Significance of Serum Amylase Level in Evaluating Pancreatic Trauma

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High speed automobile accidents and other acts of violence have increased the occurrence of pancreatic injury secondary to blunt abdominal trauma [1]. The diagnosis of pancreatic injury is difficult because there are no early signs or symptoms that are pathognomonic and because symptoms related to pancreatic injury are often masked by symptoms of other internal injuries. Although the signs and symptoms of pancreatic injury are nonspecific, hyperamylasemia has historically been considered a sensitive indicator of such injury.

A correlation between elevated serum amylase and pancreatic injury was first suggested by Elman, Arnenson, and Graham [2] in 1929. Several groups of investigators subsequently affirmed this diagnostic specificity of an elevated serum amylase [3-4]. Nick, Zollinger, and Williams [4] in 1965 reported seventy-two patients with blunt abdominal trauma who underwent acute serum amylase determinations. Of the thirteen patients found with elevated serum amylase, twelve had pancreatic injuries at exploratory laparotomy. The authors concluded that an elevated serum amylase is diagnostic for a pancreatic injury. Olsen [5], however, in a recent prospective study found that only 8 per cent of patients with hyperamylasemia had pancreatic injuries. In addition, 33 per cent of patients with hyperamylasemia had no significant intra-abdominal injuries. The author concluded that a serum amylase determination performed within a few hours of blunt abdominal trauma had little prognostic significance since it could neither identify nor exclude a pancreatic injury.

The present study was carried out to examine the diagnostic specificity of elevated serum amylase levels in patients with blunt abdominal trauma and, hopefully, to resolve the conflicting views expressed in the literature.

Material and Methods

The medical records of all patients undergoing exploratory laparotomy for blunt abdominal trauma during the past five years (January 1970 to December 1974) at the Oklahoma University Health Sciences Center were reviewed. Particular attention was devoted to the findings at laparotomy and the preoperative serum amylase level. A serum amylase value of greater than 160 Somogyi units/100 ml is considered abnormal in our laboratories. Patients with associated facial injuries, because of the possibility of unrecognized salivary gland injury, were excluded from the study. Since some patients presented with multiple visceral injuries, it was decided that the data could best be evaluated if the evaluation was based on the number of visceral injuries rather than the number of injured patients.

The data collected was subjected to statistical evaluation with particular attention focused on determining the sensitivity, specificity, and accuracy of serum amylase determinations in the diagnosis of pancreatic inju-

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TABLE I  Visceral Injuries at Laparotomy (51 patients)

<table>
<thead>
<tr>
<th>Organ Involved</th>
<th>Number of Patients</th>
<th>Number of Patients with Amylase &gt;160 Somogyi Units</th>
<th>Number of Patients with Amylase &gt;300 Somogyi Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>9</td>
<td>5 (56%)</td>
<td>2 (22%)</td>
</tr>
<tr>
<td>Pancreas</td>
<td>5</td>
<td>3 (60%)</td>
<td>2 (40%)</td>
</tr>
<tr>
<td>Spleen</td>
<td>20</td>
<td>5 (25%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Small bowel</td>
<td>8</td>
<td>1 (13%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Large bowel</td>
<td>4</td>
<td>2 (50%)</td>
<td>1 (25%)</td>
</tr>
<tr>
<td>Bladder</td>
<td>3</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Liver</td>
<td>6</td>
<td>5 (83%)</td>
<td>1 (17%)</td>
</tr>
<tr>
<td>Kidney</td>
<td>4</td>
<td>2 (50%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Stomach</td>
<td>1</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>23 (38%)</td>
<td>7 (12%)</td>
</tr>
</tbody>
</table>

ry. The sensitivity of a diagnostic test can be defined as its ability to identify all patients with a particular disease entity such as pancreatic injury. The specificity of a diagnostic test, on the other hand, is the ability of the test to exclude all patients without the disease. Accuracy is calculated by dividing the number of correct decisions by the total number of decisions. Probabilities were calculated using Fisher’s Exact Test.

In an attempt to determine whether or not the selection of a significantly more elevated serum amylase level for our break point between normal and abnormal levels would improve the accuracy of the test, all visceral injuries were also divided into those presenting with an amylase level of greater than 160 Somogyi units and those presenting with an amylase level of greater than 300 Somogyi units. (Table I.)

Results

During the five year period of study, seventy-eight patients underwent exploratory laparotomy for blunt abdominal trauma. Fifty-one of these patients (65 per cent) (thirty-seven males and fourteen females, aged from 1.5 to 77 years) had preoperative serum amylase determinations performed and form the basis of this report.

Individual organ injuries were tabulated separately. There were sixty such injuries in the fifty-one patients. The operative findings are summarized in Table I. Five of the nine patients (56 per cent) with negative explorations had elevated serum amylase determinations. There were five pancreatic injuries. Three of the five pancreatic injuries (60 per cent) were associated with a preoperative serum amylase value greater than 160 Somogyi units/100 ml. A total of eighteen visceral injuries were associated with an elevated serum amylase. Of the eighteen visceral injuries associated with hyperamylasemia, only three (17 per cent) were pancreatic injuries.

Five visceral injuries and two negative explorations were associated with serum amylase values of greater than 300 Somogyi units/100 ml. Two of the five injuries (40 per cent) were pancreatic injuries. Thus, three of five pancreatic injuries (60 per cent) and fifteen of forty-six injuries to other organs (33 per cent) were associated with an elevated preoperative serum amylase.

There were twenty-three patients with visceral injuries with a preoperative serum amylase level of greater than 160 Somogyi units. Three of these injuries were pancreatic injuries. This data was evaluated using 2 x 2 tables. The sensitivity of the test (considering a serum amylase value greater than 160 Somogyi units/100 ml as abnormal) was 0.60 and the specificity 0.64. The false-positive rate was 36 per cent and the false-negative rate 40 per cent. Accuracy was 63 per cent. By Fisher’s Exact Test we could not reject the hypothesis (p = 0.28) that pancreatic injury and elevated serum amylase are independent variables.

The data was again cast in 2 x 2 tables and evaluated using a serum amylase value of greater than 300 Somogyi units/100 ml as the break point. There were seven patients in this group, two of whom suffered from pancreatic injuries. The sensitivity of the method (considering a serum amylase value greater than 300 Somogyi units/100 ml as abnormal) was 0.40 and the specificity 0.91. The false-positive rate was 9.1 per cent and the false-negative rate 60 per cent. Accuracy was 86.7 per cent. By Fisher’s Exact Test, we once again could not reject the hypothesis (p = 0.099) that pancreatic injury and elevated serum amylase are independent variables.
Comments

Since major pancreatic injuries often present with rather nonspecific signs and symptoms, a laboratory test that would reliably identify such injuries and lead to early exploration would be most useful. Although serum amylase has long been regarded as a sensitive indicator of pancreatic injury, our data, together with the recent report by Olsen [5], suggest that there is actually a poor correlation between elevated serum amylase and pancreatic injury in blunt abdominal trauma. Accepting an abnormal serum amylase value as greater than 160 Somogyi units/100 ml, we were able to identify only three of five pancreatic injuries (60 per cent). Conversely, two of the five pancreatic injuries were not identified, for a false-negative rate of 40 per cent. Twenty of fifty-five patients with visceral injuries other than pancreatic injuries presented with elevated serum amylase levels for a false-positive rate of 36 per cent. The false-positive rate was significantly improved when we used serum amylase values greater than 300 Somogyi units/100 ml as the break point between normal and abnormal, for then only five of the fifty-five nonpancreatic injuries (9.1 per cent) were incorrectly identified. The false-negative rate, however, actually worsened at this higher break point for only two of the five pancreatic injuries (40 per cent) were correctly identified.

It must be concluded that there is a poor correlation between elevated serum amylase levels and pancreatic injury in blunt abdominal trauma. Decisions regarding the advisability of laparotomy in patients with suspected pancreatic injury should therefore be based on other parameters.

Summary

A series of fifty-one patients who underwent exploratory laparotomy for blunt abdominal trauma is reviewed. Attempts to correlate preoperative serum amylase levels with pancreatic injury were unsuccessful. We could find no statistically significant correlation between elevated serum amylase and pancreatic injury. The accuracy of the test improved somewhat with markedly abnormal serum amylase levels (greater than 300 Somogyi units/100 ml), but even at these levels the correlation was not significant. One must conclude that there is no correlation between elevated serum amylase and pancreatic injury in blunt abdominal trauma. Decisions as to the advisability of operation in patients with such trauma should therefore be based on other parameters.

References


Discussion

Lawrence Chun (Salt Lake City, UT): Has the author any data regarding urine amylase?

Lawrence W. Way (San Francisco, CA): Many diagnostic tests that clinicians use to advantage daily have a good percentage of false-negative results. To be useful a diagnostic test need only reduce one or the other of these categories, false-negative or false-positive results. When there is a fairly high percentage of both, the test is impossible to interpret. If, for example, we said that a serum amylase value in their study over 300 Somogyi units/100 ml had a 90 per cent reliability of indicating pancreatic trauma, that would be a useful clinical statement, and that is what the data would support.

David P. Campbell (closing): In response to Doctor Chun's questions, urine amylase values were not obtained because ample time to both collect and determine the data was not available in these acutely ill patients. In response to Doctor Way's statements, although the accuracy of serum amylase levels increased to 86.7 per cent when 300 Somogyi units/100 ml was used as the break point, this is a misleading value, for as our statisticians point out in the paper, we still misdiagnosed three of the five patients with pancreatic injury. This is the group of patients one is most interested in exploring. This inability to correctly identify patients with pancreatic injury is reflected in the rather poor sensitivity of 0.40, which is a value one must consider in addition to the somewhat misleading accuracy determination.