

CASE REPORTS

THE USE OF NEGATIVE PRESSURE WOUND THERAPY (NPWT) IN THE MANAGEMENT OF ENTEROATMOSPHERIC FISTULA – CASE REPORT AND LITERATURE REVIEW

*RAJMUND JAGUŚCIK, DOMINIK A. WALCZAK, JOANNA PORZEŻYŃSKA,
PIOTR W. TRZECIAK*

Department of General Surgery, John Paul II Memorial Hospital in Belchatów
Ordynator: lek. *P. W. Trzeciak*

An enteric fistula that occurs in an open abdomen is called an enteroatmospheric fistula (EAF) and is the most challenging complication for a surgical team to deal with. The treatment of EAF requires a multidisciplinary approach. First of all, sepsis has to be managed. Any fluid, electrolyte and metabolic disorders need to be corrected. Oral intake must be stopped and total parenteral nutrition introduced. The control and drainage of the effluent from the fistula is a separate issue. Since there are no fixed algorithms for the treatment of EAF, surgeons need to develop their own, often highly unconventional solutions.

We present the case of a 24-year-old man who developed enteroatmospheric fistula after laparotomy and relaparotomy due to acute necrotic pancreatitis. Both the laparostomy and the fistula were successfully managed using modified negative pressure wound therapy. The literature regarding this issue was also reviewed.

Key words: enteroatmospheric fistula, negative pressure wound therapy, dressing, open abdomen, laparostomy

An enterocutaneous fistula (ECF), especially one that affects the small bowel is invariably challenging for the surgeon and constitutes a huge problem for the patient, not only physically but also mentally and socially. Intestinal fistulae in the open abdomen, i.e. within the laparostomy are called enteroatmospheric fistulae (EAFs) and are particularly problematic.

Appropriate control of the fistula output and the fact that regular stoma equipment may not be used are greatly challenging.

Negative pressure wound therapy (NPWT) or vacuum assisted closure (VAC) is a system that has revolutionised contemporary medicine. Initially, this system was used primarily in the management of chronic leg ulcerations, diabetic foot ulcers and bedsores; however, new indications continue to emerge (1, 2, 3). Anal-

yses have shown that NPWT was used most frequently in open abdomen management during the last decade (4). It is therefore hardly surprising that VAC is being used in the management of enteroatmospheric fistula, a complication of laparostomy (5).

We present the case of a 24-year-old man who developed enteroatmospheric fistula after laparotomy and relaparotomy due to acute necrotic pancreatitis. Modified NPWT was successfully used for fistula management in this patient.

CASE REPORT

The patient was admitted to the general surgery department due to severe abdominal pain. The patient reported suffering from an

abdominal injury several days earlier while under the influence of alcohol. Computed tomography revealed haematoma or infiltration in the pancreatic tail and spleen pedicle. Laboratory tests revealed severe anaemia and elevated levels of inflammation markers. The patient was qualified for exploratory laparotomy which revealed partial necrosis in the body and tail of the pancreas, with a large inflammatory infiltration in the splenic cavity and pancreatic tail that could not be dissected. Following partial necrectomy, a flow drain was inserted in the infiltration area with two drains and a several-hour heated saline infusion each day. After five days, due to increasing symptoms of infection and lack of improvement in imaging tests of the abdomen, the patient was qualified for relaparotomy; partial necrectomy of pancreatic tissue was performed once again and the flow drain was maintained. As before, the abdominal wound was closed with a slow-resorbing continuous loop suture. Flow drainage was continued. Within seven days of relaparotomy, spontaneous wound dehiscence without eventration was observed. The base of the wound was covered with granulation tissue. At that time, the wound was covered with a hydrocolloid dressing. The wound did not show signs of infection. After another five days (18th day of hospitalisation), small amounts of intestinal/biliary matter were found in the lower edge of the wound where a spontaneous enteroatmospheric fistula approx. 2-3 mm in diameter developed (fig. 1). RTU total parenteral nutrition was implemented via the central route that was adjusted to the patient's energy demand. Initially, there were

small amounts of effluent from the fistula (about 50 ml/day) and control was gained over the fistula with regular dressings once oral nutrition was completely eliminated. However, output increased significantly over the next 4 days (to about 200-250 ml/day). On the 25th day of hospitalisation, an NPWT dressing was inserted and an attempt was made at reducing the wound surface.

During the surgery, skin flaps were dissected with small amounts of subcutaneous tissue from the upper part of the wound and closed with a single suture; this way, the wound was reduced by about 30%. Subsequently, a modified vacuum dressing was placed as proposed by Pepe et al.

A black-coloured foam (VivanoMed Foam, Hartmann) was cut in the shape of the missing skin surface. The bottom part of the foam which was in contact with the wound was covered with polyurethane foil (Hydrofilm, Hartmann). Subsequently, cults were made in multiple places of the foil using a scalpel blade. Three Nelaton drains the length of the foam were inserted through the foam at the fistula opening. The NPWT port was placed above the drains. Continuous pressure of 60 mm Hg was used (fig. 2, 3, 4) (6).



Fig. 1. Laparostomy covered with granulation tissue; enteroatmospheric fistula visible in the lower edge of the wound



Fig. 2. NPWT foam with a polyurethane film backing on the bottom and penetrating drains



Fig. 3. Prepared NPWT foam over the wound



Fig. 4. Port located directly above the drains penetrating to the fistula

The dressing was changed every 2-3 days and parenteral nutrition was continued. Fistula output reduced to about 100 ml/day.

After 14 days of negative pressure therapy (39th day of hospitalisation), the patient underwent further surgery where, once again, skin flaps were dissected on both sides of the wound and brought together as close as possible. At the same time, a small half-moon-shaped flap was dissected and moved over the navel so as to achieve a surface area of unchanged skin required to attach an ostomy pouch (fig. 5). The wound was once again covered with a modified NPWT dressing as proposed by Pepe which was changed every 2 days.

After the subsequent 10 days, the skin flaps bonded and the wound was almost completely closed. Fistula output remained at approx. 100 ml/day. An ostomy pouch sealed with paste could be attached. Oral nutrition was reintroduced, increasing the fistula output to 200 ml/day. Minimal inflammation was observed around the stoma (fig. 6). On the 60th day of hospitalisation, the patient was discharged



Fig. 5. Skin plasty: rotation flaps

from hospital and referred to the nutritional therapy clinic.

DISCUSSION

The challenges of intestinal fistulae (and attempts at managing these) have been present since ancient times. Nearly 2500 years ago, Susruta described the treatment of ECF that comprised its dissection and subsequent management with severed ant heads (7). However, with the exception of individual cases, mortality among these patients was nearly 100% until the 1960s (7). It was not until the advancement of modern medicine, especially due to the achievements of Dudric in the field of parenteral nutrition, that many patients were given the chance to survive and heal (8). Another milestone development occurred in the 1990s when Rotondo presented a new concept in traumatology: damage control surgery. With this new philosophy, the issues of the open



Fig. 6. Patient's wound on the day of discharge from hospital

abdomen, including a new type of fistula: enteroatmospheric fistula, became more and more common (7, 9).

The frequency of EAF within laparostomy largely depends on the initial indications for an open abdomen. In trauma patients, the occurrence of this complication ranges from 2 to 25%, in patients with severe septic peritonitis, 20-25%, and in patients with acute pancreatitis with concomitant infected necrosis, even up to 50% (10). Clinical EAFs are most common in the first week of open abdomen treatment. EAFs may be classified according to location (proximal/distal and superficial/deep), as well as the amount of effluent (low-output: < 200 ml/day, moderate-output: 200–500 ml/day, and high-output: > 500 ml/day) (11, 12). Deep EAFs drain intestinal matter into the peritoneal cavity, causing septic infection. In such cases, immediate surgery is necessary to isolate the peritoneal cavity from the uncontrolled leakage (13). Superficial fistulae, on the other hand, drain matter within the granulating wound of a “frozen abdomen”. These fistulae occur primarily due to environmental or mechanic injury of an uncovered intestinal loop or are a transformed, controlled deep fistula. Superficial fistulae are not life-threatening, but interfere with the process of healing laparostomy (14). Contrary to enterocutaneous fistulae, 30% of which spontaneously close in appropriate conditions (11), cases of spontaneous EAF healing are virtually non-existent (15).

EAFs are a huge challenge for the medical team and require a multidisciplinary approach. First of all, sepsis has to be managed. Any fluid, electrolyte and metabolic disorders need to be corrected. Oral intake must be stopped and total parenteral nutrition introduced. Due to hypercatabolism as well as the losses caused by the laparostomy and fistula, appropriate calorie, protein, vitamin and microelement supplies must be ensured. Proton pump inhibitors, somatostatin or its analogue, octreotide may be used to reduce output via the gastrointestinal mucosa, thereby reducing fistula output.

The control and drainage of the effluent from the fistula is a separate issue. There are two possible solutions. The first carries a large risk of failure and consists in attempting to close the EAF, the second – in transforming the fistula in a stoma. There are single reports of direct fistula closure. Sarfeh and Jakowatz

suggest that in the case of small bud fistulae, the edges should be refreshed, closed with a suture, and the suture line should subsequently be covered with biological material such as a medium-thickness skin graft or acellular dermal matrix (AlloDerm). The authors report that this procedure has an effectiveness rate of 50% and highlight that it is not associated with any additional risk for the patient and may be repeated. (16) Using a similar procedure, Jamshidi and Schecter managed to heal 5 out of 7 fistulae (71%), although an average of 4 attempts per patient were required (17).

Since there are no fixed algorithms for the treatment of EAF, surgeons need to develop their own, often highly unconventional solutions. Authors from Ankara report a case where they plugged the opening of an enteroatmospheric fistula with a silicone disc. The elastic disc was attached to a rubber band with a thread, and inserted in the fistula opening. All of these elements were suspended on an aluminum scaffolding over the patient’s abdomen. Once the plug was inserted, fistula output stopped. After 10 days, the scaffolding was eliminated and the size of the fistula was significantly reduced. The disc on the thread was maintained in place in the EAF and the laparostomy was additionally reinforced with NPWT. After about 2 months the wound was virtually healed; the thread was cut and the silicone plug was found in the stool 3 days later (18).

As mentioned earlier, the key issue in the treatment of EAF patients is isolating the peritoneal cavity or granulation surface of the laparostomy from the intestinal matter discharged from the fistula. To this end, a number of different methods have been developed. One of these was developed by Subramaniam et al. and is called a floating stoma. In this method, a plastic foil is sewed in between the edges of the wound and the fistula opening. This way, the viscera are isolated while an ostomy pouch may be attached above the EAF (13).

Intubation of the fistula with a drain is a highly controversial method. Some authors believe that it is absolutely prohibited, especially in the case of deep fistulae (11, 19), because it does not guarantee appropriate tightness and may additionally expand the EAF opening. Meanwhile, others report cases where

a Malecot catheter was successfully used, especially in combination with NPWT or when tunnelled (20) using a pedicle flap (21).

Many surgeons use various modifications of vacuum therapy for fistula management. Layton et al. proposed a method where VAC was used with a silicone baby pacifier. The pacifier combined with a Foley catheter allowed to pass intestinal matter while NPWT secured the laparostomy. Other methods use tunnels made of syringes, barrier rings or secured NPWT foams that are additionally sealed with paste (21, 22).

It is worth highlighting the evolution of vacuum therapy with regard to intestinal fistulae: once contraindicated, it is now a widely used method.

The last decade has seen a new concept: endoluminal negative pressure wound therapy (E-NPWT or endo-VAC). To date, endo-VAC has been successfully used to treat perforations, fistulae, and esophageal, gastric, duodenal and rectal anastomotic leakage. Importantly, the healing rate reaches 80-90% depending on the aetiology and location. The high effectiveness of this method and further advancements in endoscopy and vacuum therapy give hope for wider use of E-NPWT in the future (23).

In our patient, we used the method proposed by Pepe et al. (6). Continuous, controlled drainage of matter from the fistula via drains in a foam allowed to avoid the highly challenging phenomenon of spreading over and irritating the adjacent tissues. As a result, the wound could be healed quickly by moving

skin flaps. The perforated polyurethane film backing (made e.g. of surgical foil) on the bottom of the foam is an economic way of protecting the intestinal conglomerate covered with granulation tissue that allows to avoid expensive commercial solutions. The authors recommend that the pressure used be 50-75 mm Hg. Higher values cause the pores in the foam to close which further impedes drainage of the wound exudate and fistula effluent. An Italian team used this method to treat 4 ECF patients and 4 EAF patients. All enterocutaneous fistulae and one enteroatmospheric fistula closed (6).

SUMMARY

Many authors highlight the fact that prevention is the best therapeutic strategy with regard to EAF. Unfortunately, the desired results are not always achieved (11, 17, 24). The case we present here as well as the discussed papers prove that a number of different techniques may be combined with NPWT, yielding appropriate management of laparostomy with fistula. Control over the discharged intestinal matter improves the conditions for the open abdomen to heal and provides the opportunity to place skin grafts, rotation flaps, or use other reconstructive surgery techniques. Enteroatmospheric fistula is ultimately transformed into enterocutaneous fistula, and the latter may eventually be closed within a longer period of time (several to sometimes 10+ months) (11, 24).

REFERENCES

1. Walczak DA, Jaguścik R, Porzeżyńska J et al.: Large venous ulcers treated with negative pressure wound therapy – case report. *Negative Pressure Wound Therapy* 2014; 1: 100-04.
2. Walczak DA, Jaguścik R, Porzeżyńska J et al.: Negative Pressure Wound Therapy in the treatment of a large chronic venous leg ulceration – as a perfect method for quick wound bed preparation and support for skin grafts healing. *Negative Pressure Wound Therapy* 2014; 1: 81-85.
3. Krokowicz L, Borejsza-Wysocki M, Mackiewicz J et al.: 10 years of negative pressure wound therapy (NPWT). *Negative Pressure Wound Therapy* 2014; 1: 27-32.
4. Quyn AJ, Johnston C, Hall D et al.: The open abdomen and temporary abdominal closure systems--historical evolution and systematic review. *Colorectal Dis* 2012; 14: e429-38.
5. Hutan M, Banasiewicz T, Veverowka L et al.: Use of Negative Pressure Wound Therapy in treatment of enteroatmospheric fistulas: Critical review of the literature *Negative Pressure Wound Therapy* 2014; 1: 10-16.
6. Pepe G, Magalini S, Callari C et al.: Vacuum Assisted Closure (VAC) therapy as a swiss knife multi-tool for enteric fistula closure: tips and tricks: a pilot study. *Eur Rev Med Pharmacol Sci* 2014; 18: 2527-32.
7. Polk TM, Schwab CW: Metabolic and nutritional support of the enterocutaneous fistula patient: a three-phase approach. *World J Surg* 2012; 36: 524-33.

8. *Dudrick SJ, Wilmore DW, Vars HM et al.*: Can intravenous feeding as the sole means of nutrition support growth in the child and restore weight loss in an adult? An affirmative answer. *Ann Surg* 1969; 169: 974-84.
9. *Rotondo MF, Schwab CW, McGonigal MD et al.*: Damage control: an approach for improved survival in exsanguinating penetrating abdominal injury. *J Trauma* 1993; 35: 375-83.
10. *Becker HP, Willms A, Schwab R*: Small bowel fistulas and the open abdomen. *Scand J Surg* 2007; 96: 263-71.
11. *Schechter WP, Hirshberg A, Chang DS et al.*: Enteric fistulas: Principles of management. *J Am Coll Surg* 2009; 209: 484-91.
12. *Open Abdomen Advisory Panel, Campbell A, Chang M et al.*: Management of the open abdomen: From initial operation to definitive closure. *Am Surg* 2009; 75: S1-S22.
13. *Subramaniam MH, Liscum KR, Hirshberg A*: The floating stoma: a new technique for controlling exposed fistulae in abdominal trauma. *J Trauma* 2002; 53: 386-88.
14. *Schein M*: What's new in postoperative enterocutaneous fistulas? *World J Surg* 2008; 32: 336-38.
15. *Visschers RG, Olde Damink SW, Winkens B et al.*: Treatment strategies in 135 consecutive patients with enterocutaneous fistulas. *World J Surg* 2008; 32: 445-53.
16. *Sarfeh IJ, Jakowatz JG*: Surgical treatment of enteric 'bud' fistulas in contaminated wounds. A riskless extraperitoneal method using split-thickness skin grafts. *Arch Surg* 1992; 127: 1027-30; discussion 1030-31.
17. *Jamshidi R, Schechter WP*: Biological dressings for the management of enteric fistulas in the open abdomen: A preliminary report. *Arch Surg* 2007; 142: 793-96.
18. *Ozer MT, Sinan H, Zeybek N et al.*: A simple novel technique for enteroatmospheric fistulae: silicone fistula plug. *Int Wound J* 2014; 11: 22-24.
19. *Terzi C, Egeli T, Canda AE et al.*: Management of enteroatmospheric fistulae. *Int Wound J* 2014; 11: 17-21.
20. *Al-Khoury G, Kaufman D, Hirshberg A*: Improved control of exposed fistula in the open abdomen. *J Am Coll Surg* 2008; 206: 397-98.
21. *Ramsay PT, Mejia VA*: Management of enteroatmospheric fistulae in the open abdomen. *Am Surg* 2010; 76: 637-39.
21. *Verhaalen A, Walkins B, Brasel K*: Techniques and cost effectiveness of enteroatmospheric fistula isolation. *Wounds* 2010; 22: 212-17.
22. *Banasiewicz T, Drews M*: Negative pressure wound therapy (NPWT) in open abdomen – an animal model for surgeons training. *Negative Pressure Wound Therapy* 2014; 1: 48-53.
23. *Senderak F, Laukoetter M, Malinger S, Bansiewicz T*: Endoskopowa terapia podciśnieniowa. W: Banasiewicz T, Zieliński M (red.) *Terapia podciśnieniowa ran*. Wyd. 1. Poznań, Termedia 2015 s. 219-29.
24. *Marinis A, Gkiokas G, Argyra E et al.*: Enteroatmospheric fistulae – gastrointestinal openings in the open abdomen: a review and recent proposal of a surgical technique. *Scand J Surg* 2013; 102(2): 61-68.

Received: 6.02.2015 r.

Address correspondence: 97-400 Belchatów, ul. Czapliniecka 123

e-mail: rajdi@interia.pl