Endoscopy—specifically, endoscopic retrograde cholangiopancreatography (ERCP)—has probably nearly reached its maximum potential in the management of biliary-tract disease. There is always room for better stents and the endoscopic management of bile duct stones associated with strictures remains problematic. However, the basic approach to the endoscopic management of biliary-tract disease has been set, and although variations on current techniques and devices may be introduced in the future, significant advances are unlikely. Thus, endoscopists with expertise in ERCP naturally turn to the pancreas to

Endoscopic Management of Pseudocysts

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Endoscopic retrograde cholangiopancreatography (ERCP) has gained acceptance as a treatment of pancreatic pseudocysts in patients suited to this procedure. This article describes a standard approach to the technique. Evaluation prior to endoscopic drainage of pseudocysts should involve review of a high-quality computed tomography (CT) scan; most experts agree that endoscopic ultrasound is also useful. Complications of the procedure include perforation, bleeding, and infection. Endoscopists performing the procedure should have a good understanding of these complications and how to minimize risks and should have expert, multidisciplinary backup available at their institution in the event of complication or failure. The endoscopist should try to obtain a complete pancreatogram at the index ERCP. Follow-up involves a CT scan 3 to 6 weeks after the procedure. Pseudocysts can recur and are largely related to ductal anatomy.

[Rev Gastroenterol Disord. 2003;3(3):135-141]

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**Key words:** Endoscopy • Endoscopic retrograde cholangiopancreatography • Pseudocyst • Pancreatitis • Endoscopic ultrasound
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ensure their future livelihood. Un-questionably, diseases of the pancreas will be more difficult to manage, as the bile duct is a passive tubular structure; whereas the pancreas is an active and venomous snake ready to strike back, and erupt into acute pancreatitis, at anyone who tries to manipulate it. The endoscopic management of pancreatic diseases is a discipline undergoing tremendous evolution, and the management of pseudocysts is one part of this evolution. One could liken the current situation to a fast-moving train: a few endoscopists are riding up at the front, pushing the limits of the technique and technology; some are riding comfortably in coach by performing the technique on very selected (another term for ideal) patients; and others are standing on the platform trying to decide whether to get on board. By clarifying the issues relevant to ERCP treatment of pancreatic pseudocysts, this review aims to get more people on board who are willing to attempt this procedure in ideal candidates, while perhaps at the same time instilling caution in those at the front of the train. This author hopes this review will stimulate careful prospective studies, which will lead to overall improvement in the care of our patients with pancreatitis.

Following the first description of endoscopic drainage of pseudocysts by Kozarek in 1985,1 this technique has gradually been adopted into the routine clinical practice at expert pancreaticobiliary centers and seems on the verge of gaining even wider acceptance in the general endoscopic community.

This review will focus on the article published by Baron and colleagues in the July 2002 issue of Gastrointestinal Endoscopy.2 In this article, Baron and colleagues reviewed their experience with endoscopic treatment of pancreatic pseudocysts. They provide a definition for acute pseudocyst, chronic pseudocyst and pancreatic necrosis, and divide the results into these three categories. There were a total of 138 patients, half of the patients having chronic pseudocysts. Overall, complete resolution was achieved in 113 patients (82%). Complete resolution was most often successful in patients with chronic pseudocysts (92%) when compared to acute pseudocysts (74%, P = .02) and necrosis (72%, P = .006). Complications were seen most often in patients with pancreatic necrosis (37%) and were statistically more significant than those of patients with chronic and acute pseudocysts. Similarly, recurrence occurred more often in patients with pancreatic necrosis (29%) compared to patients with acute pseudocysts (9%) or with chronic pseudocysts (12%). The recurrence rate for pancreatic necrosis was statistically significantly more common when compared with both acute pseudocysts and chronic pseudocysts.

One of the main points that Dr. Baron and his group make is an appeal for standardization of nomenclature used to classify pseudocysts and for future publications on the management of pseudocysts to use this uniform nomenclature. Baron and colleagues’ suggested nomenclature

<table>
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<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Acute fluid collection</td>
<td>A collection of enzyme-rich pancreatic juice occurring early (within 48 hours) in the course of acute pancreatitis, is located in or near the pancreas and always lacks a well-defined wall of granulation tissue or fibrous tissue.</td>
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<tr>
<td>Pancreatic necrosis (early)</td>
<td>A diffuse or focal area of nonviable pancreatic parenchyma &gt; 30% of the gland by CECT, which is typically associated with peripancreatic fat necrosis.</td>
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<tr>
<td>Organized (late) pancreatic necrosis</td>
<td>Evolution of acute necrosis to a partially encapsulated, well-defined collection of pancreatic juice and necrotic debris.</td>
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<tr>
<td>Acute pseudocyst</td>
<td>A collection of pancreatic juice enclosed by a wall of nonepithelialized granulation tissue arises as a consequence of acute pancreatitis, requires at least 4 weeks to form, and is devoid of significant solid debris.</td>
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<tr>
<td>Chronic pseudocyst</td>
<td>A collection of pancreatic juice enclosed by a wall of fibrous or granulation tissue, which arises as a consequence of chronic pancreatitis.</td>
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<tr>
<td>Pancreatic abscess</td>
<td>A circumscribed intra-abdominal collection of pus, usually in proximity to the pancreas, containing little or no pancreatic necrosis, which arises as a consequence of acute pancreatitis or pancreatic trauma.</td>
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CECT, contrast-enhanced computed tomography.
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follows a recommendation proposed by a group participating in an international symposium on acute pancreatitis held in Atlanta in 1992. This proposed nomenclature is outlined in Table 1.

Clinically, patients with established chronic pancreatitis who present with a mature-walled, fluid-filled cyst (chronic pseudocyst) that is welded to the wall of the stomach or duodenum creating an obvious bulge on endoscopic examination should be considered ideal candidates for endoscopic drainage. Patients presenting with acute pancreatitis (no history of chronic pancreatitis) who over the course of 4 to 6 weeks develop an unequivocal wall around a fluid collection that is devoid of debris and is clearly adherent to the gastrointestinal wall (demonstrates a clear endoscopic bulge) would also be considered reasonable candidates for endoscopic intervention. In the opinion of this author, all other patients—those with acute fluid collections, early pancreatic necrosis, or any signs of infected necrosis or fluid collections—should be managed only by expert pancreatic groups consisting of endoscopists, interventional radiologists, and surgeons, preferably in the context of a prospective study. However, all gastroenterologists should be familiar with this nomenclature and should make decisions about patient management according to where in this classification system each pancreatic fluid collection fits.

Technique

The actual technique for performing endoscopic pseudocyst drainage is relatively straightforward. Endoscopic inspection is first performed to get a "lay of the land." The stomach should be fully distended and carefully examined for a clear and well-defined bulge. The location of the bulge can be ascertained by careful review of the computed tomography (CT) scan. Once the bulge is located, its apex should be identified. After achieving adequate distention, some advocate puncturing the pseudocyst using the Howell aspiration needle (Wilson-Cook, Winston-Salem, NC). The needle is loaded with contrast and is pressed firmly against the gut wall. Once the needle is in position, contrast is slowly injected. If the needle penetrates into the pseudocyst lumen, one will see clear streaming of contrast as it enters the pseudocyst. If one has failed to enter the pseudocyst, a submucosal injection will result. This maneuver is particularly helpful in cases where endoscopic ultrasound (EUS) is not available to confirm that the distance between the gut and cyst lumen is small and that the cyst adheres to the gut. In cases in which the pseudocyst adheres to the duodenum, this maneuver is probably not necessary.

Once one has defined the location for puncture, a needle-knife–like instrument, preloaded with a guidewire, is used to drill a hole through the gut wall and into the pseudocyst cavity. The needle-knife should be advanced perpendicular to the bowel wall and should be pushed directly into the pseudocyst cavity without any lateral displacement of the needle track. In other words, this procedure should result in a puncture rather than an incision into the cyst cavity. Once the pseudocyst cavity has been entered, the guidewire is advanced until several coils of the wire are formed within the pseudocyst lumen. The needle-knife is then withdrawn, and a dilation balloon is passed over the guidewire. The balloon diameter should usually be 8 or 10 mm, and the balloon is inflated to enlarge the fistula until there is no waist. When this technique was first described, a papillatome was often used to enlarge the fistula instead of a balloon dilator. This earlier "cutting technique" is thought to be associated with a high incidence of bleeding and has largely been abandoned in favor of balloon dilation. Following balloon dilation, most endoscopists use a double-pigtail stent (usually 10-Fr) and usually try to place two or more stents side by side. The purpose of the stents is to maintain the endoscopically formed fistula opening. In contrast, some groups particularly favor use of a 10-Fr electrocautery sleeve, as they believe that patency of the fistula is best assured by cautery necrosis rather than balloon dilation. In general, the stents are left in place for 4 to 6 weeks, and a CT scan is used to confirm resolution of the cyst before the stents are endoscopically removed. Experienced endoscopists commonly add a variety of additional maneuvers to the technique outlined above. The above approach represents a relatively standard technique.

Preoperative Evaluation

Consensus exists that a high-quality CT scan is a prerequisite to attempting endoscopic drainage of pseudocysts. The CT scan should be reviewed with attention to certain findings that can affect the success and safety of endoscopic pseudocyst drainage. First, there should be a well-developed wall around the cyst cavity. Additionally, the cyst wall should be adjacent and opposed to the gut wall at some point, either in the

One of the strongest points that Dr. Baron and his group make is an appeal for standardization of nomenclature used to classify pseudocysts.
duodenum or in the posterior wall of the stomach. The internal architecture of the cyst cavity should also be carefully reviewed. Thick septations dividing the cavity into several distinct sections should serve as a warning sign to the endoscopist that the cyst cannot be fully drained with a single puncture. The CT scan should be reviewed carefully to determine the internal contents of the cyst. The presence of obvious necrotic debris within the cyst cavity represents a case that should be tackled only by expert and experienced endoscopists with backup from experienced interventional radiologists and surgeons. In the view of this author, the greatest weakness of the CT scan is its insensitivity to solid debris within the cyst cavity. This limitation is important because the presence of solid debris necessitates placement of a nasocystic tube, as the tube provides a mechanism to vigorously flush the cyst cavity, which aids in the removal of the necrotic material. Finally, the CT scan should be performed using a technique that enables an accurate examination of the relationship between the cyst and arterial structures. The presence of a splenic artery aneurysm or an intimate relationship between the cyst wall and the splenic artery represents a clear contraindication to endoscopic therapy; in this case, the surgical approach is recommended. Several reports have described erosion of stents into the splenic artery, which can lead to disastrous complications.

Perhaps the biggest controversy regarding the evaluation of the patient’s candidacy for endoscopic drainage is whether or not EUS is mandatory. The best investigation of this issue to date may be a retrospective study by Paul Fockens in which he reviewed the records of 32 patients referred to the Amsterdam Medical Center between 1992 and 1995. All patients were referred with the intent to have them undergo endoscopic drainage of pseudocysts. The presence of obvious necrotic debris within the cyst cavity represents a case that should be tackled only by expert and experienced endoscopists with backup from experienced interventional radiologists and surgeons.

All patients underwent EUS prior to the procedure. Seven patients were found to be inappropriate candidates, three because they had no identifiable pseudocyst and two because their lesion was inconsistent with a pseudocyst (concerns were raised about a cystic neoplasm). In addition, seven patients were considered inappropriate candidates for transmural drainage; in four, the distance between the gut wall and the pseudocyst lumen was too great, and in two, varices were present between the cyst and gut lumen. The final patient was found to have normal pancreatic parenchyma between the cyst and the gut. The author concluded that EUS influenced the management of almost one third of patients referred with “intention to treat” endoscopically.

This study did not prospectively or randomly compare CT scan versus EUS, and one can argue that a high-quality CT scan performed instead of an EUS might have provided similar information. Nevertheless, most experts agree that EUS is a useful adjunct for decision making prior to initiating endoscopic drainage of pseudocysts, and it is routinely used for this purpose in centers where it is available. However, the literature provides insufficient evidence to demonstrate that EUS is necessary. This author would recommend that if EUS is available and the endosonographer is experienced in pancreatobiliary imaging, EUS should be performed. If EUS is not available, a high-quality, pancreatic, dedicated, spiral CT should be performed immediately prior to attempting endoscopic drainage. One should also pay particular attention to the status of the splenic vein, and if splenic vein thrombosis is present, one would be advised to seriously consider surgical management if feasible.

Complications
Complications are inevitable with endoscopic interventions. The key issues for endoscopists who contemplate performing endoscopic drainage of pseudocysts are (1) whether they have a good understanding of the potential complications and how best to minimize the risks and (2) whether their institution has the expertise to manage the complications. In Baron’s series, the complication rate was similar in those patients with acute and chronic pseudocysts (19% and 17%, respectively) but was significantly greater for those with pancreatic necrosis (37%)..

One potential complication is perforation, an event that may occur when the cyst cavity is entered but space exists between the cyst wall cavity and the gut. Puncturing such a cyst can lead to leakage of cyst and gastric contents into the retroperitoneal space. This complication can be best avoided by careful review of the CT scan and/or EUS to make sure that the cyst is welded to the gut wall. Additionally, if there is no clear and obvious bulge present against the gut wall, one is advised to take another, nonendoscopic approach to drainage.

A second complication is bleeding. This complication has been reduced
with the advent of puncture-tract dilation rather than enlargement of the fistula with a sphincterotome or needle-knife. Nevertheless, significantly sized vessels coursing through the submucosa or along the gastric serosal surface can still be lacerated in the process of a puncture. This complication can be minimized by excluding patients with splenic vein thrombosis and by careful attention to keeping the needle-knife perpendicular to the gut wall while puncturing the cyst cavity.

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review of the CT scan. It is interesting that the one death in Baron’s series occurred in the patient who had a splenic artery rupture, but at a location far removed from the catheters or drainage site. The most common complication is infection. Once a communication is created between the gut and the cyst cavity, bacteria will inevitably be introduced into the cyst cavity. This complication can be minimized by the use of pre- and post-procedure antibiotic and antifungal therapy as well as careful selection of patients who only have fluid-filled cavities and no evidence of necrotic debris. Maintaining effective drainage also avoids infection. Anyone performing endoscopic drainage of a pseudocyst must be prepared to place a nasocystic catheter if, after entering and dilating the cyst cavity, necrotic debris is discovered. The nasocystic tube is placed alongside the pigtail stents and should be repeatedly flushed with 50 to 200 cc of saline over the course of several days. One can then infuse contrast into the cyst cavity to ensure that all necrotic material has been removed prior to discontinuing nasocyst drainage.

Ductography
At the time of the index ERCP, the endoscopist should try to obtain a complete pancreatogram. If there is a significant communication between the pancreatic ductal system and the cyst, it is recommended that a transpapillary stent be placed either into the cyst cavity itself or across the area of duct disruption. This practice is particularly important if there is any distal obstruction present (stones or stricture). In Baron’s series, pancreatography was ultimately obtained in 136 of 138 patients and communication of the collection with the main pancreatic duct was demonstrated in 85 patients.
When performing pseudocyst drainage, the endoscopist is in the unique position (compared with surgeons and radiologists) of being able to visualize the pancreatic ductal system and, in selected cases, use it as a sole means of draining pseudocysts. It is recommended that the transpapillary approach only be used in those patients with a significant communication between the ductal system and the cyst and in cases in which the endoscopist can be completely confident that the cyst contains pure fluid with no necrotic debris. However, due to edema, inflammation, and anatomic distortion from the cyst, complete endoscopy may not be possible at the index ERCP. In this case, transmural drainage (see above) can proceed, and ductography can be performed at a follow-up session. In some cases, it may be necessary to perform pancreatic sphincterotomy to facilitate removal of stones or placement of multiple stents. Thus, the endoscopist should be comfortable with this procedure prior to attempting transpapillary cyst drainage.

It has been argued that magnetic resonance cholangiopancreatography (MRCP), a technique that has recently become available, can supplant ERCP for assessment of the pancreatic duct in patients with pseudocysts. In the view of this author, this argument is not often correct. Obviously, MRCP has no therapeutic potential, and therefore, even if obstruction is identified, it cannot be treated. Additionally, in this author's experience, the T2-weighted images, which provide the pancreatic ductal images, are frequently obscured by the overlying cyst cavity. Thus, MRCP is not as yet an adequate substitute for direct pancreatography.

Follow-up
After successful cyst drainage, patients can generally be discharged within a few days. Follow-up consists of a CT scan 3 to 6 weeks after the procedure. If resolution has occurred, one should see the stents entering into an inflammatory area that may contain some air but should not have any significant fluid present. If this is the case, the stents can be removed by grasping the intraluminal end with a polypectomy snare.

In Baron's series, drainage was significantly more successful in the group with chronic pancreatitis (92%) than in the groups with acute pancreatitis (74%) and pancreatic necrosis (72%). Recurrence of pseudocysts occurs in about 10% of cases. In Baron's series, those patients with chronic and acute pseudocysts had a 12% and 9% recurrence rate, respectively, which was significantly lower than that in the group with pancreatic necrosis (29%). Pseudocyst recurrence is largely related to ductal anatomy. For example, if complete duct cut-off exists (most common in the neck area of the pancreas) and the pseudocyst cavity is being fed by viable exocrine pancreas in the body and tail region, endoscopic (and percutaneous) treatments generally fail (Figure 1A, 1B). This scenario requires surgical intervention often involving pancreatectomy and/or drainage of the cyst cavity into a Roux limb.

Summary
The key requirements for successful endoscopic management of pseudocysts involve careful selection of
patients and having the procedure performed by an appropriately prepared endoscopist. This individual must have adequate experience in ERCP, be cognizant of potential complications, and have a multidisciplinary group available to help manage complications or failures. The author hopes that this review of Baron’s recent article will improve the reader’s overall understanding of the management of pseudocysts and provide aid to those contemplating performing this procedure.

References