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Interventional Radiology for Necrotizing Pancreatitis

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Abstract Necrotic pancreatitis is a complex clinical entity that requires collaboration of care from surgeons, gastroenterologists, and interventional radiologists. CT scans play a pivotal role in the diagnosis of pancreatic necrosis, while image-guided percutaneous pancreatic drainage is a safe and effective treatment method in certain cases. The diagnostic criteria for pancreatic necrosis, indications for pancreatic drainage, technique, and efficacy are discussed in this article.

Keywords Pancreatic necrosis · Pancreatitis · Percutaneous catheter drainage · Interventional radiology

Introduction

Acute pancreatitis has a wide spectrum of presentations that ranges from self-limited to life-threatening diseases. The possible complications of acute pancreatitis are many and include fluid collections as a frequent manifestation.[1] These fluid collections also have a wide range of presentations and include the so-called acute peri-pancreatic fluid collections, pseudocysts (sterile or infected), abscesses, and pancreatic necrosis (sterile or infected).[2] The latter category will be the main focus of this manuscript.

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Diagnostic Criteria

Several clinical and radiologic scoring systems exist to diagnose acute pancreatitis.[3–7] Balthazar et al.[5] developed the first widely used CT severity index model that stratified pancreatitis by degree of inflammation and necrosis. Other authors later modified this grading scheme by simplifying it and including an assessment of extrapancreatic complications. These authors stated that the modified CT severity index correlated more closely with patient outcome measures than the previous model.[7] Intravenous contrast administration is essential to diagnose necrotizing pancreatitis using CT criteria. Normal pancreatic parenchyma measures 40–50 Hounsfield units (HU) on unenhanced CT and increases to 80–90 on enhanced CT. If the HUs are below 80, and especially if <50 HU, pancreatic necrosis or another type of collection should be suspected.[8]

Necrotic pancreatic fluid collections can be sterile or infected. The imaging appearance can be identical, however. Occasionally, retroperitoneal or lesser sac gas is detected, suggesting infection, although necrosis without infection may appear as gas on CT also. At times, a dissociation exists between the CT appearance and the patient's status. Obviously, the patient's clinical appearance and discussion with the referring clinician takes precedence over imaging findings in deciding what actions should be undertaken. It is essential for radiologists performing interventional radiology procedures to evaluate patients clinically.

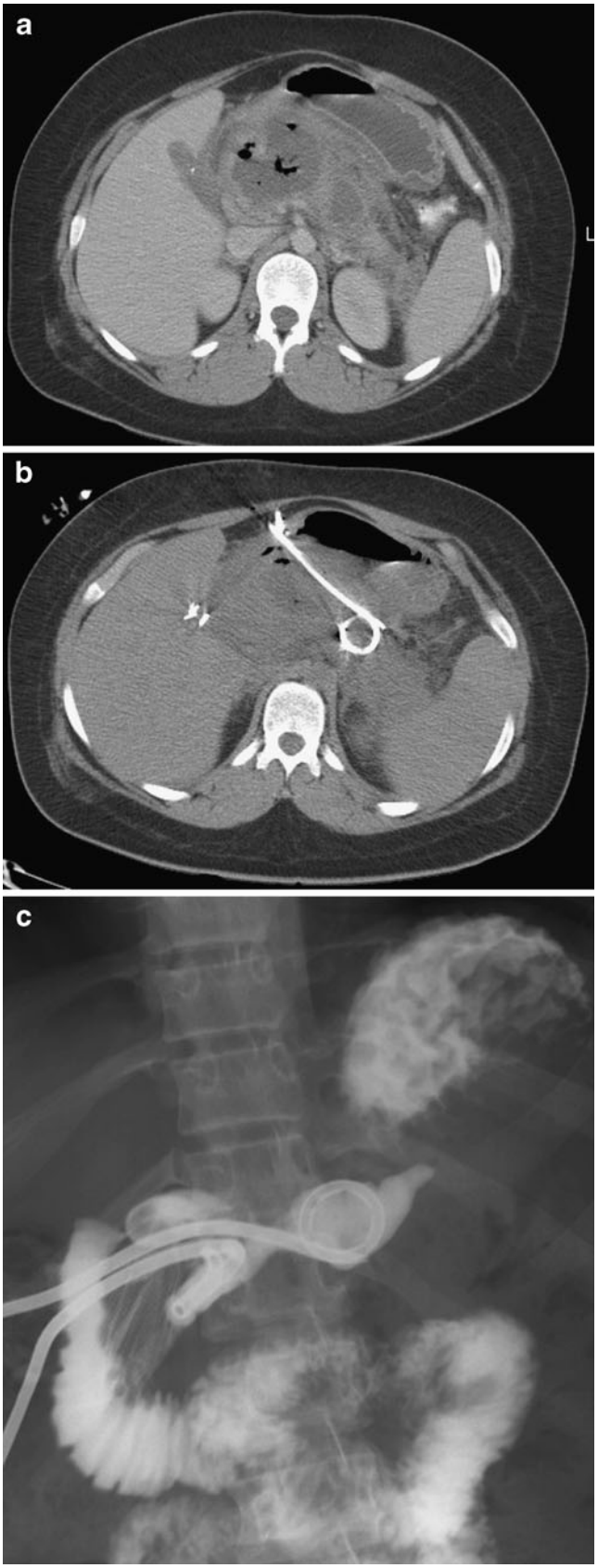

Fig. 1 **a–c** Successful percutaneous drainage of complex pancreatic necrosis from gallstone pancreatitis: **a** Axial CT scan demonstrates multiple necrotic collections with gas (Balthazar grade E). **b** Axial CT scan shows one of three large-bore percutaneous drains into one necrotic collection. **c** Catheter sinogram reveals multiple percutaneous catheters in the now decompressed collections, but with spontaneous communication to the duodenum. After 1 month of drainage of these infected collections, the patient was cured

Indications for Percutaneous Drainage

The decision for percutaneous drainage of necrotic pancreatic fluid collections is based on numerous factors: the patient's clinical status, prior surgery or interventions, sterile vs. infected necrotic fluid collection, degree of liquefaction, and other comorbidities such as multisystem organ failure. Close cooperation and communication between surgeons, gastroenterologists, and interventional radiologists are essential.

Percutaneous drainage alone for sterile necrosis, or combined with antibiotics for infected necrosis, can be curative. Catheter drainage also may be a temporizing measure prior to surgery[9], or, conversely, a follow-up procedure to "clean up" after surgery. The two disciplines and procedures commonly are complementary to manage pancreatic necrosis. Contraindications to percutaneous drainage consist of solid necrosis, active bleeding, uncorrectable coagulopathy, phlegmonous tissue, pseudoaneurysm, and an uncooperative patient.

Technique

US or CT can be used to guide percutaneous drainage. However, CT is utilized far more due to its superior resolution and spatial detail, particularly with respect to surrounding structures that should be avoided (Fig. 1a). The routes for catheter drainage are numerous, but a direct approach is preferred if possible, attempting to avoid bowel or solid organs. The catheter should be positioned so that the largest number of side holes lies in the most dependent part of the fluid collection (Fig. 1b). The number of percutaneous drainage catheters depends on the number of fluid collections; ideally, there should be one catheter for each major necrotic fluid collection. Since pancreatic necrosis often contains both liquefied and solid components, large-bore catheters (20–30 F) may be required.

After the catheter has been placed, daily monitoring of output is routinely performed, as well as frequent irrigation with saline to ensure patency of the catheter and aggressive cleansing of the cavity or cavities. Furthermore, daily Interventional Radiology ward rounds are essential to evaluate the patient's status, the efficacy of the drainage, catheter wound sites, and laboratory parameters. Follow-up imaging can be done to evaluate drainage response (Fig. 1c). If there is a lack of clinical improvement, poor

drainage output, or the presence of persistent fluid collections on imaging, additional catheters or manipulations are done. Commonly, these additional maneuvers will be crucial to the effectiveness of percutaneous drainage. Conversely, inadequate follow-up by radiologists may sabotage a potentially successful outcome.

Lastly, percutaneous necrosectomy can also be performed if large solid pieces of necrotic material impede catheter drainage. Techniques that have been implemented for percutaneous necrosectomy include percutaneous baskets, snares, or forceps to remove debris through large (up to 30 F) tracts,[10–13] similar to what interventional radiologists and urologists use for percutaneous stone management in the kidneys.[14]

Results

Several studies have discussed the effectiveness of percutaneous catheter drainage for pancreatic necrosis.[8,10,11,15–17] In an early study of 34 patients, 47% were cured with percutaneous catheter drainage alone, while sepsis was controlled in 74%.[10] Another study reported a comparable overall success rate (49%) in 35 patients, with similar success rates between percutaneous drainage of sterile (50%) and infected (46%) necrotizing pancreatic collections.[17] In a study of 20 patients, a 100% success rate was reported using large-bore catheters with large side holes coupled with suction catheters, stone baskets, and lavage fluid for debris removal.[11] Catheters can remain for weeks to months, but as patients improve, follow-up can be done on an outpatient basis in Interventional Radiology clinics. Catheter removal occurs when the patient is clinically well and there is no drainage or recurrence of collections.

Spontaneous communication with the gastrointestinal tract occurs infrequently, but serves as another egress route for the pancreatic collection; despite the spontaneous communication, percutaneous drainage typically is successful. Pancreatic collections including necrosis can obstruct the bile ducts, pancreatic duct, or gastrointestinal tract; these types of obstructions can be indications for another interventional radiologic, endoscopic, or surgical procedure. Complications, albeit infrequent, can include bleeding, sepsis, or perforation.

Conclusions

Percutaneous catheter drainage is an effective and safe treatment method for necrotizing pancreatitis. It serves either as curative treatment in itself or complementary to surgery (either before or after an operation). Lastly, careful catheter care and close cooperation among surgeons, gastroenterologists, and interventional radiologists is *sine qua non* to ensure effective treatment of pancreatic necrosis.

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