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Interventional and Surgical Treatment of Pancreatic Abscess

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Abstract. Pancreatic abscess is one of the infectious complications of acute pancreatitis. It is a collection principally containing pus, but it may also contain variable amounts of semisolid necrotic debris. Most of these abscesses evolve from the progressive liquefaction of necrotic pancreatic and peripancreatic tissues, but some arise from infection of peripancreatic fluid or collections elsewhere in the peritoneal cavity. Included also are abscesses found after surgical débridement and drainage of pancreatic necrosis. Although open surgical treatment of infected necrosis is the established treatment of choice, percutaneous drainage of abscesses is successful in some circumstances. We used percutaneous catheter drainage in 39 patients during 1987–1995. Only 9 of 29 (31%) attempts at primary therapy were successful; 2 patients died, and 18 required subsequent surgical drainage. On the other hand, 14 of 14 patients with recurrent or residual abscesses after surgical drainage were successfully drained percutaneously. Percutaneous catheter drainage of pancreatic abscesses may be useful for initial stabilization of septic patients, drainage of further abscesses after surgical intervention (especially when access for reoperation will be difficult), associated abscesses remote from the pancreas, and selected unilocular collections at a sufficient interval after necrotizing pancreatitis to have allowed essentially complete liquefaction.

Approximately 45,000 cases of acute pancreatitis are diagnosed in the United States every year [1]. In most cases the disease is relatively mild and resolves without major sequelae. Complications develop in about 25% of patients, and 9% die from these complications. Previous studies have demonstrated that improvements in early fluid management and respiratory intensive care have markedly diminished the numbers of patients dying from shock and multiple organ failure early during the fulminant phase of acute pancreatitis. Only 20% of deaths occur within the first few days, and now most of the remaining lethality (3000 patients per year in the United States) occurs later in the course of the disease from infectious complications [2, 3]. Thus secondary pancreatic infection has currently emerged as the most important determinant for morbidity and mortality from acute pancreatitis [3]. The diagnosis and optimal treatment of infectious complications after acute pancreatitis represents the central challenge in achieving further reductions of overall mortality from acute pancreatitis.

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Pathogenesis of Pancreatic Abscess

Infection of the pancreas occurs in 5% to 9% of patients with acute pancreatitis [4–9]. Several investigators have found a relation between the incidence of pancreatic infection and the severity of the disease, as reflected by the number of Ranson's criteria [7, 8] and the APACHE II score [10, 11], both of which are believed to reflect the extent of pancreatic tissue injury. Similarly, clinical [12] and experimental [13] studies have confirmed a positive correlation between the risk of pancreatic infection in acute pancreatitis and the amount of tissue necrosis, which is believed to serve as a bacterial culture medium. In the past, most secondary infections of the pancreas associated with acute pancreatitis were indiscriminately termed pancreatic abscess. However, it has become apparent that *infected pseudocyst*, *infected necrosis*, and *abscess* are different aspects of secondary pancreatic infection that vary in their associated morbidity and mortality; and precise differentiation between these forms is crucial for the formulation of a treatment plan [14]. The recently developed Atlanta classification [15] attempts to clarify the terms commonly used to describe the infectious complications of acute pancreatitis. This system defines pancreatic abscess as a collection of purulent peripancreatic material contained within a more-or-less defined fibrous tissue wall and differentiates it from necrotic or semiliquefied pancreatic or peripancreatic tissue with positive microbial cultures (infected necrosis) and from an encapsulated collection of pancreatic juice from which bacteria can be grown (infected pseudocyst).

Pancreatic abscess is diagnosed in 1% to 30% of all patients with clinical acute pancreatitis [7–9, 14, 16, 17] but occurs in up to 50% to 70% of patients with severe necrotizing disease [18]. The higher prevalence associated with necrotizing pancreatitis probably represents a consequence of more severe tissue destruction [12, 19], greater intestinal permeability to bacteria [20], and an increased rate of infection of the necrotic tissue [12, 13, 21]. Abscesses probably all begin as infected necrosis. In patients who survive and who do not precipitate earlier débridement and drainage because of the severity of their clinical manifestations, progressive liquefaction of the infected necrotic tissues causes evolution to a predominantly or completely liquid collection of pus and pancreatic secretions, a pancreatic abscess. Abscesses are

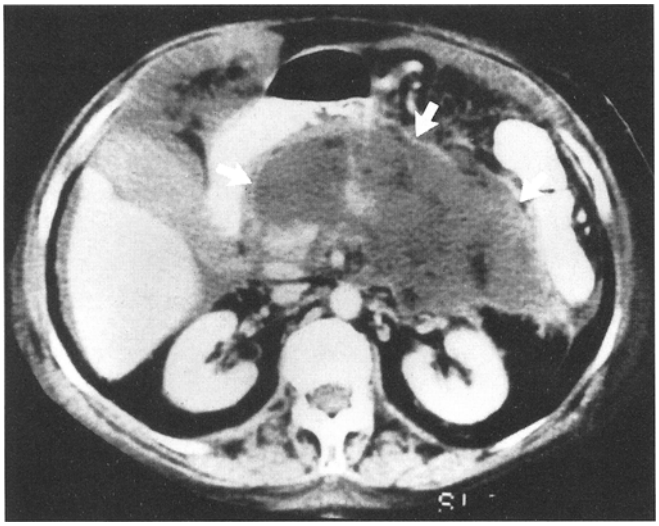

Fig. 1. CT image obtained from a patient with severe pancreatitis and pancreatic necrosis. This contrast-enhanced CT scan demonstrates an extensive area of pancreatic and peripancreatic necrosis (arrows). Low density areas from the collection represent fat enveloped by the inflammatory process.

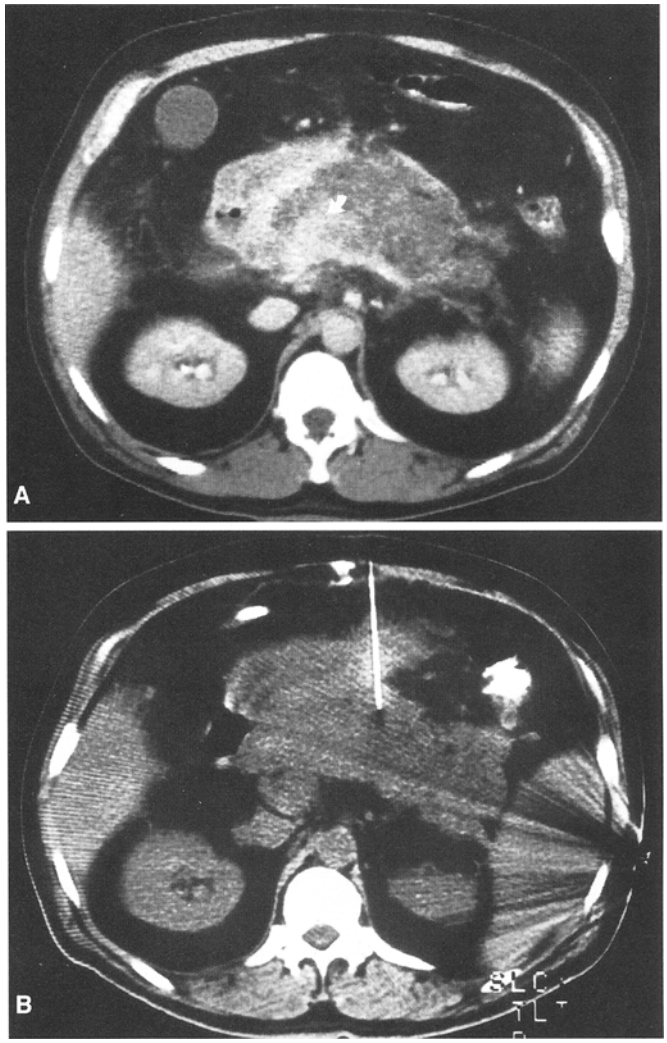

Fig. 2. Use of CT guidance to aspirate an area of pancreatic necrosis for bacteriologic stain and culture. **A.** Contrast-enhanced CT demonstrates an area of pancreatic necrosis. Note the area of normally enhanced pancreas surrounded by nonenhancing necrotic tissues (arrow). **B.** A 20-gauge needle was inserted under CT guidance. Bacteria were demonstrated in the thick purulent material by both Gram stain and culture. Surgical débridement and drainage followed.

most likely to have formed after the second week or even weeks later than that, whereas infected necrosis is usually identified within 1 to 3 weeks [9, 12, 14]. Both infected necrosis and abscesses usually contain one or more enteric organisms (or *Candida* if prior antibiotic therapy has been instituted) [4]. The activated proteases, vasoactive substances, and inflammatory mediators found in the abscess probably facilitate their extension into the peripancreatic tissue and progression in retroperitoneal spaces. The proclivity for extension and the eventual remoteness from the originating infected necrosis further distinguishes pancreatic abscess as an entity. This factor, as well as any residual nonliquid necrotic tissues, makes their therapy more difficult than that for other abdominal abscesses.

Diagnosis

The first step toward appropriate treatment of pancreatic abscess is early, accurate diagnosis. Delayed diagnosis has been identified as a major factor resulting in poor outcome and mortality [22]. Because its clinical presentation may be variable or even obscure, pancreatic infection should be considered in any patient who is still febrile or becomes so 2 weeks or more after an attack of acute pancreatitis, even if other symptoms are absent [4]. In addition to fever, pancreatic abscess may present with abdominal pain, nausea and vomiting, tenderness, a palpable mass (in 50% of cases), leukocytosis, and occasional hyperamylasemia [23]. Chest roentgenograms show sympathetic pleural effusions, atelectasis, or an elevated hemidiaphragm in 50% while also providing important information about any pulmonary origin of the fever [23]. Blood cultures can help to distinguish abscesses from sterile pseudocysts and provide guidance for selection of antibiotics but unfortunately are positive in only a few cases. Imaging techniques are the gold standard for diagnosis of pancreatic abscess. Both ultrasonography and computed tomography (CT) can be helpful with the detection and localization of pancreatic abscesses, which may extend from the pancreas anywhere into the retroperitoneum, mesentery, mediastinum, and even the neck or genitalia [24–27]. Multiple abscesses occur in about 30% to 39% of cases [23]. Good bowel opacification with oral contrast is essential to differentiate abdominal fluid collections from loops of bowel during CT examination. Ultrasonography in this setting suffers from severe handicaps in that gaseous distension, which is often present because of the ileus in acute pancreatitis, greatly limits the applicability in these patients. Overall, CT represents the most useful technique for diagnosing pancreatic abscesses and for distinguishing them from other infectious complications. CT can demonstrate changes in the entire abdomen and pelvis, including regions in which ultrasonographic visualization may be difficult [24–26]. In a study of 45 patients with pancreatic abscess following acute pancreatitis, CT had a sensitivity of 74% (Fig. 1), compared with 35% for ultrasonography [9]. Because CT cannot distinguish sterile inflammation from infection, fine-needle aspiration of the

fluid collection under aseptic conditions has become the procedure of choice for verification of bacterial infection (Fig. 2). This simple procedure has a sensitivity of 90% to 100% [11, 27] and a low complication rate, including iatrogenic infection of a sterile collection introduced by the needle passage. Fine-needle aspiration has deservedly become an indispensable aid for the early diagnosis of infectious complications and for avoiding unnecessary laparotomy in many patients. It is not necessary in all cases (i.e., those who are clearly septic and unequivocally in need of drainage or, conversely, those who are clinically well and on the road to recovery), but it is invaluable for clarifying the treatment requirements of patients who have significant signs of inflammation that could be consistent with either infected collections or with sterile inflammation and early pseudocysts.

Treatment

Surgical Drainage

Despite isolated reports of spontaneous internal drainage of pancreatic abscesses [28], there is a now a consensus that pancreatic infections do not resolve spontaneously and that only early intervention can prevent inevitable death [23]. Certainly, whenever pancreatic infection has been demonstrated by CT and fine needle aspiration, drainage is considered mandatory. Early studies reported a mortality of 50% to 70% after surgery for pancreatic abscess [8, 17, 23]. More recently, improved means for diagnosis and more aggressive surgical approaches have produced better outcomes [9, 22, 23]. Owing to the differences in the infectious complications and the variable location of the abscesses, various surgical approaches have been proposed. Retroperitoneal laparotomy [29], subtotal resection and packing [30], synchronous anterior celiotomy and posterior drainage [31], and even prophylactic pancreatectomy [32, 33] have been suggested with more-or-less limited acceptance. There is now consensus that the important elements of the primary surgical intervention should include a wide, thorough exploration of the abdomen, complete unroofing of pancreatic abscesses, and aggressive and complete débridement of the pancreatic, peripancreatic, and retroperitoneal necrosis [10].

Various techniques have been described for postoperative drainage and management of the wound. Probably the most common at present is the method of open drainage and packing of the wound with scheduled reexplorations [22, 34, 35]. This approach is based on the perceived inability to eliminate the infected necrotic tissues at the first débridement and the tendency of the necrotizing process to evolve and spread beyond the limits of the area of the primary surgical débridement. After the initial débridement, the cavities are packed with nonadherent, moist dressings; and the abdominal wall is loosely adapted with heavy nylon retention sutures [34] or with a prosthetic patch and zipper technique [36]. Planned reexplorations are then carried out every 2 to 3 days with further débridement of any newly developed necrosis until the wound is clean, stable, and granulating. After a while the reexplorations and dressing changes can in some cases be accomplished in the intensive care unit (ICU) under sedation, rather than under anesthesia in the operating room. The overall mortality of this technique has been 16% in a multicenter study of 300 patients [35] and ranges from 9% to 22% [34, 37, 38]. The main drawbacks are the side effects of the frequent anesthesia, the high incidence of intestinal fistulas (up to 20% of cases [38]), and the 15% incidence of incisional hernias due to secondary healing of the open wound [34].

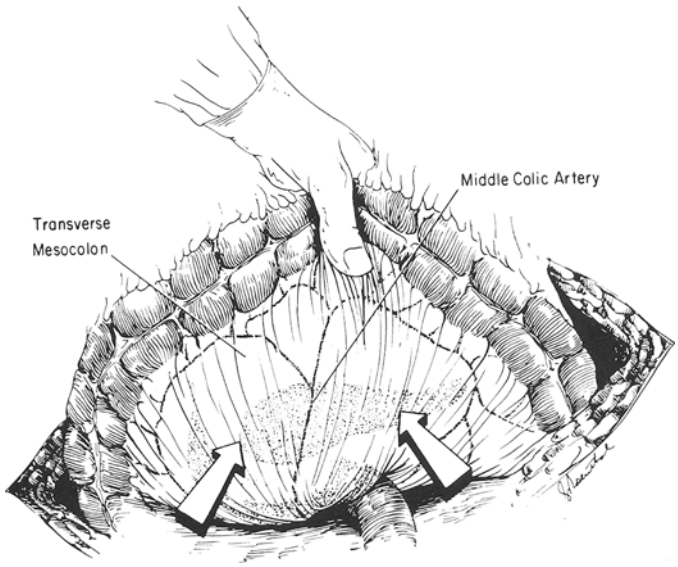

Fig. 3. Transmesocolic approach for débridement of pancreatic necrosis and drainage of infected collections.

Beger et al. [39] proposed the "semiclosed technique" of lesser sac lavage with large volumes (up to 20 liters per day). This concept combines the principle of aggressive initial débridement with a washing out of the peripancreatic collections of bacteria, bacterial toxins, activated pancreatic proteases, kinins, and other injurious agents that accumulate after the initial débridement, the aggressive nature of which may contribute to further pancreatic and peripancreatic necrosis. In addition to facilitating egress of newly developing necrotic slough, the lavage helps to prevent pancreatic abscesses from reforming in the irrigated area. The results of this approach are excellent and have been associated with a mortality of 8% to 29% [39–42]. The major shortcoming of this technique, however, is its limitation to the lesser sac. Therefore if the necrotic process extends beyond the confines of an anatomic compartment, which occurs in one-third of all cases, this technique may be difficult to apply.

The traditional approach of closed drainage has been frequently used with excellent outcome at our institution [9, 10]. As with the other techniques, this approach emphasizes initial complete exploration of the whole abdominal cavity and retroperitoneum with thorough digital débridement of devitalized tissue and unroofing of abscesses. The transmesocolic approach (Fig. 3) has proved especially simple and useful. Multiple gauze-stuffed soft rubber (Penrose) drains are used to pack the cavities, and soft silicone rubber (Jackson-Pratt) suction drains are left in the cavities to evacuate any fluid collection or continuing pancreatic secretions. Suction drains alone may be used when the abscess consists solely of a well formed cavity without necrotic tissue. Primary closure of the abdominal wall incision has been successful with a subsequent wound infection rate of 5%; it also minimizes the risk of an incisional hernia. Drains are left in place for at least 1 week with stepwise removal. Using this technique, further treatment for recurrent abscess was necessary in only 26% [10] compared to the 50% described in other studies [8, 37, 43, 44]. In

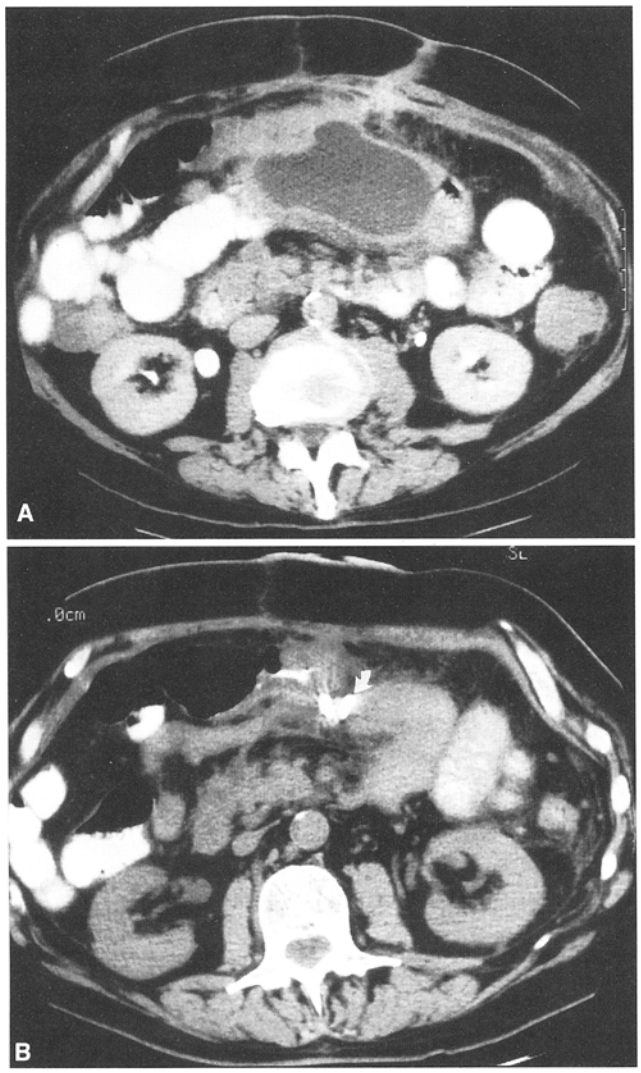

Fig. 4. Successful percutaneous drainage of a pancreatic abscess that formed after surgical débridement of infected pancreatic necrosis. **A.** CT examination demonstrates a unilocular fluid collection in the mesentery. Aspiration yielded infected pus. **B.** CT examination 1 week after catheter placement demonstrates the catheter to be coiled in the area of the previously noted collection. There is no residual abscess. The patient was clinically well, and the catheter was removed.

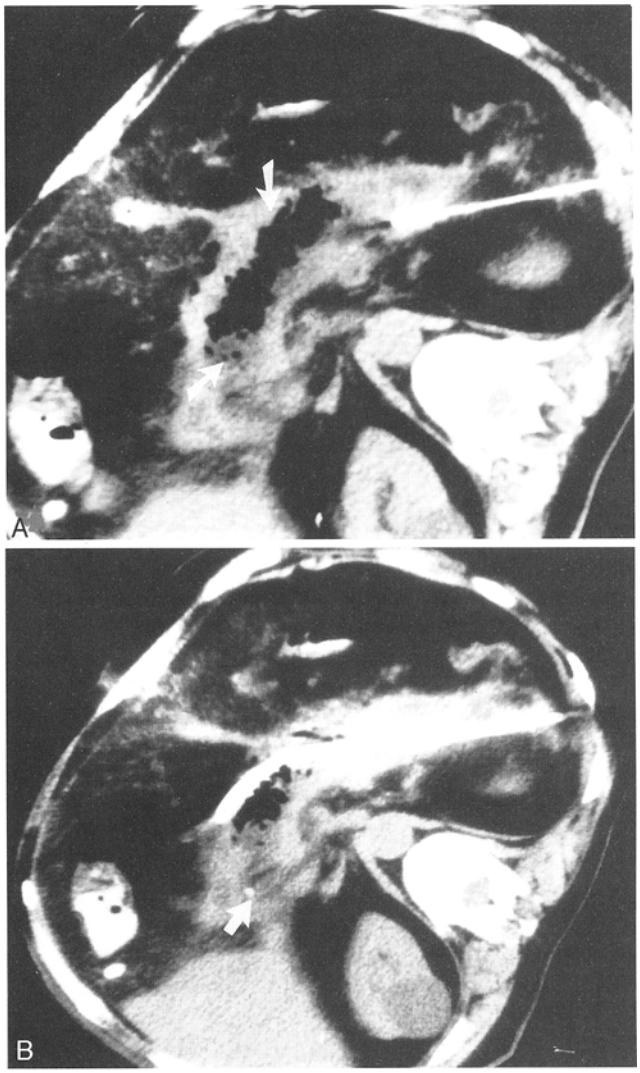

Fig. 5. Failure of percutaneous drainage in a patient with infected pancreatic necrosis. **A.** CT examination demonstrates an enlarged pancreas with a substantial amount of gas and low density areas representing necrosis (arrows). Aspiration via a 20-gauge needle yielded purulent material. **B.** A 14F catheter was placed through the pararenal space into the collection. Approximately 50 cc of purulent material was removed, but a substantial volume of semisolid debris remained. The patient continued to be febrile and toxic and was operated on for débridement 2 days after catheter placement.

15% of patients reexploration with minimal débridement was required, whereas in 7% recurrent abscesses could be successfully drained through percutaneous catheters. The thoroughness of the initial débridement is the most important factor affecting survival and the need for reexploration [10]. In our experience, mortality rates as low as 5% for pancreatic abscesses can be obtained with this technique. Potential complications include pancreatic fistulas in about 20%, most of which close spontaneously.

Percutaneous Catheter Drainage

With the significant mortality associated with the operative drainage of pancreatic abscess in earlier studies [8, 17, 23] and with remarkable advances in the methodology of percutaneous drainage of abdominal abscesses [45, 46], transcutaneous drainage of pancreatic abscesses has been proposed as an alternative, less invasive therapeutic approach for the primary treatment of pancreatic abscess. Early reports demonstrated a success rate of up to 79% [45–49] and have suggested that this technique could largely replace surgical operations as the method of choice for initial treatment of pancreatic abscesses (Fig. 4). However, many of these favorable reports included only a few cases [45–48] of pancreatic abscess, used only a carefully selected patient subgroup with unilocular abscess formation, or included patients with infected pseudocysts in their analyses. It is now known that pancreatic abscesses are multilocular in up to 40% of cases [23]

Table 1. Percutaneous therapy of pancreatic abscess at Massachusetts General Hospital (1987–1995).

Therapy	No.
Total	39
Primary percutaneous	
Drainage	29
Successful	9 (31%)
Deaths	2 (7%)
Postsurgical percutaneous	
Drainage	14
Successful	14 (100%)

and that infected pseudocysts are a different clinical entity, the percutaneous drainage of which is easier, safer, and more likely to be successful [50, 51]. Following the initial enthusiasm for percutaneous drainage, subsequent larger studies in which the distinction between infected pseudocysts and pancreatic abscesses was more sharply drawn found effective drainage of pancreatic abscess in only 14% of cases (Fig. 5) [52]. These studies, which still did not clearly distinguish between pancreatic abscess and infected necrosis, have generated a continuing controversy over the role of interventional treatment as primary therapy for pancreatic abscess.

At our institution percutaneous drainage of pancreatic abscess following acute pancreatitis was investigated in 39 patients between 1987 and 1995 (Table 1). In this patient population only 31% of patients (9 of 29) were successfully treated with percutaneous drainage alone as the primary therapy. Two patients died subsequent to percutaneous drainage before surgical therapy could be initiated. The other 18 required surgical exploration and débridement despite percutaneous drainage. In contrast, recurrent abscesses after surgical débridement and drainage or residual abscesses were treated by percutaneous drainage in 14 patients, and all were successful. Several other studies have also shown that many patients with pancreatic abscess undergoing primary percutaneous drainage do not improve but progress to multiorgan failure and death if subsequent surgical drainage is not performed [10, 52–54]. It is likely that the principal reason for failure of percutaneous drainage is that the associated necrotic tissues and solid debris, unlike the pus, cannot egress through the relatively small catheters. There is thus only temporary relief of the sepsis, and "pus under pressure" recurs.

Percutaneous management of pancreatic abscesses may pose technical challenges, requiring placement of multiple catheters and repeated manipulations over long drainage intervals. The interventional radiologist must be astute, adept, and dedicated. In a review from this hospital, Lee et al. [55] described 30 patients with complicated pancreatic necrosis treated by catheter drainage. Eighty-one catheters were placed in 59 collections. They found that up to 10 catheters (average 3) were required per patient, and repositioning was frequently necessary (average 3 per patient). The average duration of catheter drainage was 5 weeks, and each patient underwent an average of eight CT scans. Catheters are usually placed under CT control for deep collections or complicated anatomic locations such as the lesser sac, but ultrasonographic guidance may suffice for more superficially located abscesses. At our institution an initial aspiration is performed for Gram staining and to confirm that the collection contains drainable fluid. A 12F or 14F double-lumen sump or single-lumen 12F to 16F catheter can be placed by trocar of Seldinger technique to avoid transgression of enteric structures. Double-lumen sump catheters are preferred over single-lumen catheters because of their significantly higher drainage efficacy and better long-term patency. The abscess is aspirated as completely as possible, irrigated repeatedly, and then reimaged to rule out further undrained locules that require additional catheterization. Gravity drainage is equally as effective as continuous suction [54]. Periodic irrigation of the catheters is continued to obviate occlusion by debris. However, if the drainage catheters repeatedly become blocked, larger catheters (24F or 30F) can be placed, or intracavitary instillation of urokinase is useful [56]. Although intracavitary antibiotics have been unrewarding, Gerzof et al. [45] proposed the use of intravenous antibiotics in conjunction with the drainage procedure following culture of the aspirate. Catheters are usually left in place until cessation of drainage (<10 ml/day). Radiologic examination and clinical status (temperature, white blood cell count) are used to monitor the control and resolution of the abscess.

Complications

The most frequent and lethal complications after open or closed drainage are hemorrhage and recurrent or unrelenting sepsis. Perioperative or postoperative hemorrhage usually results from release of the tamponade effect on necrotic or eroded vessels, but trauma from the drains may be responsible. Arteriographic localization and embolization successfully controls the bleeding vessel in some cases [57], but surgical exposure and ligation with packing are likely to be required. Recurrent or residual abscesses have been described in 30% to 70% of earlier studies [8, 17, 23], but wide, thorough abdominal exploration and aggressive débridement at the first operation have reduced the incidence to 16% [4, 10, 44]. Depending on the extent and location, surgical repeat débridement or percutaneous drainage [54, 58] can be performed. Our own experience with percutaneous drainage of residual abscesses indicates that this entity might be a primary domain of interventional treatment. Pancreatic fistulas occur in approximately 30% of patients after débridement and drainage of a pancreatic abscess [9, 38, 39, 44]; spontaneous closure can be expected in 90% of these cases within a few months [59]. Persisting high-output fistulas with recurrent hemorrhagic episodes and infection may necessitate distal pancreatectomy [60]. Enteric fistulas have been observed in 10% to 40% [9, 38, 44, 61, 62] and often require operative treatment owing to their associated high morbidity and mortality.

Conclusions

Pancreatic abscess is a life-threatening complication of acute necrotizing pancreatitis. Because the clinical presentation may be late and indolent, suspicion should lead to early diagnostic use of CT. CT-guided fine-needle aspiration of the suspicious collection may be necessary to confirm infection. If the aspirate confirms the presence of infection, adequate drainage (plus débridement of necrotic tissues if also present) is mandatory. Surgical drainage can be performed by closed, semiclosed, or open techniques with

equally good results depending on the expertise and preference of the individual surgeon. Though percutaneous drainage of pancreatic abscesses is often unsuccessful as primary treatment, a role for percutaneous therapy can nonetheless be defined. Our and other data [47, 54–56] indicate that percutaneous drainage can play an important role as the initial means of treatment of septic and unstable patients by providing primary decompression and evacuation of pus. This temporizing measure may thereby improve the patient's general condition in preparation for subsequent surgical drainage. Another valid circumstance is the treatment of additional abscesses following surgical débridement of the necrotic material [52, 54–56], especially when access for reoperation is difficult [9, 55, 56, 58]. In our experience, percutaneous drainage was successful in 100% of these cases.

Finally, it has been demonstrated that postpancreatitis abscesses remote from the pancreas itself, such as pelvic and mesenteric abscesses, contain little or no necrotic debris and can therefore be drained successfully via catheter [46, 47]. Percutaneous catheter drainage may also be chosen wisely for selected unilocular abscesses in and around the pancreas that do not contain significant quantities of semisolid necrotic debris, especially when the interval between pancreatitis and treatment is long enough to have allowed complete liquefaction.

Résumé

L'abcès pancréatique est une des complications infectieuses de la pancréatite aiguë. Il s'agit d'une collection contenant principalement du pus, mais elle peut également contenir une certaine quantité de débris semi-solides. La plupart de ces abcès proviennent d'une liquéfaction progressive de la nécrose pancréatique et péripancréatique mais, parfois, l'infection se développe à partir des collections péri ou extra - pancréatiques de la cavité péritonéale. On peut également voir des abcès post chirurgicaux après débridement chirurgical et drainage de la nécrose pancréatique. Alors que le traitement chirurgical de la nécrose infectée est le traitement de choix, le drainage percutané peut parfois être utiliséc avec succès. Un drainage par cathéter percutané a été utilisé chez 39 patients pendant la période 1987–1995. Seulement 9 des 29 drainages (31%) tentés ont été des succès d'emblée; il y a eu deux décès et 18 patients ont nécessité un drainage chirurgical ultérieur. Par contre, les 14 patients ayant un abcès résiduel après drainage chirurgical ont tous pu être drainés avec succès par voie percutanée. Le drainage percutané des abcès pancréatiques peut être utile en première ligne, en attendant de pouvoir stabiliser le patient septique fragile, pour drainer les abcès résiduels après drainage chirurgical (surtout lorsque l'accès paraît problématique), pour des abcès distants et pour certaines collections uniloculaires survenant à distance après une pancréatite nécrosante en période de liquéfaction complète.

Resumen

El absceso pancreático es una de las complicaciones sépticas de la pancreatitis aguda. Se trata de una colección que contiene principalmente pus, pero también puede contener cantidades variables de material necrótico semisólido. La mayoría de los abscesos pancreáticos evolucionan a partir de la licuefacción de los tejidos pancreáticos y peripancreáticos necróticos, pero algunos se originan en la infección de líquido o de colecciones peripancreáticas en otras ubicaciones en la cavidad peritoneal. También se incluyen abscesos que aparecen luego del desbridamiento o del drenaje de necrosis pancreática. Aunque el drenaje quirúrgico abierto es el tratamiento de elección en la necrosis pancreática infectada, el drenaje percutáneo de abscesos puede resultar exitoso en algunas circunstancias. Hemos utilizado drenaje percutáneo en 39 pacientes en el período 1987–1995. Sólo 9 de 29 (31%) intentos de usarlo como terapia primaria fueron exitosos, 2 pacientes murieron y 18 requirieron drenaje quirúrgico subsiguiente. Pero por otra parte, 14/14 pacientes con abscesos recurrentes o residuales fueron drenados exitosamente por la vía percutánea. El drenaje percutáneo con catéter de los abscesos pancreáticos puede ser de utilidad en la estabilización inicial de pacientes sépticos, en el drenaje de abscesos adicionales luego de intervención quirúrgica (especialmente cuando el acceso para la reoperación es dificil), en abscesos remotos asociados y en colecciones uniloculares seleccionadas, si se practica con un razonable intervalo luego de la pancreatitis necrotizante para permitir el proceso de lo que esencialmente viene a ser una licuefacción total.

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