Research Article

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Predicting the Severity of Acute Pancreatitis Using Ultrasound Markers and Clinical Scales

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ABSTRACT For the timely determination of the tactics of treatment of acute pancreatitis, it is necessary to predict the severity when the patient enters the hospital.

AIM OF THE STUDY To assess the possibility of predicting the severity of acute pancreatitis using ultrasound markers, clinical scales.

MATERIAL AND METHODS A retrospective analysis of the diagnostic results of 84 patients who were hospitalized for acute pancreatitis was carried out. The results of clinical-laboratory and morphological diagnostic methods obtained upon admission of a patient to a hospital in patients with varying degrees of severity of AP were analyzed. Clinical and laboratory data were analyzed using prognostic scales — Marshall, Ranson, SOFA, BISAP. The analysis of morphological changes in the pancreas during ultrasound and computed tomography was performed using the Balthazar classification.

RESULTS The sensitivity of clinical scales for determining the severity of AP was 67% on the SOFA scale, 87.5% on the BISAP scale, and 100% on the Ranson and Marshall scales. All patients (22) who had signs corresponding to the Balthazar stage D and E upon ultrasound examination subsequently had a moderate and severe course of the disease.

CONCLUSION The use of ultrasonic markers of acute pancreatitis in conjunction with the data of clinical and laboratory scales makes it possible to predict the severity of acute pancreatitis.

Keywords: acute pancreatitis, pancreatic necrosis, ultrasound examination, clinical prognostic scales

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AP – acute pancreatitis
BISAP – bedside index of severity in pancreatitis
CT – computed tomography
IFS – intestinal failure syndrome
SOFA – sequential organ failure assessment

INTRODUCTION

Acute pancreatitis (AP) is one of the most common emergency surgical pathologies. Complications of destructive pancreatitis still remain the main cause of death in this most severe category of patients.

Thus, postoperative mortality in necrotizing pancreatitis is within 20–45% according to most authors [1, 2]. It is difficult to determine the severity of AP.

The need to distinguish between degrees is required, first of all, for early intensive care for patients, timely determination of treatment tactics [3]. To assess the severity of AP and predict the development of the disease, many different scales based on clinical and laboratory data are currently used: Ranson, BISAP (bedside index of severity in pancreatitis), Marshall and others.

The results of the isolated application of these scales in the literature are controversial. Some authors were unable to statistically confirm a direct relationship between scores and mortality rates according to clinical scales. In addition, clinical recovery has been observed even in those patients who have an extremely high score on the predicted scale [3].

Computed tomography (CT) with contrast is considered the method of choice for diagnosing, staging, and detecting complications of AP [3–6]. E.J. Balthazar offered to determine the severity index depending on the degree of inflammation, the presence of fluid accumulations, the prevalence of necrosis, a higher score is associated with a higher incidence of complications and mortality according to the results of CT [7–9]. At the same time, CT on the day of admission solely for the purpose of prognosis is not recommended [10].

In the recommendations of the World Society for Emergency Surgery of 2019 (WSES), ultrasound examination is provided for all patients with AP upon admission [11]. The ultrasound method is considered highly informative for diagnosing pancreatic necrosis [12–14].

We suggested to use the results of ultrasound in combination with clinical and laboratory data upon admission of the patient to predict the severity of AP.

Aim of study: to assess the possibility of predicting the severity of AP using ultrasound markers, clinical scales.

MATERIAL AND METHODS

A retrospective analysis of the results of diagnosis and treatment of 84 patients who were hospitalized at the Ufa Emergency Hospital for AP in the period 2019–2021 was carried out.

To determine the severity of AP, the classification of AP from 2012 and the definition of Atlanta based on international consensus were used [15]. According to the severity of the completed case of the disease, the patients were distributed as follows: a mild degree was determined in 26 patients (31%), a moderate degree of severity was found in 36 patients (42.9%), a severe degree was found in 22 patients (26.2%).

Clinical and laboratory data were analyzed using Marshall, Ranson, SOFA (sequential organ failure assessment), BISAP prognostic scales [16–18]. An analysis of the morphological changes in the pancreas was also carried out using ultrasound and CT in the conditions of the admission and diagnostic department. To interpret the obtained ultrasound data, the criteria for pathological changes in the pancreas were also used in accordance with the CT classification of AP according to E.J. Balthazar.

The data obtained during ultrasound were compared with the results of CT in patients who underwent this study, as well as with the results of video laparoscopy and intraoperative revision of the pancreas, parapancreatic retroperitoneal tissues.

RESULTS

Among 26 patients with a mild degree of severity, upon the fact of a completed case of the disease, ultrasound revealed signs corresponding to stage A according to the Balthazar scale in 4 patients (15.4%), B — in 15 patients (57.7%), C — in 4 patients (15.4%), in 3 patients (11.5%), the pancreas could not be visualized due to the phenomenon of aerocolia. Changes corresponding to stages on the Balthazar D and E scale were not identified. Organ dysfunctions according to the SOFA scale were observed in 4 patients (15.4%), according to the Marshall, Ranson, BISAP scales, organ dysfunctions were not revealed.

In the group of patients with moderate severity of AP (n = 36) according to ultrasound criteria corresponding to those of the Balthazar CT scale, stage *A* of pancreatitis was in 3 (8.3%), stage *B* — in 8 (22.2%), stage *C* in 4 (11.1%), stage *D* in 11 (30.6%), and stage *E* in 1 patient (2.8%). The absence of visualization of the pancreas in the conditions of the admission and diagnostic department was in 10 patients (27.8%), among which in 7 patients during dynamic observation, signs corresponding to stages D and E were found. In 22 patients (61.1%), organ failure was detected using the SOFA scale, according to the Ranson scale — in 8 patients (22.2%). Signs of organ failure according to the BISAP scale were observed in 8 patients (22.2%), according to the Marshall scale — in 2 patients (5.6%).

In patients with severe pancreatitis (n = 22), ultrasound revealed signs corresponding to stage A according to the Balthazar scale in 2 patients (9%), B in 1 patient (4.5%), D in 9 patients (40, 1%), in 2 patients (9%) stage E was established.

In 8 cases (36.4%), the pancreas was not visualized during the initial examination; during dynamic observation, these patients showed ultrasound signs corresponding to the Balthazar scale of stages D and E.

In 1 patient with a severe course of the disease, an unchanged pancreas was visualized during primary ultrasound (corresponding to stage A) and ultrasound signs of acute calculous cholecystitis and signs of intestinal failure syndrome (IFS) of the 2nd stage were detected; during dynamic observation, signs of AP were detected, corresponding to the scale Balthazar Stage D.

In 2 cases, when visualizing an unchanged and enlarged pancreas by ultrasound diagnostics (corresponding to stages A and B), the presence of free fluid in the abdominal cavity was additionally detected, and during dynamic observation, signs of AP corresponding to the Balthazar scale, stages D and E.

In all "prognostically ineffective" observations of ultrasound diagnostics (correspondence on the Balthazar scale to stages A and B in the group with severe AP), the patient's visit was less than 2 days from the onset of symptoms of the disease, and all 3 patients showed signs of organ dysfunctions according to clinical scales. Signs of organ failure were recorded using the SOFA clinical scale in 14 patients (63.6%), Marshall scale — 4 (18.2%), Ranson — in 10 (45.5%), BISAP — in 14 (63.6 %) %).

In addition, ultrasound signs were found indicating the development of systemic manifestations in severe disease: splenomegaly, effusion in the abdominal and pleural cavities, and IFS of varying degrees.

In 10 patients, an enlarged spleen was found, where 4 patients had a severe course of the disease, 5 had an moderate severity of AP. Effusion in the abdominal and pleural cavities was observed in 8 patients (22.2%) in the group of moderate AP, in 10 patients (45.5%) in the group of patients with severe AP. IFS was detected in 13 patients (36.1%) with moderate AP, in the group of patients with severe AP, IFS was detected in 11 cases (50%).

Table 1

The frequency of ultrasound signs detection upon admission of the patient, depending on the severity of the course of the disease

Ultrasound signs	The severity of the disease					
	Mild		Moderate		Severe	
	n	%	*n*	%	*n*	%
Enlargement of the pancreas	17	65.4	20	55.6	11	50
Diffuse changes in the structure of the pancreas	12	46.2	16	44.4	7	31.8
Focal changes in the structure of the pancreas	0	0	2	5.6	0	0
Accumulation of fluid in the omental sac	0	0	6	16.7	5	22.7
Omental sac infiltrate	3	11.5	4	11	3	13.6
Omental sac infiltrate with fluid component	0	0	3	8.3	2	9
Accumulation of fluid in the retroperitoneum	0	0	1	2.8	5	22.7
Infiltrate in the retroperitoneal tissue	0	0	1	2.8	2	9
Free fluid in the abdomen	3	11.5	9	25	11	50
Free fluid in the pleural cavities	0	0	0	0	2	9
Splenomegaly	1	3.8	5	13.9	4	18.2
Intestinal failure syndrome	3	11.5	12	33.3	11	50

CT was performed in 26 patients (31%). CT data were compared with US signs of AP (Table 2). When comparing the results of ultrasound and CT in these patients (n = 26), the coincidence of the conclusions of the two research methods took place in 25 cases (96.55%).

Table 2

Ultrasound and computed tomography signs at various stages of pancreatitis according to the Balthazar scale

Stage of acute pancreatitis (according to *Balthazar*)	signs	
	Ultrasound	Computed tomography
B	Enlargement, blurred edematous structure, preservation of clear contours, absence of parapancreatic formations	Local or diffuse enlargement of the pancreas
C	Enlargement, blurred edematous structure, fuzzy contours, parapancreatic infiltrate without a liquid component	Local or diffuse enlargement of the pancreas with the presence of inflammatory infiltration of parapancreatic tissues
D	Enlargement, blurred structure, fuzzy contours, the presence of parapancreatic fluid accumulation in the omental sac	Accumulation of fluid of a single location
E	Enlargement, blurred structure, fuzzy contours, the presence of parapancreatic fluid accumulation (in the omental sac) pararenal, in paracolytic tissue	Two or more accumulations of fluid and/or gas bubbles in the pancreas or surrounding tissues

We also analyzed the effectiveness of the isolated use of clinical prognostic scales. The specificity and sensitivity of the SOFA scale in AP reached 64.3% and 67%, respectively. The specificity and sensitivity of the BISAP scale was 61.5 and 87.5%. The Ranson scale showed the highest sensitivity of the method (100%), and the specificity was 38.5%. The sensitivity of the modified Marshall scale in our study was 100%, while the specificity was only 15.4%.

DISCUSSION

In a number of studies, the high information content of ultrasound in AP has been confirmed [19, 20]. There is an opinion that in most patients with AP, CT is not required; ultrasound is quite informative [5]. According to our data, during the primary ultrasound, performed during hospitalization in the conditions of the admission and diagnostic department, the group of patients with mild AP, there were no fluid accumulations of any location.

According to clinical data, organ dysfunctions in this group of patients were detected only on the SOFA scale (15.4%). Considering that the severity was determined in accordance with the Atlanta classification, according to which there are no organ dysfunctions with mild severity, these results on the SOFA scale were considered false positive.

After analyzing the results of stratification on the SOFA scale of at least 2 points in the group of patients with a mild course of the disease, it was found that the increase in the level of bilirubin, creatinine was associated with the chronic condition. All patients who had stage D and E AP according to Balthazar (36.2%) at primary ultrasound were subsequently assigned to groups of patients with moderate and severe AP.

Where it was not possible to visualize the pancreas in the conditions of the admission and diagnostic department (71.4% of cases), patients were subsequently assigned to groups of patients with moderate and severe AP. Thus, the phenomenon of aerocolia (31% of observations) is an independent unfavorable sign of a severe course of the disease.

When analyzing the results of using clinical scales, it was noted that in the same patient, signs of organ dysfunctions can be observed on one scale and not be detected on another.

But at the same time, the BISAP and Ranson scales showed the highest sensitivity of the method. In all "prognostically ineffective" observations of ultrasound diagnostics (corresponding to stages A and B according to the Balthazar scale in the group with severe AP), signs of organ dysfunctions were revealed according to clinical scales.

CONCLUSION

Thus, predicting the severity of acute pancreatitis in the first hours of the patient's admission to the hospital using one method or one scale is not possible.

It is required to develop and introduce an integrated approach to forecasting into wide practice, taking into account both clinical and morphological signs. Morphological assessment of the state of the pancreas in order to predict when a patient is admitted to a hospital is rational using the ultrasound diagnostic method as the most accessible. Our experience of using the Balthazar scale for interpreting ultrasound data has shown the convenience for clinicians in determining treatment tactics.

FINDING

1. Clinical scales BISAP, Ranson and the modified Marshall scale showed high sensitivity: 87.5%, 100% and 100%, respectively.

2. Ultrasound signs of pancreatic necrosis, corresponding to stages *D* and E according to the Balthazar scale make it possible to predict the moderate and severe course of the disease.

3. The use of ultrasonic markers of acute pancreatitis in conjunction with the data of clinical and laboratory scales makes it possible to most reliably predict the severity of acute pancreatitis.

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