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Evaluating the role of the Minimal Incision Retroperitoneal Necrosectomy (MIRN) in the management of infected pancreatic necrosis: Experience from a tertiary care center

Mohanasundaram Avudiappan [a], Venu Bhargava [a], Aditya Kulkarni [a], Mandeep Kang [b], Surinder Singh Rana [c], Rajesh Gupta [a,*]

[a] Department of Surgical Gastroenterology, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India
[b] Department of Radio Diagnosis and Imaging, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India
[c] Department of Gastroenterology, Postgraduate Institute of Medical Education and Research, Chandigarh 160012,India

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ABSTRACT

Background: The conventional open necrosectomy was associated with high mortality and morbidities like secondary organ failure, incisional hernia, enterocutaneous fistula, and external pancreatic fistula. In acute pancreatitis, collections are primarily confined to the retroperitoneal space. Hence, the retroperitoneal approach can be used to drain the collection and necrotic material. It benefits smaller incisions and better outcomes in terms of morbidity and mortality than the conventional open necrosectomy. This study primarily aims to describe the effects of minimal incision retroperitoneal necrosectomy versus conventional open necrosectomy for treating INP. Moreover, it provides evidence supporting the efficacy and safety of this method.

Methods: A single-center retrospective study of the prospectively maintained database from April 2008 to December 2021.

Results: A total of 122 patients were included in the study. Seventy-eight patients had an open necrosectomy, 30 had a MIRN, and 14 had a VARD procedure. These three groups were comparable in demographic variables. Preoperative variables like APACHE II at presentation, Modified CTSI, percentage of necrosis, multi-organ failure, time to surgery, and need for preoperative ICU stay were comparable among the three groups. Postoperative mortality was low in the MIRN group{open 35.8 % vs. MIRN 20.5 % vs. VARD 35.7 %, $p = 0.066$}. The postoperative stay was also significantly low in the MIRN and VARD group {open 23.62 ± 16.61 vs. MIRN 11.77 ± 7.73, VARD 8.86 ± 2.98, $p = 0.00$}. No significant difference in re-intervention rate, postoperative bleeding, and enterocutaneous fistula.

Conclusion: MIRN is a simple and easy-to-adapt procedure for infected pancreatic necrosis in the appropriately selected patient group.

Introduction

Acute pancreatitis is a common and fatal disease complicated by pancreatic and peripancreatic tissue necrosis in 15–20 % of patients. Most necrosis is sterile, but around 30 % is associated with infected pancreatic necrosis (IPN), with mortality reaching up to 30 % [1–3]. It is essential to take active and effective treatment measures [4,5]. Treatment of necrotizing pancreatitis has evolved over the past two decades. Our understanding of the indications, timing, and type of interventions in the step-up approach has improved [1,6,7].

Conventional open necrosectomy is associated with high morbidity and mortality, like secondary organ failure, incisional hernia, enterocutaneous fistula, and external pancreatic fistula. [8,9] After the Panter trial, the step-up approach has been accepted as the standard of care for infected pancreatic necrosis (IPN) [1]. Minimally invasive techniques have gradually replaced the traditional surgical method of open necrosectomy. The commonly used techniques are percutaneous catheter drainage, endoscopic drainage, endoscopic necrosectomy, and video-assisted retroperitoneal debridement (VARD) [10–13].

In acute pancreatitis, collections primarily start or remain confined

* Corresponding author.
E-mail address: rajsarakshi@gmail.com (R. Gupta).

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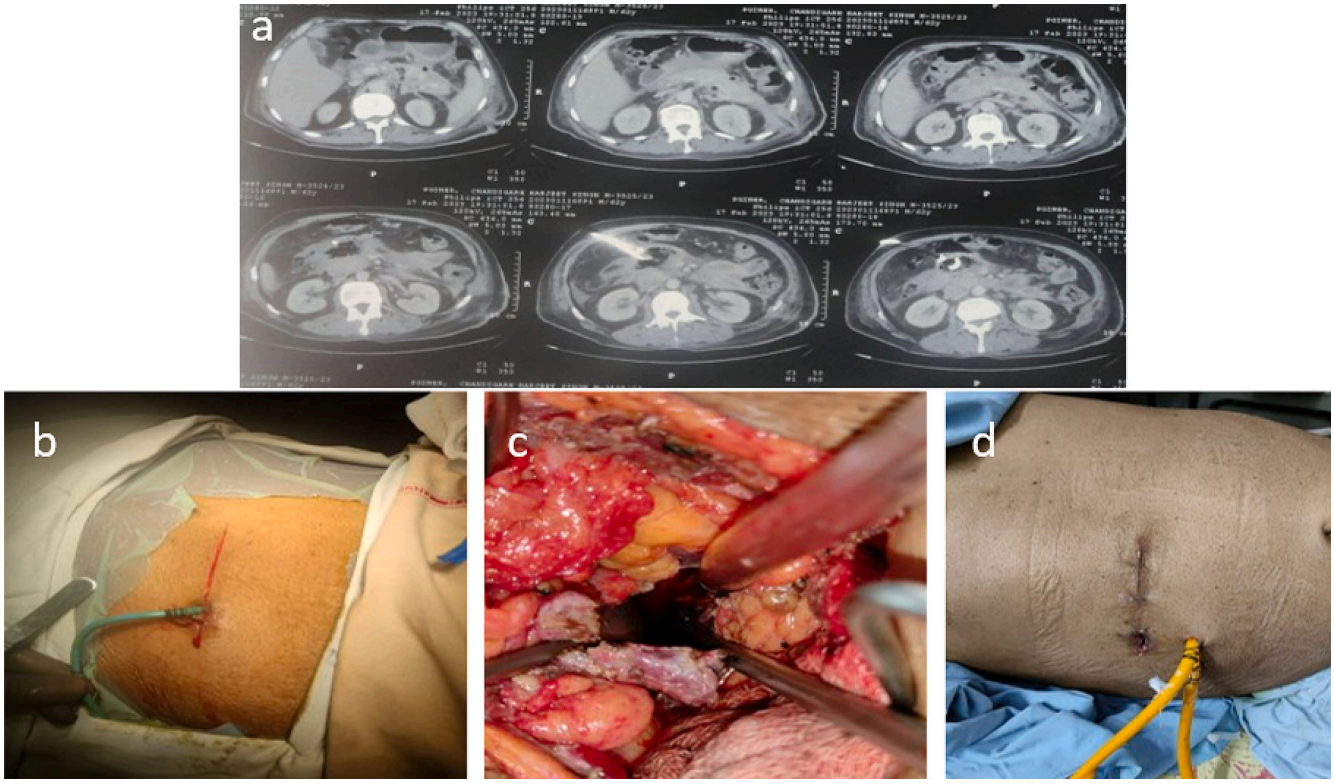

Fig. 1. a)Preoperative CT images with WON with pigtail in situ. b)Incision along the pigtail. c) WON cavity. d) Healed scar with drainage Foley catheters.

to the retroperitoneal space. As part of the step-up approach, a pre-placed percutaneous catheter guides the approach to the necrotic cavity. A small incision around 2–3 in. extending on either side of this percutaneous catheter is given. This approach contrasts with the traditional large anterior abdominal wall incision, where the necrotic cavity is approached through the gastro-colic or trans-mesocolic route. The smaller incisions placed directly over the collection ensure compartmentalization in contrast to traditional open necrosectomy, with better outcomes in terms of morbidity and mortality [14]. Therefore, in addition to video-assisted retroperitoneal debridement and transgastric necrosectomy, minimal incision necrosectomy can also be part of the step-up approach.

Only a few studies evaluating minimal incision necrosectomy are available in the literature [14,15]. This study primarily aims to compare the outcomes of minimal incision necrosectomy with conventional open necrosectomy and video-assisted retroperitoneal debridement for treating infected pancreatic necrosis using a step-up approach.

Methods

We included all patients who underwent pancreatic necrosectomy from the prospectively maintained database from April 2008 to December 2021 in the Department of Surgical Gastroenterology, Postgraduate Institute of Medical Education and Research, Chandigarh, India.

We excluded the patients who previously underwent open, laparoscopic transgastric, and endoscopic transgastric necrosectomy from the study.

The diagnosis of acute pancreatitis was established using clinical, biochemical, or imaging criteria [16]. Initial management was supportive with fluid resuscitation, analgesics, nutritional support, and organ support. Acute Physiology and Chronic Health Evaluation II score at admission and modified CT severity score were used for severity assessment.

Infected necrosis was defined by gas in the necrotic cavity visible on CECT or positive culture of pancreatic or peripancreatic necrotic fluid obtained by fine needle aspiration. Suspected cases of infected necrosis were defined as a persistent clinical manifestation of sepsis, worsening of organ failure, new onset organ failure, and elevated infective markers like procalcitonin.

The patient who failed to improve on conservative management with antibiotics and supportive care underwent percutaneous catheter drainage (PCD) insertion. PCD was placed using Seldinger's technique under ultrasound or CT guidance in the necrotic collection, preferably in the left lumbar region. The initial diameter of the PCD was 8 Fr or 10 Fr, and subsequently upsized as required up to a maximum of 28 to 32 Fr. Additional interventions like upsizing, repositioning, replacement or insertion of additional catheters were done as indicated. The number of catheters placed in a cavity would depend on the size of the cavity and the response to index catheter drainage. Saline irrigation was employed using a Y-connector attached to a pigtail catheter. The volume of irrigation depended on patient tolerance and ranged from 0.5 to 4.0 l of saline/drain/day. The PCD was removed after clinical improvement (defervescence, resolution of organ failure, and sepsis reversal) and radiological resolution of the necrotic cavity. Necrosectomy was performed if there was no clinical improvement (i.e., persistent sepsis, worsening, or new-onset organ failure) after PCD. Surgical procedures included, Video-assisted retroperitoneal debridement (VARD), minimal incision retroperitoneal or open necrosectomy with closed lesser sac drainage and lavage depending on the location of necrosum.

We focused on maintaining nutrition in these patients. Target caloric intake was 30–35 kcal/kg of body weight/day, with the fat intake being around 30 % of total calories and protein intake of 1.2–1.5 g/kg of body weight/day. We preferred the enteral route whenever it was available. Patients were initially started on oral or nasogastric feeds with standard or peptide-based formulae. Naso-enteric feeds via endoscopically placed naso-jejunal tube were started in case of delayed gastric emptying persisting for more than three days. Parenteral nutrition was employed if patients could not tolerate the enteral route of nutrition for >3–5 days. We continued with parenteral nutrition till at least 75 % of nutritional

Table 1
Demographic variables.

	Open (78)	MIRN (30)	VARD (14)	*P* value
Age, Median, yr	37 (19–61)	35.5 (14–70)	27 (14–60)	0.63
Male: Female	65:13	35:9	11:3	0.867
Alcohol (%)	44 (56.4)	13 (43.3)	7 (50)	0.859
GSD (%)	20 (25.6)	10 (33.3)	6 (42.8)	
Idiopathic (%)	6 (7.7)	2 (6.7)	1 (7.1)	
Trauma (%)	2 (2.6)	1 (3.3)	0 (0)	
ERCP (%)	2 (2.6)	1 (3.3)	0 (0)	
Drugs (%)	0	1 (3.3)	0 (0)	
Alcohol + GSD (%)	4 (5.4)	2 (6.7)	0 (0)	

needs were met by the enteral route and gradually tapered it off as the oral diet was advanced.

Surgical techniques

The decision of retroperitoneal necrosectomy was made in case of a) predominant necrotic collection in the body and tail region and b) when the abscess cavity is close to the abdominal wall. In this group of patients, we usually place the PCD in the left lumbar region.

Video-assisted retroperitoneal debridement (VARD) was generally employed on the left side. We commonly used the two-port technique with previously placed PCD as a guide to the cavity. The Seldinger technique was used to dilate the tract and access the cavity. We used a bladeless optical trocar, Visiport, to enter the cavity. The cavity is then filled with saline to increase its size, and a second trocar is inserted under the guidance of percutaneous ultrasound, avoiding injury to the kidney, colon, and spleen.

The procedure of minimal incision retroperitoneal necrosectomy (MIRN) is as follows. (1) The patient is placed in the right/left lateral position. (2) A small oblique incision approximately 6–7 cm long is given along the pigtail site. (3) The skin, subcutaneous tissue, and muscle are incised until the posterior sheath, which is dilated digitally or with blunt forceps, and the necrotic cavity is entered. (4) The septae in the abscess cavity is broken, leading to drainage of infected necrotic fluid. The solid necrosum is digitally mobilized and carefully removed using a sponge holder with gentle traction under finger guidance. (5) A thorough saline lavage is given. (6) Two large-bore Foley catheters are placed in the cavity for irrigation and drainage **(**Fig. 1**)**.

In open pancreatic necrosectomy, we use either midline or subcostal incisions concerning the location of the necrotic collection. The lesser sac is entered via the gastro-colic omentum or the transverse mesocolon or sometimes using the tract of the pigtail catheter.

All patients start saline irrigation postoperatively from POD 1 and gradually increase it to 3–4 l/day as per the tolerance of the patient and the nature of the egress fluid. The drains are removed once there is a clinical improvement and resolution of the necrotic cavity in a CT scan.

Preoperative data recorded included demographic data, the maximal extent of pancreatic necrosis, APACHE II score at admission and immediate preoperative period, organ dysfunction score, and ICU stay.

APACHE II and organ dysfunction scores were repeated 24 h postoperatively. Outcomes measures recorded were total and postoperative hospital and ICU stay, postoperative organ dysfunction, complications, and mortality.

Statistical analysis

We used IBM SPSS v.25 to perform statistical analysis. Continuous data were reported as mean, standard deviation, median and interquartile range as appropriate. Continuous data were expressed as frequency and percentage. The chi-square and Fisher exact tests were used for the categorical data analysis, and a 95 % confidence interval was calculated for categorical data.

Table 2
Preoperative variables.

	Open (78)	MIRN (30)	VARD (14)	P value
APACHE II at presentation, Mean ± SD	10.81 ± 4.34	11.07 ± 3.75	11.14 ± 4.62	0.739
Modified CTSI, Mean ± SD	8.79 ± 1.8	9.14 ± 1.25	9.29 ± 1.26	0.268
> 50 % necrosis (%)	52 (66.6)	22 (50)	6 (42.8)	0.194
Multi-organ failure (%)	41 (52.5)	18 (40.9)	7(50)	0.216
Time to surgery, Days, Mean ± SD	51.53 ± 25.45	50.05 ± 27.62	42.5 ± 8.59	0.765
Need for ICU stay (%)	67 (85.8)	32 (72.7)	10 (71.4)	0.074

Table 3
Postoperative outcomes.

	Open (78)	MIRN (30)	VARD (14)	P value
Postoperative stay, days, Mean ± SD	23.62 ± 16.61	11.77 ± 7.73	8.86 ± 2.98	0.000
Postoperative bleeding (%)	7 (9)	2 (6.7)	3 (21.4)	0.283
Enterocutaneous fistula (%)	10 (12.8)	1 (3.3)	1 (7.1)	0.312
Re-intervention rate (%)	10 (12.8)	6 (20)	3 (21.4)	0.532
Mortality (%)	28 (35.8)	9 (20.5)	5 (35.7)	0.066

Results

From April 2008 to December 2021, 122 patients underwent pancreatic necrosectomy at Surgical Gastroenterology. Seventy-eight patients had an open necrosectomy, 30 had a MIRN, and 14 had a VARD procedure. These three groups were comparable in demographic variables (Table 1). The most common etiology was alcohol in all three groups.

Preoperative variables like APACHE II at presentation, Modified CTSI, percentage of necrosis, multi-organ failure, time to surgery, and need for preoperative ICU stay were comparable among the three groups (Table 2).

The postoperative stay was much lower in the MIRN and VARD groups, which was statistically significant. Postoperative complications like bleeding and enterocutaneous fistula were comparable in groups. Again, the percentage of patients requiring second surgery was not significantly different in groups. However, MIRN patients had a lower mortality rate than the open and VARD groups, though it was not statistically significant **(**Table 3**)**.

Discussion

In this single-center retrospective study, we found that patients undergoing minimal access surgery (MIRN and VARD) had significantly lower postoperative stay than open necrosectomy. At the same time, our results did not show a significant difference in the VARD and MIRN groups regarding postoperative stay. The postoperative mortality rate was lowest in the MIRN group compared to VARD and open necrosectomy group.

The explanation for better outcomes in the MIRN group is that it causes less tissue injury with a decreased proinflammatory response than open necrosectomy . Another contributing factor is the early start of oral feeding [14]. Open necrosectomy is associated with exacerbation of physiological stress due to laparotomy and more extensive tissue handling. Moreover, it leads to higher rates of postoperative organ failure and mortality, which may be partly attributed to peritoneal cavity contamination [1,17–19].

Few studies compared open necrosectomy with MIRN. The large retrospective analysis of 108 retroperitoneal necrosectomies using oblique lumbar incision showed significantly better postoperative mortality of 8.3 % vs. 20.4 % in the open group, as noted in the present

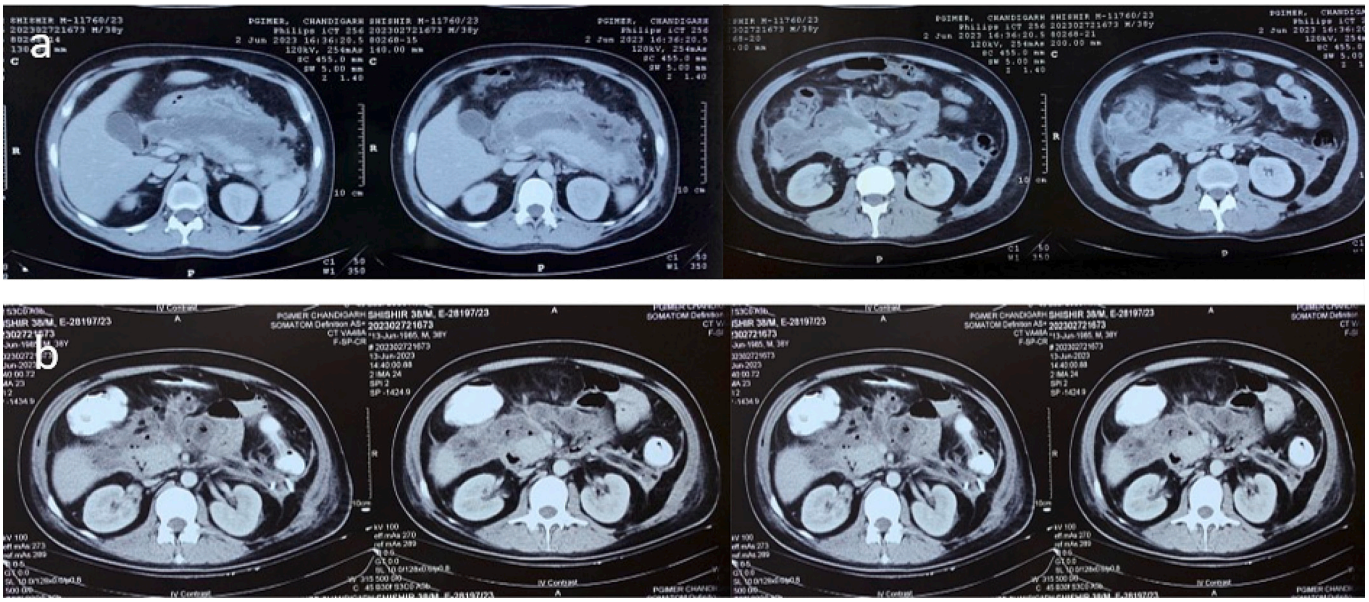

Fig. 2. a)Pre operative CT images of patient underwent VARD. b) Postoperative CT images of the same patient with remnant deep seated necrosum in the pancreatic head region.

study. However, our mortality rate was higher, possibly due to more patients with organ failure compared to the study by Guo et al. [14] Other outcomes like surgical time, postoperative hospital stay, and ICU stay were significantly better in the retroperitoneal necrosectomy group as observed in the present study also [14]. A large meta-analysis comparing retroperitoneal and open intraperitoneal necrosectomy showed similar surgical re-intervention rates, lower postoperative mortality, and shorter hospital stay for the retroperitoneal approach [15]. In our study, no significant difference in the postoperative complications and surgical re-intervention rate was noted among the three groups.

Another large retrospective study included 137 patients of minimal access retroperitoneal necrosectomy using an operating nephroscope. This study showed a lower incidence of postoperative organ failure and better postoperative mortality than the open necrosectomy group. However, in this study, the median length of stay and post-surgery stay were significantly higher in the minimal access retroperitoneal necrosectomy group. The minimal access group also required more procedures than the open necrosectomy group [10]. In contrast, in our study, the postoperative stay was significantly lower in the MIRN group than in the open group (11.7 vs. 23.6 days).

Laparoscopic necrosectomy and retroperitoneal access with laparoscopic necrosectomy also successfully treat infected pancreatic necrosis. However, these procedures require special instruments and repeated procedures that increase the hospital stay [20–22]. In our study, we used the minimal incision technique, which does not require any special instruments. Good postoperative lavage of the cavity reduces the requirement for repeated procedures.

In our Institution, we employ 2/3 port left-sided VARD for accessing the necrotic cavity in the body and tail of the pancreas. The third port is inserted superiorly if access is required for necrosum extending into paracolic areas. We have found that more commonly used two-port left-sided VARD may not completely remove the necrosum if it extends to the head of the pancreas and right paracolic areas. Also, in some situations, VARD may be challenging if the necrosum is deep-seated and the cavity has shrunk due to drainage of necrotic fluid by PCD (Fig. 2). The use of percutaneous ultrasound in these situations may help in the placement of the first port in the necrotic cavity as an adjunct to the Seldinger technique. In our study, there is a higher mortality rate in the VARD group compared to open necrosectomy, and that may be due to the higher incidence of postoperative bleeding and the higher rate of re-intervention.

The present study is the retrospective study of the prospectively maintained database; hence we did not have all postoperative data like new onset organ failure, which is transient, and postoperative external pancreatic fistulas. One of the potential limitations of this study is that not all patients are suitable for MIRN, though with more experience minimal access techniques treat more patients. However, this has a potential selection bias risk for a particular surgical procedure.

In summary, we have shown that MIRN is associated with lesser postoperative stay and reduced mortality compared to the open necrosectomy group. MIRN is a simple and easy-to-adapt procedure for infected pancreatic necrosis in the appropriately selected patient group. Minimal incision retroperitoneal necrosectomy should be part of the armamentarium of pancreatic surgeons dealing with infected pancreatic necrosis.

CRediT authorship contribution statement

All authors were involved in forming the study concept and design; acquisition of data; analysis and interpretation of data; drafting of the manuscript; critical revision of the manuscript for important intellectual content; statistical analysis; and administrative, technical, or material support.

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Ethical publication statement

This study received IRB approval from the Institutional Ethics Committee of the Postgraduate Institution of Medical Education and Research, Chandigarh.

Declaration of competing interest

The author reports no conflict of interest and has no financial disclosures concerning this manuscript.

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