Chapter 4

Duodenal Fistulas

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Introduction

A fistula is an abnormal communication between two hollow organs or one hollow organ and skin. Up to 85% of enteric fistulas are related to abdominal surgery or interventional endoscopy. Duodenal fistulas are not an exception, consecutive to upper abdominal surgery or gastro-intestinal (GI) endoscopy, especially endoscopic retrograde cholangiography (ERCP), and they represent 3-14% from all enterocutaneous fistulas [1].

There are a large interest concerning the management of duodenal fistulas since of the beginning of the 1900 [2, 3], because of the high rate of mortality in those times. Despite all advances in therapy, and cumulated experience morbidity and mortality in duodenal fistula management is still high ranging between 38-75% and 7-40% respectively [1].

Up to 25% of postoperative mortality from duodenal fistulas is caused by infection and sepsis as complications from fistulas, retroperitoneal involvement in cases of post ERCP perforations often leads to an unrecognized diffuse infection of the areolar tissue, which is a starting point for a severe sepsis, sometimes with unfavorable end. Uncontrolled fistula output often leads to fluid and nutritional loss which adds morbidity and mortality.

Particularity of duodenal fistulas are high enzyme rich output and anatomical location [1].

Many duodenal fistulas may heal spontaneously, for temporary or even definitive tratment of fistulas, non-operative interventions such as interventional radiology or endoscopic can be used, but in setting of uncontrolled sepsis, emergency surgery may be required.

Definition and Classification

Duodenal fistulas can be classified as external or internal depending upon the place of draining: to the skin, respectively internally to other organs (eg, gall bladder, colon, etc.). Considering the output of the fistula they are:

- low output fistulas, drains less than 200 mL/day

- moderate output fistulas, drains between 200 and 500 mL/day

- high output fistulas, drains more than 500 mL/day

After the localization they can be lateral or duodenal stump fistulas.

Etiology and Risk Factors

Various etiologies can lead to duodenal fistulas, but the most frequent are postoperative and post interventional endoscopy. This chapter propose an overview of the complete management in those cases.

Postoperative: Postoperative fistulas are the result of duodenal injury during surgery (pancreatic, biliary, lymphadenectomy, etc.), a leak from a duodenal anastomosis or duodenal stump closure after gastrectomy [4]. Preoperative factors that increase the likelihood of the development of a fistula include malnutrition, immunosuppression, traumatic injury, infection, and emergency procedures [5, 6].

Post interventional endoscopy or ERCP- After polypectomy, submucosal dissection, ampulectomy, emergency hemostasis with injection of hemostatic agents, a duodenal perforation and fistula can occur. The ERCP can lead to a perforation in the periampullary region. Those injuries could be in the peritoneal cavity, sometimes covered by another organ (omentum, liver, etc), or in the retroperitoneal cavity which cause retroperitoneal cellulitis with necrosis and abscess formation.

The gravity of the duodenal leaks is given by the corrosive action of the pancreatic, biliary and gastric secretion.

Clinical Presentation

Initial presentation is different in postoperative fistulas with or without drains left in place or leaks which appear after a post endoscopic or post ERCP perforation. The last one is often misdiagnosed and leads to an abscess formation and sepsis.

The most common presentation of a duodenal fistula is that of a postoperative patient who fails to recover normally from abdominal surgery. The patient may present abdominal discomfort, distension and tenderness, a low grade fever, or signs of abdominal sepsis. Most typically, a wound infection is recognized 7 to 10 days postoperatively, and following incisional drainage, enteric contents appear in the surgical wound [4].

Diagnosis - if an intraabdominal drain is present, the aspect of drainage content can lead to the diagnosis, in cases of suppressed drainage diagnosis is more difficult, any changes in the postoperative course of a recently operated patient, or an abnormal recover with abdominal discomfort or tenderness, fever, tachycardia, sub-occlusion, etc. could be signs of alarm.

A simple water soluble contrast swallow can show a duodenal fistula, mostly at a level of a gastroduodenal anastomosis or a lateral type; often a duodenal stump fistula cannot be visualized with this examination, especially if a Roux en “Y” anastomosis is present.

In cases of enterocutaneous fistulas, fluoroscopic fistulography may add further information considering the localization of the fistula or the length of the traject [7].

A computed tomography (CT) with oral and intravenous contrast is more feasible and may demonstrate the anatomy of the fistula, the presence of an intraabdominal abscess, distal intestinal obstruction, or communication with other organs. In the cases of fistulas with well-defined cutaneous opening, a

water soluble contrast fistulogram, could be an alternative but rarely identifies specific origin of the tract [8].

Small fistulas may not be apparent on imaging, the presence of a fistula can be determined by the oral administration of dye (indigo carmine, methylene blue, etc.), but without any further information considering the origin.

Diagnosis in cases of post endoscopy or ERCP perforation is much more difficult because sometimes the first signs of perforation are those of sepsis.

Differential diagnosis — Drainage from an abdominal incision following gastrointestinal surgery may represent a surgical site infection but the character of the drainage, and lack of persistence of the drainage once the wound has been opened, usually makes the distinction.

Workup - In normal conditions, after gastric surgery oral fluid/semisolid intake starts at postoperative day 1 or 2, and after seven days patients will be practically completely nourished per orally. In cases of surgical patients with protein/caloric deficiency intravenous fluid and protein/caloric administration starts preoperatory and will go parallel with the postoperative oral intake.

In some cases feeding jejunostomy is mandatory in postoperative nutrition, sometimes even in preoperative nutrition in patients whose undergone major surgical interventions.

In patients with postoperative duodenal fistulas, depending on different factors, oral intake is not possible (stops after the appearance of the fistula) or is insufficient, that’s why in those patients a complete reevaluation is absolutely necessary in correct therapeutically decision.

➔Blood tests- hemoleucogram and biochemistry - shows anemia, hepatic and renal function, protein and albumin levels, acid/basic status, ionic levels, etc.

➔CT scan with oral and intravenous contrast material or ultrasound (possible

also with contrast material) is very important in evaluation of the eventually intraabdominal abscess or other fluid collections.

➔Endoscopy - is not a usual examination in the first postoperative days but in experienced hand could be a very important diagnostic and therapeutic tool.

➔Anathomopathological evaluation/histology - is important in cases of malignancy, because of a possible R1/R2 resection, with positive duodenal margin, which could be a cause of a postoperative fistula.

Generally speaking a postoperative early (up to 5 days) fistula is more likely to be a consequence of an inadequate surgical procedure or iatrogenic lesion, while duodenal fistulas between days 6-10 are possible in course of fibrinogenesis/fibrinolysis mainly in poorly nourished patients.

The most common postoperative fistula occurred in duodenum are from the duodenal stump, in partial gastrectomy (Billroth II type procedure). It is believed that duodenal fistulae from the stump are most feared complications of interventions Billroth type II; seriousness of these fistulas is due to the fact that by them, bile and pancreatic fluid from the duodenum will drain into the peritoneum with development of chemical peritonitis in the first instant. Later occurs the supra-infection (bile is a very good growth medium for bacteria) with developing an infectious peritonitis.

The most common fistulas from the duodenum lead to the formation of collections in subhepatic space with possible extension in peripancreatic space.

Imaging diagnosis of duodenal stump fistulas is more difficult than the gastric or esophageal fistulas. This is because the product will not penetrate or hyperdense contrast will penetrate very least the enteral loop. Thus the contrast extravasation cannot be seen as direct sign of the existence of fistulas. In this case, the diagnosis will rely on indirect signs of the presence of a fistula - existing collections.

In the presence of appropriate clinical context collections around the duodenal stump or in space as perihepatic indicate the presence of duodenal fistulae. If the collection has hyper-vascularized walls or if there are air bubbles distributed diffusely inside the collection, we suspect the formation of abscesses.

In some cases, to confirm the existence of a fistula, a contrast imaging study could be done by injecting the contrast with ultrasound or CT guidance in the abscess and its subsequent viewing in duodenal lumen on CT.

Treatment

In the treatment of a duodenal fistula there are a few steps (each one has their own importance) from diagnosis/recognition to definitive treatment [9, 10].

➔Initial management - Initial treatment of duodenal fistulas focuses on the correction of fluid and electrolyte imbalance, treatment of infection, abscess drainage (if needed), nutritional support, and for external fistulas (including pancreatic), control of the effluent drainage and skin care. This measures should take place in the first 24-48 hours after the apparition of a fistula.

- Fluid therapy - aggressive correction of hypovolemia and electrolyte loss is mandatory, hypokalemia is the most common abnormality, mostly in the high output fistulas, when bicarbonate replacement is also required because of the development of metabolic acidosis.

- Treatment of infection - associated abscess or intraabdominal sepsis (peritonitis) or retroperitoneal cellulitis must be recognized promptly and beside antibiotics, surgery or interventional radiology is needed for drainage to reduce the risk of progressive organ dysfunction or failure [11, 12]. While peritonitis is a surgical emergency, percutaneous ultrasound or CT guided abscess drainage is possible [13].

- Nutritional support - oral intake in patients with duodenal fistulas is not

possible (sometimes when a Roux "Y" anastomosis is present a duodenal stump fistula permit also fractioned oral nutrition), that's why a nutritional support must be initialized after correction of fluid, electrolyte and vitamin deficits [14-16].

➔Controlling external fistula output - bag drainage is possible at the skin level where the fistula opening is present, with correct protection of skin surface.

Some pharmacological agents as proton pump inhibitors or somatostatin analogues should be efficient in reducing the fistula output.

➔Fistula closure with conservative management

Spontaneous closure rates are in relation with multiple factors, as shown in the table below [17, 18].

Table 1. *Factors involved in spontaneous closure of duodenal fistula.*

Factor	Likely to close	Unlikely to close
Anatomical location	Lateral duodenal Duodenal stump	Retroperitoneal
Tract length	>2 cm	<2 cm
Defect size	<1 cm^2	>1 cm^2
Fistula output	Decreasing	Stable/increasing
Nutritional status	Well nourished	Malnourished
Sepsis	Absent	Present

The majority of postoperative duodenal fistulas are healed with nonoperative treatment in absence of abscesses, distal obstruction or other causes which interfere with normal tissue formation (ex: cortisone therapy). In cases of post ERCP (endoscopy) duodenal perforation, when imagistic methods are undoubtful, emergency surgery is necessary.

Even if conservative treatment measures are likely to help closing the fistula, considering the necessity of good nourishing in those patients, beside the endoscopic technique of placement a nasojejunal feeding tube, a surgically placed feeding jejunostomy must be considered if needed [9, 19].

➔Endoscopic treatment

A special consideration should be given to perforation of the duodenal wall secondary to endoscopy, especially endoscopic retrograde cholangiopancreatography (ERCP). Stapfer et al. have recognized four types of perforation complicating ERCP, the first two dealing with duodenal perforation [20]:

- Type I: Free bowel wall perforation
- Type II: Retroperitoneal duodenal perforation secondary to periampullary injury
- Type III: Perforation of the pancreatic or bile duct
- Type IV: Retroperitoneal air alone

Fistuloscopy could be used to identify the cause of fistula. It can be done by inserting a small caliber endoscope through the fistula. It can identify abscesses, malignancy and could help to close the fistula by injecting glue or by inserting a drain.

Although most enteral fistulae are treated surgically, some are amenable to endoscopic treatment, depending on their location and size, by using one or more of the following: metallic stents, endoscopy clips (including through-the-scope clips and over-the-scope devices), endoscopic suturing, and injection of tissue sealants.

Through-the-scope as well as over-the-scope endoscopic clips have been successfully used to close free bowel wall perforation, with the mention that endoscopic therapy of a duodenal perforation is much more difficult than that of a colonic or gastric perforation due to limited space [20-23]. One prospective, international, multicenter study concluded that 89% of patients with acute iatrogenic perforations had successful closures without adverse events using

over-the-scope clips [24].

In case of periampullary injury, endoscopic management is usually possible, surgery or percutaneous drainage being reserved for patients with a large amount of retroperitoneal air and signs of systemic inflammation. Because the perforation is usually smaller than in the case of free bowel wall perforation, usually extending at the site of the sphincterotomy, through-the-scope clips can be used in addition to placement of a nasoduodenal tube [25].

Endoscopic band ligation (EBL), which was first introduced for the treatment of esophageal varices, is now widely used for perforation repair. The biggest advantages of EBL are that it can be easily performed for perforations that are 1 to 2 cm in size regardless of the perforation site or angle and it can be performed immediately after the perforation is diagnosed [26]. Endoscopic devices used for variceal ligation are placed over the endoscope's tip. The device, or cap, has a soft sheath portion that fits to the endoscope and a plastic part. Elastic rubber bands are stretched over the plastic portion and deployed by twisting a knob placed on the port of the operating channel of the endoscope. After locating the lesion, its edges are aspirated inside the cap, and the bands are deployed, effectively clamping the breach. A few case reports published recently have demonstrated its feasibility for enteral perforations [26, 27].

Another technique, endoscopic purse-string suture, has recently been developed with good clinical results. Its main disadvantage is that it needs a double working-channel endoscope, thus being more rigid and making some areas more difficult to reach. First, a nylon ring and a titanium clip are inserted along the double channels of the endoscope. After adjusting the angle and location of the nylon ring and titanium clip, the first titanium clip is used to hold the distal end of the nylon ring vertically, firmly approximating the normal mucosa at the distal edge of the defect, and fixing it by deploying the clip. Afterwards, several titanium clips are placed along the nylon string, around the

perforation. One last clip is inserted to hold the proximal end of the nylon ring, approximating and fixing it to the normal mucosa at the proximal edge of the defect and then the nylon ring was retracted to draw the distal and proximal edges of the mucosa of the wound together [28].

In a case report, a perforation in the posterior wall of the duodenal bulb, caused by direct injury from the endoscope was sealed with fibrin glue and managed conservatively, with good clinical results [29]. Another case report of a type II ERCP-related perforation was treated successfully using fibrin sealant [30]. However, due to limited experience, it is unclear if fibrin glue can be used for perforations other than retroperitoneal ones, as the retroperitoneum is a more enclosed space compared to the peritoneal cavity, and a smaller volume of glue is needed to adequately fill a cavity beyond the perforation site. Injection of fibrin sealant next to the papilla should be done carefully, as it can lead to the occlusion of either the biliary or the pancreatic orifice. Placement of temporary stents inside the bile or pancreatic duct can offer additional protection. Also, it should be noted that this technique can only be used in small perforations, up to 1 cm.

Temporary placement of fully covered self-expandable metal stents (FCSEMS) for the treatment of intestinal perforation has been reported as effective in different situations. A case series of 8 patients with perforated duodenal ulcers treated with covered self-expandable metal stents has been published, all patients with the exception of one having recovered without complications [31]. Encouraging clinical outcomes were also reported in selected cases of perforations following endoscopic sphincterotomy [32-35].

Endoscopic snare resection of the major papilla, usually performed in early papillary neoplasms can result in perforation, and small perforations usually can be managed conservatively with or without biliary fully covered FCSEMS [36].

In cases of perforation after EMR or ESD, the breaches are usually small in size and can be managed using endoscopic clips [37]. Large iatrogenic

perforations can be managed using multiple techniques, such as over-the-scope clipping combined with stenting [38].

A novel technique for managing large high-output enterocutaneous fistulae was recently described, with good clinical results [39]. Two FCSEMS were inserted endoscopically, one in the afferent loop, and the other in the efferent loop through the fistula with a length of 2 cm of each stent that protrude through skin. After that, the proximal stent was passed into the distal stent with enough overlapping. A Prolene suture was then passed to fix the anterior wall of both stents in order to prevent migration.

➔Surgical treatment - In selected cases in duodenal postoperative fistulas (iatrogenic perforation, duodenal stump or gastro-duodenal anastomosis), in the early postoperative period and in the absence of any unfavorable factors, endoscopic methods for closing the fistula, are suitable and efficient. Small defects could be closed with metallic clips, for the larger defects OVESCO (over the scope clip) [40] system or endoscopic covered stents are available.

Interventional radiology may also help, by placing a trans-parieto-hepatic or a trans-parieto-duodenal and biliary diversion tube [41, 42].

When a duodeno-cutaneous fistula is present, conservative management is the method of choice, even in cases of gastrectomy for cancer [43], definitive treatment with surgical procedure must be applied just if the fistula does not close in 5-6 week, or has an increasing output despite conservative measures, and the management is specific for this type of fistula [44, 45].

In cases of surgery, first of all we must keep in mind that adhesions sometimes are dense, and to avoid any other enteric (or other) lesions a careful approach is mandatory.

The surgical technique is adapted to the primary lesion, that’s why if the patient was operated in another institution a well-documented history of the

previous intervention /interventions is important.

There are no standardized surgical techniques described in the literature but for optimizing surgery success we must follow some rules:

- surgery is recommended after a 4-6 weeks period of watchful waiting, if fistula doesn't closes.

- patient must be well nourished, stable

- surgical procedure must be adapted to the case but success rate seems to be better in those interventions which by-pass the damaged duodenum.

In cases of surgical procedures, first of all we should keep in mind not to damage. That's mean we must choose a procedure with maximum efficiency but minimum risk. Careful adhesiolysis is mandatory because lesions of other organs or bowels could lead to development of further enteric fistulas.

In case of small output fistulas without any signs of infection we can ignore the fistula site, but instead, the section and closure of the gastric antrum (preferable with stapling device) followed by a gastro-entero-anastomosis, is the method of choice.

If we have a duodenal stump fistula or a lateral fistula after a gastro duodenal anastomosis we must try to excise cicatriceal tissue and close duodenal stump using a linear stapling device, gastric stump will be managed making a gastro-entero anastomosis or an anastomosis using a Roux "y" enteric loop, the last one has the advantage of decompressing the duodenum.

In special cases when the lesion is on the level of D2 or D3, primary closure of the duodenum with serosal jejunal patch protection or Harrisson-Debas procedure, could have good results, mainly if a naso-jejunal tube or a feeding jejunostomy is left in place.

In cases of perforation in the retroperitoneal portion of the duodenum (post ERCP,

post interventional endoscopy), biliary decompression by hepatico-jejunostomy or transparieto-hepatic catheter or surgically placed “T” tube (Kehr) in the main biliary duct, associated with duodenal or antral transection, with gastro-entero anastomosis is the method of choice.

Endoscopically placed partially covered stents could be an alternative to intervention in small perforation without retroperitoneal septic involvement.

In selected cases conservative treatment is feasible and safe, but early diagnosis needed and meticulous follow up in which CT scan is the method of choice [46].

Follow-up

In postoperative period it’s very important to continue reechilibration and assure a good nutritional status.

Ultrasound and CT scan will provide important information considering closure of the fistula.

Conclusions

Duodenal fistula is a challenging postoperative morbidity, with a frequency of 3-14% from all entero-cutaneous fistula.

In the absence of a proper treatment (which is complex and multimodal), morbidity and mortality remains still high.

The correct strategy in management is watchful waiting, with energic nutritional support and hidroelectrolitic reechilibration, most of the postoperative fistulas heals in 4-6 weeks.

Surgical management is reserved for those with conservative treatment failure or association of other complication.

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