

# Evaluation of Mannheim Peritonitis Index in predicting the prognosis of hollow viscus perforation

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## Abstract

**Background:** Peritonitis due to hollow viscous perforation continues to be one of the most common surgical emergencies and a potentially life threatening condition. Its accurate diagnosis and management is still a challenge to surgeons worldwide. A scoring system should be able to assess the need, type, and quality of the care required for a particular patient. Realizing the need for a simple and accurate scoring system in these conditions, the present study was undertaken to evaluate the performance of Mannheim peritonitis index (MPI) scoring system in predicting the overall risk of morbidity and mortality in patients with peritonitis due to hollow viscous perforation.

**Objective:** To predict the risk of mortality and morbidity in patients with peritonitis due to hollow viscous perforation in a sample study of 100 patients and to study the prognostic factors which determine the outcome of the disease.

**Materials and Methods:** This study is a clinical, prospective, observational, and open study conducted at NRI Medical College and General Hospital during a period of 2 years on 100 patients. MPI scoring system was done in all patients and patients were classified according to the scores into 3 groups.

**Result:** MPI scoring system was done on all patients depending on preoperative and intraoperative finding and patients were categorized into the three categories. In the score group of <21 it is observed that 94.23% of the patients survived, 5.77% had morbidity and 0% had mortality. In the score group of 21–29 it is observed that 17.24% of the patients survived, 41.38% had morbidity and 41.38% had mortality. In the score group of >29 it is observed that, 15.78% had morbidity and 84.22% had mortality. A threshold index score of MPI is derived at 27 for predicting the mortality with a sensitivity of 80%, specificity of 91.94% and a PPV = 76.19%.

**Conclusion:** The results of this study proves that MPI scoring system is a simple and effective tool for assessing this group of patients, and can be used as a guiding tool to decide on the management of the patient after the definitive procedure is done.

**KEYWORDS:** Mannheim peritonitis index, hollow viscus perforation, scoring system, morbidity, mortality

## Introduction

Peritonitis is inflammation of the peritoneum and or peritoneal cavity due to localized or generalized infections. Peritonitis due to hollow viscous perforation continues to be

one of the most common surgical emergencies and a potentially life threatening condition attended by a surgeon on emergency duty. Despite the recent advances in antimicrobial agents and supportive care, the mortality rate of suppurative peritonitis remains unacceptably high. This can be attributed to various risk factors like *Helicobacter Pylori* infection, NSAID's use, enteric fever and several others. Its causes vary from the one requiring immediate surgical intervention in selected cases to that requiring conservative management in others. Its accurate diagnosis and management is still a challenge to every surgeon. A scoring system should be able to assess the need, type, and quality of the care required for a particular patient. Most of the scoring systems are inappropriate for use in therapeutic decisions concerning individual patients. In a country like India, where most of the critical care measures

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are meagerly available and unaffordable by the majority of citizens, it is important that a scoring system is employed to not only prognosticate accurately the outcome, but should also be simple and cost effective. In 1982, Knaus et al.<sup>[1]</sup> and others proposed a scoring system to be used for classifying patients admitted to ICU. They devised a two part scale. The combination is called APACHE. It was later modified using only 12 values into the APACHE II. Stevens<sup>[2]</sup> in 1983 recognized the need for more precision and for a greater range of potential values and devised a scoring system to represent the magnitude and severity of organ failure and devised "Sepsis Severity Score". Sepsis score of Elebute and Stoner<sup>[3]</sup> was first published in 1983. The four attributes it incorporated were local effects of tissue infection, degree of temperature elevation, secondary effects of sepsis and laboratory data. But most of the attributes are calculated subjectively, hence more prone for observer variations and there is no direct attempt to score septic shock, hence it provides indirect evidence for sepsis syndrome. Linder and Wach<sup>[4]</sup> and others in 198) developed a separate peritonitis index based on the experience with 1243 patients suffering from purulent peritonitis and treated between 1963 and 1979. The Mannheim peritonitis index (MPI) was developed with incorporated information and discriminant analysis of 17 possible risk factors like age, gender, organ failure, cancer, duration of peritonitis, involvement of colon, extent of spread within the peritoneum, and the character of peritoneal fluid to define risk. 8 of these were of prognostic relevance and is currently employed widely for predicting mortality from peritonitis (Table 1 and 2).

Detailed study of MPI was done by Billing et al.<sup>[5]</sup> in 7 different centers and their data compared. Realizing the need for a simple accurate scoring system in these conditions, the present study was undertaken to evaluate the performance of MPI scoring system in predicting the overall risk of morbidity and mortality in patients with peritonitis due to hollow viscous perforation as the published Indian studies to assess the validity of this scoring system are only a handful. The MPI

**Table 1:** Mannheim peritonitis index (Billing et al. <sup>[5]</sup>)

S.No.	Risk Factors	Weightage
1	Age > 50 Years	5
2	Female sex	5
3	Organ failure*	7
4	Malignancy	4
5	Pre Operative duration	4
6	Origin of sepsis not colonic	4
7	Diffuse generalized peritonitis	6
8	Clear exudate	0
	Cloudy exudate	6
	Purulent exudate	12
	Total score	Max score of 47

**Table 2:** \* Definition of organ failure for MPI

Kidney	Creatinine level	> 177 µmol/L > 2.31 mg/dl
	Urea level	> 167 mmol/L > 467.78 mg/dl
Lung	Oliguria	<20 ml/h
	PO <sub>2</sub>	<50 mm Hg
	PCO <sub>2</sub>	>50 mm Hg
Shock	Hypodynamic or Hyperdynamic	
	Intestinal Obstruction (Only if profound)	Paralysis > 24 hrs or Complete mechanical ileus

scoring system (Table 1) is a relatively easy scoring system to calculate with the available facilities and infrastructure in the institution this study was carried out.<sup>[6]</sup> The general opinion that the diagnosis of peritonitis is made by clinical evaluation remains true today which eliminates the need of sophisticated equipment or infrastructure for carrying out this study.

## Materials and Methods

This study was done on 100 patients with peritonitis due to hollow viscous perforation who presented to surgery OPD, at NRI General Hospital, from October 2013 to October 2015.

This study is a clinical, prospective, observational, and open study conducted at NRI Medical College and General Hospital during a period of 2 years.

## Aims and Objectives

To predict the risk of mortality and morbidity in patients with peritonitis due to hollow viscous perforation and to study the prognostic factors which determine the outcome of the disease.

This study attempts to evaluate the prognostic value of MPI scoring system in patients with peritonitis due to hollow viscous perforation, to assess it as a clinical tool in stratifying these patients according to individual surgical risk.

## Inclusion Criteria

Patients with clinical suspicion and investigatory support for the diagnosis of peritonitis due to hollow viscous perforation who are later confirmed by intra operative findings are included.

## Exclusion Criteria

Patients with hollow viscous perforation due to trauma, associated injuries to other organs, associated vascular and neurogenic injuries, mesenteric emboli or thrombosis and any other significant illness which may affect the outcome more than the disease in the study.

## Methodology

Patients from both sexes of various age groups having peritonitis of varied aetiology and who had undergone laparotomy were taken up for this study. A detailed history, thorough clinical examination and necessary investigations were performed in each case according to planned proforma. All patients were investigated for different parameters like haematological – Hb%, TLC, DLC, BT, CT ; biochemical - blood sugar, blood urea, serum creatinine and LFT; urinalysis - albumin, sugar and microscopy. Chest, supine and erect abdomen radiographs were done for evidence of pneumoperitoneum or other relevant findings. Diagnostic peritoneal aspiration was done by four quadrant method and the fluid was sent for culture and sensitivity and microscopic examination. Immediate treatment was started with intravenous fluids, continuous nasogastric decompression and combination antibiotics were given. Foley's catheterisation was done to measure the urine output hourly. Patients were prepared for emergency operation as early as possible after managing the vital parameters and adequate preoperative hydration. Laparotomy was done through a standard midline incision. After opening the peritoneum, a careful note of operative findings were made, especially the origin of sepsis, localized or diffuse generalized peritonitis and later the peritoneal fluid and pus were drained out. After closure of perforation a thorough peritoneal lavage with normal saline was done. Abdomen was closed after placing an abdominal drain through a separate incision. A proper note on the progress of each patient was maintained and any complication encountered was noted and managed accordingly. All investigations and surgical procedures were carried out with proper informed and written consent as appropriately. The data regarding patient particulars, diagnosis, investigations, and surgical procedures is collected in a specially designed case recording form and transferred to a master chart subjected to statistical methods like mean, standard deviation, proportion, percentage, and wherever necessary chi square test for proportion are used. MPI scoring system was done in all patients and patients were classified according to the scores based on Table 1 and 2 into 3 groups ; < 21, 21–29 and > 29.<sup>[4]</sup>

## Result

In this study, 100 patients who attended surgical emergency unit were included over a study period of two years who were diagnosed with secondary peritonitis due to hollow viscus perforation.

### Age and Sex:

The mean age of patients was 44.90 years (standard deviation = 13.96) ranging from 16 to 80 and majority of patients (38%) belonged to age group of 46–60 years. There was male preponderance (66%) with male to female ratio of 1.9:1 (Figure 1).

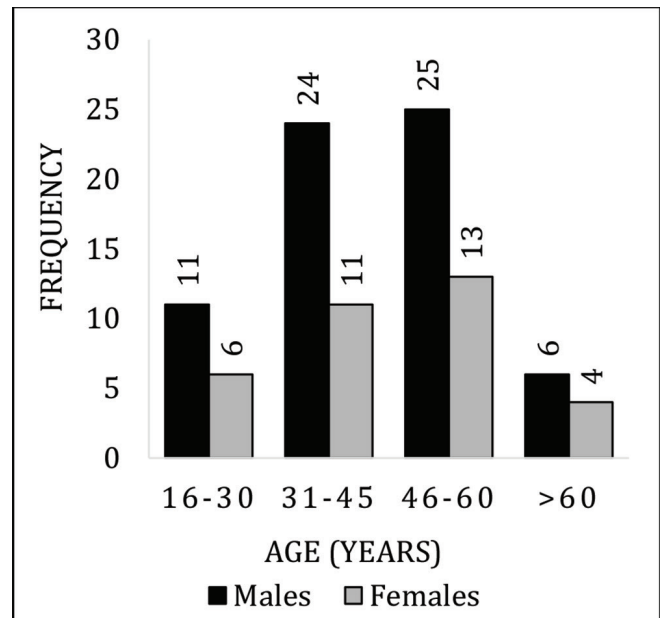


Figure 1: Age and sex distribution

### Time of Presentation

Majority of patients (86%) presented to the hospital after 24 hours of onset of symptoms. The mortality of those patients who presented within 2–5 days and after 5 days was 26.93% and 75%, respectively as compared to mortality (7.1 %) in patients who presented on the 1st day of onset of symptoms. The chi square value of these values is 11.8317 with a significant *p* - value of 0.002696 (Figure 2).

### Study subjects and MPI scoring

The graph below shows the distribution of the study subjects into the 3 MPI score groups and also categorizes the patients into individual groups of survival and mortality. It also depicts the steady increase in mortality with increase in Mannheim peritonitis index score. For patients with a score less than 21 the mortality rate was 0%, for score 21–29 it was 41.37% and for score greater than 29 it was 84.21% (Figure 3).

### Age and Mortality

The mortality was significantly high in elderly patients and precisely highest in patients belonging to age group of 60 years and more with 70% of the 10 patients belonging to that group. The mortality curve depicted in the graph in Figure 4 supports the opinion that incidence of mortality escalated as the age of the patient advanced.

### Sex and Mortality

It is observed that out of the 28 patients that have died, 13.63% mortality is recorded amongst the males and 55.88%

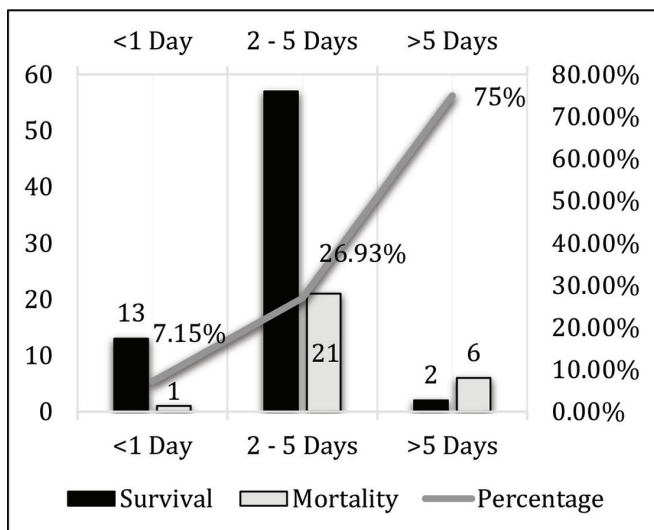


Figure 2: Distribution of time of presentation

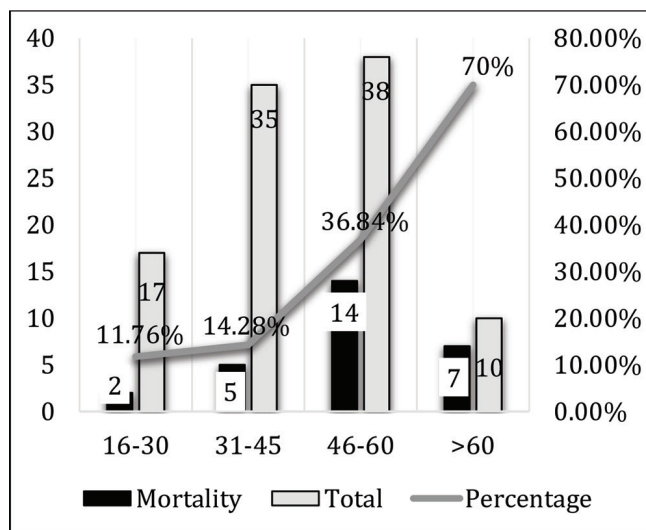


Figure 4: Mortality in relation to age

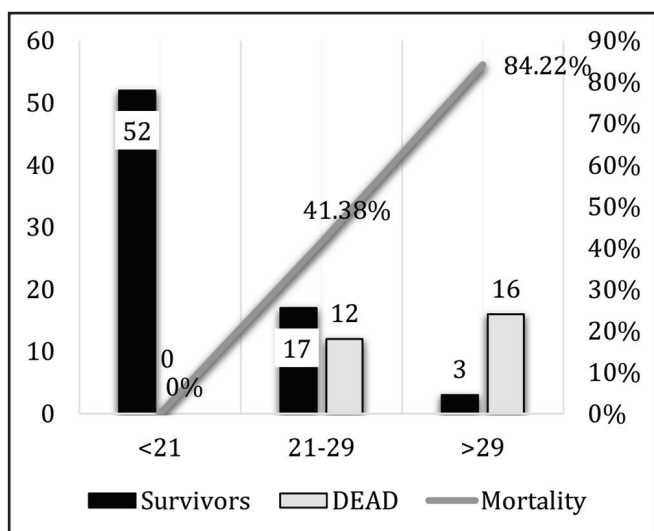


Figure 3: Distribution of study subjects according to MPI score into the 3 groups

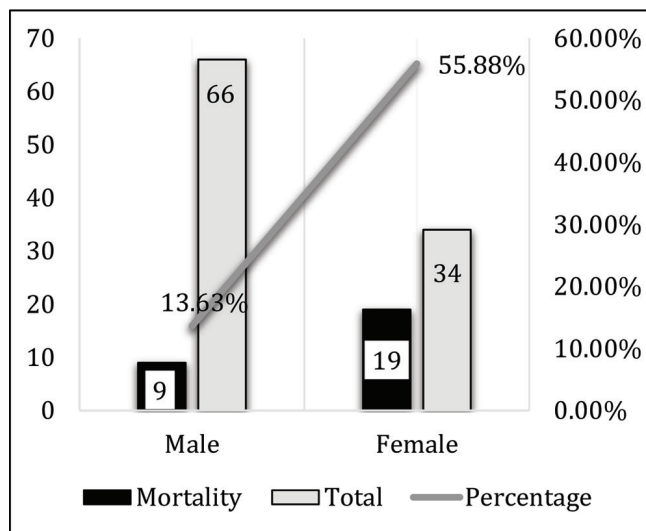


Figure 5: Mortality in relation to sex

among the female group. The mortality curve depicted in the graph in Figure 5 also supports the fact that mortality is significantly high among female patients.

**Mortality in Relation to Exudate**

When mortality is studied in relation to the type of exudate, it is clearly evident that clear exudate is associated with low mortality (7.94%), purulent exudate is associated with (60.06%) and feculent exudate is associated with significantly

high mortality rates (75%). The graph in Figure 6 also depicts the same rise in mortality rates from clear to feculent peritonitis.

**Organ Failure and Mortality**

When organ failure is evaluated, the mortality is higher (43.75%) in presence of organ failure than in absence of organ failure (13.45%). Overall survival is higher (86.55%) in absence of organ failure which is depicted in the graph in Figure 7.

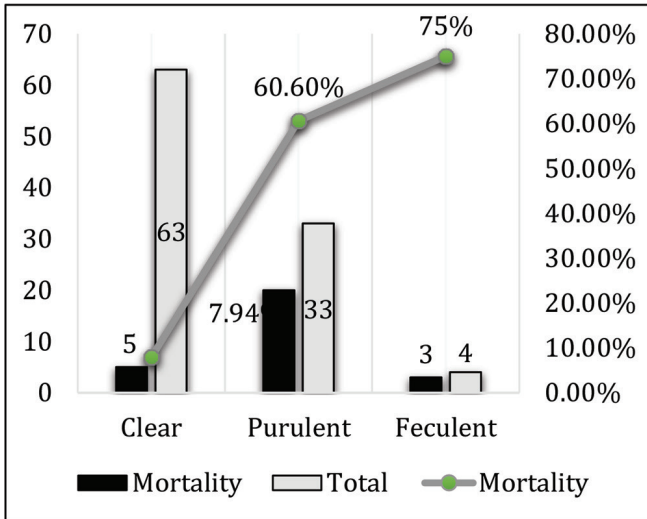


Figure 6: Mortality in relation to exudate

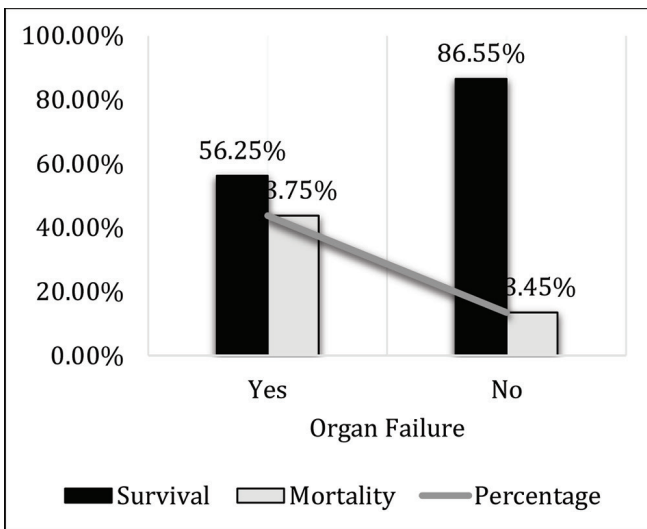


Figure 7: Mortality in relation to presence or absence of organ failure

**Morbidity and MPI Score:**

In the study group, 76.20% of the patients had wound infection (morbidity) with MPI score more than 27 as compared to 6.55% of the patients with MPI score less than 27. The positive predictive value of MPI score for morbidity is 76.19% with sensitivity - 80.00% and specificity – 91.94% (Figure 8).

**Mortality and MPI Score**

In the study group, 83.33% of the patients had mortality with MPI score more than 27 as compared to 5% of

the patients with MPI score less than 27. The positive predictive value of MPI score for mortality is 83.33% with sensitivity – 89.29% and specificity – 91.94% (Figure 9).

**Discussion**

The univariate analysis in the present study re-evaluated the prognostic factors predicting mortality including advanced age, female sex, nature of exudate, duration of presentation to the hospital from the time of onset of symptoms, high MPI, and associated organ failure.

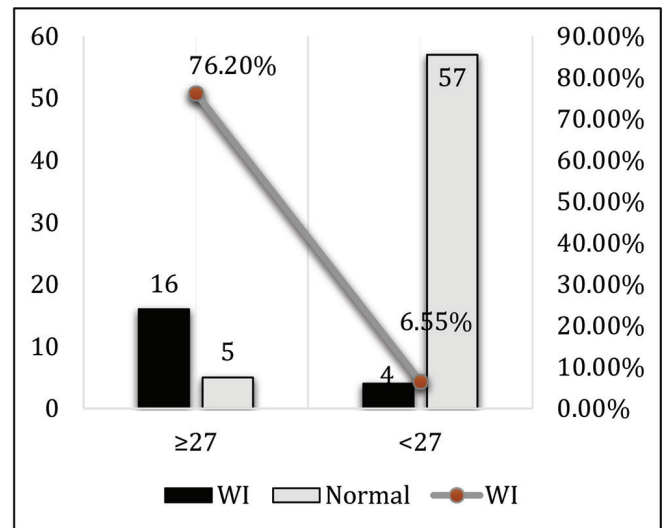


Figure 8: Morbidity in relation to MPI score ( WI = wound infection)

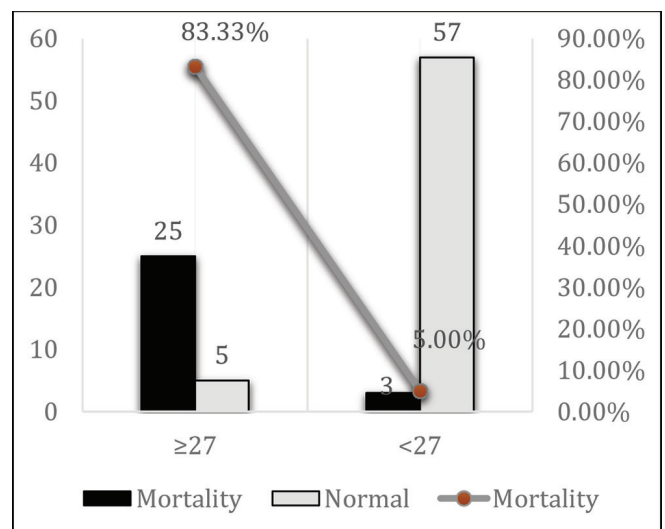


Figure 9: Mortality in relation to MPI score

### Mortality Comparison

When compared with other studies, the present study is similar to the study done by Ermolov *et al.*<sup>[6]</sup> Another study which is similar and comparable to the present study was by Ohmann *et al.*<sup>[7]</sup> in which 0% mortality is noted in score group <21, 29% in 21 – 29 score group and 100% in the score group >29.

In the study done by Billing *et al.*,<sup>[5]</sup> patients with a score < 21 the mean mortality rate was 2.3% (range = 0–11%), for score 21–29 it is 22.5% (range = 10.6–50%) and for score > 29 it is 59.1% (range = 41–87%). MPI score of more than 29 had the highest mortality of more than 80% and up to 100% in some studies.<sup>[8]</sup>

### Mortality and Threshold Index

ROC analysis was done to identify the best cut-off score for MPI. The cut off came to be 27 for which the sensitivity and specificity was calculated to be 89.29% and 91.94%, respectively. Many other studies like Billing *et al.*,<sup>[5]</sup> Notash *et al.*,<sup>[8]</sup> Batra *et al.*,<sup>[9]</sup> Yoshiko *et al.*<sup>[10]</sup> were comparable with the present study as their threshold index of MPI score was close to the present study at 26 with significant sensitivity and specificity. More synonymously, the study done by Függer *et al.*<sup>[11]</sup> had a threshold index score of 27 with a sensitivity of 93% and a specificity of 93% which is similar to the present study.

### Comparing MPI Cut Off Score

The mortality rate in score >27 of this study is comparable to that of Correia *et al.*<sup>[12]</sup> which signifies the better prediction of mortality and a sensitive threshold MPI index of the present study.

As it has been pointed out by Ohmann *et al.*<sup>[7]</sup> in their excellent review, a number of multivariate analyses have been performed, some of them resulting in the development of prognostic scores, but the results are not consistent and give no definitive answer whether prognosis is primarily determined by characteristics of peritonitis, physiological reserve or acute severity of the disease. It can also be argued that even though scoring systems are objective measures of the severity of illness helping outcome prediction and determining therapeutic efficacy, their clinical relevance due to the lack of therapeutic alternatives is limited.

Early prognostic evaluation of abdominal sepsis is desirable to select high-risk patients for more aggressive therapeutic procedures and to provide objective classification of the severity of the disease.<sup>[5]</sup>

Multiple previous studies have identified various factors associated with increased hospital mortality including advanced age, female sex, pre-existing disease, number of coexisting diseases, diabetes, low albumin levels, low cholesterol levels, thrombocytopenia, leukopenia, extended peritonitis, sepsis of upper gastrointestinal origin, occurrence of

septic shock, failure to clear the source of sepsis, requirement of multiple operations, inadequate antibiotic treatment, high APACHE II score, and early postoperative organ failure.<sup>[7,13–15]</sup>

The timing of data collection to create risk scores is rarely mentioned in the literature. The physiological values vary during the initial admission, making the scores obtained by them unreliable. But there is evidence that including operative findings and post-operative parameters in ICU improves the accuracy of the prediction.

Even if accurate pre-operative predictions of outcome were possible by estimation of a risk score, an expert surgical opinion would be required to interpret these predictions at the bedside. An experienced clinician can not only assess prognosis but also weigh up the local facilities available, the patient's quality of life and ethical issues, as well as considering the patient or relative's wishes. Scoring will never replace clinical judgment.

Scoring systems are generated and validated on specific populations that may be substantially different from the patients being scored in a different hospital. One potential resolution would be for each hospital to create a system specific to its own population, which must be regularly revalidated.

### Conclusion

This is a validation study of the Mannheim peritonitis index scoring system for predicting the morbidity and mortality in patients with peritonitis due to hollow viscous perforation. Among the various variables of the scoring system, older age, female sex, associated organ failure, duration of presentation from time of onset of symptoms and type of exudate had a significant role in predicting the eventual outcome of the patient. The results of this study proves that MPI scoring system is a simple and effective tool for assessing this group of patients, and can be used as a guiding tool to decide on the management of the patient after the definitive procedure is done. This study confirmed the high prognostic value of MPI index in perforative peritonitis.

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