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Minimally Invasive Retroperitoneal Approach for Pancreatic Necrosectomy via a Percutaneous Drainage Tract

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Abstract

Aim-Background: Infected pancreatic necrosis (IPN) develops in approximately one third of patients with necrotizing pancreatitis (NP). In the past, open necrosectomy (ON) was the standard treatment for this condition, but it carried significant morbidity and mortality. Currently, minimally invasive procedures (MIPs) have been established for the management of IPN, decreasing the risk of complications compared with ON.

Methods: A prospective study was made of patients with IPN treated by a MIP for necrosectomy via a percutaneous drainage catheter, followed by video-assisted retroperitoneal debridement (VARD).

Results: Between 2013 and 2016, 3 consecutive patients, with a mean age of 58 years, underwent a MIP for the management of IPN. All 3 patients had left lateral retroperitoneal pockets of necrosis, and the first-line procedure consisted of placement of a pigtail catheter. The drain tract was subsequently used to carry out VARD. None of the patients presented major postoperative complications or required re-intervention.

Conclusion: The management of IPN has shifted away from ON, which was associated with high morbidity, towards less invasive techniques. MIPs should be used initially as the surgical treatment of choice in most cases. When this is not feasible, or when the MIP is not successful, ON should be implemented.

Key words: *Walled-off pancreatic necrosis; minimally invasive; necrosectomy; infected pancreatic necrosis; step-up approach*

Introduction-Aim

Necrotizing pancreatitis (NP) occurs in approximately 15% of patients with severe acute pancreatitis and is characterized by pockets of pancreatic and peripancreatic tissue necrosis. About two thirds of necrotic foci are sterile and may resolve with conservative treatment, but the rest evolve to infected pancreatic necrosis (IPN) [1,2]. While sterile pancreatic necrosis is associated with a mortality rate of 5 - 10%, that of IPN is much higher, 20 - 30%, subsequent to sepsis and multiple organ failure [3,4]. The necrotic progression most commonly involves both pancreatic and peripancreatic fat tissue (75 - 80% of cases) or it may be limited to the pancreas alone (5%) [3]. Isolated peripancreatic necrosis carries a better prognosis than pancreatic parenchymal necrosis [3,5].

IPN commonly requires intervention in the form of necrotic tissue debridement (necrosectomy) and/or drainage via either surgical or radiological methods. Intervention should be delayed until the necrotic process is delimited, allowing demarcation between necrotic and normal tissue, which is named "walled-off necrosis" (WOPN), unless there is clinical deterioration and gradual multiorgan failure. Open surgical necrosectomy (ON) was initially conducted for the management of IPN, but this procedure had a poor outcome, with a high risk of bleeding and pancreatic or colonic fistula, along with an increased prevalence of postoperative organ dysfunction; the documented perioperative morbidity rate was 34 - 95%, leading to a mortality rate of 11 - 39% [1,2,4,6-8]. In recent decades, ON has been repeatedly replaced by minimally invasive procedures (MIPs), which have a lower risk of complications [9,10]. As a result, ON with repeated laparotomy is nowadays regarded as the last choice, undertaken only when other therapeutic options have failed.

Several types of MIP have been described for the man-

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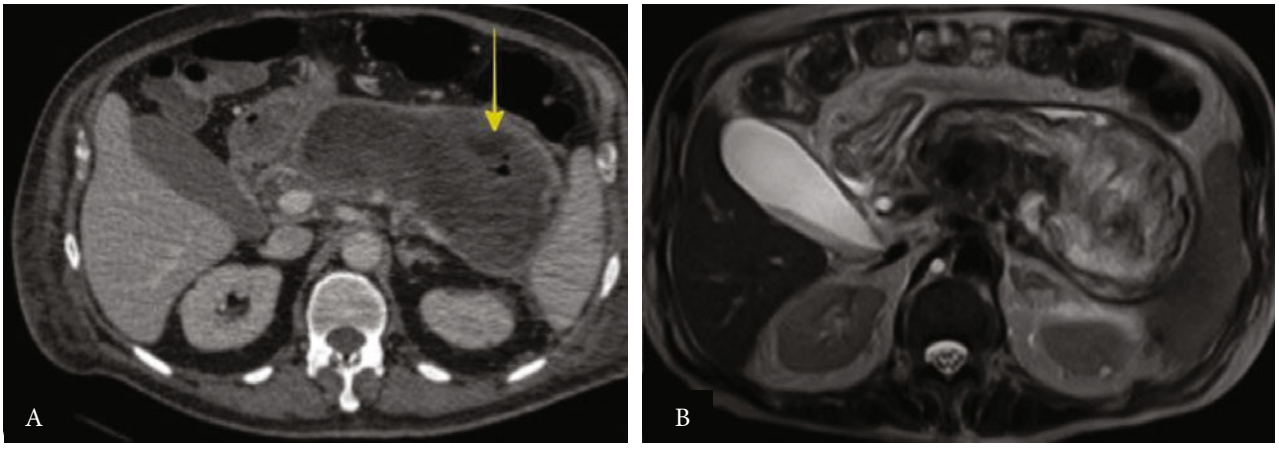

Figure 1. Infected pancreatic necrosis. A: Axial contrast-enhanced computed tomography (CT) of the upper abdomen demonstrates an encapsulated collection of fluid with small pockets of gas (arrow), overlying the pancreas, anterior to the spleen. B: Corresponding magnetic resonance (MR) image better depicts the solid elements within the encapsulated area.

agement of IPN, including percutaneous catheter drainage (PCD), video-assisted retroperitoneal debridement (VARD), transgastric endoscopic debridement (TED) and laparoscopic cystgastrostomy [11]. Currently, the step-up approach is recommended as the standard of care for NP; this consists of PCD, followed by VARD or endoscopic transluminal drainage, followed by TED [6,12]. The cases are presented here of 3 consecutive patients with acute pancreatitis who developed IPN, which was managed in our hospital by a MIP. A step-up approach with image-guided PCD, followed by VARD, was used successfully in all 3 patients.

Methods-Results

In a prospective study conducted between 2013 and 2016, 3 patients with IPN, 2 males and 1 female, mean age 58 years, were treated surgically by MIP, specifically PCD and VARD. All 3 patients were referred with a diagnosis of IPN, confirmed by positive blood culture and the presence of pancreatic or peripancreatic necrosis on multidetector contrast enhanced computed tomography (CT) scan (Figure 1). The presence of gas in a necrotic pocket on imaging of the pancreas, combined with clinical signs of infection, such as raised temperature, elevated levels of inflammatory serum markers, and exclusion of any other site of infection, was considered pathognomonic for IPN. The procedures in this series were led by AAP, who is Professor of Surgery with a pivotal role in endoscopic and laparoscopic techniques and special interest and experience in elective and emergency hepatobiliarypancreatic (HBP) surgery. The overall management plan and the indications for and timing of intervention were determined by a multidisciplinary team of consultant surgeons, gastroenterologists and radiologists. The medical ethics committee of the 2nd Department of Surgery "Aretaieio" Hospital approved the study.

All 3 patients had a history of gallbladder disease and at least one episode of acute pancreatitis approximately two months before their inclusion in the study. Two of the patients had undergone laparoscopic cholecystectomy before the presentation of NP. In all 3 patients a left lateral retroperitoneal necrotic focus was visualized on the CT scan. For all 3, the first-line procedure consisted of placement of a pigtail catheter by an interventional radiologist (Figure 2). When no clinical improvement was evident after 48 - 72 hours, because of inadequate drainage of the solid necrotic material, the drain tracts were used to perform minimally invasive necrosectomy by the VARD procedure. There were no major postoperative complications in any of the patients, and none required re-intervention or ICU admission. One of the patients underwent laparoscopic cholecystectomy 3 weeks after the VARD procedure. The mean hospital stay was 35 days and all 3 patients were discharged after clinical recovery with drainage catheters *in situ*. The drains were removed between 45 and 56 days (mean, 50 days) postoperatively as an outpatient procedure. Two of the patients remain asymptomatic one year after discharge. The third patient developed an unresolved pancreatic fistula. Endoscopic retrograde cholangiopancreatography (ERCP) revealed a carcinoma of the ampulla of Vater, which was confirmed by tissue biopsy. This patient died of complications related to peritoneal carcinomatosis 6 months later.

Technique

VARD is performed under general anesthesia with the patient positioned in such way that the access track is approximately horizontal. After preoperative skin preparation and sterile draping, a soft-tipped radio-opaque guide

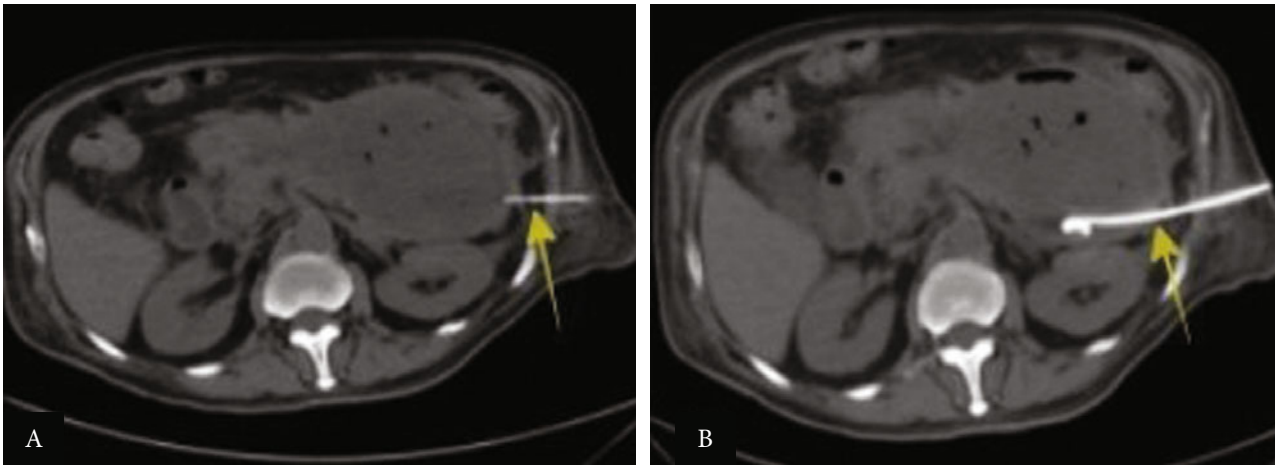

Figure 2. Minimally invasive procedure for treatment of infected pancreatic necrosis. The first step of the surgical step-up approach technique is percutaneous catheter drainage. The preferred access route is through the left retroperitoneal space between the left kidney, dorsal spleen and descending colon. Axial non-contrast CT slices illustrate the retroperitoneal percutaneous 10 Fr pigtail catheter placement by the Seldinger technique. A. Initial access is established via a 19 G needle; B: The catheter is placed in the dependent part of the necrotic area (arrows). The catheter will be used as a guide for entering the pocket of pancreatic and peripancreatic necrosis.

wire is passed through the previously placed drain, under fluoroscopic guidance to confirm the presence of the wire in the cavity. The drain is then removed leaving the percutaneous guide wire in place. Following the wire, serial gentle dilatations are gradually performed with a sponge forceps as far as the retroperitoneal pocket of necrosis (Figure 3A). A tract is created in the area between the lower pole of the spleen and the splenic flexure and a Hasson's trocar is inserted, allowing the endoscopic camera to follow the dilated tract. Under videoscopic assistance the lesser sac is entered and the visible necrotic tissue is gradually detached and removed using laparoscopic forceps and repeated irrigation/suction through a 5 mm port close to the dilated tract-opening site (Fig 3B, 3C, 3D). Because of the high risk of injury and hemorrhage, only loosely adherent pieces of necrosis are removed (Figure 4). At the end of the procedure two large bore single lumen drains are positioned in the cavity to facilitate a closed continuous postoperative lavage system (Figure 5). This approach is the technique of choice in our hospital and no other types of necrosectomy were undertaken during the reporting period.

Discussion

One of the most important advantages of MIP for the management of IPN appears to be the lower incidence of new-onset organ failure, which reflects a lower inflammatory response than occurs with ON. Since many studies have demonstrated a lower mortality rate when MIP is applied, in the range of 0 - 15%, the use of MIP for the treatment of IPN has become established [2,13,14]. Several MIPs may be used, and although each method can be considered as a definitive treatment, they can also be performed in sequence, in the "step-up" approach, which consists of the "3Ds" concept: delay, drain, and debride [11,15]. The first step is supportive treatment in the case of disease progression to PN and should last at least 4 weeks, during which a well-defined WOPN is expected to be created. The second step follows, which is percutaneous or endoscopic drainage. If, in spite of drainage, debridement is required; this involves enlargement of the drain tract to allow MIP.

This strategy was summarized in the latest guidelines of the International Association of Pancreatology/American Pancreatic Association for the management of acute pancreatitis, which recommend initial percutaneous or endoscopic drainage, followed by endoscopic or surgical necrosectomy when necessary [1,16]. These guidelines also noted that the present data are insufficient to allow definition of subgroups of patients with IPN who would benefit from a specific treatment strategy, since no single treatment approach for drainage and evacuation of pancreatic necrotic tissue is ideal for use in all patients [17].

In practice, a range of options may be required, often in combination, depending on the position of the necrotic area or the walled-off pocket of necrosis, and on the overall clinical condition of the patient. A detailed discussion of the antimicrobial treatment and nutritional management is beyond the scope of this presentation. It must be emphasized, however, that enteric feeding through a nasogastric or feeding tube can be administered, combined with total parenteral nutrition (TPN) if the nutritional target is not attained. Patients presenting with NP should undergo

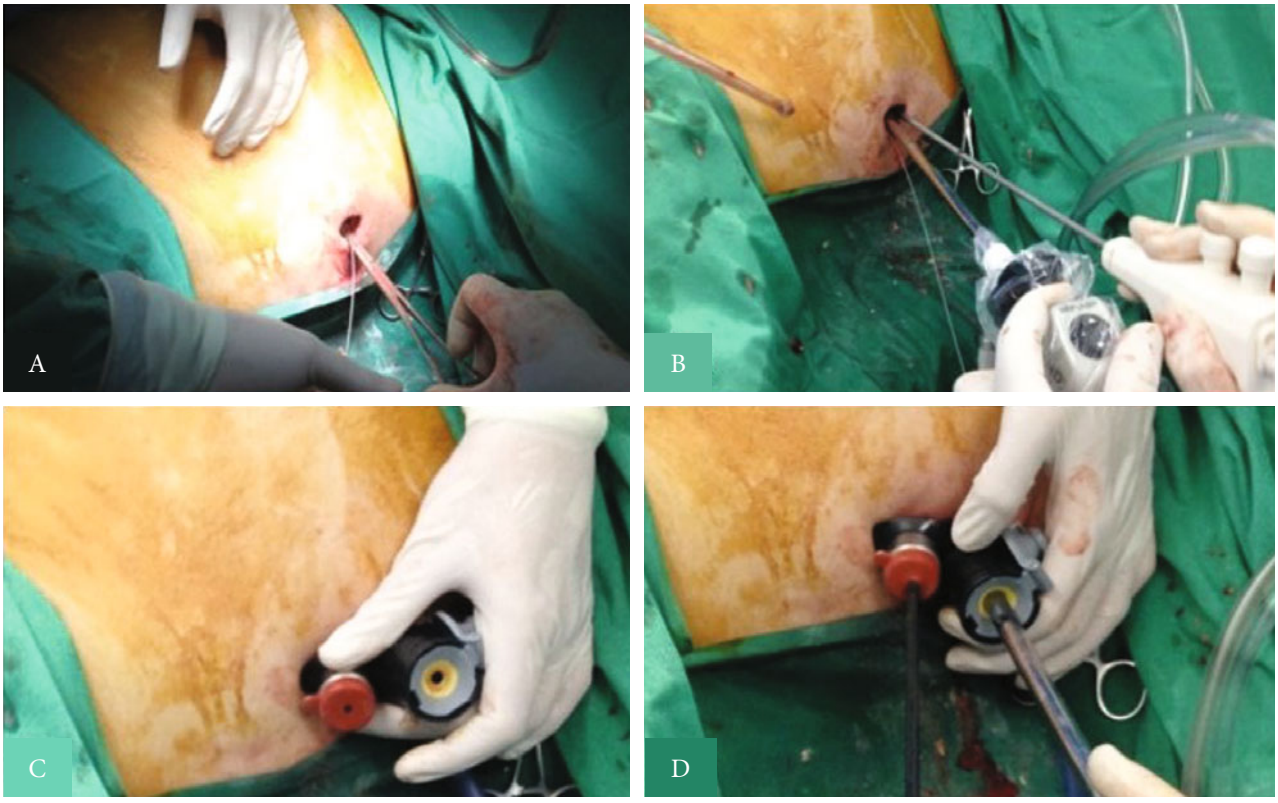

Figure 3. Minimally invasive procedure for treatment of infected pancreatic necrosis. Sequential perioperative images of video-assisted retroperitoneal debridement (VARD) through the left retroperitoneal space between the left kidney, dorsal spleen and descending colon. A: The previously placed percutaneous drain is used as a guide into the retro peritoneum to enter the necrotic area. The necrotic tissue is removed under direct vision with a long grasping forceps; B, C, D: Further debridement is performed under videoscopic assistance.

evaluation of the etiology of NP, the disease severity and whether signs of organ failure are present. During this evaluation, signs of biliary obstruction (i.e., possible malignant process), that would warrant urgent ERCP and a different treatment strategy, should be carefully ruled out. In one of the patients in our series, a carcinoma of the ampulla of Vater was diagnosed because of a persistent pancreatic fistula after the MIP.

MIPs can be classified into four broad groups: percutaneous, retroperitoneal, endoscopic and laparoscopic (transperitoneal) [18,19-23]. The choice of one MIP over another for the initial drainage of IPN is largely based on the position of the pocket of necrosis in relation to the stomach, colon, liver, spleen and kidney, and on the experience of the treatment team [11]. The initial drainage can be carried out through PCD, or transgastrically [2,23]. PCD is evolving as the first-line approach and at least 30% of patients can be treated successfully with catheter drainage only, without the need for additional necrosectomy [2,13,23]. Access using the retroperitoneal approach is preferable, as the route of percutaneous drainage should take into account the probability of subsequent "step-up" intervention, utilizing that drain tract. The use of PCD for central WOPN, such as those posterior to the stomach, is controversial, and the endoscopic transgastric routes could represent a better option for such sites. Endosonography-guided TED of WOPN with placement of transmural stents is often viewed as the first line approach in these patients. The novel lumen-apposing fully covered self-expanding metal stent (LAMS), with both proximal and distal anchor flanges, has been demonstrated to be both safe and effective for endoscopic transgastric debridement of WOPN via passage of the endoscope through the stent lumen [24]. Siddiqui and colleagues, in a retrospective study, showed complete resolution of the WOPN with a significantly lower number of procedures in the LAMS group in 90% of patients at 6-month follow up [25]. Currently, endoscopic necrosectomy procedures are carried out in different ways and at different time-points, based largely on the personal experience of the interventional endoscopist [26]. The laparoscopic approach has been demonstrated to be safe in several small case series, but it is currently the MIP least used for IPN. Laparoscopic necrosectomy allows complete exploration of the abdominal cavity and

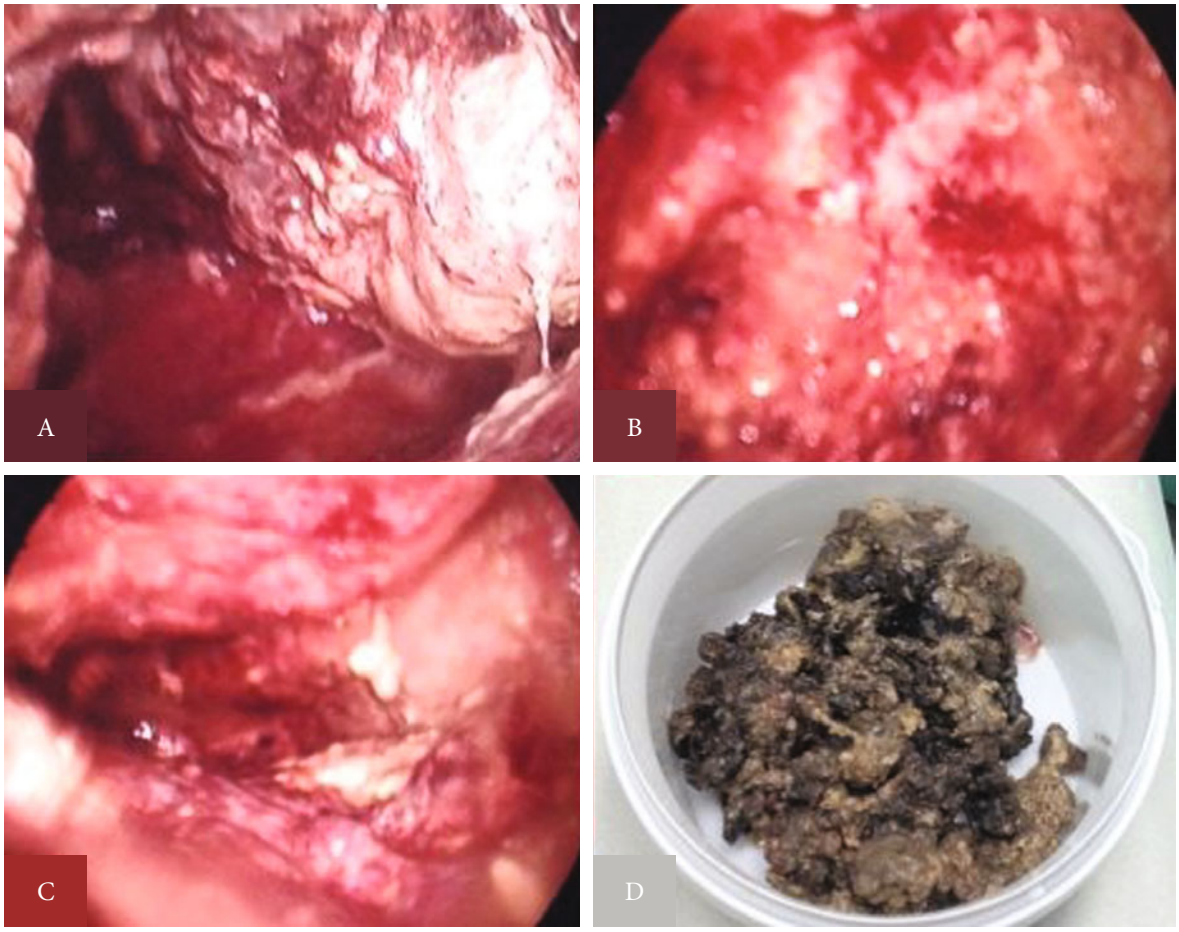

Figure 4. Minimally invasive procedure for treatment of infected pancreatic necrosis. Retro-peritoneoscopy showing images of the walled off pancreatic necrosis (WOPN) cavity. A, B: Initial findings on entry into complicated WOPN; C: Post debridement image with healthy granulation tissue after endoscopic necrosectomy; D: The necrotic material removed by video-assisted retroperitoneal debridement (VARD) necrosectomy.

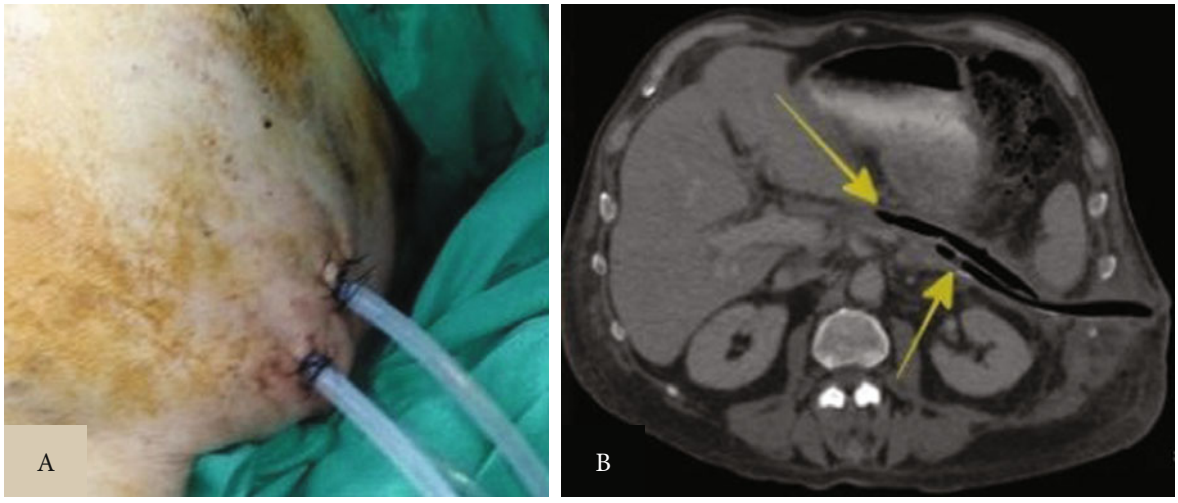

Figure 5. Minimally invasive procedure for treatment of infected pancreatic necrosis. A: Two large bore drains left in the necrotic cavity for lavage and drainage; B: Early postoperative axial-oblique contrast enhanced CT slice at the level of the pancreas depicts the two ports (arrows). Typical appearance of the area of walled off pancreatic necrosis (WOPN) immediately after retroperitoneal, necrosectomy showing substantial improvement.

surrounding organs, better exposure of the lesser sac, the left paracolic gutter and the head of the pancreas [27]. As a result, the laparoscopic approach to IPN is suitable for drainage of multiple areas of infection and permits concomitant cholecystectomy if gallbladder disease is present. The disadvantages of this procedure, as of open laparotomy, is that the walled off compartment is ruptured, leading to possible contamination of the peritoneal cavity, but the rate of conversion to open laparoscopic necrosectomy is under 20%. Based on the data reported in the literature to date, 80% of cases managed by the laparoscopic approach do not require additional surgical procedures, and the mortality rate is around 10% [19].

Depending on the individual progression of the clinical status, each of the MIP techniques can be considered as the definitive single treatment, or, alternatively, can be used as the initial step in the combination with others [18,19,28]. When the intended results are not achieved with MIP, ON-debridement should be implemented as soon as possible. The mortality of salvage ON after a failed MIP is no higher than that of primary ON [16].

In conclusion, the use of MIPs for treating IPN is associated with less complications, lower mortality and better outcome than ON, and should be preferred over ON for the initial management of IPN. In a patient with established criteria for intervention, current evidence favors simple percutaneous or endoscopic drainage of the WOPN followed by a "step-up" MIP necrosectomy if needed, to facilitate sepsis control. No single MIP is optimal for all patients, and therefore these interventions should be provided in the context of a multidisciplinary team approach in specialized centers with the appropriate expertise. ON should not be excluded *a priori* and there are still indications for its application in some cases of NP; ON is recommended for patients in whom MIP is not feasible or has been unsuccessful.

Conflict of Interest: *The authors declare that they have no conflict of interest.*

References

1. Working Group IAP/APA Acute Pancreatitis Guidelines. IAP/APA evidence-based guidelines for the management of acute pancreatitis. Pancreatology 2013; 13(4 Suppl 2):e1-e15.
2. van Grinsven J, van Santvoort HC, Boermeester MA, et al. Dutch Pancreatitis Study Group. Timing of catheter drainage in infected necrotizing pancreatitis. Nat Rev Gastroenterol Hepatol 2016;13:306-12.
3. Boumitri C, Brown E, Kahaleh M. Necrotizing Pancreatitis: Current Management and Therapies. Clin Endosc 2017; 50:357-65.
4. Werge M, Novovic S, Schmidt PN, et al. Infection increases mortality in necrotizing pancreatitis: a systematic review and meta-analysis. Pancreatology 2016; 16:698-707.
5. Bruennler T, Hamer OW, Lang S, et al. Outcome in a large unselected series of patients with acute pancreatitis. Hepatogastroenterology 2009; 56:871-6.
6. Rodriguez JR, Razo AO, Targarona J, et al. Debridement and closed packing for sterile or infected necrotizing pancreatitis: insights into indications and outcomes in 167 patients. Ann Surg 2008; 247:294-9.
7. Ashley SW, Perez A, Pierce EA, et al. Necrotizing pancreatitis: contemporary analysis of 99 consecutive cases. Ann Surg 2001;234:572-9.
8. Connor S, Alexakis N, Raraty MG, et al. Early and late complications after pancreatic necrosectomy. Surgery 2005;137:499-505.
9. 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;232:175-180.
10. Connor S, Ghaneh P, Raraty M, et al. Minimally invasive retroperitoneal pancreatic necrosectomy. Dig Surg 2003;20:270-7.
11. Logue JA, Carter CR. Minimally Invasive Necrosectomy Techniques in Severe Acute Pancreatitis: Role of Percutaneous necrosectomy and video-assisted retroperitoneal debridement. Gastroenterol Res Pract 2015. doi: 10.1155/2015/693040
12. Sorrentino L, Chiara O, Mutignani M, et al. Combined totally mini-invasive approach in necrotizing pancreatitis: A case report and systematic literature review. World J Emerg Surg 2017;12:16.
13. Velagapudi A, McKay M, Barry T, et al. A low impact approach to infected pancreatic necrosis: Review of a Case Series. Surg Infect 2016;17:749-54.
14. van Santvoort HC, Bakker OJ, Bollen TL, et al. A conservative and minimally invasive approach to necrotizing pancreatitis improves outcome. Gastroenterology 2011;141:1254-63.
15. Besselink MG. The "step-up approach" to infected necrotizing pancreatitis: delay, drain, debride. Dig Liver Dis 2011;43:421-2.
16. Wroński M, Cebulski W, Witkowski B, et al. Comparison between minimally invasive and open surgical treatment in necrotizing pancreatitis. J Surg Res 2017;210:22-31.
17. He WH, Zhu Y, Zhu Y, et al. The outcomes of initial endoscopic transluminal drainage are superior to percutaneous drainagefor patients with infected pancreatic necrosis: A prospective cohort study. Surg Endosc 2017;31:3004-13.
18. Guo Q, Li A, Xia Q, et al. Timing of intervention in necrotizing pancreatitis. J Gastrointest Surg 2014;18:1770-6.
19. Poves I, Burdío F, Dorcaratto D, et al. Minimally invasive techniques in the treatment of severe acute pancreatitis. Cent Eur J Med 2014;9:580-7.
20. Windsor JA. Minimally invasive pancreatic necrosectomy. Br J Surg 2007;94:132-3.
21. Gomatos IP, Halloran CM, Ghaneh P, et al. Outcomes From Minimal Access Retroperitoneal and Open Pancreatic Necrosectomy in 394 Patients With Necrotizing Pancreatitis. Ann Surg 2016;263:992-1001.
22. Beck WC, Bhutani MS, Raju GS, et al. Surgical management of late sequelae in survivors of an episode of acute necrotizing pancreatitis. J Am CollSurg 2012;214: 682-8.
23. van Santvoort HC, Besselink MG, Bakker OJ, et al. Dutch

Pancreatitis Study Group. A step-up approach or open necrosectomy for necrotizing pancreatitis. N Eng J Med 2010; 362:1491-502.
24. Sharaiha RZ, Tyberg A, Khashab MA, et al. Endoscopic therapy with lumen-apposing metal stents is safe and effective for patients with pancreatic walled-off necrosis. Clin Gastroenterol Hepatol 2016;14:1797-803.
25. Siddiqui AA, Kowalski TE, Loren DE, et al. Fully covered self-expanding metal stents versus lumen-apposing fully covered self-expanding metal stent versus plastic stents for endoscopic drainage of pancreatic walled-off necrosis: clinical outcomes and success. Gastrointest Endosc 2017;85:758-65.
26. Adler DG, Siddiqui AA. Nobody really knows how to perform endoscopic necrosectomy. Endosc Ultrasound 2017; 6:147-8.
27. Mathew MJ, Parmar AK, Sahu D, et al. Laparoscopic necrosectomy in acute necrotizing pancreatitis: Our experience. J Minim Access Surg 2014;10:126-31.
28. Mowery NT, Bruns BR, MacNew HG, et al. Surgical management of pancreatic necrosis: A practice management guideline from the Eastern Association for the Surgery of Trauma. J Trauma Acute Care Surg 2017;83:316-27.