PPV of 76.67%, meaning that an MPI score above the cut-off value of 24.5 can correctly identify 76.67% of patients with a true outcome of death. The negative predictive value (NPV) represents the proportion of patients who test negative and are truly not sick. As shown in the table, MPI has an NPV of 82.9%, indicating that an MPI score below 24 (Sharma et al., 2016). can accurately identify 82.9% of patients with a true outcome of returning home alive. Accuracy reflects the closeness of the measurement result to the true or target value. In this case, it refers to the accuracy of MPI in predicting patient outcomes. From the calculations in the table, it can be observed that the accuracy of MPI in estimating patient outcomes, using the threshold value of 24.5 to distinguish between a high risk of death and a chance of recovery, reaches 80.3%.

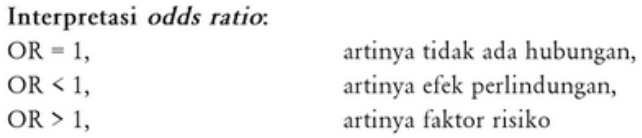
Interpretasi *odds ratio*:
OR = 1, artinya tidak ada hubungan,
OR < 1, artinya efek perlindungan,
OR > 1, artinya faktor risiko

Fig. 1. Interpretation of the odds ratio

The Odds Ratio (OR) is a measure of the association between exposure to risk factors and the occurrence of a disease. It is calculated by comparing the incidence of the disease in the at-risk group (exposed to risk factors) with the incidence of the disease in groups that are not at risk (not exposed to risk factors). In the case of MPI, the calculated Odds Ratio is 15.96 (CI 85%: 4.935 - 51.61). Since the Odds Ratio is greater than 1 (OR > 1), it can be concluded that MPI, with a cut-off derived from the ROC results, can be a predictive factor for patient outcomes (death and recovery). Specifically, if the MPI score is above the threshold (ROC result) of MPI > 24.5, the probability of a patient experiencing death is 15.96 times higher compared to a patient with a recovery outcome. Similarly, if the MPI score is below the MPI threshold of MPI < 24.5, the probability of a patient returning home alive is 15.96 times higher compared to patients with a fatal outcome.

These findings demonstrate that the MPI score holds good prognostic value for predicting the outcomes of secondary peritonitis in RSSA.

TABLE IV. COMPARISON OF MPI SCORE ACCURACY IN PREDICTING THE PROGNOSIS OF SECONDARY PERITONITIS

Studies	Number of samples	Sensitivity (%)	Specificity (%)	AUC
Notash et al., 20053	80	86	74	0.972
Muralidhar VA et al., 201420	50	80.65	57.89	-
Budzyński et al., 201522	168	66.7	97.9	0.81
Sharma et al., 201523	100	60	80	0.79
Kumar P et al., 201727	50	100	91	0.69

V. CONCLUSION

The MPI score is a variable that significantly affects patient outcomes, as there is a significant difference in the MPI score between patients who died and those who returned to life. The identified cut-off point in this study, at a score of 24.5, demonstrates a sensitivity of 76.7% and specificity of 82.9%, with an overall accuracy rate of 80.3%. Patients with an MPI score above 24.5 have a higher risk of mortality. This study highlights the effectiveness of the MPI score as a simple and valuable prognostic tool for assessing morbidity and mortality in patients with secondary peritonitis. The application of the MPI score can aid in patient stratification, facilitating the identification of high-risk individuals who may require surgical intervention and intensive postoperative care. This can help minimize the risk of postoperative complications during hospitalization.

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