

Advances in the classification and treatment of peripancreatic fluid collection

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Abstract: Peripancreatic fluid collection is one of the major complications of acute and chronic pancreatitis, and its cause and duration are the main influences on the clinical manifestations and imaging features of the disease, as well as the key to the choice of treatment options at a later stage. Based on the 2012 Atlanta Classification of Acute Pancreatitis, peripancreatic fluid collections are categorized into four types: acute peripancreatic fluid collections, acute necrotizing collections, pancreatic pseudocysts, and walled-off necrosis. The treatment options for peripancreatic fluid collection are close to its classification, such as the differences in treatment methods for different types, and the same type still requiring the combination of the patient's imaging characteristics and individual circumstances to opt for different treatment methods. Therefore, the purpose of this article is to review the imaging features, method of diagnosis and treatment options of various types of peripancreatic fluid collection.

1. Introduction

Peripancreatic fluid collection (PFC) is one of the most common complications of pancreatic diseases. It is mostly secondary to acute and chronic pancreatitis^[1], a few secondary to pancreatic trauma and pancreatic surgery, and a very small number of pancreatic tumors^[2]. The main causes are self-digestion, hemorrhage, necrosis and liquefaction of pancreatic parenchyma, as well as congenital or acquired rupture and cold resistance of the main pancreatic duct and its branches, resulting in poor drainage of pancreatic juice. According to Atlanta 2012, pancreatic complications can be categorized into four types^[3]: acute peripancreatic fluid collection (APFC), acute necrotic collection (ANC), pancreatic pseudocyst (PPC), and pancreatic pseudocyst (PPC), pancreatic pseudocyst (PPC) and walled-off necrosis (WON). Among them, APFC and ANC usually occur in the early period of interstitial edematous pancreatitis or necrotizing pancreatitis, which can be spontaneously dissolved and absorbed without intervention when asymptomatic, and require intervention if combined with bleeding, infection and other corresponding complications, both PPC and WON are as encapsulated effusions formed 4 weeks after the onset of acute pancreatitis^[4] and PPC is enriched with a high amount of amylase, while WON contains necrotic material in pancreas

or peripancreas, which are cystic solid structures with clearly defined inflammatory envelopes.

2. The imaging characteristics of PPC

Currently, the diagnosis of PPC mainly relies on imaging methods, such as ultrasound, computed tomography (CT), magnetic resonance imaging (MRI), or endoscopic ultrasound (EUS) to verify the diagnosis, and partial diagnosis can be made on the basis of pathologic methods in some surgical patients. Ultrasound: its advantages are mainly cheap, convenient, non-invasive and with the higher sensitivity and specificity, and it is the first choice of clinical diagnosis for screening and reexamination^[5], but its disadvantages are mainly susceptible to the influence of intestinal gases. EUS: It is a diagnostic as well as therapeutic technique, which can observe the effusion more clearly, understand the relationship between PPC and the surrounding organs, and be helpful for the follow-up treatment^[6]. The advantage is that for the mature cyst wall. X-ray: X-ray is mainly for the localization examination of PPC and WON, which can see the compression and displacement of the cyst on the surrounding tissues. CT: Compared to ultrasonography, it can conveniently observe the size and shape of the fluid collection, the maturity of the wall of the cyst, the thickness of the wall of the cyst, and the content of the cyst, and it is helpful for the diagnosis of the development of the condition and for the formulation of the next step of the diagnosis^[7]. MRI: Can help to distinguish PPC from pancreatic cystic tumor. Magnetic resonance cholangio pancreatography (MRCP) can display the morphological characteristics of pancreas and bile ducts better. In diagnosis, MRCP can replace endoscopic retrograde cholangio pancreatography (ERCP). ERCP: Usually, it is not used as a routine examination to diagnose PPC, but it can understand the anatomical relationship between the bile ducts, pancreatic ducts and the cysts. However, this method is invasive and may aggravate pancreatitis^[8], but treatment such as stenting is feasible when necessary.

3. Typing of PPC

APFC and ANC are the early stages of PFC, which have not been further studied by experts at domestic and international level due to the fact that the surrounding oozing fluid and necrotic material have not yet formed an encapsulation. At present, in the classification of PFC, PPC is mainly further classified according to its imaging characteristics and clinical manifestations, to be used as a guide for clinical treatment. D'Egidio et al^[9] classified PPC into 3 types according to the underlying disease of cyst formation and pancreatic ductal anatomy: Type I: Post-acute pancreatitis type: main pancreatic duct is structurally normal, and there is no traffic of cysts and pancreatic ducts; Type II: Post-acute episode of chronic pancreatitis type, main pancreatic duct chronic inflammatory changes but no stenosis, with a cyst in communication with the main pancreatic duct: Type III : chronic pancreatitis retention type is characterized by a stenosis of the main pancreatic duct, and the cyst is in communication with the main pancreatic duct. Nealon et al^[10] subdivided PPC into seven types based on D'Egidio's typing ,Type I: pancreatic duct structure is normal, and there is no communication with the cyst; Type II: pancreatic duct structure is normal, and there is a communication with the cyst; Type III : pancreatic duct stenosis ;Type IV: pancreatic duct stenosis, and cyst traffic; Type V pancreatic duct completely blocked; Type VI: chronic pancreatitis, pancreatic duct and cyst no communication; Type VII chronic pancreatitis, pancreatic duct and cyst traffic want to pass); Sichuan University West China Hospital Pan G et al^[11] who designed a new classification based on the size, anatomical location, clinical manifestations, and along the anatomical relationship between the pseudocysts and pancreatic ducts of the pancreas pseudocysts. A new classification was devised with a total of five types, Type I: <5 cm without complications, symptoms and cyst formation; Type II: suspected cystic tumor; Type III: pancreatic pseudocysts located in the leptomeninges, divided into Type IIIa and Type IIIb, Type IIIa: pseudocysts

communicating with pancreatic ducts, Type IIIb: pseudocysts having no traffic with the pancreatic ducts; Type IV: pancreatic pseudocysts located in the head, neck and body, divided into Types IVa, IVb, and IVc. Type IVa: the pseudocyst has traffic with the pancreatic duct, Type IVb: the distance of the cyst to the gastrointestinal wall is <1cm, Type IVc: neither; Type V: the location of the pancreatic pseudocyst is at the tail, divided into Type Va and Type Vb, Type Va: splenic vein involvement or upper gastrointestinal hemorrhage, Type Vb: the distance of the cyst from the gastrointestinal wall is <1cm, there is no splenic vein involvement or upper gastrointestinal hemorrhage.

4. Treatment programs for PFC

4.1 APFC and ANC Treatment Program

APFC and ANC usually appear in the early stages of pancreatitis (typically ≤ 4 weeks), are not solid, are located primarily in or near the pancreas, and lack fibrous tissue encasement, and are distinguished from each other primarily by the fact that APFC is a simple sterile peripancreatic exudate, free of infected and necrotic tissue, whereas ANC is primarily caused by necrotizing pancreatitis (pancreatic parenchyma and/or peripancreatic tissues) and may be infected. necrosis) caused by contains necrotic tissue of the pancreas and may be infected. In the first week of acute pancreatitis, APFC and ANC show non-enhancing areas on imaging features, and there is difficulty in differentiating between the two; if non-enhancing areas of varying attenuation are found in the effusion, it should be considered peripancreatic necrosis with a non-liquefying component (hemorrhage, fat, and/or necrotic fat). It has been suggested that ANC may be associated with rupture of the main pancreatic duct at the site of parenchymal necrosis, and that both have a certain chance of spontaneous dissolution and resorption, with no need for intervention when asymptomatic, and appropriate treatment when the appropriate symptoms develop^[12]. Türkvan A et al^[13], in interpreting the complications of pancreatic pancreatitis in the Atlanta pancreas in conjunction with the relevant imaging nodes, suggested that APFC is mainly a result of early pancreatic exudation and pancreatic enzyme aggregation, with the main collection mostly occurring in the vicinity of the pancreas. It occurs in approximately 30%-50% of patients with acute pancreatitis within the first 48 hours^[7] APFC is most often collected in the lesser sac but is also seen in the pararenal anterior hiatus (most commonly on the left side), the transverse mesocolon, mesenteric roots, and the gastrohepatic, gastrosplenic, and gastrocolic ligaments. Most APFC remain sterile and resolve spontaneously in 50% of patients within 2-4 weeks. When the APFC does not resolve, it evolves into a pseudocyst after about 4 weeks or more, Dong Wook Lee et al^[14] in a BISAP score study in moderate to severe pancreatitis complications showed that spontaneous regression of the APFC was more common in patients with moderate pancreatitis, in which if the BISAP score was elevated, the CRP level was elevated after 48 h, and abdominal pain was not improved APFC has a high likelihood of converting to pseudocysts or WON.

4.2 Treatment programs for PPC

PPC is defined as pancreatic exudate exudation in the peripancreatic or (and) pancreatic body, composed of granulation and proliferation of fibrous tissue, etc. by the cyst wall wrapped and formed by the cysts of clear boundaries and lack of epithelial tissue, basically does not contain necrotic, infected, and other solid material, measured by its cystic fluid biochemistry, amylase activity is significantly increased. ppc, if not properly handled in the treatment of the pancreas, can lead to infected pancreatic necrosis (IPN)^[15]. Therefore, guidelines and consensus related to the diagnosis and treatment of acute pancreatitis at home and abroad have paid close attention to the

classification and treatment principles of PPC. Currently, the treatment methods for PPC include conservative treatment, endoscopic treatment (internal drainage), surgical drainage (open or laparoscopic), and percutaneous puncture tube drainage. For clinicians, the timing of PPC is important. Chronic PPC can be prepared for surgery as soon as the cyst wall is mature. However, in acute PPC, delayed surgery is more effective because of the immaturity of the cystic wall, and premature surgical treatment may lead to inaccurate suturing and anastomotic rupture after surgery. Relevant studies^[16,17] have pointed out that surgical treatment is feasible only after the cystic wall has matured after 4-6 weeks. In most patients, the PPC is usually absorbed and becomes smaller within 1-6 months. If the PPC does not shrink after a long period of observation, or if the cyst is >6 cm and continues to grow larger and cause complications such as rupture, bleeding, obstruction, or if malignancy is suspected, different treatments can be adopted according to the specific conditions. In recent years, with the rapid development of gastrointestinal endoscopy, pancreatic surgery, imaging intervention and other diagnostic and therapeutic techniques, especially the increasing update of EUS technology, and the clinical application of new cyst drainage stents under the guidance of EUS^[18], the treatment of pancreatic pseudocysts is gradually developing in the direction of individualization, minimally invasive, and multidisciplinary cooperation, and there are more choices of treatment modalities for PFC.

Conservative treatment: which is mainly based on its clinical characteristics, imaging and laboratory examination, a treatment means using drugs, its indications for stable, no clinical manifestations and cyst diameter <6cm, by the relevant imaging results of the duration <6 weeks feasible conservative treatment, according to the relevant research reports^[19,20,21], the majority of patients with pancreatic pseudocysts can be treated conservatively by their own. The majority of patients with pancreatic pseudocysts can reduce or subside spontaneously after conservative treatment. A small number of cysts may gradually decrease or subside within 6 weeks to 1 year, during which time they need to be closely followed up with ultrasound or CT, and different interventions are needed according to different types of cysts if clinical manifestations or corresponding complications occur and the condition worsens. Conservative treatment includes fasting, gastrointestinal decompression, inhibition of pancreatic enzyme secretion, anti-infection, rehydration, and parenteral and intestinal nutritional support.

External drainage: Due to the extensive development of interventional therapy, the surgery for the purpose of pure external drainage has been basically abandoned, mainly applicable to the failure of percutaneous perforation and drainage of pseudocysts secondary to infection, the poor effect of conservative treatment after rupture of the cysts, and the immaturity of the cyst wall in cases prepared for endodrainage and forced to drain externally, etc., and the external drainage will cause a large amount of pancreatic fluid loss, resulting in electrolyte disorders.

Endoscopic treatment: With the maturity and development of endoscopic technology, endoscopic drainage is regarded as the first-line treatment for pancreatic pseudocysts because it has the advantages of less trauma, quicker recovery, less cost, shorter hospitalization, and has the same characteristics of safety and therapeutic effectiveness as surgery. The main purpose of endoscopic treatment of PPC is to establish an effective drainage channel between the cyst and the gastrointestinal tract to drain the cystic fluid out of the digestive tract, thus reducing the cyst's pressure on the surrounding tissues and itself, and its own inflammatory reaction, so that the cyst can get sufficient rest and accelerate its recovery. Cui Ming et al.^[22] pointed out that the thickness of the cyst wall should be 0.3-1.0 cm, the distance between the cyst wall and the digestive tract should be less than 1 cm, and cystic tumors and pseudoaneurysms should be excluded before puncture to avoid hemorrhage caused by endoscopic puncture. The main endoscopic treatment is cyst-jejunum Roux-en-Y anastomosis. Its location choice is more flexible, cystic fluid drainage is better, and it also reduces postoperative complications^[23], and endoscopic drainage of cysts through the gastric or

duodenal wall is feasible if obvious external compressive bulges can be seen in the lumen of the stomach or duodenum endoscopically^[11]. Sakue Masuda et al^[24] concluded that endoscopic drainage of cysts was not recommended for the management of patients with pancreatic pseudocyst-porta-ventricular fistula (PPVF) complications. Endoscopic ultrasound -cyst drainage (EUS-CD) is an equally good therapeutic option in the treatment of patients with PPVF with portal vein obstruction. In a meta-analysis, Farias et al^[25] concluded that endoscopic treatment of pancreatic pseudocysts did not show significant advantages over surgical treatment in terms of surgical and endoscopic success rates, postoperative adverse effects, and recurrence rates; however, when compared with the length of hospitalization, hospitalization costs, trauma size, recovery speed, drainage adequacy, and avoidance of pancreatic leakage, endoscopic treatment has a very good long-term cure rate, and it has been used as a primary treatment option for pancreatic pseudocysts.

EUS: EUS is mainly a kind of technology for digestive tract examination based on endoscopic technology by combining ultrasound probe with endoscopic technology. In the treatment of PPC, EUS, compared with endoscopic drainage alone, can clearly indicate the location and size of the pancreatic pseudocyst, and also clearly show the relationship between the cyst and the gastric wall, thus avoiding large blood vessels and determining the optimal site for incision and drainage, and ultrasound endoscopy thus effectively guides the surgical operation. In addition, if there is no bulge, ultrasonic endoscopic technique can also evaluate the PFC content and volume and the distance between the PFC and the cystic lumen, which allows PPC to successfully perform endoscopic transgastroduodenal wall cyst drainage for PPCs that are not pressurized with bulging changes in the gastroduodenal lumen^[26]. Nabi Z et al^[27] pointed out that the EUS-guided drainage is important for the thickness of the cystic wall in the treatment of PPC, neighboring organs, important blood vessels around the drainage incision, and necrotic material and exudate in the cyst with high accuracy, good clinical efficacy, comparable to surgical or percutaneous perforation routes, lower complication rate and cost, and the unique advantage of minimally invasive.

Surgical drainage: Surgical drainage is mainly a treatment modality adopted by laparoscopic or open surgery PPC, at present, the main surgical modalities are cyst-gastric anastomosis, cyst-jejunum Roux-en-Y anastomosis, and cyst-duodenal anastomosis, the surgical modalities are quite similar, but only in the operator's surgical operation is different, Galketiya KB et al^[28] summarized the advantages and disadvantages of laparoscopic drainage in their study, ① laparoscopic surgery compared to open surgery requires the operator to have a more skillful, fine cavity operation techniques, the operator's technical requirements are relatively high, but it can significantly reduce the time spent on opening and closing the abdomen and reduce the role of intraoperative anesthesia to combat the study reported that there is little difference between the two in terms of the length of the operation; ② laparoscopic surgery has a clearer field of vision, the abdominal cavity, adhesion separation and microscopic ultrasonography. Laparoscopic surgery has the advantages of clearer vision, separation of adhesions and microscopic ultrasonic knife can directly dissect the small blood vessel branches, and less bleeding; ③ laparoscopic surgery has a smaller incision, the chance of incisional infection is reduced compared with open surgery, and intraoperative stimulation of the body is smaller, the patient's postoperative pain is lighter, the gastrointestinal function recovers faster, which helps the patient to ventilate and eat as soon as possible, and at the same time shortens the hospitalization time after surgery. With the development of laparoscopic technology, open laparotomy is mainly an alternative surgical program to laparoscopy.

Percutaneous catheter drainage (PCD): PCD is the insertion of a catheter percutaneously into the cavity of a pseudocyst under CT or ultrasound guidance for the purpose of achieving extracystic drainage, and the retroperitoneal approach is used in clinical practice. Cui Ming et al^[22] pointed out that PCD has the advantages of being less invasive, relatively simple to operate, capable of placing

multiple drains simultaneously for drainage and rapidly improving the patient's condition. The disadvantages of percutaneous percutaneous drainage include high risk of infection, high impact on patients' quality of life, relatively high risk of drain blockage, and the need for reoperation due to long-lasting pancreatic fistulae and sinus - jejunum anastomosis in some patients. Relevant studies have shown that its long-term patency rate is 50% [29], and intracapsular hemorrhage and pancreatic peritoneal effusion are contraindications to percutaneous catheterization and drainage. Under different circumstances, PCD is an effective treatment modality for the treatment of PPC, which does not require surgery in about 63% of patients and has a low complication rate.

Endoscopic combined laparoscopic surgery: Endoscopic combined with laparoscopic surgery has obvious advantages over simple laparoscopic or open surgery. Relevant research reports^[30] have pointed out that the combined treatment of duodenoscopy and laparoscopy has shown that the combined surgical plan is used to treat severe acute pancreatitis with pancreatic pseudocyst. The operation time, intraoperative blood loss, hospitalization time, and incidence of postoperative complications in the double-mirror group were significantly lower than those in the open group. The abdominal pain relief time, exhaust time, and surgical effect were better, and the postoperative complications were less, which could effectively improve the clinical symptoms of patients.

Endoscopic retrograde cholangio pancreatography-endoscopic ultrasound (ERCP-EUS) combined treatment: ERCP-EUS combined treatment. The advantage is that a single anesthesia as well as can reduce the harm caused by the second anesthesia, improve the diagnosis and treatment of the target, reduce the unnecessary operation and cost, this method is mainly applicable to the traffic pancreatic pseudocysts with pancreatic duct communication.

4.3 Treatment options for WON

Pancreatic encapsulated necrosis, like pancreatic pseudocyst, is a typical late complication of acute pancreatitis, and drainage is required when there are symptoms of infection. At present, endoscopic ultrasound-guided drainage for the treatment of pancreatic pseudocysts has become common and has produced good therapeutic effects. However, encapsulated necrosis contains necrotic tissue, so many cases also require invasive treatment, including endoscopic necrosectomy. Relevant research reports have described methods involving surgical designated large-diameter metal stents and endoscopic assisted drainage techniques or endoscopic resection and percutaneous drainage, and the results of these methods vary from person to person. In a randomized controlled trial by Garg PK et al^[31], 60 patients with WON were randomly assigned to the endoscopic group and the laparoscopic group. It was concluded that endoscopy and laparoscopic techniques have similar effects on patients with 30 % WON. Therefore, the choice of WON surgery should depend on the doctor 's existing professional knowledge, the hospital 's existing medical conditions and the patient 's choice of treatment.

5. Prospects

The current measures for the treatment of PFC are diversified, but no matter which treatment method is used, there are advantages and disadvantages, which should be combined with the relevant imaging results, strictly grasp the indications, and then select the appropriate treatment according to the specific patients and specific conditions. However, individualized treatment for different patients and the selection of the best treatment plan by different diagnostic and treatment centers are still controversial and need further clinical validation.

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