Review article

Video-assisted Retroperitoneal Debridement and Minimal Access Retroperitoneal Pancreatic Necrosectomy

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ABSTRACT

Pancreatic necrosis is an acute necrotic collection in which there is a variable amount of fluid and necrosis, and it is the most severe stage of inflammation associated with pancreatitis, being a potentially life-threatening disease. While sterile pancreatic necrosis without organ failure is treated conservatively, surgical debridement is the keystone in the management of infected pancreatic necrosis. Surgical intervention consists of laparotomy and necrosectomy. This is an invasive procedure that is associated with high morbidity and mortality rates. Being so, the interventions for necrotizing pancreatitis have undergone a paradigm shift away from open surgical necrosectomy towards minimally invasive techniques. Surgical necrosectomy through laparotomy is still the gold standard treatment of symptomatic pancreatic necrosis, despite its postoperative mortality rate of 20–40% and morbidity reaching as much as 78%. It is a successful procedure, but it is associated with significant morbidity due to risks of incisional hernia (25–50%), hemorrhage (10%), enteric fistula (17–20%), and mortality (6–34%). Therefore, some less invasive techniques have been developed, including radiological drainage and a minimal access retroperitoneal approach. There are two basic types of this technique. One type, called video-assisted retroperitoneal debridement, is a hybrid technique combining open lumbotomy with a laparoscopic technique, introduced by Gambiez et al., who originally removed the necrotic debris visualized using a mediastinoscope through a small lumbotomy. The other is minimal access retroperitoneal pancreatic necrosectomy, introduced by Carter et al. In this technique, a nephroscope was originally used through a tract formed along a drain that was inserted during previous open necrosectomy. The visualization of the necrosis was aided by instillation of saline, and the necrotic debris was removed through the working channel of the nephroscope.

INTRODUCTION

Pancreatic necrosis is an acute necrotic collection in which there is a variable amount of fluid and necrosis (1), and it is the most severe stage of inflammation associated with pancreatitis, being a potentially life-threatening disease. Infected pancreatic necrosis is a late infective complication of acute necrotizing pancreatitis in which infection tends to spread from the pan-

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creas to the peripancreatic tissues, retroperitoneum, and, more rarely, the peritoneal cavity. Bacterial translocation mainly from the gut is the most widely accepted mechanism in the pathogenesis of infected pancreatic necrosis (2). This condition is the most important risk factor contributing to death in severe acute pancreatitis, and it is accepted that infected pancreatic necrosis should be managed surgically to prevent sepsis. Surgical intervention consists of laparotomy and necrosectomy (3). This is an invasive procedure that is associated with high morbidity and mortality rates. Being so, the interventions for necrotizing pancreatitis have undergone a paradigm shift away from open surgical necrosectomy toward minimally invasive techniques. The surgical strategy for proven infected necrosis has evolved; nowadays open necrosectomy is more or less abandoned. Instead, a step-up approach is adopted, consisting of percutaneous drains, video-assisted retroperitoneal debridement (VARD) and minimal access retroperitoneal pancreatic necrosectomy (MARPN).

BACKGROUND

Gallstones and alcohol are still the most frequent causes of acute pancreatitis, a disease with an increasing incidence during the past 20 years. This disease has a variety of clinical presentations from a mild, transitory illness to a severe, rapidly fatal disease. In about 80–90% of pancreatitis cases patients develop a mild and self-limited course with low morbidity and mortality (5). However, 10–20% of patients have a rapidly progressive inflammatory response associated with prolonged length of hospital stay and significant morbidity and mortality by developing severe forms of acute pancreatitis (6).

Severe acute pancreatitis has a two-phase clinical course. The early phase (1–2 weeks after the onset of symptoms) manifests the features of the systemic inflammatory response syndrome (SIRS) which implicates a complex inflammatory cascade and is often associated with multiple organ failure. The late phase is characterized by infectious complications, which are the major causes of mortality (2, 7, 8). Infection of necrotic pancreatic parenchyma occurs in around 30% of patients with necrotizing pancreatitis (7) and is observed after the second week of the acute attack, usually as a consequence of bacterial translocation. Microorganisms responsive for the transformation of sterile into infected pancreatic necrosis enter pancreatic tissue through multiple pathways, including biliary and duodenal-pancreatic reflux, hematogenous and lymphatic dissemination, and local bacterial translocation from the gut being the most important route of infection (9).

Necrotizing forms may present as acute necrotic collections (intra- or extrapancreatic solid-liquid heterogeneous collection with no defined wall, diagnosed during the first four weeks of the clinical course) or walled-off necrosis (with similar characteristics but with well-defined wall and with a later diagnosis above four weeks) (9). Both events present themselves as critical factors determining the clinical course of acute pancreatitis. Without radiologic, endoscopic or surgical intervention, infected necrosis eventually leads to death in almost every patient.

A SURGICAL APPROACH – FROM NECROSECTOMY AND LAPAROTOMY TO MINIMALLY INVASIVE PROCEDURES

While sterile pancreatic necrosis without organ failure is treated conservatively, surgical debridement is the keystone in the management of infected pancreatic necrosis (10). During the initial phase of acute necrotizing pancreatitis, the most important parts of medical treatment are fluid resuscitation, early enteral nutrition, endoscopic retrograde cholangiopancreatography if cholangitis is present and intensive care unit (ICU) support (9). On the contrary of sterile pancreatic necrosis, for infected necrotizing pancreatitis, the surgical approach is mandatory. Intervention is indicated when infection of (peri-)pancreatic necrosis is proven by fine needle aspiration, (peri-)pancreatic gas collections in the necrotic cavity are shown on CT scans or when sepsis persists after maximal support on the ICU (11).

Strategies for the management of patients with necrotizing pancreatitis remain controversial. Surgical necrosectomy through laparotomy is still the gold standard treatment of symptomatic pancreatic necrosis, despite its postoperative mortality rate of 20–40% and morbidity reaching as much as 78% (12). It is a successful procedure, but it is associated with significant morbidity due to risks of incisional hernia (25–50%), haemorrhage (10%), enteric fistula (17–20%), and mortality (6–34%) (13). Therefore, some less invasive techniques have been developed, including radiological drainage and a minimal access retroperitoneal approach (14).

Recent developments in minimally invasive procedures (laparoscopic, endoscopic, interventional radiologic) have been suggested as an alternative to open surgery and refueled the enthusiasm about the use of these techniques in the management of infected pancreatic necrosis. In this context, there has been changes in optimal time for surgery and the type of access for necrosectomy: from a classical open approach (with closure over large-bore drains for continued postoperative lavage or semi-open techniques with scheduled relaparotomies), trends have changed to a 'step-up' philosophy with initial percutaneous drainage and posterior minimally invasive or endoscopic access to the retroperitoneal cavity for necrosectomy if no improvement has been previously achieved.

Percutaneous drainage is one of the first minimally invasive techniques employed for the treatment of infected pancreatic necrosis. The improvement of percutaneous necrosectomy is minimally invasive retroperitoneal necrosectomy performed under the visual control offered by optical devices.

Retroperitoneal approach constitutes the maximum example of minimally invasive necrosectomy (9). It is performed through small incisions with endoscopic material, guided by a percutaneous drainage. This drainage is placed once infection of pancreatic or peripancreatic necrosis is suspected. It is positioned in the (peri-)pancreatic collection through the left retroperitoneum in a lateral position to avoid access to the abdominal cavity and to provide all the advantages of the minimally invasive approach (7).

There are two basic types of this technique. One type is VARD which is a hybrid technique combining open lumbotomy with a laparoscopic technique, introduced by Gambiez et al. (15) who originally removed the necrotic debris visualized using a mediastinoscope through a small lumbotomy. Another minimally invasive necrosectomy is MARPN, which was introduced by Carter et al. (15). In this technique, a nephroscope was originally used through a track formed along a drain that was inserted during previous open necrosectomy. The visualization of the necrosis was aided by instillation of saline, and the necrotic debris was removed through the working channel of the nephroscope (11, 15, 16).

All these minimally invasive endoscopic and laparoscopic techniques combine the benefits of open necrosectomy and percutaneous drainage while avoiding the problems associated with each of them (13). They have many advantages in comparison with open surgery such as reduced inflammatory response to intervention, substantially reduced extent of bacteremia, reduced risk of development of multiple organ failure, reduced rate of postoperative respiratory and wound complications, shorter stay in the ICU, and faster convalescence (12). Therefore, a staged, multidisciplinary, step-up approach with minimally invasive or endoscopic access for necrosectomy is widely accepted nowadays for management of pancreatic necrosis.

Although these approaches are increasingly gaining popularity since the morbidity and mortality rates have been decreased significantly, the main setback is the range of minimally invasive methods in treatment of acute necrotizing pancreatitis. That is the reason why there is a lack of studies comparing minimally invasive versus open surgery, and there is no unanimity on the optimal surgical strategy (12).

VIDEO-ASSISTED RETROPERITONEAL DEBRIDEMENT

VARD is a technique that can be considered as a hybrid between endoscopic and open retroperitoneal necrosectomy (7). It is a procedure that aims at minimizing complications and mortality by reducing surgical stress in the already critically ill patients. This reduction is achieved by minimizing the surgical incision and staying exclusively in the retroperitoneum, without contaminating the intraperitoneal space.

The VARD procedure was first described by Horvath et al. in 2001 (17). This first report described the results of six patients who underwent percutaneous drainage followed by VARD from 1995 to 1999. Four of them were successfully treated, and laparotomy with its related complications was avoided. Following these results, there was a case-study in The Netherlands comparing 15 patients undergoing VARD with other 15 patients undergoing open necrosectomy in necrotizing pancreatitis (18). In the group that underwent VARD, there were less postoperative complications and a trend towards lower mortality supporting a potential benefit of the retroperitoneal approach over laparotomy (13, 18).

The VARD procedure is part of a step-up approach consisting of percutaneous retroperitoneal catheter drainage followed by VARD, if necessary. Once the necrosis infection is diagnosed, drainage is placed in the infected collection through the left retroperitoneum. If this does not lead to clinical improvement, surgery is needed. The surgery is preferably postponed until after four weeks since the beginning of the disease. This is considered as a key point in the procedure since it allows the peripancreatic or pancreatic collections to sufficiently demarcate and the wall to mature, thus optimizing the conditions for debridement.

To do the VARD, the patient is positioned in a supine position with the left side 30–40° elevated. Then a 4–5 cm left subcostal incision is made, in the left flank at the mid-axillary line, close to the exit point of the percutaneous drain. With the help of CT images and by using the in situ percutaneous drain as a guide into the (peri-)pancreatic collection, the fascia is dissected and by that, the retroperitoneum is entered. The cavity is cleared of purulent material using a standard suction device. Following the percutaneous drain deeper into the cavity, loose necrotic material is removed while periodic irrigation and consequent suction are performed to enhance vision. When debridement can no longer be performed under direct vision, a single extra-long laparoscopic port is placed into the incision and video scope is introduced. At this stage CO_2 gas (10 L/min) can be infused through the percutaneous drain, still in position, to inflate the cavity, thereby facilitating inspection. Under videoscopic assistance, further debridement of retained necrotic tissue is performed with laparoscopic forceps.

The goal of VARD is not to remove all necrotic tissue. It allows for large pieces of necrosis to be removed, but only loose necrosis is removed to reduce the risk of bleeding from viable pancreatic tissue and nearby blood vessels. However, leaving large undrained pockets of necrosis should be avoided because this may cause on-going sepsis. In VARD, the small incision enables the surgeon to remove larger pieces of necrosis with a shorter operating time and less need for repetitive procedures. When the bulk of necrosis is removed, the cavity is irrigated with saline until the fluid comes clear and then the percutaneous drain is removed. After closing, continuous postoperative lavage is performed. One week after the procedure repeated CT is performed to evaluate the resolution of the collection and to assess whether necrosis is still present.

MINIMAL ACCESS RETROPERITONEAL PANCREATIC NECROSECTOMY

MARPN is a minimally invasive procedure that has been showing benefits regarding morbidity and mortality when compared to traditional open approaches. When planning this minimal access approach, some technical considerations also need to be assessed in deciding appropriateness for a MARPN. Both a high-quality CT and an interventional radiologist are required to do this (14).

Having decided to perform a MARPN, the patient is transferred to the radiology department, and under CT guidance the access to the necrotic cavity is obtained via the left flank, and a 12-French pigtail catheter is inserted under CT-guidance (14, 19). Most commonly, this is through a window between the upper pole of the left kidney and lower pole of the spleen. Afterward, the patient is transferred to the operating theatre, placed in a supine position on the operating table and a sandbag can be used under the site of catheter entry to improve access to the track with the operating nephroscope. Under x-ray screening and general anaesthesia, the catheter is exchanged over a guide wire for serial renal dilators and the track is dilated to 30-French (19). Then the necrosis is removed with forceps and samples are sent for microbiological examination. After initial debridement, an irrigating drain, consisting of a 28-French chest drain and 10-French nasogastric tube sutured together, is inserted into the cavity and 0.9% saline solution is used to irrigate the cavity uninterruptedly at a rate of 125 mL/h. The patients are carefully monitored postoperatively, using serial CT scans and CRP measurements to follow disease progress. Repeated debridements are performed at 7- to 10-day intervals until the necrosis cavity is seen to be clear and lined by healthy granulation tissue.

It is standard that the initial procedure involving dilatation of the track is performed under general anesthetic with following procedures performed using local anesthetic with or without light sedation, according to patient preferences. In patients with severe comorbidities, such as aortic stenosis, local anesthetic can be used from the outset.

In some patients, more than one access path is created to gain access to all the necrotic areas—access from the right side or anteriorly is technically more challenging but feasible as long as the distance between the abdominal wall and necrosis is not too great. When the necrosis has been cleared, the irrigation is stopped, and the patient is discharged home with a simple tube drain left in situ. This is later removed during regular outpatient follow-up.

The indications for MARPN are the same as those for open intervention. Any apprehension over the possibility of co-existing intraperitoneal pathology, particularly ischemic colon disease, is a contraindication to a minimal access approach. Any suspicion of this should mandate a colonoscopy to assess the viability of the colon further.

CONCLUSION

Minimally invasive techniques have been introduced for the management of infected pancreatic necrosis to minimize the perioperative trauma and to limit its negative influence on organ function. Nowadays, endoscopic, radiological, laparoscopic, and hybrid techniques combining different minimally invasive modalities are used for the treatment of acute pancreatitis, depending on the experience of the institution. There are no clinical or radiological criteria allowing the prediction of which minimally invasive techniques might prove successful in patients with infected necrosis (11). Therefore, the choice of a minimally invasive procedure depends mainly on the expertise of the treating team and the preferred technique used in the institution.

There are many minimally invasive techniques available for the treatment of complicated acute pancreatitis. In some patients, it is useful to combine various techniques or to use them at different stages of the disease. On the other hand, open necrosectomy does not exclude the possibility of subsequent usage of minimally invasive procedures. As compared with open necrosectomy, the step-up approach aims at control of the source of infection, rather than complete removal of the infected necrotic tissue, and that is the principal problem common to all the minimally invasive techniques, the difficulty in removal of the necrotic debris and the establishment of adequate drainage of the necrotic and purulent fluid (11, 15, 16, 20). Because of this, it is often necessary to repeat sessions of necrosectomy, which can be a disadvantage for these minimal procedures.

A multicentre study was enrolled by Medical centers in the Netherlands and published in the New England

Journal of Medicine in 2010. It randomly assigned 88 patients with necrotizing pancreatitis and suspected or confirmed infected necrotic tissue to undergo primary open necrosectomy or a step-up approach to treatment. The step-up approach consisted of percutaneous drainage followed, if necessary, by minimally invasive retroperitoneal necrosectomy. The conclusions of this study are presented in Table 1. This study revealed that the minimally invasive step-up approach, when compared with primary open necrosectomy, reduced the rate of major complications or death, as well as long-term complications, healthcare resource utilization, and total costs, among patients who had necrotizing pancreatitis and confirmed or suspected secondary infection. With the step-up approach, more than one-third of patients were successfully treated with percutaneous drainage and did not require major abdominal surgery.

In conclusion, the role of minimally invasive techniques remains unclear, however, these techniques seem to be promising methods for the treatment of complicated acute pancreatitis, and they are gaining popularity among the surgical community. The selection of a minimally invasive procedure depends on the extent of necrosis, timing of intervention, patient's condition, and the experience and preference of the institution. Shortly, further develop-

Table 1. Summarized data from van Santvoort et al. study (20). ICU – intensive care unit

		Minimally invasive step-up approach (N=43)	**Primary open necrosectomy (N=45)**	**Risk ratio (95% CI)**	**P-value**
Major complication or death		17 (40%)	31 (69%)	0,57 (0,38–0,87)	0,006
Major complications	New-onset multiple organ failure or systemic complications	5 (12%)	19 (42%)	0,28 (0,11–0,67)	0,001
	Multiple organ failure	5 (12%)	18 (40%)		
	Multiple systemic complications	0	1 (2%)		
	Intraabdominal bleeding requiring intervention	7 (16%)	10 (22%)	0,73 (0,31–1,75)	0,48
	Enterocutaneus fistula or perforation of visceral organ requiring intervention	6 (14%)	10 (22%)	0,63 (0,25–1,58)	0,32
Death		**8 (19%)**	**7 (16%)**	**1,20 (0,48-3,01)**	**0,70**
Other outcome	Pancreatic fistula	12 (28%)	17 (38%)	0,74 (0,40–1,36)	0,33
	Incisional hernia	3 (7%)	11 (24%)	0,29 (0,09–0,95)	0,03
	New-onset diabetes	7 (16%)	17 (38%)	0,43 (0,20–0,94)	0,02
	Use of pancreatic enzymes	3 (7%)	15 (33%)	0,21 (0,07–0,67)	0,002
Health care resources utilization	Total number of operations per patient	0–6	1–7		
	Total number of drainage procedures per patient	1–7	0–6		
	Days in ICU – median (range)	9 (0–281)	11 (0–111)		
	Days in hospital – median (range)	50 (1–287)	60 (1–247)		

ments in minimally invasive techniques and increasing popularity of hybrid methods for the treatment of infected pancreatic necrosis might be expected.

References

1. Dionigi R, Rovera F, Dionigi G, et al. Infected pancreatic necrosis. Surg Infect (Larchmt). 2006; 7 Suppl 2: S49-52.
2. Sakorafas GH, Lappas C, Mastoraki A, et al. Current trends in the management of infected necrotizing pancreatitis. Infect Disord Drug Targets. 2010; 10 (1): 9-14.
3. van Santvoort HC, Besselink MGH, Horvath KD, et al. Videoscopic assisted retroperitoneal debridement in infected necrotizing pancreatitis. HPB (Oxford). 2007; 9 (2): 156-9.
4. Lim E, Sundaraamoorthy RS, Tan D, et al. Step-up approach and video-assisted retroperitoneal debridement in infected necrotizing pancreatitis: a case complicated by retroperitoneal bleeding and colonic fistula. Ann Med Surg. 2015; 4 (3): 225-9.
5. van Santvoort HC, Bakker OJ, Bollen TL, et al. A conservative and minimally invasive approach to necrotizing pancreatitis improves outcome. Gastroenterology. 2011; 141 (4): 1254-63.
6. Jensen EH, Borja-Cacho D, Al-Refaie WB, et al. Exocrine Pancreas. In: Townsend CM, Sabiston DC, eds. Sabiston Textbook of Surgery: The Biological Basis of Modern Surgical Practice, 16th ed. Philadelphia, PA: Elsevier Saunders; 2012. p. 1515-47.
7. Brunschot S, Besselink MG, Bakker OJ, et al. Video-assisted retroperitoneal debridement (VARD) of infected necrotizing pancreatitis: an update. Curr Surg Reports. 2013; 1 (2): 121-30.
8. Nathens AB, Curtis JR, Beale RJ, et al. Management of the critically ill patient with severe acute pancreatitis. Crit Care Med. 2004; 32 (12): 2524-36.
9. Aranda-Narváez JM, González-Sánchez AJ, Montiel-Casado MC, et al. Acute necrotizing pancreatitis: surgical indications and technical procedures. World J Clin Cases. 2014; 2 (12): 840-5.
10. Beger HG, Rau BM. Severe acute pancreatitis: clinical course and management. World J Gastroenterol. 2007; 13 (38): 5043-51.
11. Besselink MG, van Santvoort HC, Nieuwenhuijs VB, et al. Minimally invasive 'step-up approach' versus maximal necrosectomy in patients with acute necrotising pancreatitis (PANTER trial): design and rationale of a randomised controlled multicenter trial [ISRCTN13975868]. BMC Surg. 2006; 6 (1): 6.
12. Wroński M, Cebulski W, Słodkowski M, et al. Minimally invasive treatment of infected pancreatic necrosis. Gastroenterol Rev. 2014; 6 (6): 317-24.
13. Horvath K. Safety and efficacy of video-assisted retroperitoneal debridement for infected pancreatic collections. Arch Surg. 2010; 145 (9): 817.
14. Werner J, Hartwig W, Hackert T, et al. Surgery in the treatment of acute pancreatitis—open pancreatic necrosectomy. Scand J Surg. 2005; 94 (2): 130-4.
15. Gambiez LP, Denimal FA, Porte HL, et al. Retroperitoneal approach and endoscopic management of peripancreatic necrosis collections. Arch Surg. 1998; 133: 66-72.
16. Carter CR, McKay CJ, Imrie CW. Percutaneous necrosectomy and sinus tract endoscopy in the management of infected pancreatic necrosis: an initial experience. Ann Surg. 2000; 232 (2): 175-80.
17. Horvath KD, Kao LS, Wherry KL, et al. A technique for laparoscopic-assisted percutaneous drainage of infected pancreatic necrosis and pancreatic abscess. Surg Endosc. 2001; 15 (10): 1221-5.
18. van Santvoort HC, Besselink MG, Bollen TL, et al. Case-matched comparison of the retroperitoneal approach with laparotomy for necrotizing pancreatitis. World J Surg. 2007; 31 (8): 1635-42.
19. Raraty MGT, Halloran CM, Dodd S, et al. Minimal access retroperitoneal pancreatic necrosectomy. Ann Surg. 2010; 251 (5): 787-93.
20. van Santvoort HC, Besselink MG, Bakker OJ, et al. A step-up approach or open necrosectomy for necrotizing pancreatitis. N Engl J Med. 2010; 362 (16): 1491-1502.