

Original Research Article

Comparison of predictive values of Mannheim peritonitis index, acute physiology and chronic health evaluation-II and Portsmouth-POSSUM scoring systems for prognosis of mortality in patients with perforation peritonitis

Lokesh Kumar¹, Sunita Singh^{1*}, Dharendra Pratap¹, Krishna K. Singh², Shubham Nayak², Shailendra Kumar², Utkarsh Tripathi¹

¹Department of General Surgery, K. K. Hospital, Lucknow, Uttar Pradesh, India

²Department of Surgery, KGMU, Lucknow, Uttar Pradesh, India

Received: 22 March 2022

Accepted: 21 April 2022

*Correspondence:

Dr. Sunita Singh,

E-mail: drkksinghkgmu@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Perforation peritonitis has emerged as one of the very common cause of surgical emergencies, particularly in developing countries like India. If left untreated for long due to improper prognosis or late diagnosis, perforation peritonitis may prove potentially fatal with a high mortality and morbidity rate. Scoring systems like APACHE-II (acute physiology and chronic health evaluation), p-POSSUM (Portsmouth-POSSUM) and MPI (Mannheim peritonitis index) may serve as simple, critical, and efficient prognostic tools in predicting the mortality in patients with perforation peritonitis. Thus, the aim of the current investigation was to examine the usefulness and accuracy of these scoring systems for predicting the mortality rate in perforation peritonitis.

Methods: Current study was a prospective observational comparative study conducted at department of general surgery, KK Hospital, Lucknow. Detailed clinical and lab investigations of the participating patients were done and their demographic details were documented. Using history, clinical examination and lab values p-POSSUM, APACHE-II and MPI scores were calculated. Scores of each scoring system were statistically analyzed in prognosticating the mortality rate.

Results: Mean age of the participating patients was 41.24±19.32 years. Abdominal pain and vomiting were observed as the most common symptoms in majority of patients. No mortality was observed in patients with ≤20 MPI score, ≤20 APACHE-II scores and ≤55 p-POSSUM score. Whereas mortality rate was observed to be 21.53% in patients with >20 MPI score, 82% in >20 APACHE-II scores and 78% in >55 p-POSSUM score.

Conclusions: APACHE II and p-POSSUM scores had a higher sensitivity and specificity in comparison to MPI for predicting the mortality in perforation peritonitis.

Keywords: Perforation peritonitis, Scoring tools, MPI, APACHE-II, p-POSSUM, Mortality

INTRODUCTION

Infection from bacteria or fungi may result into inflammation of peritoneum tissue which is a membrane that covers the inner wall of abdomen.^{1,2} Inflammation of abdominal peritoneum lining is called as peritonitis.³ Abdominal peritonitis occurs either as a consequence to

other diseases, trauma, infection, malignancy, or due to therapeutic and diagnostic procedures in abdominal region.⁴ It is one of the most common causes of surgical emergencies in developing countries, particularly in India.¹⁻⁴ Nausea, dull or persistent abdominal ache, poor appetite, abdominal distension and rigidity, restlessness, dehydration, oliguria, fever are considered to be the

common symptoms of peritonitis and if left untreated for long it can spread into blood and varied other organs, leading to potentially fatal complications like multiple organ failure and death.⁵ Prompt diagnosis and prognosis is essential for management of perforation peritonitis to reduce the mortality and morbidity rates. Thus, the need of the hour is early recognition and effective management therapies in perforation peritonitis.

Scoring systems like APACHE-II, Portsmouth physiological and operative severity score for the enumeration of mortality and morbidity (p-POSSUM) and MPI may serve as simple, critical, and efficient prognostic tools in predicting the mortality in patients with perforation peritonitis.^{6,7} However, it is essential to screen a reliable and reproducible scoring system to predict the mortality rate in perforation peritonitis. Thus, the current investigation was focused on comparing the accuracy of APACHE-II, p-POSSUM and MPI scoring systems for predicting the mortality in patients with perforation peritonitis.

APACHE-II is a commonly used prognostic tool in ICU. It not only accurately measures but also correlates the patient severity with outcomes.⁸ It is a relatively simple scoring system with no extensive calculations required and serves as an effective and efficacious tool for mortality predictions.⁹ APACHE-II scoring system is a chronic health evaluation based system which is based principally on predicting mortality rates through multiple organ failure considerations.¹⁰ An APACHE-II scoring system is composed of three parts on the basis of which the patient is placed in chronic health categories A to D.¹¹ First part i.e., the acute physiology score is composed of 12 varied laboratory values and physical findings (APS - 12, 0-60 points), the second part is based on points for patient's age above 44 years (0-6 points) and the third part is based on points for chronic health and whether the patient is post-operative or not (0, 2, or 5 points).¹²

MPI scoring system was developed in 1983 by Wacha and Linder.¹³ 1253 patients were critically examined to obtain the retrospective data of 20 possible risk factors that can be potentially used as MPI parameters. Out of 20 only 8 factors were proven to be of prognostic relevance and were included to structure the MPI based scoring system to predict the morbidity and mortality rate in patients.¹⁴ Cloudy and fecal exudates were given 6 and 12 points respectively. Organ failures were given 7 points and diffuse peritonitis was given 6 points. Age >50 years and female gender factors were given 5 points each, whereas; malignancy, duration of peritonitis >24 h and non colonic origin of peritonitis were given 4 points each. MPI is considered widely for prediction of morbidity and mortality because of its accurateness as well as simplicity.¹³⁻¹⁵

p-POSSUM scoring system was developed in 1991 by Copeland et al utilizing multivariate discriminant analysis of 18 operative variables and 48

physiological.¹⁶ p-POSSUM scoring system lead to over prediction of mortality in low risk patients which was overcome by utilizing Portsmouth predictor equation.¹⁷ Two broad parameters mainly physiological severity (age, cardiac signs, respiratory signs, systolic blood pressure, pulse, Glasgow coma scale, hemoglobin, total count, urea, sodium, potassium and ECG) and operative severity (multiple procedures, total blood loss, peritoneal soiling, malignancy, operative severity and mode of surgery) were considered for calculating POSSUM scores.¹⁸⁻²⁰ Mortality was calculated coming the POSSUM score with p-POSSUM predictor equation as stated below:

$$\text{Predicted death rate} = 1 / (1 + e^{-R})$$

Where R is $(0.1692 \times \text{physiological score}) + (0.1550 \times \text{operative score}) - 9.065$ in POSSUM and R is $(0.13 \times \text{physiological score}) + (0.16 \times \text{operative score}) - 7.04$ in p-POSSUM.¹⁶⁻¹⁹

Aim and objectives

Aim of the current investigation was to examine the usefulness of the prognostic values of POSSUM scoring systems, APACHE-II scoring system and Mannheim peritonitis index in patients with perforation peritonitis. Primary objective of current study was to compare the accuracy of these scoring systems in predicting the mortality in patients with perforation peritonitis.

METHODS

Study design, location, duration and population

Current study was a prospective observational comparative study conducted at the department of general surgery, KK Hospital, Lucknow from December 2019 to May 2021. Study population included the patients of the hospital selected on the basis of inclusion and exclusion criteria.

Inclusion criteria

Inclusion criteria for current study were; both male and female patients with clinically proven features of perforation peritonitis (secondary peritonitis), patients more than 18 years and less than 75 years of age, patients willing to give informed written consent and patients with negative RTPCR.

Exclusion criteria

Exclusion criteria for current study were; patients less than 18 years and more than 75 years of age, patients with primary and tertiary peritonitis, patients with traumatic perforation, peritonitis due to ruptured liver abscess or appendicular abscess.

Sample size

In the current investigation sample size was calculated using the formula;

$$Z^2 \times \frac{p(1-p)}{e^2} / 1 + (Z^2 \times p(1-p)/e^2 N)$$

Where N=population size, e=margin of error (percentage in decimal form) z=z-score, p=population proportion. Taking z-score = 1.65 at 90% confidence interval, N=1000, e = 10% and p=50%; the sample size was calculated to be 64. Thus 65 patients were selected in the current study for investigation.

Procedure

All biochemical investigations were done upon admission and relevant clinical details were noted. Standard operative procedures were followed for different causes of perforation peritonitis. Diagnosis of peritonitis due to hollow viscous perforation was made by history and clinical examination, X-ray, chest PA view with both domes of diaphragm showing air under diaphragm, detailed history of presenting illness and history suggestive of chronic health disorders such as cardiac, renal, hepatic conditions were examined and noted. Using history, clinical examination and lab values POSSUM scoring systems, APACHE II score and Mannheim peritonitis index were calculated. For each physiological variable, the most abnormal measurement was included, if the test had been done more than once prior to surgery. The outcome of each test for individual patient was noted and compared to the initial score. Thus, the value of each scoring system was tested in prognosticating the outcome of patients. Mortality was defined as any death occurring during the hospital stay.

Data collection and statistical analysis

In current study required data were collected from the complaints, history of presenting illness and past history of the patients, radiological investigations, biochemical lab values, intra-operative findings. The data obtained from the study was coded, recorded and analyzed using IBM SPSS (statistical package for social sciences) 21.0 software package. The two scores were compared statistically using Z-test and p<0.05 was considered significant. For data evaluation, continuous variables were expressed in mean (standard deviation) while the frequency of data was expressed in numbers (%). Kruskal-Wallis, Mann Whitney U, N-Par and Chi-square tests were used for statistical analysis.

RESULTS

Demographic details

The outcomes of current investigation revealed that 35

(53.84%) patients out of total 65 were males and the rest 30 (46.15%) of the study population were females (Table 1). Age based distribution analysis of the current study population revealed that 7 (10.76%) patients were found to be in the age group below 20 years, 9 (13.84 %) were in the age group of 21 to 30 years, 15 (23.07%) patients were found to be in the age group of 31 to 40 years, 11 (16.92%) were in age group of 41 to 50 years, 19 (29.23%) patients were in 51 to 60 years age group and 4 (6.15 %) patients were observed in the age group of 61 to 70 years (Table 1). Mean age of current study participants was observed to be 41.24±19.32 years, mean height was observed to be 164.17±6.75 cm, mean weight to be 64.55±5.56 kgs and mean BMI was found to be 24.00±2.75 kg/m² (Table 1).

Table 1: Distribution of patients based on demographic details.

Parameters	N (%)
Gender	
Male	35 (53.84)
Female	30 (46.15)
Total	65 (100)
Age group (years)	
18 to 20	7 (10.76)
21 to 30	9 (13.84)
31 to 40	15 (23.07)
41 to 50	11 (16.92)
51 to 60	19 (29.23)
61 to 70	4 (6.15)
Total	65 (100)
Mean age (years)	41.24±19.32
Mean height (cm)	164.17±6.75
Mean weight (kg)	64.55±5.56
Mean BMI (kg/m ²)	24.00±2.75

Symptoms

In current investigation common symptoms observed in patients with perforation peritonitis were; pain in abdomen (100%), distension of abdomen (41%), vomiting (61%), constipation/ loose stools (31.8%), fever (26.1%), oliguria (16.7%) and cold extremities (3.8%) (Table 2).

Table 2: Symptoms observed in patients with perforation peritonitis.

Symptoms	Percentage (%)
Abdomen pain	100
Vomiting	61
Distension of abdomen	41
Constipation or loose stools	31.8
Fever	26.1
Oliguria	16.7
Cold extremities	3.8

Comparison of survivor and non-survivor peritonitis patients based on POSSUM score, APACHE II and MPI score

Mean MPI score in survivor participants was observed to be 21.62 and in non-survivors it was observed to be 35.23. Mean APACHE II score in survivor was observed to be 15.50 and in non-survivors it was observed to be 23.651. Mean p-POSSUM score in survivors was observed to be 26.2 and that in non-survivors it was observed to be 52.3 (Figure 1).

Current investigation results revealed that in 27 patients with ≤ 20 MPI score, no mortality was observed. In 23 (35.4%) patients with MPI score between 21 to 29, mortality rate was found to be 21%, whereas in 12 (18.4%) patients with MPI score ≥ 30 , mortality rate was observed to be 75% (Table 3). In assessing the APACHE II based scoring system it was observed that no mortality was observed in patients with APACHE II score ≤ 20 , whereas the mortality rate was observed to be 82% in patients with APACHE II score >20 (Table 4). Observations based on p-POSSUM scoring system revealed that mortality rate was not observed in patients with p-POSSUM score ≤ 55 , whereas the mortality rate was observed to be 78% in patients with p-POSSUM score above 55 (Table 5).

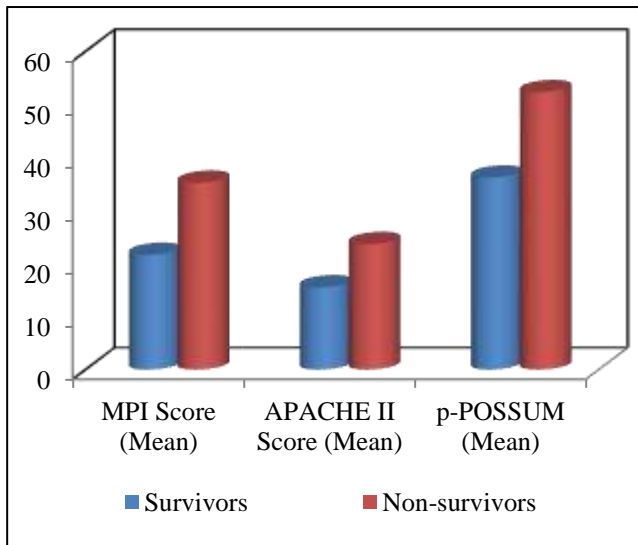


Figure 1: Comparison of survivor and non-survivor peritonitis patients based on POSSUM score, APACHE II and MPI score.

Table 3: Mortality rate of patients based on MPI scoring system.

Score	Patients, n (%)	Death, n (%)	Mortality rate, (%)
≤ 20	27 (41.5)	0	0
Between 21 to 29	23 (35.4)	5 (7.69)	21
≥ 30	12 (18.4)	9 (13.84)	75

Table 4: Mortality rate of patients based on APACHE II scoring system.

Score	Patients, n (%)	Death, n (%)	Mortality rate, (%)
≤ 10	20 (30.7)	0	0
Between 11 to 20	27 (30.7)	0	0
>20	17 (26.15)	14 (21.6)	82

Table 5: Mortality rate of patients based on p-POSSUM scoring system.

Score	Patients, n (%)	Death, n (%)	Mortality rate, (%)
≤ 35	16 (24.61)	0	0
Between 36 to 55	31 (47.7)	0	0
>55	18 (27.7)	14 (21.5)	78

ROC analysis of scoring systems

Comparative ROC analysis of the scoring systems investigated in current study was done by determining the proportion of predictions that come under a particular outcome, which in current investigation was either mortality or low probability of death. The area under the curve (AUC) for each of the scores was calculated for different cutoff points and the cut off at which maximum AUC was obtained was chosen. Results of the ROC analysis revealed that APACHE II and p-POSSUM score had a higher sensitivity as well as specificity as compared to MPI in predicting the mortality rate of perforation peritonitis patients (Table 6, Figure 2-4).

Table 6: Sensitivity and specificity-based analysis of scoring systems with cut-off values.

Parameters	Sensitivity (%)	Specificity (%)
MPI (cut off 26)	72.3	68.4
APACHE II (cut off 24)	89.2	73.2
p-POSSUM (cut off 56)	85.2	69.65

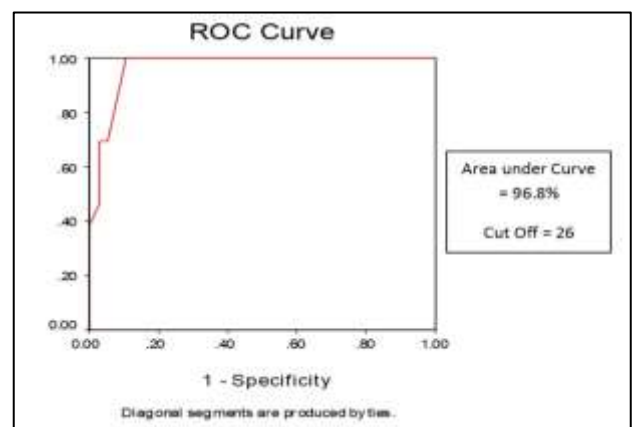


Figure 2: ROC analysis of MPI scoring system.

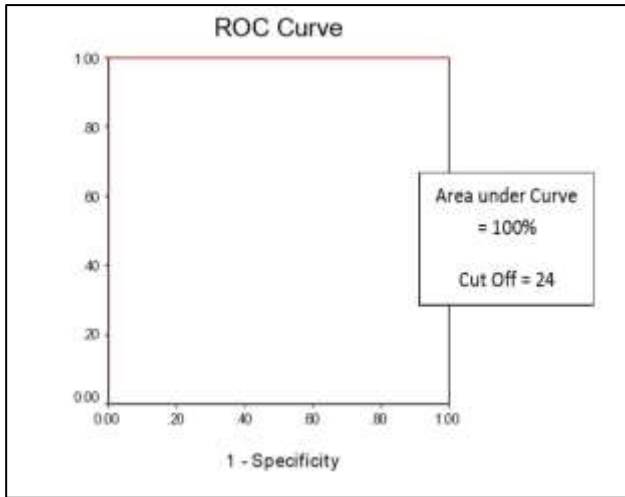


Figure 3: ROC analysis of APACHE II scoring system.

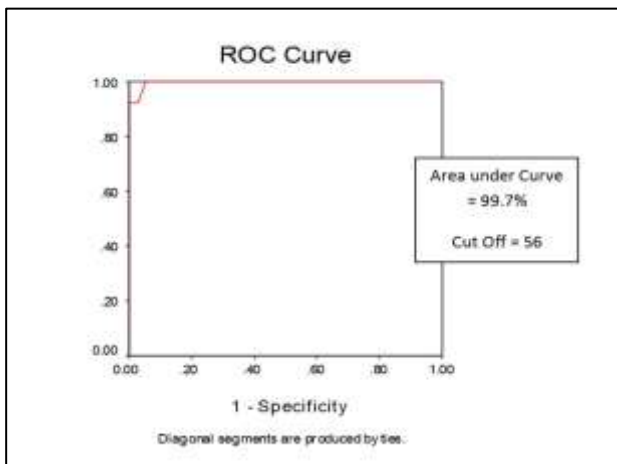


Figure 4: ROC analysis of p-POSSUM scoring system.

DISCUSSION

Results of patient distribution analysis based on demographic details in current study revealed that number of males participants slightly exceeded the number of female participants. Maximum study participants were in the age group range from 31 to 60 years. Mean age of current study participants was observed to be 41.24 ± 19.32 years, mean height was 164.17 ± 6.75 cm mean weight was 64.55 ± 5.56 kg and mean BMI was 24.00 ± 2.75 kg/m². Results of demographic observations in current study were in accordance to earlier reports published by Jhobta et al and Budamala et al.^{21,22} It was observed in current study that difference in the mortality rate was observed to be significant (χ^2 test value 4.42; $p \leq 0.05$) when participants were regrouped into ≤ 50 , >50 age groups, the results were in close agreement with the previously published report by Wacha et al who also reported significant difference in the mortality rate when patients are regrouped into <40 and >40 age groups.²³ Type of symptoms observed in current study participants was in

accordance to the earlier published reports of Halim et al and Wacha et al.^{23,24}

Current study results revealed that the MPI score in survivor participants was 21.62 and in non-survivors it was 35.23, whereas mean APACHE II score in survivor was 15.50 and non-survivors was 23.651 and mean p-POSSUM score in survivor was 26.2 and non-survivor was 52.3. Thus, it could be observed through current study findings that rate of mortality is directly related to higher score. Similar observations were published by Bohnen et al and Adesunkanmi et al in their reports.^{25,26} Results of the current study revealed that the mortality rate in patients with perforation peritonitis ranges between 7.69% to 13.84% based on the MPI scoring system. Bohnen et al reported that the hospital mortality rate in patients with perforation peritonitis ranges between 19% to 60% based on MPI scores but indicated that outcome of such patients is depends upon several other factors related to patients age and sex, disease, co morbidities, time of presentation, therapeutic intervention undertaken and the post-operative complications.²⁵ In the study reported by Kumar et al actual MPI score predicts higher mortality rate (26%) in both survivors as well as in non survivors as compared to APACHE II score (15%).²⁷ Rogy et al described in their study that MPI scores has the lowest positive predictive value and discriminatory ability compared to other scoring systems.²⁸ While, Demmel et al reported MPI scores on par with APACHE-II in predicting mortality.²⁹ Correia et al retrospectively analyzed data of 89 cases with secondary peritonitis and found the mean MPI score to be 26.6 with a sensitivity of 87.3%, and a specificity of 41.2%.³⁰

Results of current investigations revealed that based on APACHE II scoring system the mortality rate was observed to be 82% in patients with APACHE II score more than 20. In the study reports of Kumar et al; according to APACHE II system, 8.6% patients with APACHE II score less than 10 expired. Mortality rate among score 11 -20 group was 36%. With APACHE II score above 20, none of the patients were survived. In the study done by Malik 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 10.³¹ Published report of Malik et al have reported that APACHE II score have better prognostic power for outcome prediction then the MPI score because it includes physiological variables, while many other authors like Fuger et al have over weighted the MPI score then other scores because of its easy applicability.^{31,32}

Results of current investigations revealed that based on APACHE II scoring system the mortality rate was observed to be 78% in patients with p-POSSUM score above 55. The observations made in current study were similar to reports published by authors Ghooi et al.³³ Results of present investigation depicted that in predicting the mortality rate by MPI, APACHE II and p-

POSSUM scoring systems, APACHE II and p-POSSUM score had a higher sensitivity as well as specificity as compared to MPI. Similar results were also reported by Hobson et al.³⁴ In current study ROC (receiver operating characteristic) curve analysis was done for prediction of morbidity using POSSUM, MPI and APACHE II scoring system. Observed area under the curve of MPI was observed to be 96.8% (cut off 26), for APACHE II scores, area under the curve was 100% (cut off 24) and for p-POSSUM, observed area under the curve was 99.7% (cut off 56) thus p-POSSUM was not useful in predicting mortality. Similar results were observed by Kitara et al who reported p-POSSUM scores failed to predict any kind of observed complications.³⁵ Ohmann et al performed a multicentric study and compared APACHE II, MPI and peritonitis index Altona scores in 271 cases of laparotomies for perforation peritonitis.³⁶ The sensitivity and specificity of MPI score were reported to be 60% and 80%, respectively. According to reported literature APACHE-II had the maximum area under the curve followed by p-POSSUM and MPI. Thus, it was concluded through current study findings and published reports that APACHE-II is a perfect test that has the capability to predict with maximum accuracy the subset of patients that are going to die from perforative peritonitis. Published report by Pacelli et al confirmed age as a decisive factor related with mortality however current study does not show any statistical significance.³⁷

Limitations

A relatively small sample size of the investigated study participants can be considered as the limitations of the current study. More concrete results and recommendations could have been made with a larger sample size.

CONCLUSION

Management strategies for perforation peritonitis are constant evolving along with emergence of completely newer strategies. Continuous audit of scoring systems is essential periodically to check the efficacy of the management strategies as well as to predict the mortality risk. It was concluded through current study findings that APACHE II and p-POSSUM scoring systems had higher sensitivity as well as specificity when compared to MPI scoring system in predicting the mortality rate in patients with perforation peritonitis.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Chakma SM, Singh RL, Parmekar MV. Spectrum of perforation peritonitis. *J Clin Diagn Res.* 2013;7(11):2518-20.
2. Bosscha K, Van Vroonhoven TJ, Vander WC. Surgical management of severe secondary peritonitis. *Br J Surg.* 1999;86:1371-7.
3. Jhobta RS, Attri AK, Kaushik R, Sharma R, Jhobta A. Spectrum of perforation peritonitis in India - review of 504 consecutive cases. *World J Emerg Surg.* 2006;1:26.
4. Singh G, Sharma RK, Gupta R. Gastrointestinal perforations-a prospective study of 342 cases. *Gastroentrol Today.* 2006;10(4):167-70.
5. Patil PV, Kamat MM, Hindalekar MM. Spectrum of perforative peritonitis-a prospective study of 150 cases. *Bombay Hospital J.* 2012;54(1):38-50.
6. Nachiappan M, Litake MM. Scoring Systems for Outcome Prediction of Patients with Perforation Peritonitis. *J Clin Diagn Res.* 2016;10(3):PC1-5.
7. Moller MH, Adamsen S, Thomsen RW, Moller AM. Preoperative prognostic factors for mortality in peptic ulcer perforation – a systematic review. *Scand J Gastroenterol.* 2010;45:785-805.
8. Kulkarni SV, Naik AS, Subramanian N. APACHE-II scoring system in perforative peritonitis. *Am J Surg.* 2007;194(4):549-52.
9. Delibegovic S, Markovic D, Hodzic S. APACHE II scoring system is superior in the prediction of the outcome in critically ill patients with perforative peritonitis. *Med Arh.* 2011;65(2):82-5.
10. Iyapudi SK, Nanjan S, Ramasamy S, Kannan A, Kantamaneni K, Nangireddi S et al. Role of Acute Physiology, Age, and Chronic Health Evaluation (APACHE) II Score in Predicting Outcomes of Peritonitis Due to Hollow Viscous Perforation: A Prospective Observational Study. *Cureus.* 2021;13(12):e20155.
11. Mani C, Borah C, Krishna SV, Anuj M, Bhatnagar D. The role of APACHE-II triaging in optimum management of small bowel perforations. *Trop Doct.* 2001;31(4):198-201.
12. Munghate A, Kumar A, Mittal S, Singh H, Sharma J, Yadav M. Acute Physiological and Chronic Health Evaluation II Score and its Correlation with Three Surgical Strategies for Management of Ileal Perforations. *J Surg Tech Case Rep.* 2015;7(2):32-6.
13. Sharma R, Ranjan V, Jain S, Joshi T, Tyagi A, Chaphekar R. A prospective study evaluating utility of Mannheim peritonitis index in predicting prognosis of perforation peritonitis. *J Nat Sci Biol Med.* 2015;6(1):S49-52.
14. Horiuchi A, Watanabe Y, Doi T. Evaluation of prognostic factors and scoring system in colonic perforation. *World J Gastroenterol.* 2007;13(23):3228-31.
15. Salamone G, Licari L, Falco N. Mannheim Peritonitis Index (MPI) and elderly population: prognostic evaluation in acute secondary peritonitis. *G Chir.* 2016;37(6):243-9.
16. Chatterjee AS, Renganathan DN. POSSUM: A Scoring System for Perforative Peritonitis. *J Clin Diagn Res.* 2015;9(4):PC05-9.
17. Kumar S, Gupta A, Chaudhary S, Agrawal N.

- Validation of the use of POSSUM score in enteric perforation peritonitis - results of a prospective study. *Pan Afr Med J.* 2011;9:22.
18. Nag DS, Dembla A, Mahanty PR. Comparative analysis of APACHE-II and P-POSSUM scoring systems in predicting postoperative mortality in patients undergoing emergency laparotomy. *World J Clin Cases.* 2019;7(16):2227-37.
 19. Hu ZW, Xin RQ, Xia YJ, Jia GP, Chen XX, Wang S. Application of POSSUM and P-POSSUM in Surgical Risk Assessment of Elderly Patients Undergoing Hepatobiliary and Pancreatic Surgery. *Clin Interv Aging.* 2020;15:1121-8.
 20. Nag DS. Assessing the risk: Scoring systems for outcome prediction in emergency laparotomies. *Biomedicine.* 2015;5(4):20.
 21. Jhobta RS, Attri AK, Kaushik R, Sharma R, Jhobta A. Spectrum of perforation peritonitis in India--review of 504 consecutive cases. *World J Emerg Surg.* 2006;1:26.
 22. Budamala S, Penugonda A, Prakash GV. Evaluation of various prognostic factors in perforative peritonitis management. *J Evid Based Med Healthcare.* 2015;2(38):6027-35.
 23. Wacha H, Linder MM. Mannheim peritonitis index-prediction of risk of death from peritonitis; construction of a static and validation of an empirically based index. *Theoret Surg.* 1987;1:169-77.
 24. Halim DA, Murni TW, Redjeki IS. Comparison of Apache II, SOFA, and Modified SOFA Scores in Predicting Mortality of Surgical Patients in Intensive Care Unit at Dr. Hasan Sadikin General Hospital. *Crit Care Shock.* 2009;12:157-69.
 25. Bohan J, Boulanger M, Meakins JL, Mc lean APH. Prognosis in generalized peritonitis: relations to cause and risk factors. *Arch Surg.* 1983;118:285-90.
 26. Adesunkanmi ARK, Ajao OG. The prognostic factors in Typhoid ileal perforation. A prospective study of 50 patients. *J Roy Coll Surg Edinb.* 1997;42:395-9.
 27. Kumar P, Singh K, Kumar A. A comparative study between Mannheim peritonitis index and APACHE II in predicting the outcome in patients of peritonitis due to hollow viscous perforation. *Int Surg J.* 2017;4:690-6.
 28. Rogy M, Függer R, Schemper M, Koss G, Schulz F. The value of 2 distinct prognosis scores in patients with peritonitis. The Mannheim Peritonitis Index versus the Apache II score. *Chirurg.* 1990;61(4):297-300.
 29. Demmel N, Muth G, Maag K, Osterholzer G. Prognostic scores in peritonitis; Mannheim Peritonitis Index or APACHE II? *Langenbecks Arch Chir.* 1994;379(6):347-52.
 30. Correia MM, Thuler LC, Velasco E, Vidal EM, Schanaider A. Prediction of death using the Mannheim peritonitis index in oncologic patients. *Rev Bras Cancerologia.* 2001;47:63-8.
 31. Malik A. Turkish J of Trauma and Emergency surgery. *Ulus Travma Acil Cerrahi Derg.* 2010;16(1):27-32.
 32. Fugger R, Rogy M. Validation study of the Mannheim peritonitis index. *Chirurg.* 1988;59:598-601.
 33. Ghooi AM, Panjwani S. Acute abdominal emergencies: Clinical overview. *Ind J Surg* 1978;140:182-9.
 34. Hobson SA, Sutton CD, Garcea G, Thomas WM. Prospective comparison of POSSUM and PPOSSUM with clinical assessment of mortality following emergency surgery. *Acta Anaesthesiol Scand.* 2007;51(1):94-100.
 35. Kitara DL, Kakande I, Mugisa BD. POSSUM scoring system in patients undergoing laparotomy in Mulago Hospital. *East and Central African J Surg.* 2006;12(2):133-42.
 36. Ohmann C, Wittmann DH, Wacha H. Prospective evaluation of prognostic scoring systems in peritonitis. Peritonitis Study Group. *Eur J Surg.* 1993;159:267-74.
 37. Pacelli F, Doglietto GB, Alfieri S, Piccioni E, Sgadari A, Gui D, Crucitti F. Prognosis in intra-abdominal infections. Multivariate analysis on 604 patients. *Arch Surg.* 1996;131(6):641-5.

Cite this article as: Kumar L, Singh S, Pratap D, Singh KK, Nayak S, Kumar S et al. Comparison of predictive values of Mannheim peritonitis index, acute physiology and chronic health evaluation-II and Portsmouth-POSSUM scoring systems for prognosis of mortality in patients with perforation peritonitis. *Int J Res Med Sci* 2022;10:1059-65.