Factors predicting in-hospital mortality of patients with diffuse peritonitis from perforated colonic diverticulitis

Ann. Ital. Chir., 2012 83: 319-324
Published online 15 Novembre 2011
(www.annitalchir.com)

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AIM: *Diverticulitis free perforation still remains a major life-threatening condition. Herein we evaluate factors influencing prognosis of patients with perforated colonic diverticulitis and the current validity of Mannheim Peritonitis Index (MPI) in predicting mortality.*
MATERIAL OF STUDY: *From January 2000 to October 2010, 39 patients were operated on for generalized peritonitis from perforated diverticulitis*
RESULTS: *Five postoperative deaths (12.8%) related to septic shock occurred. A cross-sectional study between deceased and non-deceased patients was carried out. Deceased patients were significantly older than non-deceased (76.4 vs. 59.1 years, p=0.019); duration of symptoms was longer in deceased patients (102 vs. 26.9 hours, p=0.000); MPI was higher in deceased patients (31.4 vs. 21.2, p=0.000). Age, duration of symptoms and MPI were independent risk factors predicting poor prognosis. The highest sensitivity and specificity of MPI in predicting mortality was shown for a score >27.*
CONCLUSIONS: *MPI is still effective in predicting postoperative mortality. People who nurse older persons must pay higher attention to complaints in order to reduce the delay in hospitalization.*

KEY WORDS: Acute diffuse peritonitis, MPI, Perforated colonic diverticulitis, Prognosis, mortality

Introduction

Diverticular disease of the colon is very common in Western developed countries [1]. Despite a large majority of patients remains completely asymptomatic, the number of patients hospitalized because of acute colonic diverticulitis is rising, and up to 20.0% of them require an urgent operation on admission [2]. Although considerable advances in intensive care medicine and surgical treatment, diverticulitis free perforation with generalized peritonitis still remains a major clinical life-threatening condition associated to high mortality rate (up to 30.0%) [3,4]. Prognosis of diffuse peritonitis continues to be poor especially when multiple organ failure syndrome develops. Thus, early prognostic evaluation of abdominal sepsis is useful in assessing operative risk, predicting mortality and in selecting patients for intensive supportive care [5].

Among several classifications useful in predicting prognosis, the Mannheim Peritonitis Index (MPI) is one of the most practical scoring systems used to evaluate sever-

Pervenuto in Redazione Giugno 2011. Accettato per la pubblicazione Settembre 2011.
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ity and outcome of diffuse peritonitis with an adequate sensitivity and specificity [6-8].

The aims of this study were to evaluate factors affecting prognosis in patients operated on for generalized peritonitis from perforated colonic diverticulitis and to investigate the current validity and effectiveness of MPI in predicting postoperative mortality.

Material of the Study

Over the period from January 2000 to October 2010, 132 patients were admitted to our surgical department for complicated colonic diverticular disease. We retrospectively evaluated the clinical charts of 39 patients (29.5%) operated on in emergency setting for generalized peritonitis caused by perforated colonic diverticulitis. We considered the following characteristics: age and sex; health conditions in accordance with the American Society of Anesthesiology (ASA) score; site, diameter and degree of colonic perforation; duration of symptoms; surgical treatment; surgical risk by means of Manheim Peritonitis Index (MPI), (Table I) [6]. Generalized peritonitis from perforated diverticulitis was defined according to the Hinchey's classification by the presence of purulent exudate (Hinchey's stage III) or fecal exudate (Hinchey's stage IV) in the peritoneal cavity (Table II) [9]. Considering postoperative results, a cross-sectional study between deceased and non-deceased patients after surgical treatment was carried out in order to identify those risk factors influencing prognosis. In-hospital mortality was considered when death occurred within 30 days from the operation. Data were collected in a planned relational computer database (Microsoft Office Access). After data inputting, specific queries were devised and data retrospectively analyzed. All statistical analyses were carried out using the MedCalc® 2008 statistical software (version 9.6.4.0). Data for age, diameter of perforation, duration of symptoms and MPI were presented as the mean ± standard error of the mean (SEM) and as the median value when indicate. Data were compared for statistical analysis using the *Chi*–square test to evaluate differences between qualitative variables, and using the Student's *t*-test to compare quantitative variables. The objective of statistical analysis was mainly to identify independent risk factors significantly influencing mortality by means of stepwise Logistic Regression Analysis. The predictive prognostic power of MPI was assessed using the Receiver–operator characteristics (ROC) curve. The area under the curve (AUC) was calculated and an interactive dot diagram was obtained to show the criterion value, i.e. the point cut-off of minimal false negative and false positive results of MPI in predicting mortality. The p values were checked and reported as calculated by the statistical software. Differences were considered significant when $p < 0.05$.

TABLE I - *The Mannheim Peritonitis Index*

Risk factor	Scores
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

*Kidney failure = creatinine level > 177 umol/L or urea level > 167mmol/L or oliguria < 20ml/hour; Pulmonary insufficiency = PO2 < 50 mmHg or PCO2 > 50 mmHg; Intestinal obstruction/paralysis > 24hours or complete mechanical ileus; Shock hypodynamic or hyperdynamic.

TABLE II - *Hinchey's classification of perforated colonic diverticulitis*

Stage I	Confined pericolic abscess
Stage II	Distant abscess (retroperitoneal or pelvic)
Stage III	Generalized purulent peritonitis
Stage IV	Fecal peritonitis

Results

Our series includes 39 patients with generalized peritonitis originating from perforated colonic diverticulitis: 17 females and 22 males with an average age of 61.3 years (range, 34 – 87 years). Five postoperative deaths (12.8%) related to septic shock and multiple organ failure syndrome from peritonitis occurred: 4 patients (80.0%) had diffuse fecal peritonitis and 1 patient (20.0%) had diffuse purulent peritonitis. The deceased patients were over 70 years of age. No other reasons of in-hospital mortality were found. The cross-sectional study well matching those 5 deceased and 34 non-deceased patients revealed that deceased patients were significantly older than non-deceased (76.4 vs. 59.1 years, p=0.019). No significant difference was found for sex and surgical treatment. Perforation involved the sigmoid colon in all cases. A significant difference was found regarding ASA grading, which was higher in deceased patients (Table III); duration of symptoms, which was longer in deceased patients (102 vs. 26.9 hours, p=0.000); diameter of perforation, which was wider in deceased patients (3.3 vs. 1.1 cm, p=0.000); Hinchey's stage which was more frequently fecal in deceased patients (p=0.003); and MPI, which was higher in deceased patients (31.4 vs. 21.2, p=0.000), (Table III). Overall, 8 of 39 patients (20.5%) had fecal peritonitis

TABLE III - *Comparison of clinical and prognostic factors between deceased and non-deceased patients*

Parameter	Deceased	Non-Deceased	p
no.	5	34	
Sex (Female/Male)	0.25/1.0	1.0/1.0	0.349
Age (years), mean ± SEM	76.4 ± 2.8	59.1 ± 2.6	0.019
Range	70 – 85	34 – 87	
Median	74	61	
ASA			
1 – 2	0	22 (64.7%)	0.025
3 – 4	5 (100.0%)	12 (35.3%)	
Site of perforation			
sigmoid colon	5	34	NA
Diameter of perforation (cm)	3.3 ± 0.3	1.1 ± 0.1	0.000
Range	2 – 4	0.2 – 3	
Median	3	1	
Hinchey's stage			
III	1	30 (88.2%)	0.003
IV	4	4 (11.8%)	
Duration of symptoms (hours)	102 ± 15.3	26.9 ± 6.8	0.000
Range	48 – 130	12 – 88	
MPI	31.4 ± 2.0	21.2 ± 0.9	0.000
Range	28 – 39	12 – 28	
Surgery			
Anterior resection	1 (20.0%)	3 (8.8%)	0.984
Hartmann procedure	2 (40.0%)	18 (52.9%)	0.951
Bridge colostomy	2 (40.0%)	13 (38.3%)	0.667

SEM: Standard Error of the Mean; NA: Not applicable
ASA: American Society of Anesthesiology; MPI: Mannheim Peritonitis Index

and all but one had MPI score > 27. Half of them (4 patients) deceased while the other half survived. The deceased patients were over 70 years of age. Among 4 survivors, 3 patients were under 63 years of age and 1 patient was 83 year old. This older patient was operated on within 12 hours from the onset of symptoms and she developed a severe adult respiratory distress syndrome but she was finally discharged in postoperative day 28. The 12 patients older than 70 years who survived had diffuse purulent peritonitis in 11 cases and fecal peritonitis in 1 case.

Multivariate analysis showed that age, duration of symptoms and MPI were independent risk factors predicting poor prognosis (Odds Ratio 1.035, 1.143 and 2.745, respectively), (Table IV). ROC curve of MPI/postoperative mortality is shown in Figure 1. The AUC was calculated as 0.968 with a 95%-confidence-interval from 0.854 to 0.996 (p<0.0001). The diagnostic accuracy of a test is assessed by the area under ROC curve as follows: 0.90 – 1.00 excellent; 0.80 – 0.90 good; 0.70 – 0.80 fair; 0.60 – 0.70 poor; 0.50 - 0.60 fail [10]. The criterion value of MPI with minimal false negative and false positive results was calculated as >27. Indeed, for a threshold index score >27, MPI showed the highest sensitivity and specificity in predicting mortality (100.0% and 88.2%, respectively), (Fig. 2). Patients with >27 points of MPI score had mortality rate as high as 50.0% (5/10).

TABLE IV - *Independent risk factors influencing mortality after stepwise logistic regression analysis*

	β	SE	χ^2	p	OD	95% CI
Age	0.133	0.066	7.474	0.044	1.143	1.003-1.302
Duration of symptoms	0.034	0.013	10.095	0.009	1.035	1.008-1.062
MPI	1.010	0.514	18.584	0.0001	2.745	1.002-7.521

β coefficient; SE, standard error; χ^2, chi square; OD, odds ratio; CI, confidence interval.
MPI: Mannheim Peritonitis Index

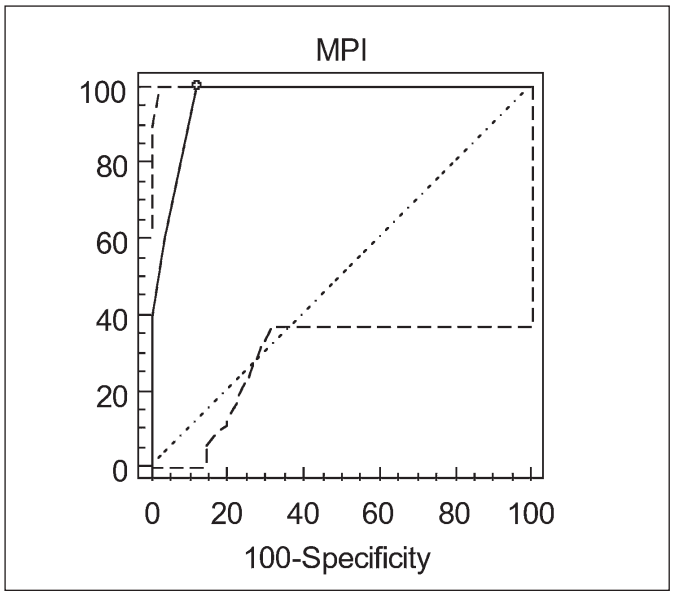

Fig. 1: Receiver-operator characteristic (ROC) curve of the sensitivity and specificity of the MPI/postoperative mortality. Area under curve 0.968.

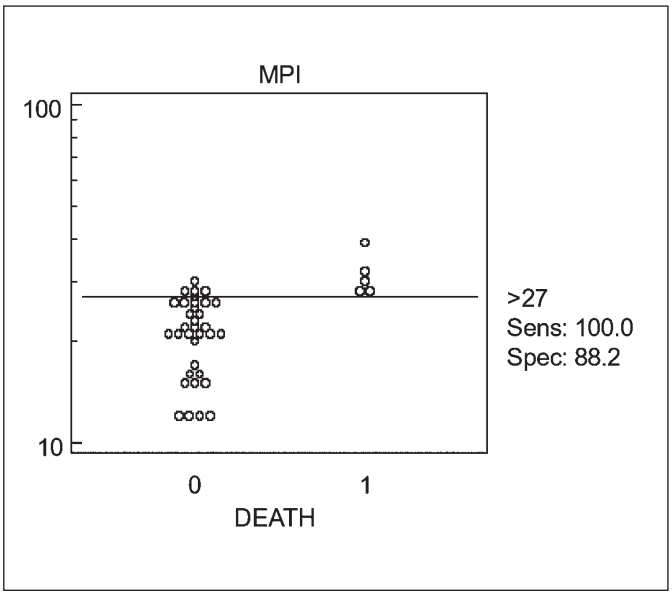

Fig. 2: Interactive dot diagram from ROC curves of MPI/postoperative mortality showing the criterion value as the point cut-off of minimal false negative and false positive results.

Discussion

Acute diverticulitis represents the most common cause of colonic perforation [11]. Diverticulitis free perforation with diffuse peritonitis requires urgent surgical treatment and continues to carry an unacceptable high mortality rate ranging from 12% to 30% [3-5,12-14]. The in-hospital mortality of our series was 12.5% and it was mostly related to septic shock and multiorgan failure syndrome following diffuse fecal peritonitis. The relevance of this clinical entity validates the search for factors influencing mortality and the need for an objective severity scoring system in evaluating outcomes of critical patients with diffuse peritonitis.

Fundamentally, the current study showed that older age, duration of symptoms, and MPI were independent risk factors predicting in-hospital mortality of patients with perforated colonic diverticulitis.

Age is an accepted prognostic factor after surgery and our investigation corroborates this statement. Previous studies have confirmed age as an independent factor influencing mortality [12,15-18], although other authors reported that outcome of older patients is more directly related to co-morbidities than age [2]. In our experience, those patients over 70 years of age had a higher risk of death than younger as reported by other authors [17].

Both atypical presentations of abdominal pain and lower sensibility to the symptoms of the disease are frequently encountered in elderly people with diffuse peritonitis as responsible for delay in diagnosis and hospitalization [16,19]. In these cases, the longer duration of symptoms is strongly related to poor prognosis of older persons making impossible the early goal directed treatment of sepsis [11].

In our experience, prognosis does not seem to be related to the surgical procedure performed, i.e. damage control vs. definitive procedure. The severity of sepsis originating from peritonitis is retained as an important factor responsible for the outcome [4,5]. Indeed, fecal peritonitis was found in 80.0% of our patients who died and this finding had greater clinical relevance. Therefore, prognosis is not related to the surgical procedure itself, but it depends on age, duration of symptoms and severity of peritonitis.

However, the early assessment of the severity of peritonitis must be related to a system of surgical risk stratification which is absolutely needed by clinicians in the treatment decision-making and in evaluating prognosis. The MPI is recognized as an objective scoring system predicting surgical prognosis of patients with peritonitis and the final score comes from the integration of 8 factors retained as relevant for prognosis: age, sex, organ failure, malignancy, duration of symptoms, and involvement of colon, extension and character of peritoneal fluid [6-8, 12]. Interestingly, age and duration of symptoms are factors included in the MPI as well as the presence of fecal peritonitis. The results of our investigation substantiate prior studies that have shown that MPI is easy to apply and effective in predicting mortality of patients with diffuse peritonitis from perforated diverticulitis [6-8]. Indeed, for a threshold index score >27, MPI showed the highest sensitivity and specificity in predicting in-hospital mortality (100.0% and 88.2%, respectively). Those patients with >27 points of MPI had mortality rate as high as 50.0%. A score of >26 has been reported to have sensitivity of 86% and specificity 74% in predicting in-hospital death with mortality rate of 60% [7]. Early estimation of severity of peritonitis by means of

MPI allows clinicians to assess the risk of death during initial surgery and patients to start early intensive treatment [2]. Moreover, MPI may be useful to compare results from different hospitals and surgeons and to inform patient's relatives with greater objectivity [5].

Conclusions

Our results confirm the current clinical value of MPI which is still an effective scoring system in predicting postoperative mortality. However, MPI shows an increased risk of death in patients with peritonitis over 50 years of age. Following the results of the present investigation, this cut off should be updated considering those patients over 70 years of age at major risk of death. Finally, we believe that the only factor that could be influenced by good medical care is the duration of symptoms, thus reducing the MPI score of at least 4 points and improving prognosis. Health care professionals and people who live with or nurse older persons must pay higher attention to complaints with early, systematic and comprehensive investigation of abdominal pain in order to reduce the delay in diagnosis and hospitalization.

Riassunto

SCOPO: La peritonite acuta diffusa da diverticolite perforata del sigma è ancora oggi da considerare come una condizione clinica ad alto rischio di mortalità. Nel presente studio abbiamo valutato i fattori che influenzano la prognosi dei pazienti con diverticolite acuta perforata del sigma e l'attuale validità del Mannheim Peritonitis Index (MPI) quale indice predittivo di mortalità.
MATERIALE DELLO STUDIO: Dal Gennaio 2000 all'Ottobre 2010, 39 pazienti sono stati sottoposti ad intervento chirurgico d'urgenza per peritonite acuta diffusa da diverticolite perforata del sigma presso la Clinica Chirurgica dell'Università di Cagliari. Abbiamo riscontrato 5 casi di mortalità post-operatoria (12.8%) generalmente in correlazione con il grave stato di shock settico del paziente. In particolare, abbiamo condotto uno studio comparativo tra il gruppo dei pazienti sopravissuti ed il gruppo dei pazienti deceduti.
RISULTATI: I pazienti deceduti erano significativamente più anziani rispetto ai pazienti non deceduti (76.4 vs. 59.1 anni, p=0.019); la durata dei sintomi è stata più lunga nei pazienti deceduti (102 vs. 26.9 ore, p=0.000); l'MPI score aveva un valore più elevato nei pazienti deceduti (31.4 vs. 21.2, p=0.000). L'età avanzata, la maggiore durata dei sintomi e un'elevato MPI score sono risultati tutti fattori predittivi di prognosi infausta. La maggiore sensibilità e specificità dell'MPI nella predizione di mortalità è stata vista per uno score >27.
CONCLUSIONI: L'MPI è ancora oggi da considerare come una efficace metodo predittivo di mortalità postoperatoria nei pazienti con peritonite acuta diffusa. Il personale medico e non-medico che segue i pazienti anziani dovrebbe prestare maggiore attenzione ai sintomi addominali riferiti dal paziente allo scopo di ridurre il ritardo nella ospedalizzazione e migliorare la prognosi.

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