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Mannheim Peritonitis Index and APACHE II - Prediction of outcome in patients with peritonitis

Mannheim Peritonit İndeksi ve APACHE II - Peritonitli hastalarda sonucun öngörülmesi

Ajaz Ahmad MALIK, Khurshid Alam WANI, Latif Ahmad DAR, Mehmood Ahmed WANI, Rauf Ahmad WANI, Fazl Qadir PARRAY

BACKGROUND

Early prognostic evaluation of patients with peritonitis is desirable to select high-risk patients for intensive management and also to provide a reliable objective classification of severity and operative risk. This study attempts to evaluate the use of scoring systems such as Acute Physiological and Chronic Health Evaluation score (APACHE II) and Mannheim Peritonitis Index (MPI) in patients with peritonitis.

METHODS

A prospective study was conducted using 101 consecutive patients (69 male, 32 female) having generalized peritonitis over a two-year period. Both scoring systems were applied to patients before laparotomy. Based upon the scores, patients were arranged into three groups. The outcome of patients was noted and the accuracy of the two systems was evaluated.

RESULTS

In the MPI system, mortality was 0 in the group of patients with a score of less than 15, while it was 4% in the patients scoring 16-25 and 82.3% in those with scores of more than 25. Similarly, in the APACHE II system, no mortality was noted in patients with scores less than 10. Mortality was 35.29% and 91.7% in the groups scoring 10-20 and more than 20, respectively.

CONCLUSION

Both scoring systems are accurate in predicting mortality; however, the APACHE II has definitive advantages and is therefore more useful.

Key Words: Peritonitis; morbidity; mortality.

AMAÇ

Peritonitli hastaların erken prognostik değerlendirmesi, yoğun bakım açısından yüksek risk taşıyan hastaların seçilmesi ve aynı zamanda güvenilir objektif bir şiddet ve operatif risk sınıflaması için tercih edilir. Bu çalışmada, peritonitli hastalarda Akut fizyolojik ve Kronik Sağlık Değerlendirme skoru (APACHE II) ile Mannheim peritonit indeksi (MPI) gibi skorlama sistemlerinin kullanımı değerlendirildi.

GEREÇ VE YÖNTEM

İki yıllık bir periyot boyunca jeneralize peritoniti olan ardışık 101 hasta (69 erkek, 32 kadın) üzerinde prospektif çalışma yürütüldü. Laparotomiden önce hastalara her iki skorlama sistemi de uygulandı. Skorlara esas alınarak, hastalar üç gruba ayrıldı. Hastaların sonuçları kaydedildi ve her iki skorlama sisteminin doğruluğu değerlendirildi.

BULGULAR

MPI sisteminde mortalite; 15'den daha düşük bir skoru olan hastalarda 0 olurken, 16-25 seviyesinde bir skoru olan hastalarda %4 ve 25 seviyesinden daha yüksek bir skoru olan hastalarda da %82,3 oldu. Benzer şekilde, APACHE II sisteminde de 10'dan daha düşük bir skoru olan hastalarda hiçbir mortalite kaydedilmedi. Mortalite; 10-20 seviyesinde bir skoru olan gruplar ile 20 seviyesinden daha yüksek bir skoru olan gruplarda, sırasıyla %35,29 ve %91,7 oldu.

SONUÇ

Her iki skorlama sistemi, mortalitenin öngörülmesinde hassastır. Bununla birlikte, APACHE II, kesin avantajlara sahiptir ve bu nedenle daha kullanışlıdır.

Anahtar Sözcükler: Peritonit; morbidite; mortalite.

Department of General Surgery,
Sheri Kashmir Institute of Medical Science, Kashmir, India.

Sher-I-Kashmir Tıp Bilimleri Enstitüsü,
Genel Cerrahi Anabilim Dalı, Keşmir, Hindistan.

Correspondence *(İletişim):* Mehmood Ahmed Wani, M.D. Sher-I-Kashmir Institute of Medical Sciences, Department of General Surgery, Kashmir, India.
Tel: +0194 - 2431501 e-mail *(e-posta):* mav807@rediffmail.com

Generalized peritonitis is a frequently lethal condition. It continues to be one of the major problems confronting physicians, surgeons and their patients throughout the world. Until the end of the last century, peritonitis was treated medically with a mortality of 90%.[1] In 1926, Krishner showed that the mortality of peritonitis could be reduced by strict implementation of surgical principles, and the mortality rate dropped to below 50%. Since then, despite innumerable advances in surgical skills, antimicrobial agents and supportive care, the mortality of peritonitis remains high and is presently reported as between 13 and 43%.[2] The prognosis and outcome of peritonitis depend upon the interaction of many factors, including patient-related factors, disease-specific factors, and diagnostic and therapeutic interventions. Categorizing patients into different risk groups would help prognosticate the outcome, select patients for intensive care and determine operative risk, thereby helping to choose the nature of the operative procedure, e.g. damage control vs. definitive procedure. Various scoring systems have been used to assess the prognosis and outcome of peritonitis. Those used include the Acute Physiological and Chronic Health Evaluation score (APACHE II), the Mannheim Peritonitis Index (MPI), the Peritonitis Index Altona (PIA), the Sepsis Score, and the Physiological and Operative Severity Score for Enumeration of Mortality and Morbidity (POSSUM). Various authors have reported APACHE to be a better system for prognostication of the outcome of patients with peritonitis,[3,4] while others concluded that MPI provides a more reliable means of risk evaluation.[5]

The present study was undertaken to assess the use of both these scoring systems in patients with peritonitis of any cause.

MATERIALS AND METHODS

This prospective study was conducted in the Department of General Surgery at the Sheri Kashmir Institute of Medical Sciences over a period of two years from May 2004. All patients above the age of 15 years clinically diagnosed as having peritonitis were included in the study. A total of 101 patients were recruited. All the patients were subjected to emergency exploratory laparotomy. The surgical procedure performed depended upon the operative findings and the surgeon's choice, as no guidelines could be laid down due to the varied etiology.

Two systems were used to score the patients. The MPI as proposed by Wacha[6] was an analysis of 17 possible risk factors, of which 8 were of prognostic significance and were included in the present study (Table 1). Points were added for each factor present and the MPI score was calculated by adding these points.

Table 1. Mannheim Peritonitis Index scoring

Risk Factor	Weighting if present
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 >177 umol/L
	Urea level >167 mmol/L
	Oliguria <20 ml/h
Lung	PO_2 <50 mmHg
	PCO_2 >50 mmHg
Shock	Hypodynamic or Hyperdynamic
Intestinal obstruction	Paralysis >24h or complete mechanical obstruction

The APACHE II scores were calculated as per the method of Knaus.[7] The Acute Physiological Score (APS) is based upon 12 physiological variables (Table 2). These values were scored in accordance with abnormally high or low range. The score ranged from 0 to 4 on each side of the normal value. Zero score represents a normal value; an increase to 4 indicates the extreme end of high or low abnormal levels. Age points for adults were included in the study as follows: <44=0, 45-54=2, 55-64=3, 65-74=5, >75=6.

Chronic Health Points (CHP) were added if the patient had a history of severe organ system insufficiency or was immunocompromised; points were assigned as follows: 2 for elective postoperative patients and 5 for non-operative or emergency postoperative patients.

The Glasgow Coma Score (GCS) ranging from 3-15 was also assessed in the study.

The APACHE II Score was then calculated by the formula:

APACHE II score = APS + Age points + CHP

For each physiological variable, we included the most abnormal measurement prior to surgery if the test had been done more than once. The outcome of each patient was noted and compared to the initial score. Thus, the value of each scoring system was tested in prognosticating the outcome of patients. The two scores were compared statistically using Student's t test, and a p value <0.05 was considered significant.

Observations

Of the 101 patients, 69 were male and 32 female

Table 2. APACHE II scoring system

Physiological variables	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature (C)	>41	39-40.9		38.5-38.9	36-38.5	34-35	32-33.9	30-31.9	<29.9
Mean arterial pressure	>160	140-179	11-139		70-109		55-69		<49
Heart rate	>180	140-179	11-139		70-109		55-69	40-54	<39
Respiration rate	>50	35-49		25-34	12-24	10-11	6-9		<5
Oxygenation PaO_2 (mmHg)	>500	350-499	200-349		<200				
Arterial pH	>7.7	7.5-7.59		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15
Serum Na (mmol/L)	>180	160-179	155-159	150-154	130-149	3-3.4	120-129	111-119	<110
Serum K (mmol/L)	>7	6-6.9		5.5-5.9	3.5-5.4		2.5-2.9		<2.5
Serum creatinine (mg/dl)	>3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
Hematocrit (%)	>60		50-59.9	46-49.9	30-45.9		20-29.9		<20
White blood count (Total/mm^3)	>40		20-39.9	15-19.9	3-14.9		1-2.9		<1
Serum HCO_3 (mmol/L) (not preferred, use if no ABG)	>52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15
**Serum urea (mmol/L)	>15	9-14	5-9		1-4.9		<1		

and their ages ranged from 15 to 90 years. The etiology of peritonitis was markedly varied (Table 3) as were the operations performed. Of the seven patients grouped under miscellaneous, two had ruptured liver abscesses, two had infected pancreatic necrosis, one had a retroperitoneal tumor ruptured into the peritoneum, one a gangrenous twisted enterogenous cyst, and one a perforated Meckel's diverticulum. Thirty-six patients had complications, giving an overall morbidity of 36.64%. Postoperatively, 11 patients continued to have shock, 6 went into renal failure, 10 had documented septicemia, 5 had anastomotic leaks and 4 had burst abdomen. Seventeen patients in the study died, for a mortality of 16.8% (Table 4).

All the patients were scored using both MPI and APACHE II scoring systems (Tables 4, 5). Based upon their MPI score, the patients were divided into three groups according to MPI scores of less than 15, 16-25 and more than 25. The overall mean MPI score in survivors was 18.4 (range: 10-31), while in the non-survivors, the mean score was 32.12 (range: 31-47), and the difference between groups was significant ($p<0.05$). None of the patients with scores less than 15 died. For the 75 patients scoring 16-25, the mortality was 4%, but the rate increased to 82.3% when the score was more than 25. While studying the individual mortality rates based upon the etiology, it was noted that all patients with colonic perforations had high MPI scores (>25) and a high mortality (Table 4).

Similarly, based upon the APACHE II scores, the patients were divided into three groups. Overall, of the 84 survivors, the scores ranged from 0-21, with a mean of 5.0. The 17 who died had scores ranging between 15-38 and a mean of 23.3, and again the difference between groups was significant ($p<0.05$). No mortality was observed in the patients with a score of less than 10, and of the 17 patients with scores between 11-20, 6 died, with a mortality of 35.29%. A mortality of 91.7% was noted in patients with scores of more than 20.

Notably, when studying the various etiological groups, it was seen that 2 of the 6 patients with colonic perforations had scores of less than 10 and both of them survived, while all the others died. All the patients in the various groups who had scores of more than 20 died, except for 1 patient who had an appendicular perforation (Table 5).

Table 3. Mortality in each etiological group

Cause of peritonitis	No of patients	No of deaths	Mortality rate
Peptic ulcer perforation	31	3	9.6%
Appendix perforation	20	0	0
Postoperative peritonitis	12	4	33%
Small intestinal perforation	10	2	2%
Colonic perforation	6	4	66.7%
Genitourinary tract perforation	6	0	0
Gangrene gut	4	1	25%
Stomach perforation (other than peptic)	3	0	0
Gallbladder perforation	2	0	0
Miscellaneous	7	3	42.3%
Total	101	17	16.8%

Table 4. Mortality rate as per Mannheim Peritonitis Index (MPI) score

Cause of peritonitis	MPI Score								
	<15			16-25			>25		
	n	NS	MR	n	NS	MR	n	NS	MR
Peptic ulcer perforation	4	0	0	25	1	4.1%	2	2	100%
Appendix perforation	1	0	0	19	0	0	0	0	0
Postoperative peritonitis	0	0	0	8	1	12.5%	4	3	75%
Small intestinal perforation	0	0	0	9	1	11.1%	1	1	100%
Colonic perforation	0	0	0	0	0	0	6	4	66.7%
Genitourinary tract perforation	0	0	0	6	0	0	0	0	0
Gangrene gut	0	0	0	3	0	0	1	1	100%
Stomach perforation (other than peptic)	0	0	0	3	0	0	0	0	0
Gallbladder perforation	0	0	0	2	0	0	0	0	0
Miscellaneous	4	0	0	0	0	0	3	3	100%
Total	9	0	0	75	3	4%	17	14	82.3%

NS: Non-survivors; MR: Mortality rate.

Table 5. Mortality as per the APACHE II scores

Cause of peritonitis	APACHE II Score								
	<10			11-20			>20		
	n	NS	MR	n	NS	MR	n	NS	MR
Peptic ulcer perforation	29	0	0	1	1	100%	1	1	100%
Appendix perforation	16	0	0	3	0	0	1	0	0
Postoperative peritonitis	5	0	0	5	2	40%	2	2	100%
Small intestinal perforation	6	0	0	2	0	0	2	2	100%
Colonic perforation	2	0	0	2	2	100%	2	2	100%
Genitourinary tract perforation	6	0	0	0	0	0	0	0	0
Gangrene gut	1	0	0	2	0	0	1	1	100%
Stomach perforation (other than peptic)	2	0	0	1	1	100%	0	0	0
Gallbladder perforation	2	0	0	0	0	0	0	0	0
Miscellaneous	3	0	0	1	0	0	3	3	100%
Total	72	0	0	17	6	35.3	12	11	91.7

NS: Non-survivors; MR: Mortality rate.

DISCUSSION

Multicenter studies have confirmed that in-hospital mortality of peritonitis continues to be high, at about 19.5%,[5] although in some studies it reaches 60%.[8-11] Various factors influence the prognosis and outcome of peritonitis, ranging possibly from disease-specific factors and patient-related factors to a multitude of diagnostic and therapeutic interventions. The outcome in most of these patients is therefore difficult to predict. Early grading of the severity of peritonitis may help in deciding surgical and medical management. Scoring systems also help in risk stratification and in the evaluation of new diagnostic modalities and therapeutic advances as well as in the comparison of treatment results from different clinics. The MPI and APACHE II systems have been shown to contribute independently to the prediction of outcome.[12]

The MPI is based upon data from 1253 patients with peritonitis treated between 1963 and 1979 and was developed by analysis of 17 possible factors.[6] In previous studies,[5,13,14] patients with scores of less than 21 had a mortality rate ranging from 0-2.3% and those with MPI between 21 and 29 had a mortality rate of approximately 65%.[14] MPI score of more than 29 had the highest mortality, up to more than 80% in some studies.[15] These authors believed the accuracy of MPI to be comparable or slightly superior to that of other sepsis scoring systems, including APACHE II.[16,17] Previous studies have shown important cut-off points to be 21 and 29 when using the MPI, with mortality of 60%, and up to 100% for scores of more than 29.[15] In the present study, the important cut-off was found to be 15, below which there was no mortality, and 25, beyond which the mortality was more than 80%.

Moshe Schein et al.,[18] in their prospective cum retrospective study of the APACHE II scoring system only in patients who underwent emergency operations for perforated peptic ulcer, confirmed the prognostic value of the scoring system and recommended its further use to stratify patients into various risk groups. However, more recent studies with the use of APACHE II in perforation peritonitis have found that the sensitivity and specificity of scoring with respect to mortality prediction were higher in the group of patients with APACHE II scores between 11 and 20.[19] Despite a rise in observed and predicted hospital mortality with increasing APACHE II score, predicted mortality did not correlate with observed mortality for patients with APACHE II scores of 1 to 10 and greater than 20. The APACHE II score has been found varyingly to underestimate or overestimate death, especially in high-risk patients.[20-22] Aggressive surgical treatment in patients with severe intra-abdominal infection may also significantly decrease postoperative mortality, whereas the impossibility of eradicating the source of infection initially significantly increases the postoperative mortality rate;[23-28] however, this is not considered in the score. In comparison, the present study showed consistently rising mortality for higher APACHE II scores. Similarly, other studies have shown the effective use of MPI or APACHE II in various forms of peritonitis.[29,30]

In the present study, both scoring systems were found to be accurate in predicting the mortality of patients, with patients having higher scores having a higher mortality. However, certain important issues were noted with the use of the two systems. The MPI, although easy to apply and accurate in predicting the mortality, does not at all consider the underlying physiological derangement of the patients, which is important in the acute classification or categorization of the patients who need intensive supportive care. Further, the MPI needs operative findings to complete the score, so in a true sense cannot be used as a preoperative scoring system. This will hamper the use of the system to stratify patients into groups to choose whether damage control or a definitive procedure could be performed safely. The APACHE II scores correlate well with mortality and are effective in the prediction of outcome. It considers the acute physiology of the patient, and can be completed before surgery. Therefore, it is very useful in the acute stratification of the patients into risk groups and in predicting which patients can be considered for more extensive procedures. The score does not consider the etiology of peritonitis or the nature of peritoneal contamination, which has an important bearing on the outcome. Furthermore, the score is not as simple as the MPI; it is more extensive and needs lab support. For a superior prediction of mortality in patients with peritonitis, it may be considered worthwhile to use the combination of the MPI together with the APACHE II score.

In conclusion, in the management of patients with generalized peritonitis, scoring the patients into various risk groups can be beneficial. Patient treatment can be optimized by intensive supportive care when it is determined to be needed; the choice of surgical procedure can be tailored to be the most beneficial; and the outcome in these patients can be predicted. Furthermore, scoring patients into groups based on risk could help future clinical research by comparing therapeutic interventions in similar patients. Of the two scoring systems evaluated, the APACHE II seems to be better suited to achieve these goals.

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