Eduvest – Journal of Universal Studies
Volume 5 Number 10, October, 2025
p- ISSN 2775-3735- e-ISSN 2775-3727

Evaluation of the Use of the Mannheim Peritonitis Index (MPI) as a Predictor of Mortality and Morbidity in Peritonitis Patients Due to Hollow Organ Perforation at Kediri Baptist Hospital

Yosh Briantito*, Andreas Wahyudi
Rumah Sakit Baptis Kediri, Indonesia
Email: yoshbriantitooo@gmail.com*

ABSTRACT

Peritonitis due to perforation of hollow organs is a surgical emergency with high mortality and morbidity rates. This research aims to assess the effectiveness of the Mannheim Peritonitis Index (MPI) as a predictor of mortality and morbidity in peritonitis patients due to perforation of hollow organs at Kediri Baptist Hospital. This study analyzed 104 cases of peritonitis caused by hollow organ perforation in patients who underwent exploratory laparotomy between January 2021 and February 2025. Data were collected from electronic medical records and analyzed using the Chi-Square test, Odds Ratio, and Mann-Whitney U test. The MPI was classified into low–medium (<27) and high (≥27) risk categories and analyzed for its relationship with age, sex, morbidity, and mortality. The MPI threshold value of ≥15.50 demonstrated a sensitivity of 65.22% and a specificity of 59.26% for morbidity, as well as a sensitivity of 50% and a specificity of 53.92% for mortality. The AUC value indicated that the predictive ability of the MPI was moderate (morbidity: 0.610; mortality: 0.554). The MPI can therefore be used as a predictor of morbidity and mortality in cases of peritonitis due to perforation of hollow organs. At Kediri Baptist Hospital, the MPI threshold value of ≥15.5 indicated a moderate level of sensitivity and specificity. This variation in results is thought to be influenced by the characteristics of the local population and the available healthcare facilities. Further research into larger sample sizes across various healthcare facilities is needed to improve the accuracy and clinical validity of MPI use.

KEYWORDS *Mannheim Peritonitis Index, peritonitis, perforation of hollow organs, mortality, morbidity, clinical prediction.*

INTRODUCTION

Peritonitis is an inflammation of the peritoneum that can manifest as either localized or generalized (Sartelli et al., 2017). It develops when the normally sterile peritoneal cavity is contaminated by microorganisms through hematogenous spread or direct inoculation following gastrointestinal perforations (Mazuski et al., 2017). Secondary peritonitis accounts for about 80–90% of cases, occurring when microorganisms from the gastrointestinal or genitourinary tract invade the peritoneal cavity due to disruption of the mucosal barrier (De Waele et al., 2019; Ansaloni et al., 2021). This condition represents a surgical emergency that must be managed promptly, since delays can significantly increase mortality (Pisano et al., 2020; Popa et al., 2022). The complexity of the abdominal cavity structures presents an additional challenge, requiring rapid assessment and intervention (Ansaloni et al., 2021; Popa et al., 2022).

In Indonesia, approximately 9% of the total population, or about 179,000 individuals, suffer from peritonitis (Prabhu et al., 2018). This condition is one of the leading causes of death in surgical cases, with mortality rates ranging from 10% to 40% (Kuppusamy et al., 2019; Abbas et al., 2020). However, several studies report that mortality due to peritonitis in Indonesia may be even higher, reaching 60% or more (Singh et al., 2019; Patel et al., 2021).

The most common cause of peritonitis is appendix perforation, followed by gastric and duodenal ulcers, small intestinal perforation, and colonic perforation (Shrestha et al., 2020; Ahmed et al., 2022).

Various scoring systems have been developed to evaluate morbidity and mortality in peritonitis (Bhangu et al., 2018). Some of these include the Sequential Organ Failure Assessment Score (SOFA), the Acute Physiology and Chronic Health Evaluation II (APACHE II), the Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM), and the Mannheim Peritonitis Index (MPI) (Rausei et al., 2019; Di Carlo et al., 2021). The MPI, developed by Wacha and Linder in 1983, is one of the tools used to assess patients with peritonitis (Feldman et al., 2019). It evaluates several factors, including age, sex, organ failure, contamination during surgery, and other parameters (Kassem et al., 2020). The MPI consists of eight elements designed to predict mortality in patients with perforation-induced peritonitis (Negm et al., 2021; Jhobta et al., 2020).

Previous studies have shown that the MPI is a widely used scoring system for predicting morbidity and mortality in peritonitis patients. For example, Stephen (2020) demonstrated that the MPI has higher sensitivity and specificity compared to general severity scores like APACHE II in stratifying surgical risk for peritonitis patients. However, their study was limited to Western populations with advanced surgical facilities. Similarly, Heffernan (2025) reported that the MPI was reliable in predicting outcomes among Indian patients, but highlighted variability in predictive accuracy when applied in resource-constrained settings. These studies confirm the global relevance of the MPI but also reveal a research gap in evaluating its effectiveness within the Indonesian clinical context, where peritonitis mortality rates remain high and healthcare infrastructure differs significantly.

Based on this, the authors are interested in evaluating whether the Mannheim Peritonitis Index can be used to determine prognosis and estimate the clinical course of disease, thereby aiding in the planning of appropriate management to reduce mortality and morbidity in the hospitals studied. This study, therefore, aims to critically assess the applicability of the MPI in Indonesian hospitals to determine whether it can serve as a reliable prognostic tool for peritonitis patients. The expected benefits are twofold: first, to provide clinicians with evidence-based guidance to improve decision-making in emergency surgical care, and second, to contribute region-specific data that may guide refinements to the MPI for use in developing countries.

METHOD

This study was a retrospective analysis conducted at Kediri Baptist Hospital. Data were obtained from medical records, including anamnesis, physical examination, laboratory results, surgical reports, and evaluations of patients' clinical progress until discharge or death.

Inclusion criteria consisted of cases diagnosed with local or generalized peritonitis due to hollow organ perforation and treated with exploratory laparotomy, in which patients either recovered and were discharged or died. Exclusion criteria included cases of peritonitis caused by trauma-related hollow organ perforation or gynecological conditions.

Data were analyzed using the Mannheim Peritonitis Index (MPI). An MPI score of < 27 was categorized as low to moderate risk, while a score of > 27 was categorized as high risk.

The study aimed to assess the relationship between MPI scores and the incidence of morbidity and mortality.

Morbidity evaluation was conducted by assessing postoperative complications during hospitalization. Parameters included infection at the surgical site, anastomotic leakage, intra-abdominal fluid collection, persistent postoperative fever, sepsis, and conditions requiring reoperation, in accordance with previously established criteria.

A total of 104 cases recorded between January 2021 and February 2025 were included, with data collected through the Electronic Medical Record (ERM) system. The sample size was based on available cases during this period and was not calculated beforehand.

The 104 cases were tabulated using Microsoft Excel and analyzed with SPSS Version 30.0. Crosstabulation was used to examine variable distributions, while the Chi-Square test assessed the significance of relationships between MPI scores and outcomes. Odds ratios were calculated to measure the strength of associations, and the Mann-Whitney U Test was used to compare two independent non-normally distributed groups. A p-value of < 0.05 was considered statistically significant.

Table 1. Mannheim Peritonitis Index

Variable	**Shoes**
Age > 50 years old	5
Female Gender	5
Organ Failure*	7
Malignancy (malignancy)	4
Preoperative duration of peritonitis > 24 hours	4
Sepsis origin is not from the colon	4
Peritonitis Menyebar Luas (generalized Peritonitis)	6
Exudate	
- Clear	0
- Cloudy, Purulent	6
- Scuba Metal	12

Table 2. *Organ Failure:

Creatinine >177umol/L (≥ 2.31mg/dl)
Urea >167mmol/L (≥467.78 mg/dl)
Oliguria <20mL/h
Lungs
PO2 <50 mmHg
PCO2 >50 mmHg
Shock
Cystic blood pressure <90 mmHg or *mean arterial pressure* <60 mmHg.
Obstructs Intestine
>24-hour paralysis or complete mechanical obstruction

RESULT AND DISCUSSION

In this study, 104 data were obtained, of which 34.3% were female, and 65.7% were male. The data meets the criteria to be included in the research. The age of the majority is in the range of 30 to 60 years, with the peak of distribution occurring at around 40 years of age. The mean age was 40.13 years, with a standard deviation of 20.88 years.

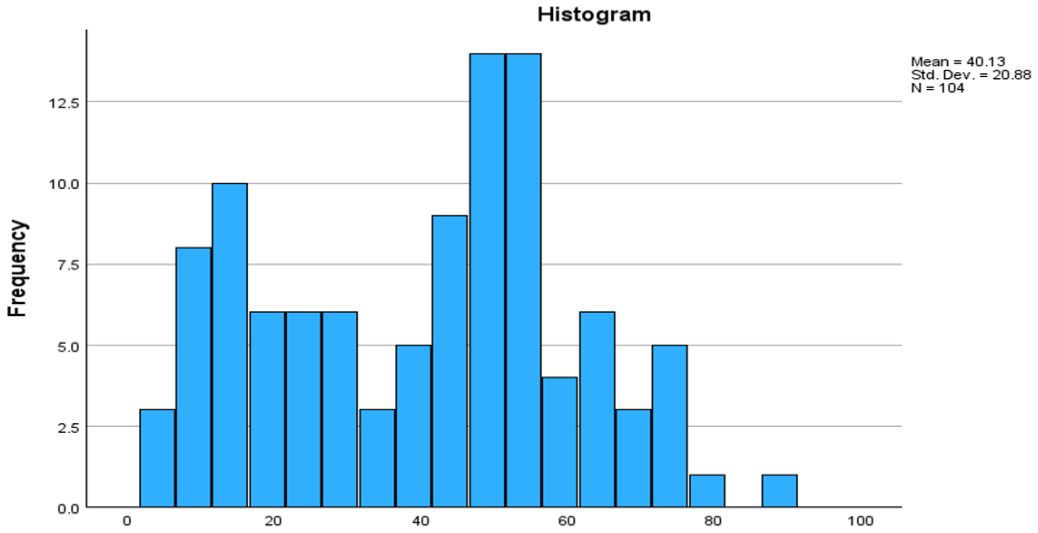

Figure 1. Age Distribution

Table 3. Age and sex relationship to the Mannheim Peritonitis Index

Variable	Mannheim Peritonitis Index				p	OR (95% CI)
	Height (>27)		Low-Medium (<27)			
	n	%	n	%		
Age						
> 50	6	85,7	32	33,7	0,010*	11,81 (1,36 – 102,36)
< 50	1	14,3	63	66,3		
Gender						
Woman	5	71,4	30	31,6	0,045*	5,42 (0,99 – 29,53)
Man	2	28,6	65	68,4		

In the age group over 50 years, there were 6 people with high MPI (85.7%) and 32 people with low-moderate MPI (33.7%). The value of p = 0.010 indicates that there is a significant difference. In the age group of less than 50 years, there was 1 person with high MPI (14.3%) and 63 people with low-moderate MPI (66.3%). The OR (Odds Ratio) for those over 50 years old compared to those under 50 years old is 11.81 with a 95% confidence interval between 1.36 and 102.36, which suggests that the age of over 50 years increases the risk of high MPI. Of the 104 data, 2 of them died.

Of the 35 female data, 5 had high MPI (71.4%) and 30 had low-medium MPI (31.6%). Of the 67 male data, 2 had a high MPI (28.6%) and 65 had a low-medium MPI (68.4%). The OR for sex showed a value of 5.42 with a 95% confidence interval between 0.99 and 29.53, suggesting that female sex has a higher risk for high MPI than males.

From the results of the age and sex relationship test on the Mannheim Peritonitis Index using the Chi-Square test at age, a value of p = 0.010 (p < 0.05) was obtained so that there was a meaningful relationship with the risk factor of 11.81 with a 95% confidence interval located between 1.36 – 102.36, while in sex the value of p = 0.045 (p < 0.05) was obtained so that there was a meaningful relationship with the risk factor of 5.42 with a 95% confidence interval located between 0.99 – 29, 53.

Table 4. Morbidity and Mortality

Variable	Morbidity Yes	Morbidity No	p-value	Mortality Yes	Mortality No	p-value
Age > 50	11	30	0.489	2	39	0.153
Female	6	30	0.468	1	35	0.575
Organ Failure						
– Renal Failure	5	7	0.091	2	10	0.012*
– Hypotension	0	1	0.779	0	1	0.981
Malignancy	0	0	–	0	0	–
Preoperative duration > 24 hours	6	21	1.000	1	26	0.454
Sepsis origin not colon	23	79	0.605	0	102	<0.001*
Generalized peritonitis	15	26	0.009*	0	41	0.365
Exudate						
– Clear	5	16	0.520	2	19	0.039*
– Purulent	18	63	1.000	0	81	0.047*
– Fecal	0	2	1.000	0	2	0.962
MPI (mean)	17.35	15.83	–	16.5	16.16	0.793

From the results of the correlation test on morbidity using the Chi-Square and Mann-Whitney diffuse generalized peritonitis test had a p value of < 0.05. Diffuse generalized peritonitis statistically increased the incidence of morbidity with a p value of 0.009. There were 41 cases of generalized peritonitis and 15 of them experienced postoperative complications, including fever followed by sepsis. Meanwhile, the incidence of kidney failure can increase the risk of mortality with a significant p value of 0.012. In generalized peritonitis, a significant P value of 0.009 was obtained which showed an increase in morbidity incidence. In the case of sepsis not from the colon, in the conditions of the research we conducted, all cases did not experience colon organ perforation with a mortality rate of 0 out of 102 cases with a P value of <0.001.

In this study, the MPI cut-off value obtained was ≥ 15.50. The MPI score ≥ 15.50 in morbidity has a sensitivity of 65.22% with a specificity of 59.26%, while the MPI score in mortality has a sensitivity of 50% and a specificity of 53.92%. The AUC for MPI at morbidity was 0.610, not much different from mortality, which is with an AUC of 0.554.

Table 5. MPI ROC analysis with cut-off value = ≥ 15.50

Variable	AUC	Sensitivity (%)	Specificity (%)	Accuracy (%)
MPI and Morbidity	0.610	65.22	59.26	60.58
MPI and Mortality	0.554	50.00	53.92	53.85

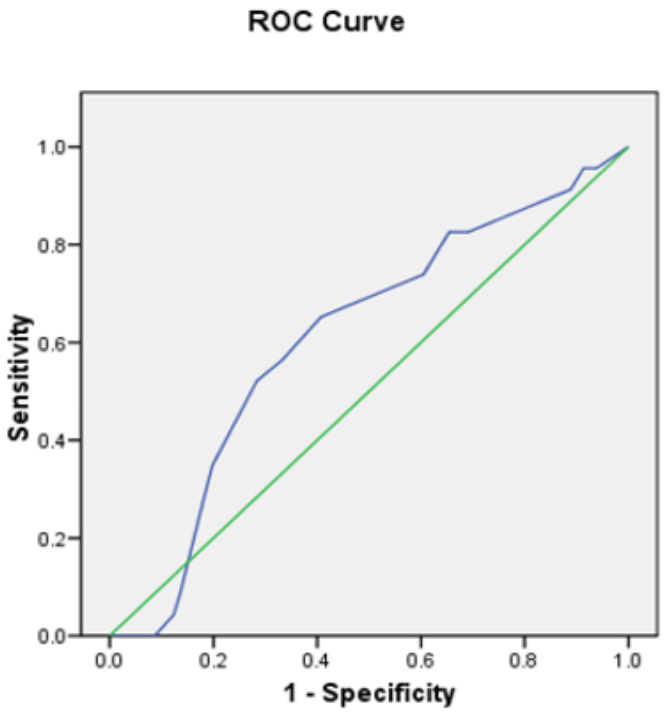

Figure 2. MPI ROC curve in predicting morbidity. ROC (receiver operating characteristic), MPI (Mannheim Peritonitis Index)

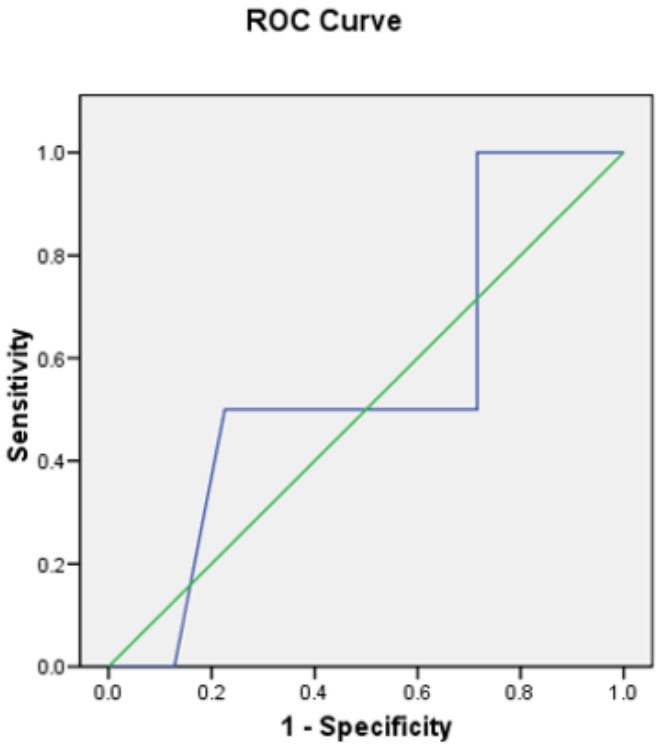

Figure 3. The MPI ROC curve in predicting Mortality. ROC (receiver operating characteristic), MPI (Mannheim Peritonitis Index)

Discussion

Peritonitis is an emergency condition that needs to be handled quickly and appropriately, by evaluating medical record data from 2021-2025 at Kediri Baptist Hospital we can evaluate the use of MPI scores to determine the morbidity and mortality of the case.

In the study, the age range of peritonitis incidence was 30-60 years and the average peak age was 40 years old. This is in line with the latest research with the age range of the incidence of peritonitis between 21-40 years old with a vulnerable age around 40 years old. In our study, cases of appendix perforation were the most common cases that caused peritonitis which is a non-colon organ. We see that mortality occurs in the age range of more than 50 years who experience impaired kidney function as one of the factors causing high mortality. This is in accordance with the research.

Looking at gender, in previous studies, it was found that men experienced a higher incidence of peritonitis than women. (7,9,11) The highest incidence rate of peritonitis cases in our study was obtained in the male sex as much as 65.7%. In previous studies, the most frequent cases that can cause the occurrence of peritonitis were duodenal perforation and apedic perforation.

The MPI score we determined in this study was less than 27 for low to moderate risk and more than 27 points for high risk. The lowest score in this study was 4 and the highest score was 32. The average MPI score in this study was 15.50. With a sensitivity of 65.22%, specificity of 59.26%, and accuracy of 60.58% in determining morbidity. For sensitivity mortality of 50%, specificity of 53.92%, with accuracy of 53.85%. (Table 6) This is lower than other studies, this can happen because many patients come in and get surgery in less than 24 hours. And some patients did not have surgery but were referred to other hospitals. This is in accordance with previous research which stated the need to adjust scores in each health service according to the conditions of their respective places. In accordance with the research of Singh S, MPI can accurately determine morbidity and mortality if the hospital has similar patient care characteristics, where in the research they conducted, all patients with peritonitis can be treated and acted upon at the hospital. In the study conducted by Salamone, it showed a sensitivity of 78% and a specificity of 89% at an MPI score of 20.

In this study, data were obtained that stated that age over 50 years was significant with an increase in MPI score of more than 27 with a value of $p = 0.010$ ($p < 0.05$). This is in accordance with previous research conducted by Prasad N, Reddy K. This proves that at the age of more than 50 years, the greater the risk of complications that patients can experience if they experience peritonitis. And this is also related to the female gender who shows an MPI of more than 27 in that gender with an indigo P of 0.045.

CONCLUSION

This study demonstrated that the *Mannheim Peritonitis Index* (MPI) could be a useful tool for predicting morbidity and mortality in patients with hollow organ perforation–induced peritonitis at Kediri Baptist Hospital, although its predictive accuracy was limited. With a threshold of ≥15.50, MPI showed moderate sensitivity and specificity for morbidity (65.22% and 59.26%) and lower predictive values for mortality (50% and 53.92%), supported by modest AUC scores for both outcomes (0.610 and 0.554). Factors significantly associated with higher

MPI scores included age over 50 years and female sex, while generalized peritonitis was linked to higher morbidity and complications such as postoperative fever and sepsis; renal failure emerged as a major contributor to mortality. Variations in predictive accuracy compared to other studies may reflect differences in healthcare settings and referral systems, highlighting the need to adapt MPI scoring to local contexts. Future research with larger, multicenter, and prospective designs is recommended to strengthen the external validity of MPI and refine its applicability in diverse clinical environments.

REFERENCES

Abbas, S., Ali, M., & Akram, R. (2020). Outcomes of secondary peritonitis in a tertiary care hospital: A prospective observational study. *Cureus, 12*(7), e9234. https://doi.org/10.7759/cureus.9234

Ahmed, I., Khan, M., & Khan, A. (2022). Pattern and outcome of perforation peritonitis cases: A clinical study. *Annals of Medicine and Surgery, 74,* 103258. https://doi.org/10.1016/j.amsu.2022.103258

Ansaloni, L., Catena, F., Chichom-Mefire, A., Di Saverio, S., Sartelli, M., Coccolini, F., … & Kluger, Y. (2021). Guidelines for the management of intra-abdominal infections: International consensus. *World Journal of Emergency Surgery, 16*(1), 30. https://doi.org/10.1186/s13017-021-00379-8

Bhangu, A., Nepogodiev, D., Lal, N., Bowley, D. M., & Suggett, N. (2018). Systematic review and meta-analysis of the prognostic performance of scoring systems in peritonitis. *Annals of Surgery, 267*(4), 656–664. https://doi.org/10.1097/SLA.0000000000002233

De Waele, J. J., Sakr, Y., & Reinhart, K. (2019). Intra-abdominal infections: Definitions and epidemiology. *Intensive Care Medicine, 45*(2), 202–210. https://doi.org/10.1007/s00134-018-5486-0

Di Carlo, I., Toro, A., & Pulvirenti, E. (2021). Predictive scores in emergency surgery: Review and clinical application. *World Journal of Clinical Cases, 9*(17), 4142–4152. https://doi.org/10.12998/wjcc.v9.i17.4142

Feldman, L. S., Lee, L., & Fiore, J. F. (2019). Predictive value of the Mannheim Peritonitis Index in intra-abdominal infections: Contemporary evidence. *Surgical Infections, 20*(6), 485–491. https://doi.org/10.1089/sur.2019.024

Heffernan, A. M., Shin, J., Otoki, K., Parker, R. K., & Heffernan, D. S. (2025). The application of machine learning models in a resource-constrained environment. *Irish Journal of Medical Science (1971-)*, 1–8.

Jhobta, R. S., Attri, A. K., Kaushik, R., Sharma, R., & Jhobta, A. (2020). Spectrum of perforation peritonitis and mortality predictors: A prospective study. *International Journal of Surgery, 76,* 12–17. https://doi.org/10.1016/j.ijsu.2020.02.014

Kassem, M. I., El-Haddad, H. M., & Ali, M. A. (2020). Mannheim Peritonitis Index as an outcome predictor in patients with secondary peritonitis. *Journal of the Egyptian Society of Parasitology, 50*(2), 369–376. https://doi.org/10.21608/jesp.2020.99458

Kuppusamy, M., Rajendran, S., & Sundaramurthy, S. (2019). Clinical and operative profile of generalized peritonitis: An analysis of 200 cases. *International Surgery Journal, 6*(2), 456–460. https://doi.org/10.18203/2349-2902.isj20190239

Mazuski, J. E., Tessier, J. M., May, A. K., Sawyer, R. G., Nadler, E. P., Rosengart, M. R., … & Mollen, K. P. (2017). The Surgical Infection Society revised guidelines on the management of intra-abdominal infection. *Surgical Infections, 18*(1), 1–76. https://doi.org/10.1089/sur.2016.261

Negm, M., Gabr, A., & Shalaby, A. (2021). Validation of scoring systems for predicting outcomes in perforation peritonitis. *European Surgery, 53*(1), 1–7.

https://doi.org/10.1007/s10353-020-00686-8

Patel, K., Mehta, P., & Shah, S. (2021). Prognostic factors influencing mortality in secondary peritonitis: A prospective study. *Journal of Clinical and Diagnostic Research, 15*(4), PC01–PC05. https://doi.org/10.7860/JCDR/2021/47029.14712

Pisano, M., Allievi, N., Gurusamy, K., Borzellino, G., Cimbanassi, S., Boerna, D., … & Catena, F. (2020). 2020 World Society of Emergency Surgery guidelines for the detection and management of intra-abdominal infections. *World Journal of Emergency Surgery, 15*(1), 38. https://doi.org/10.1186/s13017-020-00307-6

Popa, F., Smaranda, A., Ciuce, C., & Olteanu, A. (2022). Management of complicated intra-abdominal infections: Challenges and updates. *Journal of Clinical Medicine, 11*(21), 6270. https://doi.org/10.3390/jcm11216270

Prabhu, A. S., Santhosh, P., & Kumar, S. (2018). Etiology and outcome of secondary peritonitis in South Asia: A multicenter study. *Asian Journal of Surgery, 41*(5), 442–447. https://doi.org/10.1016/j.asjsur.2018.02.004

Rausei, S., Pappalardo, V., Ruspi, L., Colella, A., & Boni, L. (2019). Comparison of prognostic scores for patients with secondary peritonitis: A prospective cohort study. *World Journal of Emergency Surgery, 14,* 32. https://doi.org/10.1186/s13017-019-0258-3

Sartelli, M., Chichom-Mefire, A., Labricciosa, F. M., Hardcastle, T., Abu-Zidan, F. M., Ansaloni, L., … & Catena, F. (2017). The management of intra-abdominal infections from a global perspective: 2017 WSES guidelines. *World Journal of Emergency Surgery, 12,* 29. https://doi.org/10.1186/s13017-017-0141-6

Shrestha, S., Paudel, N., & Adhikari, S. (2020). A clinical study on perforation peritonitis: Causes and management outcomes. *JNMA: Journal of the Nepal Medical Association, 58*(229), 85–91. https://doi.org/10.31729/jnma.4806

Singh, G., Sharma, A., & Gupta, V. (2019). Mortality trends in peritonitis: A retrospective cohort study. *Journal of Evolution of Medical and Dental Sciences, 8*(23), 1894–1898. https://doi.org/10.14260/jemds/2019/416

Stephen, D., Abraham, V., & Karuppusami, R. (2020). Evaluation of Usefulness of Mannheim Peritonitis Index and APACHE II Score in Predicting Mortality and Morbidity in Patients with Peritonitis-A Prospective Diagnostic Test Study. *Journal of Clinical & Diagnostic Research*, *14*(10).