Severity Scoring for Prognostication in Patients With Severe Acute Pancreatitis

Comparative Analysis of the Ranson Score and the APACHE III Score

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Background: Despite a paucity of validation, the Ranson score is still the most popular method for gauging the severity of pancreatitis.

Hypotheses: The Ranson score more accurately predicts outcomes in patients with severe acute pancreatitis (SAP) when compared with APACHE (Acute Physiology and Chronic Health Evaluation) III scores, and the individual components of the Ranson score differ in their capacities to predict outcome in patients with SAP.

Methods: Patients admitted with SAP to a university surgical intensive care unit (ICU) were studied prospectively. Each component and the total Ranson score were recorded. Also recorded were the APACHE II and III scores. These Ranson variables were compared using univariate analysis of variance for mortality, need for operative debridement, and need for an ICU stay for longer than 7 days. Significant variables were then analyzed by a multivariate analysis of variance to assess independent predictors of mortality, the need for debridement, and prolonged length of stay. Data are given as the mean±SEM.

Results: Seventy-six patients (21.1% mortality), aged 61.8±1.9 years, were studied. The mean APACHE III score was 48.2±3.3, and the mean ICU stay was 10.4±2.1 days. The number of positive Ranson variables was significantly higher in nonsurvivors compared with survivors (5.6±0.5 vs 3.4±0.2; P<.001), as were the APACHE III score (76.9±9.9 vs 40.5±2.5; P<.001) and ICU stay (24.9±7.5 vs 76.5±1.9 days; P=.002). Ranson variables that predicted mortality included values for blood urea nitrogen, calcium, base deficit, and fluid sequestration.

Conclusions: The Ranson score remains a valid predictor of outcomes in patients with SAP, and individual Ranson variables determined 48 hours after hospital admission predicted adverse outcomes more accurately than early Ranson variables in patients with SAP.

Arch Surg. 2002;137:730-736
PATIENTS AND METHODS

DATA COLLECTION

Patients admitted primarily to the surgical intensive care unit (ICU), New York Presbyterian Hospital, New York Weill Cornell Center, New York, with SAP, between January 1, 1993, and May 31, 2001 were studied prospectively. Patients with pancreatitis who were treated at the institution but not admitted to the surgical ICU were not included in the study, nor were patients admitted after interinstitutional transfer for tertiary care. All patients were treated by the surgical ICU team, which was composed of surgically trained intensivists (S.R.E. and P.S.B.) and general surgical residents in conjunction with the primary general surgery team.

Standard operative indications included peritonitis and positive cul ture results on fine-needle aspiration, but the final decision for operative debridement (OD) was made by the attending general surgeon for the individual patient. Antibiotic use was determined by the ICU team in consultation with the attending surgeon. Prophylactic antibiotics were not used routinely for the management of pancreatitis during the study period.

Demographic data, including age, sex, hospital length of stay (LOS), and ICU LOS, were recorded for each patient. The 11 components of the Ranson score were recorded for each patient. Because many patients in the early portion of our study did not receive a base deficit, the pH value was used as a proxy for the base deficit. Other data recorded included APACHE II and III scores, which were tabulated 24 hours after admission. Daily and maximal (cumulative) multiple organ dysfunction (MOD) scores and the systemic inflammatory response syndrome (SIRS) score were recorded on admission and at 48 hours.

STATISTICAL ANALYSIS

The Ranson variables were recorded as coordinate variables (ie, a number) and as a dichotomous variable (ie, either yes or no as the presence of the given criterion). Each Ranson component was compared between survivors and nonsurvivors as a continuous variable by a univariate analysis of variance (ANOVA). Positive dichotomous Ranson values for each component were analyzed between survivors and nonsurvivors, between patients with an ICU LOS longer than 7 days and those with an ICU LOS of 7 days or less, and between patients who did and did not receive OD according to results of χ² analysis with the Fisher exact test. Significantly different variables and those that were possibly so (P<.15) were analyzed by a multivariate ANOVA to determine which variables predicted mortality.

APACHE II and III scores and the SIRS and MOD scores (on admission and at 48 hours) were compared between survivors and nonsurvivors by a univariate ANOVA. Significant factors by the univariate ANOVA were subjected to a multivariate ANOVA to test for independence of effect.

Additional subset analyses were also conducted. Patients undergoing OD were compared with patients who did not undergo OD; patients who had an ICU LOS longer than 7 days were also analyzed.

Receiver-operating characteristic curves with 95% confidence intervals comparing the APACHE III score with the Ranson score for end points of mortality, OD, ICU LOS longer than 7 days, and development of organ dysfunction (MOD) were generated to assess the discrimination of the various scoring systems. Data are reported as the mean±SEM. Statistical significance was accepted as P<.05.

RESULTS

Seventy-six patients with SAP were admitted to the surgical ICU during the study period. Their mean age was 61.8±1.9 years (range, 30-92 years). Forty-seven patients were men. Overall, patients were admitted with a mean APACHE II score of 14.7±1.0 and a mean APACHE III score of 48.2±3.3. The average hospital LOS for all patients was 31.5±3.2 days, and the ICU LOS was 10.4±2.1 days. Sixteen patients died (21.1%), 8 of whom were men (11%). Demographic data stratified by mortality are depicted in Table 1.

The number of positive Ranson criteria for each patient was tabulated from 1 to 11. For each positive individual Ranson variable, the percentage mortality is shown.
in Figure 1. A hematocrit decrease was associated with the highest mortality. The total Ranson score was also compared with outcome. No individual with a Ranson score of 9 or higher at our institution survived. The effect of incremental increases in overall Ranson score on mortality is depicted in Figure 2.

Several demographic differences were noted between the survivors and the nonsurvivors (Table 1). The hospital LOS and the ICU LOS were significantly higher for nonsurvivors compared with survivors. All markers of disease severity were higher in nonsurvivors, including APACHE II, APACHE III, and MMOD scores. The number of positive Ranson variables was also higher in nonsurvivors compared with survivors.

In the analysis using the Ranson value as a dichotomous variable (ie, present or absent), no single Ranson variable differed in positivity between survivors and nonsurvivors. Several Ranson variables differed between survivors and nonsurvivors when analyzed as continuous variables (Table 2). These differing variables included lactate dehydrogenase level, fluid balance, base deficit, BUN level, and calcium level. Of these, BUN level, calcium level, base deficit, and fluid sequestration predicted mortality in the multivariate analysis. In the analysis using the Ranson variables as dichotomous variables, fluid sequestration ($P = .02$) was the only variable significant between survivors and nonsurvivors.

A multivariate ANOVA was performed to evaluate how well each scoring system individually predicted mortality (Table 3). The Ranson, APACHE II, APACHE III, and MMOD scores taken initially and at 48 hours all differed between survivors and nonsurvivors. Of these, only the APACHE III score predicted mortality on multivariate analysis. To assess the ability of the severity scores to discriminate based on mortality and other outcomes, receiver-operating characteristic curves were constructed comparing the APACHE III, Ranson, MMOD, and SIRS scores as predictors of mortality, OD, ICU LOS longer than 7 days, and organ dysfunction (MMOD) (Table 4).

Fourteen patients required OD (Table 5). Of the patients requiring OD, 6 died. Debridement was associated with prolonged total and ICU hospitalization and with more organ dysfunction. Individual Ranson variables were compared for patients who did and did not undergo OD (Table 6), and only the base deficit differed between these patients. In analyzing the variables as dichotomous, no positive variable predicted the need for OD.

Twenty-three patients stayed in the ICU longer than 7 days. Of these patients, 10 required OD and 12 died. Individual Ranson variables were compared as continuous variables between patients with an ICU LOS longer than 7 days and those with an ICU LOS of 7 days or less (Table 7). The glucose level, hematocrit, BUN level, calcium level, base deficit, and fluid sequestration proved different between these 2 groups on univariate analysis.

No single value predicted an ICU LOS longer than 7 days on the multivariate analysis. For the dichotomous variable analysis, base deficit ($P = .009$) and aspartate aminotransferase ($P = .01$) values were more likely to be positive criteria in patients with an ICU LOS longer than 7 days than in patients with an ICU LOS of 7 days or less.

Several major controversies surround the management of SAP. Major differences in opinion concerning OD, prophylactic antibiotics, and nutrition have been ar-

![Figure 1](https://example.com/figure1.png)
gued in the literature. Variability in disease presentation has contributed to the inability to achieve consensus therapies on these issues for SAP. In attempting to standardize treatment protocols for pancreatitis, clinicians have tried to stratify each patient’s disease severity early in the course of the illness. Many clinicians believe that the early identification of the patient’s disease severity may assist in determining which patients are at highest risk for morbidity and mortality. Several investigators have shown that quantifying the initial severity of pancreatitis can directly predict the need for ICU admission, antibiotics, endoscopic retrograde cholangiopancreatography, or OD. Potentially, identifying the sickest patients early might reveal the patients who would benefit most from aggressive intervention that would not help all patients with pancreatitis. One such investigative therapy might be lexipafant, a platelet-activating factor antagonist.

As a result of this type of thinking, many different scoring systems have been applied to the initial management of pancreatitis for potential correlation with the ensuing severity of illness. Two general types of scoring systems have been applied to pancreatitis. The first type has attempted to correlate laboratory and clinical markers specific to pancreatitis with subsequent outcome and disease severity. The second type of scoring system has been the application of the nonspecific physiologic scoring systems, which were originally created for use in general populations of critically ill patients. These nonspecific scoring systems, such as the APACHE II and III scores, were initially developed to compare the disease severity of critically ill patients between different ICUs.

The most widely used severity score specific to pancreatitis to assess disease severity has been the Ranson score. Despite being devised in an era of less sophisticated critical care and not originally being subject to any rigorous statistical validation, the Ranson score has had enduring popularity. Many clinicians still use the Ranson score to stratify the patient’s need for admission to an ICU and the need for early parenteral nutrition, antibiotic prophylaxis, or other interventions. Despite the widespread use of the Ranson score as a guide to these interventions in patients with pancreatitis, the Ranson score has never proved superior to clinical intuition or any other quantification schemes in predicting outcome or the need for any particular intervention.

Critics of the Ranson score have voiced other complaints. The methods surrounding the creation of the score have been extensively questioned. The factors studied in the original article were chosen by a univariate analysis between largely unequal groups from a relatively small number of patients. The critical values for each variable were determined and defined arbitrarily by a post hoc analysis. In addition, although the Ranson score can be widely purported to be a valid measure of outcome, it was never validated prospectively by its creators or tested in any type of large multicenter trial subsequent to its inception. Others contend that even if the Ranson score were an accurate predictor, a 48-hour period is required before the total score can be tabulated.

A major criticism of the Ranson score is that it has not been properly assessed in recent years. For ex-

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**Table 2. Influence of Individual Ranson Variable Raw Scores on Survival**

<table>
<thead>
<tr>
<th>Variable†</th>
<th>Survivors</th>
<th>Nonsurvivors</th>
<th>Univariate</th>
<th>Multivariate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>60.7 ± 2.2</td>
<td>65.8 ± 3.7</td>
<td>.28</td>
<td>...</td>
</tr>
<tr>
<td>WBC/µL</td>
<td>14.9 ± 1.0</td>
<td>15.9 ± 1.7</td>
<td>.67</td>
<td>...</td>
</tr>
<tr>
<td>SGOT level, IU/dL</td>
<td>152.6 ± 30.2</td>
<td>227.6 ± 136.1</td>
<td>.41</td>
<td>...</td>
</tr>
<tr>
<td>Glucose level, mg/dL</td>
<td>183.5 ± 17.9</td>
<td>184.6 ± 22.4</td>
<td>.98</td>
<td>...</td>
</tr>
<tr>
<td>LDH level, IU/dL</td>
<td>345.4 ± 31.8</td>
<td>542.1 ± 150.5</td>
<td>.05‡</td>
<td>.12</td>
</tr>
<tr>
<td>Hematocrit, %</td>
<td>34.3 ± 1.0</td>
<td>33.2 ± 1.8</td>
<td>.62</td>
<td>...</td>
</tr>
<tr>
<td>BUN level, mg/dL</td>
<td>20.2 ± 1.6</td>
<td>40.4 ± 7.7</td>
<td>&lt;.001‡</td>
<td>&lt;.001‡</td>
</tr>
<tr>
<td>Calcium level, mg/dL</td>
<td>8.3 ± 0.1</td>
<td>6.9 ± 0.3</td>
<td>&lt;.001‡</td>
<td>&lt;.001‡</td>
</tr>
<tr>
<td>PaO2, mm Hg</td>
<td>104.2 ± 11.0</td>
<td>85.3 ± 9.7</td>
<td>.37</td>
<td>...</td>
</tr>
<tr>
<td>Base deficit, mEq/L</td>
<td>7.41 ± 0.01</td>
<td>7.32 ± 0.03</td>
<td>.001‡</td>
<td>.03‡</td>
</tr>
<tr>
<td>Fluid sequestration, L</td>
<td>3148 ± 550</td>
<td>10286 ± 2212</td>
<td>&lt;.001‡</td>
<td>.02‡</td>
</tr>
</tbody>
</table>

*Data are given as the mean ± SEM. WBC indicates white blood cell count; SGOT, aspartate aminotransferase; LDH, lactate dehydrogenase; BUN, serum urea nitrogen; and ellipses, data not available.
†To convert glucose from milligrams per deciliter to millimoles per liter, multiply by 0.05551. To convert BUN from milligrams per deciliter to millimoles per liter, multiply by 0.357. To convert calcium from milligrams per deciliter to millimoles per liter, multiply by 0.25.
‡The difference between the 2 groups is significant.

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**Figure 2. A depiction of total Ranson score vs mortality in critically ill patients with pancreatitis.**
example, the presence of 3 or more criteria was associated with a 62% mortality in the original study. Because of improvements in resuscitation, antibiotics, and critical care, mortality in patients with pancreatitis has decreased markedly since 1974.16 Patients are surviving routinely with more than 6 positive Ranson variables. Other technologies have also improved the cure of patients with pancreatitis, including the superiority of modified Glasgow score over other scoring systems for pancreatitis.

### Table 3. Ability of Different Scoring Systems to Predict Mortality in Patients With Pancreatitis*

<table>
<thead>
<tr>
<th>Scoring System</th>
<th>Survivors</th>
<th>Nonsurvivors</th>
<th>Univariate</th>
<th>Multivariate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranson score</td>
<td>3.4 ± 0.2</td>
<td>5.6 ± 2.1</td>
<td>&lt;.001†</td>
<td>.41</td>
</tr>
<tr>
<td>APACHE II score</td>
<td>12.2 ± 0.8</td>
<td>24.3 ± 2.7</td>
<td>&lt;.001†</td>
<td>†</td>
</tr>
<tr>
<td>APACHE III score</td>
<td>40.5 ± 2.5</td>
<td>76.9 ± 9.8</td>
<td>&lt;.001†</td>
<td>.03†</td>
</tr>
<tr>
<td>MMOD score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>2.5 ± 0.5</td>
<td>5.2 ± 1.3</td>
<td>.02†</td>
<td>.13</td>
</tr>
<tr>
<td>At 48 h</td>
<td>2.3 ± 0.5</td>
<td>5.8 ± 1.4</td>
<td>.006†</td>
<td>.11</td>
</tr>
<tr>
<td>SIRS score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>2.8 ± 0.2</td>
<td>3.2 ± 1.5</td>
<td>.33</td>
<td>†</td>
</tr>
<tr>
<td>At 48 h</td>
<td>1.6 ± 0.2</td>
<td>2.1 ± 0.4</td>
<td>.33</td>
<td>†</td>
</tr>
</tbody>
</table>

*Data are given as the mean ± SEM. APACHE indicates Acute Physiology and Chronic Health Evaluation; MMOD, maximal multiple organ dysfunction; SIRS, systemic inflammatory response syndrome; and ellipses, data not applicable.
†The difference between the 2 groups is significant.

### Table 4. Areas Under the Receiver-Operating Characteristic Curves Comparing APACHE III, Ranson, MMOD, and SIRS Scores With Various End Points*

<table>
<thead>
<tr>
<th>Variable</th>
<th>APACHE III score</th>
<th>Ranson score</th>
<th>MMOD score</th>
<th>SIRS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>0.80</td>
<td>0.81</td>
<td>0.84</td>
<td>0.55</td>
</tr>
<tr>
<td>Operative Debridement</td>
<td>0.73</td>
<td>0.69</td>
<td>0.75</td>
<td>0.73</td>
</tr>
<tr>
<td>ICU LOS &gt; 7 d</td>
<td>0.85</td>
<td>0.78</td>
<td>0.96</td>
<td>0.65</td>
</tr>
<tr>
<td>MMOD score</td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*APACHE indicates Acute Physiology and Chronic Health Evaluation; MMOD, maximal multiple organ dysfunction; SIRS, systemic inflammatory response syndrome; ICU, intensive care unit; LOS, length of stay; and ellipses, data not applicable.

### Table 5. Features of Patients Who Did and Did Not Require Operative Debridement*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yes (n = 14)</th>
<th>No (n = 62)</th>
<th>Univariate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>9</td>
<td>38</td>
<td>†</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>24</td>
<td>†</td>
</tr>
<tr>
<td>Deaths, No.</td>
<td>6</td>
<td>10</td>
<td>.06</td>
</tr>
<tr>
<td>Hospital LOS, d</td>
<td>46.7 ± 9.2</td>
<td>28.0 ± 3.2</td>
<td>.02†</td>
</tr>
<tr>
<td>ICU LOS, d</td>
<td>331 ± 8.5</td>
<td>5.3 ± 0.8</td>
<td>&lt;.001†</td>
</tr>
<tr>
<td>APACHE II score</td>
<td>19.3 ± 1.9</td>
<td>13.7 ± 1.3</td>
<td>.03†</td>
</tr>
<tr>
<td>APACHE III score</td>
<td>63.5 ± 6.8</td>
<td>44.7 ± 5.6</td>
<td>.03†</td>
</tr>
<tr>
<td>MMOD score</td>
<td>10.3 ± 1.9</td>
<td>3.4 ± 0.6</td>
<td>&lt;.001†</td>
</tr>
</tbody>
</table>

*Data are given as the mean ± SEM unless otherwise indicated. LOS indicates length of stay; ICU, intensive care unit; APACHE, Acute Physiology and Chronic Health Evaluation; MMOD, maximal multiple organ dysfunction; and ellipses, data not applicable.
†The difference between the 2 groups is significant.

### Table 6. Influence of Individual Ranson Variables on the Need for Operative Debridement*

<table>
<thead>
<tr>
<th>Variable†</th>
<th>Yes</th>
<th>No</th>
<th>Univariate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>60.5 ± 4.1</td>
<td>62.1 ± 2.2</td>
<td>.75</td>
</tr>
<tr>
<td>WBC/cL</td>
<td>14.7 ± 1.6</td>
<td>15.2 ± 1.0</td>
<td>.82</td>
</tr>
<tr>
<td>SGOT level, IU/dL</td>
<td>108 ± 45</td>
<td>169 ± 44</td>
<td>.45</td>
</tr>
<tr>
<td>Glucose level, mg/dL</td>
<td>181 ± 25</td>
<td>184 ± 17</td>
<td>.93</td>
</tr>
<tr>
<td>LDH level, IU/dL</td>
<td>367 ± 51</td>
<td>388 ± 47</td>
<td>.84</td>
</tr>
<tr>
<td>Hematocrit, %</td>
<td>31.2 ± 3.0</td>
<td>34.6 ± 0.9</td>
<td>.24</td>
</tr>
<tr>
<td>BUN level, mg/dL</td>
<td>28.8 ± 4.6</td>
<td>23.3 ± 2.5</td>
<td>.35</td>
</tr>
<tr>
<td>Calcium level, mg/dL</td>
<td>7.7 ± 0.5</td>
<td>8.1 ± 0.2</td>
<td>.33</td>
</tr>
<tr>
<td>PaO₂, mm Hg</td>
<td>77.6 ± 15.6</td>
<td>105.0 ± 10.1</td>
<td>.24</td>
</tr>
<tr>
<td>Base deficit, mEq/L</td>
<td>7.36 ± 0.03</td>
<td>7.40 ± 0.01</td>
<td>.04†</td>
</tr>
<tr>
<td>Fluid sequestration, L</td>
<td>4720 ± 2212</td>
<td>4865 ± 880</td>
<td>.95</td>
</tr>
</tbody>
</table>

*Data are given as the mean ± SEM. †Abbreviations are explained in the first footnote to Table 2. Conversion factors for glucose, BUN, and calcium levels are given in the second footnote to Table 2.
‡The difference between the 2 groups is significant.

Other types of markers have also been applied to assess disease severity in patients with pancreatitis. Investigators have used other laboratory test results, such as those for C-reactive protein, antiproteases, complement, and cytokines, including interleukin 6, as objective markers of severity in patients with SAP. Radiologic criteria that contend that certain computed tomographic scan findings on admission are predictive of outcome in patients with pancreatitis have been developed. Other researchers have shown that clinical conditions such as obesity, age, and shock correlated with a worse outcome in pancreatitis.

In addition to these specific scoring methods, non-specific scoring systems used for ICU patients, such as APACHE II and III and organ dysfunction scoring, have been applied to patients with pancreatitis. Other studies have compared the specific scoring systems for pancreatitis with the physiologic scores. In a study of 135 pa-
tients with pancreatitis, Heath and Imrie\textsuperscript{20} found, in a direct comparison to the Ranson, Glasgow, and Hong Kong scores, that the APACHE II score was superior in predicting the clinical course of the patients. However, this patient group of 135 included 104 patients with reported “mild pancreatitis,” and the newer more rigorous APACHE III score was not tested. Subsequently, Williams and Simms\textsuperscript{2} attempted to correlate the Ranson score with the APACHE III score, but this study of 273 patients included only 12 ICU patients.

Our study differed from these other studies in several ways. Our study may provide the most rigorous analysis comparing the Ranson score with the most sophisticated ICU scoring techniques. Also, to our knowledge, no previous study isolated only ICU patients in a study of the Ranson score. We also used 3 outcome variables, including mortality, need for OD, and a long ICU stay, to enhance our analysis.

Table 7. Influence of Individual Ranson Variables on ICU LOS\textsuperscript{*}

<table>
<thead>
<tr>
<th>Variable</th>
<th>ICU LOS, d</th>
<th>Univariate</th>
<th>Multivariate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\geq 7)</td>
<td>(\leq 7)</td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td>62.8 ± 3.4</td>
<td>61.4 ± 2.4</td>
<td>.74</td>
</tr>
<tr>
<td>WBC/µL</td>
<td>15.6 ± 1.7</td>
<td>14.9 ± 0.9</td>
<td>.74</td>
</tr>
<tr>
<td>SGOT level, IU/dL</td>
<td>186 ± 90</td>
<td>161 ± 34</td>
<td>.76</td>
</tr>
<tr>
<td>LDH level, IU/dL</td>
<td>239 ± 42</td>
<td>159 ± 10</td>
<td>.01‡</td>
</tr>
<tr>
<td>Hematocrit, %</td>
<td>30.8 ± 1.9</td>
<td>35.5 ± 0.9</td>
<td>.02‡</td>
</tr>
<tr>
<td>BUN level, mg/dL</td>
<td>34.6 ± 5.5</td>
<td>19.7 ± 1.7</td>
<td>.001‡</td>
</tr>
<tr>
<td>Calcium level, mg/dL</td>
<td>7.43 ± 0.3</td>
<td>8.3 ± 0.2</td>
<td>.005‡</td>
</tr>
<tr>
<td>Paco(_2), mm Hg</td>
<td>79.6 ± 10.0</td>
<td>110.0 ± 12.0</td>
<td>.11</td>
</tr>
<tr>
<td>Base deficit, mEq/L</td>
<td>7.35 ± 0.02</td>
<td>7.41 ± 0.01</td>
<td>.005‡</td>
</tr>
<tr>
<td>Fluid sequestration, L</td>
<td>8068 ± 1028</td>
<td>3238 ± 557</td>
<td>.004‡</td>
</tr>
</tbody>
</table>

*Data are given as the mean ± SEM. ICU indicates intensive care unit; LOS, length of stay; WBC, white blood cell count; SGOT, aspartate aminotransferase; LDH, lactate dehydrogenase; BUN, serum urea nitrogen; and ellipses, data not available.
†Conversion factors for glucose, BUN, and calcium levels are given in the second footnote to Table 2.
‡The difference between the 2 groups is significant.

Our study shows that the variables for the Ranson score that were obtained by 48 hours are superior to those obtained at admission for predicting the severity of illness. While this result may seem intuitive, to our knowledge, it has not been shown previously in a critically ill population of patients with pancreatitis. In a previous study\textsuperscript{32} of all ICU patients, the importance of the physiological response to therapy at 48 hours was demonstrated. In this study of a large population of critically ill patients, it was concluded that the SIRS score at 48 hours was more predictive of outcome than the initial SIRS score. This study and the previous study\textsuperscript{32} show that the first 48 hours is vital in determining the eventual outcome of the patient. Future studies may show that aggressive interventions in sophisticated ICUs may prove beneficial in altering outcome.

More important, our study demonstrates that the simple Ranson score remains valid for predicting the outcome in patients with SAP when compared with physiological scoring systems. The Ranson score proved equal to the APACHE III score for predicting mortality and the development of organ dysfunction by receiver-operating characteristic curves. Using the established cut-off of 0.8 to represent clinically meaningful values for areas under the curves, neither score accurately predicted the need for OD. This result may stem from possible subjectivity on the part of the clinicians in establishing the need for OD. Overall, the similarity between the rather simple Ranson score and the relatively complex APACHE III score for mortality is remarkable considering the arbitrary historical basis used for the creation of the Ranson score.

Several potential theories may explain why the Ranson score fared well compared with the APACHE III score. First, the Ranson score has always been a specific predictor of outcome in patients with pancreatitis, whereas the APACHE III score was developed to encompass a wide variety of disease processes. Second, we studied a relatively small homogeneous population of patients who were sick enough to require ICU care in a surgical unit. A larger study from multiple centers might provide different results. Also, clinicians have greater familiarity with the Ranson score than the APACHE III score, and this knowledge may allow them to target certain patients with high Ranson scores for closer monitoring and more aggressive intervention.

Our study design had some limitations. The study was retrospective and involved only one ICU in a single medical center. Therefore, critically ill patients in the medical ICU and less severely ill patients with pancreatitis were excluded. Three excluded patients during our study period were initially treated at other institutions. The applicability of this analysis to patients transferred to tertiary centers after the onset of severe pancreatitis remains unknown.

Because more than one general surgeon cared for the patient and made the decision for OD, the treatment plans for each patient were not standardized. While not having absolute objective operative indications in these patients with pancreatitis may be considered a limitation, the differences in treatment stem from a lack of consensus in the literature. We also did not use early prophylactic antibiotics as a routine. During most of the study period, prophylactic antibiotics were not uni-
formally used for severe pancreatitis and only now are seeing more widespread use in other centers. However, these variations in therapy may have contributed to some heterogeneity in the patient population and may have challenged the predictive capabilities of our scoring systems.

However, our study was not intended to determine the best treatment for pancreatitis. Instead, we wanted to determine the utility of the Ranson score in critically ill patients with pancreatitis. In this regard, our study succeeded in showing that the Ranson score was still a valid predictor of outcome and that the positivity of the Ranson variables at 48 hours was more likely to portend an unfavorable outcome than positivity at admission.

This paper was presented at the 29th Annual Society of Critical Care Medicine Scientific Meeting, Orlando, Fla, February 12, 2000.

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