

## Mannheim Peritonitis Index (MPI) and elderly population: prognostic evaluation in acute secondary peritonitis

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**SUMMARY: Mannheim Peritonitis Index (MPI) and elderly population: prognostic evaluation in acute secondary peritonitis.**

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**Introduction.** Acute Secondary Peritonitis due to abdominal visceral perforation is characterized by high mortality and morbidity risk. Risk stratification allows prognosis prediction to adopt the best surgical treatment and clinical care support therapy. In Western countries elderly people represent a significant percentage of population

**Aim.** Evaluation of Mannheim Peritonitis Index (MPI) and consideration upon old people.

**Patients and methods.** Retrospective study on 104 patients admitted and operated for "Acute Secondary Peritonitis due to visceral perforation". MPI was scored. In our study we want to demonstrate ef-

ficacy of MPI and the possibility to consider older age an independent prognostic factor.

**Results.** Mortality was 25.96%. Greatest sensitivity and specificity for the MPI score as a predictor of mortality was at the score of 20. MPI score of <16 had 0.15 times lower risk of mortality compared to patients with MPI score 17 – 21 and 0.61 lower than patients with MPI >22. Patients with MPI score 17-21 had 0.46 times lower risk of mortality compared to patients with MPI score >21. In the group of patients with MPI score of >20 the mortality rate was 48.5% for patients older than 80 years old and 12.1% for younger patients ( $p < 0.005$ ); in the group with MPI score of < 20 mortality rate was respectively 8.4% and 1.4% ( $p < 0.005$ ).

**Discussion and conclusions.** Data confirm the accuracy of the test. MPI score and age over 80 years old resulted independent predictors of mortality at multivariate analysis.

**KEY WORDS:** Evaluation - Score systems - Prognosis - Acute Secondary Peritonitis - Perforative peritonitis - High mortality risk - Mannheim Peritonitis Index (MPI) - Elderly - Mortality.

### Introduction

Acute secondary peritonitis represents the common presentation of gastro-intestinal perforation and the classification, in chemical and bacterial, is well known (1). Perforative peritonitis is linked with Multiple Organ Dysfunction Syndrome (MOFS) up to 73% and mortality rates is reaching 30% (2, 3). It remains a life-threatening condition, even though considerable progresses are done in diagnostic techniques, antibiotic therapies and surgical management. The prognosis remains poor despite development in management strategies. It is useful an early identification of patients with severe peri-

tonitis in order to select them for intensive management (4).

Nonetheless, Western and industrialized countries are populated by old people (individuals older than 65 years are about 10%), and this percentage is estimated to grow up with decades (5).

Clinical management of old people is more challenging for a lot of reasons linked to physiologic alterations shown by elderly population as the well defined cellular-immunological reaction changing to environmental interaction, together with frequent associated comorbidities (6).

Grading the severity of the peritonitis improves the management of severely ill patients.

Several scores have been proposed to identify risk factors of predictiveness due to perforative peritonitis mortality; frequently they seem to be complex to calculate or difficult to use outside intensive care units.

Main score-systems reported are the Acute Physiology and Chronic Health Evaluation score (APACHE

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II), Simplified Acute Physiology Score (SAPS), Sepsis Severity Score (WSES) (7), Ranson Score, Peritonitis Index Altona (PIA), Sepsis Score and Physiological and Operative severity Score for enumeration of Mortality and Morbidity (POSSUM), Mannheim Peritonitis Index (MPI) (8, 9).

APACHE score is considered the best score-system in prognostic evaluation. Widely used in emergency, it has good correlation with perforative peritonitis mortality. It does not evaluate type of peritonitis and cause of perforation. Its use is suggested in ICU in 24h from injury (10-12). MPI instead achieves the best in reliability on risks' evaluation, allowing the prediction of the individual prognosis of patients with peritonitis (13, 14).

It was elaborated in 1980s in a German retrospective study and then validated. It collects data from clinical examination and surgical evidence, and it is precious into predict when to perform "aggressive treatment" and intensive care monitoring.

In MPI are taken into account 8 variables: age, sex, organ failure, diagnosis of carcinoma, preoperative duration of peritonitis, origin of sepsis, peritonitis extension, characteristics of exudate (14, 15).

Each of them are evaluated and scored obtaining a global score (Table 1).

MPI considers age score evaluating it in higher and lower than 50 years old but nothing is said about the prognostic impact of older age on mortality. The evidence that older age is linked with poor prognosis in surgical pathologies suggests that it could be considered an independent prognostic factor in global evaluation of MPI.

In our study we want to demonstrate efficacy of MPI and the possibility to consider older age an independent prognostic factor, analysing a perforative peritonitis population with high percentage of older patients (16-18).

## Patients and methods

Retrospective study was performed recruiting 104 patients that underwent surgical operation for "Acute Secondary Peritonitis" from 2013 to 2015 in "A.O.U Policlinico Paolo Giaccone" – Palermo, Italy, General and Emergency Surgery. Anastomotic leak or perforation in patients recently operated were not included. Standardized pre-operative work-up was represented by record of signs and symptoms, laboratory evaluation, CT scan of abdomen, i.v. fluids, antibiotics, nasogastric decompression when indicated. Site of peritonitis secondary to perforation was diagnosed during surgery, and appropriate operation performed. Peritoneal lavage was given in all the cases and description of exudate performed. Resuscitation and ICU care was given when necessary.

Required data in order to rate MPI were collected du-

TABLE 1 - THE MANNHEIM PERITONITIS INDEX.

Risk Factor	Score
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

\*Definitions of Organ Failure: Kidney Creatinine level >117 µmol/L, Urea level >167 mmol/L, Oliguria <20 ml/h, Lung PO<sub>2</sub> <50 mmHg, PCO<sub>2</sub> >50 mmHg; Shock Hypodynamic or Hyperdynamic; Intestinal obstruction; Paralysis >24 h or complete mechanical obstruction.

ring chart retrospective analysis and then compared between survivor and non-survivor groups. Informed consent was collected on hospitalization. Old age was evaluated as an independent prognostic factor.

Patients were divided into 3 age-range-groups: younger than 50 years old (y.o.), 50-80 years old, older than 80 years old.

### Statistical analysis

Statistical analysis was done using PRIMIT Package for Win. *t-Student* test was used for intergroup comparisons; statistical significance was evaluated by means of chi-squared test for categorical variables. Risk Ratio and 95% confidence interval calculated for each group. ROC curve performed to identify the threshold value of MPI with higher sensitivity and specificity. The level of significance was fixed at p-value <0.05.

Predictiveness of MPI was tested through ROC curve, and statistic significance of every single MPI inclusion criteria performed in order to verify the relevance on prognosis.

Factors independently related to an increased risk of mortality were identified through logistic regression model.

## Results

The population included 104 patients with "Acute Secondary Peritonitis" that underwent surgical opera-

TABLE 2 - MORTALITY IN EACH ETIOLOGICAL GROUP.

Site of Perforation	N° of patients	N° of death	Mortality rate
Appendix	17	0	0%
Cecum	6	2	33.3%
Gallbladder	21	0	0%
Colon	9	5	55.5%
Jejunum	2	0	0%
Ileus	11	3	27.3%
Rectum-Sigmoid Colon	23	10	43.5%
Stomach	15	7	46.6%
<b>Total</b>	<b>104</b>	<b>27</b>	<b>25.9</b>

tion with a median age of 61.9 years (range 16-94). 36.5% were female, 63.5% male.

Co-morbidities were recorded for each patient with cases in which more than one pathology co-existed.

The ASA score was II in 33 cases (31.7%), III in 47 cases (45.2%), IV in 24 cases (23.1%).

Perforation sites were: appendix (n=17), gallbladder (n=21), stomach (n=15), ileus (n=11), cecum (n=6), sigma-rectum (n=23), colon (n=9).

Mortality rate was higher in colonic localization (55.5%), than stomach (46.6%), sigma-rectum (43.5%), cecum (33.3%) and ileus (27.3%).

Mortality wasn't associated with appendix and gallbladder perforation although the elevate number of cases (n=17, n=21 respectively) (Table 2).

Death occurred in 27 patients, 10 patients died of renal failure; 5 patients died of respiratory failure; 12 died of MOF.

Pre-operative peritonitis duration was over 24 h in 31.7% of patients. Exudate was described in 100% of cases with different characteristics: 67% cloudy/purulent, 18% faecal, 15% clear.

MPI was easily scored and categorized into 3 groups: MPI<16 in 36.6%; 17<MPI<21 in 31.7%; MPI>22 in 31.7%

Each MPI class was further divided in survivor and non-survivor group.

It was useful calculate probability to survive, RR and OR. In order to test the hypothesis that prognosis is independent by MPI group, it was calculated RR in 3 groups and it was compared between them.

The comparison between 1<sup>st</sup> and 2<sup>nd</sup> group proves the independence of prognosis.

It isn't the same in the comparison between 1<sup>st</sup> - 3<sup>rd</sup> group and 2<sup>nd</sup> - 3<sup>rd</sup> group - where the probability to survive is 2.68 and 2.25 major respectively.

MPI score was analysed with the mortality. With hi-

ghest sensitivity of 78% and specificity of 89% MPI score of 20 was taken as a threshold value for dichotomous analysis using ROC curve; the AUC of the ROC curve was 0.89 (Table 3).

Statistical significance of every single risk factor used for MPI calculation was rated through *t-Student* test. *p-value* < 0.05 was considered statistically significant. Table 4 shows the results obtained by univariate analysis.

At univariate analysis, age older than 80 years, number of pathologies, malignancy, generalized peritonitis and MPI score resulted associated to increased risk of mortality.

Including MPI score and age over 80 years old in a logistic regression model, they resulted independent predictors of mortality at multivariate analysis.

ROC curve was further updated eliminating that factors with non significant *p-value*. The re-calculated ROC curve shows higher accuracy in evaluation of prognosis with MPI cut-off of 13 (AUC = 0.96) (Table 5).

In the group of patients with MPI score of >20 the mortality rate was 48.5% for patients older than 80 years old and 12.1% for younger patients (*p* < 0.005); in the group with MPI score of < 20 mortality rate was respectively 8.4% and 1.4% (*p* < 0.005) (Tables 6, 7).

## Discussion and conclusions

"Acute Secondary Peritonitis due to abdominal visceral perforation" is characterized by high mortality and morbidity risk that increases with sepsis and MOF. The early classification of seriousness and risk stratification allows prognosis prediction to be able to adopt the best surgical treatment and clinical care support therapy.

Mortality rate is estimated from 13 to 43%. Mortality rate in our series was 25.9% Prognosis depends on interaction of performance-status, etiology, diagnostic the-

TABLE 3 - ROC CURVE.

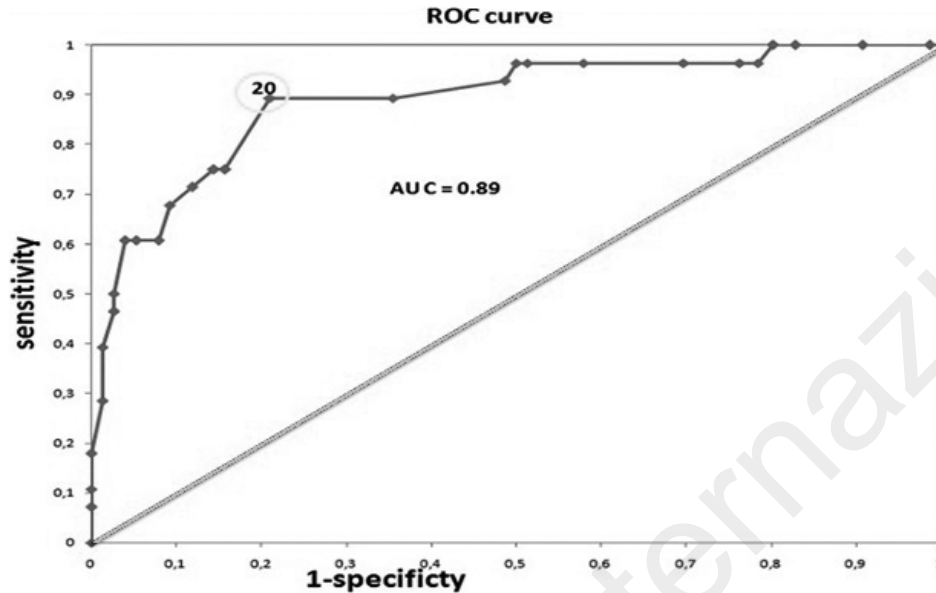


TABLE 4 - STATISTICAL SIGNIFICANCE FOR MPI RISK FACTORS.

Risk factor	p-value
Age	0.01306
Sex	0.19923
Organ failure	0.00141
Malignity	0.04854
Preoperative duration of peritonitis > 24 h	0.33632
Origin of sepsis not colonic	0.56665
Generalized peritonitis	0.02985
Exudate	0.17711

rapeutic strategies and use of immunomodulators. It is well known the correlations between pharmacological strategies, such as in Crohn's disease, and the risk to develop rare tumors or complications such as bowel perforation. Bowel herniation also represents a risk factor of perforation (19-37). Multiple Organ Failure (MOF) represents the fatal evolution of the peritonitis (4). In Western countries, the increasing number of older patients worsen the prognosis of surgical pathologies often also for relevant comorbidities presence (38).

In literature are reported numerous score-systems for prediction of peritonitis mortality risk in order to con-

sider the efficacy of surgical options compared between them, or to identify possible post-operative complications (4, 5). According with the literature, MPI is an independent, objective and effective scoring system in predicting mortality evaluating single risk factors (10-12).

It was tested the prognostic value of MPI; the data confirm the accuracy of the test as reported in international literature.

In our study patients with MPI scores of <16; 17 – 21; >22 had a mortality of 2.6%, 18% and 64% respectively. Greatest sensitivity and specificity for the MPI score as a predictor of mortality was at the score of 20. At this value we found a sensitivity of 78% and a specificity of 89%.

The risk of mortality based on MPI score was done comparing the 3 groups considered.

Patients with MPI score <16 had 0.15 times lower risk of mortality compared to patients with MPI score 17 – 21 and 0.61 lower than patients with MPI >22. Patients with MPI score 17-21 had 0.46 times lower risk of mortality compared to patients with MPI score >21.

This suggests increasing risk of mortality with increasing MPI score. The analysis of risk factors for MPI calculation shows the possibility to create a "short MPI", evaluating the only variables with  $p < 0.05$  in our series. This allows to identify a new MPI value of 13 as score of best sensitivity and specificity.

The mortality for patients with MPI > 20 and over 80 years old was of 48.5% than 12.1% of younger patients. Patients with MPI < 20 and over 80 years old had a mortality risk of 8.4% than 1.4% of younger. MPI sco-

TABLE 5 - ROC SHORT MPI.

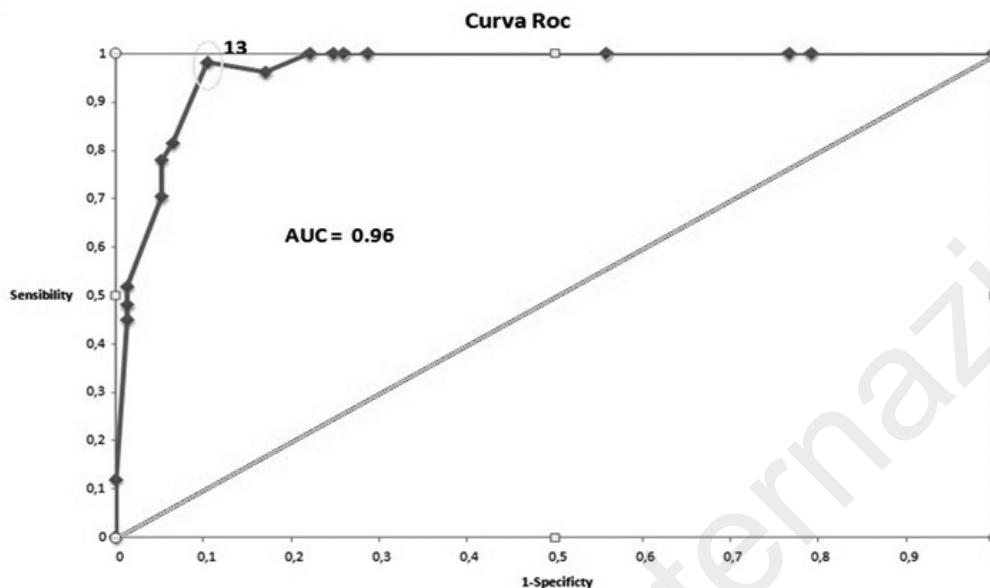


TABLE 6 - DISTRIBUTION OF PATIENTS AND OVERALL MORTALITY RATE.

n° of patients	Death		Survivors	
	104	27 (25.9%)		77 (74.1%)
< 80 y.o.		> 80 y.o.	< 80 y.o.	> 80 y.o.
5 (4.8%)		22 (21.1%)	57 (54.8%)	20 (19.2%)

TABLE 7 - MORTALITY RATE RELATED TO MPI AND AGE.

MPI	Death		
< 20	7	<80 y.o. 1.4%	P<0.005
		>80 y.o. 8.4%	
> 20	20	<80 y.o. 12.1%	P<0.05
		>80 y.o. 48.5%	

re and age over 80 years old resulted independent predictors of mortality at multivariate analysis.

The study confirmed the prognostic value of MPI index in Acute Secondary Peritonitis. Age older than 80 years old showed to be an independent risk factor of mortality evident both in low and high MPI score. Evaluation of Age and MPI should be taken into account in

the choice of which surgical operation to perform and if to realize intensive post-operative care.

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