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Vacuum Assisted Closure (VAC) therapy™ as a swiss knife multi-tool for enteric fistula closure: tips and tricks: a pilot study

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Abstract. – OBJECTIVE: Enterocutaneous fistulas (ECFs) are an uncommon surgical problem, but they are characterized by a difficult management. Vacuum-assisted closure (VAC) therapy is a method utilized for chronic and traumatic wound healing. At first, VAC therapy had been contraindicated in the treatment of intestinal fistulas, but as time went by, VAC therapy revealed itself to be a "Swiss knife multi-tool". This paper presents some clinical cases of enterocutaneous (ECF) and enteroatmospheric fistulas (EAF) treated with VAC therapy™.

MATERIALS AND METHODS: The history of 8 patients treated for complex fistulas was revised. Four of them presented with enterocutaneous and four with enteroatmospheric fistulas. All were treated with VAC therapy with variations elaborated to help in accelerated closure of intestinal wall lesions.

RESULTS: Four out of four ECFs closed spontaneously. In the EAF group, in three cases the fistula turned slowly into an entero-cutaneous fistula, and in one out of four it closed spontaneously. The mean length of VAC therapy™ was 35.5 days and that of spontaneous closure was 36.4 days.

CONCLUSIONS: The results of our study encourage the use of VAC therapy™ for the treatment of enterocutaneous fistulas. VAC therapy™ use has a double therapeutic value: (1) it promotes the healing of the skin and allows also the management of EAFs; (2) in selected cases, those in which it is possible to create a deep fistula tract ("well") it is possible to assist to a complete healing with closure of the ECFs.

Key Words:
Enterocutaneous fistula management, VAC therapy™.

Introduction

Enterocutaneous fistulas (ECFs) are an uncommon surgical problem characterized by a difficult management and healing with a mortality rate ranging between 6% and 33%[1] due to the development of malnutrition, electrolytic abnormalities and sepsis[2].

ECFs can be classified on the output volume, ranging from low to moderate to high output fistulas. Low output is classified as < 200 cc/day, moderate output as 200-500 cc/day, and high output as > 500 cc/day[3]. Furthermore, ECFs can be distinguished in simple or complex. Simple fistulas have a short, direct tract, no associated abscesses or other organ involvement. Complex fistulas are divided in: type 1, associated with an abscess or involving multiple organs, and type 2 that opens into the base of a disrupted wound and is often known as enteroatmospheric fistula (EAF). EAF fistula is defined as "an exposed fistula occurring in the midst of an open abdomen with no overlying soft tissue"[4]. By nature, complex fistulas have higher morbidity and mortality rates, as well as a lower rate of spontaneous closure[5].

Vacuum-assisted closure (VAC) therapy is a widely acknowledged method for second intention wound closure. At first, VAC therapy was contraindicated in the treatment of intestinal fistulas[6,7] as it was reported to delay their closure and cause internal organ damage[8]. But as time went by, this method revealed itself to be a "Swiss knife multi-tool"[9], a single device with multiple functions, like a pocket knife with many blades. Several reports are now available

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on the efficacy of VAC treatment in the case of many kinds of fistulas[8,10-14]. This paper presents some clinical cases of ECFs and EAFs treated with VAC therapy ™ utilizing the device with different indications, taking advantage of its multiple functions. The positive results obtained are strictly related, in our experience, to the association of some tricks and tips to the standard application of black sponge and depression.

Materials and Methods

The Department of Emergency Surgery of the Catholic University of the Sacred Heart, Gemelli Polyclinic, treats approximately 1500 patients a year. Clinical history of 8 patients treated for complex fistulas from January 2011 to December 2013 was revised (Table I). Four of them presented with ECF and four with EAF. Male to female ratio was 1/1, mean age was 53 ± 24

Table I. Postoperative complex fistulas: patient characteristics.

Pz	Gender	Age	Base pathology	Cause of fistula	Numbers of fistulas/ output	Site	Type of fistula	Outcome/ VAC time/Time of closure
1	F	71	Abdominal wall hernia repair. Reoperation for peritonitis	Leakage from inadvertent enterotomy during surgery	2 High	Ileum	ECF in the middle of wound, in the late postoperative period	Closure/25 gg/ 25 gg
2	F	72	Gastric stenosis treated with antral resection and BII reconstruction with Roux-en-Y. Two redo surgery for peritonitis	Leakage from duodenal stump Leakage from probable jejunal lesion enterotomy during surgery.	2 High	Duodenum Ileum	Double ECF in the same site under the right subcostal wound	Closure/49 gg/ 49 gg
3	M	40	IBD treated with total colectomy and ileo-rectal anastomosis. Reoperation for postoperative adhesion and peritonitis	Leakage from inadvertent enterotomy during second surgery	1 High		ECF in the periumbelical site of the abdominal wound	Closure/50 gg/ 57 gg
4	F	41	Surgery for obesity (biliopancreatic by-pass)	Leakage from inadvertent enterotomy during surgery	1 Low	Ileum (Ansa alimentare)	EAF in the open middle wound in frozen abdomen	Closure/41 gg/ 41 gg
5	M	73	Sigma volvulus operated. Reoperated twice for obstruction and peritonitis from bowel leakage	Leakage from sutured enterotomy during previous surgery	1 High	Ileum	EAF in the open middle wound in frozen abdomen	ECF/25 gg
6	F	76	Abdominal hernia repair in obese patient, reoperation for adhesion syndrome	Leakage from inadvertent enterotomy during surgery	1 High	Ileum	EAF in the open middle wound in frozen abdomen	ECF/40 gg
7	M	25	Urgent surgery for bowel obstruction in mutioperated abdomen. Redo surgery for peritonitis, multiple ileal stomas	Leakage from closure of ileal stoma	1 High	Ileum	ECF on the closure wound in rigth low abdomen	Closure/8 gg/ 10 gg
8	M	28	Bowel resection for internal hernia in plurioperated patient with IBD. Open abdomen	Leakage from inadvertent enterotomy during surgery	2 High	Ileum	EAF in frozen abdomen after open abdomen treatment. Skin graft	ECF/45 gg

years. Fistulas were all of the small bowel. Cases 1 and 2 had a double fistula; in pt 1 both fistulas originated from the small bowel, while in pt 2 they originated one from the duodenum and the other from the small bowel. With the exception of one case (pt 4) patients had gone through multiple surgeries and fistulas were due to inadvertent iatrogenic perforations of the small bowel, often treated by primary suture, that had broken down, with immediate or delayed leakage, or could not be treated due to a situation of "frozen abdomen". All patients were put on total parenteral nutrition, no somatostatin or analogs were utilized.

Treatment was by VAC therapy™ (KCI, Medical Srl, UK Holdings, Ltd). The standard technique for VAC therapy was often modified to adapt to the fistula situation. In particular, the main problem that made us look for unconventional solutions was to extract from the fistula site viscous enteric material with floating particles. Communicating cells of the sponge are 1 mm in diameter in conditions of atmospheric pressure and are easily occluded by the enteric fluid. In particular, the first line of cells, those close to the primary output site, get stuck with the particles and act as a tight filter. This determines a redirection of the fistula fluid under the inferior surface of the sponge and its appearance under the surface of the plastic sheet. Moreover, under depression cell diameter is further reduced and this phenomenon gets worse.

Tips and Tricks

Tips and tricks we used to direct the enteric fluid coming out of the fistula towards the aspiration system, while the granulation tissue proceeded to close the intestinal wall lesion are reported.

1. Cut the sponge and make a hole in the central part so as to insert from one to three spiral drains (Figure 1) that can be introduced into the intestinal opening. The SensaT.R.A.C. Pad™ will be positioned over this part of the sponge so as to directly convey the intestinal secretions towards the aspiration system.
2. Cover sponge surface overlying the bowel wall with polyethylene drape in order to avoid injury to the intestinal wall (Figure 2). Obviously the drape has to be perforated (Figure 2) (see point 3) otherwise intestinal fluid goes towards the margins of the sponge and directly under the adhesive tape irritating the healthy skin. This tip is fundamental in the EAF where the sponge is positioned directly on the conglomerated intestinal loops.
3. Performing small cuts on the sponge avoids cellular obstruction by the dense intestinal fluid (Figure 2). Augmenting cell diameter facilitates the aspiration system.
4. The aspiration system must be set at a low depression (-50/-75 mmHg) so that the sponge cells do not close. A depression greater than -75 mmHg closes the cells and does not allow the aspiration of the secretions.
5. Apply gauzes on the healthy skin to further protect it from the intestinal secretions (Figure 3) that otherwise would macerate the soft tissues avoiding the healing of the wound.

Figure 1. Tip 1: Cut the sponge and make a hole in the central part to insert from one to three spiral drains.

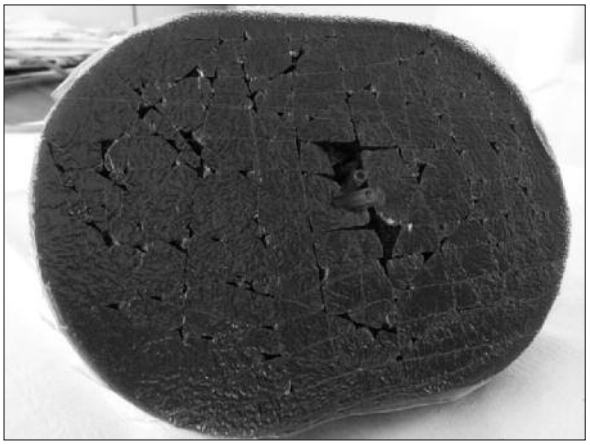

Figure 2. Tips 2-3: Cover the surface of the sponge that lies over the bowel wall with the polyethylene drape; the drape has to be perforated; performing small cuts on the sponge.

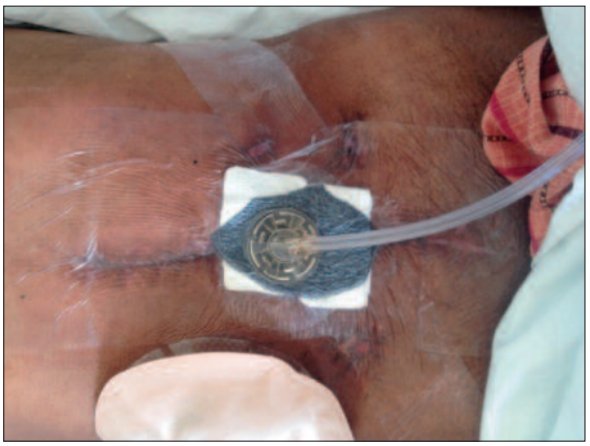

Figure 3. Tips 5-6: Apply gauzes on the healthy skin; pucker up the cutaneous and subcutaneous tissues applying on the abdominal wall stripes of polyethylene.

6. Pucker up the cutaneous and subcutaneous tissues, where possible, around the fistula and create a kind of "well" on whose bottom there is the fistula opening and whose walls are represented by the subcutaneous tissues. This can be done with sutures that tighten the tissues or applying on the abdominal wall stripes of polyethylene (Figure 3).

In some cases it is possible to think of helping the closure of an enteric fistula, especially an EAF, with a full or split thickness skin graft[15]. The contemporary use of the VAC therapy™ over the graft helps the take of the graft because it aspirates those secretions that cause graft infection.

Results

In all four cases of ECF fistula closed spontaneously. In the EAF group, in three cases fistula turned slowly into an ECF, and in one out of four it closed spontaneously. This happened because the fistula was on the alimentary loop of a bilio-pancreatic bypass and there was no passage of biliary or pancreatic fluid. The mean length of VAC therapy™ was 35.5 days (range 8-50 days). Mean interval to spontaneous closure was 36.4 days (range 10-57 days). All patients recuperated oral feeding.

Discussion

Enteric fistulas are a rare extremely difficult surgical problem[1]. Often, fistulas are a consequence of ileal perforation due to repeated abdominal interventions in the same patient for acute abdomen, especially in young subjects. Sometimes these are apparently superficial traumas of the bowel loops (so called inadverted enterotomy), other times full thickness lesions that are primarily repaired by suture. However, the primary suture often breaks down, and is not recommended when the perforations are located in the context of conglutinated inseparable bowel loops ("frozen abdomen"). Presently this pathology has risen since patients with severe acute abdominal situations are often treated by open abdomen techniques according to the concepts of damage control surgery (for example after trauma) or by two step abdominal closure due to the difficulty in approximating the abdominal wall without creating intra-abdominal hypertension. The exposure and manipulation of intestinal loops exposes them at risk of perforation.

Traditional therapy of ECF has always consisted in awaiting spontaneous closure, keeping the fistula cavity clean. Conventional medications with sometimes association of drainage tubes so as to favor drainage of enteral secretions were used[16]. The insertion of a tube, however large (i.e. Petzer catheter) through the fistula opening even deep inside the abdomen, in the attempt to obtain a complete enteric fluid drainage, is a figment of imagination that many surgeons attempt but that rarely succeeds. Safe and reliable drainage by gravity is possible, at least in our experience, only in duodenal fistulas when the tube exits posteriorly, right under the last ribs.

From its introduction, about ten years ago, wound medication in depression (VAC therapy™)[17] has been proposed as a good alternative also for ECFs. It should be remembered that at the beginning its use for wounds on top of bowel openings was discouraged. Another myth that contraindicated by principle its application was the general opinion that it might delay spontaneous closure, favoring instead through aspiration, persistence of intestinal secretions in the exact place where instead fistula closure was expected[18]. However, the extreme difficulty encountered in maintaining wounds with a enteric fistula at the bottom clean induced the progressive attempt to use VAC therapy also in these situations, ignoring theoretical contraindications that were not even proven on the field.

Various expedients were devised to reduce or avoid lesions of the intestinal bowel or of the surrounding tissues. The first and most important

was to avoid direct contact between the sponge, more precisely the cells of the sponge that respond to the depression, and the delicate tissues of the intestinal wall, allowing at the same time the aspiration of the surrounding fluids.

Other expedients address the aim of efficiently channelling through the sponge the secretions out coming from the fistula opening. The secretions are not fluid like the liquids of exudative or purrulent secretions from an infected wound but come out in sudden unexpected "bouts". This phenomenon prevents their easy passage through the 1 mm diameter sponge cells, and makes them instead penetrate under the surface with soiling of the surrounding tissues causing corrosion and inflammation. Novice utilizers of the VAC therapy™ raise the aspiration of the device not realizing that the greater the aspiration greater the stiffening of the cell walls that then behave like a tight mesh filter. A facilitated passage towards the aspiration system must be prepared.

Different systems to obtain this effect are born from the intuition and creativity of the medical staff. Some of these are craftwork and personal solutions – that even though not well systematized in agreed upon or commercially available from companies that build medication material – are generally effective. A first method consists in making deep full thickness cuts in the sponge on the part that overlies the fistula opening, so that the secretions find an easier way towards the aspiration system. A second method consists in inserting a bundle of short tubes or spiral drains whose tip can be introduced directly inside the intestine. With these expedients, VAC therapy™ is safe to use and avoids tissue damage to surrounding tissues and effectively removes secretions. Today VAC system allows to reach the main objective in fistula treatment: to keep the wound clean removing the enteric secretions, whose corrosiveness can hurt non only the walls of the bowel and the surrounding intestinal loops, but also muscular, fascial and wall tissues that surround the fistula and from whose perfect trophyism we expect the complete success of this strategy in the global cure of fistulas through conservative medical therapy.

Strategy can be divided in two phases articulated in time: the first is that of detersion and cleaning of the fistula secretion, while the second is that pertaining to the real closure of the fistula.

VAC therapy™ is perfect in the first phase[19] taking us along the path to fistula closure. After 7-15 days from start of therapy a dry, clean and granulating cavity can be seen that shows a tendency to contraction due to the formation of scar tissue. This is exactly what is expected, as propaedeutic to the second phase that should determine the growth of new tissue till the progressive closure of the fistulous tract. The presence of a prolonged depression inside the wound could represent a mechanical danger at the light of a positive evolution of the second phase. The depression induced by the VAC therapy™ instead of approximating the wound borders represented by fascial, muscular and cutaneous tissues towards the closure of the opening, can tend to draw towards the surface the fistulous bowel loop approximating it further to the cutaneous level. If this happens, it is difficult that skin can overrun the margins of the intestinal perforation so as to cover and close it. Instead it may be possible to apply an ostomy system on the solid skin that now surrounds the fistula hole. If the aim is that of fistula closure, it is necessary in the second phase to associate to the depression some kind of expedient or trick to transform the fistula tract in a kind of "well" surrounded by granulation tissue. To be more precise the distance between the hole on the bowel and the hole on the overlying skin must be at least 2 cm deep, also according to experience reported in literature[20], so that musculo-cutaneous/subcutaneous and cutaneous circumferential tissues show the tendency to coalesce and reduce and cover the tissue defect.

The tactic to adopt in the second phase is not at the moment as well defined as that used in the first phase. When the fistula is very deep, the evolution and closure takes place almost spontaneously. In other cases, it can be helped by inserting sutures that unite the surrounding tissues or puckering up, also with adhesive tapes in traction, the surrounding skin and subdermal tissues. In case of EAFs the scope of fistula closure is passed up by the target of fistula maturation into an ECF at skin level that consents the application of an ostomy system.

International literature no longer discourages the use of VAC therapy™ in ECFs and presently there are many series reporting good results with the method even in case of high output fistulas. In 2007, Waintstein et al[21] treated 91 patients with ECFs with a VAC device, and in 42 (46.1%) the Authors assisted to spontaneous closure. The application of the described tips and tricks today may ameliorate this percentage of spontaneous closure. In our experience we witnessed to the closure of 4 out of 4 ECFs and of 1 out of 4

EAFs. It is generally underlined[22] how the patient's general conditions, the presence of previous operations, the septic state, the abundance of intrabdominal adhesions contraindicate performing surgery for bowel repair, while at the same time many of the alternative conservative therapies do not have a positive outcome when they do not succeed in reducing the amount of secretions or protect from damage inflicted by these on healthy tissues.

Conclusions

Study results induce to encourage use of VAC therapy™ for treatment of ECFs. V VAC therapy™ use has a double therapeutic value: (1) it promotes the healing of skin allowing to manage also EAFs; (2) in selected cases (those in which it is possible to create a "well") it is possible to assist to a complete healing with the closure of the ECFs. In every case, however, the application of medication in depression results a versatile and indispensable tool, like the Swiss Army knife.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

References

1) Rahbour G, Siddiqui MR, Ullah MR, Gabe SM, Warusavitarne J, Vaizey CJ. A meta-analysis of outcomes following use of somatostatin and its analogues for the management of enterocutaneous fistulas. Ann Surg 2012; 256: 946-954.
2) Evenson AR, Fischer JE. Current management of enterocutaneous fistula. J Gastrointest Surg 2006; 10: 455-464.
3) Pfeifer J, Tomasch G, Uranues S. The surgical anatomy and etiology of gastrointestinal fistulas. Eur J Trauma Emerg Surg 2011; 37: 209-213.
4) Schecter W. (2014) Principles of management of enteric fistulas. www.uptodate.com
5) Wong WD, Buie WD. Management of intestinal fistulas. In: Intestinal stomas, Quality Medical Publishing, Missouri, 1993; pp. 278-306.
6) Banasiewicz T, Borajsza-Wysocki M, Meissner W, et al. Vacuum-assisted closure therapy in patients with large postoperative wounds complicated by multiple fistulas. Videosurgery and other miniinvasive techniques 2011; 6: 155-163.
7) Denzinger S, Luebke L, Burger M, et al. Vaccum-assisted closure therapy in ureteroileal anastomotic leakage after surgical therapy of bladder cancer. World J Surg Oncol 2007; 5: 41.
8) Cro C, George KJ, Donnelly J, et al. Vacuum assisted closure system in the management of enterocutaneous fistulae. Postgrad Med J 2002; 78: 364-365.
9) http://en.wikipedia.org/wiki/Swiss_knife
10) Gracias VH, Braslow B, Johnson J, et al. Abdominal compartment syndrome in the open abdomen. Arch Surg 2002; 137: 1298-1300.
11) Navsaria PH, Bunting M, Omoshoro-Jones J, et al. Temporary closure of open abdomen wounds by the modified sandwich-vacuum pack technique. Br J Surg 2003; 90: 718-722.
12) Medeiros AC, Aires-Neto T, Marchini JS, et al. Treatment of post-operative enterocutaneous fistulas by high-pressure vacuum with a normal oral diet. Dig Surg 2004; 21:401-405.
13) Erdmann D, Drye C, Heller L, et al. Abdominal wall defect and enterocutaneous fistula treatment with the Vacuum-Assisted Closure (V.A.C) system. Plast Reconstr Surg 2001; 108: 2066-2068.
14) Goverman J, Yelon JA, Platz JJ, Singson RC, Turcinovic M. The "Fistula VAC" a technique for management of enterocutaneous fistulae arising within the open abdomen: report of 5 cases. J Trauma 2006; 60: 428-431.
15) Cheesborough JE, Park E, Souza JM, Dumanian GA. Staged management of the open abdomen and enteroatmospheric fistulae using split-thickness skin grafts. Am J Surg 2014; 207: 504-511.
16) Firme CN, Paine JR. An improved sump suction drain for the management of gastric and intestinal fistulas. Surgery 1960; 47: 436-439.
17) Pan A, De Angelis G, Nicastri E, Sganga G, Tacconelli E. Topical negative pressure to treat surgical site infections, with a focus on post-sternotomy infections: a systematic review and meta-analysis. Infection 2013; 41: 1129-1135.
18) Fischer JE. A cautionary note: the use of vacuum-assisted closure systems in the treatment of gastrointestinal cutaneousfistula maybe associated with higher mortalityfrom subsequent fistula development. Am J Surg 2008; 196: 1-2.
19) Orgill DP, Bayer LR. Negative pressure wound therapy: past, present and future. Int Wound J 2013; 10: 15-19.
20) Turegano F, Garcia-Marin A. Anatomy-based surgical strategy of gastrointestinal fistula treatment. Eur J Trauma Emerg Surg 2011; 37: 233-239.
21) Wainstein DE, Fernandez E, Gonzalez D, Chara O, Berkowski D. Treatment of high-output enterocutaneous fistulas with a vacuum-compaction device. A ten-year experience. World J Surg 2008; 32: 430-435.
22) Whelan C, Stewart J, Schwartz BF. Mechanism of wound healing and importance of vacuum assisted closure in urolgy. J Urol 2005; 173: 1463-1470.