A quick and simple set of indicators for predicting the severity of acute pancreatitis

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Abstract

Acute pancreatitis is an ailment with a high mortality rate. It is essential to discern the probable clinical course of the patient as soon as possible. In the existing literature there are various sets of indicators for use in the attempt to make this prediction, but they are difficult to apply in clinical practice. This encouraged us to create a simpler set of indicators which could be applied from the moment of the patient's admission to the emergency ward. **Objective:** Evaluate a new set of indicators (hematocrit>44, heart rate>100, and serum glucose level >126 mg/dl). **Patients and methods**: Prospective study of a cohort of patients selected consecutively after admission to the emergency ward with acute pancreatitis. Clinical findings were taken as predictive variables. Development or absence of development of acute pancreatitis (according to Atlanta criteria) during the patient's hospital stay (until either hospital discharge or death), were taken as end-result variables. **Results**: 114 patients were eligible for the study. The average age was 53 (range: 18-92), 50 (44%) of the patients were males, 58 (51%) featured Atlanta criteria compatible with severe acute pancreatitis. The mortality rate was 28%. In analyzing the sensitivity of the indicators we found that if at least 2 of the 3 suggested parameters were present upon hospital admission, the probability of acute pancreatitis was greater than 90%. Sensitivity 83%, specificity was 91%, VPP (positive prognosis) was 91%, VPN (negative prognosis) was 84%.**Conclusions:** This new set of indicators may become very useful in clinical practice as it predicts the severity of pancreatitis in a simple way, is easy to remember, and has parameters that can be checked quickly and which are available in any health institution.

Key words

Pancreatitis, severity, scales, mortality.

INTRODUCTION

Acute Pancreatitis (AP) is an inflammatory illness that compromises the pancreas and peripancreatic tissues though it may affect other organic systems depending on its severity (1-3). 75% of all episodes are mild or edematous AP. Recovery tends to be quick, and the mortality is less than 3%. In contrast, severe pancreatitis, which accounts for only 25% of all cases, is associated with local and systemic complications and has a mortality rate of 40% to 50% (1). Considering different aspects of its appearance, different systems or criteria of severity have been investigated and employed in order to make an early determination of the entity's severity and to establish its prognosis (2-5). The indicators of severity in the varying scoring systems include clinical criteria, laboratory tests and imaging studies (2-6).

In 1974, Ranson and colleagues identified 11 signs for evaluating the prognosis of acute pancreatitis within the first 48 hours of a bout (7). This method is still one of the most often used tools for prognosis in clinical practice today. Five factors are determined at the outset: age, leukocyte count, glycemia values, AST, and LDH. The other 6 parameters, hematocrit, BUN, calcium, base deficit, PO2 and estimated fluid sequestration, are evaluated within the next 48 hours since they reflect the development of possible local complications and the effects of the development of a third space. In patients with two or less criteria, the mortality rate is of 5%, 10% in those with 3-5 criteria, and 60%

in patients with more than 6 criteria (7). The sensitivity of these criteria for prediction of the severity of AP is 57% to 80%. Their specificity is 68% to 85%, and their positive and negative predictive values are 50% and 90% respectively (8). One limitation of this system is that there is a high percentage of false positives. Consequently, many patients who theoretically have a serious illness recover without any complications. Furthermore, complete calculation is impossible until after 48 hours of hospitalization, and this system cannot be used to monitor a patient's evolution after the 48 hours is over. Imrie's criteria follow the same lines as Ranson's. They evaluate nine parameters in the first 48 hours of AP. The parameters include leukocyte count, glycemia, ureic nitrogen values, PO_2, calcemia, LDH, albumin and transaminase (9). This user-friendly method is widely accepted, but has limitations similar to those of the Ranson criteria with regard to quickly ascertaining a prognosis and monitoring a patient's evolution.

The APACHE II (Acute Physiology and Chronic Health Evaluation) system is a more complex classification system, but prognosis can be calculated at the moment a patient is admitted to the hospital and the system can be used to monitor the patient's evolution while hospitalized (10). At the moment of admission, sensitivity is between 34% and 70%, and specificity is between 76% and 98%. After 48 hours, sensitivity decreases to 50%, but specificity increases to close to 100% (9-11). Talamini and colleagues attempted to further simplify early evaluation of severity of pancreatitis. They analyzed the prognostic values of some routine analytical decisions such creatinine and serum glycemia measurements (12). 24 hours after admission, glycemia >250mg/dl and creatinine >2mg/dl are very useful indicators of the mortality risk ($p<0,0001$). This same group analyzed the combined value for prognosis of creatinine measures (Cr>2mg/dl) together with a chest x-ray in the first 24 hours after admission. The sensitivity for determining the risk of mortality was 90%, with a specificity of 76%. For diagnosing necrotizing pancreatitis its sensitivity was 60%, and its specificity was 88%. Finally, its sensitivity for prediction of the risk of a secondary pancreatic infection was 73%, and its specificity was 75% (13). These data are comparable to those obtained using the Ranson and Imrie criteria in 24 hours and with more than 3 positive criteria (14). The most important imaging tool for determining the severity of AP continues to be computerized tomography (CT) (15). It is basically indicated in the following situations:

a. When echography does not allow adequate evaluation
b. When there is suspicion of a pancreatic abscess
c. In the absence of clinical improvement after 72 hours of conservative treatment
d. To dismiss complications in the event of clinical deterioration
e. In patients with a score >3 on Ranson's scale or >8 on the APACHE scale (16).

In these cases, CT contributes information valuable for prognosis according to the morphological data. This permits staging and detection of local complications and is useful as a guide for implementation of intervention techniques if they are necessary (17).

Among the numerous serological factors proposed as markers of the severity of AP, the C reactive protein (CRP) is one of the most widely accepted. Its peak activity occurs 36 to 48 hours after the onset of AP, for which reason referring to it the beginning of the process is not advisable. There are differences in cutoff points used in different studies. According to data from a recent multi-centric study, CRP's predictive value for the severity of acute pancreatitis at counts >150mg/l at 48 hours shows a sensitivity of 86% and a specificity of 61%. Its positive predictive value is 37% and its negative predictive value is 94% (18). Other serological markers that have been used include PMN elastase (19), fibrin degradation products (FDP), fibronectin, antithrombin III, albumin, alpha 2 macroglobulin and coagulation factors V and VIII. However, when used alone, they do not offer any advantages. The determination of interleukin (IL) 6, IL-8, IL-10, neupterin, HPASP, tumor necrosis factor (TNF) and platelet activating factor (PAF) can contribute prognostic information, although their use should not be routine (20, 21). In spite of the great number of proposed methods, at present there are no ideal clinical criteria for predicting the course of the AP. The existing criteria are very complex. Some, like the APACHE II, are difficult to remember. Others, including Ranson, Glasgow and Imrie, require more than 48 hours. Still others, including IL-6, neupterin and HPASP, are difficult to execute in some centers because of their complexity.

Taking all of this into consideration, we believe that the criteria used to predict AP severity should be more closely based on familiar underlying physiopathological factors of the illness. These include:

1. The organic multi systemic response is reflected in heart rate >100
2. Hemoconcentration reflects systemic hypoperfusion and can be evaluated by hematocrit >44%
3. Damage to pancreatic islets is shown by glycemia >126mg/dl (diabetic range) (22-29).

We proposed this present study after taking into consideration the controversy that exists over the usefulness of the various systems for predicting the severity of AP. We also took into consideration the facts that in our environ-

ment there have been few studies on AP, and that Latin-American research on predictors of AP is scarce. In fact, in our electronic search in the Scielo library we found only three oriented toward the search for predictors of mortality (33-35). Our study looks at three parameters that we consider reflect physiopathological alterations of severity in AP in order to determine their usefulness in predicting if a patient suffering from AP who has been taken care of in the emergencies service will develop a severe illness. The main objective of this present study was to evaluate if a new scale composed of hematocrit >44, heart rate >100 per minute and glycemia >126mg/dl applied from the moment of a patient's emergency room admission permits can predict whether or not a patient will develop severe AP. The specific objectives were to determine the benefit of a new test for predicting AP severity, compare the new test with the Ranson and APACHE II criteria, determine the main causes of acute pancreatitis in our environment, define the socio demographic variables of adults are admitted to emergency wards with acute pancreatitis, evaluate the different signs and symptoms of AP presentation and evaluate the diverse risk factors related to AP severity in patients at our hospital.

MATERIALS AND METHODS

This was a prospective, observational, and analytical cross section study which consecutively included all patients with AP that were admitted to the emergency ward of the Hospital El Tunal, a third rank complexity institution. Clinical findings at admission of the patients (hematocrit >44, heart rate >100 per minute and glycemia >126mg/dl) were taken as variables for predicting whether or not severe pancreatitis would develop in the course of a patient's hospital stay until either discharge or death. The study was carried out between January, 2008 and June, 2009.

Inclusion criteria

Patients were included if they were over 18 years of age, had been diagnosed with AP based on acute abdominal pain and serum amylase at least three times the normal upper limit and/or radiological evidence of acute pancreatic inflammation.

Exclusion criteria

Patients were excluded if they had been diagnosed with chronic pancreatitis or diabetes mellitus. They were also excluded if they had mental retardation or neurological illnesses that prevented answering the questionnaire and if they were under 18 years of age.

DEFINITION OF VARIABLES

Independent variables

Demographic variables

Age in years: discrete variable.
Gender: Male =1, Female =2: Dichotomous nominal variable

Clinical History

Comorbidity: Any illness that requires permanent medical management such as hypertension, diabetes, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), acute respiratory insufficiency, asthma, and cardiovascular diseases including previous myocardial infarction, angina, congestive heart failure, claudication, and revascularization procedures. Dichotomous and categorical (nominal) variables.

Medicine consumption: Medicines that patients consumed with a minimum regularity of once per week were noted to assess any relation with pancreatitis. Tobacco addiction was noted in a dichotomous way if there was habitual and daily consumption. Alcohol consumption was noted as positive if there was a minimum frequency of consumption of once per week or if there was recent consumption at the time of admittance.

Clinical findings of causes at admission

Causes of pancreatitis:

- Biliary origin: when bilirubin is greater than 2.3mg/dl or if echography shows cholelithiasis, choledocholithiasis, or bile duct expansion (30).
- Alcohol: when no vesicle calculi or bilirubin elevation is identified and there is regular liquor consumption (31).
- ERCP (Endoscopic Retrograde Cholangiopancreatography) is considered to be the cause if acute pancreatitis appears within the first 24 hours after the procedure (32).
- Medication: when there is no evidence found of biliary origin, alcohol or other cause, but there has been recent ingestion of medicine related to pancreatitis.
- Idiopathic: when all other causes have been discarded and there are increased levels of calcium or triglycerides.
- Ranson criteria.
- APACHE II Criteria.

Radiological Definitions

Balthazar classification, Cholelithiasis: Choleolithiasis was defined as the presence of radiolucent images in the vesicle that leave an acoustic shadow. Choledocolithiasis was defined as the presence of radiolucent images in the biliary

ducts detected echographically and that leave acoustic shadows with or without bile duct expansion.

Dependent variables

The Atlanta criteria, the current standards, were used define the final severity of AP at the end of the hospitalization of a patient (5). Results were compared with the new test and Ranson and APACHE II criteria. The Atlanta criteria divide severity of AP into mild AP and severe AP. In *mild AP* there are no systemic compromises or local complications (necrosis, abscesses or pseudocysts). Recovery without incidents occurs within 3 days with minimum hydration therapy and analgesia. Abdominal CAT scans are normal or reveal nothing more than pancreatic edema (Balthazar A or B). *Severe AP* is associated with organic failure and/or local complications. It is characterized by having Ranson criteria, or 8 or more APACHE II points.

Local complications associated with AP include:

- **Acute liquid collection** occurs in or near the pancreas which has no wall.
- **Pancreatic necrosis** can be diffuse or localized in an area of nonviable parenchyma. It is associated with peripancreatic steatonecrosis, and can be wither sterile or infected.
- **Acute pseudocysts** are collections of pancreatic juice surrounded by walls (CT or Echography). Their formation requires at least 4 weeks from the beginning of AP. They are sterile. If pus or bacteria appears they are called pancreatic abscesses.

Collection techniques and procedure

The protocol and informed consent procedure were approved by the ethics and research committee of of the hospital. All patients with clinical diagnosis of AP were considered eligible for the study. Those that fulfilled the inclusion criteria and signed and accepted the informed consent form were included. All patients received an initial evaluation that included registry of vital signs, positioning of venous access, and providing blood samples for laboratory tests. Tests included a complete blood count, prothrombin time, partial thromboplastin time, nitrogen, bilirubin, AST, ALT, LDH, FA, arterial gas, PCR, blood sugar, Na, K, Ca and amylases. All exams were repeated at 48 hours to create a Ranson scale and to monitor APACHE II evolution.

Patients were stabilized with crystalloids, pain was controlled, and patients were moved to an intermediate care unit or the ICU depending on the severity of each case.

A standardized form was filled out by the emergency room doctor or the resident who evaluated the patient upon admittance. Other investigators of the group compared the results from the form with the final evolution of the patient to determine severity and which parameters or scales used predicted AP severity most closely to the Atlanta criteria which was used as the "Gold Standard".

Error and bias control

The data collected on the form were not known by the investigator who established AP severity at the end of the patient's hospitalization or upon the patient's death. All data on the collection forms were independently verified against the clinical history to control registration errors.

STATISTICAL ANALYSIS

The bivariate analysis evaluated associations among categorical independent variables. These included gender, age, hematocrit, heart rate, and blood sugar. The dependent variable in this analysis was AP severity. Pearson's asymptotic chi-square test (expected values > 5) was used to evaluate the significance of these associations (picture II). Tests were evaluated at a 5% significance level. For each one of the three variables proposed in the scale we calculated sensitivity, specificity and predictive values. We also made these calculations for the Ranson and APACHE II scales.

We also calculated positive and negative LRs (likelihood ratios) with this data. Based on the data we collected, we assumed 50% pre-test probability of severe AP. We calculated post-test probability for the proposed new variables, Ranson scale and APACHE scale using nomograms for computational analysis.

RESULTS

During the 19 month study period 124 patients who fulfilled the criteria for AP were admitted to the emergency room. 10 patients were excluded for different reasons: 6 patients had diagnoses or antecedents of diabetes, 2 patients had chronic pancreatitis and 2 patients were transferred to another institution. Finally, 114 patients were eligible for the study.

The average age was 53 years old, ranging from 18 to 92. 50 patients (44%) were men. 58 (51%) had severe AP according to the Atlanta criteria. Most of these cases of pancreatitis were of biliary origin (78%). Total mortality was 28%, but among patients with severe pancreatitis it was 55%. Table 1 shows the main characteristics of the general population. Table 2 clearly shows the statistically significant differences between patients with mild and severe pancreatitis. Significant differences appeared between the two groups in relation to alcohol consumption, body mass index over 30 kg, tachycardia, hematocrit over 44, of blood sugar over 126 mg/dl. The hospital stays of patients with severe pancreatitis were 12 days longer than other patients' stays, and they were taken to surgery more frequently. There

were no significant differences in the presence of cholelithiasis, choledocholithiasis or expanded biliary tracts.

Table 1. General characteristics of the study population.

Characteristics	General population
Age	53 years DS 40 (18-92)
Older than 55 years old	52 (46%)
Younger than 55 years old	62 (54%)
Gender	
Male	50 (44%)
Female	64 (56%)
Alcohol consumption	23 (20%)
Smoking	20 (18%)
Body mass index	25 DS 4,4 (18-44)
Cholelithiasis	70 (67%)
Choledocholithiasis	19 (17%)
Undilated biliary tract	88 (77%)
Severe pancreatitis by Atlanta classification	58 (51%)
Balthazar average score	3 DS 2 (0-6)
Apache average	8 DS 7 (0-25)
Surgery	13 (11%)
Required antibiotics	63 (55%)
Pancreatitis causes	
Biliary	89 (78%)
Idiopathic	10 (9%)
CPRE	7 (6%)
Alcohol	6 (5%)
Other	2 (2%)
Mortality	32 (28%)
Hospital stay	12 DS 12 (1-88)
Heart rate	94 DS 20 (60-140)
Hematocrit average	42 DS 6 (27-63)
Blood sugar average	135 DS 74 (50-492)

Table 3 enumerates test characteristics including sensitivity, specificity, positive and negative predictive values, quotients of positive and negative probability, 95% confidence intervals, and positive and negative LRs for each of the three parameters. Heart rates has greater sensitivity and specificity for prediction of severe pancreatitis, while the hematocrit is not as sensitive or specific. Later we performed analyzed the behavior of the proposed new scale using one, two or three criteria.

Table 4 shows differences in predictive values for these patients among the uses of one, or combinations of two, or three of the proposed criteria and existing scores. It is evident that the positivity of two criteria contributes to higher sensitivity (83%) than the Apache test (69%), and specificity (91%) which is comparable to that of the Apache test (96%). Both positive criteria offer a better negative predictive value.

To analyze sensitivity we used Nomograms. Nomogram 1 (figure 1) used two of the three proposed criteria. It showed post test probability that a patient would develop or have severe pancreatitis was higher than 90% with a positive LR (likelihood ratio) of 9.27 and a negative LR of 0.19. Sensitivity was 83%, specificity 91%, PPV (positive predictive value) 91% and NPV (negative predictive value) 84%.

Nomogram 2 (figure 2) shows the behavior of the Ranson scale. Its post-test probability was 88%. Nomogram 3 (figure 3) shows the APACHE scale with a post- test probability of 95%.

DISCUSSION

The main etiology of AP in this work was biliary (78%), similar to that found by Hernandez and colleagues (72%) (33). It is also similar to those found in American investigations (36), but is different than those found in European studies where alcoholic etiology is most frequent (37). This etiology accounted for only 5% of the patients in our study. Idiopathic AP accounted for 8% of the cases in our study, in contrast to the 17.6% of Hernandez (33). One thing that stands out is the high prevalence of severe AP (51%) that we found. This was far higher than what has been reported in other works which indicate prevalences ranging from 12% to 25% (38, 39). The prevalence rate that we found is similar to that found by Hernandez (59%) in the Military Hospital (33). This suggests that in our country AP is more frequently severe. This is an alert for doctors who handle these patients. Among the causes that could explain this high prevalence of severe pancreatitis is the fact that the main cause of AP in our patients was biliary. As is known, biliary AP has a more unfavorable course (40). Another reason that could explain the high rate of severe AP is that few patients had AP of alcoholic origin (5%). AP caused by alcohol is almost always mild. Other aspects of this investigation that draws attention are the high rate of mortality for the total group, (28%) and the even higher rate for the sub-group with severe pancreatitis (55%). This is higher than the one presented in the literature (41). This implies that in our emergency services we have to be very alert when treating these patients, and we should use reinforcing hydration, early nutrition protocols, etc. We also want to emphasize that the high mortality of AP in this work and in the literature worldwide, is higher than the rate due to acute myocardial infarction (42). Nevertheless, since the mortality rate is radically different in patients with mild AP, it is fundamental that we differentiate these two types of presentations early. Opportune establishment of treatment

Table 2. Differences between patients with mild and severe pancreatitis.

Characteristics	Severe pancreatitis	Mild Pancreatitis	p
Age older than 55 years	30 (52%)	22 (39%)	0,83
Gender			
Male	30(52%)	20 (35%)	0,085
Female	28 (48%)	36 (64%)	
Alcohol consumption	16 (28%)	7 (13%)	**0,045**
Smoking	13 (22%)	7 (12%)	0,164
Body mass index > 30 kg/m^2	12(21%)	2 (3%)	0,005
Cholelithiasis	38 (65%)	32 (57%)	0,359
Choledocholithiasis	7 (12%)	12 (21%)	0,18
Undilated biliary tract	44 (76%)	44 (78%)	0,73
Surgery	12 (21%)	1 (2%)	**0,002**
Antibiotics	48 (83%)	15 (27%)	0,000
Causes			
Biliary	48 (83%)	41 (73%)	0,699
Idiopathic	4 (7%)	6 (10%)	
Deaths	32 (55%)	0	**0,000**
Hospital stay longer than 12 days	25 (43%)	9 (16%)	**0,002**
Heart rate greater than 100 per minute	35 (61%)	7 (13%)	**0,000**
Hematocrit over 44	31 (53%)	19 (34%)	0,036
Blood sugar over 126 mg/dl	44 (76%)	11 (20%)	**0,000**
Balthazar over 3	30 (52%)	4 (7%)	**0,000**
APACHE over 8	58 (69%)	2 (4%)	**0,000**

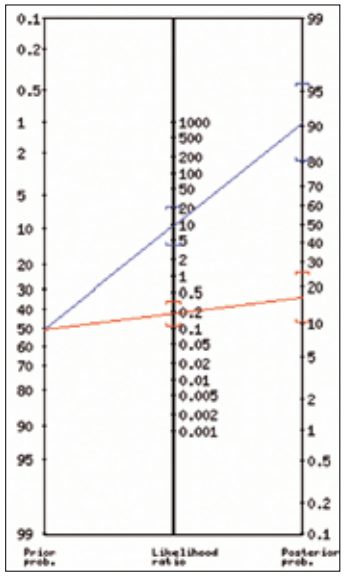
Table 3. Operating characteristics of the three parameters of the study.

Variables	Sensitivity	Specificity	CP positive	CP negative	PPV	NPV
Heart rate frequency over 100	0,6 (0,48-0,73)	0,88 (0,79-0,96)	4,83 (2,34-9,95)	0,45 (0,32-0,63)	0,83 (0,72-0,95)	0,68 (0,57-0,79)
Blood sugar over 126 mg/dl	0,76 (0,65-0,87)	0,8 (0,7-0,91)	3,86 (2,23-6,69)	0,3 (0,19-0,48)	0,8 (0,69-0,91)	0,76 (0,65-0,87)
Hematocrit over 44	0,53 (0,4-0,66)	0,66 (0,54-0,78)	1,58 (1,02-2,44)	0,7 (0,5-0,98)	0,62 (0,49-0,75)	0,58 (0,46-0,7)

Table 4. Differences among score predictors.

Tests	Sensitivity	Specificity	CP positive	CP negative	PPV	NPV	+LR	-LR
Three positive criteria out of 3	0,17(0,08-0,27)	0,98 (0,95-1)	9,66 (1,28-72,9)	0,84 (0,75-0,95)	0,91 (0,74-1)	0,53 (0,44-0,63)	1,95	0,17
Two criteria out of three	**0,83 (0,73-0,92)**	**0,91 (0,84-0,99)**	**9,27 (3,98-1,57)**	**0,19 (0,11-0,33)**	**0,91 (0,83-0,98)**	**0,84 (0,74-0,93)**	**9,27**	**0,19**
One criterion out of three	0,9 (0,82-0,97)	0,45 (0,32-0,58)	1,62 (1,26-2,08)	0,23 (0,1-0,52)	0,63 (0,52-0,73)	0,81 (0,67-0,95)	1,62	0,23
Ranson score	0,52 (0,39-0,65)	0,93 (0,86-1)	7,24 (2,73-19,23)	0,52 (0,39-0,69)	0,88 (0,77-0,99)	0,65 (0,55-0,75)	7,24	0,52
Apache score	**0,69 (0,57-0,81)**	**0,96 (0,92-1)**	**19,31 (4,9-76,13)**	**0,32 (0,22- 0,47)**	**0,95 (0,89-1)**	**0,85**	**19**	**0,32**

can change the clinical evolution of the disease. It is at this point where the use of diagnostic tests has great relevance since they allow us to quickly predict, with high probability, whether or not the patient is going to present severe AP.



POSITIVE TEST:

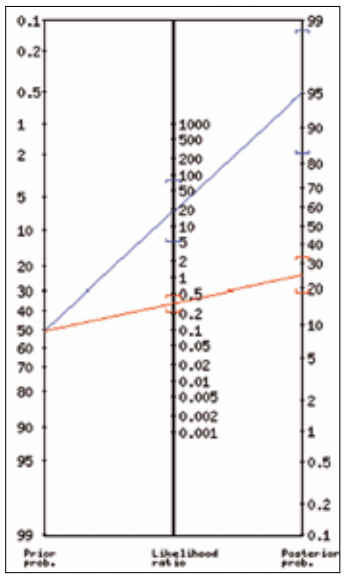
Positive Likelihood ratio:	9.27
95% confidence interval:	[3.98,22]
Posterior probability (odds):	91% (9.6)
95% confidence interval:	[80%,96%]

NEGATIVE TEST:

Negative Likelihood ratio:	0.19
95% confidence interval:	[0.11,0.33]
Posterior probability (odds):	16% (0.2)
95% confidence interval:	[10%,25%]

Odds = Probability / (1-Probability)
+LR = Sensitivity / (1 - Specificity)
-LR = (1 - Sensitivity) / Specificity
Posterior Odds = Prior Odds x LR

Figure 1. Nomogram of pretest and posttest probabilities for two and three positive criteria.



Prior probability (odds):	51% (1.0)

POSITIVE TEST:

Positive Likelihood ratio:	19
95% confidence interval:	[4.90,76]
Posterior probability (odds):	95% (19.7)
95% confidence interval:	[84%,99%]

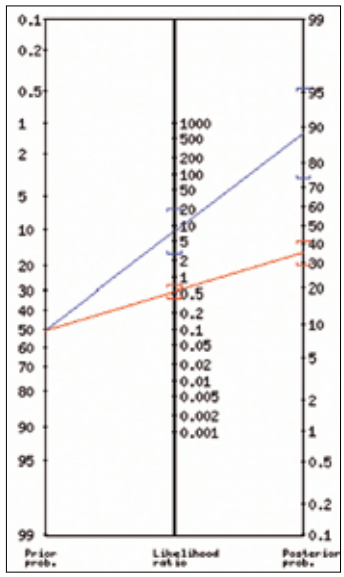
NEGATIVE TEST:

Negative Likelihood ratio:	0.32
95% confidence interval:	[0.22,0.47]
Posterior probability (odds):	25% (0.3)
95% confidence interval:	[19%,33%]

Odds = Probability / (1-Probability)
+LR = Sensitivity / (1 - Specificity)
-LR = (1 - Sensitivity) / Specificity
Posterior Odds = Prior Odds x LR

Figure 2. Nomogram of pretest and posttest probability for Apache II.

This work shows that the use of 3 simple and easy-to-use parameters (heart rate greater than 44, blood sugar greater than 100, and glycemia greater than 126) in any first level institution can be very useful for predicting severe AP. We found that if two of the three parameters are present at admission, then the post test probability that the patient will develop, or has already developed, severe pancreatitis is higher than 90% with a positive LR of 9.27 and a negative LR of 0.19. Sensitivity was 83%, specificity 91%, PPV 91% and NPV 84%. This is excellent considering that this test



POSITIVE TEST:

Positive Likelihood ratio:	7.43
95% confidence interval:	[2.77,20]
Posterior probability (odds):	89% (7.7)
95% confidence interval:	[74%,95%]

NEGATIVE TEST:

Negative Likelihood ratio:	0.52
95% confidence interval:	[0.39,0.68]
Posterior probability (odds):	35% (0.5)
95% confidence interval:	[29%,41%]

Odds = Probability / (1-Probability)
+LR = Sensitivity / (1 - Specificity)
-LR = (1 - Sensitivity) / Specificity
Posterior Odds = Prior Odds x LR

Figure 3. Nomogram for the Ranson scale.

does not require more than 48 hours for its application and considering that they are only 3 parameters, compared with 11 or more variables for other scales.

Scales like the Ranson, Irvine, Glasgow and APACHE II are normally used in clinical practice. A few radiological scales, including the Balthazar scale, have also been designed. Serologic markers such as PCR, VSG and IL-6 have also been used. All studies realized to date evaluate these scales against the "gold standard" of the Atlanta consensus. This measure allows us to establish with certainty if we have a patient with acute or severe pancreatitis. However, none of these scales is widely accepted since each of them has some weakness. Ranson and Irvine scales have long completion times. The APACHE II is very complex and not specifically designed for pancreatitis, and IL-6 requires high technology not available in all institutions.

When we compare our scale with the most frequently used scales (Ranson and APACHE II), we found that PPV for the Ranson scale was 88%, and 95% for the APACHE II. These figures are were very similar to the results of our new scale. However, even though the specificity was similar for the three scales (91 for the new scale, 93 for Ranson, and 96 for APACHE II) the sensitivity of our new scale of 83% was far better than the sensitivities of the Ranson (52%) and APACHE II (69%) scales.

Although the three parameters that we evaluated basically arose from the well-known physiopathology of the disease, until now they had not been evaluated together as a group. Other studies (43) have shown that hematocrit greater than 44 and body mass index are very good for predicting severe AP. Banks and colleagues (44) found that a pleural effusion at admittance is a useful sign for predicting severity of pancreatitis. In our work we found that 49% of the entire group of patients had some pleural effusion with similar percentages in those who had severe pancreatitis and those who had mild pancreatitis.

Other authors have reported that a high level of blood sugar in pancreatitis patients is indicative of the severity of damage in pancreatic islets (45,46) and can be used as a marker for severe acute pancreatitis. These authors used a level of 150mg/dl as a cut-off point while we used 126mg/dl. We chose this point because it is recommended by the American Diabetes Association for diagnosis. Although this lower cut-off point can increase sensitivity, it can also have the disadvantage of diminishing specificity of the examination for detecting severe pancreatitis. It is important to note that acute patients are under stress which can damage blood sugar tolerance. However, we considered that if the pancreatitis has not damaged pancreatic islets (mild pancreatitis) then the patient will not present elevated blood sugar on an empty stomach. In a study by Ueda and colleagues (47) the sensitivity and specificity of combining blood sugar over 200 mg/dL and a BUN over 20 mg/dL were 75% and 80% respectively. This combination is comparable to the Imrie, APACHE-II and Ranson scales.

Meek and colleagues (48) investigated the prognostic value of using a combination of leukocytes > 14.500, BUN> 12 mg/dL, blood sugar > 150 mg/dL and a heart rate > 100 beats/min. They found a sensitivity of 82% and a specificity of 85%. These numbers are comparable with

the APACHE-II, Ranson and Imrie scales. The main weakness of this work consists the fact that it was conducted at a highly complex medical center, whereas we do not know how this combination will behave in less complex centers. Most likely the majority of patients with AP arrive at these less complex centers. Before generalizing results, a scale must undergo external validation. That will be the objective of a future investigation.

Our scale, unlike those published in the literature, is based on monitoring of only the 3 main events in the physiopathology of acute pancreatitis. In this sense it is similar to the simple diagnostic criteria for SIRS (systemic inflammatory response syndrome). Severe AP occurs when the pancreas "digests itself", which we represent with a heart rate over 100. Hemoconcentration probably is generated by increased permeability, while the formation of a third space is represented by an initial HT over 44. Finally the damage done to the endocrine cells of the pancreas diminishes the individual's capacity to control blood sugar which we represented with a blood sugar count over 126mg/dl.

We consider that this new scale can be very useful in clinical practice since it has high sensitivity and specificity for predicting severe pancreatitis (even higher than the Ranson and APACHE scales). It has a similar post-test probability but with only three parameters that are not only easy to remember but are also possible to use in any health institution of the country, including in first level medical centers. This scale also has the advantage that it can be used with patients immediately upon admission to the emergency room. This gives the attending physician a powerful tool for determining the treatment that needs to be applied immediately and for determining the patient's prognosis.

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