In this article we introduce a novel technique of repeated single-port transgastric debridment of walled-off pancreatic necrosis using TriPort™ Access System. The presented technique seems an appealing and innovative approach to the treatment of walled-off pancreatic necrosis in acute pancreatitis patients. Studies proving feasibility, safety and efficiency are necessary to elucidate real value of the technique.

**Key words:** acute pancreatitis, walled-off pancreatic necrosis, minimally invasive debridement, single port surgery

Surgical and medical management of acute pancreatitis is still a great challenge in modern surgery. Although necrosectomy through laparotomy has evolved, been simplified and in specialist HPB centers is carried out with low mortality (1, 2) minimally invasive approaches have been studied and gradually implemented for over a decade now (3). The general goals of acute pancreatitis invasive treatment became universal and are well described. The choice of access is only to minimize damaging effect of treatment with full profit of controlling infection and effective debridement of walled-off necrosis collection. According to Windsor minimally invasive necrosectomy can be classified by the type of scope used and by route of access (4). First classification would then distinguish flexible endoscope, laparoscope or nephroscope and the second one would divide procedures into transperitoneal, transgastric and retroperitoneal.

The most extensively utilized techniques would therefore be: retroperitoneal nephroscopic approach, laparoscopic approach and endoscopic transgastric approach. Although each of those procedures is applicable in slightly different clinical scenarios at present there is no direct evidence to suggest that any of the minimally invasive necrosectomy techniques is superior to open surgery or each other (3). In each individual case benefits and potential threats of minimally invasive technique should be balanced against well established data on open technique with all its limitations (worsening of organ dysfunction, ICU requirement).

Recent implementation of single-port approaches in different fields of surgery has proven safety and feasibility of such procedures. Several procedures such as cholecystectomy or appendectomy are now being widely used. However, the benefits of single-port laparoscopic procedures over standard laparoscopic procedures are still to be proven. Extreme superiority should not be expected as in fact the route of the procedure remains unchanged.

TriPort™ Access System (Olympus) designed for single-port access carries several features enabling innovative approaches. Among these features are: openable cap—wide access, 10 mm port for clipping and stapling, reliable sealing,
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wound lining and protection (extraction bag not necessary). In this article we introduce a novel technique of repeated single-port transgastric debridement of walled-off pancreatic necrosis using TriPort™ Access System.

Clinical applications of technique

Target group of patients would include acute pancreatitis patients with walled-off pancreatic necrosis. Anatomical requirements of the procedure constitute of two main conditions:
- direct proximity of sufficiently mature and walled-off collection to the posterior wall of the stomach (similarly to the endoscopic transgastric approach),
- direct proximity of anterior wall of the stomach to the abdominal wall (accessibility similar to PEG introduction).

The indications and timing of the procedure would be no different from current state of art and would require demarcation of necrotic tissue for about 2-4 weeks to provide optimal proportions of fluid and solid content of the collection.

Contrast CT or MRI should be main imaging modalities for preoperative planning.

DESCRIPTION OF TECHNIQUE

Patient preparation

The procedure involves stomach insufflation and therefore endotracheal intubation is essential to prevent aspiration. Patient is positioned in slightly antitrendelenburg position with the surgeon between the patient’s legs. Routine gastroscopy is first performed for evaluation of technical feasibility of the procedure in an individual patient and possible identification of stomach pathologies. Good stomach insufflation through gastroscope in-sufflation channel is mandatory to maximize the approximation of anterior gastric and abdominal walls.

TriPort™ positioning

The abdominal wall is than illuminated with the light of the gastroscope to choose most appropriate part of the anterior gastric wall (adherent to the abdominal wall). Subsequently Suture Passer (GORE) is used to perform percutaneous gastropexy immobilizing the port insertion site. Endoscopic grasper is used for the assistance in thread manipulation. Gastropexy is performed with 4 sutures placed at the corners of a virtual rectangle about 4cm from each other. Once again illumination with the gastroscope is performed to prevent adjacent organ damage. Straight needle is used to puncture the abdominal wall and anterior wall of the stomach (as in PEG technique) to assess the trajectory of the TriPort™ Access System insertion.

This is followed by a skin incision (variable in size due to the thickness of the patient’s subcutaneous fat), preparation to the fascia and opening (1.5-2 cm) of the abdominal cavity and subsequently opening of the anterior gastric wall. The gastric wall opening is controlled in gastroscopy view. Port introducer is inserted into the lumen of the stomach (with counter traction of the anterior stomach wall with gastroscope to prevent posterior wall injury) and TriPort™ Access System is securely positioned and fixed as recommended by manufacturer (fig. 1). From this point both anterior abdominal and anterior gastric walls are embraced by TriPort™ Access System.

Necrotic tissue debridement

5 mm 30 degree laparoscope is introduced first to obtain proper visualization of the posterior wall of the stomach. Gastroscope can be retracted at this point. Two 5 mm instruments are introduced through the 5 mm ports: left hand – 5 mm articulating grasper (Covidien); right hand – 5 mm LigaSure™ V Sealer/Divider. The above mentioned instruments are used to incise the posterior wall of the stomach (1-3 cm) and perform lavage and gentle debridement of the necrotic tissue under direct vision. The use of articulated instrument allows workspace parallel to the splenic vessels, minimizing the risk of injury. Extensive lavage is used (one of the instruments is exchanged to lavage/suction device). Drain is introduced through one of the ports of TriPort™ Access System and is positioned in the lesser sack for continuous lavage (fig. 2). Instruments are then retracted. With TriPort™ Access System
in place the patient is transferred to the recovery room or ICU.

Repeated explorations

Repeated explorations are possible through TriPort™ Access System in OR or even in ICU. Endotracheal intubation is mandatory. Gastroscopic assistance is not necessary as a 5 mm 30 degree laparoscope is used for visualization (inserted through TriPort™ Access System). 10 mm port within the TriPort™ Access System enables for example clipping or stapling. Opening of the TriPort™ Access System cap enables direct debridment with open surgery instrumentation (fig. 3).

Instrumentation necessary for first access and revision procedures was summarized in tab. 1.

Potential improvements and optional steps

Articulated laparoscope would be of use instead of 30 degree scope for better visualization of the retrogastric space. EUS could help to identify optimal site for incision of the posterior wall and to avoid collision with vessels.

Clinical application of the technique

The technique was used in the Department of General, Endocrine and Transplant Surgery, Medical University of Gdansk, Poland. A 37 old year old male patient with infected pancreatic necrosis in the course of acute alcohol related pancreatitis underwent described procedure. TriPort™ Access System after 21 days spent implanted percutaneously directly into stomach lumen did not carry any macroscopic signs damage or disruption (fig. 4). The treatment was initially very successful (fig. 5), however in the course of hospitalization after significant improvement in clinical parameters confirmed in CT scans the patient developed a complication typical for pancreatitis and independent from the technique in our opinion.

<table>
<thead>
<tr>
<th>Table 1. Instrumentation used for the technique</th>
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<td>First access</td>
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<tr>
<td>TriPort™ Access System</td>
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<td>Laparoscope</td>
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<td>Gastroscope</td>
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<td>Articulated grasper</td>
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<td>Straight needle suture</td>
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A severe bleeding emerged several days after removal of the TriPort™ Access System. Laparotomy revealed ruptured aneurysm of the splenic artery. Despite this complication authors believe that the technique is feasible and safe and therefore it is interesting for further evaluation.

Advantages and disadvantages of the technique

The advantages of the technique are:

- compartmentalization of necrotic tissue, avoidance of intraperitoneal spread of tissue and fluid,
- intuitional topographic situation,
- effective drainage and debridment of fluid and solid contents of the collection through large opening,
- possible revisions,
- possible use of open surgery instruments after opening of the TriPort™ Access System cap (removal of large devitalized tissue fragments),
- drainage to the stomach and continuous lavage through TriPort™ Access System between revisions,
- revisions possible in ICU, avoiding patient transportation,
- easy conversion if necessary,
- good cosmetic effect,
- possible hybrid procedures with different access routes,
- direct control of nasojejunal feeding tube insertion,
- low risk of large bowel injury (comparing to open route).

The disadvantages of the technique are:

- laparoendoscopic approach during first access,
- stomach insufflation and potential risk of aspiration,
advanced skills in laparoscopy required,
- risk of bleeding difficult or impossible to control through this access, especially bleeding to the retroperitoneal space,
- gastric fistula,
- gastric stenosis or motility dysfunction,
- delayed or complicated readministration of enteral feeding.

DISCUSSION

Minimally invasive techniques in debridement of infected necrosis in acute pancreatitis patients are becoming a valid option for those patients although conclusive randomized controlled trials on large groups of patients were not yet conducted (3). In this article we describe a novel technique of repeatable single-port debridment through the lumen of the stomach. This technique offers repeatable debridment of even large necrotic tissue fragments without contamination of the peritoneal cavity as it is in laparoscopic approach. Avoiding the spread of necrotic collection contents along with bacteria, pancreatic enzymes and inflammation mediators throughout the peritoneal cavity would decrease the aggravation of organ insufficiency and patient deterioration often observed after surgical intervention (3). The communication between the stomach and the collection is wider than in endoscopic transgastric approach (up to 20 mm) and all the manipulations are well visualized and well instrumented (5). Moreover open surgery instrumentation can be used for removal of large necrotic tissue fragments as illustrated in figure. The surgeon is operating in a known topography with recognizable landmarks what offers precision and significantly improved spatial orientation. This can not be achieved in retroperitoneal nephroscopic approach. After first access TriPort™ Access System can be left in place for several days what enables and facilitates repeated debridment (difficult in laparoscopic transperitoneal approach). With the device in place continous lavage or lavage/suction system is possible to work between revisions. The technique can be used in sequel of transgastric endoscopic treatment with pigtail stent placement. In such case widening of the opening and direct debridment could be a second and final step of the treatment.

The technique can be initially technically demanding as simultaneous gastroscopy and laparoscopy is performed requiring coordination of those two modalities. Due to insufflations of the stomach, to prevent aspiration the technique requires endotracheal intubation or other way of airway management. One of the most dangerous complications in all minimally invasive techniques is bleeding. It is observed in significant percentage of the cases in all techniques (3). Instrumentation of large vessels (i.e. splenic) or aneurysms often present in this pathology can lead to catastrophic bleeding difficult to manage even when converted to open approach (5). A variety of problems related to stomach manipulations and possible dysfunction should be considered a significant drawback. Incision of both anterior wall of the stomach and performing wide opening in the posterior wall can lead to impaired gastric motility or strictures, treatment of which in changed anatomy would probably not be easy. Anatomical situation of the stomach can be assessed with gastroscopy or upper GI series (fig. 6). Closure of the stomach external fistula after removal of TriPort™ Access System (fig. 7) can also be problematic and lead
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Fig. 7. Wound after removal of TriPort™ Access System (after 21 days) before closure with drain intended to enable further lavage to chronic gastric fistula with skin erosion and other problems.

Summarizing, the presented technique seems an appealing and innovative approach to the treatment of walled off pancreatic necrosis in acute pancreatitis patients. Studies proving feasibility, safety and efficiency are necessary to elucidate real value of the technique. With its fundamental advantages and potential complications in selected cases it seems to be a promising alternative to open approach and a valuable option among minimally invasive techniques.

REFERENCES


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Adress correspondence: 80-211 Gdańsk, ul. Dębinki 7