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Post Operative Prognostic Applications Of Mannheims Peritonitis Index For Abdominal Hollow Viscous Perforation Peritonitis

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ABSTRACT
The aim of our study is to assess the morbidity and mortality in patients with perforation peritonitis using Mannheims Peritonitis Index (MPI) and to assess its effectiveness. We made a hospital based, prospective, observational study of patients presenting with perforation peritonitis in a tertiary center, Ranchi during the year of 2017-2019. We used means, proportions and chi square test for analysis and found that out of the 80 patients we studied, 74% were male and 26% were female. On dividing the patients into three groups based on the MPI score (<16, 16-25 and >25), it was found that there was one mortality in patients with scores <25, and increased mortality and morbidity in those with score >25 that confirmed the predicative value of MPI among patients with surgically diagnosed peritonitis. MPI is a simple, feasible and effective index to predict post-operative outcome and helps surgical team to take aggressive decision to improve outcome.

Keywords: *MPI, scoring system, secondary peritonitis, outcome predictors.*

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I. Background:

There is a great advancement in emergency medicine last three decades especially in high dependency unit, antimicrobial treatment and surgical procedures, but the management of peritonitis is still highly complex and represents a great challenge for clinicians. With a mortality of up to 20%, peritonitis is a dominant cause of death due to surgical infections(2). The causes, frequency and consequences of acute abdominal surgical emergencies due to peritonitis are different. The anatomic origin of bacterial contamination and microbiological findings are no longer forming predictors of outcome but the surgical clearance of the infectious contamination and the response to treatment are established prognostic factors(1) and the most important determinant for survival and has to be placed on top of the therapeutic priority list(3). A prompt diagnosis and urgent surgery is life-saving for all patients with generalized secondary peritonitis.

Utilization of scoring systems to stratify the patients with peritonitis would be of great help in applying aggressive intensive care unit treatment in high risk patients and salvaging the valuable life of a patient. There are several clinical scoring systems like MPI, APS, SAPS, SIS, APACHE, BOEYS, SOFA, POSSUM, P-POSSUM, etc. have been proposed for prognostic prediction. The Mannheim peritonitis index (MPI) is a scoring system for prognostic evaluation of patients with peritonitis which has eight risk factors and need operative findings to complete the score. As the name implies, the score was designed for surgical patients presenting with peritonitis(4).

Realizing the need for a simple, accurate and feasible scoring system in these conditions the present study was undertaken to evaluate the performance of MPI, a scoring index which utilizes feasible parameters like clinical findings, routine investigations like CBC, RFT, ABG and intra operative findings to predict the post-operative prognosis of non-traumatic perforation peritonitis. In our study we are trying to predict the post-operative outcome of patients with perforation peritonitis using Mannheim peritonitis index and to assess the significance of each risk factor of the Mannheim peritonitis index in predicting the prognosis. We also try to evaluate various conditions leading on to secondary peritonitis and to assess the morbidity and mortality rates in patients with peritonitis.

II. Methodology:

We conducted a prospective study of total 80 patients admitted with peritonitis due to hollow viscous perforation, who came to department of General Surgery, Rajendra Institute of Medical Sciences, Ranchi from September 2017 – November 2019. We included all patients aged over 15 years with clinical suspicion, investigations and intra-operative findings that confirmed the diagnosis of peritonitis due to hollow viscous perforation. We excluded all patients who were managed conservatively, had traumatic perforations and patients with any other significant illness which was likely to affect the outcome more than the disease in study. All

patients underwent complete detailed history with co morbidities and subjected to methodical physical examination to assess their general condition and diagnosis of peritonitis due to hollow viscous perforation was made. Then, the patients underwent radiological and biochemical investigations. Pre-operatively, all patients received supportive treatment for correction of hypotension and electrolyte abnormalities. During laparotomy, intra-abdominal examination of all organs was made in addition to the specific pathology and damage control surgery done. Post operatively, patients were managed in critical unit and their evolution (recovery or complications) was followed up till discharge due to improvement or death. Out-patient follow-up was continued as long as definitive treatment.

Once diagnosis of peritonitis had been determined, the patient was enrolled into the study. Details of the study protocol were explained to the subjects and an informed written consent was obtained (after clearance from ethical committee) and made details confidential. In addition to personal data such as name, age, sex, etc., the following information was registered: file number; dates of admission and discharge from the hospital; days hospitalized; date of surgery, information related to illness (surgical findings, medical treatment and evolution of illness) and post-operative follow up. Time elapsed from initial diagnosis to moment of event (death or discharge from hospital) was determined. Out-patient follow-up was continued for 30 days to establish perioperative morbidity and mortality.

Table No.1 Mannheim Peritonitis Index

S/No.	Risk factors	Score
1	Age >50years	5
2	Female sex	5
3	Organ failure*	7
4	Malignancy	4
5	Pre-op duration of peritonitis >24 hours	4
6	Non colonic sepsis origin	4
7	Generalized peritonitis	6
8	Exudates	
	Clear	0
	Cloudy and purulent	6
	Fecal	12

* Kidney failure = Creatinine level > 177μmol/L (>2mg/dl) or Oliguria < 20ml/hour;
Pulmonary insufficiency = pO_2 < 50 mmHg or pCO_2 > 50 mmHg;
Intestinal obstruction / paralysis > 24 hours or complete mechanical ileus;
Shock.

Using history, clinical examination, laboratory values and intra-operative findings, individual variable scores of Mannheims peritonitis index were added to establish main MPI score and patients were classified according to their scores as those with score less than 16, 16-25 and more than 25. Analysis was done with each variable in the scoring system as an independent predictor of morbidity or mortality and the scoring system as a whole. The data were entered in Microsoft excel 2010 and analyzed using SPSS software version 20.

III. RESULTS:

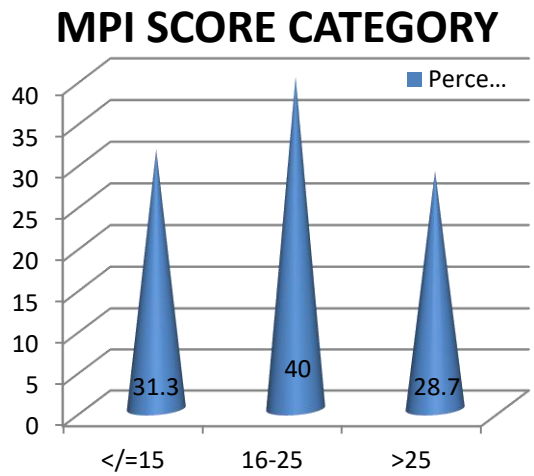
Mean age in our study was 42.50 (SD 16.4) years (range 16–80) among which 30% are females and the most common age group affected: 41-50 years. 73.75% cases presented with peritonitis and about 36.25% case had organ failure at presentation. Pre-operatively, 20 went into renal failure, 18 patients had shock, 9 acquired pulmonary complications, 7 had intestinal paralysis. The mean preoperative duration of symptoms was 2.4 days and ranged from 1-8 days. 55% of the patients either presented late (>24 hours) or were operated after 24 hours of initial symptoms due to resuscitation. Only 45% patients were operated within 24 hours of initial symptoms.

On laparotomy, Peptic ulcer perforation involving the stomach and duodenum constituted 45% cases and was the most common cause. Gastric malignancy constitutes 7.5%. Ileal perforations constituted the next common group with 22.5% cases, presumed to be due to enteric and tuberculous fever. Appendicular perforation was the third common cause, with 12.5% cases attributed on record in this study. Colonic perforation constitutes 8.75% cases (4 cases are non-malignant while two cases had sigmoid malignant perforation and one case had caecal malignant perforation). Other 3.75% cases had pathology in gallbladder, which included acute gangrenous cholecystitis, empyema of gall bladder and acalculous cholecystitis. 48.75% had clear fluid exudate and 27.5% had purulent exudate on opening peritoneum intra operatively while only

23.75% had feculent exudate. Out of 9 cancer patients, six patients survived who were discharged and referred to medical oncology.

The overall mean MPI score in survivors was 19.81 SD 8.3 (range: 4-43), while in the non-survivors, the mean score was 30 (range: 17-43). These patients were categorized to MPI score (MPI scores of less than 15, 16-25 and more than 25) categories 1(n=25), 2 (n=32), and 3(n=23), respectively.

FIGURE NO. 1 - DISTRIBUTION OF MPI SCORE



IV. POST OPERATIVE OUTCOMES:

In our study we encountered 11 deaths (13.8%) out of the 80 patients. Forty eight percent survivors (39/80) evolved without complications and thirty eight percent (30/80) evolved with complication such as shock, pulmonary complications, documented sepsis, renal failure and leaks from primary closure but due to aggressive treatment survived and all eighty six percent (69/80) were discharged from the hospital. Wound infection was the most common complication occurring in 28.98% of patients, among which 12% developed burst abdomen.

On comparing each MPI parameters with post-operative complications, it was found that there is significant association between post-operative complications and following MPI risk factors - age greater than 50years (P value < 0.021), organ failure (P value < 0.009), peritonitis (P value < 0.0006), and pre-operative duration more than 24hours (P value < 0.01). Whereas other parameters like sex, malignancy and exudate doesn't prove significant in my study.

Without any complications, patients usually recover from illness by 10 days; hence patient's hospital stay was grouped into 10 or lesser days and more than 10 days. Mean hospital stay in our study was 10 (with SD 5) days (range 4 to 35 days). Most of the patients discharged on or before post-operative day 10, only 29 patients out of 69 survived patients, required more than 10 days hospital stay due to complications.

TABLE NO. 2 - ASSOCIATION OF MPI CATEGORY WITH HOSPITAL DAYS

S No.	Scores	>10 Days	</= 10 Days	Total
1	>25	9	4	13
2	</=25	20	36	56
	Total	29	40	69
	Risk Ratio	1.938		
	P Value	0.030		

The sensitivity of MPI score at 26 is 31%, and specificity is 90%.The positive predictive value is 30%, and negative predictive value is 64%. Pearson Chi Square test value is 4.865 at degree of freedom (df) of 1. Fischer's exact test gives p-value of 0.030, which is highly significant.

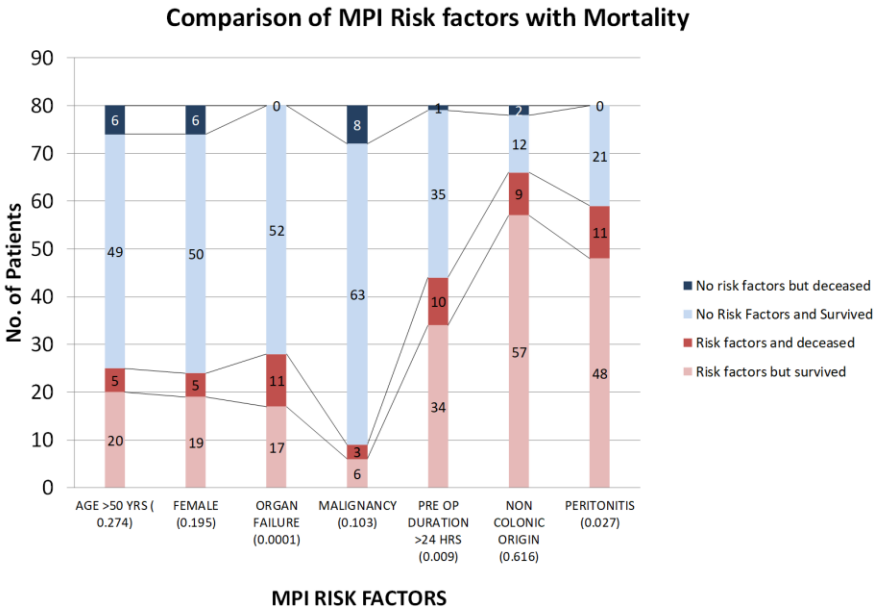


Figure No. 2 ASSOCIATIONS OF MPI PARAMETERS WITH MORTALITY

In this study higher mortality rates were associated with presence of multi- organ failure, duration of symptoms of more than 24 hours, fecal exudate, general peritonitis and non-colonic origin of sepsis. Organ failure (*P*=0.0001), Pre-operative duration of peritonitis more than 24 hours (*P*= 0.009) and generalized peritonitis (*P*=0.027) were found to be associated with mortality which was statistically significantly. Significant differences in mortality were observed depending on diagnosis and the highest mortality rate was noted peptic ulcer disease complicating to perforation amounting to 54.5%.

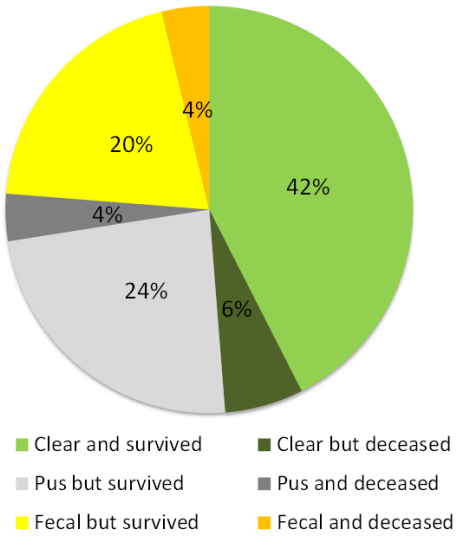


Figure No. 3 ASSOCIATIONS OF EXUDATES WITH MORTALITY

TABLE NO. 3 - DISTRIBUTION OF DEATH AMONG MPI SCORES

S No.	Scores	Deceased	Survived	Total
1	>25	10	13	23
2	15-25	1	31	32
3	<15	0	25	25
	Total	11	69	80

MPI score of 25 and more was associated with 12.5% overall mortality (p value <0.001) and in the group of patients with MPI score more than 25 the mortality rate was 76.92%. 5 patients out of 24 female were expired and were in different age groups ranging from 18 - 80 years old and 5 patients out of 25 males were expired. Thus female gender, with high MPI score, irrespective of age, has a higher mortality rate and should be managed aggressively for better outcome. There were 32 patients with MPI score between 16 and 25, and there was one death in this group (mortality 1.25%). Only one patient that expired was a 22 years old gentlemen came to emergency 5 days after onset of diffuse peritonitis with organ dysfunction and on laparotomy, it was a benign gastric perforation. In spite of aggressive management patient died due to ongoing septic shock on POD 0. Remaining 31 patients responded well to treatment and survived. Of the 25 patients that constituted the third group with MPI score less than 16 and none of the patients with scores less than 15 died (mortality 0%).

TABLE NO. 4 - MPI SCORE >25 VS MORTALITY VS MORBIDITY

S No.	Scores	Recovered	complications	Deceased	Total
1	>25	1	12	10	23
2	</= 25	38	18	1	57
	Total	39	30	11	80
	Risk Ratio		25.33	43.07	
	P Value		0.0001	0.0001	

MPI score evaluation for morbidity showed an overall 37.5% morbidity and 13.8% mortality in our study. The sensitivity of MPI score for morbidity at 26 is 40%, and specificity is 97 %.The positive predictive value is 92%, and negative predictive value is 67%. Pearson Chi Square test value is 15.541 at degree of freedom (df) of 1. Fischer's exact test gives p value of 0.000, which is highly significant. The sensitivity of MPI score for mortality at 26 is 90%, and specificity is 81%.The positive predictive value is 76%, and negative predictive value is 98%. Pearson Chi Square test value is 24.056 at degree of freedom (df) of 1. Fischer's exact test gives p value of 0.000, which is highly significant.

In all the three MPI groups studied, the influence of MPI score was statistically highly significant with regard to mortality, morbidity and overall hospital stay. The two MPI intervals above and below the score of 25 studied also showed MPI scores were statistically significant in predicting mortality, complications and duration of hospital stay.

ANALYSIS: Peritonitis secondary to hollow viscous perforation is one of the commonest reasons for emergency surgery done even today. Various factors like age, sex, organ failure, malignancy, extent of peritonitis, type of contamination, site of perforation, surgical interventions are all known to influence mortality and morbidity. Effective preoperative management, timely surgery and proper post-operative care will decide the outcome.

Mean age of patients was 42.7 years (SD ± 16.41), a range of 16–80 years and among non-survivors the mean age was 42.43 years (p <0.0001). The mortality rate among age group 50 years or less than 50 years is 10% (i.e. 6 patients among 55 patients who younger than or equal to 50years) whereas the mortality doubles to 20% among those who are older than 50years (i.e. 5 among 25 patients older than 50years). Studies done by Qureshi et al, Kusumoto et al, and Malik et al also have similar results that with increasing age there is increase in MPI score, which is associated with increased mortality. This can be explained with the fact that with increasing age immunity decreases, other being poor physiological reserve and reduced stress tolerating capacity.

With regard to spread of peritonitis, in other studies, patients with generalized peritonitis corresponded to 30%–66 %;(7, 10). In our study, generalized peritonitis corresponded to 73.75% (49/80 patients) and 38.35% (31/80 patients) with localized peritonitis; among the survivors, 49.5% (28/69) had generalized peritonitis and 59.4% (41/69) had localized peritonitis. Among patients who died, all patients had generalized peritonitis (100%) as compared to localized peritonitis, which did not have any mortality. As expected, extension of peritoneal inflammatory process was related with mortality rate.

Even though mortality rate in the presence of malignancy was 33% (3/9), the result was not conclusive due to the small number of patients with malignancy in our study.

Considering survival related with character of peritoneal fluid, we found the following gradient: clear fluid had mortality rate of 12.8% (5/39), purulent fluid had mortality rate of 13.63% (3/22) and fecal fluid had mortality of 15.7% (3/19). Of 11 patients died, all had organic failure, which shows that if the organic failure is present then it is associated with higher MPI score and higher incidence of mortality and morbidity. Similarly, if evolution time is >24 h, then there is high chances of mortality as only 1 out of 11 deaths was associated with having evolution time of <24 h.

Non-colonic origin is also considered an adverse factor, 9 of 34 (26.47%) patients having non-colonic origin died, as opposed to 2 of 17 patients (11.76%) having colonic origin. As to influence of anatomic origin or etiology of peritonitis on prognosis independent of the MPI score of the patient, the following was observed: Peptic ulcer perforations, small-bowel pathology had higher mortalities.

Studies from Western population showed relatively older age group ranging from 44 -64.8 years, even in centers where the etiological spectrum closely resembled our findings.(7, 10). With regard to etiology, studies from Western population show colonic perforation due to diverticular disease and cancer (16-70%) as the leading cause followed by gastro duodenal peptic ulcer perforation (16%) and perforated appendicitis (8%). In our study, the most common (52.5%) cause of peritonitis was secondary to duodeno-gastric peptic ulcer perforations. Overall morbidity rates in various studies for surgery in perforation peritonitis vary widely ranging from 18% to 67%. In our study the overall morbidity rate was 37.5% with sensitivity of 40% and specificity of 87% at MPI score of 26.

On the basis of the results, it can be summarized that MPI was a useful method to determine outcome in patients with peritonitis who are surgically evaluated and treated at our hospital. All the MPI adverse factors behaved as expected, and among them the following factors were especially statistically significant: presence of the organic failure, time elapsed >24 h and generalized peritonitis. When considering each risk factor, constructing a contingency table in which the presence or absence of adverse factor and result (death or survival) are considered, OR value obtained allows us to weigh, in descending order, results of OR for each risk factor were the following: presence of pre-operative duration of peritonitis >24 hours – 10.29, general peritonitis – 0.814, organ failure – 0.607. Organic failure was present in 23 patients, of which 11 died. Considering evolution time of >24h, 10 patients of 30 died. Wabwire et al(13) found female gender, age above 50 years, presence and number of organ dysfunction, character of exudate and extent of peritonitis as significant factors in prediction of complications and mortality. Seiler et al concluded preoperative duration significantly influences the outcome in addition to other factors mentioned.

Seiler et al(6) analyzed 258 patients with generalized peritonitis and reported mean MPI score of 27. Bielecki et al(8) found mean MPI score of 24.2 among patients with large bowel perforation. In our study, the mean MPI score was 19.81and 40.0% of our patients were in the MPI score group of 16-25. Overall mortality rate was 13.8%. On statistical analysis using $\chi 2$-test for degree of freedom as 1 is 24.056 and p-value is <0.0001, which shows that predictability of the MPI score in predicting survival is very strong, according to the following categories: scores of <26 and >26. A glance at the life table shows a difference in prognosis of the two established groups. There was one death among those with scores 0–26 MPI points, and increased mortality and morbidity confirms the predicative value of MPI among patients with surgically diagnosed peritonitis. The sensitivity and specificity of MPI for mortality were 90% and 81%, respectively, at a cut-off of 26 MPI score. Billing et al(9) reported a mean sensitivity of 86% (54%-98%) and specificity of 74% (58%-97%) at MPI score of 26. Variation in sensitivity and specificity found here may be attributable to differences in set of patients, conditions, sample sizes and setting of cut-off values. In a recent cohort study by Linder et al.(5), investigating patients with perforation peritonitis, overall morbidity rate was 41% and the hospital mortality rate was 14% which coincides with our study (i.e. morbidity rate of 48.5% and mortality rate of 13.8%).

Batra et al(11) calculated MPI score in a cross-sectional study of 160 patients of perforation peritonitis with cut off MPI of 26. Sensitivity and specificity of MPI in predicting mortality were calculated to be 100% and 65.54%, respectively. The rate of mortality was 5.7%. In our study we found a cut off value of 26 to be appropriate with reasonable sensitivity and specificity.

In a meta-analysis of results from 7 centers involving 2003 patients, Billing et al(9) reported an average group mortality rate of 2.3% for MPI score <21, 22.5% at score of 21-29 and 59% with score >29. In a study conducted by Qureshi AM et al(7), in the group of patients with score of <21 had mortality of 1.9%, score of 21-29 had 21.9% and score >29 had mortality of 28.1%. Mortality rate for MPI score more than 26 was 28.1% while for scores less than 26 it was 4.3%. Malik AA et al.(12), did prospective study using 101 consecutive patients having generalized peritonitis over a two-year period, in which they found the mortality was 0% in the group of patients with a score of less than 15, while it was 4% in the patients scoring 16-25 and 82.3% in those with scores of more than 25. Kusumoto Yoshiko et al.(10) evaluated the reliability of the MPI in predicting the outcome of patients with peritonitis in 108 patients in which they compared MPI and mortality and showed patients with MPI score of 26 or less had mortality of 3.8%, where as those with a score more than 26 had mortality of 41.0%. In our study, the patients with MPI scores of <16, 16-25, >25 had a group mortality of 0%,

1.25%, and 12.5% respectively and on dividing the patients into two intervals at threshold score of 26 a statistically significant difference in mortality with 1.25% for MPI score <26 and 12.5% for MPI > 25 (p-value<0.001) was observed. Thus, increasing risk of mortality with increasing MPI score is comparable in studies including ours.

V. Conclusion:

MPI (Mannheim Peritonitis Index) is simple, accurate and utilizes more feasible parameters like clinical findings, routine investigations like CBC, RFT, ABG and intra operative findings to predict the post-operative prognosis of non-traumatic perforation peritonitis.

From our study we found that,

1. The major cause of secondary peritonitis in RIMS Ranchi was peptic ulcer perforation
2. Among the various variables of the scoring age, evolution time of peritonitis, organ failure and presence of peritonitis had statistically significant association on post-operative morbidity and mortality.
3. On rising scores of Mannheim's peritonitis index scores, there was high morbidity and mortality this helped us to predict the post-operative outcome of patients with perforation peritonitis using Mannheim peritonitis index

We conclude that MPI scoring is a simple and reliable predictor of death in secondary peritonitis and can be helpful in tailoring the surgical decisions according to the individual patient demands.

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