*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*
*e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 10 Ver. IX (Oct. 2017), PP 65-69*
*www.iosrjournals.org*

# A Prospective Analytical Study Comparing The Effectiveness of Mannheim Peritonitis Index, APACHE-II And P- Possum in Predicting the Mortality of Patients with Perforative Peritonitis

Ganesan R[1],*Sundararajan G[2]
[1](Department of General surgery,Velammal Medical College/ India)
[2](Department of General surgery ,Madurai Medical College/ India)
Corresponding Author:*Sundararajan G

***Abstract:*** *This is a prospective analytical study done on 50 patients with perforative peritonitis in Govt Rajaji Hospital, Madurai. The objective of the study was to analyse Mannheim Peritonitis Index, APACHE-II and p-POSSUM by comparing Discriminatory ability, Positive predictive value, Sharpness of prediction and Reliability of prediction. Online calculators were used to calulate risk of mortality and statistical analysis was done with SPSS Version 15 for Windows.MPI score is apt for hospitals in a peripheral setting as it does not overemphasize on intensive monitoring and biochemical values.APACHE-II is a highly accurate score with good reliability at higher scores and moderate sharpness. p-POSSUM is less difficult to calculate than APACHE-II and as if not more reliable. None of the scores here provide a dynamic assessment of the patient as they are a calculated only once at a particular point of time. APACHE-II seems to be the ideal score; still using more than one score may improve the sharpness and reliability of prediction.*

***Keywords:*** *APACHE,Mannheim Peritonitis Index,Peritonitis,p-Possum, Scoring*

---

Date of Submission: 09 -10-2017 Date of acceptance: 27-10-2017

---

## I. Introduction

Generalized peritonitis is a frequently lethal condition.It continues to be one of the major problems confronting physicians, surgeons and their patients throughout the world[1]. Until the end of the last century, peritonitis was treated medically with a mortality of 90%. In 1926, Krishner showed that the mortality of peritonitis could be reduced by strict implementation of surgical principles, and the mortality rate dropped to below 50%. Since then, despite innumerable advances in surgical skills, antimicrobial agents and supportive care, the mortality of peritonitis remains high and is presently reported in various multicenter studies as varying between 13 and 43%.

The prognosis and outcome of peritonitis depend on the complex interaction of many factors, patient related, disease related and intervention related. The chronic health status is also noted to influence the outcome. Whittman demonstrated that age, duration of symptoms, white cell count, mechanisms and origin of infection are related to outcome. The outcome in most of these patients is therefore difficult to predict. Categorizing patients into different risk groups would help prognosticate the outcome, select patients for intensive care and determine operative risk, thereby helping to choose the nature of the operative procedure, e.g. damage control vs. definitive procedure. Scoring systems also help in risk stratification and in the evaluation of new diagnostic modalities and therapeutic advances as well as in the comparison of treatment results from different clinics.

Prognostic scores[2] are based on numerical weighting of clinical variables. Various scoring systems have been used to assess the prognosis and outcome of peritonitis. Those used include the Acute Physiological and Chronic Health Evaluation score (APACHE II), the Mannheim Peritonitis Index (MPI), the Peritonitis Index Altona (PIA), the Sepsis Score, and the Physiological and Operative Severity Score for Enumeration of Mortality and Morbidity (POSSUM). Various authors have reported APACHE to be a better system for prognostication of the outcome of patients with peritonitis, while others concluded that MPI provides a more reliable means of risk evaluation. The present study was undertaken to compare the use of three of the above scoring systems in patients with perforative peritonitis.

The MPI[3] is based upon data from 1253 patients with peritonitis treated between 1963 and 1979 and was developed by analysis of 17 possible factors. In previous studies, patients with scores of less than 21 had a mortality rate ranging from 0-2.3% and those with MPI between 21 and 29 had a mortality rate of approximately 65%. MPI score of more than 29 had the highest mortality, up to more than 80% in some studies.

The APACHE II[4] (Acute Physiology and Chronic Health Evaluation) score integrates estimates of the severity of disease measured by 12 physiological variables with the physiological reserve estimated by age and chronic disease APACHE II[5] is used in intensive care units to classify the severity of a disease. There are

several applications for prognostic scores in peritonitis. In clinical trials they are used to define risk, to compare treatment, to define inclusion and exclusion criteria, and to measure outcome in trials that do not involve comparisons. The use of scores for the accurate and reliable prediction of mortality in individual patients with peritonitis has not yet been analysed fully[6]. The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) [7]was developed by multivariant discriminant analysis of 48 physiological and 18 operative variables by Copeland et al in 1991. Eighteen of these variables were determined to be independent factors related to patient outcome. POSSUM[8] has since been shown to over predict mortality in low risk patient groups. The Portsmouth predictor equation (p-POSSUM) was developed to overcome this failing. Most surgeons accept that mode of presentation, physiological condition of the patient and extent of the surgical procedure performed are predictors of outcome[9].

In this present era where there is an increasing demand to audit the quality of surgical care provided by surgeons, scoring systems may provide a measure of differentiating surgeon dependent and independent variables.The preoperative risk calculated by these scoring systems may also help in prognosticating patients and decide on the course of further management operative vs non operative, damage control vs definitve surgery etc.Arriving at a preoperative risk may also help in communicating with the patient's side better about the condition and expected outcome.New techniques of intervention may be tried in different risk groups. These may then be compared in RCT to decide upon which is best suited for a particular risk group.Diffuse peritonitis continues to have a high mortality rate inspite of intensive care. Therefore the need to correctly identify this subset for appropriate management.

## II. Aims And Objectives

To calculate and compare the positive predictive value of Mannheim peritonitis index, p-POSSUM and APACHE-II scores for each of the patients.Compare standard cut offs for predicting mortality with cut offs obtained in the study.To calculate the discriminatory power of each index by plotting Receiver Operator Characteristic curves( ROC) .To determine the reliability of prediction and sharpness of prediction.

## III. Materials And Methods

It is a Prospective Analytical Study done in Govt Rajaji Hospital, Madurai, Tamil Nadu, from November 2013 to November2014. All patients admitted in General surgical wards of Govt. Rajaji Hospital with perforative peritonitis were included in the study after getting informed written consent.Required data were collected from the complaints, history of presenting illness and past history of the patient , radiological investigations, biochemical lab values, intraoperative findings.It was approved by the Institute of Ethical Comimttee, Madurai Medical College.Informed written consent from the patient obtained in the patient's mother tongue. All data were analysed using SPSS Version 15 for Windows software. Area under the curve was calculated using Receciver operator characteristic curves.

### 3.1 Inclusion criteria

All patients admitted in General surgical wards of Govt Rajaji Hospital with perforative peritonitis were included in the study which includes hollow viscous perforation due to peptic ulcer disease, enteric fever, trauma- blunt or penetrating, cases of intestinal obstruction with strangulationandruptured liver abscess.

### 3.2 Exclusion criteria

Pateints with spontaneous peritonitis, age< 12 years and those with postoperative peritonitis were excluded from the study.

### 3.3 Methodology

After the relevant data were collected in printed proforma sheets containing the requisite variables necessary, they were entered into online score calculators (www.SFAR.org and www.riskpredicton.org.uk ). The calculated scores were tabulated and analysed using statistical software SPSS.

### 3.4 Definitions

Mortality - all deaths within 30 days of surgery were taken into account.Discriminatory ability - otherwise defined as accuracy- ability of a test to discriminate with precision those who are at risk of dying and those who are not.Positive predictive value is defined as the proprtion of the patients with postive test who have the disease.Sharpness of predictionisthe ability of the test to assign subjects to wither of the outcome groups.Reliability of the scores is assessed by comparing the observed mortality with expected mortality obtained from other studies.

## IV. Observations And Results

### 4.1 Discriminatory ability and cut off points

Discriminatory ability or accuracy was analyzed using ROC and area under the curve was calculated ROC analysis was done to identify the best cut off. The cut off that we got for MPI was 26 for which the sensitivity and specificity was calculated to be 100% and 89.19% respectively.From the ROC curve, the area under the curve for MPI was calculated as 96.8% which is statistically significant

**Table 1**-Analysis of MPI scoring system with cut-off of 26

| Indices | MPI |
|---|---|
| Sensitivity | 100 % |
| Specificity | 89.19% |
| Positive Predictive Value | 76.47% |
| Negative Predictive Value | 100% |
| Positive Likelihood Ratio | 9.25 |
| Negative Likelihood Ratio | 0 |

**The positive predictive value of MPI was 76.47%**

ROC analysis was done to identify the best cut off for APACHE-II. The cut off obtained was 24 at which the sensitivity and specificity was calculated to be 100% and 100% respectively.From the ROC curve, the area under the curve for APACHE-II was calculated as 100% which is statistically significant .

**Table 2**-Analysis of APACHE-II scoring system with cut-off of 24

| Indices | APACHE-II |
|---|---|
| Sensitivity | 100 % |
| Specificity | 100% |
| Positive Predictive Value | 100% |
| Negative Predictive Value | 100% |
| Positive Likelihood Ratio | - |
| Negative Likelihood Ratio | 0 |

The positive predictive value was 100% for APACHE-II.

ROC analysis was done to identify the best cut off for p-POSSUM. The cut off was found out to be 56 at which the sensitivity and specificity was calculated to be 100% and 94.59% respectively.From the ROC curve, the area under the curve for p-POSUM was calculated as 99.7% which is statistically significant .

**Table 3**-Analysis of p-possum scoring system with cut-off of 56

| Indices | p-POSSUM |
|---|---|
| Sensitivity | 100 % |
| Specificity | 94.59% |
| Positive Predictive Value | 86.67% |
| Negative Predictive Value | 100% |
| Positive Likelihood Ratio | 18.50 |
| Negative Likelihood Ratio | 0 |

**The positive predictive value was 86.67% for p-POSSUM.**

APACHE-II had the maximum area under the curve followed by p-POSSUM and MPI. 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.p-POSSUM comes a close second with an area of 99.7% and MPI is third with a score of 96.8%.APACHE-II easily trumps the other two with apositive predictive value of 100%.

### 4.2 Sharpness of prediction

Sharpness is defined as the ability of a test to predict with accuracy any one outcome- in this case either a low probability of death < 0.1 or an increased probability of death .0.9.

**Table4**- Sharpness of prediction

| | Probability of death | | |
|---|---|---|---|
| Score | <0.1 (Sharp) | 0.1-0.89 (Not sharp) | ≥0.9 (Sharp) |
| APACHE II | 17 | 33 | - |
| p-POSSUM | 24 | 25 | 1 |

Probabilities are calculated from the predicted mortality percentages. Number of observations for probability < 0.1 and probability > 0.9 are calculated. We find that both of them show similar sharpness of prediction.In APACHE-II 51.51% of values were within the above parameters and in p-POSSUM 50%of values were within the set parameters.

**4.3Reliability of prediction**

**Table -5** Mortality rate by MPI scoring system

| Score | Number of patients | Deaths | Mortality Rate |
|---|---|---|---|
| ≤ 20 | 27 | 0 | 0% |
| 21 – 29 | 13 | 4 | 30.8% |
| ≥ 30 | 10 | 9 | 90% |

**Table-6**Mortality rate by APACHE-II scoring system

| Score | Number of patients | Deaths | Mortality Rate |
|---|---|---|---|
| ≤ 10 | 19 | 0 | 0% |
| 11 – 20 | 16 | 0 | 0% |
| >20 | 15 | 13 | 86.7% |

**Table-7** Mortality rate by p-POSSUM scoring system

| Score | Number of patients | Deaths | Mortality Rate |
|---|---|---|---|
| ≤ 35 | 15 | 0 | 0% |
| 36 – 55 | 19 | 0 | 0% |
| >55 | 16 | 13 | 81.3% |

## V. Discussion

MPI score has the lowest positive predictive value and discriminatory ability of the three.Regardless, as scores increase over the set cutoff, MPI is accurate in predicting mortality as depicted in Table no . Numerous studies have placed MPI on par with APACHE-II in predicting mortality though this study fails to find such an association, the difference in AUC between the two being statistically significant.The advantages of MPI have been highlighted before. The inconsistency of MPI may probably be attributed to the fact that it does not take into account all physiological derangements and also that colonic perforations are given less weightage. The probabilities of death obtained in the study correlate well with expected mortalities obtained from other studies.Its safe to assume that MPI is fairly reliable.

APACHE-II has the maximum AUC. The cutoff point obtained in the study seems to be a little on the higher side compared to previous studies. APACHE-II is accurately able to predict death despite not taking into account intraoperative findings and the underlying pathology.There is a definite discrepancy between studies elsewhere and this study in probabilities of death for patients with score 11-20 One also has to remember that APACHE-II scores have never been used for individual patients and they always have been applied for groups.

The main advantage of POSSUM unfortunately is also its Achilles heel- its dependence on intra operative findings. While one may assume that its accuracy of prediction may be enhanced by this characteristic, it also makes it less useful in a preoperative setting. p-POSSUM performed admirably running APACHE-II a close second in discriminatory ability. The cut off obtained in this study is very high compared to cut off values from similar studies.Like APACHE it assigns a lot of intermediate probabilities and therefore is not a very sharp score. As one approaches the higher scores the probability of death shows an increase that corresponds well with expected mortality. p-POSSUM is less difficult to calculate than APACHE-II and as if mot more reliable.

## VI. Conclusion

MPI is an easily calculable, score with good discriminatory ability and reliability let down by a moderate positive predictive value. The cut off obtained was 26 which is comparable to other studies. This score is apt for hospitals in a peripheral setting as it does not overemphasize on intensive monitoring and biochemical values.APACHE-II is a highly accurate score with good reliability at higher scores and moderate sharpness. The cut off obtained is 24 which is reasonably similar to cut off values obtained elsewhere. The main difficulty in computing this score is the plethora of biochemical and hematological values needed. Of the three APACHE had the highest positive predictive value.p_POSSUM is easily relatable to a surgeon and is nearly as accurate as APACHE-II. The cut off value obtained in this study did not match similar studies. The sharpness of this study is comparable to APACHE-II. p-POSSUM is known to overpredict mortality particularly in those with a high risk; a significant proportion of the sample presented late and with significant co morbidities. This accounted for a good number of cases with a more risk and high scores and probably is responsible for the high cut off value.To conclude we can say that while these scores do provide a method of estimating mortality, they are no substitute to clinical management. None of the scores here provide a dynamic assessment of the patient as they

are a calculated only once at a particular point of time. APACHE-II seems to be the ideal score; still using more than one score may improve the sharpness and reliability of prediction.

## References


[1]. Dellinger EP. Use of scoring systems to assess patientswith surgical sepsis. Surg Clin North Amer 1988; 68:123-145.
[2]. Hanlev JA. Mc Neil BJ. A method of comparing the areas under receiver operating characteristic curvesderived from the same cases. radiology 1983; 148: 839
[3]. Fugger R, Rogy M, Herbst F, Schemper M, Schuli F.Validierungsstudie zum Mannheimer Peritonitis-Index.Chirurg 1988; 59: 598-601.
[4]. Moser KH, Bouillon B, Troidl H, Koppen L. Validationof the continuous APACHE score (CAPS~) for a better prediction of outcome in surgical ICU patients. TheorSurg 1989; 3: 192-197.
[5]. Schein M, Gecelter ***G,*** Freinkel Z, Gerding H.APACHE 11 in emergency operations for perforatedulcers. Am J Surg 1990; 159: 309-313.
[6]. Knaus WA, Draper EA, Wagner DP, ZimmermanJE, APACHE II score: a severity of diseaseclassification system Crit Care Med. 1985;13:818-829
[7]. Whiteley MS, Prytherch DR, Higgins B,Weaver PC,Prout WG. An evaluation of the POSSUM surgical scoringsystem. *Br J Surg* 1996; 83: 812–815.
[8]. Bann SD, Sarin S. Comparative audit: the trouble withPOSSUM. *J R Soc Med* 2001; **94**: 632–634.
[9]. NearyWD, Heather BP, Earnshaw JJ. The Physiological andOperative Severity Score for the enUmeration of Mortalityand morbidity (POSSUM). *Br J Surg* 2003; **90**: 157–165.*Radiology* 1982; **143**: 29–36.


*Sundararajan G2. "A Prospective Analytical Study Comparing The Effectiveness of Mannheim Peritonitis Index, APACHE-II And P- Possum in Predicting the Mortality of Patients with Perforative Peritonitis." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 16.10 (2017): 65-69