SCORING IN ACUTE PANCREATITIS: WHEN IMAGING IS APPROPRIATE?

B. Cucuteanu¹, Cristina Cijevschi Prelipcean²*, Cătălina Mihai², Mihaela Dranga², D. Negru¹
University of Medicine and Pharmacy “Grigore T. Popa”-Iaşi
Faculty of Medicine
1. Department of Surgery
2. Department of Medical Specialties (I)
*Corresponding author. E-mail: cristinacijevschi@yahoo.com

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(Abstract). Acute pancreatitis (AP) is a frequent presentation to the emergency departments with a rising incidence and a great variability in clinical severity and outcome. The aim of this review is to offer a succinct presentation on acute pancreatitis scoring systems and the use of different imaging methods in severity prediction: Ranson criteria, Glasgow criteria, Hong Kong Score, Acute Physiology and Chronic Health Evaluation II (APACHE II), computed tomography scoring systems, Bedside Index of Severity in Acute Pancreatitis (BISAP) score, Pan 3, Japanese Severity Score (JSS), Harmless Acute Pancreatitis Score (HAPS), Pancreatitis Outcome Prediction (POP), Sequential Organ Failure Assessment (SOFA). This article also describes the Revised Atlanta Classification of AP (2012) and the correlation with computed tomography. Keywords: PANCREAS, SCORING SYSTEM, PROGNOSIS

Acute pancreatitis (AP) is defined as an acute inflammatory disease of the pancreas which may involve the peripancreatic tissue and remote organ systems (1). The incidence of AP ranges in different studies from 13 to 45 per 100,000 (2). AP can result in a systemic inflammatory response syndrome with significant morbidity and mortality in 15-20% of patients (3, 4). The most common causes of acute pancreatitis are gallstones, idiopathic and alcohol; occult microlithiasis probably the main cause of idiopathic pancreatitis (5,6).

Most patients present a mild and self-limiting disease (80-85%), and the remaining ones develop complications (major local or systemic), which lead to multiple organ failure and death. The mortality rate for the severe form of AP (SAP) is high, up to 30% (7). The possibility of selecting patients with SAP is pivotal for proper treatment, observing closely the course of disease and relying on clinical decision-making.

REVISED ATLANTA CLASSIFICATION

The revised Atlanta classification (11) divides AP into interstitial edematous pancreatitis and necrotizing pancreatitis, each with an early phase (1st week) and a late phase (after 1st week). Characteristically, the early phase of treatment is based on clinical parameters and in the late phase of treatment decisions are made by a combination of clinical parameters and morphologic criteria (peripancreatic fluid collections, pancreatic necrosis, other complications) established on the basis of computed tomographic (CT) findings (10).
Contrast-enhanced CT is the primary tool for assessing the morphologic criteria and is suited for patients who develop or are likely to develop SAP. The ideal time to visualize complications of AP with CT is 72 hours after the onset of symptoms.

In the revised Atlanta classification (11), necrotizing pancreatitis is subdivided into parenchymal necrosis alone, peripancreatic necrosis alone and a combined type (parenchymal and peripancreatic necrosis). The terminology for fluid collections is also revised, designated as acute peripancreatic fluid collection and acute necrotic collection within the first 4 weeks, and in pancreatic pseudocyst and walled-off necrosis after 4 weeks, respectively (fig. 1, 2).

The revised Atlanta classification (11) is not necessarily a predictor of severity, but it classifies disease severity based upon clinical and imaging features.

**Fig. 1.** Contrast-enhanced CT scan in a patient with interstitial edematous acute pancreatitis developing an acute peripancreatic fluid collection around body and tail (Collection of Radiology and Medical Imaging Laboratory, Iași “Sf. Spiridon” University Hospital, Prof. dr. D. Negru).

**Fig. 2.** Contrast-enhanced CT scan in a patient with acute necrotic pancreatitis, in late phase (after 4 weeks), with a pancreatic and peripancreatic fluid collection which meets the criteria for walled-off necrosis (inhomogeneous content, well defined wall). (Collection of Radiology and Medical Imaging Laboratory, Iași “Sf. Spiridon” University Hospital, Prof. dr. D. Negru).

**PROGNOSTIC SCORING SYSTEMS**

The correct identification of SAP only by clinical assessment on admission is reported in 40-64% of patients. The requirement for an early objective measure of AP severity was recognized in the mid ’70s by Ranson who established the characteristics of the ideal prognostic method: objectivity, accuracy, simplicity, availability at diagnosis, non-invasiveness, quantitative-ness, independence with regard to etiology and pre-existing disease, complication specificity, usefulness for disease course monitoring (13).

*Prognostic assessment by means of single laboratory markers is easier to use than scoring systems which are often difficult to apply and have a high degree of complexi-
Scoring in acute pancreatitis: when imaging is appropriate?

There are many analyses used in the prognostic evaluation of patients with AP (e.g. amylase, calcium, white blood cell count, blood glucose, hematocrit, phospholipase A2, coagulation factors, polymorphonuclear elastase, arterial hypoxemia, acidosis, ribonuclease, endotoxin, trypsinogen activator peptide, pancreatitis-associated peptide, neopterin, interleukin 6, interleukin 8, C-reactive protein (CRP), procalcitonin, creatinine, blood urea nitrogen -BUN) without confirmation of their validity. CRP usually peaks 72 hours after the onset of symptoms, at the end of therapeutic window, but it is an important marker for necrosis. BUN elevation on admission or rising 24 hours after the onset is associated with higher mortality (14).

Numerous multifactorial prognostic scoring systems (15, 16) have been proposed in the last 40 years, incorporating physiologic, laboratory, imaging parameters, performing with moderate sensitivity and high negative predictive value; also the positive predictive value is suboptimal, but there are debates regarding the design for initial and sequential studies, many studies that have used or assessed these scoring systems having limitations due to the small number of enrolled patients with SAP.

Ranson criteria (18) are divided into two parts: on admission, when included are: age, white blood cell count (WBC), glucose, lactate dehydrogenase (LDH), aspartate transaminase (AST), and after 48 hours there are evaluated hematocrit (Hct), calcium, blood urea nitrogen (BUN), base deficit, fluid loss, pO2.

Glasgow scoring system uses pO2, albumin, calcium, WBC, AST, LDH, glucose, and BUN. Hong Kong system requires just BUN and glucose (18). APACHE II is a scoring system used in intensive care unit based on multiparametric evaluation: temperature, heart rate, mean arterial pressure (MAP), respiratory rate, WBC, Hct, plasma Na+, plasma K+, creatinine, arterial pH, venous bicarbonate, pO2, alveolar–arterial pO2 difference, age, Glasgow Coma Scale (GCS), Chronic Health Score (CHS) (19). Other multifactorial prognostic scores are described, such as Marshall (based on MAP, FiO2/pO2, GCS, platelet count, creatinine), BISAP – bedside index for severity in acute pancreatitis (BUN, impaired mental status, SIRS, age, pleural effusion), Panc 3 (Hct, body-mass index, pleural effusion), JSS – Japanese severity score (base excess, pO2, BUN, creatinine, LDH, platelet count, calcium, CRP, SIRS, age), HAPS – harmless acute pancreatitis score (abdominal tenderness, Hct, creatinine), POP – pancreatitis outcome score (age, MAP, FiO2/pO2, arterial pH, calcium, BUN), SOFA – sequential organ failure assessment (MAP, FiO2/pO2, GCS, platelet count, creatinine, urinary output, bilirubin) (20, 21, 22, 23, 24).

The most widely used multiparametric scores are APACHE II score, Ranson and Glasgow criteria; APACHE II score initially developed for intensive care units requires a large number of variables being cumbersome in clinical practice, but can be used since admission; Ranson and Glasgow scores take 48 hours from admission, but require less amount of variables. Bedside index for severity in acute pancreatitis (BISAP) score is easier to use, requires those variables (vital signs, laboratories and imaging) commonly obtained in the emergency department, and can predict in-hospital mortality with higher accuracy (25).

Imaging prognostic scoring systems

These systems are based on computed tomography, a valuable method to depict pancreatic necrosis. Pancreatic necrosis is
more likely associated with severe clinical outcome and necrotizing pancreatitis and severe acute pancreatitis are practically interchangeable terms (26). Identifying pancreatic necrosis requires intravenous iodine-contrast administration and a delay in CT examination at 72 hours when necrosis is fully accomplished, to prevent under-scoring.

Balthazar scoring system (27) developed in 1985 is based on the presence of pancreatic changes and the delay from onset of symptoms is 10 days. Balthazar scoring system uses a five-grade scale (from A to E) assessing the presence of pancreatic and peripancreatic inflammation, and fluid accumulation.

PSI – pancreas severity index (28) evaluates the pancreatic modifications with a delay of 72 hours; it is calculated by multiplying the largest anteroposterior diameter of the head by the largest anteroposterior diameter of the body. A PSI higher than 10 cm$^2$ is associated with severe acute pancreatitis.

CTSI – computed tomography severity index (1990) is based on Balthazar system, but adds necrosis of pancreatic parenchyma, requires intravenous contrast administration, and the delay is minimum 72 hours. CT severity index (CTSI) depends on the presence and degree of pancreatic and peripancreatic inflammation, and fluid accumulation in combination with the amount of pancreatic necrosis, using a 10-grade scale (29). It demonstrates a good correlation between necrosis, length of hospital stay, development of complication, and death, indicating no significant relationships between pancreatic necrosis and organ dysfunction, extrapancreatic parenchymal complications, and ultimate clinical outcome (30).

Modified CTSI (m-CTSI) (31) requires intravenous contrast administration, aggregates pancreatic inflammation, pancreatic necrosis and extrapancreatic complications (pleural effusion, ascites, thrombosis in portal venous system, arterial pseudoaneurysm, gastrointestinal tract involvement) on a 10-grade scale. m-CTSI shows a good correlation between calculated severity of pancreatitis and the outcome parameters, and with organ dysfunction.

Extrapancreatic inflammation on CT (EPIC) (32) score combines radiological manifestation of SIRS and organ dysfunction, without considering necrosis; incorporates pleural effusion, ascites, retroperitoneal and mesenteric inflammation.

Mesenteric edema and peritoneal fluid (MOP) score is based on the predictive value of intraabdominal inflammatory changes and severity of acute pancreatitis (33).

Simple prognostic score (SPS) combines biochemical and radiological parameters for risk stratification and prognosis of AP. SPS is based on quantifying serum lactate dehydrogenase (LDH > 900 IU/L), blood urea nitrogen (BUN > 25 mg/dL), and the presence of pancreatic necrosis assessed by contrast-enhanced CT performed within 2 days after admission (34).

**CONCLUSIONS**

Concluding imaging prognostic scoring systems should be used for mortality prediction and for therapeutic guidance after the first 24–72 hours from admission, while nonspecific illness scoring systems (BIS-AP, APACHE II) are more suitable for the risk stratification within first 24 hours. Different prognostic scores should be applied to the different phases in acute pancreatitis, the goal being the correct identification of patients at risk to develop major complications or fatal outcome. Clinical scoring systems accurately correlate with
mortality and systemic complications, while imaging scoring systems diagnose clinically severe disease and have a better correlation with pancreatic infection and the need for intervention.

In our opinion we consider that on admission the selection of patients with mild AP should be based on the identification of pre-existing risk factors (obesity, advanced age), together with the common laboratory markers (BUN, creatinine) and chest-x-ray. Assessment of patients with a multifactorial scoring system (BISAP) at 24 hours after admission is important for identifying the group at risk for persistent organ failure. After 48-72 hours the group of patients at risk for organ failure should be checked by a prognostic score system plus CRP and a radiological score (CTSI, mCTSI). Monitoring in the late phase of AP must be based on CRP values, an organ failure score (Marshall) and repetition of contrast-enhanced CT should be used to diagnose the occurrence of complications and the changes in the extent of pancreatic necrosis or peripancreatic fluid collections.

REFERENCES