

# Risk factors influencing mortality of patients with severe acute pancreatitis within 24 hours after admission

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**OBJECTIVE:** To study the risk factors for death of patients with severe acute pancreatitis (SAP) within 24 hours after admission.

**METHODS:** Clinical and laboratory data of 74 patients with SAP were analyzed retrospectively. The 27 possible risk factors for death within 24 hours after admission were investigated using logistic regression (SPSS software package 10.0), and the equation of logistic regression was set up.

**RESULTS:** Among the 27 possible risk factors, arterial pH, APACHE II scores, early shock, multiple organ failure were associated with mortality. Single logistic regression analysis of the 27 parameters showed that early shock, pleural effusion, arterial pH, complications and APACHE II scores were associated with death of SAP patients, but using multiple logistic regression analysis showed that only acidosis ( $\text{pH} < 7.35$ ) was associated with death.

**CONCLUSION:** To maintain the function of organs and correct disequilibrium of water-electrolyte and acid-base in early treatment of SAP is essential to lower the mortality.

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**Key words:** severe acute pancreatitis; death; predictor

## Introduction

Severe acute pancreatitis (SAP) as a common acute abdomen is characterized by complicated causes, lots of morbidities and high mortality. Despite considerable improvements in understanding of the pathophysiological mechanisms and management of these patients, mortality of SAP remains between 15%-40%.<sup>[1]</sup> During the past years, some reports indicated that the extent of necrotic pancreatic parenchyma and the presence of bacterial infection have been identified as major determinants of outcome,<sup>[2,3]</sup> but these factors could not predict the

outcome as early as possible. In this study, 27 risk factors for death were analyzed using logistic regression (SPSS software 10.0) according to the clinical and laboratory data from 74 patients within 24 hours after admission and death.

## Methods

### Patients and treatment

During the period from January 1993 to December 2002, 74 patients with SAP were admitted to the Department of Hepatobiliary Surgery, First Hospital of Xi'an Jiaotong University, Xi'an, China. All patients were diagnosed as having SAP, according to the Criteria for Clinical Diagnosis and Classification of Acute Pancreatitis approved in 1996 by the Pancreatic Surgery Society of the Chinese Medical Association.<sup>[4]</sup> In these patients 40 were men and 34 women with a male to female ratio of 1.18:1. Their mean age was 49.3 years (range

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14–87 years). Forty-two patients suffered from non-gallstone pancreatitis and 32 patients from gallstone pancreatitis.

Initial nonsurgical management of all patients included bowel rest, intravenous fluid resuscitation, gastric secretion, suppression of pancreatic external secretion, and use of prophylactic antibiotics. Indications for surgical treatment were as follows: infection of necrosis, pancreatic abscess, cholangitis, obstructive jaundice and pseudocyst formation for a long time. Surgical procedures included necrosectomy and continuous postoperative lavage of the peritoneal cavity and lesser sac in addition to common bile duct exploration and stone extraction if necessary. Three patients were treated surgically within 24 hours after admission and 1 patient (33.3%) died (Two patients were subjected to necrosectomy and continuous postoperative lavage of the necrotic cavity and 1 patient died; 1 patient was subjected to necrosectomy and common bile duct exploration). The remaining 71 patients were treated nonsurgically within 24 hours after admission and 11 patients (15.5%) died.

### Risk factors

Symptoms and laboratory data of all patients within 24 hours after admission to the hospital were analyzed, including age, gender, upper abdominal pain, nausea and vomiting, febrile, jaundice, abdominal distention, shock, peritonitis, hemoglobin, hematocrit, white cell count, percentage of neutrophils, serum amylase (sAMS), urine amylase, arterial pH, arterial PO<sub>2</sub> and PCO<sub>2</sub>, urine pro-

tein, urine glucose, pleural effusion, hydroperitonitis, surgical treatment, associated multiple organ failure, preoperative complications, APACHE II scores, and gallstone pancreatitis.

### Statistical analysis

Student's *t* test was used to compare continuous variables between survivors and deaths and the chi-square test was used to compare categorical variables. Logistic regression analysis was performed to determine the parameters in predicting death and a regression equation was set up. Statistical calculations were performed with computer SPSS software 10.0 and a *P* value of <0.05 was considered significant.

### Results

The death rate in this group was 16.2% (12/74). The causes of death were pancreatic encephalopathy (*n* = 1), multiple organ failure (*n* = 7), pulmonary insufficiency (*n* = 4), respectively.

The results of Student's *t* test and the chi-square test of the above mentioned risk factors are listed in Table 1. pH levels and APACHE II scores showed a statistical significance between survivors and deaths (Table 1). The death rate of patients associated with shock or multiple organ failure was significantly higher than that of those without shock or multiple organ failure. No relations were observed of death to age, gender, upper abdominal pain, nausea and vomiting, febrile, jaundice, ab-

**Table 1.** Comparison of admission measurements between survivors and deaths (Student's *t* test)

Factors	Survivors ( <i>n</i> = 62)	Deaths ( <i>n</i> = 12)	<i>P</i> value
Age (y)	48.350 ± 14.03	52.340 ± 14.35	0.201
Hemoglobin (g/L)	134.260 ± 25.71	145.320 ± 29.54	0.082
Hematocrit (%)	0.401 ± 0.087	0.413 ± 0.076	0.371
White blood cell count (10 <sup>9</sup> /L)	14.631 ± 4.382	14.213 ± 4.358	0.714
Percentage of neutrophils (%)	0.851 ± 0.059	0.892 ± 0.061	0.942
Serum amylase (U/L)	475.730 ± 471.34	1141.270 ± 1412.68	0.213
Urine amylase (U/L)	2967.590 ± 4651.97	4017.460 ± 7314.26	0.542
Arterial pH	7.432 ± 0.058	7.297 ± 0.079	0.003
PaO <sub>2</sub> (mmHg)	59.532 ± 23.431	56.031 ± 16.463	0.463
PaCO <sub>2</sub> (mmHg)	30.897 ± 7.261	29.638 ± 14.623	0.759
APACHE II scores	24.670 ± 2.98	33.760 ± 5.43	0.0001

**Table 2.** Single logistic regression analysis of risk factors for death of SAP patients

Variables	B	SE	Wald	Sig	OR
Early shock	-1.819	0.818	4.500	0.034	0.162
Pleural effusion	-2.101	1.095	3.678	0.055	0.122
Serum amylase	0.001	0.001	0.296	0.130	1.001
Arterial pH	-23.666	11.238	4.435	0.035	0.000
Preoperative complications	2.133	1.205	3.132	0.077	8.439
APACHE II scores	0.335	0.097	11.862	0.001	1.398

Early shock: N = 1, Y = 0; pleural effusion: N = 1, Y = 0; arterial pH: Y = 1, N = 0; preoperative complication: Y = 1, N = 0. B: regression coefficient; SE: standard error; Wald; wald  $\chi^2$  value; Sig: significance; OR: odds ratio.

**Table 3.** Multiple logistic regression analysis of risk factors for death of SAP patients

Variables	B	SE	Wald	Sig	OR
Arterial pH	-23.666	11.238	4.435	0.035	0.000
Constant	173.514	82.675	4.405	1	2.270E + 75

B: regression coefficient; SE: standard error; Wald: wald  $\chi^2$  value; Sig: significance; OR: odds ratio.

**Table 4.** Stratified analysis of relationship between arterial pH and death of SAP patients

	pH < 7.35	pH $\geq$ 7.35	OR
Deaths	9	3	13.9
Survivors	11	51	

dominal distention, peritonitis, pleural effusion, surgical treatment, hydroperitonitis, urine protein, urine glucose and gallstone pancreatitis. Single logistic regression analysis showed that early shock, pleural effusion, arterial pH, complications, and APACHE II scores were associated with death of SAP patients (Table 2), but multiple logistic regression analysis showed that only arterial pH was associated with death ( $P = 1/1 + e^{-173.514 + 23.666\text{pH}}$ ) (Table 3). The patients were divided into two groups by arterial pH (pH < 7.35 and pH  $\geq$  7.35). The results of stratified analysis revealed that pH < 7.35 was significantly associated with death of SAP patients (OR = 13.9) (Table 4).

## Discussion

Some predictive systems have been used to indicate the severity of acute pancreatitis, such as Ranson's system, Bank's system, APACHE II score,<sup>[5]</sup> computed tomography severity index,<sup>[6]</sup> and urinary trypsinogen activation peptide.<sup>[7]</sup> But few investigations have been made to predict the death of SAP patients at early natural cause. This study analyzed 27 risk factors including symptoms, physical signs, laboratory test and treatment within 24 hours after admission by using logistic regression so that some risk factors relevant to death of SAP patients were screened.

Among the 27 risk factors, arterial pH, APACHE II scores, early shock, and multiple organ failure were found to be related to death of SAP patients (Table 1). Single logistic regression analysis showed that early shock, pleural effusion, arterial pH, complications and APACHE II scores were related to death of SAP patients (Table 2), but multiple logistic regression showed that only arterial pH was associated with death and stratified analysis showed that acidosis (pH < 7.35) was significantly associated with death (Tables 3 and 4). Others<sup>[8]</sup> reported that age, gender, time of onset, early shock, adult respiratory distress syndrome (ARDS), temperature, white cell count and percentage of neutrophils, and serum glucose were not relevant to death. Our study demonstrated that age, gender, febrile, hematocrit, white cell count, percentage of neutrophils, serum and urine amylase level, urine glucose, urine protein, and gallstone pancreatitis were not related to death.

Based on the experimental and clinical data, Zhang<sup>[9]</sup> and colleagues proposed that the natural course of SAP can be divided into 3 phases. The first 10 days after the onset of the disease are called acute reactive period, which is characterized by the alterations of hemodynamics and systemic vascular permeability. The major complications and causes of death in this period are early shock, renal dysfunction, ARDS, and pancreatic encephalopathy. The second phase, beginning approximately 10 days after the onset of the disease to 2 months, is named septic phase, in which systemic infection is the most important risk factor of death. The third phase is called the period of remnant in-

fection, in which the mortality rate is very low. The present study demonstrated that early shock and multiple organ failure are correlated with the death of SAP patients, which is consistent with the cause of death in the first phase, but that infection is not correlated with death. This may be due to the risk factors that were collected in our study within 24 hours after admission, during which manifestations of systemic infection were not obvious. However, if systemic infection occurs, it may lead to dysfunction of organs and death. Our study also showed the correlation of APACHE II scores and arterial pH with death. The more APACHE II scores of patients, the more severity of disease and the more possibility to death. Arterial pH is a comprehensive reflection of physical status. After the onset of SAP, the body of the patient is at a state of hypermetabolism, which leads to increased production of hydrogen ion. Mammals have a highly developed compensatory mechanism for regulating the acid-base balance such as buffer system, respiratory hyperventilation, and excretion acid of renal tubules. When the clinical course of the disease progresses rapidly, efficient mechanisms are not available for buffering and eliminating the acid, the pH of body fluids would fall. This affects the normal function of systemic organs and results in disorder of internal environment of the body. Simultaneous abnormality of the systemic organs may cause disturbance of the internal environment of the body. Both could result in death of SAP patients. In our study, the pH of body fluids was the only risk factor for death of SAP patients, shown by multiple logistic regression. Acidosis ( $\text{pH} < 7.35$ ) was significantly related to death ( $\text{OR} = 13.9$ ), indicating that it is very important to maintain the stability of the internal environment of the body in early treatment of SAP.

The above results indicate that a stable internal environment of the body is predominant in the early treatment of SAP. Hence it is paramount important to secure the function of organs of patients in ICU unit and correct water-electrolyte and acid-base dysequilibrium. In the meantime, hemodialysis and peritoneal lavage are performed to prevent injury to organs from cytokine, inflammatory media-

tor and pancreatic enzymes. Moreover, octreotide for inhibiting pancreatic enzyme excretion and prophylactic broad-spectrum antibiotics are helpful to patients to spend the acute reactive period. Surgery is not appropriate within 24 hours after hospitalization because it would add load to organs. The present study showed a higher mortality rate in patients treated surgically within 24 hours after admission than in those treated nonsurgically (33.3% vs 15.5%). If surgery is necessitated, drainage is a major choice.

In conclusion, acidosis ( $\text{pH} < 7.35$ ) within 24 hours after hospitalization is significantly associated with death of SAP patients ( $\text{OR} = 13.9$ ). Conservative treatment and a stable internal environment of the body are predominant in the early treatment of SAP.

### Competing interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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