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Original research

Re-evaluation of Mannheim prognostic index in perforative peritonitis: Prognostic role of advanced age. A prospective cohort study

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HIGHLIGHTS

- Perforative peritonitis is a common condition associated to relevant mortality.
- Mannheim Peritonitis Index (MPI) has high prognostic value in perforative peritonitis.
- MPI takes into account the prognostic impact of age with a cutoff of 50 years old.
- According to our data age older than 80 years is an independent predictor of mortality.
- Older age should be considered in planning therapy and in patients' consulting.

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ABSTRACT

Background: Peritonitis from perforation of abdominal viscera is associated with high mortality. In western countries individuals older than 65 years constitute a significant proportion of the population and intra abdominal infections are more challenging to manage in these aged patients. **Methods**: This prospective cohort study included 143 consecutive patients operated on for primary perforative peritonitis. The aim of the study was to assess the prognostic efficacy of Mannheim Peritonitis Index (MPI) in a population with a significant proportion of older patients and to substantiate advanced age as an independent prognostic factor. Patients' informations were collected both on hospitalization and after surgical exploration; severity of peritonitis was evaluated using the MPI. The prognostic value of MPI was compared to older age and other clinical variables. **Results**: The intra-hospital mortality was 25.2%. According to the MPI score, the ROC curve identified 21 as cut-off value with a sensitivity of 86% and a specificity of 59% in predicting the risk of death. MPI score and age over 80 years old resulted independent predictors of mortality at multivariate analysis. In the subgroup of patients with MPI score $\geq$21, the mortality rate was 46.4% for patients older than 80 years old and 38.3% for younger patients ($p = 0.07$); in patients with MPI score <21, the mortality of those aged more than 80 years reached 33.3% compared to 3.4% for younger patients ($p = 0.001$). **Conclusions**: Age older than 80 years is strongly related to major increase in mortality rates and should be taken into account together with the MPI score in planning the surgical approach and the post-operative care.

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1. Introduction

Peritonitis from perforation of abdominal viscera or perforative peritonitis is an acute pathology frequently observed in surgical practice. Perforative peritonitis represents a complex condition due to various etiologies with different prognoses and is associated

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with an incidence of multiple organ dysfunction syndrome (MOFS) up to 73% and mortality rates reaching 30% [1,2]. Such unfavorable prognosis remains relevant despite significant progress both in surgery and in intensive care during the last decades [3]. Correct staging of this heterogenous group of patients and planning of treatment are very complex problems in clinical practice.

In western countries, individuals older than 65 years represent about 10% of the population, and this percentage is expected to grow up to 25% by 2050 [4]. Intra abdominal infections that affect older people are more challenging to manage in so much as a variety of physiologic alterations becomes manifest in the elderly population and, together with frequently associated co-morbidities, makes more difficult the response to intra-abdominal infections [5].

An effective predictive model of outcome of perforative peritonitis may be clinically useful, in order to provide adequate care with optimal allocation of resources, both in terms of surgical procedure adopted and intensive care unit admission. Moreover, such a model would offer an affordable prognostic assessment and a correct patient information, which may even result in reduction of malpractice litigation.

Several scores have been used to identify those risk factors predictive of perforative peritonitis mortality, but most of them are complex to calculate and difficult to use outside intensive care units.

The Mannheim Peritonitis Index (MPI) was elaborated in a retrospective study on 1253 patients affected by peritonitis treated in the 1980s in two surgical departments in Germany [6] and was then validated in a multi-institutional study [7]. The MPI had the objective to classify the severity of peritonitis or intra-abdominal infections and to identify those patients requiring a prompt and aggressive treatment, using parameters readily collectable at clinical examination and surgical exploration.

The MPI score, defined as an "empirically deduced first risk score", took into account age, general conditions, time from the onset of symptoms, type of surgery, type and extension of peritonitis and presence of signs of organ dysfunction (Table 1); each parameter was given a score, and a total score value higher than 26 identified patients at risk of death from severe peritonitis with a good specificity (79%), sensitivity (84%) and overall accuracy (81%).

Other scores have been proposed for evaluation of patients affected by peritonitis. The acute physiology and chronic health evaluation II score (APACHE II) is widely used in emergency patients and considers many different physiological and clinical parameters. A good correlation of this score with mortality in perforative peritonitis is described in literature, even if it does not include indicators such as type of peritonitis and causes of perforation [2,8]. Nonetheless, it is a complex score which can only be calculated after 24 h in intensive care unit, while the MPI has showed equivalent efficacy in similar series of patients [9,10].

Although the MPI has demonstrated its effectiveness in stratifying patients for higher risk of mortality after perforative peritonitis [11,12], it considers age score only as higher or lower than 50 years old, therefore overlooking the possible prognostic impact of older age on mortality. Such impact has been analyzed in few studies and, even if older age was commonly associated with worse prognosis, at multivariate analysis it did not result as an independent prognostic factor [13–15].

The purpose of our prospective cohort study was to evaluate the efficacy of MPI in perforative peritonitis analyzing a population with a significant proportion of older patients and to use this prognostic tool to substantiate advanced age as an independent prognostic factor.

Table 1
Mannheim Peritonitis Index [6].

Risk factor	Score
Age >50 years old	5
Female sex	5
Organ failure[a]	7
Malignancy	4
Properative duration of peritonitis >24 h	4
Origin of sepsis not colonic	4
Diffuse generalized peritonitis	6
Exudate	
Clear	0
Cloudy	6
Fecal	12

[a] Kidney failure: creatinine level >177 μmol/l, urea level >167 mmol/l, oliguria <20 ml/h; pulmonary insufficiency: PO_2 <50 mmHg, PCO_2 >50 mmHg; shock hypodynamic or hyperdynamic; intestinal obstruction/paralysis or complete mechanical ileus.

2. Methods

The study was designed as a prospective cohort study on a population of patients affected by primary perforative peritonitis, treated in an emergency setting at a referral hospital with standardized surgical and intensive care treatment protocols. Primary endpoints of the study included the assessment of the prognostic value of MPI compared to other clinical variables and the evaluation of advanced age as an adjunctive independent prognostic factor. The study was approved by the Scientific Committee of the Department of Medicine, Surgery and Neurosciences of the University of Siena.

Patients submitted to laparotomy for peritonitis secondary to hollow viscus perforation at the General Surgery and Surgical Oncology Unit of the University of Siena from January 2007 to December 2012 were included in the present prospective cohort study. We considered only those cases of primary visceral perforation; patients with anastomotic leak or viscus perforation following recent abdominal surgery were not included in the study. The study period was planned in order to recruit a minimum of 130 patients.

Patients' informations were collected upon informed consent on hospitalization and after surgical exploration. Data analyzed included age, gender, presence of co-morbidities, time from onset of symptoms, clinical parameters, laboratory tests, site and cause of visceral perforation, extension and characteristic of peritonitis, type of surgery performed and clinical outcome, including number and type of complications and in-hospital mortality.

In the definition of co-morbidities we considered cardiological pathologies as electrocardiographic or echocardiographic abnormalities or pathologies for which the patient was assuming medications; hypertension was included in cardiological co-morbidities. Respiratory diseases were assessed as chest X-ray or CT scan abnormalities or pathologies for which patient was under specific treatment. Diabetes mellitus, hepatic diseases, cerebrovascular diseases and chronic kidney disease were assessed by patient history and as pathologies for which patient was on medication.

On admission, clinical signs and symptoms were recorded and a laboratory evaluation including full blood cells count and renal function panel was performed in all cases.

Decision for surgery was based either on clinical assessment or on the results of plain radiogram and CT scan of the abdomen.

At surgical exploration, the site of perforation was identified and recorded in all cases; the decisions on the surgical procedure and on the need for a stoma were based on surgeon intra-operative assessment. An extensive lavage of the abdominal cavity was performed at the end of the procedure in all cases.

Severity of peritonitis was assessed using the MPI index criteria.

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