# Prediction of Death Using the Mannheim Peritonitis Index in Oncologic Patients

## Previsão de Morte Usando o Mannheim Peritonitis Index em Pacientes Oncológicos

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## ABSTRACT

Mannheim Peritonitis Index (MPI) is a scoring system with prognostic value usually applied to patients with peritonitis. It was performed an eight year analysis of medical records from eighty-nine patients with peritonitis and malignant underlying disease who underwent surgical procedures. The mean MPI score was 26.6 points (range 5-47), with a sensitivity of 87.3%, and a specificity of 41.2%. The best accuracy (69.7%) was reached at score of 21. In conclusion, the MPI was a reliable predictor of death in oncologic patients with peritonitis and can be helpful in planning and evaluating future treatments.


Key words: Peritonitis, Neoplasms, Mannheim index, Mortality predictor.


## *RESUMO*

*O Índice de Peritonite de Mannheim (MPI) é um sistema de escore idealizado para avaliar o prognóstico de pacientes com peritonite. Realizamos um estudo retrospectivo de oito anos dos prontuários de 89 pacientes com doença maligna e peritonite submetidos a cirurgia. O índice médio foi de 26.6 pontos (5-47), com sensibilidade de 87,3% e especificidade de 41,2%. A melhor acurácia (69,7%) foi obtida com o escore de 21. Concluimos que o MPI foi um preditor de morte confiável em pacientes oncológicos com peritonite e pode ser de utilidade no planejamento e avaliação de futuras formas de tratamento nestes pacientes.*


*Palavras-chave: Peritonite, Neoplasias, Preditor de mortalidade, Índice de Mannheim.*

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## INTRODUCTION

Peritonitis in oncologic patients is associated with a high mortality rate. Despite the surgical treatment, sophisticated intensive care units, last generation antibiotics and a better understanding of peritonitis and pathophysiology, the mortality rates are still high The outcome of an abdominal infection depends on the complex interaction of many different factors and the success obtained with the early onset of specific therapeutic procedures[1]. It may also depend upon exact recognition of the seriousness of the disease and an accurate assessment and classification of the patient's risks. Early prognostic evaluation of abdominal sepsis is desirable to select high-risk patients for more aggressive therapeutic procedures such as radical debridement, lavage systems, open management, and planned reoperations[2]. An accurate risk index classification is the only way to settle a standard of comparison between groups of patients and different treatment methods which would allow further prospective adequate comparative studies.

Many score systems have been created for assessing patient risks of death during an event of peritonitis, nevertheless equal results have been achieved with the Mannheim Peritonitis Index (MPI) which was developed by Wacha and Linder[3] in 1983. It was developed based on the retrospective analysis of data from 1.253 patients with peritonitis, in which 20 possible risk factors were considered. Of these only 8 proved to be of prognostic relevance and were entered into the MPI, classified according to their predictive power. (Table 1) Patients with a score exceeding 26 were defined as having a high mortality rate.

The effectiveness of the MPI as a reliable predictor of the peritonitis outcome was also confirmed after investigation exceeding two thousand patients from several European surgical units[4,5]. Some authors[6] did not find significant difference in prognostic value between MPI and APACHE II scores systems and others suggested a combination of these two scores to enhance the efficiency[7]. Nevertheless, there has not been any study for validation of these indices in oncologic patients.

Encouraged by the high accuracy and simplicity of the MPI, we decided to perform this study in oncologic patients with secondary peritonitis. The objective was to evaluate the surgical outcome, arrange those patients into risk groups according to the MPI and estimate the index for prediction of the individual risk of death from peritonitis.

Table 1 - The Mannheim peritonitis index

| RISK FACTOR | SCORES |
|---|---|
| Age > 50 years | 5 |
| Female sex | 5 |
| Organ failure* | 7 |
| Malignancy | 4 |
| Preoperative duration of peritonitis > 24 h | 4 |
| Origin of sepsis not colonic | 4 |
| Diffuse generalized peritonitis | 6 |
| Exudate | |
| Clear | 0 |
| Cloudy, purulent | 6 |
| Fecal | 12 |

**Kidney failure = creatinine level ≥ 177 umol/L or urea level ≥ 167mmol/L or oliguria < 20ml/hour; pulmonary insufficiency = PO2 < 50 mmHg or PCO2 > 50 mmHg; intestinal obstruction/paralysis ≥ 24hours or complete mechanical ileus, shock hypodynamic or hyperdynamic*

## PATIENTS AND METHODS

The study enrolled only patients submitted to an emergency operation for secondary peritonitis. The Hospital setting was the National Cancer Institute, INCA-Brazil, a tertiary center exclusively dedicated to cancer care, in which are carried out nearly 4.000 surgeries/year. Benign acute inflammatory diseases are only treated when occurring in oncologic patients of the institute. Patient selection for the study was performed through an eight year retrospective review of trustworthy data from the Nosocomial Infection Control Committee. Only 11 cases were excluded, and criteria for patients exclusion was non-malignant disease or incomplete data. Frequencies of MPI components were calculated and the total score was obtained by adding individual risk scores. Differences between death and survival were evaluated by $c^2$ and also Fisher's exact tests when at least one expected score was less than 5. Resulting *P* values were reported as significant only when below to 0.05. After cross matching the different scores with the mortality, the

sensibility, the specificity and the accuracy, MPI were calculated and the best cut-point was chosen. The score distribution was displayed and receiver-operating characteristic (ROC) curves plotted to correlate specificity and sensitivity. Mean mortality rate was determined for each MPI score. Statistical analysis was carried out with the software SPSS-pc 4.01, Microsoft Corp.1990.

## RESULTS

Eighty-nine patients with cancer were selected for this study. Their ages ranged from 0 to 89 years, mean of 58,4 (SD ±16.1) years. Sixty five patients were men (73.3%) and 24 women (26.7%). Among them only 8 were pre-operative and all others were post-operative. Thirty eight (42,7%) were submitted to peritoneostomy. Most of the underlying cancer diseases were gastrointestinal. (Table 2) The most frequent diagnosis were colorectal 34/89 (38.2%), gastric and esophageal cancer 19/89 (21.4%). The hospitalization stay ranged from 4 to 131 days, median of 36.2 days. The overall mortality rate was 61.8% (55/89), 71.1% (27/38) in those with peritoneostomy and 54.9% (28/51) in those without peritoneostomy (p = 0.12).

Table 2 - Anatomic cancer localization in patients with peritonitis (n=89)

| CANCER SITE | No (%) |
|---|---|
| Colon/rectum/anus | 34 (38.2) |
| Stomach/esophagus | 19 (21.4) |
| Pancreas and papila | 9 (10.1) |
| Genitourinary System | 6 (6.7) |
| Uterus | 5 (5.6) |
| Respiratory tract | 4 (4.5) |
| Others | 12 (13.5) |

The preoperative duration of peritonitis was longer than 24 hours in 65,5%. (Table 3) A purulent exudate was observed in 63,3% and generalized diffuse peritonitis occurred in 62,2% of the patients. In 55,6% of cases the peritonitis had a non-colonic sepsis origin and organ failure was observed in 48,9% of cases. Comparison of the MPI variables in the two groups (survival and postoperative death) showed that only organ failure, age older than 50 years and diffuse generalized peritonitis reached statistical significance. Preoperative peritonitis duration longer than 24 hours was slightly more frequent among patients who died than among survivors, but the difference was not significant (P = 0.06).

Table 3 - Distribution of MPI variables between patients who died and survivors (n=89)

| RISK FACTOR | Total (%) | Death (%) | Survival (%) | p-value |
|---|---|---|---|---|
| Age > 50 years | 79.3 | 85.2 | 67.6 | **0.04** |
| Female sex | 26.7 | 25.5 | 29.4 | 0.74 |
| Organ failure | 48.9 | 56.4 | 33.3 | **0.03** |
| Malignancy | 100 | 100 | 100 | 1 |
| Preoperative duration of peritonitis > 24 h | 65.5 | 74.5 | 55.9 | 0.06 |
| Origin of sepsis not colonic | 55.6 | 58.2 | 47.1 | 0.34 |
| Diffuse generalized peritonitis | 62.2 | 69.1 | 47.1 | **0.04** |
| Exudate | | | | |
| Clear | 20.0 | 16.4 | 23.5 | |
| Cloudy, purulent | 63.3 | 63.6 | 67.6 | 0.15 |
| Fecal | 16.7 | 20.0 | 8.8 | |

The MPI scores varied from 5 to 47, with a mean value of 31.7 and 24.5, respectively in those with or without peritoneostomy ($p < 0.001$). The mortality rate increased proportionally according to the MPI score. (Figure 1) Linear correlation between the index score and the mortality rate in our study resulted in an excellent correlation coefficient ($r = 0.99$). The sensitivity and specificity of the index are shown as a ROC curve in. (Figure 2) The area under the curve (AUC) was 69,5%. The comparison of the different score cut-points showed that with the critical score 21 (equal or over) we have the best accuracy (69.7%) with a sensitivity of 87,3%. (Table 4, Figure 3) This cut-point missed only 12.7% of deaths. The negative predictive value of the MPI is 66.7% and the positive

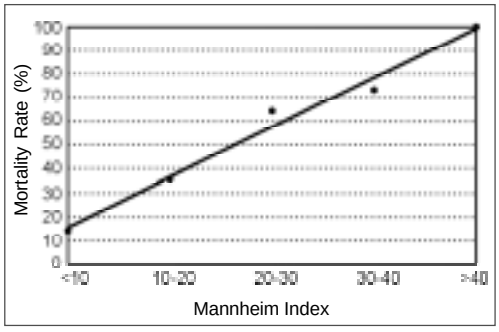


*Figure 1 - Correlations between MPI and mortality rate*

predictive value is 70.6%. The mortality rate under score 21 was of 33.3% and equal or over 21 was 70.6% (Odds Ratio = 4.8; 95% CI 1.5 - 15.7; p = 0.002).

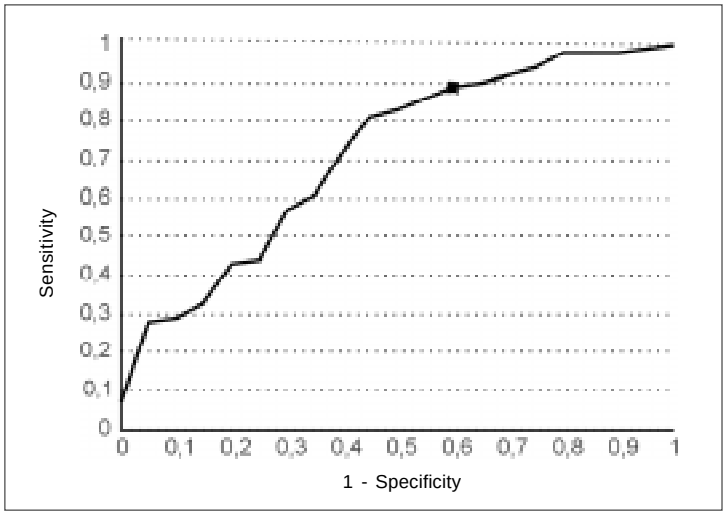


*Figure 2 - Comparison of sensitivity and specificity of the MPI for oncologic patients using receiver-operating characteristic curves. The point marked represents the threshold for maximun accuracy of the index.*

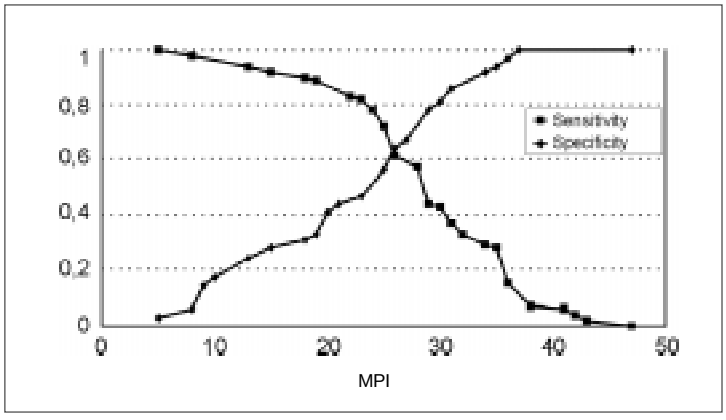


*Figure 3 - Sensitivity and specificity of the MPI*

Table 4. Observed mortality with the MPI score (n=89)

| | Observed mortality | | |
|---|---|---|---|
| | death | survival | total |
| MPI ³ 21 | 48 | 20 | 68 |
| MPI < 21 | 7 | 14 | 21 |
| total | 55 | 34 | 89 |

*Note: Sensitivity, 87.3%; Specificity, 41.2%*

## DISCUSSION

The most common type of peritonitis oncologic patients is generally caused by a ruptured viscus. The classic clinical manifestations use to be fever, abdominal pain, nausea, vomiting, diffuse abdominal tenderness, rebound tenderness and paralytic ileus[8]. The diagnosis may be delayed by recent post-operative status, immunodepression, concomitant use of antibiotics and age.

The action of bacteria and digestive enzymes on the peritoneal serosal surface leads to an outpouring of serum protein and electrolytes from the blood to the cavity and enzymatic digestion and necrosis. The classic pathophysiologic finding is a local formation of exudate rich in granulocytes, which may be diffuse or confined to an abscess. Systemically there is paralysis of the bowel, hemoconcentration and alterations of the cardiac output due to the shift of fluids and later acidosis. Intrapulmonary shunting, hypoxemia, hypo or hypercapnia, acute tubular necrosis, progressive azotemia, weight loss by protein consumption, loss of heat production, fall of body temperature, exhaustion are other complications that may lead to the death of the patient, if the process is not interrupted.

Peritonitis in oncologic patients presents high mortality rates, essentially related to the severity of the underlying disease. Oncologic patients are less prone to survive serious infections. Many disturbances of the immune system have been identified in oncologic patients, such as destruction of the anatomic barriers and derangement in the phagocytic activities and humoral and cellular responses[9-12]. A consumption of opsonins may occur in the course of severe infections leading to failure of the immune system.

Among the most widely known prognostic score indices used for classifying patients with abdominal sepsis are the Acute Physiology and Chronic Health Evaluation (APACHE) and the Peritonitis Index Altona (PIA)[2]. The APACHE II system is based upon physiological findings and it is adjusted according to the patient's evolution. It has a large range of scores with small increments, each of them contributes to the risk calculation, and the score value defines the mortality risk level, and correlates with the observed mortality. The Peritonitis Index Altona (PIA) is based upon history and clinical examination derived data, intraoperative findings, and physiologic information. Qualitative variables are transformed into quantitative data and it has proved

to be predictive for death[3].

The MPI is a specific score, which has a good accuracy and provides an easy way to handle with clinical parameters, allowing the prediction of the individual prognosis of patients with peritonitis. Our statistical validation showed the MPI to be an accurate and reliable predictor of surgical mortality, and we believe that the inclusion of a pathophysiological variable may raise its accuracy. In our study, the mortality rate of 61,8% and the high incidence of risk variables such as organ failure (48,9%), suggest peritonitis as a major pathological event. Wittmann[2] showed in his study, a high mortality rate (50%) when the diagnosis of peritonitis was made after 48 hours. The observed high frequency of patients with a preoperative peritonitis duration longer than 24 hours (65.5%) might be correlated with our high death rate.

In our patients, only age over 50 years, organ failure and diffuse generalized peritonitis showed a statistical significant difference between survival and death groups. Although the type of exudate, female sex, malignancy, preoperative duration of peritonitis longer than 24 hours and non-colonic sepsis origin have not reached statistical significance between the groups, they showed a good performance (accuracy of 69.7%) when all MPI components were considered together. This accuracy was obtained with a cut point of 21, but if it were used the original cut point score of 26 proposed by Billing, there would be a loss in sensitivity (63,9%) and in accuracy (62%).

The preoperative duration of peritonitis longer than 24 hours was more frequently observed among non-survivors, but the difference was not statistically significant (P = 0.06). Nevertheless, special attention must be given to an earlier diagnosis and intervention.

The general concept for treatment of peritonitis is to eliminate the cause, clean the peritoneum and adequate antibiotic coverage. In the literature there is no consensus about when choosing an “open management” and how this management should be. The same happens at our hospital. Peritoneostomy is usually reserved for severe, diffuse fecal peritonitis and it was used in 38 patients. The mean reoperation index was 4.3 per patient, ranging between 1 and 12. The open management may be sometimes associated with some drainage system if a fistula or main abscess is present and a contention system is usually present (abdominal wall contention sutures of contention dressings). Patients have the abdomen re-inspected under general anesthesia in the operating room or in the intensive care unit and washed with saline, having the debris removed. There is no pre-established period for re-inspection. This may be done daily of every two or three days, according to outcome, general and local abdominal conditions. No difference could be found between the death rates of patients with and without peritoneostomy, in spite of the significant difference between their scores.

We recommend that the MPI cut-point should be adjusted for each hospital. Obviously our present results can only be applied to hospitals with very similar characteristics, in order to support the prediction power of the index.

Based on our results we conclude that Mannheim Peritonitis Index is accurate to be used with oncologic patients with peritonitis and should be considered a reliable and simple reference for estimating their risk of death.

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