Comparative Evaluation of performance of Mannheim Peritonitis Index (MPI) and Multiple Organ Failure Score in Patients with Peritonitis

Salamat Khan[1], V P Singh[1]

ABSTRACT

Introduction: Secondary bacterial peritonitis is a life threatening condition if not well managed. It is associated with high morbidity and mortality. Early stratification by scoring system will allow in predicting the possible outcome and providing more critical care services to the serious patients. Aim: This study was done to evaluate the performance of Mannheim Peritonitis Index (MPI) score and MOF score in patients with secondary peritonitis.

Material and Methods: This is a prospective,observational evaluation of MPI and MOF score which was conducted on 105 consecutive patients of peritonitis who were admitted in our institution and underwent appropriate surgical treatment. Patient's characteristics, clinical, laboratory findings, operative findings and postoperative outcome were noted.

Results: Overall, mortality was 11.4%.The highest prediction of mortality rate of 85.7% was at MPI score of>27.The prediction of mortality of MOF score was 80% (12/15). Non-survivors had mean score of MPI and MOF was 28.50± 3.6and 3.46 ±2.19 respectively whereas survivors had mean MPI and MOF of 17.48±5.8 and 0.82 ±0.115 respectively. The Score sensitivity of mortality were 100% and 83.33% for MPI score >20 and MOF score respectively. The lower sensitivity of MOF score was due to death of some cases above 50 years of age without organ failure. These deaths were due to sudden cardio-respiratory arrest.

Conclusion: Increasing MPI and MOF score were associated with poor outcome. Both MPI and MOF were good predictors of mortality in cases of peritonitis. However; MPI scoring system is better (sensitivity 100% *Vs*. 83.3%) predictor of mortality than MOF score.

Keywords: MPI score, MOF, Peritonitis, Mortality, Stratification, Morbidity

INTRODUCTION

Peritonitis when associated with multiple organ dysfunctions carries poor prognosis, despite advancement in diagnostic technique, surgical and medical management of the condition. Early and objective stratification of severity of peritonitis may help in selecting patient for appropriate surgical management.[1-3] For this purpose several scoring system have been developed. These include Mannheim Peritonitis Index (MPI)[4] which consists of 8 variables (clinical and biochemical (Table-1), Acute Physiology and Chronic Health Evaluation (APACHE)[5] II score which consists of 12 physiological variables, and Simplified Acute Physiology score(SAP) and Sepsis Severity Score (SSS).[2,6]

The MPI includes 8 factors; age, gender, organ failure, malignancy, preoperative duration of peritonitis, origin of sepsis, extent of spread, and character of the peritoneal fluid. This score was developed by Wacha and associates from discriminant analysis of data from 1253 patients with peritonitis.[4] It appears to be more practical and simple than other scoring systems like APACHE-II, which is time-consuming and not possible to apply in the setting of secondary bacterial peritonitis.[7] A multicenter trial including 2003 patients has also confirmed that MPI has good sensitivity and specificity.[8]

Organ dysfunction and failure develops with secondary bacterial peritonitis.[9] So it is routinely monitored in Intensive Care Unit (ICU). Multiple organ grading score system which was developed in 1985 grades the MOF patients into 3 point scale (Table-2).[10] The MOF scoring system includes 8 systems. These are cardiac, pulmonary, hepatic, renal, central nervous system, gastrointestinal system and haematological. The aim of the present study was to compare the performance of MPI and MOF prognostic scoring system in secondary peritonitis.

MATERIAL AND METHODS

This was prospective observational study conducted at universal college of medical sciences and Career institute of medical science and hospital at Lucknow, a tertiary academic center with well-equipped ICU, during a period of 2 years (November 2013- October 2015).Ethical clearance was taken from college ethical committee and informed consent was obtained from each patient. *Exclusion criteria were* patients with tuberculous peritonitis, due to chemical peritonitis due to post-operative bile leak and cases with primary peritonitis (renal or hepatic failure), laparotomy done elsewhere for peritonitis or transferred out to continue treatment elsewhere. Informed consents were obtained. Clinically suspected cases of peritonitis were admitted and diagnosis was confirmed by laboratory and radiological investigations. The 110 confirmed cases were subjected to appropriate treatment and per-operative findings were noted. Operated cases were shifted to postoperative ward or ICU where monitoring is done. Data was collected on pre-structured format. Out of 110 cases, 5 cases were excluded and finally 105 cases were selected for study.

The sample size was calculated using16% incidence from previous study using formula $n = z^2 p\, q/d^2$ where n = required sample size, z = 1.96 at 93% confidence interval, p=estimated incidence from previous study, q=100-p, d = maximum tolerable error 7%.[1] The sample size obtained was 105. Data were collected on a prepared format of all patients registered.

[1]Assistant Professor, Career Institute of Medical Sciences and Hospital Lucknow, India

Corresponding author: Dr. Salamat Khan, 21/204 Malhar Type Sahara States, Jankipuram, Lucknow, India

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Risk factor	Weightage (if any)
Age >50years	5
Female gender	5
Organ failure*	7
Malignancy	4
Preoperative duration of peritonitis>24 hours	4
Origin of sepsis non colonic	6
Diffuse generalized peritonitis	6
Exudates	
Clear	0
Cloudy/purulent	6
Fecal	12
*Definitionof organ failure, Kidney: Creatinine>117µmol/L, Urea:>167µmol/L, Oliguria: <20mL/h, Lung: pO2<50mmHg, pCO2>50mmHg, Shock: hypodynamic or hyper dynamic Intestinal obstruction (only if profound), paralytic ileus >24 or complete mechanical ileus	

Table-1: Mannheim Peritonitis Index[4]

Socio-demographic, clinical, laboratory results (haematological, biochemical) and surgical findings and outcome were noted. MPI score and Organ failure score were recorded on admission, after surgery, and during postoperative management. Patients were followed up until death or 30 days after discharge.

STATISTICAL ANALYSIS

Compiled data was analyzed musing SPSS version 21 and result considered significant if P was equal or less than< 0.05. Chi square test and relative risk were used to check for the difference.

RESULT

The mean preoperative duration of symptoms was 3.71 days and ranged from 12 hours-15 days with median of 3 days. The vast majority of patients (73.30%) presented during the first week after the onset of the symptoms (Table-3).

Acute appendicitis was the commonest cause of peritonitis, 56 (55.31%), followed by appendicular perforation 16 (15.23%), small bowel perforation 15 (14.28%), and peptic ulcer perforation 14 (13.32%).Other uncommon causes include uterine perforation, caecal gangrene and perforation (figure-1).

The mean preoperative duration of symptoms was 3.71 days and ranged from 12 hours-15 days with median of 3 days. Majority of patients (73.30%) presented during the first week after the onset of the symptoms (Table-3). With regards to the extent of peritonitis, 45 (42.85%) cases had generalized peritonitis and 60 (57.14%) had 1/4thperitonitis. Out of the 12 mortality, 10(83.33%) had generalized peritonitis and 2 (16.66%) had localized peritonitis (Table-4). Death of 2 cases of localized peritonitis occurred due to development of septicemia and multiple organ failure. Organ dysfunction and failure was observed in15 (14.28%) patients. Out of 12 deaths 10 were associated with organ failure and rest 2 cases died due to sudden cardio-respiratory arrest. Death occurred due to multiple organ failure. The decreasing order of organ dysfunction/failure were, renal (15), cardiac (13), respiratory (12), liver dysfunction (9), and haematological (7) cases.

Local complication was observed in 22 cases. The overall morbidity rate was of 20.95%. Of 22 cases, 14 cases had superficial surgical site infections (SSSIs), 8 cases had septic shock, 4 cases had chest infection, one case had wound dehiscence, five had prolonged paralytic ileus. None of the case had intra-abdominal abscess, re-perforation, anastomotic leak and DVT. The commonest complication was surgical site infection (SSSI) (15.3%), followed by septic shock (8.60%), prolonged postoperative ileus up to 3-4 days (5.37%), chest infection (4.3%) and wound dehiscence (1.075%).

Relative Risk (RR) of the mortality recorded was higher inpatients aged >50 years (risk ratio 4 (CI 0.1075-0.755), Small bowel perforation 1.8 (CI 0.436-6.597) and PPU 1.5 (CI 0.58-7.59), >24 hour of pre- operation duration of symptoms 1.3 (CI 0.375-0.76.) Patient with >29 MPI score had high risk of mortality 59 (0.116-2.22).

Non survivors had higher

Organ	Normal function	Organ dysfunction	Organ failure
	0 point	1 point	2 point
Lung	No mechanical ventilation	Mechanical ventilation with PEP<10 with FiO2<0.4	Mechanical ventilation with PEP>10 with FiO2>0.4
Heart	Normal blood pressure (systolic)	BP systolic >100 mmHg with low dose of vasoactive drugs[a]	Periods of BP systolic <100 mmHg with high dose of vasoactive drugs[b]
Kidney	Serum creatinine<2 mg /dL (<150 µmmol/L)	Serum creatinine>2 mg /dL (>150µmmol/L)	Hemodialysis and peritoneal dialysis
Liver	Normal AST and bilirubin	AST >25 unit/L Bilirubin >2mg/dL (>30µmol/L)	AST >50unit/L Bilirubin >6 mg /dL (>100 µmol/L)
Blood	Normal count	Leukocytes >30,000/µL Platelet count<50000/µL	Leukocytes >60,000 or <2500/µL
GIT	Normal	Stress ulcer Acalculous cholecystitis	Bleeding ulcer/necrotizing enterocolitis and or pancreatitis
CNS	Normal	Diminished responsiveness	Severely disturbed responsiveness/ Diffuse neuropathy

a=Dopamine hydrochloride <10µg/kg/min or nitroglycerine >20 µg/kg/minor volume loading; b=Dopamine hydrochloride >10µg/kg/min and/or nitroglycerine >20 µg/kg/minor volume loading; GIT= gastrointestinal tract.

Table-2: The Multiple Organ Failure (MOF) score [10]

Character	Frequency (n,%)	Mean (SD)	Median	Minimum duration	Maximum duration
Age group (years)					
<9	03(2.85)	27.28±13.4	20	66	7
10-19	33(31.42)				
20-29	17(16.19)				
30-39	17(16.19)				
40-49	13(12.38)				
>50	22(20.95)				
Sex					
Male	64(60.95)				
Female	41(39.04)				
Duration of symptoms					
≤24 hour	18(17.13)				
2-7 days	77(73.30)				
8-15 days	08(07.61)	3.7±3.26	3	12 hours	15
>15 days	02(03.80)				
Duration of hospital stay (days)					
1-7	65(61.88)				
8-14	35(33.32)	7.85±1.59	8	3	40
15-21	02(1.90)				
≥22	03(2.80)				

Table-3: Characteristics of the subjects (N=105)

MPI score	Generalized peritonitis		Localized peritonitis		
	Survivors	Death	Survivors	Death	Total
≤20	22	00	57	00	79
21-29	12	06	01	02	21
>29	01	04	00	00	05
Total	35	10	58	02	105

Table-4: Distribution of peritonitis in 3MPI groups

Parameter	Mortality rate	Risk ratio (95%CI)
Age (years)		
<50	8.64%(7/81)	Base line
>50	41.61(5/12)	4.8(0.1075-0.755)
Cause of peritonitis		
AA and AP	1.4(1/71)	Base line
SBP	2.6(4/15)	1,8(0.436-6.597)
PPU	2.1(3/14)	1.5(0.58-7.59)
Interval till surgery		
<24 hour	10(2/20)	Base line
>24 hour	13.6(10/73)	1.36(0.375-0.76)
MPI score		
<21	1.38(1/74)	Base line
21-29	28.8(7/18)	20.7(0.35-6.61)
>29	86.0(4/1)	59.59(0.116-2.22)

a=AA, acute appendicitis, AP, appendicular perforation. b=SBF, small bowel perforation. c=PPU, peptic ulcer perforation

Table-5: Relation of patient's parameters to death

Parameter	Survivors (n =93)	Non survivors (n=12)	P-value
MOF score	0.82±0.115	3.80 ±1.74	<0.001
MPI score	17.48±5.8	28.50±3.6	<0.001

Table-6: Distribution of MOF score and MPI score among survivors and non survivors

Score	Sensitivity
MPI score at 20	100%
MOF score	83.3%

Table-7: Sensitivity of score for mortality

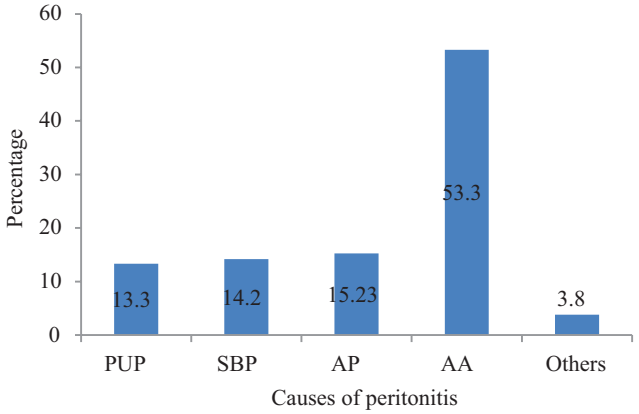

Figure-1: Distribution of cases in different etiologies

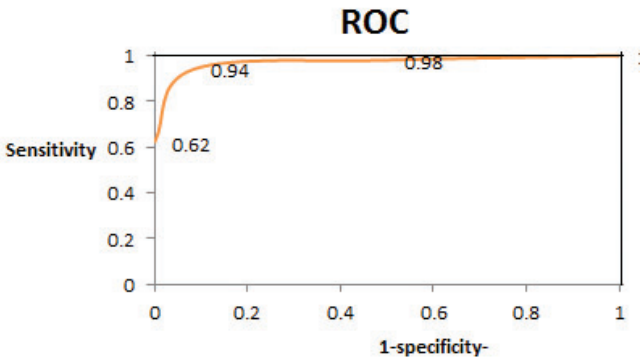

Figure-2: Mortality ROC curve for sensitivity and specificity. Area under the curve is 0.922with a sensitivity of 50.0% and specificity of 98.5% at an MPI of 27 points.

mean(5.9±0.831) compared to survivors (3.25±0.95). This difference is statistically significant (*P*=<0.001).Similarly, non-survivors had higher MPI mean(28.50±3.6) compared to survivor (17.48±5.8). This difference is statistically significant (*P*<0.001) (Table-6).

The area under the curve (AUC) of the receiver operating characteristic(ROC) curve analysis for predictive power of MPI was 0,922 with sensitivity of 50% and specificity of 98.5% at an MPI of 27 points in hospital mortality (figure-2)

DISCUSSION

Previous reports of studies conducted at multiple centers have confirmed mortality rates in peritonitis continues to be high ranging from 19.5% to 60% despite advances in antimicrobials, critical care management and aggressive surgical techniques.[1-4] In the present study, mortality rate was 11.4%. This lower rate of mortality was because of sample demographics as it constituted localized and generalized peritonitis.

Present study showed increasing mortality rates with increasing MPI score. Mortality rate of 0%, 61.5% and 80% was observed at MPI score of ≤20, 21-29 and >29. On stratifying patients in 2 MPI score of ≤27 and >27, mortality rates were 6.1% and 85.7% respectively. The lowest (0%) mortality was at ≤ 20 and highest (85.7%) at >27 MPI score. This shows that there was strong association between increasing mortality with increasing MPI score. Sensitivity and specificity of MPI score at >27 and >29 were 50%, 33% and 98%, 9% in both scores respectively. The cutoff point of zero mortality and highest mortality and sensitivity and specificity of MPI score for predicting mortality varies in different studies.[11-13] This difference could be because of demographics of sample.

Organ dysfunction and failure was observed in 15 (14.28%) patients. Out of 12 mortality recorded, 8 had multiple organ failure. The difference in the mortality between presence and absence of organ failure was statistically significant (*P* <0.001). The decreasing order of organ dysfunction/failure were, renal (15), cardiac (13), respiratory (12), liver dysfunction (9), and haematological (7) cases. There were 2 cases of CNS dysfunction in non-survivors and none in survivors. There was no a single case of GI failure as defined in MOF score. There was very low incidence of CNS and GI failure and rarely associated with poor outcome. This finding is consistent with reports of previous workers.[1] Due to lack of clear definition and poor incidence original MOF was revised in 2002 that does not include GI and CNS system.[15] Non- survivors had mean MOF score 5.90±0.831 and survivor had a mean of3.25±0.95. This difference is statistically significant (*P*<0.001).

Age as risk factor was associated with outcome. Patients <50 years of age with three or four organ failure and patients >50 years of age with 1 or 2 organ failure carry poor prognosis. None of the patient <50 years of age died without organ failure whereas 2 of the patient >50 years of age died suddenly due to cardio-respiratory failure. These finding suggests that age plays an important role in mortality. The mortality rate of 50% and 6.4% was associated with >50 and <50 years of respectively. Patients with MPI >29 score with one failing organ and or age >60 years had poor outcome. There is strong association in mortality with increase in MPI and MOF score.[1,11-13]

Previous studies have confirmed that mortality prediction of MPI scoring system is comparable to the other scoring system like APACHE II.[12,14] In the present study, both MPI and MOF scoring system have shown increasing mortality with increasing MPI and MOF score. The Score sensitivity of mortality were 100% and 83.33% for MPI score 20(cutoff point) and MOF score respectively (Table-7). The lower sensitivity of MOF score was due to death of some cases above 50 years of age without organ failure. The present study shows that MPI had higher sensitivity in prediction of mortality than MOF. To the best of my knowledge this finding was not reported by previous workers.

CONCLUSION

Increasing MPI and MOF score were associated with poor outcome. Both MPI and MOF scores were good predictors of mortality in cases of peritonitis. However; MPI scoring system is more sensitive than MOF score.

Recommendation

MPI score is easy, more sensitive, can be used in stratification of cases of peritonitis for choosing appropriate treatment and prognosticating outcome.

Limitation

The study included both localized and generalized peritonitis. The cases of generalized peritonitis are less in number. Further studies are required to validate the finding of the present study

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