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Negative pressure wound therapy (NPWT) in duodenal breakdown fistulas: negative pressure fistula therapy (NPFT)?

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Abstract. – OBJECTIVE: To describe for the first time in literature the specific methodology of use of negative pressure wound therapy (NPWT) for duodenal fistula through clinical cases. The constant increase of use of NPWT for complex surgical situations imposes tailored previously undescribed solutions for the technique.

PATIENTS AND METHODS: Herein, three cases of high output duodenal fistula successfully treated with Negative Pressure Wound Therapy (NPWT) are reported. The technical details for the application of NPWT to these fistulas are discussed and described.

RESULTS: All three patients recovered without the necessity of further surgical operations.

CONCLUSIONS: When using NPWT, management of high-output duodenal fistulas must rely on some degree of customization of the aspiration systems. The aim of the procedure is to put under depression the duodenal hole and surrounding tissues "all in one" and not to separate the complex wound in sectors as usually indicated. We suggest calling this technique Negative Pressure Fistula Therapy.

Key Words:
NPWT, Negative pressure, Wound therapy, Duodenal fistula.

Introduction

Duodenal fistulas present as a surgical emergencies and sometimes as surgical catastrophes. These fistulas usually follow the breakdown of a previous suture. They have a deep anatomical location, consent the transit of enteric fluid rich in activated enzymes, have a very high output and present problems of skin care[1]. Mortality rates are reported to range from 7 to 40% according to review of the literature[2,3]. Duodenal fistulas are usually treated with surgical intervention[3]. These patients, sometimes in septic shock, are exposed to several operations. The presence of macerated duodenal tissues requires a damage control approach. Damage control means avoiding new sutures on the duodenum or an intestinal anastomosis and allowing duodenal output to exit the abdomen in an easy and direct way in order not to contaminate the peritoneal cavity. Tubes inside or in the proximity of the duodenal hole usually serve this purpose[4].

One of the best techniques for draining secretions in complex, infected or also deep wounds is the negative pressure wound therapy (NPWT) technique. NPWT has the capacity of removing fluids from every site of the wound with the use of gauzes and/or open cell polyurethane foam in the wound cavity. Moreover, the sealed wound care improves the infection control and the well-being of the patient. A previous opinion that negative pressure was contraindicated in case of bowel exposed in the wound has been rethought and, presently, most surgeons believe a safe negative pressure dressing can be realized over the exposed bowel (as in the case of enteroatmospheric fistula)[5,6]. However, there is no specific description of the use of NPWT for the treatment of duodenal fistulas. We report three clinical cases of duodenal breakdown fistula, successfully treated with damage control and NPWT after rescue surgery[7,8].

Patients and Methods

Case 1

A 47-year-old man, with a history of steroid and nonsteroidal anti-inflammatory abuse for

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chronic back pain, underwent an emergency operation for duodenal ulcer perforation. The abdomen was severely contaminated and the patient was in shock. Duodenorraphy was performed, with the aid of omental patch to cover the suture. On the 7th postoperative day, general conditions deteriorated and a second laparotomy revealed dehiscence of the suture. A new suture was performed and tubes positioned. A few days later, due to persisting sepsis and duodenal leak, a third laparotomy was performed through a left lumbotomy on the bed of the 12th rib, multiple tubes were positioned nearby the duodenal hole (Figure 1) and the wound was filled with polyurethane VAC™ sponge (GranuFoam®, KCI, San Antonio, TX, USA). An ostomy bag was placed, covering the wound and the exiting tubes, and put under depression (Figure 2) with a home-made vacuum system at a continuous depression of –70 mmHg. The sponge in contact with the duodenum was covered with an adhesive drape riddled with holes. A jejunostomy was realized in the left abdomen and enteral nutritional support started.

A nasoduodenal tube was inserted endoscopically, and put under negative pressure. A progressive resolution of fever and leukocytosis was observed in a few days. The wound was medicated every two or three days with change of foam dressing until the drainage initially 1 L a day progressively dwindled in the following two months. Eventually, after progressive introduction of feeding by mouth, the patient healed and was dismissed.

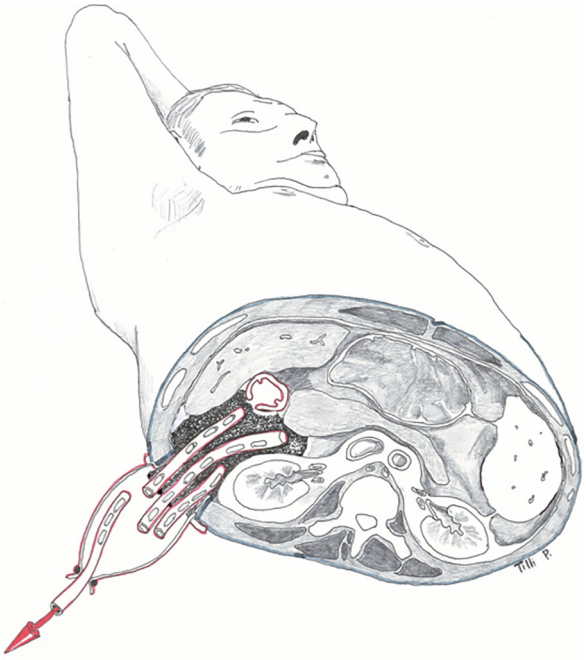

Figure 1. The medication with the tubes close to the duodenal hole, exiting from the skin in the ostomy bag. The aspiration tube is inserted into the ostomy bag in contact with the tubes.

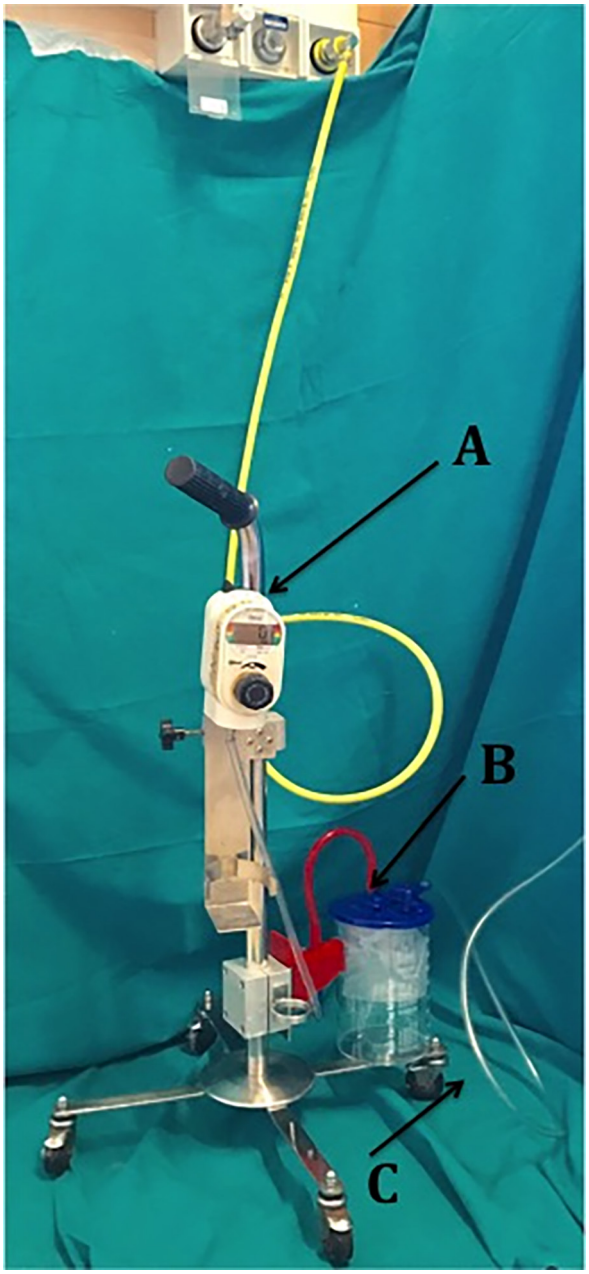

Figure 2. Home-made apparatus, indicated is the tube to the patient. The canister for secretions must be big (over 1L/day). ***A,*** Vacuum regulator connected to the wall vacuum system (yellow tube); ***B,*** Canister for secretion; ***C,*** Tube to the ostomy bag.

Case 2

A 50-year-old female presented a massive duodenal bleeding in the 3rd postoperative day after open surgery for a benign gynecological condition. After two unsuccessful attempts of endoscopic hemostasis, open surgical duodenotomy and suture hemostasis of a large duodenal-pancreatic ulcer were performed in an emergency setting.

On the 5th postoperative day, the patient presented fever, leukocytosis and biliary leak from the drainage tubes. A reoperation was deemed necessary and the leak was treated with the placement of multiple tubes near the duodenum and in the sub-hepatic space. A nasogastric tube was inserted and a jejunostomy for enteral nutrition was positioned in the left abdomen. The drains were passed through a left lumbostomy, and the wound treated under depression as in the previous patient.

The volume of duodenal leak exiting through the dressing was initially over 600 ml/day and progressively dwindled until it stopped in the following 95 days. The patient started eating by mouth and was dismissed.

Case 3

A 72-year-old woman, treated with a Roux-en-Y subtotal gastrectomy for gastric cancer in another hospital underwent a complicated postoperative period with the development of a sub-hepatic abscess and septic episodes. She was re-operated on for abscess drainage and again for adhesions. After one month, she was transferred to our ICU for the persistence of sepsis. She was severely malnourished, septic, hypoxic, with tender abdomen and a fistulous tract from the infected wound in the right hypochondrium. Enteric fluid leakage from the wound exceeded 500 ml in the 24 hours. A CT exam and a fistulogram revealed a deep entero-cutaneous jejunal fistula and a large sub-hepatic fluid collection.

She was re-operated through the right subcostal incision. Two intestinal leaks were discovered, close to each other: the first from the jejunum and the second from the duodenal stump. The jejunum was sutured with a reinforced suture and the stump fistula drained through a Petzer tube. In a redo operation two days later for persistent leakage, we decided to leave the subcostal wound open for a length of approximately 10 cm and apply a negative pressure dressing. The cavity was filled with Granufoam®, protected by a polypropylene adhesive sheet on the side facing bowels as previously described. To facilitate drainage, some chunks of the large surgical tube were inserted into the sponge, starting from the leakage points and terminating on the external surface of the sponge. Negative pressure applied was –100 mgHg. Foam dressings were changed every two or three days.

The cavity progressively got cleaner and smaller, until a wound diameter of 2 cm was reached. The duodenal fistula closed first and the intestinal fistula persisted for another 50 days before closing as well. The patient was fed for a period through the intestinal hole with a jejunostomy tube and when the hole shrunk the tube was removed and the patient fed by mouth with a definitive healing of the fistula tract.

Discussion

Duodenal fistulas are a rather rare entity among the variegated family of enterocutaneous fistulas that include also enteroatmospheric fistula. Literature reports them to represent from 3 to 14% of external intestinal leaks[2]. Duodenal fistulas may be of two kinds: the first are "stump" fistulas that arise after gastric surgery were the duodenum has been excluded from the passage of gastric content, the second are called "lateral duodenal" fistulas and occur in a non-excluded duodenum, usually after trauma, perforated ulcer and duodenorraphy dehiscence. The "post-endoscopic" fistulas (after ERCP) are usually quite small, retroperitoneal, and often leaking only air[9]. They have a different type of evolution and treatment and are not considered in this discussion.

In general, duodenal fistulas can be very difficult to manage if the direct surgical closure fails or is not feasible due to frail and injured tissues and septic environment (breakdown fistulas). Local sepsis and duodenal tissue damage are more frequent in case of a second or third operation attempting to control the leak. In fact, the challenging situation of duodenal fistulas, is based on the three main nightmares: (1) the leak is intraperitoneal, very deep in the abdomen and sometimes difficult to identify, nearby delicate intestinal structures; (2) the output is consistent (it may reach 600-1400 ml/die), and (3) the secretions are corrosive. Provided the first point is common in all duodenal fistulas, the other two are more challenging in the "lateral fistula" originating from an anatomically normal duodenum where duodenal exclusion has not been performed.

In the duodenal stump fistula (as after Billroth II intervention) gastric secretion is absent, output is lower and bile and pancreatic enzymes are not activated by the acid. Accordingly, duodenal stump fistulas are associated with a lower mortality and morbidity. In any case, according to the current literature, duodenal stump fistulas (after gastrectomy) have a 11.7% mortality[10]. In selected cases, the treatment can be non-surgical[10-13], with endoscopic or percutaneous attempts of biliary drainage, abscess drainage[14], injection of fibrin glue in submucosa[15], clipping of the duodenal hole[16], administration of drugs (somatostatin, octreotide)[17], nasogastric and enteric tubes[10-13].

There are not many recent articles on "lateral duodenal" fistulas. A series from developing Countries, were duodenal perforation is still high, reports that the incidence of breakdown after primary repair of the duodenum is about 7.6-8%[19] and confirms the long-standing advice that re-suturing of these fistulas is uniformly unsuccessful[20].

In the severe cases of stump, as well as in the "lateral duodenal" fistulas (except the small ones associated with ERCP), surgery is required and includes a possibility of different operations: direct fistula closure associated with duodenostomy, duodenal-jejunostomy, pancreatic-duodenostomy, duodenal diverticularization, many types of drains[3]. This means that in the worst cases (breakdown fistulas), usually the surgeon adds some solution to decompress the duodenum by an intraluminal tube and/or to divert temporarily or definitively the gastric secretion and/or bile from the duodenal transit to reduce the high output and favor healing[4]. This shows how difficult it is to guarantee with the surgical suture the closure of the leak in a duodenum where duodenal exclusion has not been performed and how catastrophic the possibility of a recurrent leak is perceived as.

A damage control approach that concentrates on the full external drainage of the leak, through the aid of negative pressure techniques, can represent a valuable option in these situations. The negative pressure dressing is an established technique and widely validated in the treatment of wound therapy, open abdomen[21] and – with the due precautions – also for enteric fistulas[5,6]. The system works better in case of liquid fluid, and the depression distributed everywhere in the wound stimulates the tissue growth through the micro-deformation. Granulation tissue adheres to the open cells of the foam and grows inside in clean environment. However, the direct contact with the rough surface of the sponge can be traumatic for the bowel loops and has been associated with the opening of new fistulas[22]. NPTW caring of a complex wound with bowel wall inside was considered risky or contraindicated[23], however in the open abdomen situation, the sponge can be put inside a multi-hole plastic bag that realizes half and half both the goal of draining and the necessity of being very delicate on the intestinal loops. In this case, since the peritoneal liquid to be drained is clear, the system works quite well.

Consequently, the NPWT has been used also in some cases of enteroatmospheric fistula, a situation very difficult to manage otherwise, but where the secretions to be drained are much denser. It can be considered a cutting-edge technology with the help of some tricks that funnel the dense enteric secretions with special home-made systems[5,6]. Independently from the bowel protection, the foam filling the wound must be changed more frequently to prevent the cells from clogging with the dense intestinal secretions (personal observations) and chunks of drain should be inserted into the sponge over the source of the leak. Other useful elements of the fistula care can be to institute a gravitational exit site for the secretions, for example through a lateral lumbostomy in case of duodenal leak, and provide a large aspiration tube from the dressing to the drainage canister. Because the commercial NPWT kits have small diameter tubes that get immediately obstructed, this usually means assembling almost partially a home-made apparatus with tubes of larger diameter.

The commercial firms marketing NPWT, in case of enteroatmospheric fistula, do not suggest the use of negative pressure directly on the fistula hole, but have recently adopted accessory devices as Fistula Adapter® (Phametra, Herne, Germany) or Fistula Solution Devices® (Acelity, San Antonio, TX USA)[24,25]. The proposed technique divides the complex wound in sectors: one sector is the fistula hole that will be spared from the depression, the other sector is the rest of the wound which is treated with the negative pressure. The devices, positioned over the intestinal hole (or holes), are cylinders of soft plastic material with a diameter corresponding to the hole – 1-3 cm in width and of 2-6 cm in height – according to the distance (depth) of the fistula hole from the skin level. They are inserted through and through in the foam that fills the wound's entire cavity and

an ostomy bag (not in depression) is applied on top. The rest of the wound filled with foam is treated with NPWT. These indications are commonly followed and reported in small series with many creative names (Fistula VAC, Tube VAC, Nipple VAC and Chimney VAC)[26].

In case of duodenal fistulas, the wound is very deep and the fistula is not visible and direct and for this reason, the mentioned devices are not applicable. We instead adopt the "all-in-one" solution of draining all that exits from the leak, contiguous tissues, and wound. We put pieces of large surgical drains near the lacerated duodenum (without worrying to position them right into the hole) extracting them from the skin and cutting them at this level. The rest of the wound is filled up with foam and the whole system is put under depression through an ostomy bag that consents to insert a large bore aspiration tube (Figure 1).

This technique could be better called Negative Pressure Fistula Therapy, provided the depression is taken not only inside the wound but directly on the fistula as described for example in some circumstances for enterocutaneous fistulas[27].

A technical point that must be stressed is that all the connections among the ostomy bag and the canister should be large. This is the main reason why the system must be customized. The depression inside the canister should be regulated by an efficient and stable vacuum depression controller. Simple mechanical regulators are not adequate and electromechanical devices are necessary. As shown in Figure 2, we drain the secretions directly from the ostomy bag into a big tube and then into a large aspiration canister like those present in the operating room.

Every technique has its limits and drawbacks. The technical solution proposed is not adequate for every condition of duodenal fistula even though we have found it useful in "lateral duodenal" fistulas and difficult to treat stump fistulas. Probably in the future commercial devices will be devised to treat these challenging conditions.

Conclusions

Duodenal fistulas represent a hard rock for the surgeon and very few papers are found in literature on the topic, especially on the treatment of lateral duodenal fistulas which are for sure the most complex. The use of negative pressure can represent a good and safe alternative in the management of breakdown situations realizing a true negative pressure therapy on the fistula itself if the surgeon or the ostomy nurse is able to manage the high intestinal output of these conditions, with some degree of creativity.

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Conflict of Interest

The Authors declare that they have no conflict of interests.

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