(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 6, Issue 2 , Page No: 748-760
March-April 2023

IJMSCR

A review on Pancreatic Pseudocyst – Etiology, Classification, Incidence, Pathogenesis, Clinical Presentation, Diagnosis and Treatment Modalities

Priyanka Tanwar[1*], Mamta Naagar[2], Manish Kumar Maity[2]
[1]Department of Pharmacology, Bhagvan Mahavir Institute of Medical Sciences, Sonipat-131030, Haryana, India
[2]Department of Pharmacy Practice, MM College of Pharmacy, Maharishi Markandeshwar (Deemed to be university), Mullana-133207, Ambala, Haryana, India

***Corresponding Author:**
Priyanka Tanwar
Department of Pharmacology, Bhagvan Mahavir Institute of Medical Sciences, Sonipat-131030, Haryana, India
Email id – rphpriyanka1995@gmail.com

Type of Publication: Review Paper
Conflicts of Interest: Nil

Abstract

Acute or chronic pancreatitis can result in pancreatic pseudocysts. Cross-sectional imaging is frequently used to make an initial diagnosis. To identify pseudocyst from other cystic lesions of the pancreas, endoscopic ultrasonography with fine needle aspiration has become the more recommended diagnostic process. With supportive treatment, most pseudocysts dissolve spontaneously. Although the size of the pseudocyst and the amount of time it has been present are poor indicators of whether the cyst will resolve or produce issues, bigger cysts are more likely to be symptomatic or cause difficulties in general. The existence of problems or persistent patient discomfort are the two primary criteria for any form of invasive drainage surgery (infection, gastric outlet or biliary obstruction, bleeding). Endoscopic (transpapillary or transmural) drainage, percutaneous catheter drainage, or open surgeries are the three options for draining pancreatic pseudocysts. There have been no direct comparisons of these techniques in prospective controlled trials to far. As a result, treatment varies depending on the knowledge of expertise, but endoscopic draining is increasingly becoming the most preferred method since it is less intrusive than surgery, eliminates the need for an external drain, and has a high long-term success rate. In all circumstances, a customised therapeutic strategy should be explored, taking into account patient preferences and integrating a multidisciplinary team of therapeutic endoscopists, interventional radiologist, and pancreatic surgeons.

Keywords: Pancreatic pseudocyst, Cyst, Pancreatititis, Endoscopic ultrasound

Introduction

The pseudocyst of the pancreas is a small fluid collection rich in amylase and other pancreatic enzymes that is surrounded by a fibrous tissue wall that is not coated with epithelium [1]. The pancreatic duct system is related to pseudocysts either directly or indirectly through the pancreatic parenchyma. Pancreatic ductal disruption occurs as a result of elevated pancreatic ductal pressure, which can be produced by stenosis, calculi, or protein plugs blocking the primary pancreatic ductal system, or pancreatic necrosis following an incident of acute pancreatitis [2, 3]. Pseudocysts are a prevalent clinical issue that can aggravate the course of chronic pancreatitis in up to 30% - 40% of patients [4].

Etiology

The occurrence of pseudocysts is similar to that of pancreatitis, and the etiology of pseudocysts is

similar to that of pancreatitis, though pseudocyst formation is less common after acute pancreatitis than chronic pancreatitis, and it is more common after alcohol-induced pancreatitis than non-alcohol-related pancreatitis. In research from several countries with heavy alcohol use, alcohol-related pancreatitis appears to be the leading cause, accounting for 59 percent to 78 percent of all pseudocysts [5].

Walt et al [6] published findings from Wayne State University Hospital in Detroit, Michigan. According to that study, in the 357 hospitalization patients for pancreatic pseudocysts, the causal causes were alcohol consumption in 251 instances (70%), biliary tract illness in 28 cases (8%), blunt trauma in 17 cases (5%), penetrating trauma in 4 cases (1%), surgical trauma in 1 case (0.3%), and idiopathic in 56 cases (16%). The majority of the patients in the idiopathic category were assumed to be connected to alcohol, but no conclusive proof was found [6].

Classification

In 1991, D'Egidio and Schein proposed a pancreatic pseudocyst categorization based on the underlying cause of pancreatitis (acute or chronic), pancreatic ductal morphology, and the existence of contact between the cyst and the pancreatic duct [7]. They distinguish three forms of pseudocysts [7].

Type I pseudocysts, also known as acute "post-necrotic" pseudocysts that form after an acute pancreatitis episode and are linked with normal duct structure. They seldom interact with the pancreatic duct.

Type II pseudocysts, also known as post-necrotic pseudocysts, develop following an acute-on-chronic pancreatitis episode (the pancreatic duct is diseased, but not strictured, and there is often a duct-pseudocyst communication).

Type III pseudocysts, often known as "retention" pseudocysts, are related with duct stricture and pseudocyst duct communication in chronic pancreatitis.

Another classification, based entirely on pancreatic duct anatomy, is proposed by Nealon and Walser [8]. These are –

Type I: normal duct/no communication with the cyst.

Type II: normal duct with duct-cyst communication.

Type III: otherwise normal duct with stricture and no duct-cyst communication.

Type IV: otherwise normal duct with stricture and duct-cyst communication.

Type V: otherwise normal duct with complete cut-off.

Type VI: chronic pancreatitis, no duct-cyst communication.

Type VII: chronic pancreatitis with duct-cyst communication [8].

Incidence

Regardless of the cause, the incidence of pseudocyst is minimal, ranging from 1.6 percent to 4.5 percent per year, or 0.5 - 1 per 100000 adults [9, 10]. Pseudocysts formed in 86 participants in a study by Imrie after an emergency hospital admission for an episode of acute pancreatitis [11]. 62 of the 86 pseudocysts caused by acute pancreatitis were from the local hospital population, where 879 patients with acute pancreatitis were hospitalised at the same time. As a result, pseudocysts as a complication of acute pancreatitis were seen in 7 % of patients [11].

Fluid collections were found in 83 (9%) of 926 patients with non-alcoholic acute pancreatitis. After 6 weeks, 48 (5%) of the participants experienced a fluid collection consistent with a pseudocyst [12].

128 patients with acute pancreatitis (mostly alcohol-induced) were tracked prospectively using computed tomography (CT) by Kourtesis et al [13]. Fluid accumulation in the pancreatic area occurred in 48 individuals (37%). The bulk of these issues were handled on their own. Symptomatic pseudocysts occurred in 15 patients (12%).

Pseudocysts are more prevalent in chronic pancreatitis than in acute pancreatitis. In the literature, incidence rates ranging from 30 % to 40 % have been reported [4]. However, there is a lack of precise data based on the long-term follow-up of patients with chronic pancreatitis, in contrast to acute pseudocysts where the patient with chronic pancreatitis may have had the disease for 10, 20 or more years giving a greater risk of developing a pseudocyst at least once over a long period of sickness [14].

Pathogenesis

Volume 6, Issue 2; March-April 2023; Page No 748-760

Pseudocysts appear to be caused by pancreatic duct abnormalities caused by pancreatitis or trauma, followed by extravasation of pancreatic fluids. Pseudocysts in two-thirds of individuals exhibit visible connections between the cyst and the pancreatic duct. In the other third, an inflammatory response most likely obliterated the link, making it impossible to prove.

Only if the acute fluid collection continues for more than 4-6 weeks and is well-defined by a wall of fibrous or granulation tissue, one can say that an acute pseudocyst has formed following an episode of acute pancreatitis. Enzymatic fluid and necrotic debris are commonly seen in such pseudocysts [1, 5].

The cyst may arise as a result of an abrupt worsening of the underlying illness or obstruction of a major branch of the pancreatic duct by a protein plug, calculus, or localised fibrosis [15].

Clinical Presentation, Diagnosis and Differential Diagnosis

Pancreatic pseudocysts can appear in a variety of ways, from asymptomatic patients to significant abdominal catastrophes due to complications [16 - 18]. Bleeding (typically from a splenic artery pseudoaneurysm), infection, and rupture are all acute consequences.

Gastric outlet blockage, biliary obstruction, and thrombosis of the splenic or portal vein with the formation of gastric varices are all chronic complications [18].

The clinical appearance of pancreatic pseudocyst can be mimicked by a number of illnesses (Table - 1). Once a pancreatic cyst has been discovered using imaging, the next step is to distinguish pseudocyst from other cystic lesions of the pancreas (Table - 2).

Table -1 shows Differential diagnosis of pancreatic pseudocyst

Pancreatic diseases	Extrapancreatic diseases
Acute & chronic pancreatitis	Peptic ulcer disease & gastric cancer
Pancreatic necrosis & abscess	Acute cholecystitis & gallstones
Adenocarcinoma of the pancreas	Abdominal aortic aneurysm
Pancreatic cystic neoplasms	Intestinal ischemia
Pancreatic artery pseudoaneurysm	Ovarian cysts & cancer Bowel Obstruction Acute myocardial infarction Pneumonia

Table – 2 shows Differential diagnosis of cystic pancreatic lesions

	SCA	MCN	IPMN	SPN	PSEUDOCYST
Prevalant Age	Middle age	Middle age	Elderly	Young	Variable
Sex	Mostly female	Mostly female	Male > female	Mostly female	Male > female
Presentation	Mass/pain	Mass/pain	Pancreatitis	Mass/pain	Pain

Volume 6, Issue 2; March-April 2023; Page No 748-760

Location	Evenly	Body/tail	Head	Evenly	Evenly
Malignant potential	Very low	Moderate to high	Low to high	Low	None

History and Physical Examination

Pseudocysts have no distinctive symptoms; nevertheless, after a case of pancreatitis, a patient with chronic stomach discomfort, anorexia, or an abdominal mass should be evaluated for the potential of a pseudocyst. Patients with an infected pseudocyst may appear with jaundice or sepsis [16]. Even people with a big pancreatic pseudocyst might be asymptomatic at times. When a patient presents with a pancreatic cyst that was detected by chance on imaging, it is critical to determine whether the patient has a history of pancreatitis. Physical examination findings have a limited sensitivity. Abdominal pain is mostly common in patients. Sometimes patients may have palpable abdominal lump. Peritoneal symptoms point to a cyst rupture or infection. Fever, scleral icterus, or pleural effusions are other potential findings [17].

Laboratory Evaluations

The value of serum testing is restricted. The levels of amylase and lipase are frequently increased, but they may be within normal limits. If the bile duct is occluded by stone, extrinsic compression from the pseudocyst, or an underlying liver condition, serum bilirubin and liver chemistries may be high (e.g. alcoholic hepatitis). Some laboratory tests may reveal information about the underlying cause of pancreatitis (e.g. elevated triglycerides or calcium level). The presence of elevated liver chemistry raises the possibility of biliary pancreatitis.

Imaging Modalities

1) Transabdominal ultrasound

In this examination, a pancreatic pseudocyst presents as an echoic object with distal acoustic amplification. They are well-defined, round or oval, and enclosed by a smooth wall. Pseudocysts might seem more complicated in the early stages of growth, with various degrees of internal echoes. This look is usually caused by the presence of necrotic debris and is more prevalent in pseudocysts that arise as a consequence of acute necrotizing pancreatitis than in pseudocysts that form as a result of chronic pancreatitis. In most situations, the debris is cleaned over time. When a bleed into the cyst develops, or when infection of the cyst affects the clinical course, the pseudocyst might seem more complicated. In cystic lesions, colour Doppler or duplex scanning should always be conducted to establish that the lesion is not a huge pseudoaneurysm. The sensitivity of transabdominal ultrasound in the identification of pancreatic pseudocysts ranges from 75% to 90%. As a result, transabdominal ultrasound is inferior to CT, which has a sensitivity range of 90% to 100%. In the first diagnosis of a pseudocyst, transabdominal ultrasound has numerous disadvantages as compared to CT: the presence of overlaying intestinal gas reduces the sensitivity of transabdominal ultrasound, and unlike CT, transabdominal ultrasound examination is largely operator dependent [19].

2) Computerized Tomography (CT)

An abdominal CT scan that shows a thick-walled, spherical, fluid-filled mass next to the pancreas in a patient with a history of acute or chronic pancreatitis is almost pathognomonic for pancreatic pseudocyst. In this clinical setting, positive CT results do not need to be confirmed with another diagnostic modality. Because considerable volumes of intestinal gas caused by ileus or blockage reduce the sensitivity of transabdominal ultrasound in the acute environment, a CT scan is the best option. CT scans also reveal more details about the surrounding anatomy and can reveal further pathologies, such as pancreatic duct dilatation and calcifications, common bile duct dilatation, and pseudocyst expansion outside the smaller sac. The difficulty of CT scanning to distinguish pseudocyst from cystic neoplasm, particularly mucinous cystadenomas and intraductal papillary mucinous neoplasm (IPMN) [20], is a major flaw. Furthermore, the intravenous contrast used during a CT scan might cause or exacerbate renal disease.

Volume 6, Issue 2; March-April 2023; Page No 748-760

3) Magnetic resonance imaging (MRI)

For pancreatic pseudocysts, MRI and magnetic resonance cholangiopancreatography (MRCP) are sensitive diagnostic modalities. They are not commonly utilised since CT scanning normally provides all of the diagnostic information needed. The greater contrast, allows for improved definition of fluid collections. When it comes to detecting debris within fluid collections and pseudocysts, MRI or MRCP outperforms CT. A fluid-filled cystic mass creates high signal strength and appears bright on T2-weighted imaging. Although the pancreatic duct and biliary systems are easily visible, evaluating the condition of pancreatic duct integrity can be challenging [21]. MRI or MRCP is considerably more effective than CT or transabdominal ultrasound for detecting choledocholithiasis. In chronic pancreatitis, MRCP methods can also detect mild branch-chain dilatation. MRI is also very good at detecting bleeding in complicated fluid collections.

4) Endoscopic retrograde cholangiopancreatography (ERCP)

Although ERCP is not required for the diagnosis of pseudocysts, it can be used to give conclusive treatment in some circumstances. It can also aid in the development of a drainage strategy. The use of ERCP in the treatment of pseudocysts and acute pancreatitis was explored by Nealon et al, [22] who found that ERCP results may impact the treatment approach. As a result, several researchers advise getting an ERCP before doing any surgical operations. It is believed that, with the development of alternative imaging technology [CT, MRI, MRCP, and endoscopic ultrasound (EUS)], ERCP is no longer required in the vast majority of patients, although this has yet to be shown in a prospective research.

5) Endoscopic Ultrasound (EUS)

EUS is typically performed as a follow-up test to assess a pancreatic cyst discovered by other imaging modalities (transabdominal ultrasound, CT or MRI). When seeking to identify pancreatic pseudocyst from other cystic lesions of the pancreas, EUS is the test of choice. Due to the near proximity of the ultrasonic transducer to the region of interest, EUS visualisation of the pancreas produces high-quality pictures. A cyst wall thickness larger than 3 mm, macro-septation (all cystic components bigger than 10 mm), the presence of a mass or nodule, and cystic dilatation of the main pancreatic duct are all signs of cystic neoplasm [23 - 25]. Fine needle aspiration (FNA) of the cyst can be done during the EUS procedure, and cyst fluid can be collected for laboratory testing. Therapeutic endoscopic drainage can also be guided with EUS.

The cyst fluid can be used to distinguish pseudocysts from pancreatic cystic tumours (Table - 3). EUS is the recommended method for obtaining cystic fluid for analysis. The most often utilised marker is the amount of carcinoembryonic antigen (CEA) in the cystic fluid. Pseudocysts and serous cystadenomas have low levels, whereas mucinous cystadenomas have high levels. A CEA level in the cyst fluid of more than 400 ng/mL strongly predicts a mucinous lesion [23, 24, 26]. Amylase levels in pseudocysts are generally high, but they are low in serous cystadenoma. Although cytology can be useful in some cases, a negative result does not rule out the possibility of cancer.

Table - 3 shows Cystic fluid analysis in cystic pancreatic diseases

	SCA	MCN	MCAC	PSEUDOCYST
CEA	Low	High	High	Low
CA125	Variable	Variable	High	Low
CA19-9	Variable	Variable-high	Variable-high	Variable
Amylase	Low-high	Low-high	Low-high	High

Volume 6, Issue 2; March-April 2023; Page No 748-760

Lipase	Low	Low	Low	High

Hammel et al. [27] conducted a research to determine the accuracy of preoperative biochemical and tumour marker analyses in cyst fluids acquired by FNA for pathological diagnosis. Preoperatively, cyst fluid was taken using FNA, and biochemical and tumoral marker values were determined. Surgical specimen examination confirmed the diagnosis of cystic tumours (7 serous cystadenomas and 12 mucinous tumours). Thirty-one pancreatic pseudocysts worsening chronic pancreatitis were also investigated. Carbohydrate antigen (CA) 19-9 levels of > 50000 U/mL exhibited a sensitivity of 75% and a specificity of 90% for identifying mucinous tumours from other cystic lesions, according to the findings. For separating serous cystadenomas from other cystic lesions, CEA values of less than 5 ng/mL achieved 100 percent sensitivity and an 86 percent specificity. Amylase levels more than 5000 U/mL were shown to have 94 percent sensitivity and 74 percent specificity for identifying pseudocysts from other cystic lesions. It was concluded that high levels of carbohydrate antigen 19-9, low CEA, and high amylase in cyst fluid are all signs of mucinous tumours, serous cystadenomas, and pseudocysts, respectively [27].

Sperti et al. [28] reported a research that looked at the efficacy of enzymes (amylase and lipase) and tumour markers (CEA, CA 19-9, CA 125, and CA 72-4) in serum and cyst fluid analyses in the differential diagnosis of cystic pancreatic lesions. Serum and cyst fluid were collected from 48 individuals with pancreatic cysts (21 pseudocysts, 14 mucinous cystic neoplasms, 6 ductal carcinomas, and 7 serous cystadenomas) diagnosed between 1989 to 1994. The results revealed that serum CA 19-9 levels in ductal carcinomas (all > 100 U/mL) and mucinous cystic neoplasms ($P < 0.05$) were considerably higher. With 95 percent specificity and 80 percent sensitivity in diagnosing mucinous or malignant cysts, CA 72-4 cyst fluid levels were considerably greater in mucinous cystic tumours ($P < 0.005$). With just one false-positive result (3.6 percent), a combination test of blood CA 19-9 and cyst fluid CA 72-4 successfully detected 19 of 20 (95 percent) pre-malignant tumours. The sensitivity of cytology was 48 percent and the specificity was 100 percent. Any pancreatic cyst with high serum CA 19-9 levels, positive cytology, or high CA 72-4 in the fluid should be evaluated for excision, according to their findings [28].

A prospective investigation of the efficacy of molecular analysis of the pancreatic pseudocyst was reported by Khalid et al [29]. Endoscopic ultrasound-guided pancreatic cyst aspirates were collected over a 19-months period and analysed for cytology, CEA level, and molecular analysis in this study. Using fluorescent capillary electrophoresis, the molecular assessment included DNA quantity (amount and quality), κ-ras point mutation, and wide panel tumour suppressor related micro-satellite marker allelic loss analysis. A clonal growth model was used to compute the sequence of mutation acquisition, which was then compared to the final pathology. Thirty-six cysts were examined with verified histopathology. There were 11 cancerous cysts, 15 pre-cancerous cysts, and 10 benign cysts. The fluid CEA level ($P = 0.034$), DNA quality ($P = 0.009$), number of mutations ($P = 0.002$), and sequence of acquired mutations ($P < 0.001$) could all be used to distinguish malignant cysts from premalignant cysts. The most predictive of a malignant cyst was an early κ-ras mutation followed by allelic loss (sensitivity, 91 percent; specificity, 93 percent). Malignant cyst fluid has enough DNA to perform mutational analysis, according to the study. The presence of malignancy in a pancreatic cyst is most likely to be predicted by a first-hit κ-ras mutation followed by allelic loss. This method should be used in conjunction with the standard pancreatic cyst examination.

Treatment options for Pancreatic Pseudocyst

- **Supportive medical care –**

Fluids, analgesics, and antiemetics are administered intravenously on a regular basis. Low-fat diets are indicated for people who can tolerate oral consumption. Support can be provided by naso-

Volume 6, Issue 2; March-April 2023; Page No 748-760

enteral feeding or total parenteral nutrition (TPN) in patients who cannot tolerate oral nourishment. There have been no research comparing these two procedures for treating pancreatic pseudocysts, therefore the option is determined on availability and local preferences. If studies comparing the two methods in the treatment of acute necrotizing pancreatitis are to be believed, jejunal feeding will be associated with fewer problems (infection), but it will not be able to supply as many calories as TPN.

The use of octreotide as a treatment for pancreatic pseudocyst is justified since it reduces pancreatic secretions and aids in pseudocyst resolution. Regrettably, this method has not been well evaluated, with just a few case studies published [30, 31].

With supportive medical treatment, most pseudocysts will dissolve. Vitas et al. [32] studied 114 individuals diagnosed with pancreatic pseudocyst over the course of five years. Primary surgical treatment was performed on 46 patients, with 13% requiring emergency surgery due to pseudocyst-related complications. Despite the fact that there were no operational fatalities, 26% of patients had substantial morbidity (emergency operations, 67 percent; elective procedures, 10 percent). The remaining 68 patients were given a non-operative, observing approach at first. Only six patients (9%) had severe, life-threatening problems after 46 months of follow-up; 19 patients finally required elective surgery to remove the pseudocyst or other pancreatitis complications. Overall, clearance of the pseudocyst occurred in 57 percent of the 24 patients with good radiographic follow-up, with 38 percent resolving more than 6 months after diagnosis in patients treated nonoperatively. Although patients who subsequently underwent surgery had bigger pancreatic pseudocysts than those who were successfully managed non-operatively (6.9 cm vs. 4.9 cm), no major consequences occurred in seven patients who were treated expectantly with pancreatic pseudocysts higher than 10 cm [32].

Several studies have found that cyst size and length of time present are poor indicators of potential for pseudocyst resolution or problems, although bigger cysts are more likely to become symptomatic or produce issues in general [33]. However, some individuals with bigger collections do well; therefore the size of the pseudocyst alone is not a factor in deciding whether or not to drain it [34, 35]. The existence of symptoms or the occurrence of consequences is the two primary indications for invasive intervention (infection, bleeding, gastric outlet or biliary obstruction).

- **Drainage Procedures**

The major two indications for a drainage surgery are symptomatic pseudocysts or the existence of certain problems (infected pseudocyst, gastric outlet, or biliary blockage). There have been no prospective controlled trials that directly compare percutaneous, surgical, and endoscopic draining methods. As a result, therapy varies depending on local competence, although endoscopic drainage is increasingly becoming the recommended method.

1) Percutaneous drainage

CT or transabdominal ultrasound guidance can be used to accomplish external drainage. A drainage pigtail catheter is inserted percutaneously into the fluid cavity and fluid is drained using this procedure. Three-dimensional ultrasonography has been shown to be effective in guiding catheters into cyst cavities while avoiding vessels [36]. The fluid is collected in an external collecting system over several weeks. The catheter is withdrawn when the drainage output is modest. The size of the residual cyst cavity may be determined by a contrast injection into the cyst cavity, and this information can be utilised to track progress. This method is effective in removing pseudocysts, however it comes with a significant risk of infection. The external drain causes a lot of pain for the patients. In addition, the catheter has a tendency to clog and may need to be repositioned or exchanged. For US-guided pseudocyst drainage, the reported long-term success rate for pseudocyst clearance is roughly 50%. Large ductal leaks or obstructions of the primary pancreatic duct are the most common causes of failed drainages. Patients who are uncooperative and unable to handle a catheter at home are not candidates for percutaneous catheter drainage. Patients with strictures of the primary pancreatic duct and cysts containing bloody or solid material are likewise contraindicated [37, 38].

2) Surgical drainage

Surgical drainage of pseudocysts is performed by creating a conduit between the cavity of the

Volume 6, Issue 2; March-April 2023; Page No 748-760

pseudocyst and the stomach or small intestine. Patients who cannot tolerate or have failed percutaneous or endoscopic drainage are generally candidates for this kind of drainage. To increase the odds of full drainage, the surgical stoma should be positioned in the most dependent area of the cystic cavity. For several months, the stoma is normally patent and functioning.

The results of a retrospective investigation of 94 patients were published by Adams and Anderson [39]. There were 42 patients who had internal surgical drainage and 52 patients who had percutaneous pseudocyst drainage in the research. Significant problems occurred in 16.7% of patients who underwent surgery and 7.7% of patients who underwent percutaneous drainage ($P > 0.05$). In 9.5% of the surgical group and 19.2% of the percutaneous drainage group ($P > 0.05$), a later surgery was necessary. Surgical therapy (9% death rate) was shown to be considerably greater than percutaneous therapy (1% mortality rate) ($P < 0.05$) [39].

3) Endoscopic drainage

Because it is less intrusive than surgery, removes the need for an external drain, and has a high long-term success rate, endoscopic draining of pseudocysts is becoming the preferred treatment option. Direct drainage through the stomach or duodenal wall, or a transpapillary technique with ERCP. When the pseudocyst connects to the main pancreatic duct, commonly in the genue of the pancreatic duct, a transpapillary technique is employed. Patients with pancreatic duct disruption benefit from this therapy as well.

When the pseudocyst is located next to the gastro-duodenal wall, a transgastric or transduodenal technique is employed. EUS has become the test of choice for determining the size and location of the pseudocyst, as well as measuring the thickness of the pseudocyst wall. The presence of significant intervening arteries or varices, as well as a space of more than 1 cm between the stomach or duodenal wall and the cyst wall, are relative contraindications for endoscopic drainage [40, 41]. Endoscopic stenting of pseudocysts under fluoroscopic guidance or utilising EUS to deliver the guidewire into the pseudocyst cavity are two options for stenting pseudocysts.

To select the entry site for catheterization, the endoscopic technique relies on the existence of a protrusion into the stomach or duodenal lumen. This method carries various dangers, including missing the pseudocyst, damaging intervening arteries, and placing the drainage catheter incorrectly [42]. Pseudocysts can now be treated with EUS-guided transmural stenting using therapeutic echoendoscopes [43]. The deployment of a 7 Fr stent using a needle knife catheter has been documented in several series [44]. The use of 10 Fr stents across the stomach or duodenum is now possible because to a new large-channel echoendoscope [45]. In a limited group of patients with persistent pseudocysts, the EUS method resulted in a success rate of more than 90% [46]. After endoscopic drainage, the recurrence rate is just 4%, and the complication rate is less than 16% [47].

EUS can also use naso-cystic drains to guide the drainage of diseased pseudocysts [48]. EUS and endoscopic procedures may potentially be used to evacuate infected necrotic pancreatic tissue [49].

A chart analysis and prospective follow-up for 116 patients with attempted endoscopic drainage of symptomatic pancreatic-fluid collections (pseudocysts and organised pancreatic necrosis) was published by Hookey et al [50]. There were 116 individuals with fluid collections, which were divided into five categories: acute fluid collection (n = 5), necrosis (n = 8), acute pseudocyst (n = 30), chronic pseudocyst (n = 64), and pancreatic abscess (n = 9). The collection drained had a median diameter of 60 mm (15-275 mm). After drainage, the median follow-up period was 21 months. Transpapillary drainage was used in 15 patients, transmural drainage in 60, and both in 41. In 87.9% of patients, the symptoms were resolved and the collection was successful. The success rates of individuals with acute pancreatitis and those with chronic pancreatitis were not different. Drainage of organised necrosis was linked to a much greater failure rate than other collections. When illness, drainage technique, and drainage site were taken into account, no significant variations in success were found. Thirteen patients (11%) experienced complications, and six patients died in the 30 days following drainage, one of them died as a result of the surgery. Finally the conclusion was endoscopic draining of pancreatic-fluid accumulation is effective in the majority of patients and has a low complication rate [50].

Volume 6, Issue 2; March-April 2023; Page No 748-760

A case report of alcohol use for the treatment of a pancreatic pseudocyst was reported by Muscatiello et al [51]. According to this report, once aspiration of the pancreatic pseudocyst had begun and the volume of the pseudocyst had decreased by about 30%, 30 mL of 100% ethanol mixed 1:1 with saline was administered and maintained for about 10 minutes. The cyst was then aspirated until EUS imaging revealed that it was fully empty. A CT scan 24 hours later revealed no issues and verified the procedure's effectiveness. *Pseudomonas aeruginosa* and *Citrobacter freundii* combination was found in the culture of aspiration fluid. There were no malignant cells found on cytological testing. On the seventh day, the patient was discharged with no symptoms and normal laboratory testing. It appears that, in addition to generating cystic wall sclerosis, ethanol also helps to sterilise the contaminated fluid collection. A lengthy follow-up time (18 months) in which the pseudocyst did not reappear demonstrates that this approach may be used to treat organised necrotic abscesses and pancreatic abscesses when there is no contact with the pancreatic duct [51].

Only one patient in a comprehensive retrospective examination of 603 individuals who had EUS-FNA of pancreatic cysts developed potential infection. The majority of patients in this study (90 percent) got antibiotic prophylaxis, the most frequent of which was a fluoroquinolone administered for three days following the surgery, which might explain the low infection rate. Prospective randomised trials have not investigated the effect of prophylactic antibiotics before a FNA of cystic lesions [52].

The American Society for Gastrointestinal Endoscopy (ASGE) released recommendations for the prophylactic use of antibiotics for GI endoscopy in 2008. Prophylaxis with an antibiotic, such as fluoroquinolone, is recommended before EUS-FNA of cystic lesions along the GI tract, including pancreatic cysts, according to these guidelines. Antibiotics should be taken for further 3 to 5 days following the operation (supported by observational studies). Fluoroquinolone delivered before the surgery and maintained for 3 days following the treatment is an acceptable antibiotic prophylaxis regimen [53].

Cahen et al. [54] performed a retrospective analysis to assess the short-term and long-term outcomes of endoscopic draining of pancreatic pseudocysts, with the goal of identifying procedural changes that might improve the procedure's safety and efficacy. There were a total of 92 patients were included in this study (66 men, 26 women; median age 49 years). The drainage method had a 97 percent technical success rate and a 1 percent mortality rate. Thirty-one patients (34%) experienced complications, eight of which (9%) needed surgery: bleeding in four cases (three of which were caused by erosion of a straight endoprosthesis through the cyst wall), secondary infection in three cases, and perforation in one. During a median follow-up period of 43 months, ten patients (11%) received further (nonendoscopic) therapy for a persistent cyst, and five (5%) received treatment for a recurring cyst. 65 patients (71%) had effective endoscopic drainage. Endoscopic drainage is an excellent treatment for pancreatic pseudocysts, according to this study, and it provides a final solution in nearly three-quarters of instances. The majority of significant problems may have been avoided if pigtail stents had been used instead of straight stents, and if secondary cyst infection had been prevented and treated more aggressively [54].

Complications of Pancreatic Pseudocyst

1) Splenic complications

Massive bleeding into the pseudocyst, sepsis with splenic infarction, and splenic vein thrombosis are all splenic consequences of pseudocysts. The diagnosis of intrasplenic pseudocyst is difficult to make only on the basis of clinical signs, although the presence of a mass in the left upper quadrant should raise suspicion. In order to establish splenic involvement, sonography and computed axial tomography may be very useful. When splenic involvement is suspected, a selective celiac arteriography should be conducted to confirm the diagnosis and rule out the creation of pseudoaneurysms. Because of the high prevalence of significant complications and the proclivity for fast clinical deterioration, urgent surgical intervention is frequently required. The treatment of choice is splenectomy and distal pancreatectomy to remove the pseudocyst [55].

2) Rupture

A pseudocyst rupture can have a positive or negative effect, depending on whether it ruptures into the gastrointestinal tract, the general peritoneal cavity, or

Volume 6, Issue 2; March-April 2023; Page No 748-760

the vascular system [56, 57]. Rupture of the gastrointestinal system causes either no symptoms or melaena or hematemesis, which need immediate medical attention. Peritonitis and in rare cases, hemorrhagic shock arise from a rupture into the general peritoneal cavity. Surgical exploration is frequently necessary in an emergency. While internal drainage should always be sought, a thorough abdominal lavage and external drainage are usually all that can be safely accomplished.

3) Hemorrhage

A pseudocyst's course might be substantially complicated by hemorrhage [58]. Because it can emerge without notice and is frequently caused by erosion of a major vessel in the region of the pseudocyst, the morbidity and fatality rates are quite high. Both in detecting the site of bleeding and in embolization of the bleeding artery, interventional radiology can be quite useful [59]. Surgical exploration can be dangerous and difficult without previous knowledge of the bleeding site.

4) Infection

Infection can arise naturally or as a result of therapeutic or diagnostic procedures. While infected pseudocysts can be managed conservatively at first, the majority of patients will require surgery. Surgery has traditionally been the favoured treatment option, however endoscopic therapy is gaining popularity [48, 60]. When there are indications of gross sepsis and the patient is too unstable to undergo surgical or endoscopic drainage, an external drainage system may be required.

5) Biliary complications

Obstructive jaundice is caused by a big cyst in the pancreatic head area blocking the common bile duct, resulting in biliary complications [61, 62]. In this case, therapeutic endoscopy with short-term biliary stenting is beneficial. It can be kept until the pseudocyst clears out or is treated with intervention.

6) Portal hypertension

Portal hypertension can be caused by a cyst compressing or obstructing the splenic vein or portal vein alone or in combination with chronic pancreatitis [63]. Surgery appears to be the only therapy option in this circumstance, and a suitable surgical technique can effectively treat this kind of portal hypertension.

Conclusion

Pancreatic pseudocysts are the most frequent cystic lesions of the pancreas, accounting for 75 percent to 80 percent of such lesions. They are caused by acute or chronic pancreatitis. Abdominal discomfort, nausea, and vomiting are the most prevalent symptoms; however they can sometimes be asymptomatic. For first imaging, abdominal CT is best option. EUS is useful in distinguishing pseudocysts from other cystic lesions of the pancreas, and it can also help in transmural endoscopic drainage. Supportive care is the first line of treatment. Invasive intervention is required when symptoms persist and complications emerge. The surgical, percutaneous, and endoscopic techniques for pseudocyst drainage have not been directly compared in high-quality prospective randomised studies, and the recommended treatment differs depending on patient preferences and local competence. Endoscopic drainage has gained favour in recent years, with surgery reserved for patients who have failed endoscopic or percutaneous draining. In all circumstances, a customised therapeutic strategy should be explored, taking into account patient preferences and integrating a multidisciplinary team of therapeutic endoscopists, interventional radiologist, and pancreatic surgeons.

References

1. Bradley EL 3rd. A clinically based classification system for acute pancreatitis. Summary of the International Symposium on Acute Pancreatitis, Atlanta, Ga, September 11 through 13, 1992. Arch Surg. 1993;**128**:586–590.
2. Sanfey H, Aguilar M, Jones RS. Pseudocysts of the pancreas, a review of 97 cases. Am Surg. 1994;**60**:661–668.
3. Gumaste VV, Pitchumoni CS. Pancreatic pseudocyst. Gastroenterologist. 1996;**4**:33–43.
4. Boerma D, Obertop H, Gouma DJ. Pancreatic pseudocysts in chronic pancreatitis. Surgical or interventional drainage? Ann Ital Chir. 2000;**71**:43–50.
5. Pitchumoni CS, Agarwal N. Pancreatic pseudocysts. When and how should drainage be performed? Gastroenterol Clin North Am. 1999;**28**:615–639.

Volume 6, Issue 2; March-April 2023; Page No 748-760

6. Walt AJ, Bouwman DL, Weaver DW, Sachs RJ. The impact of technology on the management of pancreatic pseudocyst. Fifth annual Samuel Jason Mixter Lecture. Arch Surg. 1990;**125**:759–763.
7. D'Egidio A, Schein M. Pancreatic pseudocysts: a proposed classification and its management implications. Br J Surg. 1991;**78**:981–984.
8. Nealon WH, Walser E. Main pancreatic ductal anatomy can direct choice of modality for treating pancreatic pseudocysts (surgery versus percutaneous drainage) Ann Surg. 2002;**235**:751–758.
9. Sandy JT, Taylor RH, Christensen RM, Scudamore C, Leckie P. Pancreatic pseudocyst. Changing concepts in management. Am J Surg. 1981;**141**:574–576.
10. Wade JW. Twenty-five year experience with pancreatic pseudocysts. Are we making progress? Am J Surg. 1985;**149**:705–708.
11. Imrie CW, Buist LJ, Shearer MG. Importance of cause in the outcome of pancreatic pseudocysts. Am J Surg. 1988;**156**:159–162.
12. Maringhini A, Uomo G, Patti R, Rabitti P, Termini A, Cavallera A, Dardanoni G, Manes G, Ciambra M, Laccetti M, et al. Pseudocysts in acute nonalcoholic pancreatitis: incidence and natural history. Dig Dis Sci. 1999;**44**:1669–1673.
13. Kourtesis G, Wilson SE, Williams RA. The clinical significance of fluid collections in acute pancreatitis. Am Surg. 1990;**56**:796–799.
14. Ammann RW, Akovbiantz A, Largiader F, Schueler G. Course and outcome of chronic pancreatitis. Longitudinal study of a mixed medical-surgical series of 245 patients. Gastroenterology. 1984;**86**:820–828.
15. Grace PA, Williamson RC. Modern management of pancreatic pseudocysts. Br J Surg. 1993;**80**:573–581.
16. Zdanyte E, Strupas K, Bubnys A, Stratilatovas E. [Difficulties of differential diagnosis of pancreatic pseudocysts and cystic neoplasms] Medicina (Kaunas) 2004;**40**:1180–1188.
17. O'Malley VP, Cannon JP, Postier RG. Pancreatic pseudocysts: cause, therapy, and results. Am J Surg. 1985;**150**:680–682.
18. Gouyon P, Levy P, Ruszniewski P, Zins M, Hammel P, Vilgrain V, Sauvanet A, Belghiti J, Bernades P. Predictive factors in the outcome of pseudocysts complicating alcoholic chronic pancreatitis. Gut. 1997;**41**:821–825.
19. Pitchumoni CS, Agarwal N. Pancreatic pseudocysts. When and how should drainage be performed? Gastroenterol Clin North Am. 1999;**28**:615–639.
20. Siegelman SS, Copeland BE, Saba GP, Cameron JL, Sanders RC, Zerhouni EA. CT of fluid collections associated with pancreatitis. AJR Am J Roentgenol. 1980;**134**:1121–1132.
21. Morgan DE, Baron TH, Smith JK, Robbin ML, Kenney PJ. Pancreatic fluid collections prior to intervention: evaluation with MR imaging compared with CT and US. Radiology. 1997;**203**:773–778.
22. Nealon WH, Walser E. Surgical management of complications associated with percutaneous and/or endoscopic management of pseudocyst of the pancreas. Ann Surg. 2005;**241**:948–957; discussion 957-960.
23. Lewandrowski KB, Southern JF, Pins MR, Compton CC, Warshaw AL. Cyst fluid analysis in the differential diagnosis of pancreatic cysts. A comparison of pseudocysts, serous cystadenomas, mucinous cystic neoplasms, and mucinous cystadenocarcinoma. Ann Surg. 1993;**217**:41–47.
24. Linder JD, Geenen JE, Catalano MF. Cyst fluid analysis obtained by EUS-guided FNA in the evaluation of discrete cystic neoplasms of the pancreas: a prospective single-center experience. Gastrointest Endosc. 2006;**64**:697–702.
25. Sedlack R, Affi A, Vazquez-Sequeiros E, Norton ID, Clain JE, Wiersema MJ. Utility of EUS in the evaluation of cystic pancreatic lesions. Gastrointest Endosc. 2002;**56**:543–547.
26. Brugge WR, Lewandrowski K, Lee-Lewandrowski E, Centeno BA, Szydlo T, Regan S, del Castillo CF, Warshaw AL. Diagnosis of pancreatic cystic neoplasms: a report of the cooperative pancreatic cyst study. Gastroenterology. 2004;**126**:1330–1336.
27. Hammel P, Levy P, Voitot H, Levy M, Vilgrain V, Zins M, Flejou JF, Molas G, Ruszniewski P, Bernades P. Preoperative cyst fluid analysis is useful for the differential diagnosis of cystic lesions of the pancreas. Gastroenterology. 1995;**108**:1230–1235.

Volume 6, Issue 2; March-April 2023; Page No 748-760

28. Sperti C, Pasquali C, Guolo P, Polverosi R, Liessi G, Pedrazzoli S. Serum tumor markers and cyst fluid analysis are useful for the diagnosis of pancreatic cystic tumors. Cancer. 1996;**78**:237–243.
29. Khalid A, McGrath KM, Zahid M, Wilson M, Brody D, Swalsky P, Moser AJ, Lee KK, Slivka A, Whitcomb DC, et al. The role of pancreatic cyst fluid molecular analysis in predicting cyst pathology. Clin Gastroenterol Hepatol. 2005;**3**:967–973.
30. Gullo L, Barbara L. Treatment of pancreatic pseudocysts with octreotide. Lancet. 1991;**338**:540–541.
31. Suga H, Tsuruta O, Okabe Y, Saitoh F, Noda T, Yoshida H, Ono N, Kinoshita H, Toyonaga A, Sata M. A case of mediastinal pancreatic pseudocyst successfully treated with somatostatin analogue. Kurume Med J. 2005;**52**:161–164.
32. Vitas GJ, Sarr MG. Selected management of pancreatic pseudocysts: operative versus expectant management. Surgery. 1992;**111**:123–130.
33. Yeo CJ, Bastidas JA, Lynch-Nyhan A, Fishman EK, Zinner MJ, Cameron JL. The natural history of pancreatic pseudocysts documented by computed tomography. Surg Gynecol Obstet. 1990;**170**:411–417.
34. Cheruvu CV, Clarke MG, Prentice M, Eyre-Brook IA. Conservative treatment as an option in the management of pancreatic pseudocyst. Ann R Coll Surg Engl. 2003;**85**:313–316.
35. Andersson B, Nilsson E, Willner J, Andersson R. Treatment and outcome in pancreatic pseudocysts. Scand J Gastroenterol. 2006;**41**:751–756.
36. Gumaste VV, Pitchumoni CS. Pancreatic pseudocyst. Gastroenterologist. 1996;**4**:33–43.
37. Criado E, De Stefano AA, Weiner TM, Jaques PF. Long term results of percutaneous catheter drainage of pancreatic pseudocysts. Surg Gynecol Obstet. 1992;**175**:293–298.
38. Heider R, Meyer AA, Galanko JA, Behrns KE. Percutaneous drainage of pancreatic pseudocysts is associated with a higher failure rate than surgical treatment in unselected patients. Ann Surg. 1999;**229**:781–787; discussion 787-789.
39. Adams DB, Anderson MC. Percutaneous catheter drainage compared with internal drainage in the management of pancreatic pseudocyst. Ann Surg. 1992;**215**:571–576; discussion 576-578.
40. Weckman L, Kylanpaa ML, Puolakkainen P, Halttunen J. Endoscopic treatment of pancreatic pseudocysts. Surg Endosc. 2006;**20**:603–607.
41. Deviere J, Bueso H, Baize M, Azar C, Love J, Moreno E, Cremer M. Complete disruption of the main pancreatic duct: endoscopic management. Gastrointest Endosc. 1995;**42**:445–451.
42. Lo SK, Rowe A. Endoscopic management of pancreatic pseudocysts. Gastroenterologist. 1997;**5**:10–25.
43. Chak A. Endosonographic-guided therapy of pancreatic pseudocysts. Gastrointest Endosc. 2000;**52**:S23–S279.
44. Giovannini M, Bernardini D, Seitz JF. Cystogastrotomy entirely performed under endosonography guidance for pancreatic pseudocyst: results in six patients. Gastrointest Endosc. 1998;**48**:200–203.
45. Wiersema MJ, Baron TH, Chari ST. Endosonography-guided pseudocyst drainage with a new large-channel linear scanning echoendoscope. Gastrointest Endosc. 2001;**53**:811–813.
46. Norton ID, Clain JE, Wiersema MJ, DiMagno EP, Petersen BT, Gostout CJ. Utility of endoscopic ultrasonography in endoscopic drainage of pancreatic pseudocysts in selected patients. Mayo Clin Proc. 2001;**76**:794–798.
47. Libera ED, Siqueira ES, Morais M, Rohr MR, Brant CQ, Ardengh JC, Ferrari AP. Pancreatic pseudocysts transpapillary and transmural drainage. HPB Surg. 2000;**11**:333–338.
48. Giovannini M, Pesenti C, Rolland AL, Moutardier V, Delpero JR. Endoscopic ultrasound-guided drainage of pancreatic pseudocysts or pancreatic abscesses using a therapeutic echo endoscope. Endoscopy. 2001;**33**:473–477.
49. Fuchs M, Reimann FM, Gaebel C, Ludwig D, Stange EF. Treatment of infected pancreatic pseudocysts by endoscopic ultrasonography-guided cystogastrostomy. Endoscopy. 2000;**32**:654–657.
50. Hookey LC, Debroux S, Delhaye M, Arvanitakis M, Le Moine O, Deviere J. Endoscopic drainage of pancreatic-fluid collections in 116 patients: a

Volume 6, Issue 2; March-April 2023; Page No 748-760

comparison of etiologies, drainage techniques, and outcomes. Gastrointest Endosc. 2006;**63**:635–643.
51. Muscatiello N, Pietrini L, Gentile M, Tonti P, Ricciardelli C, Sorrentini I, Ierardi E. Endoscopic ultrasound-guided ethanol lavage of a pancreatic fluid collection. Endoscopy. 2006;**38**:951.
52. Lee LS, Saltzman JR, Bounds BC, Poneros JM, Brugge WR, Thompson CC. EUS-guided fine needle aspiration of pancreatic cysts: a retrospective analysis of complications and their predictors. Clin Gastroenterol Hepatol. 2005;**3**:231–236.
53. Banerjee S, Shen B, Baron TH, Nelson DB, Anderson MA, Cash BD, Dominitz JA, Gan SI, Harrison ME, Ikenberry SO, et al. Antibiotic prophylaxis for GI endoscopy. Gastrointest Endosc. 2008;**67**:791–798.
54. Cahen D, Rauws E, Fockens P, Weverling G, Huibregtse K, Bruno M. Endoscopic drainage of pancreatic pseudocysts: long-term outcome and procedural factors associated with safe and successful treatment. Endoscopy. 2005;**37**:977–983.
55. Sitzmann JV, Imbembo AL. Splenic complications of a pancreatic pseudocyst. Am J Surg. 1984;**147**:191–196.
56. Yamamoto T, Hayakawa K, Kawakami S, Nishimura K, Katsuma Y, Hayashi N, Maeda M, Ishii Y. Rupture of a pancreatic pseudocyst into the portal venous system. Abdom Imaging. 1999;**24**:494–496.
57. Lesur G, Bernades P. [Pseudocysts of the pancreas. Diagnosis, course and principles of treatment] Presse Med. 1996;**25**:939–943.
58. Ungania S, Panocchia N. [Splenic artery rupture in pancreatic pseudocyst] Ann Ital Chir. 2000;**71**:251–255.
59. Gambiez LP, Ernst OJ, Merlier OA, Porte HL, Chambon JP, Quandalle PA. Arterial embolization for bleeding pseudocysts complicating chronic pancreatitis. Arch Surg. 1997;**132**:1016–1021.
60. Boerma D, van Gulik TM, Obertop H, Gouma DJ. Internal drainage of infected pancreatic pseudocysts: safe or sorry? Dig Surg. 1999;**16**:501–505.
61. Noda T, Ueno N, Tamada K, Ichiyama M, Fukuda M, Tomiyama T, Nishizono T, Tano S, Aizawa T, Iwao T. A case of chronic pancreatitis with pseudocysts complicated by infection and obstructive jaundice. Am J Gastroenterol. 1994;**89**:2066–2069.
62. Maema A, Kubota K, Bandai Y, Makuuchi M. Proximal bile duct stricture caused by a pancreatic pseudocyst: intra-operative placement of a metallic stent. Hepatogastroenterology. 1999;**46**:2020–2023.
63. Bernades P, Baetz A, Levy P, Belghiti J, Menu Y, Fekete F. Splenic and portal venous obstruction in chronic pancreatitis. A prospective longitudinal study of a medical-surgical series of 266 patients. Dig Dis Sci. 1992;**37**:340–346.

Volume 6, Issue 2; March-April 2023; Page No 748-760