Original Article

Evaluation of Mannheim peritonitis index and multiple organ failure score in patients with peritonitis

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Background: Early classification of severity of peritonitis by scoring systems, including the Mannheim peritonitis index (MPI) and the multiple organ failure (MOF) score, modulates surgical and medical management. **Aim:** To predict outcome of patients with peritonitis using the MPI and MOF scoring systems. **Methods:** Prospective evaluation of the MPI and MOF score was performed in 80 consecutive patients with peritonitis who underwent uniform surgical treatment. Risk ratios were calculated for the MPI and other patient characteristics. Risk ratio was not calculable for the MOF score. **Results:** Overall in-hospital mortality rate was 17.5%, including 80% of patients with MPI >29. In non-survivors the mean score was 4.8 (SD 1.46) and 33.07 (4.81) for the MOF score and MPI, respectively. Survivors had mean MOF score of 0.28 (0.20) and mean MPI of 19.39 (6.68). **Conclusion:** The MPI and MOF score provide simple and objective means to predict the outcome of patients with peritonitis. [*Indian J Gastroenterol* 2005;24:197-200]

The prognosis of peritonitis and intra-abdominal sepsis, particularly when multiorgan dysfunction develops, remains poor despite improvements in diagnosis and surgical and medical management of this condition. Early and objective classification of the severity of peritonitis may help in selecting patients for aggressive surgical approach.[1-4] Several scoring systems have been developed for this purpose, such as the Acute Physiology and Chronic Health Evaluation (APACHE) II score that considers 12 physiological variables,[5] Simplified Acute Physiology Score (SAPS), Sepsis Severity Score (SSS), Ranson score, Imrie score, and Mannheim Peritonitis Index (MPI) (Table 1).[6,7]

The MPI takes into account age, gender, organ failure, cancer, duration of peritonitis, involvement of colon, and extent of spread and character of the peritoneal fluid. This score was originally developed by discriminant analysis of data from 1253 patients with peritonitis.[8] It appears to be more practical than other scoring systems, such as the APACHE II,[9] which is time-consuming and may be impossible to apply in the setting of intra-abdominal sepsis.[9,10] Also, in a multicenter study of 2003 patients, the MPI had an acceptable specificity and sensitivity.[11]

Recently, a simplified scoring system (Jabalpur Index; JI) for peptic perforation was introduced.[12] In this system, each factor received a score based on its severity in accordance with the APACHE II scoring system. JI had an accuracy similar to those of the MPI and APACHE II systems.

Because organ dysfunction and failure evolve in patients with sepsis,[13] organ function is monitored routinely in intensive care patients. In 1985, Goris *et al*[14] published the Multiple Organ Failure (MOF) score that grades patients on a three-point scale (Table 2). The MOF score takes into consideration dysfunction of the pulmonary, cardiovascular, hepatic, renal, nervous, hematological and gastrointestinal (GI) systems; however, in a recent revision, GI and nervous systems have been taken away.[15]

The present study was performed to predict outcome of patients with peritonitis using the MPI and the MOF scores.

Methods

Eighty consecutive patients with secondary peritonitis managed in the surgical wards of Sina Hospital, a

Table 1: Mannheim Peritonitis Index[8,11]

Risk factor	Weightage, if any
Age >50 years	5
Female gender	5
Organ failure*	7
Malignancy	4
Preoperative duration of peritonitis >24 h	4
Origin of sepsis not colonic	4
Diffuse generalized peritonitis	6
Exudates	
Clear	0
Cloudy, purulent	6
Fecal	12

*Definitions of organ failure: Kidney: creatinine >177 μmol/L, urea >167 μmol/L, oliguria <20 mL/h; Lung: pO_2<50 mmHg, pCO_2 >50 mmHg; Shock:[11] hypodynamic or hyperdynamic; Intestinal obstruction (only if profound): Paralysis >24 h or complete mechanical ileus

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Table 2: The Multiple Organ Failure score[14]

Organ	Normal function	Organ dysfunction	Organ failure
	0 point	1 point	2 points
Lung	No mechanical ventilation	Mechanical ventilation with PEEP <10 and FiO2 <0.4	Mechanical ventilation with PEEP >10 or FiO2 >0.4
Heart	Normal blood pressure (BP syst)	BP syst >100 mmHg with low dose of vasoactive drugs[a]	Periods with BP syst <100 mmHg and/ or high dose of vasoactive drugs[b]
Kidney	Serum creatinine <2 mg/dL (<150 μmol/L)	Serum creatinine >2 mg/dL (>150 μmol/L)	Hemodialysis or peritoneal dialysis
Liver	Normal AST and bilirubin	AST >25 units/L Bilirubin >2 mg/dL (>34 μmol/L)	AST >50 units/L Bilirubin >6 mg/dL (>100 μmol/L)
Blood	Normal counts	Leukocytes >30000/μL Platelets <50000/μL	Leukocytes >60000/μL or <2500 μL
Gl tract	Normal	Stress ulcer Acalculous cholecystitis	Bleeding ulcer, necrotizing enterocolitis and/or pancreatitis Gall bladder perforation
CNS	Normal	Diminished responsiveness	Severely disturbed responsiveness Diffuse neuropathy

[a] Dopamine hydrochloride <10 μg/kg/min, or nitroglycerin >20 μg/kg/min, or volume loading; [b] Dopamine hydrochloride >10 μg/kg/min, and/or nitroglycerin >20 μg/kg/min; GI: gastrointestinal

tertiary academic center with well-equipped ICUs, during the period August 2001 to December 2003, were studied. Their mean age was 44 (SD 20; range 7-80) years. Forty-nine (61.3%) patients had co-morbid conditions, including GI disease (26 cases), hypertension (11), malignant disease (8), cardiac disease (6), pulmonary disease (5), and other diseases (17). Patients with primary peritonitis, defined as those without a recognizable preceding cause, spontaneous bacterial peritonitis (SBP), pancreatitis or those with intra-abdominal sepsis due to peritoneal dialysis were excluded. Resuscitation measures, antibiotic therapy, vasoactive drugs, nasogastric intubation and analgesics were administered as required.

All 80 patients underwent laparotomy, extensive lavage[16] and debridement (except one patient who received only lavage). Resection surgery was done in 23 (28.8%) patients with appendicitis (17), cholecystitis, Meckel's diverticulum, or ruptured ovarian cyst. Thirty-seven (46.3%) patients with ruptured peptic ulcer underwent suturing and omental patch. Resection and colostomy, suturing and resection, and other interventions were done in 20 (25%) patients. After surgery, interventions like antibiotic therapy, vasoactive drugs, resuscitation, and ICU care were done as necessary. Four cases had delayed closure.

The MPI and revised and original MOF score were calculated at admission or during management. The MOF score was calculated on the basis of evidence of organ failure after surgery. Patients were followed up until death or discharge.

Patients were grouped into three categories based on disease severity: those with MPI less than 21, between 21 and 29, and greater than 29.[17]

Data were analyzed using SPSS software (version 11.5; SPSS, Chicago, IL, USA). Student's *t* and chi-squared tests were used for intergroup comparisons. Risk ratio and 95% confidence interval (CI) were calculated for each category. The predictive power of the MPI for prediction of in-hospital death was calculated. Results were summarized by ROC curve analysis and the area under the curve (AUC) was calculated. p value of <0.05 was considered statistically significant.

This study was conducted according to the tenets of the Helsinki Declaration and good clinical practices.

Results

Fourteen patients developed local complications due to surgery, including wound infection, abscess, suture dehiscence; six of them underwent re-operation. Thirty-three patients developed systemic complications following surgery (Table 2); these included cardiac failure (13 patients), respiratory failure requiring mechanical ventilation (11), liver failure (10), hematological abnormalities (14), and renal failure (5). Sixteen patients had multiorgan failure. All the non-survivors had failing nervous system, while none of the survivors had failing or dysfunctional nervous system. Of the 80 patients, 14 (17.5%) died, including 9 of multiorgan failure or septicemia, 3 of myocardial infarction, one of pulmonary emboli and another one of respiratory failure. The survivors spent

Table 3: Relation of patient parameters to death

	Mortality rate	Risk ratio (95% CI)
Age <60y	6.35% (4/63)	Baseline
Age >60y	58.8% (10/17)	9.2 (3.3-25.8)
Cause		
Appendicitis	5.9% (1/17)	Baseline
Small intestine	14.3% (2/14)	2.4 (0.2-26.7)
Perforated peptic ulcer	23.1% (9/39)	3.9 (0.5-28.2)
Biliary tract	25% (1/4)	4.2 (0.8-53.5)
Interval up to surgery		
<24h	11.4% (5/44)	Baseline
>24h	25% (9/36)	2.2 (0.8-5.9)
MPI		
<21	- (0/39)	Baseline
21 <MPI <29	7% (2/29)	6.7 (0.3-134.3)
>29	80% (12/15)	63.7 (4.0-1011)

a mean of 9.5 (SD 7.3; median 9, range 7-38) days in hospital. Characteristics of these patients and their relation to MPI score are shown in Table 3.

The risk of in-hospital death was higher in patients aged above 60 years (risk ratio 9.2 [95% CI 3.3-25.8]) and time interval from presentation to surgery of 24 hours or longer (2.2 [0.8-5.9]). Patients with MPI score >29 had high risk of death (63.7 [4.0-1011.0]).

Non-survivors had higher mean original and revised MOF scores (6.8 [1.46] and 4.8 [1.46], respectively), whereas survivors had mean MOF score of 0.3 (0.2). Survivors had mean MPI of 19.39 (6.68) but that of non-survivors was 33.07 (4.81); these scores were significantly different (Table 4). The AUC of the ROC curve analysis for predictive power of MPI was 0.972. MPI of 21 had sensitivity of 100% and specificity of 79%, and MPI of 29 had sensitivity of 79% and specificity of 96% for prediction of in-hospital death (Fig).

Discussion

In-hospital mortality rate due to peritonitis remains high – a mean of 19.5% in a multicenter study[11] and reaching 60% in some series,[1-4] although advances in intensive care medicine and aggressive surgical techniques have been introduced. In the current study, the mortality rate was 17.5%, mostly due to multiorgan failure and septicemia. Early objective grading of

Table 4: Distribution of MOF score and MPI among survivors and non-survivors

Parameter	Survivors (n=66)	Non-survivors (n=14)	p value
Revised MOF	0.3 (0.2)	4.8 (1.5)	<0.0001
Original MOF	0.3 (0.2)	6.8 (1.5)	<0.0001
MPI	19.4 (6.7)	33.1 (4.8)	<0.0001

All values as mean (SD)

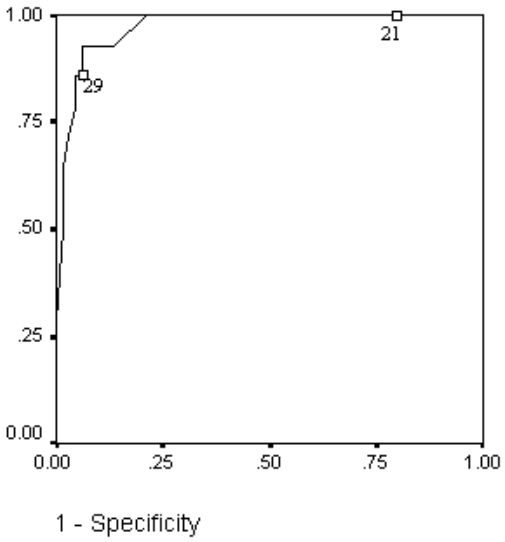

Fig: ROC curve of specificity and sensitivity of the MPI. Area under curve = 0.972

severity of peritonitis may help change surgical and medical management. The MPI and APACHE II score have been shown to contribute independently to the prediction of outcome.[6]

Accuracy of the MPI was comparable or slightly superior to that of other sepsis classification systems, including APACHE II.[18,19] In previous studies,[11,17,20] patients with a score less than 21 had mortality rate ranging from 0%-2.3%, and patients with MPI more than 29 had the highest mortality rate, up to 100% in some studies; prognosis with MPI between 21 and 29 was approximately 65%.[20] A score of 26 had sensitivity of 86% and specificity of 74% in predicting death.[11] In our study, MPI of 21 had a sensitivity of 100% and specificity of 79% for in-hospital death; in comparison, MPI of 29 had sensitivity of 79% and specificity of 96% for this purpose.

In 2002, Goris *et al*[15] suggested a revised MOF score that did not include GI and nervous system failures. GI failure lacked a clear definition, its incidence was low, and its occurrence was rarely associated with poor outcome.[15,21] In the present study, none of the 80 patients had GI failure, as defined in the original MOF score. Also, a valid assessment of mental function is difficult in intensive care patients who are receiving sedative drugs and assisted ventilation.[21,22,23] In this study, all 14 non-survivors had failing nervous system, while none of the survivors had failing or dysfunctional nervous system. Non-survivors had a mean MOF score of 4.80 (1.46), and all 80 patients had mean MOF score of 1.07

(0.64). If failure of the nervous system was considered, the mean MOF score would be 6.80 (1.46) and 1.43 (0.64), respectively.

Irrespective of age, failure of four or five organs had a very bad prognosis; however, mortality is remarkably increased in patients over 60 if only two or three organs have failed.[15] In the present study, mortality rate in patients >60 years was 58.8%.

Patients with MPI >29 and at least one failing organ (except GI and nervous system) and/or age >60 have poor prognosis.

The MPI has been shown to be an appropriate objective prognostic factor in patients with peritonitis to predict their outcome pre- and intra-operatively.[6-11] The MOF score was one of the first attempts to create an objective point system and has been revised recently.[15] It seems that the most accurate cut-off points of the MPI are 21 and 29, with mortality rate of 60%, and up to 100% when the MPI is >29.

A combination of the MPI and the MOF score will predict the outcome of patients with peritonitis in surgical intensive care units.

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