Evaluation of Mannheim's Peritonitis Index in Patients with Peritonitis due to Hollow Viscus Perforation

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Abstract: *This prospective observational study evaluated the prognostic value of the Mannheim Peritonitis Index (MPI) in patients with peritonitis secondary to hollow viscus perforation. Clinical, laboratory, and intraoperative parameters were recorded, and MPI scores were calculated to stratify patients into risk categories. Higher MPI scores were significantly associated with increased mortality and postoperative complications, with patients scoring >29 demonstrating markedly higher mortality compared to those with scores <21. Sensitivity and specificity analysis confirmed the effectiveness of MPI as a predictor of adverse outcomes. These findings validate the Mannheim Peritonitis Index as a simple, reliable, and effective tool for early risk stratification, aiding surgical decision-making and improving patient outcomes in perforation peritonitis.*

Keywords: Mannheim Peritonitis Index; Hollow viscus perforation; Peritonitis; Mortality prediction; Surgical outcomes

I. Introduction

Peritonitis remains one of the most challenging and life-threatening conditions encountered in general surgery. It is defined as inflammation of the peritoneum, usually resulting from microbial contamination following perforation of a hollow viscus, such as the stomach, small intestine, or colon. Despite advances in surgical techniques, antimicrobial therapy, and intensive care support, peritonitis continues to be associated with high morbidity and mortality rates worldwide, particularly in developing countries [1,2].

Hollow viscus perforation is among the most common causes of secondary peritonitis. The etiology varies geographically and includes peptic ulcer disease, typhoid fever, tuberculosis, trauma, malignancy, and nonspecific inflammatory conditions [3]. In low- and middle-income countries, delayed presentation, limited healthcare access, and poor nutritional status further contribute to worse outcomes [4]. Early identification of patients at high risk of adverse outcomes is therefore crucial for guiding management strategies and optimizing resource allocation.

Over the years, several scoring systems have been developed to assess the severity of peritonitis and predict patient outcomes. These include the Acute Physiology and Chronic Health Evaluation (APACHE II), Simplified Acute Physiology Score (SAPS), and Sequential Organ Failure Assessment (SOFA). While these scoring systems are widely used in critical care settings, they require extensive physiological and laboratory data, making them less practical in emergency surgical settings, especially in resource-limited environments [5].

In contrast, the Mannheim Peritonitis Index (MPI), introduced by Wacha and Linder in 1983, is a disease-specific scoring system designed specifically for patients with peritonitis [6]. It incorporates eight easily obtainable clinical and intraoperative parameters: age, gender, organ failure, malignancy, duration of peritonitis, origin of sepsis, extent of peritoneal contamination, and character of exudate. Each parameter is assigned a weighted score, and the total score correlates with the severity of the disease and risk of mortality.

The simplicity and reproducibility of the MPI make it particularly suitable for use in emergency settings. Numerous studies have validated the MPI as a reliable predictor of mortality in peritonitis, demonstrating that higher scores are associated with worse outcomes [7–9]. Patients are typically categorized into three risk groups: low risk (MPI <21), moderate risk (21–29), and high risk (>29), with mortality rates increasing significantly across these groups [10].

Several investigators have specifically evaluated the role of MPI in patients with hollow viscus perforation. These studies have consistently shown that MPI is effective in predicting mortality, postoperative complications, and length of hospital stay [11,12]. Additionally, MPI has been found to be comparable or even superior to more complex scoring systems in certain settings due to its ease of application [13].

However, variations in patient populations, etiological factors, and healthcare infrastructure necessitate further validation of MPI in different clinical settings. In particular, there is a need to assess its applicability in patients presenting with hollow viscus perforation in diverse geographic and socioeconomic contexts.

The present study aims to evaluate the effectiveness of the Mannheim Peritonitis Index in predicting outcomes in patients with peritonitis secondary to hollow viscus perforation. By correlating MPI scores with clinical outcomes such as mortality and postoperative complications, this study seeks to determine its utility as a prognostic tool in routine surgical practice.

II. Methodology

The present prospective observational study was conducted in the Department of General Surgery at a tertiary care hospital over a period of 18 months. All consecutive patients presenting with clinical features suggestive of peritonitis due to hollow viscus perforation and undergoing emergency exploratory laparotomy were included in the study. Patients aged more than 18 years were considered eligible, while those with primary peritonitis, postoperative peritonitis, or traumatic hemoperitoneum without evidence of perforation were excluded. A total of 120 patients fulfilling the inclusion criteria were enrolled after obtaining informed consent.

On admission, a detailed history and thorough clinical examination were performed for each patient. Relevant clinical parameters including age, sex, duration of symptoms, presence of shock, comorbid conditions, and evidence of organ failure were recorded. Routine laboratory investigations such as complete blood count, renal function tests, serum electrolytes, and arterial blood gas analysis were carried out. Radiological investigations, including erect abdominal X-ray, ultrasonography, and when required computed tomography scan, were used to confirm the diagnosis of perforation.

All patients were resuscitated appropriately and subsequently underwent emergency exploratory laparotomy. Intraoperative findings such as the site of perforation, cause of perforation, extent of peritoneal contamination (localized or generalized), and nature of peritoneal exudate (clear, purulent, or fecal) were carefully documented. Based on clinical and intraoperative parameters, the Mannheim Peritonitis Index (MPI) score was calculated for each patient using standard criteria, which include age, sex, presence of organ failure, malignancy, duration of peritonitis greater than 24 hours, origin of sepsis, extent of peritonitis, and nature of exudate.

Patients were then stratified into three groups according to their MPI scores: low risk (score <21), moderate risk (21–29), and high risk (>29). Postoperatively, patients were closely monitored for the development of complications such as surgical site infection, respiratory complications, septicemia, and multi-organ dysfunction. The primary outcome measured was mortality, while secondary outcomes included postoperative morbidity and duration of hospital stay. All patients were followed up until discharge or death.

The collected data were entered into a structured database and analyzed using appropriate statistical methods. Continuous variables were expressed as mean with standard deviation, while categorical variables were presented as frequencies and percentages. The association between MPI scores and outcomes such as mortality and complications was assessed using the chi-square test, and a p-value of less than 0.05 was considered statistically significant.

III. Results

1) Out of 120 patients, the majority were males (75%). The mean age was 42.6 ± 15.3 years. The most common cause of perforation was peptic ulcer (45%), followed by ileal perforation (30%). A majority of patients, 78 (65%), presented after a duration of more than 24 hours from the onset of symptoms, indicating delayed presentation. Organ failure at the time of admission was observed in 32 patients (26.7%), reflecting the severity of the disease in a considerable subset of the study population. Furthermore, generalized peritonitis was noted in 85 patients (70.8%), suggesting widespread intra-abdominal contamination in most cases.(Table 1)

2) Most patients fell into the moderate-risk group, comprising 50 cases (41.7%). Low-risk patients (MPI <21) accounted for 40 cases (33.3%), while 30 patients (25%) were in the high-risk category (MPI >29), indicating a substantial proportion with moderate to severe disease.(Fig 1)

3) Table 2 shows the analysis of mortality across different MPI groups showed a clear increasing trend with higher scores. In the low-risk group (MPI <21), only 2 patients (5%) died, whereas mortality increased to 8 patients (16%) in the moderate-risk group (MPI 21–29). The highest mortality was observed in the high-risk group (MPI >29), where 15 patients (50%) succumbed. This association between MPI score and mortality was found to be highly statistically significant ($\chi^2 = 22.26$, $p < 0.001$), indicating a strong correlation between increasing MPI scores and higher risk of death.

Postoperative complications increased with higher MPI scores, from 20% in the low-risk group to 40% in the moderate-risk group and 73.3% in the high-risk group, indicating a clear association between higher MPI scores and increased morbidity.

Clinical Table 1: Demographic and Characteristics

Variable	Number (n=120)	Percentage (%)
Age >50 years	48	40%
Male	90	75%
Female	30	25%
Duration >24 hrs	78	65%
Organ failure	32	26.7%
Generalized peritonitis	85	70.8%

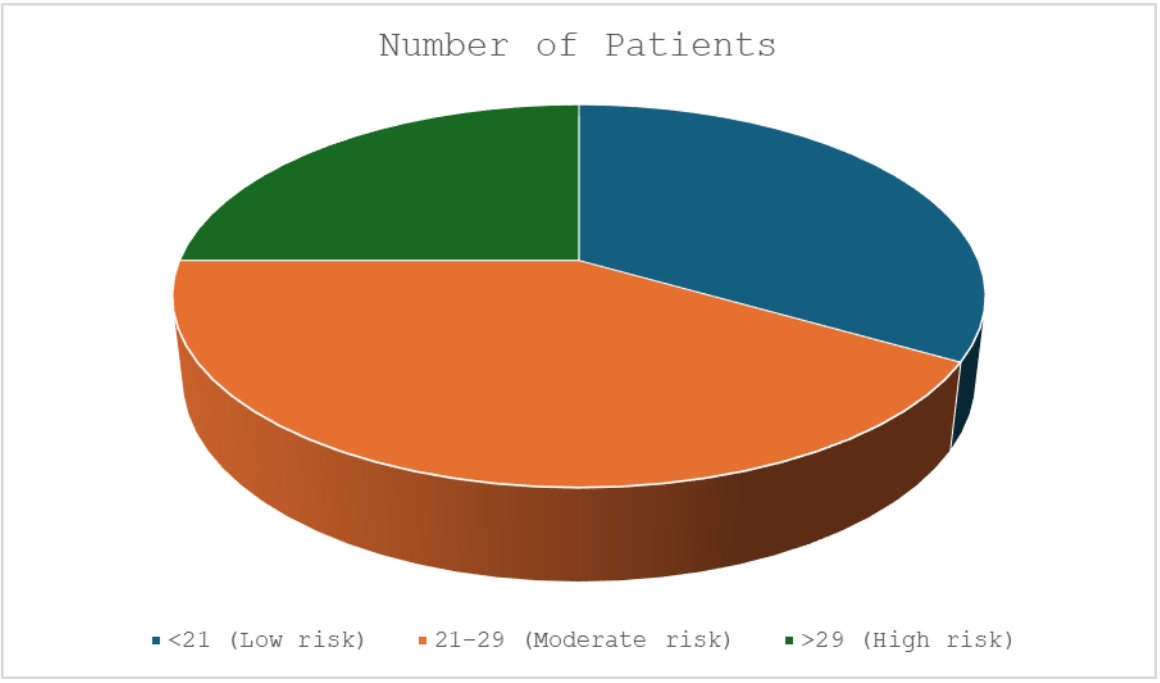

Fig 1: MPI Score Distribution

Table 2: MPI Score vs Mortality

MPI Group	Deaths	Mortality Rate (%)	Chi-square (χ^2)	p-value
<21	2	5%	22.26	**<0.001**
21–29	8	16%		
>29	15	50%		

Table 3: MPI Score vs Complications

MPI Group	Complications (n)	Percentage (%)
<21	8	20%
21–29	20	40%
>29	22	73.3%

IV. Discussion

The present study evaluated the effectiveness of the Mannheim Peritonitis Index (MPI) in predicting outcomes in patients with peritonitis due to hollow viscus perforation. The findings demonstrate a strong correlation between MPI scores and both mortality and postoperative complications, reinforcing its role as a reliable prognostic tool.

In this study, the overall mortality rate was 20.8%, which is comparable to previously reported rates ranging from 10% to 40% depending on patient population and healthcare settings [1,7]. The higher mortality observed in patients with elevated MPI scores is consistent with the original work by Linder, who reported a sharp increase in mortality when MPI exceeded 29 [6].

A key observation in the present study is the progressive increase in mortality across MPI categories: 5% in low-risk, 16% in moderate-risk, and 50% in high-risk groups. These findings closely align with studies by Billing et al. and Malik et al., who also demonstrated mortality rates exceeding 40% in patients with MPI >29 [8,11]. This consistency across studies highlights the robustness and reproducibility of MPI as a scoring system.

The predominance of male patients (75%) and the relatively younger mean age (42.6 years) observed in this study reflect demographic patterns commonly reported in developing countries, where peptic ulcer disease and infectious causes of perforation are prevalent [3,4]. In contrast, studies from Western populations often report higher mean ages due to increased incidence of malignancy-related perforations [9].

The most common etiology in this study was peptic ulcer perforation (45%), followed by ileal perforation (30%). Similar trends have been reported in studies by Sharma et al. and Gupta et al., where peptic ulcer disease remains the leading cause of perforation in South Asian populations [12,13]. The etiology of perforation plays a crucial role in determining prognosis, as colonic perforations and fecal peritonitis are associated with worse outcomes.

Organ failure emerged as a significant predictor of mortality in this study, consistent with findings from previous research [5,10]. The presence of organ dysfunction reflects systemic inflammatory response and sepsis, which significantly worsen patient outcomes. Similarly, delayed presentation (>24 hours), observed in 65% of patients, was associated with higher

MPI scores and poorer outcomes. Delayed treatment allows progression of infection and widespread peritoneal contamination, leading to increased morbidity and mortality.

The extent of peritoneal contamination also had a significant impact on outcomes. Patients with generalized peritonitis had higher MPI scores and worse outcomes compared to those with localized peritonitis. This finding is in agreement with multiple studies that emphasize the prognostic importance of intraoperative findings [7,8].

One of the major strengths of the MPI is its simplicity and ease of application. Unlike APACHE II or SOFA scores, MPI does not require complex laboratory parameters, making it particularly useful in emergency and resource-limited settings [5]. In this study, MPI proved to be a practical and reliable tool that could be applied intraoperatively without additional cost or delay.

When compared to other scoring systems, MPI has been shown to have comparable predictive accuracy. Billing et al. demonstrated that MPI has a sensitivity of over 80% in predicting mortality [8]. Similar findings were reported by Qureshi et al., who concluded that MPI is superior in emergency surgical settings due to its simplicity [14].

Despite its advantages, MPI has certain limitations. It does not account for postoperative variables or dynamic changes in patient condition. Additionally, some parameters, such as the nature of exudate, are subjective and may vary between surgeons. Nevertheless, its overall predictive value remains high.

The findings of this study support the routine use of MPI in patients with peritonitis due to hollow viscus perforation. Early identification of high-risk patients allows for more aggressive management, including intensive monitoring, early antibiotic therapy, and timely surgical intervention.

V. Conclusion

The Mannheim Peritonitis Index is a simple, reliable, and effective prognostic tool for predicting mortality and complications in patients with hollow viscus perforation. Its routine use facilitates early risk stratification, guiding clinical decision-making and improving surgical outcomes, especially in resource-limited healthcare settings.

Acknowledgement

The authors acknowledge the support of the Department of Orthopedics, Chirayu Medical College and Hospital, Bhopal, and the patients who consented to participate in this study.

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