

Pseudocyst Management

Endoscopic Drainage and Other Emerging Techniques

Vivek V. Gumaste, MD, MRCP (I), FACP and Joshua Aron, MD

Abstract: Pseudocyst formation is a well known complication of pancreatitis. Not all pancreatic pseudocysts require intervention. Selected patients who are asymptomatic can be subject to expectant management. Spontaneous resolution has been shown to occur in 40% to 50% of patients with no serious complications occurring during the observation period. Intervention is warranted if the patient is symptomatic, there is a progressive increase in size or if the pseudocyst is infected. Surgery was the only available treatment for pseudocysts for a long time. Of late other modalities like percutaneous, endoscopic, and laparoscopic drainage have come to be seen as viable alternatives.

Key Words: pancreatitis, pseudocyst, endoscopy
(*J Clin Gastroenterol* 2010;44:326–331)

The first documented description of a pancreatic pseudocyst can be ascribed to Morgagni in 1761.¹ A pseudocyst, according to the Atlanta Classification is defined as a collection of pancreatic juice enclosed by a nonepithelialized wall of fibrous or granulation tissue that arises as a consequence of acute pancreatitis, chronic pancreatitis, or trauma.² Pseudocysts usually take 4 weeks to develop. Collections of lesser duration lack a well-defined wall and are referred to as acute fluid collections.

The incidence of pseudocyst formation in acute pancreatitis ranges from 5.1% to 16% - this wide range being partly owing to the varying definitions of pseudocysts used by different authors.³ Nonalcoholic acute pancreatitis is associated with a lower incidence of pseudocyst formation when compared with acute alcoholic pancreatitis.⁴ The incidence of pseudocyst formation in the case of chronic pancreatitis is even higher. In a recent multicenter survey, 26% of patients with chronic pancreatitis developed pseudocysts.⁵

Not all pancreatic pseudocysts require intervention. Selected patients who are asymptomatic can be subject to expectant management. Spontaneous resolution has been reported to occur in 40% to 50% of patients treated in this manner with no serious complications occurring during the observation period.^{2,6,7} The traditional criteria of size

greater than 6cm and duration more than 6 weeks being indicators for intervention no longer hold true. Large pseudocysts may also resolve spontaneously. In one study, 3 of 11 cysts greater than 10cm resolved without intervention.⁷

Intervention is warranted if the patient is symptomatic, there is a progressive increase in size or if the pseudocyst is infected. Surgery was the only available treatment for pseudocysts for a long time. Of late other modalities like percutaneous, endoscopic, and laparoscopic drainage have come to be seen as viable alternatives.

The first successful endoscopic pancreatic pseudocyst drainage was performed by Kozarek et al⁸ in 1985. Since then endoscopic drainage of pseudocysts has become increasingly popular.^{9–19}

PREDRAINAGE EVALUATION

Before embarking on a drainage procedure, it is important to confirm the diagnosis of a pseudocyst and ascertain its characteristics so as to direct appropriate management.²⁰ The predrainage evaluation must focus on the following:

1. Ensure that the lesion is not a cystic neoplasm masquerading as a pseudocyst.
2. Rule out the possibility of an underlying cause like intraductal papillary mucinous tumor or pancreatic cancer.
3. Determine the solid content of the pseudocyst as it is likely to impact on the technique chosen.
4. Delineate the relationship of the pseudocyst to the stomach and duodenum and detect the presence of vascular structures in the vicinity which could prove to be a bleeding hazard. This is especially important in patients with a history of portal hypertension.

A computed tomography scan usually suffices but additional details maybe sought by means of a magnetic resonance imaging or endoscopic ultrasound (EUS).

ENDOSCOPIC DRAINAGE

Endoscopic access to the pseudocyst can be achieved by a transmural route or through a transpapillary approach. Sometimes a combination of both methods maybe necessary to drain a pseudocyst.

TRANSPAPILLARY APPROACH

A transpapillary approach is possible only when the pseudocyst communicates with the pancreatic duct. Such a communication is present in 36% to 69% of patients with pseudocysts.^{10,11,21,22} This suggests that anywhere between one-third to two-third of pseudocysts are not amenable to transpapillary drainage which itself must be considered a limitation of this procedure.

Received for publication September 29, 2009; accepted November 29, 2009.

From the Division of Gastroenterology, Department of Medicine, Mount Sinai Services at Elmhurst, and the Mount Sinai School of Medicine of the City University of New York, New York.

The authors have not received any funding for the article and do not have any financial interest in the views expressed in the article.

The authors do not have any conflict of interest.

Reprints: Vivek V. Gumaste, MD, MRCP (I), FACP, Division of Gastroenterology, Mount Sinai Services at Elmhurst, 79-01 Broadway, Elmhurst, New York, NY 11373 (e-mail: GUMASTE@nychhc.org).

Copyright © 2010 by Lippincott Williams & Wilkins

Procedural Details

An endoscopic retrograde cholangiopancreatography (ERCP) is first performed to establish the presence of a communication between the pancreatic duct and the pseudocyst, after which a guide wire is passed into the pseudocyst. A pancreatic sphincterotomy may or may not be necessary. Once access to the cyst is obtained, a plastic stent is inserted into the cavity and left in place with its other end draining out of the ampulla. Usually a straight plastic stent 7F in diameter is used, but an 8.5F stent maybe used when the pancreatic duct is large. A larger diameter stent is more likely to facilitate the drainage of solid debris. If direct passage into the cyst cavity is not possible, an attempt is made to bridge the cyst communication with the stent. Anatomic considerations make pseudocysts in the head easier to drain than those in the tail. The stent is left in place until resolution of the pseudocyst which occurs in most cases within 3 months.

Some clinicians prefer to place a nasocystic drain^{9,10} initially to facilitate saline lavage of cysts complicated by necrosis and debris. The nasocystic drain is subsequently replaced by a pancreatic stent.

Success Rate

Technical success of transpapillary drainage is very high with success rates of 100% being reported by most groups. The clinical success of transpapillary drainage ranges from 80% to 100% (Table 1).

Complications

Transpapillary drainage is a safe procedure with a low complication rate. Complications occur in 10% to 20% of patients (Table 1) and are usually self-limited or resolve with minimum intervention. Complications noted with transpapillary drainage include mild pancreatitis and bleeding owing to pancreatic sphincterotomy.⁹ Rarely a biliary fistula may develop.⁹ Perforation and significant bleeding that are well-known complications of transmural drainage are usually not seen with transpapillary drainage.²⁰ Scarring of the pancreatic duct is a long-term complication of stenting.²³

Recurrence

Recurrence rates range from 10% to 20% (Table 1).

Mortality

No procedure-related mortality has been reported with transpapillary drainage.

TRANSMURAL APPROACH

In transmural drainage, access is gained to the cyst cavity through an incision made in the stomach wall or duodenum. The transduodenal route is preferred when feasible as it is safer and technically less challenging than transgastric path.²⁴

PROCEDURE

Non-EUS-guided Drainage²³

Before attempting transmural drainage certain requirements need to be fulfilled. The pseudocyst must be in close apposition to the gastrointestinal wall (< 1 cm) and there must be a bulge either into the stomach or duodenum marking the location of the pseudocyst. Portal hypertension is a contraindication for performing this procedure because of the risk of bleeding from intramural varices.

A duodenoscope is used for this method. The cyst wall is punctured at the site of the bulge using either electrocautery (needle-knife) or a plain needle that accepts a guide wire. Entry into the cyst is confirmed by aspirating the fluid contents or injecting radio opaque contrast into the cavity under fluoroscopy. The next step involves balloon dilation of the transmural tract to a diameter of 8 to 10 mm. Cautery is not generally employed to widen the stoma as it increases the risk of bleeding.²³ Finally 1 or 2 short (3 to 5 cm) 10Fr double pigtail stents are inserted through the opening to drain the cyst.

EUS-guided Drainage²³

EUS has become a useful adjunct in the endoscopic drainage of pseudocysts. The advantage of using EUS is that it does not rely on bulging to locate the site of the pseudocyst and excludes the presence of interposed blood vessels. In addition, it provides information on the presence or absence of debris that may influence management.

EUS can be used in 2 ways to aid drainage. A radial or linear echoendoscope maybe used initially to localize the pseudocyst and mark the point of entry. The echoendoscope is then withdrawn and replaced by a therapeutic endoscope or duodenoscope to complete the procedure. Alternatively a linear echoendoscope maybe used to perform a one-step procedure similar to EUS-guided fine needle aspiration obviating the need to change scopes.^{17,25}

Technical Success

Most studies evaluating non-EUS-guided transmural drainage report technical success rates ranging from 70% to 100% (Table 2). However these figures maybe exaggerated

TABLE 1. Transpapillary Drainage

Authors	No.	Technical Success (%)	Clinical Success (%)	Complications (%)	Recurrence (%)	Mean Duration Stenting	Follow-up
Kozarek et al (1991)	14	100	12 (85)	NA	NA		16 mo
Binmoeller et al (1995)	33	100	31 (94)	1 (3)	5 (15)	NA	22 mo
Barthet et al (1995)	20	100	16 (80)	3 (15)	2 (10)	4.8 mo	15 mo
Smits et al (1995)	12	100	7 (58)	1 (8)	NA	3 mo	32 mo
Sharma et al (2002)	5	100	5 (100)	0 (0)	1 (20)	3 mo	44 mo
Hookey et al (2006)	15	93	14 (93)	0 (0)	3 (20)		
Barthet et al (2008)	8	100	8 (100)	0 (0)	0 (0)	3 mo	13 mo

NA indicates not available.

TABLE 2. Transmural Drainage Without Endoscopic Ultrasound

Author	No.	Technical Success (%)	Clinical Success (%)	Complications (%)	Recurrence (%)
Binmoeller et al (1995)	24	83	95	12.5	30
Smits et al (1995)					
ECG	10	70	30	33	30
ECD	7	100	100	0	0
Sharma et al (2002)					
ECG	27	100	100	18	15
ECD	6	100	100	0	16
Hookey et al (2006)	28	96	89	11 +	4
Barthet et al (2008)	14	93	92	14 +	0
Varadarajulu et al (2008)	15	33	80	13 +	0

+ includes one death from bleeding.

ECD indicates endoscopic cystduodenostomy; ECG, endoscopic cystgastrostomy.

as several studies suffered from a selection bias in that they selected out patients with an obvious bulge into the lumen.

A luminal compression is not always present being noted in only 42% to 45% of all pseudocysts.^{10,16} In one study¹⁸ only 6 of 15 patients (40%) randomized to eshagogastroduodenoscopy and drainage had a bulge and successful drainage was possible in only 5 patients making the overall success rate only 33%. Therefore endoscopic drainage per se has a limited scope and is feasible in only a minority of cases when all comers are included.

When performed in conjunction with EUS,^{11,16–18} technical success rates ranging from 95% to 100% have been consistently recorded (Table 3).

The clinical outcome, once drainage is established ranges from 80% to 100% and does not vary whether EUS is used or not (Tables 2 and 3).

Complications

Complications occur in 4% to 33% of patients undergoing transmural drainage (Tables 2 and 3). The transgastric approach carries a higher risk when compared with transduodenal drainage.⁸ There does not seem to be a significant difference in complication rate whether EUS is used or not.^{16,26}

Bleeding is the most serious complication seen with transmural drainage occurring in 3% to 13% of patients (Table 4). The use of cautery while making the initial puncture does not seem to impact the bleeding rate.²⁷ Bleeding can be severe at times necessitating endoscopic or surgical intervention. Although studies do not show a statistically significant difference in bleeding rate with or without EUS, this may not be actually so; patients with risk factors for bleeding appear to have been preselected to be done under EUS guidance skewing the outcome.²⁶ Some authors are of the opinion that the incidence and intensity of bleeding is minimized when EUS is used as an adjunct.^{11,18} Three studies^{11,16,18} reported procedure-related deaths owing to bleeding. Autopsies performed in 2 of the patients revealed signs of bleeding at the puncture

site and in 1 of them varices were noted in the gastric wall.¹⁸ In all these 3 cases EUS was not used.

Retroperitoneal perforation may be seen in 3% to 6% of patients undergoing transmural drainage^{9,13,16} and seems to be more common with endoscopic cystgastrostomy.^{9,13} Patients usually respond to conservative treatment with antibiotics and observation.

Other complications noted include cyst infection^{11,13} and complications intrinsic to stents like migration and clogging.⁹

Although there does not seem to be any significant difference in the clinical outcome with or without the use of EUS once drainage is established, it is advisable to use EUS for it enhances the technical success rate. Also life-threatening bleeding seems to be diminished. Fifty percent of respondents in a survey of transmural drainage practices indicated that they employed EUS-guided transmural drainage.²⁰

COMBINED TRANSMURAL AND TRANSPAPILLARY DRAINAGE

Some groups have used a combination of transmural and transpapillary techniques to drain pseudocysts. Barthet et al¹⁰ achieved successful drainage in 7 of 10 patients who underwent combined therapy. Likewise Smits et al⁹ showed a positive outcome in 7 of 8 cysts that were drained by both techniques.

FACTORS AFFECTING OUTCOME OF ENDOSCOPIC DRAINAGE

Size

The size of the pseudocyst does not seem to affect the outcome of endoscopic drainage. Smits et al⁹ found no statistically significant difference in resolution between cysts greater or less than 7 cm in size. They noted that cysts upto 20 cm in size disappeared completely after endoscopic drainage.

TABLE 3. Endoscopic Ultrasound-guided Transmural Drainage

Author	No.	Technical Success (%)	Clinical Success (%)	Complications (%)	Recurrence (%)
Varadarajulu et al (2008)	24	100	95	1 (4)	0 (0)
Hookey et al (2006)	32	94	91	3 (9)	4 (12)
Kruger et al (2006)	35	94	80	11 (31)	4 (12)
Barthet et al (2008)	28	100	89	7 (25)	0 (0)

TABLE 4. Bleeding During Transmural Drainage

Author	Total	No. With Bleeding (%)	Procedure	Treatment	Deaths	EUS
Binmoeller et al	24	2 (8)	1 ECG, 1 ECD	Surgery	0	NA
Smits et al	17	2 (12)	2 ECG	1 sclerotherapy	0	NA
				1 surgery		
Sharma et al	33	1 (3)	1 ECG	Surgery	0	No
Barthet et al	14	1 (7)	NA	None	1	No
Hookey et al	116	6 (5)	NA	4 endoscopy	1	No
				1 surgery		
Vardarajulu et al	15	2 (13)	NA	1 endoscopy	1	No

ECD indicates endoscopic cystduodenostomy; ECG, endoscopic cystgastrostomy; ESU, endoscopic ultrasound; NA, not available.

Collections drained by the transpapillary route tend to be significantly smaller usually <6 cm than those drained transmurally because they are less likely to produce a bulge.^{10,16,20}

Communication With Pancreatic Duct

The presence or absence of communication with the pancreatic duct has no influence on the success of endoscopic drainage.⁹ However, defining pancreatic ductal anatomy via ERCP may provide other useful information that may direct further management in the event of failed endoscopic drainage.^{28,29} Patients with a complete cutoff in the main pancreatic duct, associated chronic pancreatitis, and duct-cyst communication are preferred candidates for surgical intervention as they are less likely to respond to percutaneous drainage.³⁰ Also prior knowledge of pancreatic ductal anatomy has been shown to alter the operative plan and thereby decrease adverse outcomes postsurgery.³⁰ ERCP in the setting of a pseudocyst does carry the risk of introducing infection into a sterile collection and efforts must be made to schedule the procedure immediately before a planned intervention.²⁹ Magnetic resonance cholangiopancreatography seems to be an attractive noninvasive option that can provide the same information as an ERCP but more data is required.²⁹

Necrosis

Necrotic tissue in the cyst impairs the outcome of endoscopic drainage. In one study¹⁶ only 2 of 8 patients, that is 25% of patients, with necrosis resolved with endoscopic therapy.

Employment of aggressive and innovative techniques can lead to higher success rates.^{23,31} Dilation of the stoma to a size greater than 15 mm facilitates better drainage of the necrosis. The placement of an additional 7 Fr naso-irrigation tube alongside the transmural stent allows repeated saline lavage helping to clear the cyst of debris.²³

Alternatively, a forward viewing scope can be directly passed into the cavity through the dilated opening and the debris extracted with the aid of a basket or grasping forceps.²³

Number of Procedures

Most patients will require an average of 2 procedures to achieve drainage.^{9,10,16} In complex cases up to 7 procedures maybe required for a successful outcome.⁹

ENDOSCOPIC DRAINAGE VERSUS SURGERY

Surgery despite being the gold standard for decades is beset with a high mortality rate. A cumulative review of

several studies²⁸ indicated a rate of 8.5% for all surgical procedures and 5.8% specifically for internal drainage. More recent studies^{6,7} demonstrate a decreasing mortality making it a less prohibitive option in the face of minimally invasive techniques.

At present, there are no prospective, randomized trials that directly compare endoscopic intervention with surgical therapy. Retrospective comparisons^{19,32} have failed to show any significant difference in complications, success rate, or mortality. However, one study¹⁹ indicated that the mean length of postprocedural hospital stay was lower among the EUS-guided endoscopic group when compared with those undergoing surgery. In addition, the average direct cost per case for EUS-guided cystgastrostomy was \$9077 compared with \$14,815 for surgical cystgastrostomy.

Another study³³ that compared endoscopic cystgastrostomy alone with surgical and laparoscopic cystgastrostomy found that the primary success rate was significantly higher for laparoscopic and open groups compared with the endoscopic group. These results could have been skewed by the noninclusion of patients undergoing endoscopic cystduodenostomy and by the selective use of EUS.

PERCUTANEOUS DRAINAGE

Percutaneous drainage is the least invasive of these modalities but requires an external drainage catheter that may need to be in place for over 50 days.³⁴ Although early reports³³ of percutaneous drainage were encouraging with regards to the outcome, recent studies have been disappointing with successful drainage being achieved in only 40% to 60% of patients undergoing the procedure.^{34–36}

Additionally patients treated by percutaneous drainage tend to have a higher complication rate, higher mortality, and an increased length of stay when compared with surgery.³⁴ The high mortality rate persisted despite correcting for comorbidities as patients undergoing percutaneous drainage tend to be usually sicker.³⁴

One of the drawbacks of percutaneous drainage has been its inability to effectively clear necrotic debris. A new technique that involves dilation of the tract up to a diameter of 26 Fr and the use of grasping forceps to extract the debris and one which can be repeated as required seems promising.³⁷

LAPAROSCOPIC SURGERY

Advances in laparoscopic surgery have facilitated laparoscopic internal drainage of pancreatic pseudocysts.^{38–44} Internal drainage can take the form of either a

TABLE 5. Laparoscopic Drainage of Pseudocysts

Name	n	Conversions (%)	Complications (%)	Recurrence (%)	Mortality
Park and Heniford (2002)	29	1	2	0	0
Mori et al (2002)	18	4	3	1	0
Hauters et al (2004)	17	1	2	0	0
Hindmarsh et al (2005)	15	3	2	2	0
Davila (2004)	10	0	2	0	0
Total	89	9 (10)	11 (12.4)	3 (3.4)	0

cystgastrostomy or a cyst-jejunostomy. Cystgastrostomy can be performed via the endogastric, transgastric, or exogastric routes. The mean operative time for laparoscopic drainage is 152 minutes with a range from 60 to 305 minutes. The mean postoperative hospital stay is 5.7 days.³⁸

A systematic review of 89 patients from series that reported on 10 or more patients¹ revealed a success rate of 96.6% (Table 5). Complications, usually bleeding and infection occurred in 11 (12.4%) of the 89 patients with no reported mortality. Conversion to open surgery was required in 9 patients (10%). Recurrence occurred in 3 (3.4%) of the patients.

Laparoscopy seems to have a distinct advantage over endoscopic drainage in the case of pseudocysts that contain significant debris or necrosis because of the larger size of the stoma created. Present endoscopic methods are limited in their ability to fashion stomas greater than 2 cm, the result being repeated stent occlusion and high recurrence rates.³⁸

One disadvantage of laparoscopic surgery is that it may not be suitable for patients unfit to undergo general anesthesia or for patients with extensive previous abdominal surgery.

NATURAL ORIFICE TRANSLUMENAL ENDOSCOPIC SURGERY

Natural Orifice Transluminal Endoscopic Surgery (NOTES) is a technique that combines endoscopy and surgery using natural orifices like the mouth, anus, vagina, and urethra as access routes. The role of NOTES in pseudocyst drainage is still in the investigational stage.⁴⁵

The procedure is performed by a gastroenterologist and surgeon working in tandem and involves the use of a medical device that includes a computer powered stapler. This innovative device is positioned alongside an endoscope in the stomach so that one jaw of the stapler is in the pseudocyst whereas the other jaw is in the stomach. The stapler when closed and fired creates a permanent connection between the cyst cavity and stomach allowing drainage of the pseudocyst. The procedure is carried out under general anesthesia and may take anywhere between 2 to 3.5 hours.⁴⁵ This technique is still in its early stages and can be difficult to perform.

The most obvious advantage of this technique over endoscopic cystgastrostomy seems to be the ability to create a larger stoma thus facilitating superior drainage of the cyst contents. Stomal openings upto 55 mm in size can be created by this technique as opposed to a 20 mm opening achieved by endoscopic methods.⁴⁵ Additionally an external surgical incision is avoided.

CONCLUSIONS

Although it is tempting to compare one technique with another, one must be cautious when interpreting the results from nonrandomized trials that suffer from an inherent selection bias. The apparent superiority of one technique over another could be the result of this bias.

In addition, a pseudocyst is a complex entity with multiple characteristics, each of which may dictate one method over another. For example, a pseudocyst in the tail of the pancreas may not be amenable to endoscopic drainage forcing one to choose a surgical option. The presence of extensive necrotic material may make laparoscopic surgery a better choice compared with endoscopic drainage. And surgery, either laparoscopic or conventional, maybe preferable when adjunctive procedures like cholecystectomy need to be performed. In fact in one series more than 50% of patients had gallstone pancreatitis necessitating laparoscopic or open cholecystectomy.³³ Therefore it is important to assess the overall clinical picture, outline the specific details, and then choose the appropriate technique.

In the absence of a specific deciding factor and no obvious contraindications, and where endoscopic expertise is available, it is advisable to employ endoscopic drainage as the initial procedure of choice because it is associated with a good success rate. Moreover it can be carried out with conscious sedation and is relatively less invasive and less expensive than laparoscopic or conventional surgery with the added benefit of a decreased postprocedure length of stay. Laparoscopy and surgery may be used as rescue techniques in case of endoscopic failure. Recourse to percutaneous drainage may be necessary in extremely sick patient with multiple comorbidities who cannot tolerate any form of sedation. NOTES as a technique for pseudocyst drainage is still in the experimental phase.

REFERENCES

1. Bergman S, Melvin WS. Operative and non-operative management of pancreatic pseudocysts. *Surg Clin N Am*. 2007;87:1447–1460.
2. Gumaste VV, Pitchumoni CS. Pancreatic pseudocyst. In: Brandt LJ, ed. *Clinical Practice of Gastroenterology*. Philadelphia: Churchill Livingstone; 1999:1219–1224.
3. Aghdassi A, Mayerle J, Kraft M, et al. Diagnosis and treatment of pancreatic pseudocysts in chronic pancreatitis. *Pancreas*. 2008;36:105–112.
4. Maringhini A, Uomo G, Patti R, et al. Pseudocysts in acute nonalcoholic pancreatitis: incidence and natural history. *Dig Dis Sci*. 1999;44:1669–1673.
5. Wang LW, Li ZS, Li SD, et al. Prevalence and clinical features of chronic pancreatitis in China: a retrospective multicenter analysis over 10 years. *Pancreas*. 2009;38:248–254.
6. Vitas GJ, Sarr MG. Selected management of pancreatic pseudocysts: operative versus expectant management. *Surgery*. 1992;111:123–130.

7. Yeo CJ, Bastidas JA, Lynch-Nyhan A, et al. The natural history of pancreatic pseudocysts documented by computed tomography. *Surg Gynecol Obstet*. 1990;170:411–417.
8. Kozarek RA, Brayko CM, Harlan J, et al. Endoscopic drainage of pancreatic pseudocysts. *Gastrointest Endosc*. 1985; 31:322–328.
9. Smits ME, Rauws EA, Tytgat GN, et al. The efficacy of endoscopic treatment of pancreatic pseudocysts. *Gastrointest Endosc*. 1995;42:202–207.
10. Barthet M, Sahel J, Bodiou-Bertei C, et al. Endoscopic transpapillary drainage of pancreatic pseudocysts. *Gastrointest Endosc*. 1995;42:208–213.
11. Barthet M, Lamblin G, Gasmi M, et al. Clinical usefulness of a treatment algorithm for pancreatic pseudocysts. *Gastrointest Endosc*. 2008;67:245–252.
12. Binmoeller KF, Seifert H, Walter A, et al. Transpapillary and transmural drainage of pancreatic pseudocysts. *Gastrointest Endosc*. 1995;42:219–224.
13. Sharma SS, Bhargawa N, Govil A. Endoscopic management of pancreatic pseudocyst: a long term follow-up. *Endoscopy*. 2002;34:203–207.
14. Kozarek RA, Ball TJ, Patterson DJ, et al. Endoscopic transpapillary therapy for disrupted pancreatic duct and peripancreatic fluid collections. *Gastroenterology*. 1991;100: 1362–1370.
15. Cremer M, Deviere J, Engelholm L. Endoscopic management of cysts and pseudocysts in chronic pancreatitis: long-term follow-up after 7 years of experience. *Gastrointest Endosc*. 1989;35:1–9.
16. Hookey LC, Debroux S, Delhaye M, et al. Endoscopic drainage of pancreatic-fluid collections in 116 patients: a comparison of etiologies, drainage techniques, and outcomes. *Gastrointest Endosc*. 2006;63:635–643.
17. Kruger M, Schneider AS, Mannis PM, et al. Endoscopic management of pancreatic pseudocysts or abscesses after an EUS-guided 1-step procedure for initial access. *Gastrointest Endosc*. 2006;63:409–416.
18. Varadarajulu S, Christein JD, Tamhane A, et al. Prospective randomized trial comparing EUS and EGD for transmural drainage of pancreatic pseudocysts. *Gastrointest Endosc*. 2008;68:1102–1111.
19. Varadarajulu S, Lopes TL, Wilcox CM, et al. EUS versus surgical cyst-gastrostomy for management of pancreatic pseudocyst. *Gastrointest Endosc*. 2008;68:649–655.
20. Baron TH. Endoscopic drainage of pancreatic pseudocyst. *J Gastrointest Surg*. 2008;12:369–372.
21. Kolars JC, Allen MO, Ansel H, et al. Pancreatic pseudocysts: clinical and endoscopic experience. *Am J Gastroenterol*. 1989;84:259–264.
22. Sahel J, Bastid C, Pellat B, et al. Endoscopic cystoduodenostomy of cysts of chronic calcifying pancreatitis: a report of 20 cases. *Pancreas*. 1987;2:447–453.
23. Baron TH. Treatment of pancreatic pseudocysts, pancreatic necrosis, and pancreatic duct leaks. *Gastrointest Endoscopy Clin N Am*. 2007;17:559–579.
24. Roeder BE, Pfau PR. Endoscopic pancreatic pseudocyst drainage. *Tech Gastrointest Endosc*. 2005;7:211–218.
25. Ahlawat SK, Charabaty-Pishvaian A, Jackson PG, et al. Single-step EUS-guided pancreatic pseudocyst drainage using a large channel linear array echoendoscope and cystotome: results in 11 patients. *JOP*. 2006;7:616–624.
26. Kahaleh M, Shami V M, Conaway MR, et al. Endoscopic ultrasound drainage of pancreatic pseudocyst: a prospective comparison with conventional endoscopic drainage. *Endoscopy*. 2006;38:355–359.
27. Monkemuller KE, Baron TH, Morgan DE. Transmural drainage of pancreatic fluid collections without electrocautery using the Seldinger technique. *Gastrointest Endosc*. 1998;48: 195–200.
28. Gumaste VV, Pitchumoni CS. Pancreatic pseudocyst. *Gastroenterologist*. 1996;4:33–43.
29. Cannon JW, Callery MP, Vollmer CM. Diagnosis and management of pancreatic pseudocysts: what is the evidence? *J Am Coll Surg*. 2009;209:385–393.
30. Nealon WH, Walser E. Main pancreatic ductal anatomy can direct choice of modality for treating pancreatic pseudocysts. *Ann Surg*. 2002;235:751–758.
31. Charnley RM, Lochan R, O'Sullivan CB, et al. Endoscopic necrosectomy as primary therapy in the management of infected pancreatic necrosis. *Endoscopy*. 2006;38:925–928.
32. Johnson MD, Walsh RM, Henderson JM, et al. Surgical versus non-surgical management of pancreatic pseudocysts. *J Clin Gastroenterol*. 2009;43:586–590.
33. Melman L, Azar R, Beddow K, et al. Primary and overall success rates for clinical outcomes after laparoscopic, endoscopic and open pancreatic cyst-gastrostomy for pancreatic pseudocysts. *Surg Endosc*. 2009;23:26.
34. Heider RH, Meyer AA, Galanko JA, et al. Percutaneous drainage of pseudocysts is associated with a higher failure rate than surgical treatment in unselected patients. *Ann Surg*. 1999;229:781–789.
35. Morton JM, Brown A, Galanko JA, et al. A national comparison of surgical versus percutaneous drainage of pancreatic pseudocysts: 1997–2001. *J Gastrointest Surg*. 2005;9: 15–21.
36. Habashi S, Draganov PV. Pancreatic pseudocyst. *World J Gastroenterol*. 2009;15:38–47.
37. Bala M, Almogy G, Klimov A, et al. Percutaneous “stepped” drainage technique for infected pancreatic necrosis. *Surg Laparosc Endosc Percutan Tech*. 2009;19:e113–e118.
38. Aljarabah M, Ammori BJ. Laparoscopic and endoscopic approaches for drainage of pancreatic pseudocysts: a systematic review of published series. *Surg Endosc*. 2007;21:1936–1944.
39. Bhattacharya D, Ammori BJ. Minimally invasive approaches to management of pancreatic pseudocysts. *Surg Laparosc Endosc Percutan Tech*. 2003;13:141–148.
40. Park AE, Heniford BT. Therapeutic laparoscopy of the pancreas. *Ann Surg*. 2002;236:149–158.
41. Mori T, Abe N, Sugiyama M, et al. Laparoscopic pancreatic cystgastrostomy. *J Hepatobiliary Pancreat Surg*. 2002;9: 548–554.
42. Hauters P, Weerts J, Navez B, et al. Laparoscopic treatment of pancreatic pseudocysts. *Surg Endosc*. 2004;18:1645–1648.
43. Hindmarsh A, Lewis MP, Rhodes M. Stapled laparoscopic cystgastrostomy. *Surg Endosc*. 2005;19:143–147.
44. Davila-Cervantes A, Gómez F, Chan C, et al. Laparoscopic drainage of pancreatic pseudocysts. *Surg Endosc*. 2004;18: 1420–1426.
45. Romanelli JR, Desilets DJ, Earle DB. Pancreatic pseudocyst-gastrostomy with a peroral, flexible stapler: human natural orifice transluminal endoscopic surgery anastomoses in 2 patients (with videos). *Gastrointest Endosc*. 2008;68:981–987.