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Evaluation of Mannheim's Peritonitis Index in Prediction of Mortality in Patients with Non-traumatic Hollow Viscus Perforation Peritonitis

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ABSTRACT

Background: Hollow viscus perforation peritonitis is one of the commonest surgical emergencies with high mortality and morbidity. The objective of this study was to evaluate the effectiveness of Mannheim's peritonitis index in prediction of mortality in these patients.

Methods: This is a retrospective, observational cohort study in these patients managed in a single-center from January 1, 2013 to December 30, 2019. Total index scores were plotted in the receiver operating characteristic curves to find out the cut-off point. Sensitivity, specificity, relative risk, positive and negative predictive values were calculated. The individual risk factors were analyzed for mortality as well.

Results: Case records of 395 cases of non-traumatic hollow viscus perforation peritonitis were available, there were 33 mortalities (8.2%), mean score was 22.96 ($\pm$7.6) points (range 10-43 points). The sensitivity and specificity with score cut-off of 25 came to be 75.8% and 56.35%; positive and negative predictive value being 13.7% and 96.2%. Risk of patients for mortality with scores $\geq$25 was 3.62 times those with scores <25 for mortality. Mortality rate was 2.4% with scores <21, 8.9% with 21–29 and 20.9% with >29 respectively (p-value <0.05). Univariate analysis showed age >50 years, presence of organ dysfunction, diffuse peritonitis, non-colonic origin and character of exudates were significant factors; multivariate analysis showed only organ failure as significant.

Conclusions: Mannheim peritonitis index is very useful in stratification of severity of the disease and prediction of mortality in patients with peritonitis, and should be included in management of all these patients.

Keywords: Mannheim's peritonitis index; perforation peritonitis

INTRODUCTION

Hollow viscus perforation peritonitis is a potentially life-threatening condition, and is one of the commonest surgical emergencies with high mortality and morbidity rate.[1] Early identification of these patients helps in selecting patients for aggressive surgical and intensive care approach.[2] It is from this background that different scoring systems such as APACHE-II, SAPS-II, and Mannheim Peritonitis Score (MPI) were introduced practice to indicate prognosis of this challenging entity.[3-7] MPI, proposed by Wacha and Linder in 1983, has 8 clinical, biochemical and pathological risk factors , and gives a relatively easy means of evaluation and categorization of patients with non-traumatic hollow viscus peritonitis.[5] Published literature of the application of MPI in Nepalese population is also limited.[1,8,9] We plan to deliver a consolidated analytical study to evaluate the MPI scoring system to predict the risk of mortality in patients with non-traumatic hollow viscus peritonitis and analysis of its independent risk factors.

METHODS

The study was conducted as a single centered, retrospective, observational study, started from January 1 2013 to December 30 2019, including all patients presenting to emergency of Civil Service Hospital, Minbhawan, Kathmandu, Nepal with confirmed diagnosis (clinical, radiological and intraoperative) of peritonitis

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due to non-traumatic hollow viscus perforation. Ethical approval was taken from the Institutional Ethical Review Committee of Civil Service Hospital (protocol no. 01/2020). Inclusion criteria were 1] age >14yrs (children to be excluded), 2] patient presenting to emergency department or admitted in ward with clinical or laboratory features suggestive of non-traumatic hollow viscus perforation peritonitis. Exclusion criteria were 1] patient with history of trauma, 2] patient with concomitant mesenteric thrombosis, found intraoperatively or preoperatively, 3] patients managed conservatively, 4] patient having other associated significant illness which affects the outcome more than the disease, such as severe COPD, recent massive MI.

Data was collected by one of the authors from the medical record section of Civil Service Hospital on a structured proforma covering the relevant subject matter of the study; viz. the parameters constituting MPI including age, sex, duration of presentation, and co-morbidity escalating to organ failure, blood urea, serum creatinine, serum electrolytes, arterial blood gas analysis for spo2 and pCO2. Intraoperative diagnosis confirming site of perforation (colonic or non-colonic), and intraoperative findings as to the characteristics of exudates were recorded. The outcome of the patients was recorded, i.e. mortality or discharge; and histopathology reports were collected to determine malignant and non-malignant pathology. Total MPI score was designated to each patient totaling the scores as per risk factors, as originally described by Wacha and Linder; viz. age >50 years scoring 5, female gender 5, organ failure (defined as kidney failure = creatinine level >177 umol/L or urea level >167 mmol/L or oliguria <20 ml/h; pulmonary insufficiency = pO2 <50 mmHg or pCO2 >50 mmHg; intestinal obstruction/paralysis >24 h or complete mechanical ileus) 7, malignancy 4, preoperative duration of peritonitis >24 hours 4, origin of sepsis non-colonic 4, diffuse generalized peritonitis 6 and character of exudates clear 0 or cloudy purulent 6 or fecal 12.[5] The maximal possible total MPI score is 47 and minimal possible score is 0.

Data obtained was analyzed using statistical software – SPSS (Statistical Package for Social Sciences) for windows version 16 (SPSS inc, Chicago, IL ,USA). Frequency distribution was calculated for nominal and ordinal variables. Total MPI scores were stratified for risk factor analysis. The receiver operating characteristic (ROC) curve was plotted with sensitivity against 1-specificity, and cut off value in MPI score was identified for mortality. Depending upon the cutoff value patients were further categorized in two groups. The statistical analysis was done by Pearson's Chi-square test for qualitative data and univariate analysis comparing two groups (survivors and non-survivors); and results obtained are presented in tables. 'P' value less than 0.05 was considered statistically significant. Sensitivity, specificity, relative risk, positive and negative predictive values were calculated. Multivariate analysis was done using binary logistic regression analysis.

RESULTS

Out of records of 415 patients of non-traumatic hollow viscus perforation peritonitis during the intended period, 5 had been managed conservatively and 15 had other significant co-morbidities such as severe COPD, recent history of severe myocardial infarction, and hemorrhagic stroke, which did affect the outcome more than the disease itself, so were excluded from the study. Thus, 395 patients who were operated for hollow viscus perforation peritonitis within the study period and meeting the inclusion criteria was included. Of these, 289 (73.16%) were males while 106 (26.83%) were females (Table 1). The mean age of presentation was 39.15 (±11.2) years, (range 15-87). 148 patients (33%) were aged between ≥50 years. The mean duration of symptoms prior to presentation to hospital was 2.82 (±1.65) days (ranged 1-9 days) with two peaks on the second and five days. The mean MPI was 22.96 (±7.6) points (range 10-43).

Table 1. Age and Gender distribution.

Variables		Number (Percentage of total, n=395)
Age, years	≥50	148 (37.46%)
	<50	247 (62.54%)
Gender	Male	289 (73.16%)
	Female	106 (26.83%)

Out of 395 patients, 33 patients died, giving 8.2% overall mortality rate. Overall, 8 patients (3.77%) among 212 patients with MPI core <25 died, and in 183 patients with total MPI score ≥25, 25 patients (13.66%) died. ROC curve was generated to identify the cutoff of MPI score (Figure 1). Area under curve being 0.63, MPI score 25 is the cutoff. and the corresponding sensitivity and specificity came to be 75.8% and 56.35%; and positive and negative predictive value being 13.7% and 96.2% (Table 2). The relative risk of patients with MPI ≥25 is 3.62 than those with <25 for mortality. When grouped with total scores <21, 21-29, and >29, observed mortality rate was 2.4%, 8.9%, and 20.9%, respectively

(p-value <0.05) (Table 3). Univariate analysis of individual risk factors for correlation with increasing MPI scores using the Chi-square test showed that age ≥50 years, presence of organ dysfunction, non-colonic origin, diffuse peritonitis and character of exudates all were significantly associated with an MPI score of ≥25 and hence increased mortality (Table 4). Multivariate analysis showed that only presence of organ failure was significantly associated with mortality (Table 5).

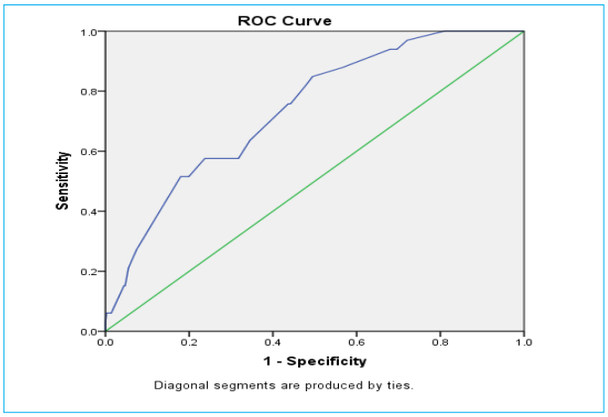

Figure 1. ROC Curve analysis for mortality.

Table 2. Correlation of MPI with Mortality.

Variables	Number, or Percentage (95%CI)
Mortality, MPI Score <25, n=212	8 (3.77%)
Mortality, MPI Score ≥25, n=183	25 (13.66%)
Relative Risk (RR)	3.62
Sensitivity	75.76% (0.57- 0.89)
Specificity	56.35% (0.51- 0.62)
Positive predictive value	13.66% (0.11- 0.16)
Negative predictive value	96.23% (0.93 - 0.98)

X^2 = 12.54, p-value = 0.000398

Table 3. MPI score sub-groups correlation with mortality.

MPI score	Total Patient(n)	Outcome (n)		Percent
		Discharged	Death	
<21	161	157	4	2.4%
21-29	145	132	13	8.9%
>29	86	68	18	20.9%

X^2 = 23.45, df = 2, p-value = 0.000103

Table 4. Univariate analysis of correlation of mortality with individual risk factors.

Risk Factors		Total	Death	Suvivors	X^2	Df	p- Value
Age	<50y	148	20	128	8.220	1	0.004
	≥50y	247	13	234			
Gender	F	106	11	95	1.346	1	0.379
	M	289	22	267			
Organ failure	Present	163	23	140	12.009	1	0.0005
	Absent	232	10	222			
Malignancy	Present	6	1	5	0.549	1	0.458
	Absent	389	32	357			
Pre-op duration	>24hrs	303	24	279	0.3195	1	0.572
	<24hrs	92	9	83			
Site	Non-colonic	277	30	247	7.4239	1	0.006
	Colonic	118	3	115			
Peritonitis	Diffuse	315	32	283	6.613	1	0.01
	Localized	80	1	79			
Exudate	Clear	16	1	15	7.904	2	0.019
	Cloudy	353	26	357			
	Faecal	26	6	20			

statistically significant 'p'-values (<0.05). df = Degrees of Freedom.

Table 5. Binary Logistic regression analysis for Mortality.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper	
Step 1[a]	Age(1)	-.585	.416	1.971	1	.160	.557	.246	1.261
	Sex(1)	-.636	.418	2.314	1	.128	.530	.234	1.201
	Duration(1)	.249	.446	.310	1	.578	1.282	.535	3.074
	Organ failure(1)	-.909	.438	4.309	1	.038	.403	.171	.951
	Exudate MPI score			3.062	2	.216			
	Exudate MPI score(1)	-1.203	1.207	.993	1	.319	.300	.028	3.197
	Exudate MPI score(2)	-.255	1.113	.052	1	.819	.775	.087	6.875
	Noncolonic origin MPI score(1)	-.923	.694	1.772	1	.183	.397	.102	1.547
	Malignant(1)	-.029	1.215	.001	1	.981	.972	.090	10.502
	Diffuse peritonitis(1)	-1.169	1.108	1.112	1	.292	.311	.035	2.728
	Constant	5.336	1.535	12.082	1	.001	207.590		

a. Variable(s) entered on step 1: Age, Sex, Duration, Organ failure, Exudate, Noncolonic origin, Malignant, Diffuse peritonitis
B=coefficient for Constant , SE = Standard Error, Wald. = Wald test, df = Degrees of Freedom, Sig. = Statistical Significance, Exp (B)=Odds ratio, CI = Confidence Interval; statistically significant variable(s) in bold.

DISCUSSION

This study regarding the MPI scores comprises one of largest consecutive sample of patients diagnosed as non-traumatic hollow-viscus perforation over a relatively long time, reported from Nepal. Previous studies have been of smaller sample sizes; though they have also demonstrated effective prediction and usefulness of MPI scores, as with our results.[1,8,9] We had an overall mortality rate of 8.2%; which is in keeping with other similar studies in Nepal and other developing countries, but in contrast to studies in western countries which report much less mortality.[6,-10] Our study concluded the mean MPI to be 22.96 (±7.6) points, which favors well with other previous studies, which have reported varied mean MPI scores of 27.1 points, 24.2 points, and 20±8 points.[5,7,9-11] MPI has been used to define risk groups as well as predict outcome in patients with peritonitis, as indicated by various studies. One study showed patients who obtained <21 points and more than 29 points, mortality rate was 6% and 50%, respectively.[5] Another showed mortality at score of above 21 and 29 of 60% and 100%; another author showed that below 21, mortality was 0%; between 21 and 29, mortality was 29%; and more than 29, it was 100%.[6,12-14] Studies showed that mortality among patients who obtained <21 points varied between 0% and 2.3%, in the 21-29 point group between 3.85% and 60%, and in patients with score of >29 between 15% and 100%.[15,16] The only meta-analysis showed the following mean mortality rates in the groups with <21 points, between 21 and 29 points, and above >29 points: 2.3% (0-11%), 22.5% (10.6-50%), and 59.1% (41-87%), respectively.[17] Our study showed mortality rate with score <21, 21-29, and >29 was 2.4%, 8.9%, and 20.9%, respectively. The predictions resulting from MPI were reliable, indicating stratification of risk groups can be done by probability intervals.

Many studies used different cutoff points for better prediction of mortality. In a study from Japan, patients with MPI score of 26 or less had mortality of 3.8%, whereas score of 26 or more had mortality of 41%.[18] Another author showed 100% mortality above MPI of 27.[4] Others have also reported high sensitivity (86-100%) but low specificity (16-74.8%) of this scoring index.[2,6] Most authors have also concluded that mortality is significantly higher in patients with mean score >26 points.[11,12,16] From our study, MPI 25 was identified as the cut-off point of the score: those in group with MPI ≥25 had 13.66% mortality compared to 3.77% mortality in group with MPI <25 (p-value <0.05); with sensitivity of 75.8% and specificity of 56.3% for mortality. Such difference in these cutoff values might be due to different geographical location, population and differing treatment strategies. The predictive factors found significant for mortality in our study were age >50yrs, organ failure, non-colonic origin, diffuse peritonitis, and character of exudates by univariate analysis, and only organ failure by multivariate analysis. The factors found insignificant were female gender, malignant cause and preoperative duration >24 hrs. These findings are in somewhat contrast to some studies earlier, where

female sex, colonic origin and malignant cause were found significant.[6,19,20]

Perforation peritonitis is a frequently encountered surgical emergency in all countries. It is necessary to recognize patients at risk preoperatively and prepare for an intensive postoperative management strategy. This becomes more significant in our underdeveloped setup, where the intensive care facilities are limited and overwhelmed by the number of patients. The successful management of hollow viscus peritonitis has always been a great challenge to the surgeon in spite of advancements in medical sciences. Therefore, prognostication has become part and parcel of modern medical practice. The best part about MPI is that it is a simple and reproducible scoring system; that allows a surgeon to determine the severity of the intra abdominal infection, and to indicate individual risk to select patients who may require a more aggressive surgical approach. Thus MPI score, along with its stratification and resulting prognostication appears to be practical, less time consuming, and can be equally applied in all emergency conditions; hence is more apt to be applied in resource-limited setting as ours.

CONCLUSIONS

The results of our study on MPI score and its stratification to predict the outcome in non-traumatic hollow-viscus perforation peritonitis is in concordance with most studies worldwide. Our study differs in three adverse outcome variables: female sex, preoperative duration and malignancy, we advocate need for further studies on validation in this matter. This study though conducted in a relatively large number of patients; due to its retrospective nature in a single-center scenario, multi-centric prospective studies are recommended. Finally we like to conclude that MPI score must be included in management of all patients with hollow viscus perforation peritonitis, aiming to identify high risk patients and to ultimately help in aggressive management and improvement of outcome.

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