DIAGNOSIS AND MANAGEMENT
OF
ACUTE PANCREATITIS

By
MARY HOERNER

A manuscript submitted in partial fulfillment of
The requirements for the degree of
MASTER OF NURSING

WASHINGTON STATE UNIVERSITY
College of Nursing
Intercollegiate Center for Nursing Education

June 1999
To the Faculty of Washington State University:

The members of the committee appointed to examine the ICNE research requirements and manuscript of Mary J. Hoerner find it satisfactory and recommend that it be accepted.

__________________
Chair

[Signature]
# TABLE OF CONTENTS

- ACKNOWLEDGMENTS ................................................................. 2
- ABSTRACT ............................................................................. 3
- LIST OF TABLES .................................................................... 4
- LIST OF FIGURES ................................................................. 5
- MANUSCRIPT ...................................................................... 6
- TABLES ................................................................................. 16
- REFERENCE LIST ............................................................... 23
ACKNOWLEDGMENTS

At the beginning, the destiny of the journey was unknown. At the conclusion, the path was well traveled, but the destiny is still unknown. My endeavor to become a Nurse Practitioner has finally ended, but my travels into the future are just beginning. This was not a singular venture but was rather the joint effort of multiple people. The commitment could never have been completed without the support, assistance and love from my husband Ron and my daughter Nicole. The knowledge and expertise from Dr. Lorna Schumann, whose steps I hope to follow. And the fun, laughs and encouragement from Kim Tucker, who talked me into taking this long, but fulfilling journey.
ABSTRACT

Much controversy exists regarding treatment for the obscure pathogenesis of acute pancreatitis. Many patients will recover spontaneously regardless of the cause or the treatment, while others experience a fulminent course with multi-organ failure and resultant death. The merits of various tests have been explored and reviewed looking at sensitivity, specificity and cost, as related to the clinical setting. Patient care providers will be increasingly called upon to treat and appropriately refer patients with pancreatitis and its complications. Understanding treatment options and keeping current with evolving guidelines is imperative for the management of these patients.
LIST OF TABLES

Table 1: Causes of acute pancreatitis................................. 14
Table 2: Ranson’s 11 early objective signs of acute pancreatitis........... 15
Table 3: Specifics of laboratory and diagnostic studies for acute pancreatitis 16
Table 4: Complications associated with acute pancreatitis.................. 18
LIST OF FIGURES

Figure 1: Pathophysiological mechanisms of acute pancreatitis............. 18
Figure 2: Management for acute pancreatitis treatment...................... 19
Introduction

Acute pancreatitis follows a precarious pathway, from a mild and self-limiting episode, to complete multi-organ failure with fatality. This sudden onset disease process stems from a multitude of causes and has an enigmatic pathogenesis. Most patients with acute pancreatitis recover rapidly and completely, regardless of the cause or the treatment, but in a small percentage of patients the disease takes a fulminate course. Of these patients, severe attacks may result in shock, respiratory failure, renal failure and death (Marshall, 1993 pp.1185). Treatment is dependent upon the cause of the symptoms, but in most cases is largely supportive in nature. “Despite recent advances in diagnosis and treatment, acute pancreatitis continues to be a serious illness with an overall mortality of 5-10%” (Banks, 1997, p.377).

Acute pancreatitis is a common disorder and seems to be on the rise with certain disease processes such as acquired immunodeficiency syndrome (AIDS). In the United States, gallstones account for about 45% of the cases of obstructive pancreatitis. Alcohol is the second leading cause of pancreatitis, accounting for approximately 35% of the cases (Steinberg and Tenner, 1994). The frequency of these two causes varies, dependent upon the patient population and the clinicians referral population. Many other causes of acute pancreatitis have been identified as well, but only account for approximately 10% of the populations causes (See table 1 for causes).

Acute pancreatitis is best defined as an acute inflammatory process of the pancreas that may also involve peripancreatic tissues and/or remote organ systems (Banks, 1997). Although there are many theories on the pathogenesis of pancreatitis, it is
well known that pancreatitis stems from an auto-digestive process within the pancreas itself.

The pancreas has been described as a fish shaped organ that lies behind the stomach with important endocrine and exocrine roles. The exocrine pancreas is constructed with lobules that consist of acinar cells, all of which secrete digestive enzymes into a system of microscopic ducts. These ducts are terminal branches of larger ducts that drain into the main pancreatic duct. In most people, the main pancreatic duct (the duct of Wirsung) transports the pancreatic juices, and eventually joins the common bile duct from the liver and the gallbladder, to release the enzymes where the common channel enters the duodenum. The pancreas is responsible for secreting amylolytic enzymes (amylase), lipolytic enzymes (lipase, phospholipase A, and cholesterol esterase), and proteolytic enzymes (trypsin, chymotrypsin). These enzymes assist in the breakdown of starch, fats, and proteins (Harrisons, 1998). Under normal circumstances, these enzymes are secreted in their inactive form and become activated once they enter the intestine (Porth, 1994, p.868). The autodigestion theory suggests that these enzymes are activated within the pancreas rather than within the intestinal lumen (Harrisons, 1998). Figure 1 presents the pathophysiological mechanisms of acute pancreatitis.

The activation of trypsin to trypsinojen within the pancreas, is thought to be the initiating event in acute pancreatitis. Why trypsin is activated remains unanswered. Endogenously secreted trypsin inhibitor ordinarily prevents trypsin from being activated inside of the pancreas. “Although trypsin is a proteolytic enzyme in it’s own right, it has been found responsible for the activation of many other enzymes and bioactive substances that appear to cause most of the pancreatic and systemic abnormalities that
characterize acute pancreatitis” (Marshall, 1993, p.1188). Trypsin is also known to have effects on the cardiovascular and coagulation systems. Trypsin converts the peptide kallikrein to bradykinin, which causes vasodilation, increased vascular permeability, and leukocyte accumulation. Elastase, once activated, dissolves the elastic fibers of blood vessels, causing necrosis and erosion and potential for hemorrhage to occur. This may also lead to thrombosis and hypoperfusion, potentially causing ischemia. Early activation of lipase may cause pancreatic parenchymal necrosis (Marshall, 1993).

“The damage to pancreatic cells and blood vessels that these enzymes and substances cause can result in tissue hypoxia and further cellular necrosis, resulting in a vicious cycle in which more pancreatic enzymes are released and more pancreatic injury occurs” (Marshall. 1993, pp.1188).

Regardless of the cause, the sum effect of the early activation of these enzymes is auto-digestion of the pancreas leading to pancreatic parenchymal destruction.

Clinical Presentation

Diagnosis of acute pancreatitis is made on the basis of the clinical presentation combined with the results of lab and radiographic findings (Lillemoe & Yea, 1998). The presentation can range from a mild, difficult to diagnose state, to a morbid condition associated with hypovolemia, sepsis, shock, metabolic changes, and death.

Abdominal pain, localized to the epigastrium, is a common finding of acute pancreatitis. The degree of pain is dependent upon the amount of pancreatic involvement. It is not unusual for this pain to radiate to various parts of the body, spine, flank, left shoulder, but primarily the back. History may help to reveal the obvious
causes of onset, such as the use of alcohol. For most, onset of acute pancreatitis presents as gradually increasing epigastric pain, reaching maximal intensity within 30-60 minutes which may persist for hours to days without relief. This abdominal pain is frequently described as unbearable, worsens in the supine position, and palpation of the abdomen elicits guarding (Banks, 1997).

Nausea and vomiting to the point of persistent retching, is a common sequela of acute pancreatitis. Other symptoms may be present, but are not specific for this disease process. Fever greater than 101 degrees, tachycardia, and abdominal distention resulting from a paralytic ileus may occur. In patients with severe pancreatitis, hypotension, hypovolemia, and hypoperfusion may be present (Lillemoe & Yea, 1998). If hemorrhagic pancreatitis occurs, a bluish discoloration in the left flank area (Grey Turner’s Sign) or in the periumbilical region (Cullen’s Sign) may be noted. These two signs would indicate increased severity of acute pancreatitis, and increases the mortality significantly. Although unusual, jaundice might be present indicating common bile duct obstruction, or some form of gallstone associated pancreatitis (Lillemoe & Yea, 1998).

The majority of patients with acute pancreatitis require conservative therapy. Ranson’s Criteria, the most widely used multiple clinical criteria system, is used to help assess and identify those patients with severe signs and symptoms so that more aggressive treatment and surveillance can prevent complications (Marshall, 1993).

To help classify uncomplicated versus complicated pancreatitis, Ranson uses 11 early objective signs to classify the severity of pancreatitis. (See table 2)
Studies have shown that there is a direct relationship between the number of prognostic signs and the risk of death and/or complication requiring more than one week of an ICU setting for care (Ranson, 1995).

**Laboratory and Diagnostic Testing**

Mild cases of pancreatitis represent a diagnostic challenge as the clinical symptoms may be non-specific and lab values may only be mildly elevated. In patients with moderate to severe pancreatitis, diagnosis may be straightforward and easy to determine by the clinical history, elevated lab values of amylase or lipase, and by a CT scan of the pancreas.

Serum amylase levels have remained central to diagnosis, because they are readily available, quick and simple to perform, and have a relatively low cost. Levels greater than 65 IU/L should make one suspicious of pancreatic injury. Levels greater than 130 IU/L make the diagnosis most likely, and greater than three times normal is diagnostic (Harrison, 1998). Persistent elevation of amylase levels may be indicative of pancreatic necrosis, pseudocyst or abscess formation (Lillemoe & Yeo, 1998).

Serum lipase levels tend to stay elevated longer than serum amylase levels and are useful in patients who are not examined until several days after the onset of symptoms. Serum lipase levels will parallel amylase levels and the value of doing both tests will enhance diagnostic abilities (Harrison, 1998).

Leukocytosis, hyperglycemia, hypocalcemia, hypertryglyceridemia, are other common abnormal lab results that may be noted, but are not specific for the diagnosis of
pancreatitis. However, these tests may help diagnose or narrow down the cause of pancreatitis.

Advanced imaging techniques, especially the use of CT scanning has dramatically improved the ease of diagnosing acute pancreatitis. The pancreas has notoriously been the hidden organ for most radiographic studies, but CT scanning has provided a means of visualizing the pancreas to help note pancreatic inflammation (Agarwal, Pitchumoni, Sivaprasad, 1990). Sequential, contrast-enhanced CT, allows detection of pancreatic necrosis, which becomes important for assessing the severity of the disease (Marshall, 1993). A slight enlargement of the gland may demonstrate mild pancreatitis. Moderate to severe cases of pancreatitis will show evidence of pancreatic necrosis and peripancreatic inflammatory changes, as well as fluid collection (Marshall, 1993).

Table 3 lists the specifics of the most commonly ordered tests used in the diagnosis of acute pancreatitis. Routine lab studies may be helpful but are not diagnostic in themselves. A thorough clinical history and physical, amylase and lipase levels, and CT scanning provide the best diagnostic tools for the diagnosis of acute pancreatitis. (See table 3 for specifics of laboratory and diagnostic studies for acute pancreatitis.)
Treatment:

There are four primary therapeutic objectives to consider when treating acute pancreatitis. These are:

1.) To limit the severity of pancreatic inflammation.

2.) To carefully observe and prevent complications by interruption of their pathogenesis.

3.) To support the patient and treat complications aggressively as they arise.

4.) To identify the cause of pancreatitis and eliminate the causative factor, if treatable (Ranson, 1995; Marshall, 1993).

Ranson's 11 early objective signs provide valuable information regarding the severity of the disease process. Ranson's criteria provides data on admission criteria, and 48 hours post-admission to detect systemic changes, and to provide early warning that an episode may become severe (Banks, 1997).

Treatment for acute pancreatitis is supportive. Figure 2 presents the decision making algorithm for the management of acute pancreatitis. If mild pancreatitis is diagnosed, as defined by the absence of organ dysfunction, elimination of oral intake, intravenous hydration, and analgesia may be all that is called for. In most cases, the disease will subside spontaneously within 3-7 days after treatment is initiated (Harrisons, 1997). Oral intake is discontinued until there is almost complete resolution of abdominal pain. Nasogastric suction is often instituted to "rest" the pancreas by decreasing duodenal enzyme release, but studies have shown that NG tubes do not decrease pain nor shorten hospital stays (Steinberg et al, 1994). Nasogastric tubes are appropriate for vomiting patients, or those who may present with an ileus.
Pharmacological management has been suggested to help shorten the course of acute pancreatitis. The use of anticholinergic drugs have been recommended for the suppression of gastric and pancreatic secretions. H2 blockers are used to decrease gastric acid secretion. Glucagon and Somatostatin are believed to cause hormonal suppression of pancreatic secretions. Prophylactic antibiotics are used for prevention of infectious complications. Studies have shown that pharmacological management is controversial and the therapeutic benefits are questionable at best (Marshall, 1993).

Severe pancreatitis, as defined by the presence of organ failure, requires close observation and follow-up in a specialized unit. Danger signals on presentation, such as hypotension, oliguria, hypoxemia, or evidence of third space losses guide the provider’s decision regarding admission to ICU (Merck, 1997). Endoscopic retrograde cholangiopancreatography (ERCP) with sphincterotomy is recommended with patients who have gallstone induced pancreatitis, within 2-3 days after the onset. A computerized tomography (CT) scan may be performed, if a surgical condition can not be excluded. A contrast enhanced CT is useful for distinguishing between interstitial and necrotizing pancreatitis and may help distinguish between different options for treatment (Banks, 1997).

If the patient is diagnosed with having severe necrotizing pancreatitis, as defined as “one or more areas of non-viable pancreatic parenchyma,” guided percutaneous aspiration should be performed. This procedure will help to differentiate between infected versus sterile necrosis. Sterile necrosis can continue to be treated medically, but infected necrosis may require surgical debridement after 4-6 weeks (Banks, 1997).
There are many local and systemic complications that can occur as sequela of acute pancreatitis. Table 4 lists some possible complications. (See table 4)

Summary

Many aspects of acute pancreatitis treatment have been controversial, but with the refinement of contrast enhanced computed tomography, advances have been made towards quicker diagnosis and treatment of acute pancreatitis. The management of this disease process continues to be supportive, with continual observation for complications, and determination of cause so those future occurrences may be prevented (Marshall, 1993).
### Table 1: Causes of Acute Pancreatitis

<table>
<thead>
<tr>
<th>Category</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biliary tract disease</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td></td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td></td>
</tr>
<tr>
<td>Hypercalcemia</td>
<td></td>
</tr>
<tr>
<td>Familial (Inherited conditions)</td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td></td>
</tr>
<tr>
<td></td>
<td>External (blunt trauma)</td>
</tr>
<tr>
<td></td>
<td>Operative (ERCP, Retrograde pancreatography)</td>
</tr>
<tr>
<td>Ischemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypoperfusion (Cardiopulmonary bypass)</td>
</tr>
<tr>
<td></td>
<td>Atherosclerotic emboli</td>
</tr>
<tr>
<td></td>
<td>Vasculitis (SLE, Malignant hypertension)</td>
</tr>
<tr>
<td>Pancreatic duct obstruction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tumor</td>
</tr>
<tr>
<td></td>
<td>Ampullary stenosis</td>
</tr>
<tr>
<td>Duodenal obstruction</td>
<td></td>
</tr>
<tr>
<td>Viral infections</td>
<td></td>
</tr>
<tr>
<td>Bacterial Infections</td>
<td></td>
</tr>
<tr>
<td>Scorpion venom</td>
<td></td>
</tr>
<tr>
<td>Idiopathic</td>
<td></td>
</tr>
<tr>
<td>Drugs</td>
<td></td>
</tr>
<tr>
<td>Pregnancy (Occurring after 2nd trimester)</td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Ranson’s 11 Early Objective Signs of Acute Pancreatitis

At admission or diagnosis
- Age > 55 yr
- WBC count > 16,000/mm³
- Glucose > 200 mg/dl
- Lactic Dehydrogenase > 350 IU/L
- SGOT > 250 u/L

During initial 48 hours of hospitalization
- Hematocrit decrease > 10%
- BUN rise > 5 mg/dl
- Serum Ca++ < 8.0 mg/dl
- Arterial oxygen pressure < 60 mm Hg
- Base deficit > 4 mEq/L
- Estimated fluid sequestration > 6 Liters

2 or fewer signs: 1% mortality
- 3 signs: severe pancreatitis
- 3-4 signs: 15% mortality
- 5-6 signs: 40% mortality
- More than 6 signs: 100% mortality
<table>
<thead>
<tr>
<th>Test</th>
<th>Specificity and Sensitivity</th>
<th>Cost</th>
<th>Time for Results</th>
<th>Patient Teaching</th>
<th>Special Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum Amylase</td>
<td>High sensitivity 91%-100%</td>
<td>$44.00</td>
<td>1-2 hours</td>
<td>Explain procedure. No fasting required.</td>
<td>Value &gt;65IU/L should raise questions. Elevates within 24 hours and remains ↑ 3-4 days after onset of symptoms.</td>
</tr>
<tr>
<td>56-190 IU/L</td>
<td>Low specificity 71%-98%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urinary Amylase</td>
<td>High sensitivity 90%-100%</td>
<td>$48.00</td>
<td>1-2 hours</td>
<td>Explain procedure to the patient. No fasting is required. Begin 24-hour urine collection. Collect all urine. Keep specimen refrigerated. Get urine sample to the lab promptly</td>
<td>No more sensitive or specific than serum amylase levels, for a higher cost. May be useful several days after the onset of symptoms, when serum amylase levels may be normal, urine amylase levels will remain elevated.</td>
</tr>
<tr>
<td>3-35 IU/hr</td>
<td>Low specificity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum Trypsinogen</td>
<td>Sensitivity 92%-100%</td>
<td>$72.00</td>
<td>3 days</td>
<td>Explain the procedure. Does not require fasting.</td>
<td>Enzyme specifically released by pancreas. A normal trypsinogen level in a patient with minimal elevation of serum amylase helps to rule out acute pancreatitis.</td>
</tr>
<tr>
<td></td>
<td>Specificity 84%-85%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum Lipase</td>
<td>Sensitivity 86%-100%</td>
<td>$36.00</td>
<td>3-4 hours</td>
<td>Requires blood draw. Does not require fasting.</td>
<td>Enzyme found predominantly in the pancreas. An elevation with acute pancreatitis often 5-10 times normal values. Remains elevated longer than amylase. Good diagnostic tool.</td>
</tr>
<tr>
<td>0-110 U/L</td>
<td>Specificity 86%-100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal plain film X-ray</td>
<td>Suggestive but not diagnostic</td>
<td>$200.00</td>
<td>10 minutes</td>
<td>Explain reason for the X-ray. Question whether the patient is pregnant.</td>
<td>May see generalized ileus, sentinel loops, or the &quot;colon cut off sign.&quot;</td>
</tr>
<tr>
<td>Procedure</td>
<td>Sensitivity/Specificity</td>
<td>Cost</td>
<td>Timing</td>
<td>Associated Information</td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------------------------</td>
<td>------------</td>
<td>------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Ultrasound of the pancreas</td>
<td>Low sensitivity 62%-95%</td>
<td>$350.00</td>
<td>30 minutes</td>
<td>Helps to confirm pancreatitis associated with gallstones. Can provide information on edema, inflammation, pseudocyst, and mass lesions.</td>
<td></td>
</tr>
<tr>
<td>Contrast enhanced CT scan</td>
<td>Sensitivity 85% Specificity 100%</td>
<td>$600.00+</td>
<td>30-60 minutes</td>
<td>Explain procedure. Patient must lie still. Ask about iodine allergies. Patient should be NPO 4-8 hours pre-test. Encourage patient to drink fluids post-test. Very diagnostic for determining the severity of pancreatitis and the extent of pancreatic necrosis that may be present. Most sensitive non-invasive imaging method.</td>
<td></td>
</tr>
<tr>
<td>ERCP</td>
<td>Highly specific but CT scan just as good</td>
<td>$450.00</td>
<td>1-2 hours depending on ease</td>
<td>Explain the procedure. Patient must be NPO. Do not eat or drink until gag reflex has returned. Risk associated with performing the ERCP includes the possible exacerbation of an already inflamed pancreas. Helps diagnose gallstones.</td>
<td></td>
</tr>
<tr>
<td>MRI</td>
<td>Highly specific but CT scan just as good</td>
<td>$1100.00</td>
<td>1-2 hours</td>
<td>Explain the procedure to the patient. Assure there is no metal being worn. Patient should remain motionless as possible. Provides information similar to a CT scan but is much more costly and offers no real advantage.</td>
<td></td>
</tr>
<tr>
<td>MRCP</td>
<td>Highly specific but CT scan just as good</td>
<td>$1100.00+</td>
<td>1-2 hours</td>
<td>Relatively new diagnostic ability.</td>
<td></td>
</tr>
</tbody>
</table>

Cost: Obtained from Kennewick General Hospital, Kennewick, Washington and are only the cost for the test. They do not include miscellaneous charges (physician, contrast, etc.). Timelines differ from facility to facility.
### Table 4 Complications associated with acute pancreatitis

<table>
<thead>
<tr>
<th>Local</th>
<th>Systemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Necrosis (sterile, infected)</td>
<td>Pulmonary (ARDS, atelectasis)</td>
</tr>
<tr>
<td>Pancreatic abscess</td>
<td>Cardiovascular (Hypotension)</td>
</tr>
<tr>
<td>Pancreatic pseudocyst</td>
<td>DIC</td>
</tr>
<tr>
<td>Pancreatic ascites</td>
<td>Renal (Oliguria, Azotemia)</td>
</tr>
<tr>
<td>Involvement of other organs</td>
<td>Metabolic (Hyperglycemia, hypocalcemia)</td>
</tr>
<tr>
<td>Obstructive jaundice</td>
<td>Fat necrosis</td>
</tr>
</tbody>
</table>

Source: Harrison's, 1997
Figure 1 Pathophysiological Mechanisms of Acute Pancreatitis

Causative factors

Pancreatic Acinar Cell Damage

Trypsin Activation

Kallikrein-Kinin Activation

Chymotrypsin Activation

Elastase Activation

Lipase Activation

Phospholipase-A Activation

Vasodilation

↑Vascular permeability

Leukocyte accumulation

Edema

Inflammation

Edema Vascular Damage

Dissolves elastic fibers of blood vessels

Vascular damage Hemorrhage

Fat Necrosis

Vascular Damage Hemorrhage

Figure 2 Management for Acute Pancreatitis Treatment

History-previous episodes, ETOH abuse
Abrupt onset of deep epigastric pain with radiation to back
N/V, diaphoresis, weakness
Abdominal distention
Leukocytosis, ↑amylase, ↑lipase

Assess severity using Ranson’s 11 prognostic signs

Mild
Absence of organ dysfunction

Admit to Med/Surg unit

Supportive therapy:
- NPO
- Analgesia (Demerol)
- IV fluid and electrolyte replacement
- NG tube if indicated
- Q 24 hr amylase, lipase, CBC

Improvement?

Yes
- Diet when abdominal pain decreased and amylase, lipase levels continue to decrease

No
- Contrast enhanced CT scan for further management

Severe
Presence of organ dysfunction

Perform ultrasound if suspicious of gallstone induced pancreatitis

ERCP with sphincterotomy

Supportive Therapy as for mild, plus:
- Contrast enhanced CT scan, daily CMP panel, with a daily chest X-ray

Necrotizing with clinical improvement

Continue medical therapy. Anticipate potential complications

Necrotizing without clinical improvement

Guided percutaneous aspiration

Infected Necrosis

Determine organism consider surgery

Sterile necrosis

Treat medically

( Source: Harrison’s, 1997)
Reference List


