Section: General Surgery

Original Research Article

PATIENTS WITH PERFORATIVE PERITONITIS – EARLY VS LATE PRESENTATION AND ITS INTERVENTION

T. Manikandan[1], R. Prabha[2], G. Sivakumar[3], A.Casmier Leeth[4]

[1]Associate Professor, Department of General Surgery, Government Namakkal Medical College Hospital, Tamil Nadu, India.
[2]Assistant Professor, Department of Biochemistry, Government Mohan Kumaramangalam Medical College Hospital, Salem, Tamil Nadu, India.
[3]Associate Professor, Department of General Surgery, Government Mohan Kumaramangalam Medical College Hospital, Salem, Tamil Nadu, India.
[4]Junior Resident, Department of General Surgery, Government Erode Medical College and Hospital, Perundurai, Tamil Nadu, India.

Received : 01/09/2025
Received in revised form : 17/10/2025
Accepted : 04/11/2025

Keywords:
Perforative peritonitis, The Mannheim Peritonitis Index, APACHE II score.

Corresponding Author:
Dr. A. Casmier Leeth,
Email: suren8sam@gmail.com

DOI: 10.47009/jamp.2025.7.6.63

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (6); 315-326

ABSTRACT

Background: Perforative peritonitis is a critical condition resulting from the rupture of the gastrointestinal system, causing the spillage of intestinal contents into the peritoneal cavity.1 This leads to acute peritoneal inflammation, which can swiftly advance to sepsis, multi-organ failure, and mortality if not properly addressed. The Mannheim Peritonitis Index (MPI) and the Acute Physiology and Chronic Health Evaluation II (APACHE II) scores are two of the most prevalent and validated assessment instruments. Both scores employ a synthesis of clinical, physiological, and biochemical characteristics to assess the severity of the patient's illness and forecast mortality risk. **Materials and Methods:** This was a Prospective study which was conducted in Department of General Surgery and biochemistry, Government Erode, Namakkal and Salem Medical College Hospital. The study was conducted from September 2022 to September 2024.Patients who presented to Department of General Surgery and biochemistry at Government Erode, Salem and Namakkal Medical College Hospital with perforative peritonitis with a sample size of 50 participants. **Result:** Among participants with a Mannheim score of ≥ 22, 8 out of 16 (50%) did not survive, while the remaining 8 participants (50%) survived. In contrast, participants with scores < 22 had a much lower mortality rate, with only 1 out of 34 participants (2.9%) deceased, while 33 participants (97.1%) survived. A Chi-square test demonstrated a statistically significant relationship between Mannheim score and survival, with a Chi-square value of 13.29 and a p-value of 0.001 ($p < 0.05$). This indicates that a higher Mannheim score (≥ 22) is significantly associated with an increased risk of mortality. **Conclusion:** This study evaluated the prognostic value of the Mannheim Peritonitis Index (MPI) and APACHE II scoring systems in predicting outcomes for patients with perforative peritonitis at a tertiary care hospital. The findings highlight that both scoring systems are effective tools for assessing the severity of the condition and guiding clinical decision-making. The analysis demonstrated that patients presenting with higher scores on either system had significantly worse outcomes, emphasizing the importance of timely intervention to improve prognosis. Overall, the study provides insights into the utility of these scoring systems in predicting mortality and aiding in the management of patients with abdominal sepsis.

INTRODUCTION

Perforative peritonitis is a critical condition resulting from the rupture of the gastrointestinal system, causing the spillage of intestinal contents into the peritoneal cavity. This leads to acute peritoneal inflammation, which can swiftly advance to sepsis, multi-organ failure, and mortality if not properly addressed. The illness frequently manifests as an abdominal emergency, necessitating prompt diagnosis and surgical intervention to enhance patient outcomes. Notwithstanding improvements in surgical methods and intensive care, the morbidity and mortality linked to perforative peritonitis remain

ISSN (O): 2687-5365; ISSN (P): 2753-6556

elevated, especially in environments where delayed presentations are prevalent.

The aetiology of perforative peritonitis is varied, encompassing causes such as gastric ulcers, appendicitis, diverticulitis, malignancies, and traumatic traumas. Peptic ulcer disease, particularly in the duodenum, is a prevalent condition, especially in developing nations where the incidence of Helicobacter pylori infection and the consumption of non-steroidal anti-inflammatory medicines (NSAIDs) is elevated. The many origins and fluctuating clinical manifestations complicate the early identification and successful management of perforative peritonitis, requiring dependable prognostic instruments to inform treatment choices.

In clinical practice, it is essential to identify patients at elevated risk of adverse outcomes to prioritise surgical procedures and distribute resources effectively, particularly in resource- limited environments. Prognostic scoring systems have been established to assist doctors in evaluating the severity of peritonitis and forecasting patient outcomes. The Mannheim Peritonitis Index (MPI) and the Acute Physiology and Chronic Health Evaluation II (APACHE II) scores are two of the most prevalent and validated assessment instruments. Both scores employ a synthesis of clinical, physiological, and biochemical characteristics to assess the severity of the patient's illness and forecast mortality risk.

The Mannheim Peritonitis Index (MPI) is a straightforward, bedside grading system that incorporates factors such as patient age, organ failure, length of peritonitis, and the nature of the exudate observed during surgery. It is especially beneficial in resource-limited environments where swift clinical evaluations are crucial. The MPI has shown useful in stratifying patients based on their mortality risk, enabling surgeons to make educated judgements on the urgency of intervention. Nonetheless, its simplicity may occasionally constrain its precision relative to more elaborate scoring systems.

Conversely, the APACHE II score is a more intricate and thorough approach that assesses several physiological factors, encompassing vital signs, laboratory findings, and chronic health issues. The APACHE II score is extensively utilised in critical care units to evaluate sickness severity and forecast patient outcomes. Despite its greater complexity in calculation compared to the MPI, it offers a more precise evaluation of a patient's status, particularly in environments where comprehensive laboratory data are accessible. Nonetheless, its intricacy may restrict its use in emergencies that necessitate swift decision-making.

Prior research has emphasised the effectiveness of both MPI and APACHE II ratings in forecasting outcomes for patients with perforative peritonitis. Nonetheless, there is persistent discourse over the reliability of various scoring systems, especially across diverse clinical environments. Some studies indicate that the APACHE II score is preferable owing to its heightened sensitivity and specificity, while others contend that the MPI is more pragmatic and comparably effective, particularly in resource-constrained settings. Considering the considerable burden of perforative peritonitis on healthcare systems, especially in poor nations, it is crucial to determine which scoring method provides the most accurate prognosis in various situations. The present study aims to compare the effectiveness of the MPI and APACHE II scores in predicting the prognosis of patients with perforative peritonitis, focusing on the impact of early versus late presentation. Understanding the correlation between these scores and patient outcomes can help optimize clinical decision-making and improve the management of patients presenting with this condition. By assessing the predictive accuracy of these scoring systems in a tertiary care setting, this study seeks to provide evidence-based recommendations for their use in emergency surgical care

AIMS AND Objectives

Aim: To compare the prognosis in early and late presentation among patients presenting with perforating peritonitis at a tertiary care hospital.

Objectives:

- To assess the prognosis in patients presenting with perforating peritonitis using the Mannheim Peritonitis Index (MPI) and APACHE II scoring systems at a tertiary care hospital.
- To compare the prognostic outcomes between early and late presentation of patients with perforative peritonitis, with a focus on identifying the most effective scoring system for predicting mortality and guiding timely intervention at a tertiary care hospital.

MATERIALS AND METHODS

Study Design: Prospective study

Study Settings: The study was conducted in Department of General Surgery and Biochemistry, Government Erode, Salem And Namakkal Medical College Hospital.

Study Period: The study was conducted from September 2022 to September 2024

Study population: Patients who presented to Department of GENERAL Surgery at Government Erode, Salem and Namakkal Medical College Hospital with perforative peritonitis.

Inclusion Criteria

All patients diagnosed with perforative peritonitis within 72 hours (early) or more than 72 hours (late), Who gave informed written consent.

Exclusion Criteria

- Patients in moribund state and with Malignancy
- Patients with polytrauma.

Sample size calculation: The sample size was calculated based on the study by Mishra et al1 in 2020 where the sensitivity of APACHE II score was 86.2%; with 95% confidence interval, 10% absolute precision and with 10% excess sampling to account

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for non- response, sample size was derived using the formula:

$n = Z2 \times PQ / d2$

Were,

n is the required sample size,

Z is the standard normal deviate corresponding to 95% confidence interval which is 1.96,

P is the prevalence = 86.2%

Q is (100-P) =100 – 86.2 = 13.8%

d is the absolute precision of 10%

Sample size $n = Z2 \times PQ / d2$

$=3.84 \times 86.2 \times 13.8 / 10 \times 10 = 45.6$

Considering 10% non-response rate, sample size, n= 50 participants

Sampling method: Convenient sampling

Study method: Study was done in Department of General Surgery and biochemistry, Government Medical College and Hospital Erode, Salem and Namakkal. Patients were enrolled according to the inclusion and exclusion criteria. After selection, proper counselling was done by explaining the aim, objectives, benefits, risks and procedure of the study to the patients. An informed written consent was obtained from patients after fully explaining the study procedure. A Pretested, semi-structured interviewer administered proforma was then completed with the data collected.

Details of participants were collected. Blood sample was taken and relevant basic investigations were carried out. The patient received resuscitation with fluids, and electrolyte levels were corrected and maintained within the normal range. A urethral catheter was placed for hourly urine output monitoring, and a nasogastric tube was inserted to decompress the stomach. Upon admission, the modified APACHE II score and Mannheim Peritonitis Index parameters were documented. The patient was managed according to standard treatment protocols, and their outcome was subsequently recorded.

Tool for data collection: Pretested, semi-structured interviewer administered proforma was used for data collection.

Study Variables

- Information on socio-demographic details
- Perforation cases
- Outcome
- Manheim's score
- APACHE II score

Ethical consideration: Owing to ethical consideration, permission was obtained from the Institutional Ethical Committee of Government Erode Medical College and Hospital. The participation was voluntary and written informed consent was obtained from all the participants. Confidentiality of participants was maintained. Participants were free to exit the study anytime they wish. No financial expenses were taken from the side of the participants.

Data processing and analysis: Data were entered in Microsoft excel and SPSS version 25 was used for analysis. Descriptive data were analyzed in the form of frequency, percentage, mean and standard deviation. Categorical variables were mentioned as frequency distribution and percentage. Data were represented by tables and bar chart wherever relevant. Chi square test was used to find association between categorical variables. Receiver operating characteristic (ROC) curve was done to find the cut off value of scores in predicting mortality. P value of less than 0.05 was considered as significant.

RESULTS

Age group of the study participants: Eight participants (16%) were from the 15-25 years age group, while six participants (12%) belonged to the 26-35 years age range. Eleven participants (22%) were aged 36-45 years, and the largest group, comprising 18 participants (36%), was in the 46-55 years age category. Five participants (10%) fell within the 56-65 years age range, and the smallest group, with only two participants (4%), was aged 66-75 years.

Table 1: Age group of the study participants

Age group	Frequency	Percentage
15 to 25	8	16
26 to 35	6	12
36 to 45	11	22
46 to 55	18	36
56 to 65	5	10
66 to 75	2	4
Total	50	100

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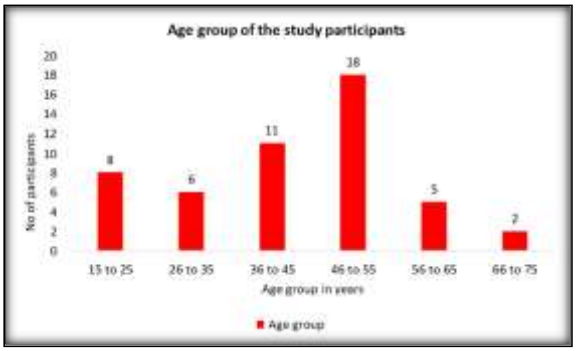

Figure 1

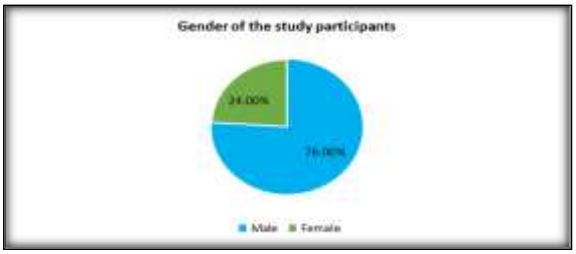

Figure 2

Thirty-eight participants (76%) were male, while twelve participants (24%) were female.

Gender of the study participants:

Table 2: Gender of the study participants

Gender	Frequency	Percentage
Male	38	76
Female	12	24
Total	50	100

Table 3: Association between age and gender among the study participants

	15-25	26-35	36-45	46-55	56-65	66-75	Total	Chi square value	P value
Male	6	5	7	15	4	1	38	2.42	0.79
Female	2	1	4	3	1	1	12		
Total	8	6	11	18	5	2	50		

Association between age and gender among the study participants: Among males, the highest cases were observed in the 46-55 age group with 15 participants, followed by 7 participants in the 36-45 age range. The 15-25, 26-35, and 56-65 age groups had 6, 5, and 4 males, respectively, while the lowest count was in the 66-75 age group with 1 male. In contrast, females were most commonly represented in the 36-45 age group with 4 participants, followed by 3 in the 46-55 age range. The remaining age groups had fewer female participants: 2 in the 15-25 age range, and 1 each in the 26-35, 56-65, and 66-75 groups.

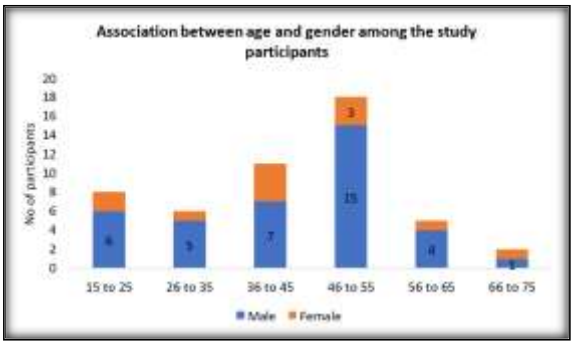

Figure 3: Association between age and gender among the study participants.

Table 4: Perforation Cases among the study participants

Perforation	Male	Female	Total	Percentage
Duodenal	16	2	18	36%
Appendicular	6	4	10	20%
Gastric	7	1	8	16%
Ileal	5	1	6	12%
Colonic	3	2	5	10%
Jejunal	2	0	2	4%
Gall bladder	0	1	1	2%
Total	39	11	50	100%

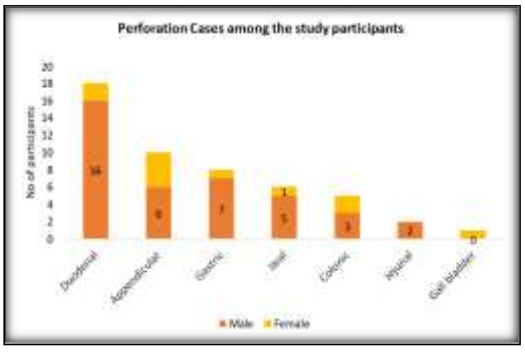

Figure 4: Perforation Cases among the study participants.

Perforation Cases among the study participants: The distribution of perforation cases among the study participants revealed that duodenal perforations were the most common, accounting for 36% (n = 18) of the cases, with 16 males and 2 females affected. Appendicular perforations were the second most prevalent, comprising 20% (n= 10) of the total, with 6 males and 4 females. Gastric perforations were observed in 16% (n = 8) of the participants, predominantly affecting males (n = 7) compared to females (n = 1). Ileal perforations constituted 12% (n = 6) of cases, with 5 males and 1 female. Colonic perforations represented 10% (n = 5) of the cases,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

with a distribution of 3 males and 2 females. Jejunal perforations were seen in 4% (n = 2) of participants, all of whom were male. The least common was gall bladder perforation, occurring in 2% (n = 1) of the cases and affecting only one female participant.

Upper Gastro-intestinal perforations, namely peptic ulcer perforations constituted the most common perforation in our study. They accounted for 52 % of the total cases, with duodenal ulcer constituting 36 % (18 cases) and gastric ulcer forming the rest 16 % (8 cases).

Outcome among the study participants: 41 participants (82%) were alive and 9 participants (18%) died.

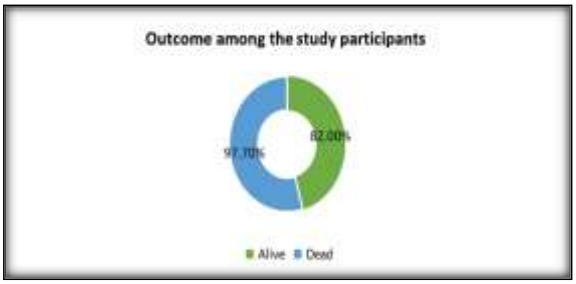

Figure 5: Outcome among the study participants

Table 5: Outcome among the study participants

Outcome	Frequency	Percentage
Alive	41	82
Dead	9	18
Total	50	100

Table 6. Association between perforation and outcome among the study participants

Perforation	Alive	Dead	Total	Chi square value	P value
Gastric	6 (75%)	2 (25%)	8 (100%)		
Duodenal	16 (88.9%)	2 (11.1%)	18 (100%)		
Jejunal	1 (50%)	1 (50%)	2 (100%)	10.18	0.12
Ileal	6 (100%)	0	6 (100%)		
Appendicular	9 (90%)	1 (10%)	10 (100%)		
Colonic	2 (40%)	3 (60%)	5 (100%)		
Gall bladder	1 (100%)	0	1 (100%)		

Association between perforation and outcome among the study participants: For gastric perforations, 6 participants (75%) survived, while 2 participants (25%) did not.

In cases of duodenal perforations, 16 participants (88.9%) survived, while 2 participants (11.1%) succumbed. Jejunal perforations had an equal distribution, with 1 participant (50%) surviving and 1 participant (50%) deceased. All participants with ileal perforations survived (6 participants, 100%), as did the sole participant with a gall bladder perforation (1 participant, 100%). For appendicular perforations, 9 participants (90%) survived, while 1 participant (10%) did not. However, colonic perforations had a lower survival rate, with 2 participants (40%) surviving and 3 participants (60%) resulting in mortality. The Chi-square value was 10.18 with a p-value of 0.12, indicating that there was no statistically significant association between the type of perforation and survival outcome ($p > 0.05$).

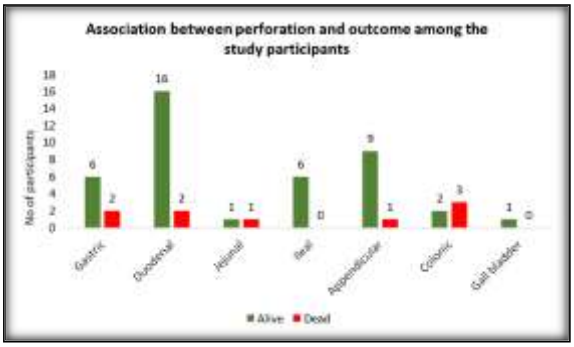

Figure 6: Association between perforation and outcome among the study participants

Table 7: Mortality in perforations according to Manheimms score

Perforation	≤ 15			15 - 25			≥ 26		
	Total	Dead	%	Total	Dead	%	Total	Dead	%
Gastric	4	0	0	1	0	0	3	2	66.7
Duodenal	11	0	0	5	1	20	2	1	50
Jejunal	1	0	0	0	0	0	1	1	100
Ileal	1	0	0	5	0	0	0	0	0
Appendicular	6	0	0	3	1	33.3	1	0	0
Colonic	1	0	0	0	0	0	4	3	75
Gall bladder	0	0	0	1	0		0	0	0
Total	24	0		15	2		11	7	

Mortality in perforations according to Manheimms score: For gastric perforations, no mortality was observed among those with scores ≤ 15 (n = 4) or 15-25 (n = 1), but the mortality rate increased to 66.7% (2 out of 3) in those with scores ≥ 26. In duodenal perforations, no deaths occurred in the ≤ 15 category (n = 11); however, in the 15-25 score group (n = 5), there was a 20% mortality rate (n

ISSN (O): 2687-5365; ISSN (P): 2753-6556

= 1), and in the ≥ 26 category (n = 2), the mortality rate was 50% (n = 1). Jejunal perforations showed a mortality rate of 100% in the ≥ 26 category, with 1 out of 1 participant deceased. Ileal perforations did not result in any deaths, regardless of the score, with participants spread between the ≤ 15 and 15-25 categories. For appendicular perforations, no deaths were recorded in the ≤ 15 (n = 6) or ≥ 26 (n = 1) groups, while the 15-25 group (n = 3) had a 33.3% mortality rate (n = 1). Colonic perforations were associated with a high mortality rate of 75% (3 out of 4) among participants with scores ≥ 26, while those in the ≤ 15 and 15-25 categories showed no deaths. In the case of gall bladder perforations, no mortality was observed, with one participant in the 15-25 category. Overall, participants with lower Mannheim scores (≤ 15) had no deaths (n = 24), while those in the 15-25 score category had a mortality rate of 13.3% (2 out of 15). The highest mortality rate of 63.6% (7 out of 11) was seen in the ≥ 26 score category, highlighting the increased risk of mortality with higher Mannheim scores.

Association between Manheim's score and outcome among the study participants: Among participants with a Mannheim score of ≥ 22, 8 out of 16 (50%) did not survive, while the remaining 8 participants (50%) survived. In contrast, participants with scores < 22 had a much lower mortality rate, with only 1 out of 34 participants (2.9%) deceased, while 33 participants (97.1%) survived. A Chi-square test demonstrated a statistically significant relationship between Mannheim score and survival, with a Chi-square value of 13.29 and a p-value of 0.001 ($p < 0.05$). This indicates that a higher Mannheim score (≥ 22) is significantly associated with an increased risk of mortality.

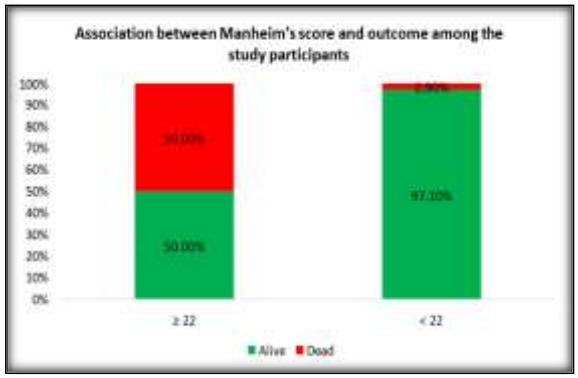

Figure 7: Association between Manheim's score and outcome among the study participants

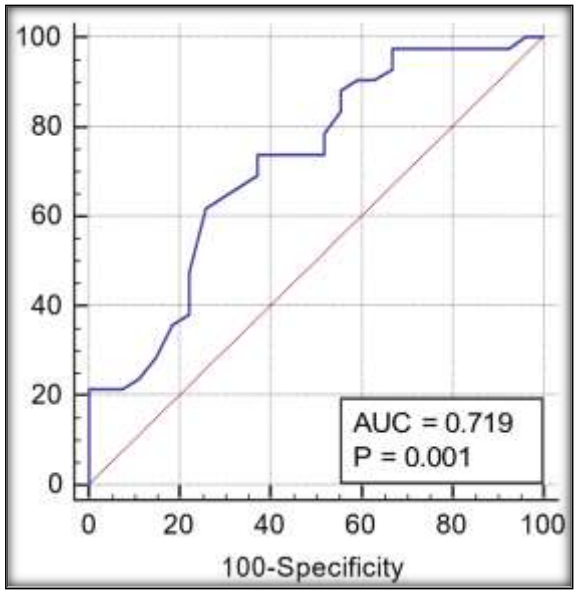

Figure 8: ROC curve for Manheim's score to predict mortality among the study participants.

Table 8: Association between Manheim's score and outcome among the study participants

Manheim's score	Dead	Alive	Total	Chi square value	P value
≥ 22	8 (50%)	8 (50%)	16 (100%)	13.29	0.001*
< 22	1 (2.9%)	33 (97.1%)	34 (100%)		
Total	9 (18%)	41 (82%)	50 (100%)		

*- statistically significant by Chi square test

Table 9: ROC curve for Manheim's score to predict mortality among the study participants

Manheim's score	Area under the curve (AUC)	Younden index	Sensitivity	Specificity	Positive LR	Negative LR
> 22 (21 to 23)	0.719 (0.665-0.852)	0.763	90.0% (55.5-99.7%)	86.4% (80.3-91.2%)	6.61	0.12

The analysis of the receiver operating characteristic (ROC) curve for Mannheim's score in predicting mortality among the study participants demonstrated an area under the curve (AUC) of 0.719 (95% CI: 0.665-0.852). The optimal cut-off range for the Mannheim score was determined to be > 22 (21 to 23) based on the Youden index, which was 0.763. The sensitivity at this threshold was 90.0% (95% CI: 55.5-99.7%), indicating that the score correctly identified 90% of those who did not survive. The specificity was 86.4% (95% CI: 80.3-91.2%), reflecting the ability to correctly identify 86.4% of survivors. The positive likelihood ratio (LR) was 6.61, suggesting a moderate increase in the probability of mortality with higher scores, while the negative likelihood ratio (LR) was 0.12, indicating a relatively low probability of mortality when the score is below the threshold.

Sensitivity and specificity of Manheim's score to predict mortality: The evaluation of the Mannheim's score for predicting mortality among the study participants demonstrated strong diagnostic performance. The sensitivity was found to be 90% (95% CI: 56.50-98.01%), indicating that the score

ISSN (O): 2687-5365; ISSN (P): 2753-6556

correctly identified 90% of the patients who did not survive. The specificity was 86.4% (95% CI: 65.99-89.77%), which shows that the score accurately identified 86.4% of the survivors. The positive predictive value (PPV) was 67.1% (95% CI: 28.00-72.00%), suggesting that 67.1% of those predicted to be at risk of mortality were indeed non-survivors. The negative predictive value (NPV) was notably high at 95.4% (95% CI: 85.08- 99.48%), indicating that 95.4% of patients predicted to survive did, in fact, survive. The overall diagnostic accuracy of the Mannheim's score was 83.1% (95% CI: 69.20-90.23%), demonstrating its reliability as a predictive tool for mortality.

Table 10: Sensitivity and specificity of Manheim's score to predict mortality

Parameter	Estimate	Lower - Upper 95%CIs
Sensitivity	90%	56.50, 98.01
Specificity	86.4%	65.99, 89.77
Positive Predictive Value	67.1%	28.00, 72.00
Negative Predictive Value	95.4%	85.08, 99.48
Diagnostic Accuracy	83.1%	69.20, 90.23

Sensitivity and specificity of Manheim's score to predict mortality:

The evaluation of the Mannheim's score for predicting mortality among the study participants demonstrated strong diagnostic performance. The sensitivity was found to be 90% (95% CI: 56.50-98.01%), indicating that the score correctly identified 90% of the patients who did not survive. The specificity was 86.4% (95% CI: 65.99-89.77%), which shows that the score accurately identified 86.4% of the survivors. The positive predictive value (PPV) was 67.1% (95% CI: 28.00-72.00%), suggesting that 67.1% of those predicted to be at risk of mortality were indeed non-survivors. The negative predictive value (NPV) was notably high at 95.4% (95% CI: 85.08- 99.48%), indicating that 95.4% of patients predicted to survive did, in fact, survive. The overall diagnostic accuracy of the Mannheim's score was 83.1% (95% CI: 69.20-90.23%), demonstrating its reliability as a predictive tool for mortality.

Mortality in perforations according to APACHE II score: The analysis of mortality among participants with perforations according to the APACHE II score demonstrated significant variation across different score categories. For gastric perforations, there were no non-survivors among those with scores ≤ 5 (n = 4) and 6-15 (n = 3). However, for participants with a score ≥ 16 (n = 2), the mortality rate was 100% (n = 2). Similarly, duodenal perforations had no non-survivors in the ≤ 5 (n = 12) and 6-15 (n = 3) categories, but the mortality rate was 100% (n = 2) among those with a score ≥ 16. In jejunal perforations, the single case with a score ≥ 16 resulted in 100% mortality. For ileal perforations, no deaths were recorded across all score categories, with participants distributed between ≤ 5 (n = 1) and 6-15 (n = 4) groups. Appendicular perforations showed no mortality in the ≤ 5 (n = 9) and 6-15 categories, but the single participant with a score ≥ 16 did not survive (100% mortality). Colonic perforations had no non-survivors with scores ≤ 5 (n = 1) and 6-15 (n = 3), but among those with scores ≥ 16 (n = 2), there was a 100% mortality rate (n = 2). Lastly, no deaths were observed in gall bladder perforations, with one participant in the 6-15 category. Overall, participants with lower APACHE II scores (≤ 5) showed no mortality (n = 28), while those in the 6-15 score category had a mortality rate of 7.1% (n = 1 out of 14). In contrast, participants with scores ≥ 16 exhibited a mortality rate of 100% (n = 8 out of 8), highlighting the significant impact of higher APACHE II scores on the likelihood of mortality.

ROC curve for APACHE II score to predict mortality among the study participants:

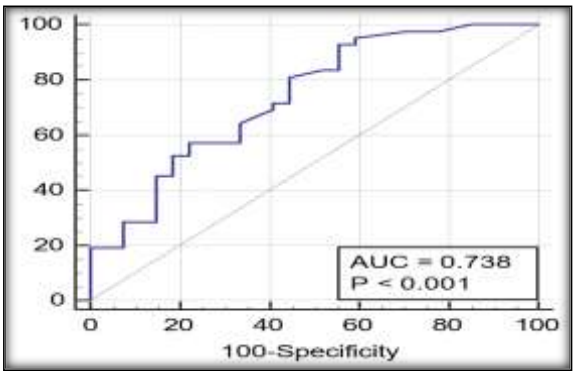

Figure 9: ROC curve for APACHE II score to predict mortality among the study participants

The analysis of the receiver operating characteristic (ROC) curve for the APACHE II score in predicting mortality among the study participants showed an area under the curve (AUC) of 0.738 (95% CI: 0.665-0.952). The optimal cut-off range for the APACHE II score was determined to be > 15 (13 to 17) based on the Youden index, which was 0.791. At this threshold, the sensitivity was 94.2% (95% CI: 55.5-99.7%), meaning that the score correctly identified 94.2% of non- survivors. The specificity was 89.1% (95% CI: 80.3-91.2%), indicating that the score accurately classified 89.1% of survivors. The positive likelihood ratio (LR) was 7.86, suggesting a strong association between a higher APACHE II score and mortality risk, while the negative likelihood ratio (LR) was 0.05, indicating a very low probability of mortality when the score is below the cut- off.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 11: Mortality in perforations according to APACHE II score

Perforation	≤ 5			6 - 15			≥ 16		
	Total	Non survivor	%	Total	Non survivor	%	Total	Non survivor	%
Gastric	4	0	0	3	0	0	2	2	100
Duodenal	12	0	0	3	0	0	2	2	100
Jejunal	1	0	0	0	0	0	1	1	100
Ileal	1	0	0	4	0	0	0	0	0
Appendicular	9	0	0	0	0	0	1	1	100
Colonic	1	0	0	3	1	33.3	2	2	100
Gall bladder	0	0	0	1	0	0	0	0	0
Total	28	0		14	1		8	8	0

Table 12: ROC curve for APACHE II score to predict mortality among the study participants

APACHE II score	Area under the curve (AUC)	Younden index	Sensitivity	Specificity	Positive LR	Negative LR
> 15 (13 to 17)	0.738 (0.665-0.952)	0.791	94.2% (55.5-99.7%)	89.1% (80.3-91.2%)	7.86	0.05

Table 13: Association between APACHE II score and outcome among the study participants

APACHE II score	Dead	Alive	Total	Chi square value	P value
≥ 15	8 (80%)	1 (20%)	9 (100%)	31.74	0.001*
< 15	1 (2.4%)	40 (97.6%)	41 (100%)		
Total	9 (18%)	41 (82%)	50 (100%)		

*- statistically significant by Chi square test

Association between APACHE II score and outcome among the study participants: Of the participants with an APACHE II score of ≥ 15, 8 out of 9 (80%) did not survive, while only 1 participant (20%) survived. In contrast, among those with a score < 15, only 1 participant (2.4%) died, while 40 participants (97.6%) survived. The Chi-square analysis revealed a value of 31.74 with a p-value of 0.001, indicating a statistically significant association ($p < 0.05$) between a higher APACHE II score and increased mortality. This suggests that participants with an APACHE II score of ≥ 15 have a significantly higher risk of mortality compared to those with lower scores.

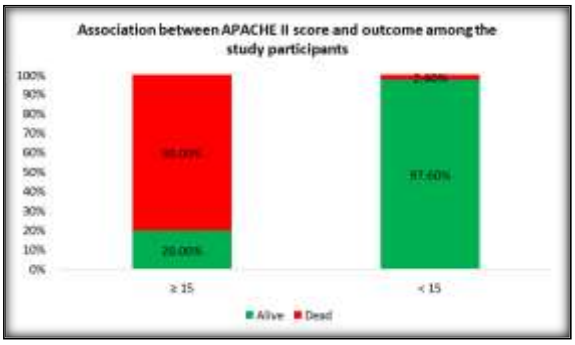

Figure 10: Association between APACHE II score and outcome among the study participants.

Table 14. Sensitivity and specificity of APACHE II score to predict mortality

Parameter	Estimate	Lower - Upper 95%CIs
Sensitivity	94.2%	74.2 – 98.6
Specificity	89.1%	84.7-92.3

Sensitivity and specificity of APACHE II score to predict mortality: The analysis of the APACHE II score's performance in predicting mortality among the study participants showed high sensitivity and specificity. The sensitivity was 94.2% (95% CI: 74.2-98.6%), indicating that the score accurately identified 94.2% of non-survivors. The specificity was 89.1% (95% CI: 84.7-92.3%), reflecting the score's ability to correctly classify 89.1% of survivors. The positive predictive value (PPV) was 76.7% (95% CI: 67.6-81.4%), suggesting that 76.7% of those predicted to be at risk of mortality were actually non-survivors. The negative predictive value (NPV) was notably high at 96.5% (95% CI: 82.4-98.1%), indicating that 96.5% of patients predicted to survive did indeed survive. The overall diagnostic accuracy of the APACHE II score was 91.4% (95% CI: 82.6-94.2%), demonstrating its effectiveness as a predictive tool for mortality.

DISCUSSION

Perforative peritonitis is a severe and life-threatening condition characterized by the perforation of the gastrointestinal tract, leading to peritoneal contamination and acute abdominal sepsis. The timely management of these cases is crucial, as delays in diagnosis and intervention can significantly impact patient outcomes. Various prognostic scoring systems, such as the Mannheim Peritonitis Index (MPI) and Acute Physiology and Chronic Health Evaluation II (APACHE II), have been developed to aid in the stratification of patients based on the severity of their condition. These scoring systems are vital for guiding clinical decision-making, prioritizing interventions, and improving resource allocation in emergency surgical settings. In our study, we aimed to assess and compare the utility of

ISSN (O): 2687-5365; ISSN (P): 2753-6556

MPI and APACHE II scores in predicting outcomes among patients with perforative peritonitis, particularly focusing on the timing of presentation and its impact on prognosis.[1-5]

In our study, the most affected age group was 46-55 years, comprising 36% of the participants. This finding aligns with Mishra et al1 where the maximum number of patients were aged 51-60 years, suggesting that older adults are at higher risk for perforative peritonitis. Similarly, Stephen et al,[5] found the mean age to be 48 years, with a significant number of patients above 40 years, indicating that age is a crucial factor influencing the incidence of perforation. Dalai et al reported a mean age of 40.8 years, with a higher incidence in those above 35 years. In Rani et al the age range of the study population was predominantly between 40-60 years, with a mean age of 45.7 years, suggesting that middle-aged and older adults are more susceptible to complications requiring surgical intervention.[6-10]

In our study, males were predominantly affected, accounting for 76% of the cases, while females made up 24%. This male predominance is consistent with previous research. For instance, Mishra et al,[1] found that 83% of their patients were male, which they attributed to lifestyle factors such as smoking and alcohol consumption. Stephen et al,[5] also reported a higher male-to-female ratio (78% male), reflecting similar risk factors prevalent among men. Dalai et al,[10] observed a male predominance of 72%, while Mahadevi et al found that 79% of their patients were male, further supporting the trend that males are more prone to gastrointestinal perforations, likely due to dietary habits, alcohol use, and higher rates of peptic ulcer disease.[11-20]

Our study showed that duodenal perforations were the most common, accounting for 36% of the cases, followed by appendicular (20%) and gastric (16%) perforations. Kumar et al,[3] also found that duodenal perforations were the most frequent (42%), emphasizing the high prevalence of peptic ulcer disease as a cause of perforation. Dekonda et al reported upper gastrointestinal perforations as the most common type, particularly duodenal ulcers, which made up 52% of their cases. Dalai et al found a similar pattern, with duodenal and gastric perforations together comprising 58% of their study population. Jaiswal et al also reported that duodenal perforations were the most prevalent, constituting 36% of cases, supporting the consistency of upper GI perforations being more common.[21-30]

In our study, the overall mortality rate was 18%, with significant mortality observed in patients with colonic perforations (60%) and those with a Mannheim score ≥26 (63.6%). This is consistent with Rani et al,[2] who reported a mortality rate of 44.19% for patients with an MPI score >30. Kumar et al,[3] demonstrated that patients with an MPI score above 25 had a mortality rate of 22.8%, indicating that higher MPI scores correlate with poorer outcomes. Maran et al,[4] found that an MPI score of ≥22 predicted mortality with a sensitivity of 87.5%. Similarly, Mahadevi et al observed a significant association between higher MPI scores and mortality rates, emphasizing the utility of MPI in predicting outcomes.[31-40]

In our study, the ROC curve analysis identified a Mannheim score cut-off of >22 with an AUC of 0.719, which provided a sensitivity of 90% for predicting mortality. Maran et al,[4] reported a similar cut-off of ≥22 with a sensitivity of 87.5% and specificity of 77.38%. Stephen et al,[5] found an optimal cut-off of ≥27, with a sensitivity of 90%, indicating the score's robustness in predicting mortality. Rani et al,[2] determined a cut-off of >30, achieving 100% sensitivity but with lower specificity, indicating that the ideal cut-off may vary slightly depending on the population studied. Dalai et al,[10] also suggested a cut-off of 27 for MPI to predict mortality, showing a sensitivity of 89%.[41-45]

Our study determined an optimal cut-off for the APACHE II score at >15, with an AUC of 0.738, indicating a strong predictive value for mortality. This cut-off aligns with findings from Agrawal et al who found that an APACHE II score >15 was associated with a significant increase in mortality. Stephen et al,[5] identified an APACHE II cut-off of ≥10, but with lower sensitivity compared to MPI. Mahadevi et al reported a cut-off score of ≥15 with a high sensitivity of 94.2% for predicting mortality. Kumar et al,[3] showed that an APACHE II score >20 was associated with 100% mortality, underscoring the utility of this scoring system in stratifying high-risk patients.[46-52]

In our study, the MPI demonstrated a sensitivity of 90% for predicting mortality with a cut-off score of >22, while the APACHE II score showed a higher sensitivity of 94.2% at a cut-off of >15. These findings are in line with several previous studies: Rani et al,[2] reported a sensitivity of 100% for MPI, although with a lower specificity, making it highly effective for identifying patients at risk of poor outcomes. For APACHE II, they found a sensitivity of 87%, slightly lower than our results, indicating the MPI's superior sensitivity in certain settings. Maran et al,[4] found that the sensitivity of MPI at a cut-off of ≥22 was 87.5%, while APACHE II at a cut-off of ≥15 had a sensitivity of 93.75%. These values are comparable to our study, which found APACHE II to be slightly more sensitive than MPI. Stephen et al,[5] reported a sensitivity of 90% for MPI with a cut- off of ≥27 and 93.75% for APACHE II with a cut-off of ≥15. This similarity in sensitivity suggests that both scores are effective for early identification of high-risk patients. Agrawal et al60 observed a sensitivity of 94% for APACHE II at a cut-off of >15, consistent with our findings, highlighting APACHE II's effectiveness in predicting mortality in critically ill patients.[53-62]

In terms of specificity, our study found that MPI had a specificity of 86.4%, while APACHE II demonstrated a higher specificity of 89.1%. This indicates that APACHE II is slightly better at accurately identifying patients who are likely to

ISSN (O): 2687-5365; ISSN (P): 2753-6556

survive. Rani et al,[2] reported a specificity of 89% for MPI, which closely aligns with our study's findings. For APACHE II, they found a perfect specificity of 100%, which was higher than our observed value, suggesting variability depending on patient demographics. Maran et al,[4] found that the specificity of MPI at a cut-off of ≥22 was 77.38%, while APACHE II at a cut-off of ≥15 had a specificity of 100%. This shows that APACHE II may be more reliable in correctly identifying survivors, particularly in more severe cases. Stephen et al,[5] reported a specificity of 57% for MPI and 78% for APACHE II, which were lower than our findings, indicating that the specificity of these scores can vary based on patient populations and clinical settings. Mahadevi et al found that MPI had a specificity of 83.5% while APACHE II showed a specificity of 89.1%, consistent with our results, reinforcing the utility of APACHE II in accurately classifying patients who are not at risk of mortality.[63-66]

Our study found that the overall diagnostic accuracy of the MPI was 83.1%, while the APACHE II score had a higher diagnostic accuracy of 91.4%. These results highlight the robustness of both scoring systems, with APACHE II being slightly more accurate. Rani et al,[2] reported that the MPI had an accuracy rate of 70%, whereas APACHE II achieved an accuracy of 84.5%. This difference in diagnostic accuracy indicates that while MPI is simpler to use, APACHE II may offer better precision in predicting outcomes. Maran et al,[4] observed an overall accuracy of 79% for MPI and 99% for APACHE II, suggesting that APACHE II is superior in terms of diagnostic accuracy, especially in settings where laboratory data is readily available. Dalai et al,[10] reported a diagnostic accuracy of 80% for MPI, with APACHE II showing a slightly higher accuracy of 85%. These values are comparable to our study, demonstrating the effectiveness of both scores, particularly in stratifying patients for intensive care. Agrawal et al,[60] found that the MPI had an accuracy of 83%, similar to our study, while APACHE II demonstrated an accuracy of 91%, which aligns closely with our findings, underscoring its utility in critical care settings.

Our study revealed significant associations between higher Mannheim Peritonitis Index (MPI) and APACHE II scores with increased mortality among patients with perforative peritonitis. Participants with an MPI score of ≥22 exhibited a markedly higher mortality rate (50%), while those with lower scores (<22) had a significantly better prognosis, with only a 2.9% mortality rate. The Chi-square analysis demonstrated a statistically significant association ($p = 0.001$) between the MPI score and survival, indicating that patients with scores ≥22 had a substantially increased risk of mortality. The analysis of the Receiver Operating Characteristic (ROC) curve for the MPI score showed an area under the curve (AUC) of 0.719, with a sensitivity of 90% and specificity of 86.4%. This suggests that a cut-off score of >22 is an effective predictor of mortality, making MPI a valuable tool in assessing the severity of peritonitis in resource-limited settings where rapid clinical assessments are essential.

Similarly, the APACHE II score demonstrated a strong correlation with mortality outcomes. Patients with a score of ≥15 showed a significantly higher mortality rate (80%) compared to those with scores <15, where only 2.4% of patients did not survive. The Chi-square analysis confirmed a statistically significant relationship ($p = 0.001$) between higher APACHE II scores and increased mortality risk. The ROC analysis for APACHE II revealed an AUC of 0.738, with a sensitivity of 94.2% and a specificity of 89.1% at the optimal cut-off of >15. These findings indicate that the APACHE II score is a highly sensitive and specific predictor of mortality in patients with perforative peritonitis. The higher diagnostic accuracy of APACHE II compared to MPI suggests its greater utility in settings where detailed physiological assessments and laboratory measurements are feasible, allowing for more precise prognostication and tailored clinical management.

CONCLUSION

This study evaluated the prognostic value of the Mannheim Peritonitis Index (MPI) and APACHE II scoring systems in predicting outcomes for patients with perforative peritonitis at a tertiary care hospitals. The findings highlight that both scoring systems are effective tools for assessing the severity of the condition and guiding clinical decision-making. The analysis demonstrated that patients presenting with higher scores on either system had significantly worse outcomes, emphasizing the importance of timely intervention to improve prognosis. Overall, the study provides insights into the utility of these scoring systems in predicting mortality and aiding in the management of patients with abdominal sepsis.

Significant associations were observed between higher MPI and APACHE II scores and increased mortality rates. Specifically, patients with an MPI score of ≥22 had a 50% mortality rate, whereas those with lower scores (<22) had a much lower mortality rate of 2.9%. For the APACHE II system, patients with a score of ≥15 had an 80% mortality rate compared to only 2.4% in those with scores below this threshold. The ROC curve analysis showed that the MPI cut-off of >22 had a sensitivity of 90% and a specificity of 86.4%, while the APACHE II cut-off of >15 had a sensitivity of 94.2% and specificity of 89.1%. These findings indicate that both scoring systems are reliable for predicting mortality, with APACHE II showing slightly higher sensitivity and overall diagnostic accuracy.

Based on the results of this study, it is recommended that both MPI and APACHE II scores be routinely utilized in clinical practice to assess the prognosis of patients presenting with perforative peritonitis. Early stratification of patients using these scores can help prioritize surgical interventions and optimize

ISSN (O): 2687-5365; ISSN (P): 2753-6556

resource allocation, particularly in settings with limited resources. Further research with larger, multi-center studies is recommended to validate these findings and explore the integration of these scoring systems into standardized treatment protocols for abdominal emergencies.

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