Acute pancreatitis is a reversible inflammatory process of the pancreas. Although the disease process may be limited to pancreatic tissue, it also can involve peripancreatic tissues or more distant organ sites. Acute pancreatitis may occur as an isolated attack or may be recurrent. It has a variety of causes and can range in severity from mild to severe and life threatening. Some patients may require brief hospitalization, whereas others may be critically ill with multiple organ dysfunction requiring intensive care monitoring. Mild acute pancreatitis has a very low mortality rate (less than 1 percent), whereas the death rate for severe acute pancreatitis can be 10 to 30 percent depending on the presence of sterile versus infected necrosis. In the United States, up to 210,000 patients per year are admitted to a hospital for acute pancreatitis.

Risk Factors
The most common risk factors for acute pancreatitis are gallbladder disease (often caused by choledocholithiasis) and chronic alcohol consumption. Table 1 lists risk factors for acute pancreatitis. Given newly emerging
diagnostic modalities, recent guidelines have recommended against the diagnosis of “idiopathic acute pancreatitis.”

Clinical Presentation
The hallmark symptom of acute pancreatitis is the acute onset of persistent upper abdominal pain, usually with nausea and vomiting. The usual locations of the pain are the epigastric and periumbilical regions. The pain may radiate to the back, chest, flanks, and lower abdomen. Patients are usually restless and bend forward (the knee-chest position) in an effort to relieve the pain because the supine position may exacerbate the intensity of symptoms. Physical examination findings are variable but may include fever, hypotension, severe abdominal tenderness, guarding, respiratory distress, and abdominal distention.

Diagnosis
No single laboratory or clinical sign is pathognomonic for acute pancreatitis; many biomarkers and inflammatory mediators for predicting the severity of acute pancreatitis are being evaluated. The initial laboratory evaluation should include amylase and lipase levels; complete blood count with differential; metabolic panel (blood urea nitrogen, creatinine, glucose, and calcium levels); triglyceride level; urinalysis; and arterial blood gases.

Amylase and lipase, secreted by the acinar cells of the pancreas, are the most common laboratory markers used to establish the diagnosis of acute pancreatitis (Table 2). Elevated amylase and lipase levels can be nonspecific, depending on the time since onset of pain, other intra-abdominal processes, and concomitant chronic diseases such as renal insufficiency. Amylase levels may be normal in patients with alcoholism who present with acute pancreatitis, especially if they have had previous attacks of alcoholic pancreatitis; thus, serial testing may not be helpful. Plasma lipase is more sensitive and specific than plasma amylase.

Recent research has examined potential biologic markers for predicting the severity and prognosis of pancreatitis (Table 2). Trypsinogens and pancreatic proteases involved in the autodigestive processes of acute pancreatitis appear promising. Other investigational serologic markers include trypsinogen activation peptide, C-reactive protein, procalcitonin, phospholipase A₂, and the cytokines interleukin-6 and interleukin-8. Currently, these markers have limited clinical availability, but there is significant interest in better understanding markers of immune response and pancreatic injury because these could be valuable tools for reliably predicting the severity of acute pancreatitis and supplementing imaging modalities.

Prognosis
Early evaluation and risk stratification for patients with acute pancreatitis are important.
to differentiate patients with mild versus severe disease because patients with severe disease often need intensive care treatment. Several scoring systems can predict the severity of pancreatitis, and recent work has attempted to compare their relative predictive values.

Ranson’s criteria,\(^1\) the Imrie scoring system,\(^2\) the Acute Physiology and Chronic Health Evaluation (APACHE II) scale,\(^3\) and the Computed Tomography (CT) Severity Index\(^4\) have been developed and validated to predict adverse outcomes, including mortality, in patients with pancreatitis (Table 3).\(^5\) Research has shown some advantages of the CT Severity Index in predicting the severity of acute pancreatitis compared with the other systems. One study found that a CT Severity Index score of 5 or greater correlated with prolonged hospitalization and higher rates of mortality and morbidity.\(^6\) A CT Severity Index score of 5 or greater was associated with a mortality rate 15 times higher than in those with a score of less than 5. No association was found between Ranson’s criteria and APACHE II scale scores and mortality or length of hospitalization.\(^7\)

Another study demonstrated that the CT Severity Index was a stronger predictor of severe acute pancreatitis than Ranson’s criteria or the APACHE II scale; however, the CT Severity Index was conducted 72 hours after admission, whereas the APACHE II scale and Ranson’s criteria scores were calculated at 24 and 48 hours, respectively.\(^8\)

An observational study showed that CT Severity Index scores, when obtained within 48 hours, correlated better with complications and mortality than Ranson’s criteria.\(^9\) Because of the number of available scoring systems, the Atlanta Classification of Severe Acute Pancreatitis has become widely used as a means of comparing scores (Ranson’s criteria, APACHE II scale, and contrast–enhanced CT) to define severe acute pancreatitis,\(^10\) which has helped standardize clinical research trials.

### Table 2. Serum Markers for Determining Diagnosis and Prognosis in Acute Pancreatitis

<table>
<thead>
<tr>
<th>Laboratory test</th>
<th>Time of onset (hours)</th>
<th>Purpose</th>
<th>Clinical observation/limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alanine transaminase</td>
<td>12 to 24</td>
<td>Diagnosis and etiology</td>
<td>Associated with gallstone pancreatitis; threefold elevation or greater in the presence of acute pancreatitis has a positive predictive value of 95 percent in diagnosing acute gallstone pancreatitis</td>
</tr>
<tr>
<td>Amylase</td>
<td>2 to 12</td>
<td>Diagnosis</td>
<td>Most accurate when at least twice the upper limit of normal; amylase levels and sensitivity decrease with time from onset of symptoms</td>
</tr>
<tr>
<td>C-reactive protein</td>
<td>24 to 48</td>
<td>Predictive of severity</td>
<td>Late marker; high levels associated with pancreatic necrosis</td>
</tr>
<tr>
<td>Interleukin-6</td>
<td>18 to 48</td>
<td>Predictive of severity</td>
<td>Early indication of severity</td>
</tr>
<tr>
<td>Interleukin-8</td>
<td>12 to 24</td>
<td>Predictive of severity</td>
<td>Early indication of severity</td>
</tr>
<tr>
<td>Lipase</td>
<td>4 to 8</td>
<td>Diagnosis</td>
<td>Increased sensitivity in alcohol-induced pancreatitis; more specific and sensitive than amylase for detecting acute pancreatitis</td>
</tr>
<tr>
<td>Phospholipase A(_2)</td>
<td>24</td>
<td>Predictive of severity</td>
<td>Associated with development of pancreatic necrosis and pulmonary failure</td>
</tr>
<tr>
<td>Procalcitonin</td>
<td>24 to 36</td>
<td>Predictive of severity</td>
<td>Early detection of severity; high concentrations in infected necrosis</td>
</tr>
<tr>
<td>Trypsinogen activation peptide</td>
<td>Within a few hours</td>
<td>Diagnosis and predictive of severity</td>
<td>Early marker for acute pancreatitis and close correlation to severity</td>
</tr>
</tbody>
</table>

Information from references 5 and 11.
Table 4 summarizes evidence comparing these prognostic systems and patient-related outcomes such as ruling out severe acute pancreatitis. The higher the prognostic score, the poorer the clinical outcome, including mortality. Irrespective of scoring criteria, signs of organ failure within 24 hours of admission significantly increase the risk of death; and thus, physiologic response to treatment needs to be monitored closely.

**Advances in Radiologic Imaging Techniques**

Radiologic imaging is used to confirm or exclude the clinical diagnosis, establish the cause, assess severity, detect complications, and provide guidance for therapy. In recent years, the range of imaging modalities has greatly expanded. Traditional imaging modalities include plain film radiography, abdominal ultrasonography, CT scans, and endoscopic retrograde cholangiopancreatography (ERCP); newer options include endoscopic ultrasonography and magnetic resonance cholangiopancreatography (MRCP). Recent research in this area has focused on development of these tests and the better understanding of their application to clinical care.

Transabdominal ultrasonography is used to determine cholelithiasis. Bowel gas can limit the accuracy of pancreatic imaging, but if the pancreas is visualized, then imaging can reveal pancreatic enlargement, echotextural changes, and peripancreatic fluid.

Contrast-enhanced CT is the standard imaging technique for detection of acute pancreatitis. CT generally is not indicated for patients with mild, uncomplicated pancreatitis but should be reserved for cases of clinical or biologic worsening. It is controversial whether routine use of CT increases length of hospital stay and the potential risk of contrast media-induced morbidity limits its use in certain patients. Magnetic resonance imaging is not commonly used but may be indicated if better visualization of peripancreatic inflammation, necrosis, or fluid collections is needed.

ERCP is helpful in evaluating less-

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**Table 3. Clinical Criteria Used in Prognostic Scoring Systems for Acute Pancreatitis**

<table>
<thead>
<tr>
<th>APACHE II scale</th>
<th>CT Severity Index</th>
<th>Imrie scoring system</th>
<th>Ranson’s criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation includes the following factors: age, rectal temperature, mean arterial pressure, heart rate, PaO₂, arterial pH, serum potassium, serum sodium, serum creatinine, hematocrit, white blood cell count, Glasgow Coma Scale score, chronic health status</td>
<td>CT grade A is normal pancreas (0 points) B is edematous pancreas (1 point) C is B plus mild extrapancreatic changes (2 points) D is severe extrapancreatic changes plus one fluid collection (3 points) E is multiple or extensive fluid collections (4 points)</td>
<td>Age &gt; 55 years White blood cell count &gt; 15,000 per mm³ (15.0 × 10⁹ per L) Blood glucose &gt; 180 mg per dL (10 mmol per L) in patients without diabetes Serum lactate dehydrogenase &gt; 600 U per L Serum AST or ALT &gt; 100 U per L Serum calcium &lt; 8 mg per dL PaO₂ &lt; 60 mm Hg Serum albumin &lt; 3.2 g per dL (32 g per L) Serum urea &gt; 45 mg per dL (16.0 mmol per L)</td>
<td>At admission or diagnosis: Age &gt; 55 years White blood cell count &gt; 16,000 per mm³ (16.0 × 10⁹ per L) Blood glucose &gt; 200 mg per dL (11.1 mmol per L) Serum lactate dehydrogenase &gt; 350 U per L AST &gt; 250 U per L During initial 48 hours: Hematocrit decrease &gt; 10 percent Blood urea nitrogen increase &gt; 5 mg per dL (1.8 mmol per L) Serum calcium &lt; 8 mg per dL (2 mmol per L) Base deficit &gt; 4 mmol per L (4 mEq per L) Fluid sequestration &gt; 6,000 mL PaO₂ &lt; 60 mm Hg</td>
</tr>
<tr>
<td>Scoring: Can be calculated at <a href="http://www.sfar.org/scores2/apache22.html#calcul">http://www.sfar.org/scores2/apache22.html#calcul</a></td>
<td>CT grade + necrosis score</td>
<td>Scoring: One point for each criterion met 48 hours after admission</td>
<td>Scoring: One point for each criterion met</td>
</tr>
</tbody>
</table>

| APACHE II = Acute Physiology and Chronic Health Evaluation; PaO₂ = partial arterial oxygen tension; CT = computed tomography; AST = aspartate transaminase; ALT = alanine transaminase. | Scoring: CT grade + necrosis score | Scoring: One point for each criterion met 48 hours after admission | Scoring: One point for each criterion met |

Information from references 16 through 19.
common causes of pancreatitis (e.g., micro-
lithiasis; sphincter of Oddi dysfunction;
pancreas divisum; and pancreatic duct stric-
tures, which can be benign or malignant).29
Urgent ERCP is indicated in patients at risk
of or with evidence of biliary sepsis, severe
pancreatitis with biliary obstruction, chol-
angitis, elevated bilirubin, worsening and
persistent jaundice, or signs of worsening
pain in the setting of an abnormal ultra-
sound examination because these patients
may need more immediate surgical or gas-
troenterologic intervention.30,31 In patients
with severe gallstone pancreatitis, morbidity
and mortality is reduced with the use of
early selective ERCP.32
MRCP is a newer, noninvasive technique
that has been referred to as “the pancreato-
gram.”33 MRCP can be used preoperatively
to determine which patients would benefit
from ERCP.27 MRCP has been found to be
as accurate as contrast-enhanced CT in
predicting the severity of pancreatitis and
identifying pancreatic necrosis.32 Unlike
ERCP, MRCP does not have interventional
capability for stone extraction, stent inser-
tion, or biopsy. MRCP is less sensitive for
detection of small stones (i.e., smaller than
4 mm), small ampullary lesions, and ductal
strictures.33 MRCP can assess pancreatic
and peripancreatic cysts.34 It is helpful in
patients when ERCP is not possible or is
unsuccessful.32
Another new technology is endoscopic
ultrasound, which is highly accurate in
documenting stones and tumors but
is used less often than ERCP. Endoscopic
ultrasoundography is useful in obese patients
and patients with ileus, and can help deter-
mine which patients with acute pancreati-
tis would benefit most from therapeutic
ERCP.31 Endoscopic ultrasonography can
assist with endoscopic transmural cyst and
abscess drainage. Endoscopic ultrasonog-
raphy and MRCP show promise in increas-
ing the range of options available to search
for the cause of acute pancreatitis. Table 5
compares the sensitivity and specificity of
various imaging techniques.8,13,26,32

Table 4. Clinical Outcomes and Predictive Value of Prognostic Scoring Systems for Acute Pancreatitis

<table>
<thead>
<tr>
<th>Prognostic scoring system</th>
<th>Associated outcomes</th>
<th>Positive LR</th>
<th>Negative LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>APACHE II score ≥ 8 at 24 hours</td>
<td>Need for intensive care unit, severity, secondary pancreatic infection, pancreatic necrosis, mortality, organ failure, and longer hospital stay</td>
<td>1.7 to 4.0</td>
<td>0.25</td>
</tr>
<tr>
<td>Imrie score ≥ 3</td>
<td>Mortality, severity, pancreatic fluid collections</td>
<td>4.6</td>
<td>0.36</td>
</tr>
<tr>
<td>Ranson’s criteria score &gt; 3 at 48 hours</td>
<td>Major complications, severity, organ failure, pancreatic necrosis, mortality, longer hospital stay</td>
<td>2.4 to 2.5</td>
<td>0.47</td>
</tr>
</tbody>
</table>

LR = likelihood ratio; APACHE II = Acute Physiology and Chronic Health Evaluation.
Information from references 8, 21, and 24.

Table 5. Comparison of Imaging Techniques for Acute Pancreatitis

<table>
<thead>
<tr>
<th>Imaging technique</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast-enhanced computed tomography</td>
<td>78 percent sensitivity and 86 percent specificity for severe acute pancreatitis</td>
</tr>
<tr>
<td>Endoscopic ultrasonography</td>
<td>100 percent sensitivity and 91 percent specificity for gallstones</td>
</tr>
<tr>
<td>Magnetic resonance cholangiopancreatography</td>
<td>81 to 100 percent sensitivity for detecting common bile duct stones</td>
</tr>
<tr>
<td></td>
<td>98 percent negative predictive value and 94 percent positive predictive value for bile duct stones</td>
</tr>
<tr>
<td></td>
<td>As accurate as contrast-enhanced computed tomography in predicting severity of pancreatitis and identifying pancreatic necrosis</td>
</tr>
<tr>
<td>Magnetic resonance imaging</td>
<td>83 percent sensitivity and 91 percent specificity for severe acute pancreatitis</td>
</tr>
<tr>
<td>Transabdominal ultrasonography</td>
<td>87 to 98 percent sensitivity for the detection of gallstones</td>
</tr>
</tbody>
</table>

Information from references 8, 13, 26, and 32.
Treatment Issues for Acute Pancreatitis

Aggressive volume repletion, pain control, close monitoring of hemodynamic and volume statuses, attention to nutritional needs, and monitoring for complications are essential in patients with acute pancreatitis. Because several clinical guidelines and reviews describe these management issues in detail, this article only provides a brief update based on recent developments in two important aspects of management: nutrition and the role of antibiotics.

Physicians often find the decision about nutritional management in patients with acute pancreatitis challenging because historically it was believed that pancreatic rest was needed. However, total enteral nutrition, when compared with total parenteral nutrition,
has been shown to have clear benefits in patients with severe acute pancreatitis. A meta-analysis concluded that total enteral nutrition is equal to if not better than total parenteral nutrition.36 However, more research is needed to clarify which type of total enteral nutrition (i.e., oral, nasogastric, or nasojejunal feeding) most benefits patient outcomes. Several randomized studies have shown that nasojejunal feeding prevents morbidity and mortality, possibly by preventing development of infected necrosis by inhibiting bacterial translocation from the gut.15 It is often the preferred option in patients with severe pancreatitis but may not be possible if ileus is present.

One of the late complications of severe acute pancreatitis is pancreatic necrosis. Mortality increases when necrosis becomes infected. Antibiotics have been shown to improve patient outcomes in severe acute pancreatitis. A recent, double-blind, randomized controlled trial of 114 patients with acute necrotic pancreatitis receiving ciprofloxacin (Cipro), metronidazole (Flagyl), or placebo found no significant difference in the rate of infected pancreatic necrosis, systemic complications, or mortality.37 Yet, meta-analyses of studies of acute necrotic pancreatitis conclude that prophylactic antibiotics can decrease pancreatic sepsis, mortality, extra-pancreatic infections, and surgical rates.38 Because evidence is mixed on the issue of prophylactic antibiotics for necrotic pancreatitis, the aforementioned benefits must be weighed carefully with risks (e.g., adverse effects, fungal infections, drug resistance).

Surgical debridement also may be indicated for infected necrosis. Surgery for sterile necrosis is indicated only if the patient clinically deteriorates or if there is no improvement. Surgery is usually performed no earlier than two weeks after the onset of symptoms. When compared with immediate surgery, this delay has been shown to decrease the mortality rate.9,39 Surgical techniques are evolving, and ongoing research is evaluating the effectiveness of various approaches.

Figure 1 is an overview and summary of the key principles and steps involved in the diagnostic evaluation, differential diagnosis, prognostic evaluations, and treatment of mild and severe acute pancreatitis.4,7-9,11,15,35

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Acute Pancreatitis


