## ORIGINAL RESEARCH

# A Comparative Study Between APACHE II Scoring And Mannheim Peritonitis Index To Assess Prognosis In Perforation Peritonitis

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## Abstract

**Aim**: To find out efficacy of MPI in comparison to APACHE II to prognosticate perforation peritonitis.

**Material and Method:** The present cross sectional observational study was conducted among 100 patients admitted in Dept. of Surgery with hollow viscus perforation from 1 October 2019 till 30st September 2022. APACHE II and Mannheim Peritonitis Index (MPI) scoring systems was calculated in all the patients in order to assess their individual risk of morbidity and mortality. All the patients were subjected to emergency surgery. Outcome variables assessed were post-operative wound infection, wound dehiscence, anastomotic leak, respiratory complications, duration of hospital stay, need of ventilator support and mortality.

**Results:** A total of 76 (76%) patients survived while 24 (24%) died during the hospital stay. Among 43 patients with MPI >30, a total of 19 (44.19%) died. Statistically, the association between APACHE II scores and mortality was significant (p<0.001). The sensitivity, specificity, positive predictive value and negative predictive value of MPI in the present study is 100%, 89%, 72%, 100% respectively. The accuracy rate of MPI is 70%. The sensitivity, specificity, positive predictive value and negative predictive value of APACHE II in the present study is 87%, 100%, 100%, 94% respectively. The accuracy rate of APACHE II is 84.50%.

**Conclusion:** The findings of the study showed that both MPI as well as APACHE II were good predictors of outcome among patients with perforation peritonitis, however, APACHE II had a slightly higher sensitivity as well as specificity as compared to MPI.

**Keywords:** Perforation Peritonitis, APACHE II, MPI

## Introduction

Peritonitis is inflammation of the peritoneum, the lining of the inner wall of the abdomen and which covers the abdominal organs[1]. It may be localized or generalized, and may result from infectious (often due to rupture of a hollow abdominal organ) or from a non-infectious process[2].

The spectrum of perforation peritonitis in India continues to be different from its western counterparts. In India, the most commonly affected population is the young men in the prime

of their life as compared to the west where the mean age for the occurrence of perforation peritonitis is usually 45-60 yrs. In majority of cases in tropical countries like India the presentation to the hospital is late with established generalized peritonitis with fecal or purulent contamination and varying degree of septicemia. In India perforations of the proximal gastrointestinal tract were more common as compared to the distal ones[3].

Conventional methods of management include pre-operative resuscitation, operative treatment, followed by a period of nasogastric suction, intravenous therapy to maintain adequate hydration and to correct the electrolyte imbalance until the period of paralytic ileus has resolved, the use of systemic antibiotics, and in the more severe cases showing evidence of circulatory collapse the judicious use of blood transfusion and vasopressors. The respected aphorism that states than the diagnosis of peritonitis is made by clinical evaluation remains true today[4].

In general, routine laboratory and radiographic studies often add little specific information in the evaluation of peritonitis. Leukocytosis, with a predominance of immature neutrophil is almost uniformly present. Plain x-ray abdomen in supine may reveal obliteration of the peritoneal fat lines and the psoas shadow indicating the presence of edema. Free intraperitoneal air, indicative of a perforated viscus, may be found on upright abdominal, left lateral dicubitus, or upright chest x-ray. Diagnostic peritoneal aspiration from one or more quadrants of the abdomen may be helpful in aetiological diagnosis. The role of ultrasonography, CT and MRI in peritonitis is limited to those patients presenting with abdominal pain who have no immediate, compelling indication for abdominal exploration[3].

Various scoring systems have been used to indicate prognosis of patients with peritonitis:[5-8]

a) Disease independent e.g., Acute Physiological and Chronic Health Evaluation (APACHE)-II, Simplified Acute Physiology Score II, Multiple Organ Dysfunction Score.
b) Disease dependent e.g., MPI, Peritonitis Index of Altona-II score.

APACHE II score was developed by Knaus et al[9]. It was devised to stratify prognosis in group of critically ill patients, and to determine the success of treatment. The Surgical Infection Society (SIS) adopted APACHE II score. APACHE II score is consisting of 12 acute physiological variables, age point and chronic health point. Scores of physiological variable ranges from 0 to 4 on each side of normal value according to both high and low abnormal ranges.

Mannheim peritonitis index (MPI) was developed by Wacha and Linder in 1983[10]. It was designed based on the retrospective analysis of the data from patients with peritonitis, in which 20 possible and significant risk factors were considered. Among these 20 risk factors, only 8 proved to be of prognostic relevance and they were entered into the Mannheim Peritonitis Index and they were classified according to their predictive power. Patients with a score more than 26 are defined as having a high mortality rate. The Mannheim Peritonitis Index (MPI) is a specific score, which has a very good accuracy and serves as an easy way to assess clinical parameters, allowing the determination of the individual prognosis of patients with peritonitis[11,12].

APACHE II is a disease independent scoring system used most commonly in ICU settings. MPI on the other hand is disease specific scoring system. APACHE II has a greater number of variables than MPI which makes it more time consuming and cumbersome calculation when compared to MPI which is relatively simple to calculate and less time consuming. In emergency settings, time is an important factor. So, we need a scoring system which is easy, less time consuming and also precise in assessing prognosis of the disease. This study was done to find out efficacy of MPI in comparison to APACHE II to prognosticate perforation peritonitis.

## Material and method

The present cross sectional observational study was conducted among 100 patients admitted in Dept. of Surgery with hollow viscusperforation from 1 October 2019 till 30$^{st}$ September 2022.

## Inclusion Criteria

1. Peritonitis secondary to hollow viscus perforation.
2. Age 18 years and above
3. Pregnant and Lactating Females

## Exclusion Criteria

1. Perforation secondary to abdominal trauma.
2. Primary peritonitis.
3. Post-operative peritonitis due to anastomosis leak, etc.
4. Age between 0-17 yrs.

## Outcome Variables

1. Post-operative wound infection
2. Wound dehiscence
3. Anastomotic leak
4. Respiratory complications
5. Duration of Hospital stay
6. Need of ventilator support
7. Mortality

APACHE II and Mannheim Peritonitis Index (MPI) scoring systems was calculated in all the patients in order to assess their individual risk of morbidity and mortality. All the patients were subjected to emergency surgery.

## I. Apache II

The APACHE II score – a score from 0 to 71 consisting of weights for age at admission to our unit (0 to 6 points) and severe conditions in the past medical history (0 to 5 points) plus an Acute Physiology Score (0 to 60 points) based on weightings for deviations from normal in the following twelve physiological parameters during the first 24 hours in the unit.

Patients were divided into three categories according to the score:

Score 0-10 Low Risk

Score 11-20 Moderate Risk

Score >20 High Risk

## II. Mannheimperitonitisindex

The following parameters were recorded meticulously for the calculation of the Mannheim PeritonitisIndex:

1. Age
2. Sex
3. Organ Failure

The criteria published by Deitchin 1992, was used to assess the presence of organ failure areas follows:

- Renal failure: serumcreatinine>177mmol / L (>2mg/dl) orserumurea>16.7mmol/L (>46.78mg/dl) {conversionfactoris 88.40 and 0.3570respectively} oroliguria<20ml/ hour.
- Shock: Hypotensionis defined as asystolic BPof<90mm Hg or a reduction of>40mmHg frombaseline, in the absence of other causes for the fallin blood pressure.

- Intestinalobstruction (only if profound): paralysis>24 hours or complete mechanicalileus.
- Respiratory failure: pO2<50mmHgorpCO2>50mmHg.

## 4. Malignancy

Patients with known malignancy or with features of malignancy on gross examination e.g. malignant gastric perforations, perforation of acolonic growth suspicious of malignancy, perforation of proximal bowel duet odistal obstruction by malignant growth on gross examination were included in the study.

## 5. Evolutiontime

Patients were divided into two groups (<24 hour / >24 hour) on the basis of history and timing of surgery.

## 6. Origin of sepsis (colonic / noncolonic)

This parameter is recorded on the basis of findings of laparotomy.

7. Extensionofperitonitis (Diffuse/ localized)

8. Character of exudates or peritoneal fluid

a) Clear

b) Cloudy/purulent

c) Fecal

Bilious collections in cases of recent perforation without superadded infection were grouped as clear.

The individual score of each parameter is added to calculate Mannheimperitonitis index score of each case. Patients were divided into three categories according to the score:

1. Scoreless than 21 – Low risk
2. Score between 21 to 29 – Moderate risk
3. Score more than 29 – High Risk

Data was collected and subjected to statistical analysis.

## Statistical analysis

Data so collected was tabulated in an excel sheet, under the guidance of statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS inc, Chicago, USA). Difference between two groups was determined using student t-test as well as chi square test and the level of significance was set at $p < 0.05$. Diagnostic test viz. sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate were calculated to compare the efficacy of MPI Score and APACHE II Score.

## Results

In our study males (71%) were comparatively more as compared to females (29%).

Maximum subjects were from the age group of 51-60 years. Pain was reported in all the subjects. Generalized/localized tenderness and rigidity & guarding was found among 94% and 96% of the subjects respectively (graph 1).
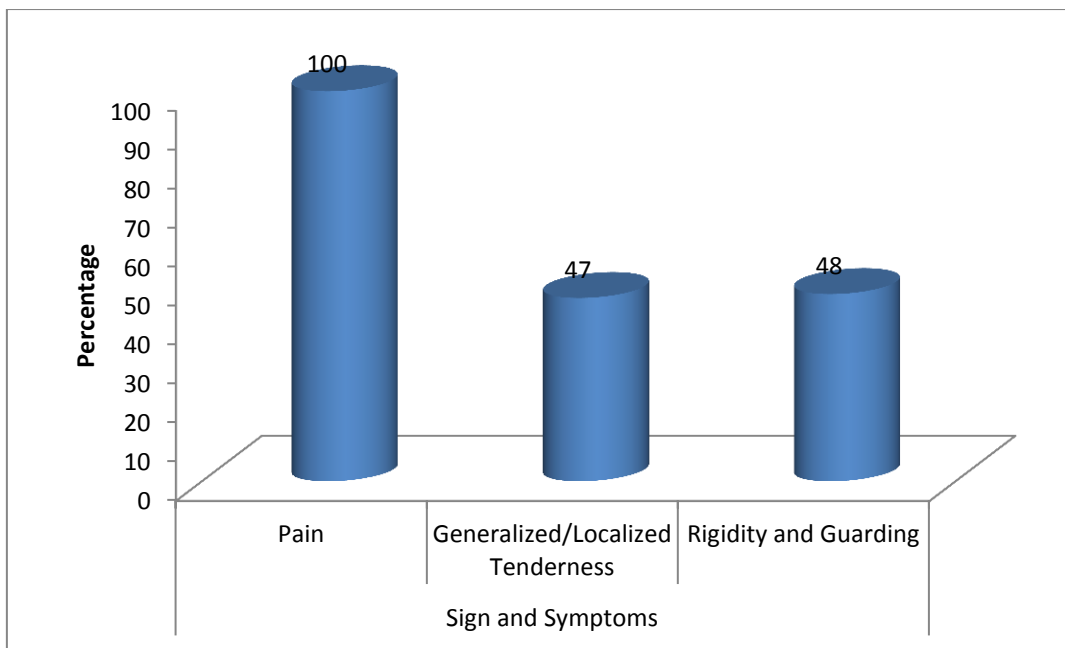
**Graph 1: Sign and symptoms among the study subjects**

Diffuse and localized peritonitis was reported among 93% and 7% of the subjects respectively (graph 2).
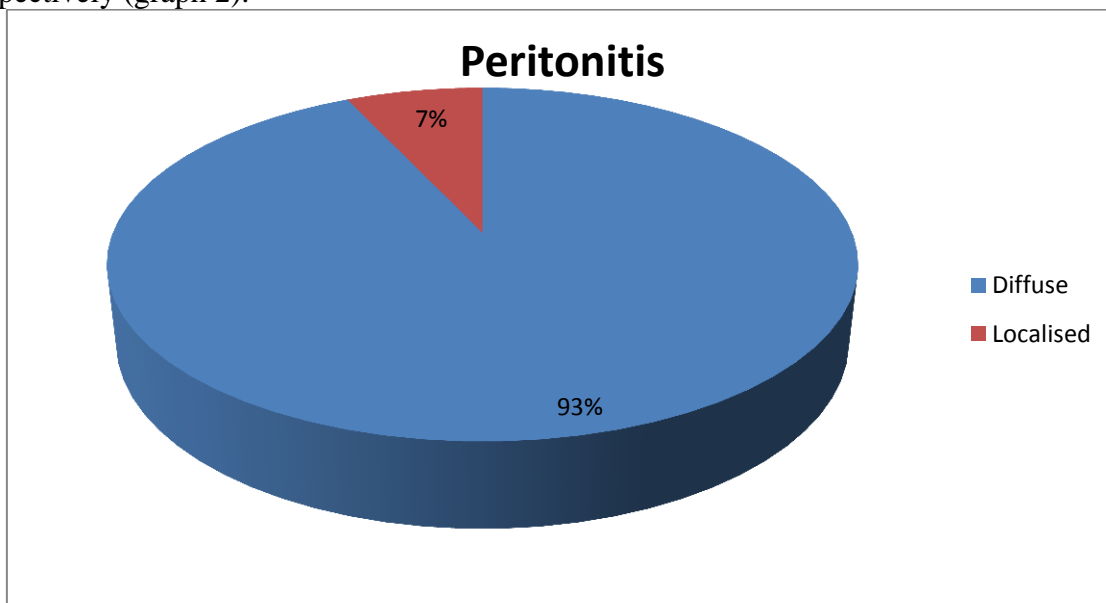


**Graph 2: Type of Peritonitis among the study subjects**

Maximum number of cases (43%) had MPI >30 followed by those having MPI in 21- 30 range (36%), 11-20 (12%) and only 9% had MPI in 0-10 range (table 1).

**Table 1: MPI score among the study subjects**

| MPI Score | N | % |
|-----------|-----|-----|
| 0-10 | 9 | 9 |
| 11-20 | 12 | 12 |
| 21-30 | 36 | 36 |
| >30 | 43 | 43 |
| Total | 100 | 100 |

APACHE II scores ranged from 9 to >19. Majority of patients (49%) had APACHE II scores >19. There were 3 (3%) cases with APACHE II scores in 0-9 range and 48% had APACHE II scores in 10-19 range (table 2).

**Table 2: APACHE II score among the study subjects**

| APACHE II Score | N | % |
|---|---|---|
| 0-9 | 3 | 3 |
| 10-19 | 48 | 48 |
| >19 | 49 | 49 |
| Total | 100 | 100 |

A total of 76 (76%) patients survived while 24 (24%) died during the hospital stay.

**Table 3: Association of the two scoring systems with outcome**

| MPI Score | N | Mortality | | Chi Square | p value |
|---|---|---|---|---|---|
| | | N=24 | % | | |
| 0-10 | 9 | 0 | 0 | | |
| 11-20 | 12 | 0 | 0 | 23.56 | <0.01* |
| 21-30 | 36 | 5 | 13.89 | | |
| >30 | 43 | 19 | 44.19 | | |
| APACHE II Score | | | | | |
| 0-9 | 3 | 0 | 0 | | |
| 10-19 | 48 | 7 | 14.58 | 16.81 | <0.01* |
| >19 | 49 | 17 | 34.69 | | |

*: statistically significant

There was no mortality in patients with MPI 0-10 and 11-20. Out of 36 patients with score 21-30, a total of 5 (13.89%) died. On the other hand among 43 patients with MPI >30, a total of 19 (44.19%) died. On evaluating the data statistically, a significant association between higher MPI scores and mortality was seen (p<0.001). None of the patients with APACHE II score in 0-9 range died. A total of 7 out of 48 patients with APACHE II score in 10-19 range died and 17 out of 49 patients with APACHE II score >19 died. Thus, mortality rate was 0%, 14.58% and 34.69% respectively among patients with APACHE II score 0-9, 10-19 and >19 respectively. Statistically, the association between APACHE II scores and mortality was significant (p<0.001) as shown in table 3. Mean MPI score of non-survivors was 33.05±4.87 which was significantly higher as compared to that of survivors who had mean MPI score of 22.98±5.91 (p<0.001). Mean APACHE II score of nonsurvivors (25.84±4.83) was significantly higher as compared to that of survivors (17.09±5.14) (p<0.001).

The sensitivity, specificity, positive predictive value and negative predictive value of MPI in the present study is 100% , 89% , 72%, 100% respectively. The accuracy rate of MPI is 70%. The sensitivity, specificity, positive predictive value and negative predictive value of APACHE II in the present study is 87%, 100% ,100%, 94% respectively. The accuracy rate of APACHE II is 84.50% (table 4).

**Table 4: Diagnostic efficacy of MPI and APACHE II Score**

| Parameters | MPI Score | APACHE II Score |
|---|---|---|
| Sensitivity | 100% | 87% |
| Specificity | 89% | 100% |
| Positive Predictive Value | 72% | 100% |
| Negative Predictive Value | 100% | 94% |
| Accuracy Rate | 70% | 84.50% |

**Discussion**

Scoring systems are generated and validated on specific populations that may be substantially different from the patients being scored in a different hospital. Scoring systems also help in risk categorization, evaluation of new diagnostic modalities and therapeutic advances as well as in the comparison of treatment results from different clinics[13]. The present study was carried out to evaluate the usefulness and severity of MPI score in comparison to APACHE II scoring system for prediction of outcome in patients with perforation peritonitis.

**Gender**

In our study males (71%) were comparatively more as compared to females (29%).
The present study was supported by Godara et al[14], which showed that majority of patients were from males.
Similarly in a study by Mishra A et al[1], majority of patients were males (73%) compared to females (27%).
Kumar P et al[13] in their study revealed that out of 50 patients, there were 36 (72%) male and 14 (28%) female.

**Age**

17%, 19%, 14%, 14% and 36% of the subjects belonged to age group of <20, 21-30, 31-40, 41-50 and 51-60 years respectively. Hence maximum subjects were from the age group of 51-60 years which was similar to the study findings by Godara et al[14]. Mishra A et al[1] too in their study reported that majority of patients were of age group of 51-60 years.
Similarly according to Kumar P et al[13], most of the patients were of age group between 51 to 60 years (28%).

**MPI Score and APACHE II Score**

Maximum number of cases (43%) had MPI >30 followed by those having MPI in 21- 30 range (36%). APACHE II scores ranged from 9 to >19. Majority of patients (49%) had APACHE II scores >19. There were 3 (3%) cases with APACHE II scores in 0-9 range and 48% had APACHE II scores in 10-19 range.
Mishra A et al[1] too in their study revealed that maximum number of patients, 45% had MPI >30 and 53% had APACHE II scores >19.
Kumar et al[13] in their study reported similar findings too.

**Outcome**

A total of 76 (76%) patients survived while 24 (24%) died during the hospital stay.
Kumar P et al[13] in their study revealed mortality rate of 18%.
Mishra A et al[1] in their study showed that 29.0% of the patients died during the hospital stay.

**Association of the two scoring systems with Outcome**

There was no mortality in patients with MPI 0-10 and 11-20. Out of 36 patients with score 21-30, a total of 5 (13.89%) died. On the other hand among 43 patients with MPI >30, a total

of 19 (44.19%) died. On evaluating the data statistically, a significant association between higher MPI scores and mortality was seen (p<0.001). None of the patients with APACHE II score in 0-9 range died. A total of 7 out of 48 patients with APACHE II score in 10-19 range died and 17 out of 49 patients with APACHE II score >19 died. Thus, mortality rate was 0%, 14.58% and 34.69% respectively among patients with APACHE II score 0-9, 10-19 and >19 respectively. Statistically, the association between APACHE II scores and mortality was significant (p<0.001).

Similar findings were revealed by Mishra A et al[1].

Malik et al[12] in their study found that majority of mortality rate was associated with MPI score >30 and APACHE II score >19.

Kumar P et al[13] in their study reported that MPI score >25, 22.86% patients expired. MPI score between 25-15, 6.7% patients expired and with score ≤14 none of the patient expired. With APACHE II score above 20, none of the patients were survived.

In a study by Ahmed A et al[15], there was no mortality in MPI score group less than 15, while 28% mortality in group with the score more than 25.

Ntirenganya et al[16] in their study reported 15% mortality in score group more than MPI score 29. 65% of the patients who survived in their study had a MPI score less than 29. MPI score of more than 29 had the highest mortality, up to more than 80% in some studies. In a meta-analysis of results from 7 centers involving 2003 patients, Billing et al reported an average group mortality rate of 2.3% for MPI <21 points, 22.5% at MPI of 21-29 points and 59% with MPI of >29 points.

Comparatively, in study conducted by Bohnen et al[17], Adesunkanmi et al[18], Agarwal S etal[19], the mean APACHE II score among survivors was 8 (low risk group) and among non-survivors was 22.4 (high risk group). Thus conclusive of the fact is that mortality is directly related with higher scores.

## Diagnostic Efficacy of Two Scoring Systems

The area under curve values of MPI and APACHE II were observed to be 0.903 and 0.94 respectively. The sensitivity, specificity, positive predictive value and negative predictive value of MPI in the present study is 100% , 89%, 72%, 100% respectively. The accuracy rate of MPI is 70%. The sensitivity, specificity, positive predictive value and negative predictive value of APACHE II in the present study is 87%, 100%, 100%, 94% respectively. The accuracy rate of APACHE II is 84.50%.

According to Kumar P et al[13], the accuracy rate of APACHE II (83.3%) is higher than the MPI (69%) in predicting the mortality. The sensitivity, specificity, positive predictive value and negative predictive value of MPI in the present study is 100%, 91%, 69%, 100% respectively. The sensitivity, specificity, positive predictive value and negative predictive value of APACHE II in the present study is 85%, 100%, 100%, 96% respectively. These findings were similar to our study.

In a study by Mishra A et al[1], MPI had 82.8% sensitivity and 64.7% specificity in prediction of mortality whereas for APACHE II, sensitivity was 86.2% and specificity was 69.1% in prediction of mortality. These findings are approximately similar to our study.

## Limitations

In this study, there was no case of malignant aetiology. The impact on preoperative score and final outcome therefore could not be assessed. Multicentric studies with large sample size may alleviate this issue.

## Conclusion

The findings of the study showed that both MPI as well as APACHE II were good predictors

of outcome among patients with perforation peritonitis, however, APACHE II had a slightly higher sensitivity as well as specificity as compared to MPI.

Mannheim peritonitis index is a simpler tool, easy to calculate, considers the etiology of peritonitis and the nature of peritoneal contamination, which are lacking with APACHE II score. Furthermore, the APACHE II score is more extensive and requires lab support so, cannot be done in remote areas where laboratory setup is not present. The Mannheim peritonitis index do not considers the underlying physiological derangement of the patients, which is important in the categorization of the patients who need intensive supportive care. Furthermore, the Mannheim peritonitis index needs the operative findings to complete the score, so in a true sense cannot be used as a preoperative scoring system. This hampers its use to stratify patients into groups to decide whether definitive surgery or damage control surgery can be carried out safely. On the other hand, APACHE II can be calculated preoperatively to categorise patients but it does not take into account peritoneal contamination which has a huge bearing on the final outcome. It is worthwhile to use combination of both scores for a superior prediction of mortality in patients of perforation peritonitis.

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