

Study of Mannheim Peritonitis Index (MPI) in Acute Peritonitis due to Hollow Viscus Perforation - A Prognostic Evaluation

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Abstract: Introduction: Peritonitis is severe inflammation of the peritoneum caused by pathogenic microorganisms and their products. The complex nature of peritoneal infection and the diversity of treatment make evaluation of new diagnostic and therapeutic advances in this field very difficult. MPI score is calculated by collecting data from clinical examination and operative findings that accounts 8 variables: age, sex, organ failure, diagnosis of carcinoma, preoperative duration of peritonitis, origin of sepsis, peritonitis extension, characteristics of exudate. Methods: This was a hospital based observational study of 62 consecutive patients who presented with peritonitis due to hollow viscus perforation in the emergency setting. MPI scoring was done in all patients who were classified those with score less than 21, 21 to 29 and more than 29. Aim: To validate Mannheim peritonitis index (MPI) for prediction of outcome in patients with perforation peritonitis. Objectives: To correlate individual components of MPI with the outcome in patients with perforation peritonitis. To evaluate Mannheim Peritonitis Index in individual patients and to assess the accuracy of predicting the outcome of the patients. Observation and Results: Among 62 patients, 29 patients (53.7%) with MPI <21 and 25 patients (46.3%) with 21 - 29 were discharged. 8 deceased patients were all having MPI 21 - 29. The results were statistically significant with p value of 0.04. As per our study, the MPI score with the cut off value of 21 has a sensitivity of 54% and specificity of 100%. Conclusion: MPI scoring system is easy score to apply, the determination of risk is available during operation and surgeon can know about the possible outcome and the appropriate management can be decided. MPI is more effective in predicting the mortality in peritonitis due to hollow viscous perforation.

Keywords: Peritonitis, Mannheim peritonitis index, outcome of perforation peritonitis, intestinal perforation

1. Introduction

The peritoneum is a sterile environment reacting to various pathologic stimuli with a uniform inflammatory response. According to the pathology, the resultant peritonitis may be infectious or sterile (i.e. chemical or mechanical). Peritonitis is severe inflammation of the peritoneum caused by pathogenic microorganisms and their products¹. The complex nature of peritoneal infection and the diversity of treatment makes evaluation of new diagnostic and therapeutic advances in this field very difficult². Hence, it is better to select high - risk patients through early prognostic evaluation for aggressive treatment and to provide an objective classification of the severity of the disease³.

According with the literature, Mannheim peritonitis index (MPI) is an effective scoring system used for predicting mortality evaluating single risk factors⁴. MPI is a scoring system used in peritonitis was originally derived from data collected from 1253 patients with peritonitis treated between 1963 and 1979 involving analysis of 17 possible risk factors, by Wacha⁵. Out of these 17 factors, 8 were prognostically relevant and is employed widely for predicting mortality from peritonitis at present. In MPI score is calculated by collecting data from clinical examination and operative findings that accounts 8 variables: age, sex, organ failure, diagnosis of carcinoma, preoperative duration of peritonitis, origin of sepsis, peritonitis extension, characteristics of exudate^{5,6}.

MPI score was preferred because

- The MPI appears to be more practical than other scoring systems, such as the APACHE II and SAPS which are time consuming and may be impossible to apply in the setting of intra - abdominal sepsis.

- Like in APACHE II and SAPS there are lots of physiological variables which needs lots of time and lots of calculations which is practically very hard or need a scoring calculator software.
- Unlike these scoring systems Mannheim Peritonitis Index is very easy to use scoring can be done without calculator and Mannheim Peritonitis Index does not have physiological variables.

Therefore, this study has been planned to prognosticate the value of MPI in patients of peritonitis due to perforation of hollow viscus.

2. Methods

This is a hospital based observational study of 62 consecutive patients admitted under various surgical units in our hospital, who presented with peritonitis due to hollow viscus perforation in the emergency setting. All patients aged more than 15 years of age undergoing exploratory laparotomy for peritonitis due to hollow viscus perforation were included. Patients with associated vascular or neurogenic injuries were excluded.

Data Collection

Patients were evaluated by detailed history and clinical examination. The diagnosis of perforation peritonitis was clinical, and they underwent relevant investigations as warranted. All patients underwent exploratory laparotomy at the earliest once the basic physiologic parameters were restored to acceptable limits. MPI score were calculated on all patients. The investigations included: Routine blood investigations required for surgery including CBC, Complete LFT, KFT with serum electrolytes, RBS, Urine routine and microscopy, X ray abdomen & chest -PA,

Ultrasonography of abdomen, CECT/NCCT abdomen as indicated, ECG (as indicated), Blood gas (as indicated). Records including that of clinical details, investigation details, details of operative interventions and the findings as well as MPI score (Table 1) were maintained. MPI scoring system was done in all patients and patients were classified those with score less than 21, 21 to 29, and more than 29. Primary closure of hollow viscous perforation, bowel resection anastomosis, diversion ostomies was done in cases as appropriate with thorough peritoneal lavage and abdominal drains were kept in all patients. Post operative period was monitored; intake output charts and vital charts were maintained. Drains were removed after 48 hours with output less than 30ml. Sutures were removed from the 7th post operative day. The patients were followed up for 6 months.

Table 1: Mannheim Peritonitis Index (MPI)

Risk factor	Weighting if present
Age >50 years	5
Female sex	5
Organ failure	7
Malignancy	4
Origin of sepsis not colonic	6
Diffuse generalized peritonitis	6
Pre operative duration of peritonitis > 24 hours	4
Intraperitoneal exudates	
Clear	0
Turbulent/purulent	6
Fecal	12
Organ failure:	
Kidney:	
Creatinine > 177µmol/L (≥ 2.31mg/dl)	
Urea > 167mmol/L (≥ 467.78mg/dl)	
Oliguria < 20 ml/hour	
Lung:	
PaO ₂ < 50 mmHg	
PaCO ₂ > 50 mmHg	
Shock: hypodynamic or hyperdynamic	
Intestinal Obstruction: paralytic ileus >24 hours or complete mechanical ileus	

Patients were divided into 3 categories of severity as MPI < 21, 21 – 29, > 29.

Aim

To validate Mannheim peritonitis index (MPI) for prediction of outcome in patients with perforation peritonitis.

Objectives

Primary: To correlate individual components of MPI with the outcome in patients with perforation peritonitis

Secondary: To evaluate Mannheim Peritonitis Index in individual patients and to assess the accuracy of predicting the outcome of the patients.

3. Observation and Results

In the study population of 62 patients, 48 were male and 14 were females. The frequency of peritonitis was most common in the age group of 31 - 40 years constituting 19

patients. The mean age of the patients was 37.25 (SD 14.07) years (Table 2).

Table 2: Distribution of Age & Sex in Study Population

Age	Range	Male	Female	Total
<50 Years	10 - 20	5	0	5
	21 - 30	10	4	14
	31 - 40	14	5	19
	41 - 50	10	3	13
>50 Years	51 - 60	5	1	6
	61 - 70	4	1	5
Total		48	14	62

In the total study population, among patients younger than 50 years of age, 28 patients (57.14%) had MPI < 21, 21 patients (42.85%) had MPI 21 - 29 and among patients older than 50 years of age, 1 patient (7.6%) had MPI <21, 12 patients (92.3%) had MPI 21 - 29. Higher proportion of patients with age 50 years and more are having MPI scores 21 - 29 than patients with less than 50 years of age having MPI scores <21 and the difference is statistically significant with p 0.001. Higher proportion of patients with age group more than 50 years had high chance of mortality and is statistically significant with p value of 0.001.

Among the males in the study population, 28 patients (58.3%) had MPI<21, 20 patients (41.6%) MPI 21 - 29 and among females, 5 patients (35.7%) had MPI <21, 9 patients (64.28%) had MPI 21 - 29 as shown in chart 1.

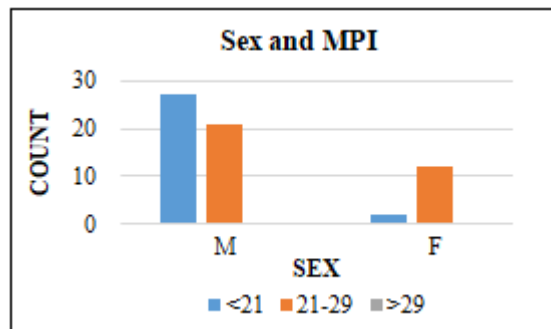


Chart 1: Correlation of Sex with MPI

Higher proportion of female patients are having MPI scores 21 - 29 than male patients having MPI scores <21 and the difference is statistically significant with p 0.006. Higher proportion of males had high chance of mortality and it was statistically not significant with p value of 0.861

Higher proportion of patients with organ failure are having MPI scores 21 - 29 than patients without organ failure having MPI scores <21 and the difference is not statistically significant with p 0.06. In the study, all the patients had peritonitis due to benign pathology of which 29 patients (48.7%) were with MPI <21 and 33 patients (53.3%) were with MPI 21 - 29. No patients had malignancy as a cause for perforation.

Among those with peritonitis duration < 24 hours, 6 patients (85.7%) had MPI <21 and 1 patient (14.3%) had MPI 21 - 29 and among those with duration >24 hours, 23 patients (41.8%) had MPI <21, 32 patients (58.2%) had MPI 21 - 29 as shown in chart 2.

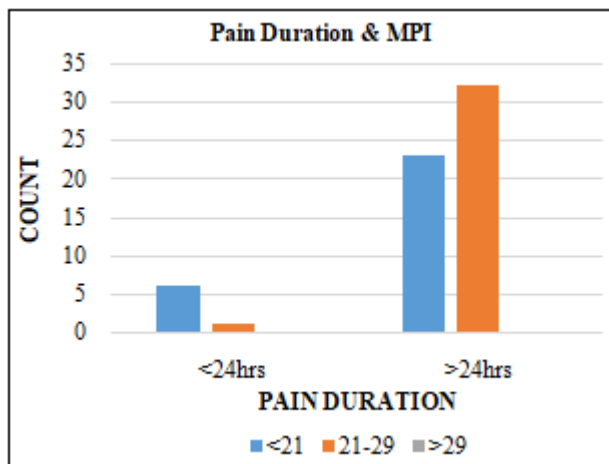


Chart 2: Correlation of pain duration with MPI

Higher proportion of patients with pain duration <24 hours are having MPI scores <21 than patients with pain duration > 24 hours having MPI scores 21 - 29 and the difference is statistically significant with p value of 0.02. Higher proportion of patients with pain duration >24 hours had high mortality but it was not statistically significant with p 0.280.

Among those with colonic pathology 1 patient (16.66%) had MPI <21 and 5 patients (83.33%) had MPI 21 - 29 and none had MPI >29 and non colonic pathology 29 patients (46.7%) had MPI <21 and 33 patients (53.3%) had MPI 21 - 29 (Table 3).

Table 3: Correlation of site of pathology with MPI

SITE OF PATHOLOGY		MPI_CAT			Total	p value	
		<21	21 - 29	>29			
SITE OF PATHOLOGY	STOMACH	Count	1	2	0	3	0.03
		% within site	33.30%	66.70%		100.00%	
	DUODENUM	Count	3	3	0	6	
		% within site	50%	50%		100.00%	
	JEJUNUM	Count	11	6	0	17	
		% within site	64.70%	35.29%		100.00%	
	ILEUM	Count	6	14	0	20	
		% within site	30%	70%		100.00%	
	APPENDIX	Count	7	1	0	8	
		% within site	87.50%	12.50%		100.00%	
	COLON	Count	1	5	0	6	
		% within site	16.66%	83.33%		100.00%	
	GALLBLADDER	Count	0	2	0	2	
		% within site	0.00%	100.00%		100.00%	
Total	Count	29	33	0	50		
	% within site	46.70%	53.30%		100.00%		

The most common site of pathology in our study was ileum and the results were statistically significant with p value of 0.03. Higher proportion of patients with non colonic pathology had low mortality and the results were statistically significant with p 0.000.

Among those with localized peritonitis, 7 patients (87.5%) had MPI <21 and 1 patient (12.5%) had MPI 21 - 29. Among those with generalised peritonitis, 22 patients (40.74%) had MPI <21 32 patients (59.25%) had MPI 21 - 29 as shown in chart 3.

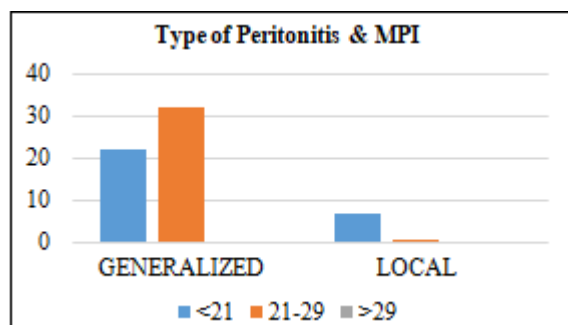


Chart 3: Correlation of type of peritonitis with MPI

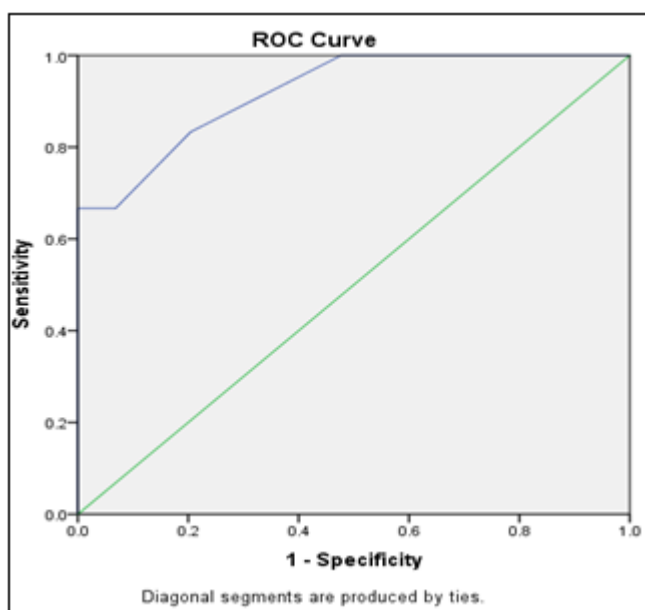
Higher proportion of patients with local peritonitis are having MPI scores <21 than patients with generalized peritonitis having MPI scores 21 - 29 and the difference is statistically significant with p value of 0.013. Higher proportion of patients with generalized peritonitis had high mortality and the results were statistically significant with p 0.030

Among those with cloudy exudate, 23 patients (56.1%) had MPI <21, 18 patients (43.9%) had MPI 21 - 29. Among those with purulent exudates 6 patients (33.3%) had MPI <21, 12% (66.7%) had MPI 21 - 29 and no patients had MPI >29 and those with feculent exudates none had MPI <21, 100% had MPI 21 - 29. The most common nature of exudate was cloudy and the results were statistically not significant. Higher proportion of patients with cloudy exudate had less mortality and is statistically significant with p0.03

Final Outcome

		MPI			Total	p value	
		<21	21 - 29	>29			
Patient outcome	Discharged	Count	29	25	54	0.04	
		Percentage	53.70%	46.30%	0		100%
	Death	Count	0	8	0		8
		Percentage		100%			100%
Total	Count	29	33	0	62		
	Percentage	46.70%	53.30%	0	100%		

Among 62 patients, 54 patients were discharged of which 29 patients (53.7%) were having MPI <21 and 25 patients (46.3%) were having 21 - 29.8 patients died who were all having MPI 21 - 29. The results were statistically significant with p value of 0.04. As per our study, the MPI score with the cut off value of 21 has a sensitivity of 54% and specificity of 100%. In the ROC curve, the area under curve (AUC) being 0.94 suggesting high accuracy.



4. Discussion

Peritonitis remains a challenge for the surgeons, since the outcome depends on multiple factors like age, sex, duration, site of perforation, nature of the disease causing it, extent of peritonitis and the time of intervention. Hence, the morbidity and mortality can be judged by making an algorithm that includes all the factors.

In the present study, sixty - two cases of peritonitis those attended emergency department in our hospital for a period of two years.

The mean age of the patients was 37.25 (SD 14.07) years. Many studies have mean age of the patients between 35 - 45^{7, 8, 9} like the study by Sharma et al¹, the mean age of the patient was 33.52±13.22 and in the study by Khalid M. Osman et al⁸, the mean age of the patients was 33.9±16.

There was male preponderance of 48 out of 62 patients (77.4%) in this study which was similar to most of the previous studies. But the correlation of sex with mortality was more in males than in females. There was mortality of 6

patients out of which 4 were male patients which was not statistically significant but the overall prediction was accurate which was similar to the study by M M Correia¹⁰. In his study, the factor of female sex has not reached statistical significance between the groups, but it showed a good performance (accuracy of 69.7%) when all MPI components were considered together.

The most common aetiology of peritonitis was ileal perforation in our study which was seen in 20 patients of which 14 were having MPI 21 - 29 denoting high mortality, followed by jejunal perforation in 17 patients, appendicular perforation in 8 patients, colonic perforation in 6 patients, duodenal perforation in 6 patients, stomach perforation in 3 patients and gall bladder perforation in 2 patients.

In a study by Sharma et al⁷. of 100 patients, most of them 53 were small intestine perforation out of which the commonest were ileal.

In other studies, by Koppad et al¹¹, duodenal ulcer perforation was the commonest (42%) and Ileal perforations were presumed to be due to enteric fever.

Most patients presented with history of abdominal pain, abdominal distension and fever with varying duration, 55 out of 62 patients (88.7%) presenting after 24 hours of onset of symptoms. Similarly, in a study by Muralidhar et al¹²., there were 37 out of 50 patients (74%) presenting after 24 hours of onset of symptoms.

Ali Yaghoobi Notash⁹ found mortality of 11.4% in patients presenting within 24hours of the onset of symptoms while the mortality was 25% in patients presenting late.

Only two patients (20%) with MPI score less than 21 developed complications. Complications included minor (wound infection) and major (Respiratory, Renal, Circulatory, Post operative leak) categories.8 patients (24.24%) had complications with MPI score 21 - 29. There was respiratory failure in 10 patients out of which only 2 had MPI <21 and 8 had MPI 21 - 29.6 patients had cardiac failure out of which 1 had MPI score of 21 and the rest 5 patients had MPI score between 21 - 29. Post - operative leak in 4 patients, all with MPI score of 21 - 29. Fluid collection and paralytic ileus in 2 patients who had MPI score of 21 - 29. Thus, there was no mortality in patients with MPI less than 21, whereas those patients with MPI score 21 - 29 had mortality rate of 24.24%.

A systemic inflammatory response induced by the peritoneal infection may further progress to septic shock and multi

organ failure.

Ali Yaghoobi Notash et al⁹ confirms that the risk of in hospital death was higher in patients aged above 60 years. MPI scoring system done in all patients depending on preoperative and intra - operative finding and patients were categorized into three categories those <21, 21 to 29, >29. Majority (33 patients - 53.3%) of patients had MPI between 21 - 29.

Factors of MPI and Mortality

In our study we found that patients over 50 years undergoing emergency surgery for laparotomy have a higher risk of mortality and morbidity. Mortality after surgery undoubtedly increases with age but this could be because of increased prevalence of comorbid medical conditions in the elderly. The results were statistically significant with a p value of 0.001. In our study, the patients with organ failure, colon as site of pathology, generalized peritonitis and faecal or purulent discharge had high chance of mortality and the results were statistically significant with p value of 0.001, 0.001, 0.030, 0.030 respectively. There was high mortality in male patients in our study but it was not statistically significant with a p value of 0.861. The site of perforation was also not statistically significant in our study.

In accordance with our study, Sharma et al⁷ reported, when the individual parameters of MPI score were assessed against the mortality only, age >50 years ($P = 0.015$), organ failure ($P = 0.0001$), non colonic origin of sepsis ($P = 0.002$) and generalized peritonitis ($P = 0.0001$) were significantly associated with mortality. On plotting the ROC curve, the sensitivity was 92%, and specificity was 78% with area under curve (AUC) being 0.9 at a cut - off of 21 MPI score¹². The difference in mortalities among MPI score categories was observed to be highly significant ($P < 0.0001$).

Among 62 patients in our study, 54 patients were discharged of which 29 patients (53.7%) were having MPI <21 and 25 patients (46.3%) were having 21 - 29. 8 patients died who were all having MPI 21 - 29. The results were statistically significant with p value of 0.04. The sensitivity and specificity of MPI score as per our study was 54% and 100% respectively.

Similarly, in a study conducted by Qureshi AM et al¹³, score of < 21 had mortality of 1.9%, score of 21 - 29 had 21.9% and score > 30 had mortality of 28.1%. There was no patient with MPI score of > 29 and the mortality rate was not calculated. The outcome of the study is statistically significant by chi - square test with p Value <0.0001.

Sanjay N. Koppad¹¹ made an analysis of Mannheim peritonitis index scoring in predicting outcome in patients with peritonitis secondary to hollow viscus perforation. MPI score of 29 had sensitivity of 87.21%, specificity of 78.57% and predictive power of 0.945 in predicting mortality. Similarly, in our study of 62 patients with hollow viscus perforation, the sensitivity was 52.3% and specificity was 100% and it was statistically significant ($p < 0.05$)

In a study, patients with MPI scores of <16; 17 -21; >22 had a mortality of 2.6%, 18% and 64% respectively. Greatest sensitivity and specificity for the MPI score as a predictor of mortality was at the score of 20. At this value a sensitivity of 78% and a specificity of 89% was reported¹⁴.

At the end of the study, it was found that there was positive correlation with age, sex, site of perforation, pain duration and type of peritonitis with p value of 0.001, 0.006, 0.030, 0.028 and 0.013 respectively and the results were statistically significant. There was no correlation with organ failure and nature of exudate in our study as it was found to be statistically insignificant.

The new finding in the study was:

- It would be better to define individual site of pathology as there were more cases of ileal and jejunal perforation with considerable morbidity and mortality compared to colonic pathology.
- Benign pathology should be considered in the score as it holds a high number of cases comparatively as in our case there was no patients with malignancy.

The limitation of the study was:

- There was no patients with MPI >29 and the mortality of high MPI score could not be estimated.
- There was no patients in the study with the pathology of perforation being malignancy
- The correlation of organ failure and nature of exudate was not statistically significant while there was some correlation in previous studies on MPI.

5. Conclusion

Peritonitis remains a hot spot for the surgeons despite advancements in surgical technique and intensive care treatment. Various factors like age, sex, duration, site of perforation, extent of peritonitis and delay in surgical intervention are associated with morbidity and mortality. Duodenal perforation is the most common etiology of peritonitis followed by appendicular perforation, gastric, ileal, colon and jejunal perforation in this study. Males are commonly affected compared to females in this study. Emergency laparotomy and primary repair of the hollow viscus perforation is more effective in patients with secondary and tertiary peritonitis. In the management of patients with generalized peritonitis, scoring the patients into various risk groups can be beneficial. MPI scoring system is easy score to apply, the determination of risk is available during operation and surgeon can know about the possible outcome and the appropriate management can be decided. MPI is more effective in predicting the mortality in peritonitis due to hollow viscus perforation.

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