The two-port laparoscopic retroperitoneal approach for minimal access pancreatic necrosectomy

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ABSTRACT

INTRODUCTION Despite advances in surgery and critical care, severe pancreatitis continues to be associated with a high rate of mortality, which is increased significantly in the presence of infected pancreatic necrosis. Controversy persists around the optimal treatment for such cases, with specialist units variously advocating open necrosectomy, simple percutaneous drainage or one of several minimal access approaches. We describe our technique and outcomes with a two-port laparoscopic retroperitoneal necrosectomy (2P-LRN).

METHODS Thirteen consecutive patients with proven infected pancreatic necrosis were treated by 2P-LRN over a three-year period in the setting of a specialist hepatopancreatobiliary unit. The median patient age was 46 years (range: 28–87 years) and 10 of the patients were male.

RESULTS The median number of procedures required to clear the necrosis was 2 (range: 1–5), with a median time to discharge following the procedure of 44 days (range: 10–135 days). There was no 90-day mortality and the morbidity rate was 38%, consisting of pancreatic fistula (31%) and bleeding (23%).

CONCLUSIONS Two-port laparoscopic retroperitoneal necrosectomy has been demonstrated to confer similar or better outcomes to other techniques for necrosectomy. It carries the additional advantages of better visualisation, leading to fewer procedures and the opportunity to deploy simple laparoscopic instruments such as diathermy or haemostatic clips.

KEYWORDS

Acute necrotising pancreatitis – Pancreas – Minimally invasive surgery – Necrosis – Debridement methods

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Severe pancreatitis carries a significant risk of potentially life threatening complications including the development of necrosis and systemic complications. The mortality rate for necrotising pancreatitis remains around 15% and can be up to 30% in the presence of infected necrosis. Improvements in critical care, better imaging, early radiological intervention and evidence-based management can reduce this to single figures in specialised tertiary centres providing multidisciplinary care.^{1–5}

Around 5–10% of patients will develop necrosis of either the pancreatic parenchyma, the peripancreatic tissue or both. The 2012 Atlanta classification defines this as acute necrotic collections (ANCs), which contain fluid and variable amounts of necrotic tissue on contrast enhanced computed tomography (CT). They can be multiple with a loculated appearance. The classification distinguishes them from acute peripancreatic fluid collections, which contain only fluid, appear homogenous on contrast enhanced CT and do not have a well defined wall. It may be difficult to

differentiate between the two based on contrast enhanced CT in the first week as both would appear as areas of fluid density. The entity of walled off necrosis (WON), a well defined collection consisting of necrotic tissue with an enhancing wall of reactive tissue on contrast enhanced CT, occurs normally after four weeks from onset of necrosis. This may also be multiple and found at sites distant from the pancreas.⁴

Both ANCs and WONs can become infected, presenting as deterioration in the patient's clinical course and displaying the presence of gas in the collections on contrast enhanced CT. The 2002 International Acute Pancreatitis Guidelines recommended non-operative management for those patients with sterile necrosis and surgical intervention for those with evidence of infection.⁵ The guidelines also advise avoiding surgical intervention during the first 14 days unless there is progressive multiorgan failure and clinical deterioration. Subsequent studies have suggested that morbidity and mortality can be reduced further if surgery is delayed beyond

four weeks, allowing clear demarcation between necrotic and normal tissue.⁶

Traditionally, pancreatic necrosectomy is carried out as an open procedure through a midline incision with transperitoneal access to the necrotic tissues. Repeat laparotomies are usually needed to ensure complete debridement and perioperative mortality varies from 11% to 50%.^{5,7} In recent years, various techniques for minimal access methods of debridement of the pancreatic bed have been described.

At an international conference in 2010, organised by the American Pancreatic Association, to develop a consensus on interventions for necrotising pancreatitis, various minimal access necrosectomy methods were discussed and a classification taxonomy was developed.¹⁴ This was based on method of visualisation (open, radiological, endoscopic, laparoscopic, hybrid or other), route (per oral transpapillary or transmural, percutaneous transmural or other) and purpose (drainage, lavage, fragmentation, debridement, excision or other). The main advantages of minimal access approaches are a reduction in systemic complications and a lower risk of developing new organ failure. While local complications were slightly increased in some retrospective studies, it is recognised that this might reflect a learning curve.¹⁴ The use of radiologically placed drain tracts to carry out necrosectomy is termed sinus tract endoscopy when only endoscopic debridement is carried out and video assisted retroperitoneal debridement (VARD) when direct access is used. The adverse event rate is reported to be less than 5% and the morbidity rate as low as 10–30% with a mortality rate of 0–20%.¹⁴

At our unit, we have considerable experience of minimal access necrosectomy using a variety of methods, and until recently, we favoured the single port technique using a nephroscope placed through a drain site for lavage and debridement. We have since developed a technique of retroperitoneal laparoscopic necrosectomy through two radiologically placed drain tracts, a technique that we have found to be effective and safe. We detail the technique here and outline our early outcomes.

Methods

This series reports the outcomes of 13 consecutive patients transferred or admitted to a tertiary specialist unit with a diagnosis of acute necrotising pancreatitis. All patients were managed in a critical care setting and underwent contrast enhanced CT on admission. Those with clinical and radiological evidence of infected ANC's or WONs (according to the 2012 Atlanta classification)⁴ were managed in a stepwise approach, initially having one or two drains inserted under radiological guidance, which were then upsized to allow continuous or regular irrigation of the necrotic tissue. If no clinical improvement occurred over 48–72 hours, the drain tracts were used to carry out a laparoscopic retroperitoneal necrosectomy as described below. This approach is the technique of choice in our institution and no other approaches to necrosectomy were undertaken during the reporting period.

Technique

Accurate initial placement of the drains is essential, with one placed more superiorly in the necrotic cavity and the other placed more posteriorly to maximise the subsequent operating angles between ports. Optimal drain placement requires close collaboration with colleagues in interventional radiology, with the appropriate use of imaging techniques (Fig 1).

The anaesthetised patient is placed in a supine position with the left flank elevated by the use of sandbags, and the left arm abducted at the shoulder and positioned on an arm board. Effective neuromuscular blockade is essential.

Following skin preparation and cleansing of the percutaneous drain tubes, an adhesive sterile drape is positioned to cover the operative field. We find that the transparent orthopaedic drape designed for the insertion of dynamic hips screws are ideal, with the collecting funnel placed just beneath the drain sites. A small incision in the material of the drape allows delivery of the drains.

A soft-tipped radio-opaque guidewire is passed through the more superiorly placed drain under fluoroscopic guidance, allowing a length of wire to lie in the cavity. At this point, the drain is removed without displacing the wire.

A 10mm NephroMax balloon dilator (Boston Scientific, Natick, MA, US) is passed over the guidewire and used to dilate the tract gently to a pressure of 12atm for 30 seconds. A soft 12mm Amplatz sheath (Cook Medical, Bloomington, IN, US) is introduced into the cavity over the balloon under fluoroscopic guidance, following which the NephroMax dilator and guidewire can be removed.

A heavy silk stitch is passed through and tied to the distal end of the Amplatz sheath with the long end of the stitch passed through a 12mm laparoscopic port, following removal of the gas valve. The port can now be 'railroaded' into position over the sheath, which is then retrieved by traction on the silk stitch.

The procedure is repeated for the more inferiorly placed drain and the gas valves are subsequently reattached to the ports to permit insufflation of the cavity. Higher pressures than standard are typically required and 20mmHg provides good visualisation in the small cavity.

A variety of laparoscopic forceps and graspers can be used to perform the necrosectomy under direct vision.

Figure 1 Imaging techniques used for optimal drain placement

Figure 2 Typical operative appearances of the pancreatic necrosis and cavity during (A) and following (B) two-port laparoscopic retroperitoneal necrosectomy

Figure 3 Typical appearances of the area of walled off necrosis before (A), immediately after (B) and at six weeks (C) following discharge (following cholecystectomy) after two-port laparoscopic retroperitoneal necrosectomy

Devitalised tissue is gently dissected and removed via the operating port, and suction/irrigation can be used. Simple interventions such as monopolar diathermy or clip application can be employed in the case of bleeding.

At the end of the procedure, soft silicone, closed, non-suction drains are reintroduced into the cavity under fluoroscopic guidance.

Typical appearances of the necrotic cavity during and after debridement are shown in Figure 2. The radiological appearances before and after debridement are shown in Figure 3.

Results

Thirteen patients underwent two-port laparoscopic retroperitoneal necrosectomy (2P-LRN) between October 2010 and September 2013 (Table 1). Ten of the series were male and the overall median age was 46 years (range: 28–87 years). The cause of pancreatitis was confirmed as gallstones in five, ERCP in three (2 for the retrieval of ductal stones and 1 for biliary manometry for the investigation of sphincter of Oddi dysfunction), alcohol related disease in two and idiopathic in two. One patient had developed severe pancreatitis secondary to an isolated pancreatic trauma due to a crush injury.

The median time to first 2P-LRN was 34 days (range: 20–59 days) since onset of symptoms. However, one patient had a decompressive laparostomy carried out for abdominal compartment syndrome on day 30 and another had upsizing of drains on day 18 when a washout using a nephroscope was carried out.

Table 1 Patients undergoing two-port laparoscopic retroperitoneal necrosectomy

Age / sex	Aetiology	APACHE II score	Time to first procedure	Number of procedures	Time to discharge	Total hospital stay	Procedure related morbidity
38 M	Alcohol	8	40 days	5	64 days	134 days	
80 M	ERCP	9	22 days	1	135 days	139 days	Pancreatic fistula, died from respiratory failure on ICU
44 M	Idiopathic	11	20 days	1	21 days	26 days	Bleeding – splenic artery embolised
50 M	Gallstones	6	34 days	2	56 days	90 days	Bleeding – splenic artery embolised
28 M	Alcohol	6	23 days	3	63 days	97 days	Pancreatic fistula
74 M	Idiopathic	10	59 days	2	10 days	120 days	
87 M	Gallstones	12	47 days	1	79 days	126 days	
39 M	ERCP	10	40 days	2	44 days	84 days	Bleeding – splenic artery embolised
41 F	ERCP	14	23 days	2	38 days	61 days	
82 F	Gallstones	10	36 days	1	20 days	56 days	
76 F	Gallstones	12	28 days	1	14 days	42 days	
46 M	Gallstones	11	30 days	1	12 days	42 days	
44 M	Trauma	14	32 days	3	64 days	96 days	

APACHE = Acute Physiology and Chronic Health Evaluation; ERCP = endoscopic retrograde cholangiopancreatography; ICU = intensive care unit

The median number of procedures carried out in these patients was 2 (range: 1–5). The discharge date was recorded as either discharge to the patient's home or back to the referring hospital. The median time to discharge after the last procedure was 44 days (range: 10–135 days) and the median length of hospital stay was 90 days (range: 26–139 days).

There were no mortalities within 90 days of the procedures. However, one patient with chronic airway disease was discharged to the referring hospital on day 135 (60 days following the necrosectomy), was readmitted to its intensive care unit 4 weeks later and died of respiratory complications.

Three patients had postoperative bleeding, which required embolisation of the splenic artery. In two patients, CT angiography did not show active bleeding but splenic artery embolisation was carried out on days 3 and 6 respectively. The third patient was discharged back to the referring hospital on the sixth postoperative day but was readmitted with suspected intra-abdominal bleeding six days later. CT angiography confirmed a bleed from the greater pancreatic branch of the splenic artery, which was embolised successfully.

A pancreatic fistula (as per the International Study Group of Pancreatic Fistula definition of any measurable volume of fluid on or after postoperative day 3 with an amylase level greater than three times the normal limit of serum amylase)⁹ was present in four patients (31%). One of these patients underwent ERCP with pancreatic duct stent insertion. Another was treated successfully with octreotide and lanreotide, and the other 2 patients still had the fistula at 24 months and 6 months following the procedure.

Discussion

The 2P-LRN technique is a straightforward method of directly accessing the pancreatic bed and provides good visualisation of the necrotic tissue. It is not difficult technically and with the availability of various laparoscopic instruments, effective debridement of necrotic tissue is possible. We believe the crucial advantage over the single port technique is the enhanced view of the cavity containing the necrosis, and the improved ergonomics afforded by separating the optical and operating ports. This allows for more efficient debridement and therefore fewer visits to the operating theatre than the conventional single port approach. While this series does not reflect a randomised trial or even a direct comparison, the median number of procedures required per patient was 2 (range: 1–5), which is lower than most retroperitoneal necrosectomy series, where it varies from 3 to 5.²⁰ However, lower numbers have been reported from endoscopic,²¹ transperitoneal² and combined approaches.^{12,15}

There was one death in our series of patients, which was due to respiratory complications that developed after the patient had been discharged to his local hospital and more than 90 days after the necrosectomy procedure. Consequently, our 90-day procedural mortality rate was 0%. Despite the limitations outlined above (of a descriptive series versus a trial), this compares extremely favourably with other published mortality rates following retroperitoneoscopic necrosectomy of 0–26%.^{14,20}

A systematic review of endoscopic necrosectomy suggested outcomes may be improved with this route compared with open or direct retroperitoneal access as overall morbidity and mortality rates were found to be 27% and 5% respectively, which was lower than with surgical minimal access methods.¹⁷

The multicentre PENGUIN (Pancreatitis, ENdoscopic transGastric versUs primary necrosectomy in patients with Infected Necrosis) trial by the Dutch Pancreatitis Study Group randomised patients to either endoscopic or surgical necrosectomy and found endoscopic necrosectomy to be superior with significantly less new onset organ failure (0% vs 50%, $p=0.03$) and fewer pancreatic fistulas (10% vs 70%, $p=0.02$).¹⁸ Mortality was also lower (10% vs 40%) but this was not statistically significant.

This method, however, is not applicable to all patients as the collections to be drained need to be within 2cm of the gastric or duodenal wall. A visible swelling indicating the site for transmural puncture is only present in 50–60% of patients and endoscopic ultrasonography (EUS) is therefore needed to reach a higher technical success rate (95%).¹⁴ While this requires advanced endoscopic and EUS skills, a prospective randomised study has shown lower adverse event rates of 0–4%.¹⁹ Typically, 3–6 sessions are required to complete the debridement through the endoscopic route, which is significantly more than our experience of 2P-LRN. Whether a combination of endoscopic debridement with percutaneous drainage might be the best way forward is being examined in an ongoing randomised trial.¹⁴

In one patient, bleeding was encountered during the procedure itself and was found to be originating from a pulsatile vessel. With the use of suction irrigation to isolate the bleeding point, the vessel was clipped using a 10mm laparoscopic clip applicator. No other adverse events were encountered during these procedures, which is consistent with the low rate reported by the American Pancreatic Association.¹⁴ Pancreatic fistula is a common problem following necrosectomy and our rate of 31% is consistent or better than what others have found with minimally invasive techniques although comparisons are hindered by varying definitions.^{2,10,12}

Several operative techniques for minimally invasive necrosectomy have been described over the past 10–15 years. Like ours, most descriptive series consist of small numbers but various approaches have been found to be safe and effective. The advantages of minimally invasive techniques over open surgery were highlighted by the multicentre PANTER (Pancreatitis, Necrosectomy versus sTEp up appRoach) trial in the Netherlands where patients with necrotising pancreatitis or infected necrosis were randomised to either a 'step-up' approach that initially involved percutaneous or endoscopic drainage followed by necrosectomy performed via a flank incision if there was no clinical improvement within three days or to a group that went straight to open surgery.¹³ Patients assigned to the step-up approach had a lower rate of major morbidity and mortality than the open surgery group (40% vs 69%, $p=0.006$) as well as a lower total number of operations ($p=0.004$).

Our overall morbidity rate of 38% compares extremely favourably with the Dutch experience as the PANTER study

did not include pancreatic fistulas in the stated morbidity figure as they were not considered a major complication. If pancreatic fistulas are similarly excluded from our analysis, our morbidity rate would be 23%.

The minimally invasive technique used in the PANTER trial was the VARD whereby a 5–7cm subcostal incision is made to allow direct access to the necrotic tissue. While this allows easier removal of large pieces of necrotic tissue, we have not found this to be a problem through the 12mm laparoscopic port, where the gas valve can be removed temporarily to allow retrieval of large fragments of necrosis. Indeed, Gambiez *et al* reported that 2 out of 20 patients developed late hernias through the lumbotomy wound following endoscopic retroperitoneal drainage and both needed reoperation.¹⁶ Minimising the number and length of incisions may therefore prevent this complication, and we have not had any issues with hernias at the laparoscopic port sites.

A further advantage of direct percutaneous access to the retroperitoneum over a transperitoneal laparoscopic approach is the avoidance of a pneumoperitoneum in a critically ill and potentially unstable patient. Our technique also requires less dissection, is easier technically and avoids contamination of the peritoneal cavity by infected material from within the pancreatic bed.

Access to the pancreatic bed from the left flank, as described in our technique, allows drainage of collections from the distal portion of the pancreas, along the left retrocolic gutter and even to the pelvis. We have also used a modification of the technique to permit debridement of retroperitoneal necrosis from the right retrocolic area, via suitably placed right-sided drains.

Most areas of WON may therefore be accessed via the 2P-LRN approach, with the possible exception of those in the transverse mesocolon or mesenteric root.¹⁶ Close collaboration with interventional radiologists to allow the accurate placement of drains is therefore the most important step.

In our series, one patient had developed an abdominal compartment syndrome secondary to his pancreatitis, which is a complication that has been reported in up to 30% of cases of severe pancreatitis.²² In this case, we elected to treat the abdominal compartment syndrome as a separate entity to the infected pancreatic necrosis and despite the patient undergoing a decompressive laparostomy, we chose to then treat the necrosis via 2P-LRN. This approach was successful in avoiding contamination of the peritoneal cavity with the infected necrotic material and although clearly anecdotal, we felt that by separating the route of access for the two procedures, we were able to achieve definitive abdominal closure faster than we would have managed following conventional open necrosectomy.

Conclusions

Minimal access methods for pancreatic necrosectomy have been proven to be superior to traditional open surgery for the majority of patients, leading to fewer complications and faster recovery. A step-up approach with percutaneous drainage followed by minimal access debridement if there

is no clinical improvement has been shown repeatedly to offer an effective strategy.

2P-LRN appears to be as safe and effective as other techniques for minimal access debridement. Furthermore, it possibly has the additional advantages of superior visualisation and access to the necrotic cavity with small laparoscopic incisions. This seems to confer the benefit of fewer procedures being required to clear all necrosis and it is associated with a low morbidity rate for this critically unwell group of patients.

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