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Retroperitoneal Laparoscopic Debridement and Drainage for Pancreatic Abscess

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Abstract

In patients with severe necrotizing pancreatitis, pancreatic necrosis and secondary infection of surrounding tissues can quickly spread to the whole retroperitoneal space. Treatment of pancreatic abscess complicating necrotizing pancreatitis is difficult and has a high mortality rate. The well-accepted treatment strategy is early debridement of necrotic tissues, drainage, and postoperative continuous retroperitoneal lavage. However, traditional open surgery has several disadvantages, such as severe trauma, interference with abdominal organs, a high rate of postoperative infection and adhesion, and hardness with repeated debridement. The retroperitoneal laparoscopic approach has the advantages of minimal invasion, a better drainage route, convenient repeated debridement, and avoidance of the spread of retroperitoneal infection to the abdominal cavity. In addition, retroperitoneal drainage leads to fewer drainage tube problems, including miscounting, displacement, or siphon. The debridement and drainage of pancreatic abscess tissue via the retroperitoneal laparoscopic approach plays an increasingly irreplaceable role in improving patient prognosis and saving healthcare resources and costs. The main procedures described here include laying the patient on the right side, raising the lumbar bridge and then arranging the trocar; establishing the pneumoperitoneum and cleaning the pararenal fat tissues; opening the lateral pyramidal fascia and the perirenal fascia outside the peritoneal reflections; opening the anterior renal fascia and entering the anterior pararenal space from the rear; clearing the necrotic tissue and accumulating fluid; and placing drainage tubes and performing postoperative continuous retroperitoneal lavage.

Introduction

The treatment of severe acute pancreatitis (SAP) complicated by peripancreatic infection and necrosis has long been a difficult problem to solve[1,2]. Pancreatic infection and necrosis are serious complications of severe acute pancreatitis[3]. Reducing abdominal and retroperitoneal pressure, removing necrotic tissue as much as possible,

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and reducing the absorption of toxic substances are the main surgical principles for successfully treating SAP[4]. Traditional open surgery and continuous postoperative lavage have saved the lives of many SAP patients. However, the transabdominal approach requires perforation of the gastrocolic ligament, entry into the minor omental sac, and subsequent invasion of all segments of the pancreas, which inevitably interferes with various abdominal organs and might introduce retroperitoneal bacteria into the abdominal cavity, increasing the risk of abdominal infection. In addition, the drainage tube is drained from the retroperitoneal cavity to the outside of the abdominal wall. Owing to poor drainage, compression of the intestinal tube may also cause intestinal fistula and abdominal bleeding. In 2013, the Evidence-based Guidelines for the Treatment of Acute Pancreatitis issued by the International Society of Pancreatology and the American Society of Pancreatology noted that minimally invasive debridement of necrotic tissue was superior to open debridement for patients with symptomatic infectious necrosis[5]. Chen et al.[6] used peritoneal laparoscopy to reach the peritoneum, remove necrotic pancreatic tissue, and place the drainage tube, achieving satisfactory results. However, theoretically, problems such as bacterial displacement and peritoneal infection caused by communication between the peritoneum and retroperitoneum are inevitable. Sileikis et al.[7] used three-hole laparoscopic retroperitoneal resection of pancreatic necrotic tissue and catheter drainage from 2007 to 2009 and cured 8 SAP patients.

Since 2016, we have adopted retroperitoneal laparoscopy to remove necrotic pancreatic tissue through a retroperitoneal approach. Compared to other minimally invasive surgeries, this method is more direct and safer. It provides direct access to the retroperitoneal space, allowing direct visualization and removal of necrotic tissue in the renal capsule. The field of view is clear, bleeding is easily controlled, and a drainage tube can be placed as needed, ensuring effective drainage. The drainage tube does not pass through the abdominal cavity, causing minimal disturbance to the cavity and reducing the risk of abdominal infection. The necrosis and infection of SAP occur mostly in the tail of the pancreas. There is often necrosis of the peripancreatic fatty tissue, which sometimes extends into the left colonic sulcus. Therefore, we utilized a left-sided approach in all patients, and typically, a single surgery was sufficient to thoroughly remove the necrotic tissue. We believe that retroperitoneal laparoscopic surgery via a left-sided approach is particularly suitable for patients with necrosis of the pancreatic body and tail combined with massive effusion.

Protocol

The protocol was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Meizhou People's Hospital. (MS-2023-C-95). Informed consent was obtained from patients for this study.

1. Patient selection

1. Use the following inclusion criteria for patients: meet the clinical diagnosis of acute pancreatitis; age between 18 and 80 years; have a CT-enhanced scan grade D/E; and a substantial amount of necrotic tissue and fluid accumulation around the body and tail of the pancreas, as well as in the retroperitoneal area[4].
2. Use the following exclusion criteria: exclude patients with severe cardiopulmonary dysfunction or coagulation disorders and preoperative percutaneous drainage (PCD) who had digestive fluid or abdominal bleeding in cases where gastrointestinal fistulas had occurred.

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2. Preoperative preparation

1. Ask patients to abstain from food for 6 h and refrain from consuming any liquids for 2 h before the scheduled surgery.
2. Prepare concentrated red blood cells and fresh frozen plasma for patients with hemoglobin (HGB) ≤ 80 g/L. Briefly, upon obtaining a doctor's order and patient consent, collect blood samples from the patient and label them. Send this sample to the hospital's blood bank. Conduct tests to determine the patient's blood type and Rh factor, check for any antibodies, and confirm compatibility with donor blood.
3. Administer intravenous antibiotics (such as 2.0 g of ceftriaxone) 30 min before anesthesia induction and proton pump inhibitors (such as omeprazole 40 mg).
4. Administer general anesthesia and perform endotracheal intubation. Following required assessments, the anesthesiologist first administers sedatives and then general anesthesia. After the patient is unconscious, the anesthesiologist inserts an endotracheal tube through the mouth into the trachea, guided by a laryngoscope. The tube is then connected to a ventilator to manage the patient's breathing. Throughout this process, the anesthesiologist continuously tailors anesthesia delivery and closely monitors its depth.

3. Surgical procedure

1. Review CT scans carefully to evaluate the severity of pancreatic necrosis and fluid distribution around the pancreas and retroperitoneum (**Figure 1**).
2. After successful anesthesia induction, position the patient in the right lateral decubitus position, elevate the hip bridge, and perform routine draping.
3. Arrange the three-port trocar as in laparoscopic retroperitoneal adrenal surgery[8]. In brief, make a 2 cm-long skin incision below the left axillary posterior line and rib margin using a scalpel. Separate the subcutaneous tissue and muscles with fingers, extend the fingers to push apart the lumbar fascia and peritoneum, and widen the retroperitoneal space.
4. Place a 10 mm trocar, a 5 mm trocar, and another 10 mm trocar 2 cm above the iliac crest on the left midline, below the left anterior axillary line, and 2 cm above the iliac spine on the left midaxillary line, respectively. Inject CO_2 gas and maintain the gas pressure at 12 mmHg. The trocar distribution is shown in **Figure 2**.
5. Explore the retroperitoneal tissues laparoscopically, employing a sharp dissection method to clear perirenal fat tissue and expose the perirenal fascia with dissecting forceps and an ultrasonic scalpel.
6. On the lateral side of the peritoneal reflection, use an ultrasonic scalpel to open the perirenal fascia. Use a suction device and blunt dissection to access the perirenal space between the descending colon and the left kidney. Due to inflammation and edema in the perirenal space, the process is prone to bleeding. Use bipolar electrocoagulation and an ultrasonic scalpel to achieve hemostasis.
7. Incise the anterior renal fascia and extend the retroperitoneal front space of the kidney (**Figure 3**). Aspirate the pus and send a portion of the sample for bacterial culture. Enlarge the incision, enter the abscess

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cavity, and remove the black necrotic tissue carefully and repeatedly using tissue forceps (**Figure 3**).

8. Rinse the abscess cavity with hydrogen peroxide-povidone-iodine-normal saline solution, in this order, until the rinsing fluid becomes relatively clear.
9. To achieve thorough hemostasis in the surgical area, place drainage tubes below and front of the pancreas and lead the tubes through the abdominal punctures (**Figure 2**).
10. After confirming that there was no bleeding at the incision site, remove the trocars, intermittently suture the incisions with 4-0 silk sutures, and terminate the surgery.

4. Postoperative management

1. Considering the severity and high mortality of necrotizing pancreatitis, transfer patients to the intensive care unit (ICU) for further observation after surgery.
2. Based on the bacterial culture results, initiate an appropriate antibiotic treatment regimen in accordance with the identified bacteria and its sensitivity profile.
    1. Administer the selected antibiotic at regular intervals, as prescribed by the treating physician. During this time, periodically monitor serum procalcitonin levels, a biomarker for bacterial infection, with blood tests. Continue the antibiotic treatment until these levels return to normal, indicating resolution of the infection. All procedures were performed following established protocols and guidelines for management of bacterial infections[9].
    2. Administer intravenous proton pump inhibitors (PPIs) for at least 1 week before the patients are switched to oral PPIs (single dose) for 4 weeks. If complications such as gastrointestinal or intra-abdominal bleeding occur, extend the duration of intravenous PPI usage.
3. Perform daily peritoneal lavage with 3000-6000 mL of normal saline solution with low central negative pressure suction, ensuring the drainage tubes remain unobstructed.
4. Recover patients from a liquid diet 24 h after surgery, gradually progressing to a regular diet based on gastrointestinal function recovery. Pay careful attention to maintaining regular bowel movements.

5. Follow-up procedures

1. Conduct outpatient visits and telephone interviews at 1 month, 3 months, 6 months, and 1 year after surgery.
2. In follow-up, assess the patient's diet and weight changes and schedule examinations, including enhanced abdominal CT, complete blood count, PCT, pancreatic enzymes, and liver function.

Representative Results

A total of six patients received this surgical treatment (**Table 1**). Preoperatively, all patients were assessed based on PaO_2/FiO_2, systolic blood pressure, and creatinine levels and were assigned modified Marshall score[10] and APACHE II scores (**Table 2**). All patients underwent surgery smoothly, and the duration of surgery ranged from 75 to 100 min, with an average of 84 ± 6.7 min. Preoperative bacterial cultures obtained through PCD tubes revealed *Escherichia coli, Enterococcus faecalis, Pseudomonas aeruginosa, Burkholderia cepacia*, and *Acinetobacter baumannii.* Postoperatively, systemic toxicity symptoms rapidly improved, and CT scans performed 1 week later showed a substantial reduction in necrotic tissue and peripancreatic fluid accumulation (**Figure 4**). Preoperatively,

the blood white blood cell count, neutrophil ratio, and PCT were elevated in all six patients, and their values significantly decreased 1 week after surgery. Four patients had elevated blood amylase levels preoperatively, and 1 week after surgery, all patients had normal levels (**Table 3**).

A single patient experienced recurrent high fever without resolution at 2 weeks post-surgery, with unobstructed drainage. Repeat CT indicated increased peripancreatic necrosis and fluid compared to observations 1 week earlier. A repeat laparoscopic procedure was performed on the right side with the patient in the left lateral position using the same technique as the initial left-sided retroperitoneoscopic surgery. Symptoms were rapidly ameliorated after the second surgery. Complications occurred in two patients. One patient developed a fever shortly after surgery and exhibited drainage fluid containing yellowish fluid with fecal-like debris after 2 weeks. Considering the possibility of a colonic fistula, conservative treatment was initiated for 1 week. Since the drainage fluid still contained fecal-like material (approximately 10-50 mL daily), the patient underwent subsequent surgery for terminal ileostomy, after which the drainage fluid gradually cleared. Another patient exhibited bloody drainage through the drainage tube 1 week post-surgery, accompanied by progressively decreasing hemoglobin levels in blood tests, indicating intraperitoneal bleeding. The patient received transfusions of red blood cells, fresh frozen plasma, and cryoprecipitate, followed by enhanced hemostatic treatment, which successfully stopped further bleeding. The other four patients experienced no postoperative complications.

During the 1-year follow-up period, all patients achieved satisfactory clinical outcomes, with almost complete disappearance of the peripancreatic fluid and necrotic tissue.

Figure 1: Preoperative CT scan. The preoperative CT scan shows abundant peripancreatic fluid accumulation and necrotic tissue. Please click here to view a larger version of this figure.

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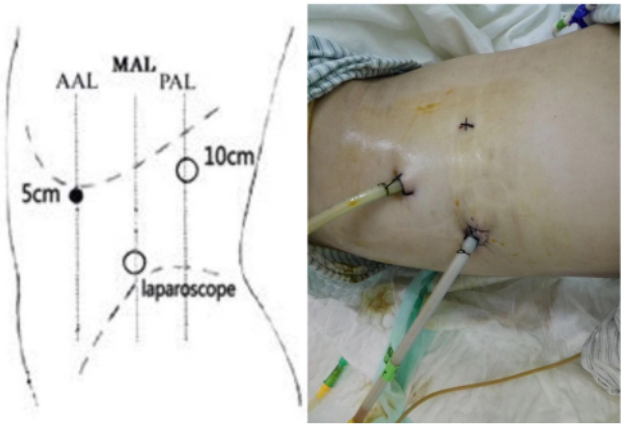

Figure 2: Trocar set up. Three-port arrangement of trocars in the retroperitoneoscopic adrenal surgery procedure and the postoperative placement of drainage tubes. Please click here to view a larger version of this figure.

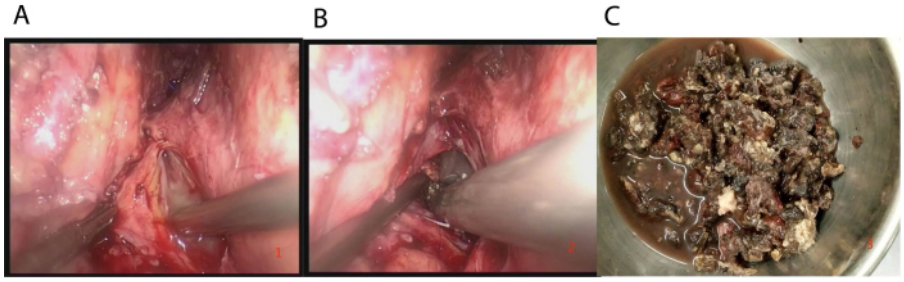

Figure 3: Surgical procedure. (**A**) Pus was discovered immediately after the aspirator entered the preperitoneal space adjacent to the kidney. (**B**) Careful extraction of black necrotic tissue using tissue forceps. (**C**) Excised pancreatic necrotic tissue during surgery. Please click here to view a larger version of this figure.

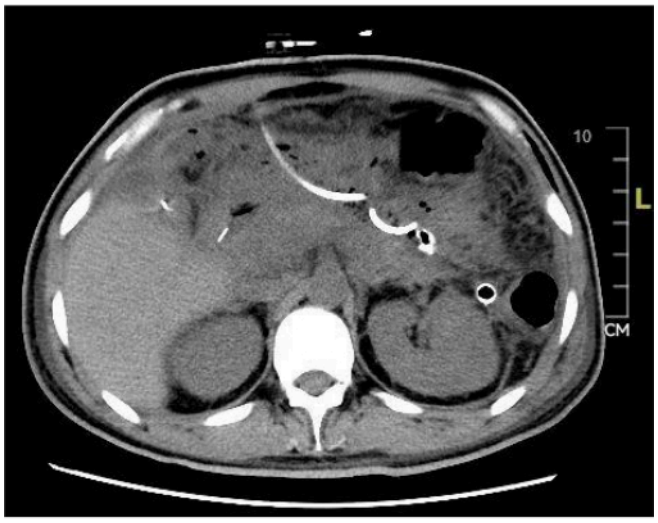

Figure 4: Postoperative CT scan. The postoperative CT scan shows a significant reduction in peripancreatic fluid accumulation and necrotic tissue after surgery. Please click here to view a larger version of this figure.

Table 1: Clinical data showing identified bacterial strains in patients receiving surgical treatment. Please click here to download this Table.

Table 2: APACHE II scores for patients. Please click here to download this Table.

Table 3: Clinical parameters of patients receiving surgical treatment before and after treatment. Please click here to download this Table.

Discussion

The optimal timing of surgical intervention for SAP has been a subject of ongoing debate. In the past, surgical intervention was assumed to be performed immediately upon the occurrence of pancreatic infection-related necrosis. However, since 2000, an increasing number of experts have suggested that the timing of surgical intervention for SAP should be postponed as much as possible[11,12,13]. Aseptic peripancreatic necrosis may not require immediate treatment. When infected necrosis develops, PCD can be considered initially to alleviate systemic toxic symptoms. Surgical removal of necrotic tissue can be delayed until approximately 4 weeks later[14]. At this point, patients have generally passed the acute inflammatory and multiorgan failure stages, and their systemic condition has stabilized. The necrotic tissue in the peripancreatic region becomes more localized and encapsulated, which helps reduce the risk of colon injury and intra-abdominal bleeding during surgery. The median surgical duration in this group was 38.5 (range: 11-63) days. In one patient who underwent early surgery, during the removal of necrotic tissue with forceps, there was a risk of tearing small, nonorganized blood vessels enveloped within the necrotic tissue, leading to bleeding and making thorough clearance of necrotic tissue challenging.

Reports suggest that endoscopic treatment of infected necrotizing pancreatitis is associated with decreased surgical complications[15]. However, this approach has strict surgical

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indications, and the clearance of necrotic tissue in the retroperitoneum remains challenging. The percutaneous nephroscopic pancreatic abscess clearance procedure is simpler but limited by restricted visualization, making effective removal of necrotic tissue challenging and often requiring multiple repetitive operations. This method is more direct, and postoperative septic symptoms were rapidly relieved in all six patients. The drainage tubes were left in place for 35-66 days and remained unobstructed. The extended use of drainage tubes is connected with the natural course of SAP, which is known for its prolonged and progressively deteriorating nature. In SAP, the pancreatic necrosis process is gradual and can continue for a long duration. Complete and sufficient drainage is the key to treatment. Most cases of SAP with pancreatic infection and necrosis occur in the tail of the pancreas and often involve necrosis of peripancreatic fat tissue that sometimes extends into the left colonic gutter. In this cohort, all patients were treated using a left-sided approach, and typically, necrotic tissue could be removed during a single operation. Since only one patient underwent bilateral surgery, the trauma associated with repeated debridement procedures during treatment was reduced overall, providing greater alignment with the concept of minimally invasive surgery[16]. The three-port approach is characterized by its high safety, direct access to the preperitoneal space adjacent to the kidney, direct visual guidance for necrotic tissue removal, excellent visualization, manageable bleeding, and flexible placement of drainage tubes for more effective drainage. The drainage tubes are placed around the abdominal cavity, minimizing disruption and decreasing the chances of retroperitoneal fluid accumulation and abdominal cavity contamination, ultimately reducing the risk of intra-abdominal infection.

For beginners, locating and identifying the retroperitoneal space is a crucial step for surgical success. In patients with pancreatitis, the retroperitoneal tissues are often swollen, necessitating thorough removal of retroperitoneal fat tissue. In this scenario, the preoperative placement of a PCD tube is particularly important. We injected approximately 1000 mL of normal saline through the PCD tube to expand the preperitoneal space further, aiding in its identification during surgery. The anterior renal space is an avascular zone, and post pancreatitis congestion and edema cause the anatomical structures to be unclear. In most cases, blunt dissection of this space using a suction device is recommended. Sharp dissection with energy platforms such as ultrasonic scalpels should be avoided to prevent unnecessary collateral damage. The renal hilum vascular structures often serve as anatomical landmarks during surgery. By analyzing CT scans before the procedure, the primary distribution of fluid and necrotic tissue can be located, and this anatomical landmark can be used as a guide to enter the preperitoneal space adjacent to the kidney.

Compared to traditional open or laparoscopic procedures, this method involves a smaller operational space, making intraoperative bleeding more challenging to manage. When using tissue forceps to grasp necrotic tissue, it is preferable to use a gentle and repetitive approach to avoid forceful tearing of large segments of necrotic tissue. In case of oozing/bleeding, rinsing with hydrogen peroxide and applying pressure can be effective for hemostasis. When there is fresh tissue on the wound and no loose necrotic tissue, surgery should be promptly performed. To avoid unnecessary bleeding, tissue forceps should not be used excessively to clamp tightly adhered necrotic tissue at this point. Inherently, SAP often leads to ongoing pancreatic necrosis and accumulation of peripancreatic fluid after surgery. Therefore,

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ensuring unobstructed drainage and thorough postoperative irrigation is particularly important. The use of larger diameter drainage tubes with irrigation capability and multiple side holes, coupled with irrigation and drainage, is essential.

Several limitations should be noted. First, the surgical removal and drainage of necrotic tissue and fluid in the pancreatic head region and the ventral side of the pancreas are challenging, which limits the applicability of this procedure to a relatively smaller subset of patients. Second, this procedure merely represents our initial exploration of retroperitoneoscopic surgery, with a small sample size and a relatively short follow-up period. Further research with multicenter collaborations and a larger sample size is necessary.

In conclusion, laparoscopic removal and drainage of pancreatic necrotic tissue for SAP with concurrent peripancreatic infection is safe and effective. The left-sided approach is commonly employed, and adherence to standardized procedures during surgery can reduce the occurrence of complications. Nevertheless, further research involving multicenter collaboration and a larger sample size is needed.

Disclosures

The authors declare that they have nothing to disclose.

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