Prognostic value of multidetector CT in acute pancreatitis compared to Ranson´s clinical scale

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Purpose

• The aim of this study, in first instance was to make a review on acute pancreatitis in the sanitary area of Leon, Spain. This is because of our high rate of colelithiasis, probably related to our local food (smoked cold meat. Figure 1) and a high rate of chronic alcoholism in the rural areas. This study is focused on the way to predict the most accurate prognosis in the early onset of the process.

The study has mainly two parts:

• The first one is the descriptive statistics of acute pancreatitis in our sanitary area (mean age, gender, causes, mortality rate).

• The second and more important part was held to determine the value of the clinical scale used in our hospital (Ranson’s scale) and the value of the imaging CT scales as prognostic factors (measured as morbidity rate, mortality rate and days of hospitalization). Therefore we analyzed and compare both methods in order to determine the most accurate way to make an early prognosis in patients with suspected acute pancreatitis.
Fig. 0: smoked cold meat (chorizo) from Leon

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Methods and Materials

Material and methods:

- **Patient selection:**

  A retrospective observational both descriptive and analytic study on acute pancreatitis was held in the sanitary area of Leon, Spain.

To do so we selected all the patients admitted in the Complejo Asistencial Universitario de León (our hospital) between the 1st of January 2009 to the 31st December 2009, whose principal diagnosis was acute pancreatitis codified as CIE-9 code. We excluded the patients with acute pancreatitis as a secondary diagnosis, because in that case the prognostical factor is meant to be the principal sickness, and so avoid possible bias.

In between those patients we selected the ones with enough data in their clinical history to complete Ranson’s clinical scale and that had an abdominal CT with intravenous contrast material in the first 96 hours of hospitalization.

- **Data Collection:**

To collect the data we proceed to an exhaustive review of the clinical history correspondent to the hospitalization for the acute pancreatitis process. This is made using the computed history, the laboratory tests and so the physical clinical history kept in the archives of the Hospital.

All the CT studies in the patients selected were done in the firsts 96 hours after admittance with a 16 multi-detector row CT, with a slice between 5-2mm thin. All of them were made with intravenous contrast material (2mg / kg of patient’s weight at 3ml/sec). All the studies had a portal phase (70 seconds) and a few of them were dual phase studies (arterial and portal phase if suspected pancreatitis was reported).

Some of the patients were also given oral contrast material (600 ml in four intakes of 150 ml within one hour before the exam is held) if the patient could tolerate it (few cases).
All the CT images were reviewed, patient by patient, without taking account the previous report, and searching only for the data necessary to fill in the items in Balthazar’s scale and the CT severity index.

The total of patients admitted in the sanitary area of Leon with acute pancreatitis as the principal diagnosis along the year 2009 is a total of 164. However, many of them have been excluded for many reasons, such as: not having performed CT, CT study without intravenous contrast material (for contraindication or negative of the patient), CT performed over 96 hours of admittance, lack of analytical data to fulfil Ranson’s scale. Taking into account the previous criteria we select a total of 67 patients of whom we fill a standardized form that includes all the following issues:

- Number of clinical history
- Age
- Gender
- Cause of pancreatitis
- Ranson’s scale punctuation (annex- table 1)
- Balthazar’s scale punctuation (annex- table 2)
- Gland necrosis grade
- CT Severity Index punctuation (annex- table 3)
- Morbidity: need of surgery, percutaneous treatment or complications (psedoquyst, pseudoaneurism, abscess, etc)
- Number of days in hospitalization
- Mortality or not during the process
- Service of admittance: Internal Medicine, Gastroenterology, Surgery or Intensive Care Unit (ICU).

- Statistical analysis

After all the data collection we proceed to the statistical analysis. In first instance, to summarize all the information, we make a table of data with three numerical variables (age, days of hospitalization and Ct severity index punctuation), all the rest are numerical qualitative categorical variables.
To obtain the graphics we use the Excel program within the Microsoft Office 2007, and to obtain the descriptive and analytical data we use the 18th version of the SPSS program.

In first place we do the descriptive study of all the variables (mean, range or frequency study).

For the analytical study we use linear correlation, X²-square, t-Student, ANOVA and contingency tables. Statistical significance limit is established in p< 0.05 (confidence interval of 95%).

• Annex

Table 1. Ranson’s clinical scale for staging acute pancreatitis

<table>
<thead>
<tr>
<th>At Admission</th>
<th>At 48 hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 55 yr</td>
<td>Hematocrit decrease &gt; 10%</td>
</tr>
<tr>
<td>WBC &gt; 16,000/mL</td>
<td>BUN increase &gt; 5 mg/dL</td>
</tr>
<tr>
<td>LDH &gt; 50 IU/L</td>
<td>Calcium &lt; 8 mg/dL</td>
</tr>
<tr>
<td>AST &gt; 250 IU/L</td>
<td>PaO₂ &lt; 60 mm Hg</td>
</tr>
<tr>
<td>Glucose &gt; 200 mg/dL</td>
<td>Base deficit &gt; 4 mg/dL Fluid sequestration &gt; 6 L</td>
</tr>
</tbody>
</table>

AST, aspartate aminotransferase; BUN, blood urea nitrogen; LDH, lactate dehydrogenase; PaO₂, partial pressure of arterial carbon dioxide; WBC, white blood cell

Mild pancreatitis <3

Moderate pancreatitis: 3-4

Hard pancreatitis: 5-6

Severe pancreatitis:>6

Table 2. Balthazar’s CT scale for staging acute pancreatitis

<table>
<thead>
<tr>
<th>Grade</th>
<th>CT Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (figure 1)</td>
<td>Normal pancreas</td>
</tr>
</tbody>
</table>
B (figure2) Pancreatic enlargement
C (figure3) Pancreatic or peripancreatic fat inflammation
D (figure4) Single peripancreatic fluid collection
E (figure 5) Two or more
and/or retroperitoneal air fluid collections

Mild pancreatitis : A, B and C.
Severe pancreatitis: D and E.

Table 3. CT severity index

<table>
<thead>
<tr>
<th>Balthazar scale grade</th>
<th>CT findings</th>
<th>Punctuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (figure 1)</td>
<td>Normal pancreas</td>
<td>0</td>
</tr>
<tr>
<td>B (figure2)</td>
<td>Pancreatic enlargement</td>
<td>1</td>
</tr>
<tr>
<td>C (figure3)</td>
<td>Pancreatic or peripancreatic fat inflammation</td>
<td>2</td>
</tr>
<tr>
<td>D (figure4)</td>
<td>Single peripancreatic fluid collection</td>
<td>3</td>
</tr>
<tr>
<td>E (figure 5)</td>
<td>Two or more</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>and/or retroperitoneal air</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fluid collections</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Necrosis grade</th>
<th>% of gland necrosis</th>
<th>Punctuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I (figure 6)</td>
<td>0-30%</td>
<td>2</td>
</tr>
<tr>
<td>II (figure 7)</td>
<td>30-50%</td>
<td>4</td>
</tr>
<tr>
<td>III (figure 8)</td>
<td>more than 50%</td>
<td>6</td>
</tr>
</tbody>
</table>

**CT Severity index**

Mild pancreatitis: 0-2 points
Moderate pancreatitis: 3-6 points
Severe pancreatitis: 7-10 points
Images for this section:

**Fig. 0:** A Balthazar grade- normal pancreas- o points

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Fig. 0: B Balthazar grade: pancreas enlargement- 1 point

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Fig. 0: C Balthazar grade- diffuse inflammation of peri-gland fat- 2 points

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**Fig. 0:** D Balthazar grade- fluid peripancreatic collection- 3 points

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Fig. 0: D Balthzar grade- air and fluid collection- 4 points

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**Fig. 0:** I necrosis grade- 0-30% gland necrosis- 2 points

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Fig. 0: II necrosis grade- 30-50% of necrosis- 4 points

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Fig. 0: III grade necrosis - > 50% of the gland with necrosis - 6 points

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Results

RESULTS:

Descriptive results:

• Incidence:

The sanitary area of Leon is about 250000 inhabitants, and in our case we registered 164 cases of acute pancreatitis in the year 2009, the incidence is around \(65.5 \text{ cases } /100000 \text{ inhabitants-year}\), which is much higher than the expected (5-11/100000) as described in other series.

• Age:

The youngest patient was 28 years old, and the oldest was 90. The mean age of all of them was 68 years old. (figure 1).

• Gender:

Related to the gender distribution there are some more men than women. 58\% of patients were men and only 42\% were women. (figure 2).

• Causes of acute pancreatitis:

The most frequent cause of acute pancreatitis in between our group is the **biliary** cause (54\% of our patients), not very far from the **alcoholic cause** (34\%). In the group of "other" causes one of them was due to a traumatic cause (the youngest patient of the serie). It is also notable a few cases due to a **high triglycerides** (hipertg, most of them in young women and with a good prognosis in all of them) (figure 3).

• Ranson clinical scale:

Following the Ranson´s clinical scale 54\% of the patients were qualified as **mild pancreatitis** (Ranson <3), 27\% were **moderate** (Ranson 3-4), 16\% **hard** (Ranson 5-6) and 3\% **severe** (Ranson>7). According to these results 19\% of them are hard or severe, that is similar to the expected (around 20\%). (figure 4).

• Balthzar´s CT scale:

Balthzar´s scale is merely morphological and patients are divided in two groups: mild (gland and peripancreatic affection: A, B and C grades), and severe (fluid collection or
gas: grades D and E). In our case 48% were mild and 52% are severe. These results seem to overestimate the percentage of severe cases. (figure 5).

- **Necrosis of the gland:**

  The grade of necrosis is divided into 0%-30% (seen in 74% of the patients), necrosis between 30-50% (16% patients in the serie) and over 50%(4%). As described in other series, the necroses above 30% is significant, and according to this 20% are severe, and this is what was expected, so the grade of necrosis, seems to be an accurate way to make a prognosis. (figure 6).

- **CT severity index:**

  The CT severity index evaluates together the Balthzar morphological scale and the grade of necrosis of the pancreas, and patients are given a range of punctuation from 0 to 10. The mean punctuation was 3,69.

  Patients are divided into mild (47% of our patients), moderate (35%) and severe (16%). (figure 7).

- **Complications:**

  By complication we understand patients who may need surgery during the staying, need interventional performances, or develop pseudoqysts, abscesses or pseudoaneurisms. 24% of the patients were found to be having complications. (figure 8).

- **Days of hospitalization:**

  The number of days of hospitalization are a good way to valorate the prognosis of the patient, because we assume that is more severe if the patient stays for longer. However, some cases stay very few days in hospital because of a soon decease. The range of days of the stay is from 1 day to 55 days. The mean is 17 days.

- **Mortality rate:**

  As obvious this is the main prognostic factor. In our serie, 6 patients have died (9% of patients), which is the expected rate. (figure 9).

- **Service of admittance:**

  In our hospital acute pancreatitis can be admitted in different services, depending on the need of an specific treatment (surgery or ERCP) or the gravity. Most of our patients were hosted in Gastroenterology (56% biliary cause and may need ERCP), many in Internal Medicine (37%) and very few in ICU or surgery.
Analytical results:

- Gender-cause relationship:

One of the quite surprising results in our series is that there is no significance difference in the gender depending on the cause; that is, that there are no more biliary pancreatitis between women, nor alcoholic pancreatitis between men.

- Age- cause relationship:

There is a statistical significance in the relationship between cause of the acute pancreatitis and the age of the patients.

Mean age of patients with biliary pancreatitis was 77, and 54 of the patients with alcoholic pancreatitis.

- Age as a prognostic factor:

Mean age of the survivors is 65 years old, and the mean age between the deceased patients is 83 years old, been statistically significative. Age is, therefore, a good prognostic factor for decease.

- Admittance service as a prognostic factor:

Our patients were admitted in different services such as: internal medicine (the elder and also the pluripathological patients), gastroenterology, ICU (severe patients) and general surgery (those with complications that needed surgery).

We found no difference in the presence of complications or in the number of deceases, but there is statistical significance in the days of hospitalization. ICU patients were in hospital for 26 days (mean), 33 days in general surgery, 17 days in gastroenterology and 14 days in internal medicine.

- # Ranson´s clinical scale as prognostic factor:

Ranson´s clinical scale has a good correlation with the days of hospitalization, been 15 days in the mild ones, 20 in the moderate and 36 in the severe ones. There is no statistical significative difference in the mortality rate or in the complication rate between those groups.

- # Balthazar´s morphological CT scale as a prognostic factor:
In our data it showed to be **prognostic factor** for the rate of **complications** and also for the **days of hospitalization**. However, it didn’t have significance as a mortality rate prognosis. Following this classification the mild are in hospital a mean of **11 days**, and the severe **21 days**. The **complication** rate between the mild are of a **3%** and **42%** in the severe.

- **CT necrosis grade as a prognostic factor:**

  The evaluation of the grade of necrosis has **statistical significance difference** for the **days of hospitalization, complication rate and mortality rate**.

  However there are **controversial data**, showing that the severe cases, may not be so severe, and many of the moderate behave worse than expected.

**Mild** patients are **14 days** in hospital, **26** the **moderate** and **17** the **severe**.

There are **complications** in **13%** of the mild, **72%** of the moderate and only **33%** of the severe.

The **mortality rate** is **3%** among the mild, **27%** in the moderate and **33%** of the severe.

- **# CT severity index as a prognostic factor:**

  CT severity index in our data showed **statistical significance** for the **days of hospitalization, complication rate and mortality rate**:

  **Mild** patients spent **10 days** in hospital, **21** the **moderate** and **26** the **severe**.

  There are **complications** in **3%** of the mild, **33%** of the moderate and **63%** of the severe.

  There is a **mortality rate** of **3%** in the mild, **5%** of the moderate and **36%** of the severe.

- **# Ranson´s clinical scale showed no correlation with any of the radiological scales, including the CT severity index.**
Images for this section:

**Fig. 0:** Age distribution - mean age: 67 years old

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Fig. 0: Gender

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Fig. 0: Causes of acute pancreatitis

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Fig. 0: Ranson’s clinical scale

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Fig. 0: Balthazar CT morphological scale

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Fig. 0: Mortality rate

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Fig. 0: Complications

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**Fig. 0:** CT severity index

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**Fig. 0:** Necrosis grade

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**Fig. 0:** Service of admittance

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Conclusion

CONCLUSIONS:

• There is a very high rate of acute pancreatitis in the sanitary area of León.

• The cause of pancreatitis and the gender of the patient are not a prognostic factor (they should not be included in clinical prognostic scales).

• The age of the patients is related to the mortality rate (higher among older than 65 years old). So, in our hospital, the clinical scales (in our case Ranson) should probably change the age from 55 to 65 to make it a real prognostic factor.

• The service of admittance is related to the days of hospitalization.

• Ranson´s clinical scale is good predicting the days of hospitalization, but not for predicting the mortality or morbidity rate.

• Balthazar morphological CT scale has good correlation with the days of hospitalization, and also with the presence of complications.

• CT necrosis grade is significant for the days of hospitalization, complications, and mortality rate; however, it does not seem to differ really well the moderate from the severe cases, and so, it is not the best choice to use this scale isolated.

• CT severity index is the most complete scale and has major significance and better correlation for the days of hospitalization, complication rate and mortality rate.

• Ranson´s clinical scale does not show good correlation with the CT scales.

• So, according to all this, it would be recommendable to all the patients with suspected acute pancreatitis in the sanitary area of Leon, independently from their age, gender and cause of pancreatitis, the evaluation with abdominal CT with intravenous contrast material in the
first **96 hours of admittance**, evaluating the morphological alteration and the grade of **necrosis** to establish and **initial and accurate prognosis**.
References


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Images for this section:

**Fig. 0**

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**Fig. 0:** Complejo Asistencial Universitario de León León’s Hospital

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