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Original Research Article

A comparative study between Mannheim peritonitis index and APACHE II in predicting the outcome in patients of peritonitis due to hollow viscous perforation

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ABSTRACT

Background: The identification and early assessment of peritonitis patient is often required in surgical emergency to select the high risk patients for intensive management for better outcome. This is a comparative study of efficacy between Mannheim peritonitis index and APACHE II in predicting the outcome in patients of peritonitis due to hollow viscous perforation.
Methods: Comparative and prospective study in 50 patients of hollow viscous perforation admitted and operated in surgical emergency, Patna Medical College and Hospital from year April 2014 to April 2016 was done. Mannheim peritonitis index and APACHE II score of each case was calculated and the prediction of outcome was compared with the final outcome.
Results: In this study with MPI score >25, 22.8% patients expired. MPI score between 25-15, 6.6% patients expired and with score ≤14 none of the patient expired. According to APACHE II system with APACHE II score less than 10, 8.6% patients expired. Between score 11 -20, 36% expired and With APACHE II score above 20, none of the patients survived I.e. 100% mortality.
Conclusions: MPI score is easy to apply and easy to calculate but APACHE II score obviously shows more accurate prediction of mortality.

Keywords: APACHE II score, Hollow viscous perforation, MPI score, Mortality rate, Peritonitis

INTRODUCTION

Peritonitis due to hollow viscous perforation continues to be one of the commonest surgical emergencies. It is a life threatening condition. The outcome of perforation peritonitis depends on the complex interaction of many factors and the success obtained with the early identification of patients and the aggressive surgical approach.[1] Many times it is difficult to decide the direction of treatment, based on clinical, biochemical and radiological evaluation required for better outcome and prognosis, particularly in emergency and intensive care settings. Many scoring systems have been designed for assessing the severity of hollow viscous perforation peritonitis like acute physiology and chronic health evaluation (APACHE II) score, Mannheim peritonitis index (MPI), POSSUM score, simplified acute physiology score (SAPS), sepsis severity score (SSS), Ranson score, Imrite score.[2,3]

Mannheim's peritonitis index (MPI) was developed by Wacha and Linder.[4]

APACHE II score was developed by Knaus et al.[5] 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.

METHODS

This prospective study was conducted on 50 patients admitted in surgical emergency, Patna Medical College as cases of peritonitis secondary to hollow viscous perforation from April 2014 to April 2016 over a period of two years.

All patients of any age and sex with hollow viscous perforation peritonitis were included in the study group. All patients with primary peritonitis, peritonitis secondary to abdominal trauma and peritonitis managed conservatively were excluded from the study group. All patients were subjected to emergency exploratory laparotomy. Both APACHE II and Manheim peritonitis index scoring system were applied and calculated in each case and their predictions of risk of mortality were compared with the final outcome.

Mannheim's peritonitis index

A simplified scoring system, Mannheim's peritonitis index (MPI) was developed by Wacha and Linder.[4] It was developed based on the retrospective analysis of data from 1253 patients with peritonitis in which 20 possible risk factors were considered. Of these 20 factors, only 8 were proved to be of prognostic relevance and were entered into MPI score (Table 1). These factors were classified according to their predictive power. Total MPI score in each case were calculated by adding points of the each of the following factors.

Table 1: Mannheim's peritonitis index.

Risk factor	Scores
Age > 50 years	5
Female sex	5
Organ failure*	7
Malignancy	4
Preoperative duration of symptoms > 24 h	4
Origin of sepsis not colonic	4
Diffuse generalized peritonitis	6
Exudates	
Clear	0
Cloudy, purulent	6
Fecal	12

Definition of organ failure*: Renal failure = creatinine level > 177 umol/L or urea level> 167mmol/L or oliguria 20ml/hour; Pulmonary insufficiency = PO2 < 50 mmHg or PCO2 > 50 mmHg; Intestinal obstruction/paralysis > 24hours or complete mechanical ileus; Shock: systolic blood pressure<90mm of hg, MAP<60mm of hg.

APACHE II Score

The APACHE II (Table 2) score were calculated as per the method of Knaus.[5] APACHE II score is consisting of 12 acute physiological variables, age point and chronic health point.

Acute physiological variables

Scores of physiological variable ranges from 0 to 4 on each side of normal value according to both high and low abnormal ranges. For each physiological variable, most abnormal measurement is included if the test has been repeated more than one time before surgery.

Age point

Range as follows-<44 = 0, 45-54 = 2, 55-64 = 3, 65-74 = 5, >75 = 6.

Chronic health point

With history of severe organ insufficiency or immunosuppression assign Points as follows:

- Non-operative or emergency postoperative -5 points
- Elective postoperative -2 points.

The outcome of each patient was noted and the initial scores of both the scoring system were compared for better prediction of the outcome.

RESULTS

Out of 50 patients there were 36 (72%) male and 14 (28%) female. male: female ratio as 2.5:1. The mean age was 41.84 years. Most of the patients were of age group between 51 to 60 years (28%). Commonest presenting symptom was pain abdomen, in all 50 patients (100%). The presenting signs on per abdominal examination were generalized/localized tenderness with rigidity and guarding in all 50 cases (100%).

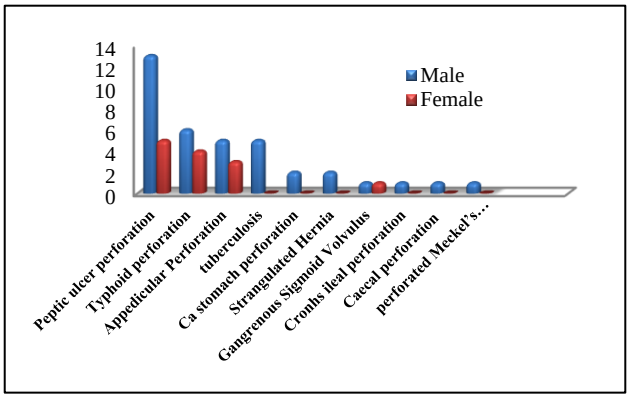

Figure 1: Causes of peritonitis in the study group.

Table 2: (APACHE II- Physiological parameters).

Physiologic variable	High abnormal range					Low abnormal range				
	+4	+3	+2	+1	0	+1	+2	+3	+4	Points
Temperature - rectal (°C)	≥41°	39 to 40.9°		38.5 to 38.9°	36 to 38.4°	34 to 35.9°	32 to 33.9°	30 to 31.9°	≤29.9°	
Mean arterial pressure - mm Hg	≥160	130 to 159	110 to 129		70 to 109		50 to 69		≤49	
Heart rate (ventricular response)	≥180	140 to 179	110 to 139		70 to 109		55 to 69	40 to 54	≤39	
Respiratory rate (non-ventilated or ventilated)	≥50	35 to 49		25 to 34	12 to 24	10 to 11	6 to 9		≤5	
Oxygenation: A-aDO$_2$or PaO$_2$ (mm Hg) a. FIO$_2$ ≥0.5 record A-aDO2 b. FIO$_2$ <0.5 record PaO2	≥500	350 to 499	200 to 349		<200 PO2>70	PO2 61 to 70		PO2 55 to 60	PO2 <55	
Arterial pH (preferred)	≥7.7	7.6 to 7.69		7.5 to 7.59	7.33 to 7.49		7.25 to 7.32	7.15 to 7.24	<7.15	
Serum HCO3 (venous mEq/l) (not preferred, but may use if no ABGs)	≥52	41 to 51.9		32 to 40.9	22 to 31.9		18 to 21.9	15 to 17.9	<15	
Serum sodium (mEq/l)	≥180	160 to 179	155 to 159	150 to 154	130 to 149		120 to 129	111 to 119	≤110	
Serum potassium (mEq/l)	≥7	6 to 6.9		5.5 to 5.9	3.5 to 5.4	3 to 3.4	2.5 to 2.9		<2.5	
Serum creatinine (mg/dl) double point score for acute renal failure	≥3.5	2 to 3.4	1.5 to 1.9		0.6 to 1.4		<0.6			
Hematocrit (%)	≥60		50 to 59.9	46 to 49.9	30 to 45.9		20 to 29.9		<20	
White blood count (total/mm3) (in 1000s)	≥40		20 to 39.9	15 to 19.9	3 to 14.9		1 to 2.9		<1	
Glasgow Coma Score (GCS) Score = 15 minus actual GCS										
A. Total acute physiology score (sum of 12 above points)										
B. Age points (years) ≤44 = 0; 45 to 54 = 2; 55 to 64 = 3; 65 to 74 = 5; ≥75 = 6										
C. Chronic health points										
Total APACHE II Score (add together the points from A+B+C)										

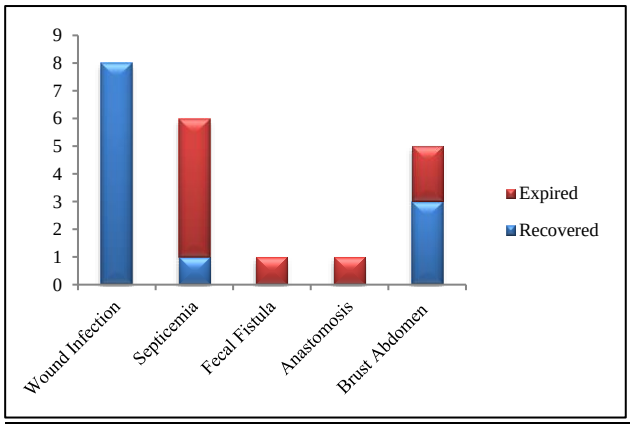

Figure 2: Post-operative complications.

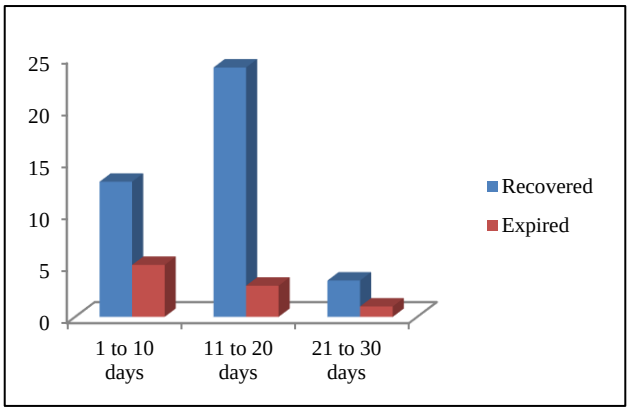

Figure 3: Duration of hospital stay in this study group.

Commonest cause of perforation peritonitis encountered in this study was peptic ulcer perforation 36% (18 cases) of total cases, followed by 20% (10 cases) typhoid ileum perforation, 16% (8 cases) appendicular perforation,10% (5 cases) tuberculous intestinal perforation, 4% cases (both was male) malignant gastric ulcer perforation, 4% cases (2 cases) strangulated hernia with perforated gangrenous intestine, one case (2%) Meckel's diverticulum perforation. Crohns Ileal perforation and caecal perforation was also found in one (2%) of each case Figure 1.

The commonest post-operative complication Figure 2 in this study was wound infection 16%, 12% patient developed septicemia out of which only 1 recovered and 5 patients died. Burst abdomen was developed in 10% of the patient out of which 3 recovered and 2 died. Each case of Anastomosis leak (2%) and fecal fistula (2%) were expired. Total patient expired in this study group was 9 (18%).

Majority of patients, 27 cases (54%) stayed in hospital between 11-20 days among which 24 recovered and 3 expired followed by 18 cases (36%) between 1-10 days among which 13 recovered and 5 expired, 5 cases between 20-30 days among which 4 recovered and 1 expired. Complications increase the duration of hospital stay Figure 3.

All the patients were scored using both MPI and APACHE II scoring systems.

Table 3: MPI versus survivors and expired.

Score range	Survivors	Expired	Total	Survival rate	Mortality rate
≤14	0	0	0	-	0
15-25	14	1	15	93.3%	6.7%
>25	27	8	35	77.14%	22.86%
Total	41	9	50		

Table 4: APACHE versus survivors and expired.

Score range	Survivor	Expired	Total	Survival rate	Mortality rate
≤10	32	3	35	91.4%	8.6%
11-20	9	5	14	64%	36%
>20	0	1	1	0%	100%
Total	41	9	50		

Table 5: Comparison of both scores (mean) for survivors and non-survivors.

Score	Survivors mean	Expired mean	Overall mean
MPI	27.317	33	31
APACHE II	8.659	14.667	10
P Value	0.0030	0.2808	0.0275

MPI result

In this study with 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 (Table 3).

APACHE II result

According to APACHE II system with APACHE II score less than 10, 8.6% patients expired. Mortality rate among score 11 -20 group was 36%. With APACHE II score above 20, none of the patients were survived (Table 4).

In the present study the mean MPI score among the survivors was 27.3, among non survivors was 33 and overall mean MPI score was 31. Mean of APACHE II among survivors was 8.659, among non-survivors was 14.667 and over all mean was 10 (Table 5).

In the present study there is no significant difference between MPI and APACHE II in predicting the mortality (Table 5).

The accuracy rate of APACHE II (83.3%) is higher than the MPI (69%) in predicting the mortality (Table 5).

The sensitivity, specificity, positive predictive value and negative predictive value of MPI in the present study is 100% , 91% , 69%, 100% respectively. The accuracy rate of MPI is 69% (Table 6).

The sensitivity , specificity, positive predictive value and negative predictive value of APACHE II in the present study is 85%, 100% ,100%, 96% respectively. The accuracy rate of APACHE II is 83.3% (Table 7).

DISCUSSION

Peritonitis due to hollow viscous perforation is still very common in surgical emergency worldwide, with more frequency in tropical countries like India. In hospital mortality rate in patients with perforation peritonitis ranges between 19% to 60%.[6,7] Outcome of such patients is depends upon several factors related to patients age and sex, disease, co morbidities, time of presentation, therapeutic intervention undertaken and the post-operative complications.[1] Pre-operative assessment by various scoring systems provide the approximate estimates of mortality risk but none have been shown to be sufficiently specific and easy to use on all emergency patients because they require large number of variables to be collected, and few variables like diagnosis of malignancy are not possible everywhere in the emergency setup. 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.

Table 6: Sensitivity, specificity, positive predictive value and negative predictive value of MPI score: comparison with other studies.

Study	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy rate
Biling et al	76 %	58 %	-	-	-
Lombordoand et al	87%	88%	93%	94%	-
Watch et al	88 %	90%	87%	90%	-
Dani et al	90.62%	91.7%	67.44%	98.12%	-
Ojuka et al	84.2%	90.7%	75.9%	94.2%	-
Present study	100 %	91%	69%	100 %	69%

Table 7: The sensitivity, specificity, positive predictive value and negative predictive value of APACHE II: comparison with other studies.

Study	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy rate
Dino et al	82.5%	55.2%	54.7%	82.8 %	66 %
Headly et al	54%	87%	-	-	-
Present study	85 %	100 %	100 %	96 %	83.33%

In this study 27 patients (54%) had their MPI score more than 25 and 14 patients (28%) had MPI score between 16 -25. The maximum mortality rate was among score more than 25 groups as 8 patients (22.86%). In the similar study by Ahmed A et al in their study had classified MPI score into ≤15, 16-25,>25. There was no mortality in MPI score group less than 15, while 28% mortality in group with the score more than 25. 75% of the patients who survived in this study were in score group 16 to 25.[8] Ntirenganya et al in their study had classified MPI score into <21, 21-29, >29.[9] They had 15% mortality in score group more than 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.[10] 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.[11]

In present study the mean MPI score among the survivor was 27.3, among non-survivor was 33 and overall mean MPI score was 31 (Table 5). Ntirenganya et al in their study the mean MPI was 26.78±6.32 points viz, 10 points as the lowest score and 39 points as the highest score.[9] Sailer et al analyzed 258 patients with an exclusive diagnosis of generalized peritonitis and reported so far the highest mean of 27.1 points.[12]

In present study 64% (32 patients) of the patient with APACHE II score less than 10 survived while 8.6% patients (3 patients) expired. Mortality rate among scoring 11-20 groups was 36% (5 patients). In patients with score above 20, none of the patients survived i.e. 100% mortality. In the study done by ajaz ahmed et al there was 91.7% mortality in the APACHE II score group

of more than 20, 35.3% in the score group of 11-20 and 0% below score 10.[8]

In this study mean of APACHE II among survivors was 8.659, among non survivors was 14.667 and over all mean was 10 (Table 5).

Comparatively, in study conducted by Bohnen et al, Adesunkanmi et al, Agarwal S et al, 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.[13,14]

In actual MPI score predicts higher mortality rate (26%) in both survivors as well as in non survivors as compared to APACHE II score (15%). Demmel et al compared MPI and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores. Statistical validation showed a sensitivity of 93% and a specificity of 16% for MPI.[15]

Table 8: Accuracy of both scores in predicting mortality.

	Actual mortality	APACHE II prediction (according to Knaus)	MPI prediction (according to Wacha and Linder)
Rate	18 % (9 out of 50 patients)	15%	26%
Accuracy		83%	69%

A prediction accuracy of 84-90% has been reported for APACHE in the previous studies.[15-17] Dino et al in their study had reported sensitivity, specificity, positive predictive value and negative predictive value of APACHE as 82.5%, 54.7%, 82.8%, 66% respectively. In present study APACHE II is more specific than MPI in prediction of mortality.[18] The accuracy rate of APACHE II is higher than the MPI in predicting the mortality rate. MPI predicts higher mortality rate compared to APACHE II.

Many authors Malik AA et al have reported that APACHE II score have better prognostic power for outcome prediction then the MPI score because it includes physiological variables, many authors Fuger RM et al, Pacelli et al have over weighted the MPI score then other scores because of its easy applicability and some authors Demmel et al, Atsushi Horiuchi et al, have reported no significant difference in prognostic value between MPI and APACHE II scoring system.[15,18-21]

In the present study no significant difference (P value = 0.2808) has been found in predicting the mortality between MPI and APACHE II. Although the accuracy rate of APACHE II (83.3%) is higher than the MPI (69%) in predicting the mortality.

CONCLUSION

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.

However, in present study we have not found any statistically significant difference between APACHE II and MPI in predicting the mortality.

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