

RISK FACTORS AND MANNHEIM PERITONITIS INDEX FOR THE PREDICTION OF MORBIDITY AND MORTALITY IN PATIENTS WITH PEPTIC ULCER PERFORATION

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ABSTRACT

• **Objective:** In urgent surgical procedures for peptic ulcer perforation, there is considerable postoperative morbidity and mortality. This study aimed to describe and analyze the risk factors that determine beforehand morbidity and mortality in cases with perforated peptic ulcer.

• **Material and Method:** Age, sex, co-morbid diseases, symptom duration, abdominal free air, amount of intra-abdominal liquid, location and diameter of perforation, type of the operation, and the Mannheim Peritonitis Index (MPI) score were prospectively analyzed in 128 cases. Significant risk factors that cause morbidity and mortality were determined through a statistical study.

• **Results:** The study sample consisted of a total of 128 cases (113 males and 15 females) with a mean age of 37 (range, 20-84). Duodenum and stomach perforations were

detected in 93% and 5.5% of the cases respectively. In 12 cases (9.4%), a total of 14 complications were detected. The mortality rate was 4.7%. Statistical analyses revealed significant relationships between morbidity and >50 age ($p=0.000$), co-morbid disease ($p=0.006$), perforation location ($p=0.010$), type of operation ($p=0.011$), and MPI score ($p=0.005$). The factors significant for mortality included >50 age ($p=0.002$), co-morbid disease ($p=0.017$), >8 hours of symptom duration ($p=0.07$), >500 cc intra-abdominal fluid ($p=0.047$), diameter of perforation >0.5 cm ($p=0.001$), omentoplasty ($p=0.025$), and a MPI score of >21 ($p=0.000$).

• **Conclusion:** Factors such as age, co-morbid disease, prolonged perforation duration, amount of intra-abdominal fluid, perforation diameter, type of surgical operation, and MPI score were significant for mortality.

• **Key Words:** Peptic ulcer, perforation, risk factor, mortality. *Nobel Med* 2009; 5(3): 74-81

ÖZET

PEPTİK ÜLSER PERFORASYONLU OLGULARDA MORBİDİTE VE MORTALİTENİN ÖNGÖRÜSÜNDE RİSK FAKTÖRLERİ VE MANNHEİM PERİTONİT İNDEKSİ

• **Amaç:** Peptik ülser perforasyonunun neden olduğu acil cerrahi girişimler ameliyat sonrası önemli morbidite ve mortalite ile birliktedir. Bu çalışmada perfore peptik ülserli olgularda morbidite ve mortaliteyi önceden saptayacak risk faktörlerini tanımlamak ve analiz etmek amaçlanmıştır.

• **Materyal ve Metod:** 128 olguda yaş, cinsiyet, yandaş hastalık, semptom süresi, batında serbest hava, batın içi sıvı miktarı, perforasyon yeri, perforasyonun çapı, cerrahi tedavi ve Mannheim Peritonit İndeks (MPİ) puanı prospektif olarak analiz edildi. İstatistik çalışması ile morbidite ve mortaliteye neden olan anlamlı risk faktörleri saptandı

• **Bulgular:** Çalışmada toplam 128 olgu (113 erkek

ve 15 kadın) mevcut olup yaş ortalaması 37 (20-84 arası) dir. Duodenum ve mide perforasyonları olguların %93 ve %5,5'inde bulundu. Oniki (%9,4) olguda toplam 14 komplikasyon saptandı. Tüm serinin mortalitesi %4,7 idi. İstatistik analizde >50 yaş (p = 0,000), yandaş hastalık (p=0,006), perforasyon yeri (p=0,010), ameliyat tipi (p=0,011) ve MPİ puanının (p=0,005) morbidite ile anlamlı ilişkisi bulundu. Mortalite için anlamlı faktörler ise >50 yaş (p=0,002), yandaş hastalık (p=0,017), semptom süresi >8 saat (p=0,07), batın içi sıvı >500 cc (p=0,047), perforasyon çapı >0,5 cm (p=0,001), omentopeksi (p=0,025) ve MPİ puanı >21(p=0,000) bulundu.

• **Sonuç:** Yaş, yandaş hastalık, perforasyon süresinin uzunluğu, batındaki sıvı miktarı, perforasyon çapı, ameliyatın tipi ve MPİ skoru gibi faktörler mortalite ile anlamlı birliktelik gösteriyordu. Bu çalışmada peptik ülser perforasyonlu olgularda primer sütünün güvenli bir işlem olduğu da görüldü.

• **Anahtar Kelimeler:** Peptik ülser, perforasyon, risk faktörü, mortalite. Nobel Med 2009; 5(3): 74-81

INTRODUCTION

The use of H₂-receptor blockers and proton pump inhibitors in cases with peptic ulcer has led to a decline in the number of elective surgical operations, while the prevalence of peptic ulcer perforation has not changed; even increased.¹ Conventional surgical method applied for peptic ulcer perforation in the 1980s was primary suturing of the perforation and definitive surgical operation at the same session. Today, treating perforations only with primary suturing is sufficient due to postoperative treatment through antiulcer medications.

Mortality is prevalent in cases with peptic ulcer perforation and performing a risk analysis for cases by detecting the prognostic factors that affect morbidity and mortality may help prognosis prediction. Along with the predictive factors affecting the morbidity and mortality of cases, scoring systems have also been developed with parameters including demographic and clinical features.²⁻⁵ Predictive factors could include independent parameters such as age, sex, time of pain onset, nausea, abdominal distension, diameter of perforation, oliguria, shock, and presence of co-morbid diseases, while they could also be indices with multiple parameters such as Mannheim Peritonitis Index (MPI) and APACHE II.⁶⁻⁹ Thus, in our study, we aimed to determine the parameters we detected and diagnostic value of MPI in cases with peptic ulcer perforation, as well as the patient groups with risk.

MATERIAL and METHOD

We analysed prospectively the records of 128 patients operated on for peptic ulcer perforation in the 2nd Surgery Clinic at Izmir Bozyaka Training and Research Hospital. The study protocol was approved by ethics committee of our Institute. In the cases, diagnosis was made by anamnesis, physical examination, and the presence of pneumoperitoneum in the directradiography and ascertained by exploration. All patients were treated by laparotomy with median incision.

Intra-abdominal fluid was aspirated to locate the perforation. In all cases, the abdomen washed using saline solution of at least 1 liter. The amount and nature of the fluid in the aspiration bottle was recorded. Debridement was performed if required. Primary suturing or omentoplasty was performed, as suggested by Graham. 3/0 silk was used as the suture material. The decision to perform omentoplasty was depended to surgeon's attitude. In all cases, silicone drains were placed in Morrison's hepatorenal pouch and pelvis. Nasogastric tubes were placed in all cases and were removed when intestinal sounds were heard. Oral food was introduced as liquid in the first two days, and later as soft foods.

Patients received a single dose of antibiotic (cephalosporin) at induction. Antibiotic was given as a measure 1-2 grams per day divided q12h to the 5-7th postoperative day.→

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All patients were treated with parenteral antibiotics. In septic cases, preoperative liquid resuscitation and vasoactive medications were prescribed. A total of 9 factors - 5 detected at the time of presentation, and 4 during laparotomy - were noted that showed the demographical and clinical status of the cases. These factors included age, sex, co-morbid diseases, time elapsed after perforation (symptom duration), the presence of free air in abdominal graphy, location and diameter of perforation, amount of intra-abdominal liquid, type of surgical operation and furthermore, the Mannheim Peritonitis Index (MPI) for each of the cases.

Following a categorization on the basis of sex (males and females); they were also divided into two groups as those with an age <50 and those with an age >50 years to follow the MPI parameters. Co-morbid diseases in the cases were categorized as pulmonary, of renal origin, and diabetes. The time elapsed between perforation and their arrival to the hospital were differentiated as ≤ 8 hours and >8 hours. The presence of unilateral or bilateral free air below the diaphragm in abdominal graphy was taken as positive. Perforation locations were categorized as the first part of the duodenum, prepyloric, stomach, and anastomotic perforations. Perforation diameter was grouped as below and above 0.5 cm. The patients with peritonitis were included in the study. Properties of abdominal fluid-whether it was purulent or fecaloid - were recorded to be used in MPI calculation. The files of the cases without abdominal contamination like closed perforation were not examined. MPI was calculated for all cases. In MPI calculation, if the case was over 50 years and female, 5 points were given for each; 7 points were given for any organ failure (Kidneys: creatinine >177 μmol/l, urea >167 μmol/l, oliguria <20 ml/hour; lungs: pO₂<50 mmHg, pCO₂>50 mmHg, Shock: hypo- or hyperdynamic; intestinal obstruction: >24 hours); the presence of malignity, duration of peritonitis longer than 24 hours, and non-colonic sepsis origin were given 4 points each; and diffuse peritonitis was given 6 points. Clear intra-abdominal fluid received 0, thick or purulent fluid received 6, and fecaloid fluid received 12 points (Table 1). The cases were first grouped into three, as described by Billing: those below 21 pts, between 21-29 pts, and those above 29 pts.³ Furthermore, following Bracho-Riguelme RL et al., they were also divided into two groups as <26 and >26 points for the sake of convenience.¹⁰

In the analysis in which the factor of perforation location was examined in four and MPI was examined in three groups, each group was separately taken as a baseline to determine their individual effects on morbidity and mortality, as well as their risk rates.

Table 1: Mannheim peritonitis index	
Risk factor	Weithage, if any
Age>50 years	3
Female	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
Purulent	6
Fecal	12

Duration of hospital stay and morbidity and mortality causes were recorded for the cases. Our purpose in conducting the statistical analysis was identified as determining the predictive power of case parameters and MPI on morbidity and mortality estimates and detecting those with risk factors. The statistical analyses used in the study were performed using SPSS for Windows (version 11.0) computer software. The selected methods included descriptive statistics and chi-square (chi²) analysis. The chi-square p (probability) values calculated were corrected p values from Fisher's Exact Test. Clinical variables for the cases were individually subjected to univariant analysis. For, the case parameters, the odds and risk ratios (OR and RR) that affect morbidity and mortality were computed with a 95% confidence interval. The parameters with a risk ratio (lower limit <1) within the confidence interval were not taken as significant. A p value below 0.05 was considered as significant.

RESULTS

Between March 2004 and March 2007, 128 cases with peptic ulcer perforation were examined prospectively. Of all cases, 113 (88.3%) were male and 15 (11.7%) were female. The mean age of the cases was 37 (range 20-84), 81 (63.2%) of whom <50 age, and 47 (36.8%) were above 50. Five (%3.9) cases in the study revealed co-morbid diseases, which included renal failure requiring dialysis (three cases), pulmonary disease (one case) and Diabetes Mellitus in one case. The time elapsed from the onset of perforation symptoms to presentation was an average of 13 hours (2 hours-6 days). 70 (54.7%) patients presented before eight hours, 58 (45.2%) after 8 hours; and eighteen (14.1%) presented with a delay of more than 24 hours. While the abdominal graphy detected free air below the diaphragm in 83 (64.8%) patients, this was not found in 45 (35.2%) patients. →

In the cases treated with laparotomy, the intra-abdominal fluid varied between 200 cc and 5000 cc. The intra-abdominal fluid was found to be below 500 cc in 93 (72.6%) cases, and above 500 cc in 35 (27.4%) cases. In one case, there was barium peritonitis related to barium prescribed for diagnostic purposes.

In 88 (68.8%) cases perforation was located in the first part of duodenum and was pyloric in 31 (24.4%) cases; yet, perforations were most frequently observed in duodenum. Furthermore, stomach, antral and anastomosis ulcer perforation were found in seven (5.5%) and two (1.5%) cases, respectively. A case with duodenum ulcer perforation was previously introduced a primary suture. The anamnesis of a case with anastomosis ulcer perforation revealed two previous stomach operations. On the other hand, multiple perforations were observed in none of the cases. While the perforation diameter was found to be below 0.5 cm in 89 (69.5%) cases, it was above 0.5 cm in 39 (30.5%) cases.

While primary sutures were placed in 122 (95.3%) cases, omentoplasty was performed on six (4.7%) cases. Of the cases performed with omentoplasty, four had duodenum perforation and two had stomach perforation. In these cases, the perforation diameter was found to be 1.8 cm in average.

While the MPI was below 21 points in 99 (77.3%) of the cases, it was calculated as between 21-29 points in 16 (12.5%) and above 29 points in 13 (10.2%) cases. The groups categorized as MPI <26 and >26 included 113 (88%) and 15 (12%) cases, respectively. Twelve (9.4%) of the cases had a total of 14 postoperative complications, which were as follows: early fistulas due to suture leakage in four cases, pulmonary complications in four cases (three were pleural effusion and one was atelectasis), surgical site infection in two cases, evisceration in two cases, and one intra-abdominal abscess, one renal failure and one upper GIS bleeding related to acute erosive gastritis in each case. Furthermore, in one case with multiple complications pleural effusion, evisceration and intra-abdominal abscess were formed.

Three cases related to suture leakage (two with omentoplasty and one placed with primary suture) recovered within 21 days on average with medical treatment. Another case with fistula was treated with relaparotomy due to the development of peritonitis symptoms. The perforation site was closed with a falciform ligament graft. The cases involving pulmonary, renal failure and acute erosive gastritis recovered with medical treatment. The two eviscerated cases were resutured. The two cases with surgical site infection were treated with antibiotic therapy through anti-biogram. The case with

Table 2: Relation of patient parameters to morbidity and mortality on chi square analysis

Patient parameters	Total number (%)	Morbidity	p-value	Mortality	p-value
Age					
<50	81 (63.2)	1	0.000*	-	0.002*
>50	47 (36.8)	11		6	
Sex					
Male	113 (88)	10	0.424	4	0.146
Female	15 (12)	2		2	
Co-morbid disease					
(+)	5 (3.9)	3	0.006*	2	0.017*
Duration of symptoms (hours)					
<8	70 (54.7)	5	0.258	-	0.007*
>8	58 (45.4)	7		6	
Pneumoperitoneum					
(+)	83 (64.8)	8	0.580	5	0.310
(-)	45 (35.2)	4		1	
Site of perforation					
Duodenum	88 (68.8)	5	0.040*	4	0.611
Prepyloric	31 (24.2)	4	0.323	2	0.449
Gastric	7 (5.5)	3	0.018*	-	0.709
Anastomosis	2 (1.6)	2	0.821	-	0.908
Diameter of perforation (cm)					
<0.5	89 (69.5)	7	0.281	-	0.001*
>0.5	39 (30.5)	5		6	
Amount of fluid (cc)					
<500	93 (72.6)	6	0.070	-	0.047*
>500	35 (27.4)	6		6	
Type of surgery					
Primary suture	122 (95)	9	0.011*	4	0.025*
Omentoplasty	6 (4.7)	3		2	
MPI**					
<21	99 (77.3)	5	0.005*	-	0.000*
21-29	16 (12.5)	3	0.174	2	0.163
>29	13 (10.2)	4	0.020*	4	0.001*

*p<0.05 significant, ** Mannheim peritonitis index

intra-peritoneal abscess was treated with CT-guided percutaneous drainage.

Postoperative mortality was observed in six (4.5%) cases, four of which were males. All the patients who died were above 50 years of age (74 years on average) and had presented within 24 hours following the onset of the symptoms. In all the cases the perforation diameter was above 1 cm. The causes of mortality were sepsis-related multiple organ failure in three, respiratory failure in two and renal failure in one case. The MPI was calculated as between 21-29 in two cases, and as >29 in four cases. The average duration of hospital stay was 7 (5-11) days among cases without any complications and was 15 (6-32) days among those

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with complications. As a result of the univariate analysis performed using the chi-square testing, >50 years (p=0.000), presence of a co-morbid disease (p=0.006), perforation site (p=0.010), performing omentoplasty (p=0.011) and MPI >21 points were found to be significant in morbidity. Furthermore, age >50 (p=0.002), co-morbid disease (p=0.017), symptom duration >24 hours (p=0.007), intra-abdominal fluid above 500 cc (p=0.047), diameter of perforation >0.5 cm (p=0.001), omentoplasty-type operation (p=0.025) and MPI score >21 (p=0.000) were found to be the factors that were significantly correlated with mortality.

On the other hand, gender and presence of free air below the diaphragm were not found to be factors significant in morbidity as well as mortality. The perforation site was examined under four groups. The presence of perforation in duodenum and stomach displayed a significant morbidity when compared to its presence in pylorus and anastomosis. Perforation sites were not found to be significant in mortality. An examination of the MPI revealed a significant morbidity and mortality in the groups of <21 points and > 21 points. The relationship of the case parameters with morbidity and mortality was subjected to a chi-square analysis, and the results are collectively presented in Table 2. It was further found that in the groups with >26 points and <26 points, the MPI was similarly significant in morbidity and mortality (p=0.035 and p=0.002). It was discovered that a MPI score >26 increased morbidity 2 times and mortality 3 times. The risk rates for other case parameters are presented in Table 3.

DISCUSSION

Ulcer perforations consist one of the most common urgent surgical procedures in our country. Causing morbidity and mortality with an incidence of 10% and 20% in our surgical practice, it is crucial in detecting the patients in risk. It is also essential in identifying the patients in risk groups, subjecting them to risk analysis and planning their treatment, as well as identifying the cases that need intensive care. Various factors and scoring systems are used for this purpose. Prospective and retrospective studies have described more than thirty predictive factors. The main factors are age, sex, co-morbid diseases, duration of onset of symptoms, location and diameter of perforation, amount of fluid in peritoneal cavity, type of surgical operation, the use of nonsteroidal antiinflammatory drugs, blood albumin level, blood transfusion, season, shock, alcohol use, and smoking.^{11, 12} In our study, we used the first eight factors and the MPI including four of these factors. In different series, perforation prevalence was reported to decline at a young age and among men, while it

Table 3: Relation of patient parameters to risk ratio (RR)

Patient parameters	Morbidity risk ratio (95% confidence interval)	Mortality risk ratio (95% confidence interval)
Age<50	Baseline	Baseline
Age>50	2.9(2.1- 4.0)	2.9(2.3- 3.8)
Male	Baseline	Baseline
Female	1.4*(0.3- 5.8)	3.1*(0.9-1.8)
Co-morbid disease (-)	Baseline	Baseline
Co-morbid disease (+)	14.5(2.6-78.3)	13.5(2.7-66.5)
Duration of symptoms <8 hours	Baseline	Baseline
Duration of symptoms >8 hours	1.3*(0.7-2.2)	2.3(1.9-2.8)
Abdominal free air(-)	Baseline	Baseline
Abdominal free air(+)	1.0*(0.6-1.5)	1.3(0.8-1.9)
Site of perforation	7.0 (1.8-28.6)	1.2*(0.7-1.8)
Diameter of perforation<0.5cm	Baseline	Baseline
Diameter of perforation >0.5cm	1.4*(0.6-2.9)	3.7(2.7-4.9)
Amount of fluid(cc)<500	Baseline	Baseline
Amount of fluid(cc)>500	2(1.0-3.8)	2.6(1.3-4.9)
Type of surgery(omentoplasty)	9.5(2.1-42.7)	10.1(2.3-44.9)
MPI <21	Baseline	Baseline
MPI>21	3(1.6-5.6)	5.3(3.6-7.6)
*Not significant		

increases among the elderly.¹¹ Our series was relatively young, with 62% of the cases below 50 years of age. Since mortality is observed in 47% of the cases above 50 years and has a prevalence among those above 65 years that is six times higher than young people, advanced age was investigated as one of the important predictive factors.¹³ Almost all studies has identified age as an independent risk factor in morbidity and mortality.^{6, 7, 14, 15} In our series as well, advanced age was found to be a significant predictive factor for morbidity and mortality, as has been the case in domestic and Western studies. Mortality risk was found to be 2.9 times higher among our cases above 50 years. Despite a few studies reporting a higher incidence of peptic ulcer perforations among women, most studies report its incidence among men and women as between 7.5:1-12:1.¹⁶ There is often a male superiority and the incidence was found as 7:1 in our series. Although there abundant evidence on the fact that sex is not a predictive factor in morbidity and mortality, some have reported female sex as a cause of morbidity.⁶ In our data, sex was not found to be a significant factor in morbidity and mortality.

Presence of co-morbid diseases leads to a delay in hospital arrival among older cases, which results in a delay in diagnosis.^{17, 18} In univariant analyses including predictive factors, the presence of co-morbid diseases was identified as one of the independent determinants of morbidity and mortality.^{6, 16, 19} The incidence of →

co-morbid diseases varies in different series between 7-26%, while it was present in 3.9% of our cases. Though co-morbid diseases were present in a few of our cases, it was found to have a significant effect on morbidity and mortality. In our series, co-morbid diseases were found to increase mortality 13 times when compared to cases without any co-morbid disease.

The time elapsed from the onset of perforation symptoms to presentation is usually examined in studies as 8, 12 or 24 hours before and after. Though we adhered to this criterion, we examined the presentations earlier and later than 8 hours in order to determine the prognostic effect of early presentation. 54.7 percent of our cases presented within 8 hours, which could be regarded as early presentations. No significant difference in morbidity between our cases in this group and those presenting 8 hours following the onset of symptoms. However, the cases with a duration of symptoms longer than 8 hours had significant mortality. Similarly, publications report 20-47% and three times higher morbidity incidence in the patient group with longer symptom durations.^{20, 21}

In 14.1% of our case series, symptom duration was longer than 24 hours. This case group accounted for all the mortality and 64% of the morbidity. In the evaluation of these results, our univariant analysis found a symptom duration longer than 8 hours as insignificant for morbidity, while it was identified as a significant predictive factor for mortality and found to be similar to other case series.^{13, 16, 18} Furthermore, mortality has been reported 2.3 times higher among cases presenting later than 8 hours.

As an auxiliary diagnostic examination, the presence of free air in direct abdominal radiography can be observed in 70% of the cases. Studies do not generally examine pneumoperitoneum as a predictive factor of morbidity and mortality. Our study does not show its predictive value in morbidity and mortality either. Yet, it is of importance as a useful diagnostic finding. Although it is reported that perforation has not been located in 4% of the cases operated on with a pre-diagnosis of perforation, we managed to locate the perforations in all our cases.²¹ In our series, perforation was frequently located in the first part of the duodenum (68%) and pylorus (24%), while the number of perforations in the stomach antrum and anastomosis was few. Reported to be found with a frequency amounting to 45%, stomach perforations were detected in only 3% of our cases.^{14, 16} In our series, we found that stomach perforation is a significant factor in morbidity and insignificant in mortality, whereas other studies suggest that it is significant in mortality.⁸ Though perforation diameter is considered as predic-

tive in prognosis, references are not adequate for small or large ulcer definitions.²² In evaluation, diameter of perforation is usually categorized as smaller or larger than 1 cm. In large case series, perforation diameter is frequently reported to be smaller than 1cm and we found perforation diameter as smaller than 0.5 cm in a greater part of our case series.²³ In a series grouping <1 cm as small, 1-3 cm as "large", and 3 cm and larger as "giant" perforation diameters, a comparison between the groups of smaller than 1 cm and larger than 1 cm showed that the latter had a higher morbidity.²¹ Thirty-nine per cent of the cases in our series had a perforation diameter larger than 0.5 cm and all the mortality was observed in this group. Though a few of our cases had perforations with large diameters, it has been reported that the rate could reach up to 40%.^{14, 22} With a perforation diameter smaller than 0.5 cm, 89% of our cases showed no mortality. In the statistical analysis of the study, it was found that perforation diameter was insignificant for morbidity and a significant predictive factor in mortality. In a study, perforation diameter was observed to be a strong predictive factor for peritoneal contamination however, it was stated that it had no relationship with postoperative complications.⁷

Western studies grouped the amount of intra-abdominal fluid as above and below 200cc, while studies conducted in our country, as well as in Eastern countries, grouped it as above and below 500, and even 1000cc.⁵ A higher amount of intra-abdominal fluid was found to be directly proportional to morbidity and paralleled with a higher rate of peritoneal contamination. In a Western study, intra-abdominal liquid of even above 200cc has been reported to affect morbidity.¹⁶ On the other hand, in our series, a higher amount of fluid than 500cc was found to be significant for mortality, while insignificant for morbidity. Although there are some studies highlighting that preoperative distension in cases is related to the amount of abdominal fluid and distension might be predictive factor, it has not yet been investigated as a risk factor.

The appropriate type of surgical operation for emergent patients has been a subject of controversy. Studies examining the effect of surgical operation type on morbidity and mortality compare cases operated with primary suturing and definitive surgery.²⁴ While some studies report a lower recurrence for postoperative ulcers but a mortality rate 16 times higher among those treated with definitive surgery, when compared to the primary suture group, there are also others reporting that primer suture is a cause of high mortality.^{12, 18} At present, as ulcer could be cured postoperatively with medical treatment, primer suturing has become the most common operation type and has been shown to have no significant differences compared to definitive

surgery.^{20, 25} As we did not apply definitive surgery, our study does not include any evaluation of its predictive effect compared to primary suture. However, a comparison of primary suture and a few (4.7%) cases of omentoplasty has revealed that the omentoplasty procedure is significant for morbidity and mortality. Morbidity incidence was high in our omentoplasty cases and in one case who developed fistulas, it needed a graft with falciform ligament.²⁶ Studies presenting omentoplasty results report low mortality rates, which has not been compatible with our results.²⁰ Along with the predictive factors, our study also used a scoring system. Scoring systems have been developed to facilitate clinical practice as there are many predictive factors.

However, the number of scoring systems has also increased in the last 10 years. The most commonly used scoring systems are ASA, APACHE II, and Reiss index, which use preoperative parameters, and MPI, which uses preoperative and operative findings.^{26, 27}

MPI, which we also used in our study, was originally developed for peritonitis patients, not for ulcer perforation.^{28, 29} The scoring systems developed for peptic ulcer perforation include the Boey and Hacettepe scoring systems.^{9, 30, 31} Among them, the Hacettepe scoring has been reported to have a sensitivity to mortality of 83%, though there are no studies to support this report. The scorings used in clinical practice in peptic ulcer perforations are the ASA, Boey score and the MPI.³² Univariate studies using the ASA, Boey score and the MPI together found all of them to be significant indicators of morbidity. In a multivariate analysis, on the other hand, probability ratios were found as superior in MPI when compared to the ASA and Boey scores.³ Therefore, the MPI was included in the study as a useful scoring system in predicting morbidity and

mortality. In our series, the cases with a MPI score below 21 had 50% of all complications, while they had no mortality. A MPI score over 29 was found to be a significant indicator of morbidity and mortality. Some studies found the mortality rate as 3% with a MPI score less than 21, and 100% if it was higher than 29.^{29, 33} Studies based on MPI scores <26 and >26 also reported mortality rate as 3% and 40%.¹⁰ Similarly, in the series we present here, a MPI score higher than 26 was found with significant morbidity and mortality.

These results point to the predictive value of MPI in determining mortality. Factors used in MPI calculation are also available from the routine records in patient files found in service hospitals and surgical notes. Therefore, we believe that MPI could be used along with predictive factors to determine morbidity and mortality in cases with peptic ulcer perforation.

CONCLUSION

Consequently, we described the predictive factors for morbidity and mortality in peptic ulcer perforation. Advanced age, co-morbid diseases, omentoplasty, and a higher MPI score were identified as risk factors that affect morbidity and mortality. Age, presence of a co-morbid disease, symptom duration, diameter of perforation, amount of abdominal fluid, type of surgical operation, and MPI were found to be the main factors predicting mortality.

Early diagnosis and treatment, as well as careful postoperative care, is recommended for older cases of peptic ulcer perforation with co-morbid diseases and high MPI. Furthermore, we believe that primary suturing can be used as a safe surgical method in peptic ulcer perforations.

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