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Management of Perforation of the Third and Fourth Part of the Duodenum; A Review Article

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ABSTRACT

A perforation or as called; diverticulum in the duodenum is the second most common location for one in the digestive system. Less than 200 occurrences of perforation were reported, therefore problems are quite uncommon. As many as 22 percent of the population may have discomfort from duodenal diverticula, which were originally identified in 1710. Bleeding, inflammation, compression of surrounding organs, growth of malignancy, cholestasis, and holes in the organ are all possible but extremely rare consequences. Due to the perforation's location in the abdomen, peritoneal irritation is a symptom that may or may not present itself. As a result, a clinical diagnosis is more challenging for the treating physician. Extra-luminal retroperitoneal air and mesenteric fat stranding can be seen on a CT scan, which can assist diagnose the problem. Although non-surgical treatments have had success with some patients, surgery remains the gold standard. Duodenopancreatectomy and diverticulitis surgery are two other alternatives for management of third and forth parts of duodenal perforations. Rare as they may be, perforated diverticula in the duodenal segment IV nevertheless respond favourably to surgical intervention. If you or someone you know sustains an abdominal injury, your first instinct should be to suspect foul play. Ideally, you would get a CT scan. Treatment options must take into account the patient's current health status and any other medical conditions they may have, as well as the surgeon's level of experience, any applicable recommendations, and any accessible resources.

INTRODUCTION

The duodenum is a part of the digestive system that connects the stomach to the small intestine (Ames *et al*., 2009). It is made up of four parts: The part closest to the stomach is called the duodenal bulb. It connects to the liver through a ligament called the hepatoduodenal ligament, which has the hepatic artery (Thompson *et al*., 1993), the portal vein, and the common bile duct in it. The head of the pancreas is surrounded by the second, or descending, segment. The horizontal part is the third part (Donovan and Hagen, 1966). The vessels of the upper mesenteric artery are below this segment. After the jejunum comes the fourth part. Duodenal perforation is rare, but when it happens, it's fatal. The literature says that the death rate is anywhere from 8% to 25% (Shimada *et al*., 2020).

A hole in the duodenum can be either open or closed. When bowel contents leak freely into the abdominal cavity, this is called a "free perforation," and it causes diffuse peritonitis (Donovan *et al*., 1966). A contained perforation happens when the ulcer makes a full-thickness hole, but the area is kept from leaking by organs like the pancreas that are close by and block the hole. Peptic ulcer disease is a major cause of a hole in the duodenum. People with duodenal ulcers usually have stomach pain at night or feel hungry. If perforation happens, it can often cause severe pain in the upper abdomen to start all of a sudden (Kumbhari *et al*., 2016). However, if a person's immune system is weak or if they are very old, the clinical signs may not be visible. This can make the diagnosis take longer. Imaging is a key part of figuring out what's wrong and then starting treatment right away. By choosing the right treatment options and looking at the risks, you can lower the risk of morbidity and death (Nepal *et al*., 2017).

HISTORY

Muralto wrote about the perforated duodenal ulcer in 1688, and Lenepneau wrote about it. After that, in 1894, Dean (1894) reported the first case, in which a perforated duodenal ulcer was successfully closed with surgery. Cellan-Jones (1929) wrote about a way to fix holes with an omental in 1929, and Graham changed that way of doing things in 1937 (Ansari *et al*., 2019).

Perforated peptic ulcer risk factors should be explored by clinicians with patients whenever possible. However, even if PPU did occur, the patient's history would not affect the recommended course of treatment. Perforated peptic ulcer (PPU) symptoms typically include rapid onset of severe abdominal discomfort that does not improve with over-the-counter medication. The characteristic triad of PPU patients is tachycardia, acute abdominal discomfort, and abdominal rigidity. Abdominal pain, stiffness, and a rapid heart rate are common clinical symptoms (Berne *et al*., 1974).

There are three distinct phases that manifest themselves in a patient's clinical PPU symptoms. Within the first two hours after the onset of symptoms (the first phase), it is common for patients to experience tachycardia (Juler *et al*., 1969), upper abdominal pain, and cold extremities. Moving causes more discomfort during the second phase, which can last anywhere from two hours to a full day (Berne *et al*., 1974). Pain in the right lower quadrant and abdominal rigidity are symptoms of fluid accumulation along the right paracolic gutter. Third-phase symptoms include abdominal distention, fever, and low blood pressure if the fast lasts more than 12 hours. Patients with retroperitoneal perforation are less vocal and demonstrate no peritoneal symptoms (Simões *et al*., 2014).

Management of third and fourth parts of duodenum perforation

The type of perforation determines the course of treatment for the duodenal perforation's third and fourth segments (Donovan *et al*., 1979). Perforations can be classified as either contained or uncontained. When it comes to non-contained perforation, there are two subcategories to consider: minor perforation and significant perforation (Oukachbi and Brouzes, 2013).

The following figure shows the main criteria of classifying the duodenal perforations' management,

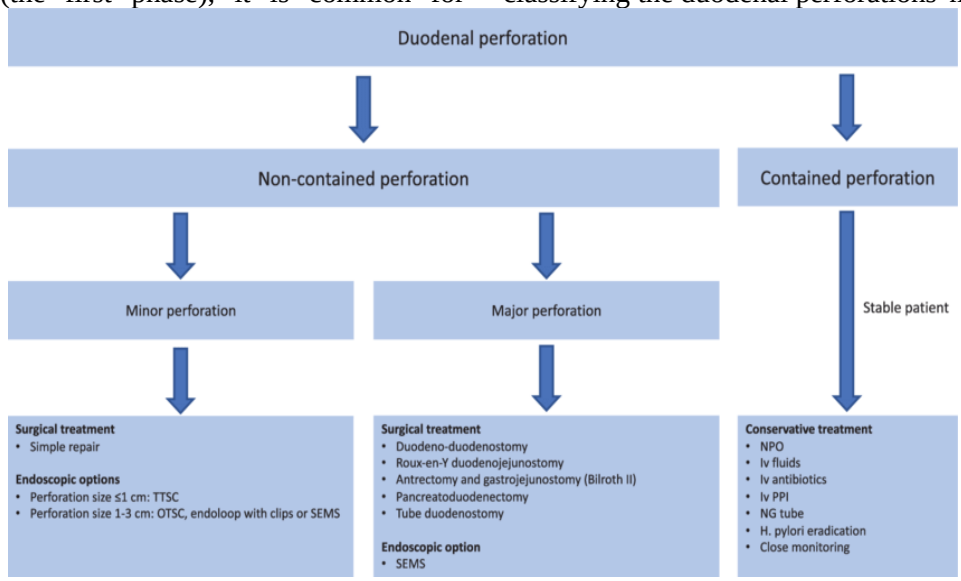

Figure 1 Criteria for duodenal perforations management (Ansari, 2019)

The area is said to be "contained" when neighbouring organs, such the pancreas, wall off the area, preventing leaking (Shimada *et al*., 2020). This perforation type can be treated conservatively. It is crucial to perform a diatrizoate investigation on the patient to rule out leakage before beginning conservative treatment (Oukachbi and Brouzes, 2013). Conservative management includes a combination of measures, such as intravenous fluid therapy, nil per os (nothing by mouth), intravenous proton pump inhibitors (PPIs), broad-spectrum antibiotics, eradication of H. pylori, and regular clinical assessments. Evidence suggests that somatostatin can aid in the closure of an enterocutaneous fistula (Ames *et al*., 2009).

The mortality rate for patients with a confined perforation was found to be 3% with conservative treatment and 6.2% with surgical treatment. When it comes to conservative treatment for duodenal perforation, the "Rs" sum up the most crucial aspects (Avgerinos *et al*., 2009): Multiple clinical evaluations, multiple blood tests, multiple scans, multiple leak checks, monitoring resources, lung and kidney support, and surgical readiness. A non-contained perforation is one in which the contents of the colon escape into the abdominal cavity. In this set, you'll find both little and big holes (Inoue *et al*., 2014).

Leaks of a minor nature: Both endoscopic and minimally invasive surgical repair are common treatments for this group. Endoscopic management makes use of a wide variety of instruments, including through-the-scope clips (TTSC), over-the-scope clips (OTSC), detachable snare loops with clips, and self-expanding metal stents (SEMS). Treatment with TTSC is recommended for linear perforations less than 1 cm in length. Perforations between 1 and 3 centimetres in length can be effectively treated with OTSC, a detachable snare loop with clips, or SEMS. Simple surgery can also be used to repair a tiny perforation that has spread. The doctor may choose to do the procedure with or without an omental patch. Two further methods exist for repairing the perforation: the free omental plug (Graham patch) and the pedicled omental flap (Cellan-Jones repair). Putting a drain in after surgery has not been found to improve outcomes in any study.

Major, unrepaired holes: These perforations typically necessitate repair surgery, such as a duodenoduodenostomy, Roux-en-Y duodenojejunostomy, or Billroth II procedure. The Billroth II procedure must fix the problem if there is a hole in the first or near the second section (Donald, 1979).

Postoperative as well as Rehabilitation Care

The 30-day mortality rate was reduced from 27% to 17% in a non-randomized research when the management strategy was followed from the time of admission to three days after a laparoscopic repair (BURRUS *et al*., 1961). The management strategy in this investigation involved shortening the interval between surgery and the beginning of sepsis treatment. Patients with an ASA score of I or II who had their tubes removed and began eating and drinking on their own early reduced their hospital stays by around three days, according to a small randomised clinical trial conducted in Turkey (Cellan-Jones, 1929; Snyder *et al*., 1980).

A meta-analysis conducted by Wong *et al*. indicated that eliminating H. pylori decreased the rate of recurrent ulcers in patients with duodenal ulcer perforation at eight weeks and one year after surgery. It is not suggested that persons who have had a perforation of the duodenum (a type of stomach ulcer) have a follow-up endoscopy due to the low risk of malignancy. Advice by following these steps: After discovering a duodenal perforation, it's best to consult with a gastroenterologist and a gastrointestinal surgeon.

Another way of classification for the management of third and fourth parts of duodenal perforation, surgical and non-surgical approaches. The following paragraphs will show the ideality, criteria of those ways of management according to the etiology (Ballard *et al*., 1997):

Alternative medical procedures to surgical operations

In 1935, Wangensteen published the first study to show the potential of ulcers to self-seal. He also reported on seven cases that were successfully cured without surgical intervention. 1946 saw the confirmation of this result when Taylor successfully treated 28 cases without resorting to surgery. This is something that should be appreciated in light of the historically high rates of death and morbidity that were associated with surgical therapy (Degheili *et al*., 2017).

Research conducted after the fact revealed that a water-soluble contrast study might be used to provide conclusive evidence of self-healing in between 40 and 50 percent of cases. It has been demonstrated that non-operative treatment for a perforated duodenal ulcer has a low death rate and few complications when a sealed perforation is visible on a gastroduodenogram. This was proved by Crofts *et al*. in an experiment that was carried out in Hong Kong in the year 1989. (Grade A) (Wichmann *et al*., 2021).

As soon as a ruptured duodenal ulcer is identified, immediate action is taken to resuscitate the patient, begin nasogastric suction, and begin antibiotic treatment that encompasses a broad spectrum. This can be aspirated to reduce pressure in the peritoneal cavity in cases where a tight pneumoperitoneum is making it difficult to breathe. A gastroduodenogram is performed

whenever there is a reason to assume that self-sealing has occurred (Kapp *et al*., 2022).

If there is continued significant fluid loss after four to six hours, surgical intervention is required. The same is true if there is progression of symptoms associated with peritonitis or expanding pneumoperitoneum (Abadir *et al*., 2005; Juler *et al*., 1969).

Crofts decided to conduct his experiment on young patients who were hemodynamically stable, had recently been perforated (within the last 24 hours) (McCreery, 1924), and could be closely followed. When all of these factors were used to select patients for randomization, a total of seventy percent of patients were assigned to receive this medication. In spite of the encouraging results of this trial as well as those of several other studies that were not randomised, the non-operative treatment of perforated duodenal ulcers is not yet widely used (Schnueriger *et al*., 2008).

The poor acceptance of non-operative therapy is probably due to the difficulties associated with recurrent examination by competent surgeons, incorrect diagnosis, and a lack of opportunities to perform definitive ulcer surgery (Howard *et al*., 1999). The only patients who have been able to receive treatment that does not include surgery are those who are in too poor of health to undergo laparotomy. In spite of the high mortality rate, it has been shown that certain critically ill individuals can be treated with restraint, and that interventional radiology can be utilised to treat any intraabdominal abscesses that may arise (Grade C) (Barillaro *et al*., 2013).

Endoscopy is required after the use of non-operative therapy because it is necessary for the objectives of determining whether or not the ulcer is healing, receiving treatment for H. pylori, and making an accurate diagnosis (Grade C) (Howard *et al*., 1999).

Medical Procedures

Surgical Procedures Carried Out Utilizing a Laparoscope

In the past, a perforated duodenal ulcer was treated with a Graham Omental Patch and extensive abdominal lavage (Yildirim *et al*., 1995). Both of these treatments are still utilised today. In recent years, it has become clear that laparoscopy is the most effective method for carrying out this treatment (Simões *et al*., 2014). It would appear that the only significant advantage of the laparoscopic method is a reduction in the amount of postoperative pain experienced. Although the total amount of time spent in hospital appears to be comparable to that of more conventional therapies, the amount of time spent in surgery is significantly longer than that of open procedures. Because there have not been enough prospective studies done on a wide scale, this strategy cannot yet be considered the gold standard. It is important to point out that research conducted by a variety of organisations has demonstrated that laparoscopic ulcer surgery can be performed successfully (Grade A/C) (Shilyansky *et al*., 1997).

Immediate and Complete Procedure

Over the course of the last century, researchers have experimented with a variety of approaches in an effort to improve the efficiency of the conventional methods of closure and lavage. This is due to the fact that even after surgery, a significant percentage of individuals, ranging from 25 to 85%, continue to have symptoms associated with their ulcer diathesis. According to the majority of research (Markogiannakis *et al*., 2008), the severity of ulcer symptoms is linked to whether the ulcer is acute (less than three months old) or chronic (more than three months old). This distinction is made according to the patient's medical history before surgery. Patients who suffer from ulcer symptoms that do not go away are, in most circumstances, more likely to face a recurrence of their ulcer (Hill, 2001). Even though the majority of research find the rate to be far lower, up to 71% of individuals will at some point require definitive surgery (Grade C) (Yamamoto, *et al*., 2014).

Since the 1940s, the surgical treatment of ulcers in an immediate and permanent manner has been a subject of discussion and debate within the realm of medicine. There is compelling evidence that extremely selective vagotomy (proximal gastric or parietal cell vagotomy) combined with simple omental patch closure of the perforation is exactly as effective as that which is performed in the elective setting, in patients who do not have the risk factors that were previously mentioned (Grade C) (Rajagopalan and Pickleman, 1982). The risk of passing away is lower than one percent, but the risk of ulcers returning is between four and eleven percent. This surgery places a significant amount of demand on the expertise of the operating surgeon. A truncal vagotomy with drainage is a standard operation that is well-known to the vast

majority of surgeons. This procedure has its supporters (Dubecz *et al*., 2012).

The widespread acceptance of this treatment has been hampered by the widespread belief that immediate definitive ulcer surgery poses a greater risk to patients than does simple closure. If a definite surgical strategy were to be applied everywhere, one school of thought contends that between 50 and 60 percent of patients would be forced to undergo unnecessary surgical risks as a result. On the other hand, a very selective vagotomy carried out by properly qualified surgeons is associated with virtually negligible morbidity (Grade A).

The majority of people believe that the most effective strategy would be to perform emergency surgery on just those patients who have a case history that has been ongoing for an extended period of time (more than three months) and who do not have any preoperative risk factors. As a result of the fact that many patients are too sick to provide a reliable history, it may be challenging to identify who among them genuinely has a history of chronic ulceration prior to surgery. In addition, as much as seventy percent of perforations happen as the initial indication of the ulcer diathesis, which suggests that many ulcers have a history of being relatively silent ulcers (Ames, *et al*. ,2009).

However, it is essential to keep in mind that in the industrialised world, the major task of the surgeon in the treatment of perforated duodenal ulcer will continue to be the performance of lifesaving procedures in elderly patients who are physically unfit (Oukachbi and Brouzes, 2013).

Modest Operation

Surgeons have gone back to employing the traditional method of omental patch closure ever since the late 1970s, when post-operative H2 antagonists and, more recently, proton pump blockers were readily available. The relevance of H. pylori in the progression of duodenal ulcer has come to be more appreciated over the past decade, which has led to an intensification of this trend (Avgerinos *et al*., 2009).

In light of the fact that Helicobacter pylori (H. pylori) may play a role in as many as 90% of perforated duodenal ulcers, it makes sense to use patch closure and then antibiotic treatment of the infectious agent in order to avoid having to resort to definitive surgical ulcer care in the case that the non-surgical treatments fail (Simões, *et al*., 2014). A recent randomised controlled trial that was carried out in Hong Kong found that patients with duodenal ulcer perforation who were treated with antibiotics to get rid of H. pylori had an ulcer heal in 78% of cases, with only a 48% recurrence risk after a year. The trial was carried out on patients who had been hospitalised for more than three days (Grade A) (Rajagopalan and Pickleman, 1982).

Because patients with perforated duodenal ulcers are a subgroup of individuals who have a particularly robust ulcer diathesis, it is possible that treating the infecting organisms and closing the ulcer on its own might not be sufficient treatment for these patients. However, this is just one line of thought. We won't have conclusive evidence until additional clinical trials with community members who are representative of the whole population are carried out (García-Molina *et al*., 2015).

In spite of this, it would be wise to proceed with extreme caution for the time being. Due to the potential involvement of H. pylori (Strong, 1958), vagotomy should not be performed on every patient who has a perforated duodenal ulcer. Vagotomy is a hazardous treatment that should be avoided wherever possible (Nepal *et al*., 2017).

H. pylori treatment

The elimination of H. pylori has been the subject of multiple proposed therapeutic strategies (Kumbhari *et al*., 2016). The current first line treatment for eliminating H. pylori, which consists of bismuth, metronidazole, and amoxycillin or tetracycline and is provided over the course of 14 days with or without a proton pumpblocker (Grade A/B), has an approximately 90% eradication rate (Oukachbi and Brouzes, 2013).

It is absolutely necessary to carry out eradication testing due to the emergence of resistance to first-line regimens, particularly in the developing world. Endoscopy, biopsies, and even non-invasive methods like as serology or testing the breath for urea can all be used to confirm that the infection has been eliminated (STONE and FABIAN, 1979). At this point, it seems like it would be a good idea to have a post-operative endoscopy in order to confirm that H. pylori has been eradicated, confirm the diagnosis, and evaluate how well the ulcer is healing (Donovan and Hagen, 1966).

The ulcer has a fair chance of healing, and it is unlikely that it will become infected again if H. pylori is eradicated (less than 1 percent per year). If the ulcer has healed, there is no need in continuing treatment with drugs intended to treat reflux disease. If the patient is required to continue

using nonsteroidal anti-inflammatory medicines, misoprostol is the most effective preventative treatment that is currently available (Grade B) (Yildirim *et al*., 1995).

Examples for interventional surgical perforation management,

Figure 2 Perforated third part of duodenum (Nepal *et al.*, 2019)

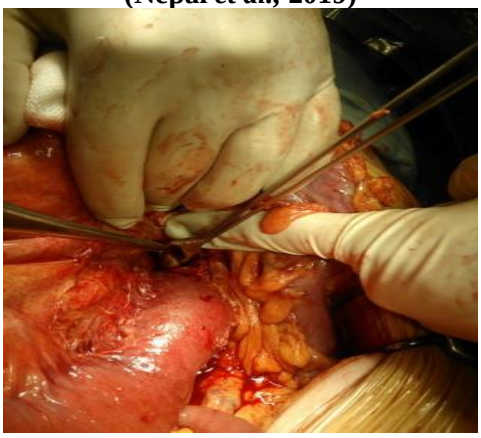

Figure 3 Surgical *intervention* for *perforated* duodenum (Dubecz *et al*., 2012)

Figure 4 Surgical intervention for perforated duodenum (*Barillaro et al., 2013*)

CONCLUSION

Current methods for treating a perforated duodenal ulcer are not set in stone. It is now more debatable whether a simple patch closure or immediate definitive surgery is preferable due to the benefits and drawbacks of laparotomy, the advent of laparoscopy, and the revelation of the role of H. pylori. The surgeon should keep in mind that non-surgical treatment should be exhausted before resorting to surgery for a patient with a perforated duodenal ulcer. The patient will need close monitoring, with appropriate measures ready to be taken at the first sign of worsening or failure to make adequate progress, if this course of action is decided (Grade A).

Evidence suggests that a simple omental patch closure, lavage, and antibiotic treatment for H. pylori can be effective if surgery is considered essential (Grade A). Even if H. pylori has been surgically removed and the patient still has an ulcer, a Highly Selective Vagotomy should be performed to ensure that the patient's hypersecretory status is not due to anything other than benign causes (Grade C). If a patient has been tested for H. pylori and found to be negative, or if they have been treated and then experienced a perforation, definitive ulcer surgery should be performed immediately if there are no prior risk factors. A Truncal vagotomy and pyloroplasty can be used to correct the condition if the surgeon has never performed a Highly selective vagotomy before. Closure and lavage should be sufficient in the event of a perforation when on ulcerogenic medications. Many people with an ulcer diathesis will show no symptoms, so an endoscopy is necessary to ensure that the ulcer has healed and H. pylori has been killed. There will be no consensus on the optimum treatment approach until a randomised prospective trial is conducted.

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