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Management of Fluid Collection in Acute Pancreatitis

Georg Beyer[1], Simon Sirtl[1], Christoph Ammer-Herrmenau[2], and Albrecht Neesse[2]

[1]*Department of Medicine II, LMU University Hospital, Ludwig-Maximilians-University, Munich, Germany*
[2]*Department of Gastroenterology, Gastrointestinal Oncology and Endocrinology, University Medical Center Göttingen, Gottingen, Germany*

Introduction

Acute pancreatitis is the most common cause for hospitalization in gastroenterology and has an incidence of 13–45/100,000 with regional variations [1,2]. Alcohol and gallstones are the main risk factors (30–50%) with alcohol as an etiology being more common in men [3].

Considering the variety of different courses of pancreatitis, ranging from mild abdominal pain to death, it is important to predict the likely severity of the disease early in the clinical course.

The current definition of acute pancreatitis, the grades of severity (mild, moderately severe, and severe), and the detailed description of the systemic and local complications based on the revised Atlanta classification from 2012 [4] are discussed in Chapter 20.

Definitions

The way acute fluid collections are classified depends on the time frame of their development as well as some morphological imaging features. The acute (peri-)pancreatic fluid collection (APFC) is a typical complication of the interstitial and edematous subtype and often develops during the first 7 days of pancreatitis. It has no wall and a homogenous internal structure. The spread of an APFC is orientated along the fascial anatomy. Occasionally, APFC are found in multiple locations and they tend to regress spontaneously. If an APFC persists for longer than 4 weeks there is a high probability that a pseudocyst or walled-off pancreatic necrosis (WOPN) will develop.

A pseudocyst is defined as a fluid-filled space, similar to a neoplastic cyst, with a fibrotic wall. In contrast to neoplastic cysts, pseudocysts have no internal epithelial cell lining. Pseudocysts are considered merely complications of chronic pancreatitis and occasionally of acute pancreatitis. Following the latter they evolve from APFC usually later than 4 weeks after the onset of symptoms. The treatment strategies of pancreatic pseudocysts are described in Chapter 3.23.

Regions of nonvital tissue damaged by hemorrhage extravasated pancreatic juice or immune cells are defined as necrosis. It represents a form of tissue injury resulting in premature nonapoptotic cell death. The morphological characteristics of necrosis caused by acute pancreatitis are highly variable. The necrotic tissue may appear as a (semi)solid or fluid structure on imaging, although the sensitivity for detecting the solid component varies greatly between computed tomography (CT), magnetic resonance imaging (MRI), and endoscopic ultrasound (EUS) [5].

An acute necrotic collection (ANC) arises within the first 4 weeks of the disease in the pancreatic parenchyma as well as the extrapancreatic tissue. It contains varying amounts of fluid or solid material. The solid parts are the crucial feature to distinguish an ANC from an APFC or a pseudocyst [4] as illustrated in Fig. 35.1.

If a necrotic area is enclosed by a radiologically distinguishable capsule it is called walled-off pancreatic necrosis (WOPN). The difference between WOPN and a pseudocyst is the presence of variable amounts of solid content in the cystic cavity. Usually it arises from an ANC later than 4 weeks from the onset of pancreatitis. Contrast-enhanced MRI and EUS are best suited to distinguish solid from liquid contents, but in most cases contrast-enhanced multiphase CT or even contrast-enhanced ultrasound will enable the diagnosis to be made [3,5].

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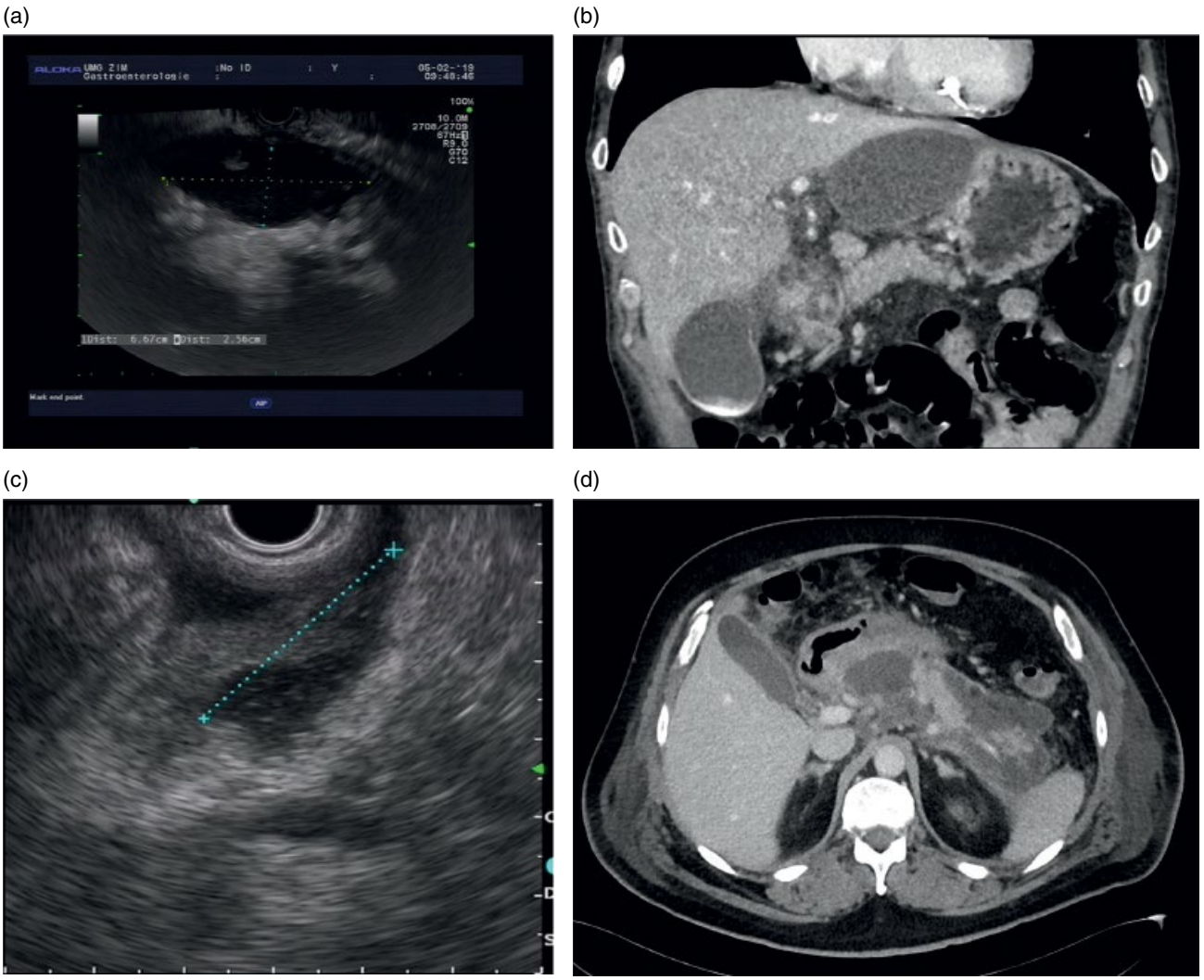

Figure 35.1 Examples for the occurrence of acute pancreatic fluid collections (APFC), post-acute pancreatic pseudocysts (PP), acute necrotic collection (ANC), and walled-off pancreatic necrosis (WOPN) on imaging. The upper panels depict an APFC on EUS (a), which later developed into a large, but oligo-symptomatic pseudocyst (b), demonstrated on a CT scan. The reader will appreciate the absence of solid debris within the collection. In contrast, the lower panel shows an ANC on EUS (c), which matured to a WOPN. On both images, the solid content is clearly visible. The CT scan (d) was obtained prior to percutaneous drainage of the collection, which was necessary due to infection.

An originally sterile necrosis can maintain its status or become infected over the course of the disease. The diagnosis of infected necrosis is based on the patient's clinical presentation and the presence of gas in the necrotic cavity on radiological imaging. It is of note that an asymptomatic fistula from the necrotic cavern to the gastrointestinal tract also leads to the presence of gas within the necrosis but can be without any signs of infection. Fine-needle aspiration followed by microbiological analysis of the content can confirm the presence of infected necrosis but is not needed in most cases and has a high false negative rate. Moreover, microorganisms isolated from the blood of patients with the clinical presentation of an infection or signs of an infected necrosis on imaging are of greater relevance for choosing appropriate antibiosis than those isolated from cultured content of the necrotic cavity. Other than the extent, there are currently no features by which to predict whether necrosis will persist or regress over weeks and months.

Imaging of Acute Fluid Collections

Transabdominal Ultrasound

Transabdominal ultrasound is an inexpensive, immediately available technique to allow a first imaging impression of a patient with an acute abdomen. The imaging of the pancreatic gland is often impaired by abdominal pain and an atonic gut. Edematous pancreas is characterized

by an inhomogeneous, hypoechoic structure with poorly defined boundaries [6]. The pancreatic main duct is often not visualized inside the edema. Necrotic and hemorrhagic tissue appears more hypoechoic than the inflamed parenchyma. The echo contrast gain or use of ultrasound contrast agent permits a somewhat better distinction between vital or nonperfused tissue. For the detection of small amounts of free fluids in the abdominal or pleural cavity ultrasound remains the undisputed gold standard. The presence of ascites or the mostly left-sided pleural effusions are predictors for a more severe course of acute pancreatitis. Another domain of sonography is the fast and reliable imaging of the gallbladder and, if present, gallstones, which can confirm or rule out a biliary pathogenesis and detection of pleural effusions, which indicate poor prognosis [7]. In expert hands, transabdominal ultrasound with optional contrast enhancement is equally accurate as CT in detecting necrosis, vascular involvement, and severity grading [8–12].

Computed Tomography Endoscopic Ultrasound, and Magnetic Resonance Imaging

Contrast-enhanced CT scan is the fastest and most accurate method for the differential diagnosis of an acute abdomen. At hospital admission CT scan is not recommended for patients with clinical confirmed acute pancreatitis unless other differential diagnosis cannot be ruled out. Imaging via CT should not be performed to assess the severity of pancreatitis on admission [13], because the extent of necrosis can still evolve until up to 72 hours after the disease onset. Therefore, a CT scan should be delayed, if required at all, for 4 days after symptom onset [3,14].

Contrast-enhanced CT can confirm the size, shape, and volume of fluid collections or necrosis and is a valuable tool to identify extrapancreatic complications including hemorrhage or pseudoaneurysms.

Two alternative methods are EUS and MRI. Despite having cost and procedural disadvantages, both methods are more sensitive in detecting solid content within a fluid collection and thus in distinguishing between plain fluid collections and pseudocysts on the one hand and areas of necrosis and WOPN on the other [5]. For more details Chapters 25 and 3.23 are recommended.

Conservative Treatment of Pancreatitis and Pancreatic Fluid Collections

Basic Support

All patients with acute pancreatitis should be monitored regularly within the first 48 hours after admission [3,15]. Important parameters include:

- heart frequency, 6-lead ECG, blood pressure, respiratory rate and oxygen saturation (to detect circulatory respiratory failure and shock);
- blood gas analysis (in case of oxygenation <90%) (to detect respiratory failure) and lactic acidosis;
- hourly urinary excretion measurements for the management of fluid resuscitation (for fluid management and to detect renal failure);
- abdominal pressure measurement via bladder pressure measurement (to detect compartment syndrome) if clinically suspected;
- blood electrolytes;
- blood glucose levels (to detect endocrine failure).

Fluid and Electrolyte Management

Due to retroperitoneal edema and increased vessel permeability a massive fluid shift is typical for acute pancreatitis leading to APFC. Fluid resuscitation is currently the most important intervention for reducing incidence of necrosis and patient mortality [16]. Mortality can increase to 61% if less than 3.5 L of fluid are transfused in the first day. An increase of blood urea nitrogen (BUN) of 5 mg/dL within 48 hours is a sign of prerenal kidney failure and increases mortality by a factor of 2.2 [17,18]. The recommended amount of fluid is 5–10 mL/kg body weight/h or 200–250 ml/h for the first day of treatment [16], or even less, as shown by a recent randomized trial comparing aggressive to moderate fluid resuscitation, which was stopped due to increased rate of fluid overload in the aggressive treatment arm (20.5% vs. 6.3%, p=.004) [33]. Greater therapeutic fluid volumes lead to a mortality increase partially due to abdominal compartment syndrome (intra-abdominal pressure >20 mmHg), sepsis, or a prolonged stay in the intensive care unit [19]. The monitoring of fluid resuscitation should use either invasive thermodilution techniques or, if unavailable, the following parameters:

- heart frequency <120 bpm;
- mean arterial pressure between 65 and 85 mmHg;
- urinary excretion >0.5–1 mL/kg per hour;
- hematocrit between 35 and 45%.

Another important point is the composition of administered fluid. Crystalline solutions are superior to colloids. Colloidal infusions are suspected of being associated with a higher incidence of renal insufficiency and should be avoided. The advantage of Ringer's solution is its similar composition to blood as well as the nonimpairment of electroneutrality by compensating the anion gap with lactate or acetate. Moreover, the incidence of systemic inflammatory response syndrome (SIRS) is reduced within the first 24 hours if Ringer's solution is used rather than saline [20].

Nutrition

Complete fasting has no positive influence on the outcome and course of pancreatitis [21]. In fact, fasting leads to atrophy of gut villi resulting in a more rapid translocation of intraluminal bacteria, facilitating the infection of necrotic areas. Starting enteral nutrition early is recommended [22]. If the patients are not able to take oral food, feeding by tube is the most effective method. Nasogastric and nasojejunal tubes have been shown to be equally effective and safe [23], although nasojejunal feeding tubes tend to dislocate more often. The best and most natural form of nutrition remains eating by mouth. Once patients are pain-free (with pain medication if required) and can tolerate food they should take oral food. If not enteral nutrition is less expensive and more physiologic than parenteral nutrition. Starting enteral nutrition immediately after admission was not found to lead to better outcomes than withholding food for 72 hours [24]. The current approach to nutrition has become much more pragmatic than in the past when all patients were put on nil-by-mouth for long periods. There is no role for a specific pancreatitis diet.

Antibiotics

Prophylactic application of antibiotics is not necessary for patients with acute pancreatitis, regardless of its predicted severity, and could contribute to the rise of multiresistant bacteria. Neither the mortality nor the rate of infected necrosis is positively influenced by prophylactic antibiotics [17]. Conversely, if infected necrosis is suspected, antibiotic therapy must be initialized immediately. Antibiotics with appropriate pancreatic tissue levels are carbapenems, fluorochinolones, or metronidazole. If the response to the administered antibiotics is insufficient, fine-needle aspiration followed by microbiological testing allows switching to antibiotics based on resistograms. In patients with sepsis other infectious foci must be considered, such as peritonitis, cholangitis, or pneumonia. In general, microbes sampled from blood cultures of pancreatitis are often more informative than those from necrotic fluid collection because of the high rate of false negatives among the latter.

Management of Edematous Fluid Collections

An APFC tends to regress spontaneously. If it persists longer than 4 weeks under conservative treatment it may develop into a pseudocyst or WOPN. Simple intra- or extrapancreatic fluid collections, the focus of this chapter, generally do not require interventional treatment unless they give rise to compartment syndrome as characterized by fluid overload and elevated urinary bladder pressure. An abdominal compartment syndrome is defined as an increased abdominal pressure (>20 mmHg) for longer than 12 hours and simultaneous organ failure [25].

Minimally Invasive Treatment of Acute Fluid Collections in Acute Pancreatitis

When conservative management is unsuccessful, minimally invasive treatment is recommended. The following sections give an overview about the different modalities.

Imaging-Guided Percutaneous Drainage

This is a technically easy and well-established method to treat pseudocysts or fluid collections. Ultrasound, CT, or MRI can be used for imaging. Although single-step needle aspiration is associated with a high relapse rate, continuous catheter-drainage systems are recommended based on their high success rate (70–100%) and a low recurrence rate[26,27]. The risk of fistula formation must be considered.

Endoscopic Drainage

This method provides a minimally invasive access for draining a pseudocyst. Transpapillary and transmural approaches from the stomach or duodenum are available. The aim is to create an artificial connection between the cyst cavity and the gastrointestinal tract. For pseudocysts communicating with the pancreatic main or branch duct transpapillary techniques are to be considered [28]. However, the superiority of transpapillary vs. transmural drainage in these cases has not been established. A larger retrospective study including 375 patients from the USA with different types of PFC compared the treatment success after transmural treatment alone with combined transmural and transpapillary access with no difference in long-term resolution (69% vs. 62%; $P = 0.61$). The presence of duct disruption was not routinely investigated [29]. Therefore, a step-wise diagnostic approach with duct assessment via MRI for cases with suspected duct disruption might be more promising [30].

In the authors' view endoscopic transmural drainage is recommended for cysts that do not communicate with the pancreatic ductal system. Based on a better visualization of vessels EUS-guided drainage is associated with a lower complication rate than the endoscopic technique without EUS visualization and the latter should be abandoned [3,14,31].

For the treatment of pseudocysts with a location distant to gastric lumen and with a thick fibrotic capsule a laparoscopic approach should be favored. In Chapter 3.23 the strategies for surgical and endoscopic interventions for pancreatic pseudocysts, infected necrosis, and WOPN are outlined and discussed in detail.

Conclusion

Fluid collections that arise in the context of acute pancreatitis generally regress under conservative treatment and do not require interventional treatment in most cases. They may require endoscopic or surgical treatment when they fulfil the morphological criteria of infected (walled-off) necrosis, when they represent complication-causing or complication-prone pseudocysts, or when they precipitate abdominal compartment syndrome. As supported by the results of the Dutch POINTER trial, an initial conservative approach is justifiable: 104 patients with infected pancreatic necrosis occurring within 35 days from onset of symptoms were randomized to either receive immediate percutaneous or endoscopic drainage or a delayed approach with antibiotic treatment first and escalation to drainage and necrosectomy if clinically needed. There was no difference with regard to complications, organ failure, or death. Patients in the delayed treatment arm had considerably fewer invasive procedures and were less often taken to necrosectomy. Notably, 39% of patients in the delayed treatment arm did not require any invasive procedures at all [32].

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