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• *BRIEF REPORTS* •

Balthazar computed tomography severity index is superior to Ranson criteria and APACHE II scoring system in predicting acute pancreatitis outcome

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Abstract

AIM: Acute pancreatitis (AP) is a process with variable involvement of regional tissues or organ systems. Multifactorial scales included the Ranson, Acute Physiology and Chronic Health Evaluation (APACHE II) systems and Balthazar computed tomography severity index (CTSI). The purpose of this review study was to assess the accuracy of CTSI, Ranson score, and APACHE II score in course and outcome prediction of AP.

METHODS: We reviewed 121 patients who underwent helical CT within 48 h after onset of symptoms of a first episode of AP between 1999 and 2003. Fourteen inappropriate subjects were excluded; we reviewed the 107 contrast-enhanced CT images to calculate the CTSI. We also reviewed their Ranson and APACHE II score. In addition, complications, duration of hospitalization, mortality rate, and other pathology history also were our comparison parameters.

RESULTS: We classified 85 patients (79%) as having mild AP (CTSI <5) and 22 patients (21%) as having severe AP (CTSI ¡Ý5). In mild group, the mean APACHE II score and Ranson score was 8.6±1.9 and 2.4±1.2, and those of severe group was 10.2±2.1 and 3.1±0.8, respectively. The most common complication was pseudocyst and abscess and it presented in 21 (20%) patients and their CTSI was 5.9±1.4. A CTSI ¡Ý5 significantly correlated with death, complication present, and prolonged length of stay. Patients with a CTSI ¡Ý5 were 15 times to die than those CTSI <5, and the prolonged length of stay and complications present were 17 times and 8 times than that in CTSI <5, respectively.

CONCLUSION: CTSI is a useful tool in assessing the severity and outcome of AP and the CTSI ¡Ý5 is an index in our study. Although Ranson score and APACHE II score also are choices to be the predictors for complications, mortality and the length of stay of AP, the sensitivity of them are lower than CTSI.

Key words: Acute pancreatitis; Ranson score; APACHE II score; Balthazar computed tomography severity index

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INTRODUCTION

Acute pancreatitis (AP) is a process of acute inflammation of the pancreas, with variable involvement of regional tissues or organ systems. The clinical expression of AP varies from edematous mild AP to severe AP, and is frequently associated with necrosis of the pancreas, a protracted clinical course, organ failure, a high incidence of local complications, and a high mortality rate[1]. Multifactorial scales including the Ranson[2] and Acute Physiology and Chronic Health Evaluation (APACHE II) systems[3] have been used for AP since the 1970s. Balthazar computed tomography severity index (CTSI) was developed since 1990[4]. Computed tomography (CT) with intravenous contrast medium injection is accepted as the imaging procedure of choice: first to document the extent of pancreatic and extrapancreatic acute fluid collections and, second, to detect pancreatic necrosis. These two parameters have been identified as prognostic indicators of the severity of AP. CTSI, based on combined assessment of peripancreatic fluid collections, and the degree of pancreatic necrosis were developed to improve prognostic accuracy. The purpose of this review study was to assess the early predictability of a variety of parameters in AP, such as Ranson, APACHE II, and CTSI. We compared the accuracy of CTSI, Ranson score, and APACHE II score in course and outcome of AP prediction and the prognostic value of CT in the assessment of AP.

MATERIALS AND METHODS

We performed a retrospective review of all 121 patients who underwent helical CT within 48 h after onset of symptoms of a first episode of AP between 1999 and 2003.

Fourteen inappropriate subjects who did not meet criteria of clinical blood data for diagnosis of pancreatitis were excluded, CT was performed without contrast because of renal dysfunction and missing chart in medical records, and we reviewed the 107 contrast-enhanced CT images. Of these, there were 57 males, 50 females, with ages ranging from 21 to 87 years, mean age 56 years. The abdominopelvic CT scans were (HiSpeed CT/I; GE Medical Systems, Milwaukee, WI, USA) acquired from patients after oral administration of 4% iothalamate meglumine (Mallinckrodt, USA) 1 000 mL and intravenous administration of iohexol (Nycoveien, Norway) 100 mL (350 mg/mL); flow rate, 2 mL/s, with a section thickness of 10 mm and a pitch of 1.5. We reviewed the CTSI of their CT images. CTSI is a 10-point scoring system derived by assessing the degree of pancreatic and peripancreatic inflammation (0-4 points), and the presence and degree of pancreatic parenchymal nonenhancement or necrosis (0-6 points)[4]. In addition, we also collected the clinical chart records (temperature, heart rate, mean blood pressure, respiratory rate, etc.) to calculate the APACHE II and Ranson score. Complications, duration of hospitalization (according to Simchuk's study[5], we defined the prolonged length of stay as ¡Ý20 d; short length of stay as <20 d), mortality rate, and other pathology history also were our comparison parameters.

RESULTS

According to Casas's study[6], we classified 85 patients (79%) as having mild AP (CTSI <5) and 22 patients (21%) as having severe AP (CTSI ¡Ý5). We found that the CTSI in all patients was 0-8 points and mean score was 3.7. The mean CTSI in mild group was 1.9±0.4 and that in severe group was 6.1±0.5. In APACHE II score aspect, the mean score among all patients was 9.4±2.4. In CTSI mild AP group, the mean APACHE II score was 8.6±1.9 and that of CTSI severe AP was 10.2±2.1. In Ranson score aspect, the mean score in all patients was 2.7±1.4. In CTSI mild group, the mean Ranson score was 2.4±1.2 and that of CTSI severe group was 3.1±0.8. Complications included pseudocyst formation in 21 (20%) including abdominal abscess in two cases. The CTSI in these patients was 5-8, and the mean score was 5.9. Mean APACHE II score and Ranson score of them were 9.4 and 2.7 respectively. Four patients (3.7%) died because of multiorgan failure and sepsis. They died at 21st, 23rd, 19th, and 12th d after admission. The CTSI of them was 3, 5, 6, and 7 respectively. The APACHE II in these four patients was 6, 7, 7, and 9 and the Ranson score was 2, 2, 2, and 3. The APACHE II and Ranson score in the patient who died but with a CTSI of 3 were not significantly higher than other patients. In the length of stay aspect, 19 patients stayed for over 20 d and the mean CTSI was 5.6. Others stayed for 3-15 d and the mean CTSI was 2.7. By comparison, there is no significant difference of APACHE II and Ranson score in the short length of stay (<20 d) group and prolonged length of stay (¡Ý20 d) group. Mean APACHE II score in short and prolonged length of stay was 8.9 and 9.8 and the mean Ranson score was 2.9 and 2.6, respectively. Comparison of CTSI, APACHE II score and Ranson score in our patients are listed in Table 1.

Table 2 shows the relationship between CTSI and outcomes. These data showed that the CTSI significantly correlated with all outcomes measured. Patients with a CTSI ¡Ý5 was 15 times to die than those CTSI <5, and the prolonged length of stay and complications present were 17 times and 8 times than that in CTSI <5, respectively. AP was due to gallstone in 36 patients (34%), to alcohol consumption in 36 patients (34%), to both causes in 16 patients (15%) and to unknown reasons in 19 patients (18%). In other pathology history aspect, the most popular disease in our patients is diabetes mellitus (DM). Thirty-six patients (34%) were with DM and two of them underwent neuropathy. The mean CTSI in these DM patients was 5.3. Three of the DM patients died and their CTSI were 5, 6, and 7. In addition, AP relapse occurred in 17 patients (16%) and they all belonged to alcoholic type. The mean CTSI of them was 4.2.

Table 1 The comparison of severity, complication, mortality, and the length of stay in CTSI, Ranson score, and APACHE II score

		CTSI[1]	Ranson score	APACHE II score
Severity	Mild	1.9±0.4	2.4±1.2	8.6±1.9
	Severe	6.1±0.5	3.1±0.8	10.2±2.1
Complications	Present	5.9±1.4	2.7±0.9	9.4±2.4
	Absent	2.1±0.6[1]	2.5±1.1	8.7±1.6
Mortality	Present	5.3±1.7	2.3±0.5	7.3±1.3
	Absent	1.8±0.6[1]	2.5±0.7	8.5±0.9
Length of stay	¡Ý20 d	5.6±1.6	2.6±1.1	9.8±0.9
	<20 d	2.7±1.1[1]	2.9±0.9	8.9±1.2

[1]Significant differences between two lines in the same parameter.

Table 2 CTSI and outcome prediction

		No. of patients	*P*	Odd's ratio
Death	CTSI ¡Ý5	3	<0.05	15
	CTSI <5	103		
Prolonged length of stay (¡Ý20 d)	CTSI ¡Ý5	19	<0.05	17
	CTSI <5	88		
Complications	CTSI ¡Ý5	21	<0.05	8
	CTSI <5	86		

DISCUSSION

Predicting the severity and outcome of AP still represents a challenge for the physician. Since the work of Ranson[2] establishing a scoring system of severity for patients with AP, there has been several other scoring systems: Imrie[7], APACHE II[3], and Balthazar CTSI[4] systems were used to assess the severity of disease that had a high sensitivity and positive predictive value (PPV). A milestone achievement in assessing the severity of AP occurred in 1974, when Ranson developed his prognostic signs. He examined the relationship of 43 different measurements made during the first 48 h of treatment, finding 11 variables that significantly correlated with overall morbidity and mortality. Imrie *et al*., later modified Ranson's criteria by removing serum transaminase and adding serum methemalbumin, albumin, and cyclic AMP to Ranson's prognostic variables. However, the Ranson and Imrie criteria cannot be calculated until data from admission and 48 h after admission are compared. Larvin and McMahon[3]

applied the APACHE II score in the setting of AP and found that those with scores >7 were likely to have a severe course. They defined a severe course as the development of major organ system failure and a pancreatic collection. An advantage of the APACHE II score was flexibility, as it could be recalculated at any time during a hospital stay. However, Larvin and McMahon also showed that the APACHE II score had just a 67% PPV at 24 h after admission. They also showed that the APACHE II score was even less accurate for identifying patients with specific complications including peripancreatic fluid collections or major organ failure. Thus, better prognostic tools are needed. The Balthazar CTSI was reported to be of value in identifying patients with severe and fatal outcome, only a few studies have investigated whether CTSI performance is superior to that of the APACHE II or Ranson score in predicting AP outcome. This is the major challenge of this study.

Robert *et al.*[8], demonstrated that the Ranson score in mild AP (defined as the course of the disease was uncomplicated) and in severe AP (defined as organ failure) were 1.9±0.9 and 2.2±0.5. The APACHE II score was 6.9±0.7 and 7.4±0.4 in mild and severe group. In Chatzicostas's study[9], the Ranson score in mild (defined as normal amylase and lipase level) and severe (defined as organ failure and complications) groups were 2.0±1.4 and 2.1±1.6. The APACHE II score was 10.1±0.2 and 9.8±0.6 in mild and severe group. There were no significant differences between these data. According to these data, Robert and Chatzicostas demonstrated that the Ranson score and APACHE II score are not absolute predictors for severity of AP. In our study, we also did not find significant differences of Ranson and APACHE II score in mild and severe groups. So we suppose that our results are similar to Robert's and Chatzicostas's. In addition, in Wilson's study[10], they demonstrated that the patients with Ranson score ¡Ý3 was always in a severe situation. On evaluation of mean Ranson score in our study, we found that in severe AP it was 3.1±0.8. However, only one-thirds of the patients with severe pancreatitis had Ranson score ¡Ý3. Compared to Wilson's results, there were still a lot of variability in Ranson score prediction.

Complications are often the major reasons that resulted in the death of AP patients. The management of complications is important to reduce the mortality rate. In our study, we found that the higher CTSI associated with higher complication rate and the CTSI ¡Ý5 is an index. However, we did not find the same situation in Ranson and APACHE II score. There were no significant differences between mild and severe groups of Ranson and APACHE II score. According to Nicolas[11], they found that complications occurred rarely in Ranson score <3 and APACHE II score <8. In our study, the mean Ranson score and APACHE II score in complications-occurred patients were 2.7 and 9.4. Our APACHE II score result was similar to Nicolas' but in Ranson score aspect, the results showed that the relationship between complications present and Ranson score appeared to involve multiple variables. In the length of stay aspect, we demonstrated that CTSI is a more sensitive predictor than APACHE II and Ranson score. The mean CTSI in short and in prolonged length of stay showed significant difference (2.7 *vs* 5.6). However, there is no significant difference of APACHE II and Ranson score in the short length of stay group and prolonged length of stay group. In Simchuk's study[5], they mentioned that the PPV of APACHE II and Ranson score for the length of stay were 31% and 38%, and the PPV of CTSI was 71%. However, in Fleszler's study[12], they mentioned that APACHE II score is the most appropriate index to predict the length of stay, but they also mentioned that this score requires an arterial blood gas level, which was not available on some patients, thus the practicality of APACHE II is lower than Ranson score and CTSI.

The reported mortality rates for patients with AP vary greatly from 15% to 56%[12]. In Casas's study[6], they demonstrated that CTSI ¡Ý5 is the index, if the patients are under the danger of death. In Bradley's study[13], their results showed that CTSI >8 is the index for death. In our study, three of the four died patients had a CTSI ¡Ý5. So we supposed that our results were more similar to Casas's. According to Simchuk *et al.*[5], they mentioned that the CTSI <3 had a 3% mortality rate, whereas patients with a CTSI >7 had a mortality rate of 17%, it is likely 5-6 times mortality rate in CTSI >7 group. From the CTSI definitional value described above, there was still a lot of variability in death prediction of CTSI. According to our results, we demonstrated that the reason resulted in the variability may be the different characteristics of patients. Age, chronic diseases such as DM present or not, alcohol consumption and organ dysfunction all may affect the mortality rate of AP. We found that three of our four died patients had DM and their CTSI were 5, 6, and 7, all of them were alcoholics, and the average age of the four died patients was 55 years. Mortality rate associated with higher CTSI and worse pathological rate, the different characteristics of individual should not be ignored.

In conclusion, the CTSI is a useful tool in assessing the severity and outcome of AP and the CTSI ¡Ý5 are likely to have a severe course in our study. Although Ranson and APACHE II scores also are choices to be the predictors for complications, mortality and the length of stay of AP, the sensitivity of them are lower than CTSI. In addition, we found that if we are using CTSI to be an indicator for mortality rate, the different characteristics of an individual should not be ignored.

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