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New technique for treating abdominal surgical site infection using CT woundgraphy and NPWT: A case report



Eisaku Ito, Masashi Yoshida, Keigo Nakashima, Norihiko Suzuki, Tomonori Imakita, Nobuhiro Tsutsui, Hironori Ohdaira, Masaki Kitajima, Yutaka Suzuki*

Department of Surgery, International University of Health and Welfare Hospital, 537-3, Iguchi, Nasushiobara-city, Tochigi, 329-2763, Japan

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ABSTRACT

INTRODUCTION: Negative pressure wound therapy (NPWT) for abdominal surgical site infection (SSI) is becoming increasingly common, although enterocutaneous fistula (ECF) has been reported as a complication. To avoid ECF, we used computed tomography (CT) woundgraphy to evaluate the relationship between the wound and the intestine, and then safely treated the abdominal SSI with NPWT.

CASE PRESENTATION: Following a laparoscopic intersphincteric resection for low rectal neuroendocrine tumor and covering ileostomy, a 59-year-old woman underwent stoma closure. Six days after surgery, we diagnosed SSI. We suspected ECF, because the wound was deep and the pus resembled enteric fluid. However, CT woundgraphy showed that the wound was separated from the abdominal cavity and the intestine by the abdominal rectus muscle. Accordingly, we performed NPWT. SSI was cured and the wound was well granulated. Twenty-three days after surgery, the patient was discharged. Eventually, the wound was completely epithelialized.

DISCUSSION: Although successful NPWT has been reported for open abdominal wounds, ECF is a common complication. ECF can be prevented by separating the wound from the intestine by the omentum or muscle fascia, protecting the intestinal serosa during surgery, and applying low vacuum pressure. The relationships among the wound, the fascia, and the intestine must be evaluated before abdominal SSI treatment. One good method is CT woundgraphy, which evaluates wound extent and depth, closure of muscle fascia, and the relationship between the wound and the intestine.

CONCLUSION: We report a case of CT woundgraphy before NPWT for abdominal SSI. CT woundgraphy is a good candidate for evaluating wound condition.

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1. Introduction

Surgical site infection (SSI) is a common complication after lower digestive tract surgery. For wounds in the contaminated and dirty wound classes, the incidence rates are 10% to 17% and >27%, respectively [1,2]. In prior years, dirty wounds were treated using delayed primary closure with wet-to-dry dressing [3]. Negative pressure wound therapy (NPWT) for abdominal SSI is now becoming increasingly common, and many reports have confirmed its association with good outcomes [4,5]. Enterocutaneous fistula (ECF) has been reported as a complication of NPWT, and it is thus important to ensure that NPWT is correctly indicated [6]. An objective method to assess the risk and safety of NPWT has not yet been

reported. In this report, we used CT woundgraphy to evaluate the relationship between the wound and the intestine, and then safely treated abdominal SSI using NPWT.

2. Case presentation

Our patient, a 59-year-old woman, had previously undergone laparoscopic intersphincteric resection for low rectal neuroendocrine tumor and covering ileostomy. The pathological diagnosis was neuroendocrine carcinoma, the invasion depth was submucosal, and there was no lymph node metastasis, lymphatic invasion, or vascular invasion. After the surgery, the patient developed anastomotic leakage and pelvic suppuration. We treated this complication without additional surgery by changing the intrapelvic drainage tube that had been placed during the surgery on a weekly basis. The patient was discharged from our hospital 40 days after the operation. Anastomotic stenosis was subsequently diagnosed. The patient underwent 19 rounds of stenosis by means of endoscopic balloon dilation, and a stoma closure operation was planned for one year after the first surgery. Under general anesthesia, a cir-

* Corresponding author.

E-mail addresses: i.eisaku.ukasie@yahoo.co.jp (E. Ito), masashi@iuhw.ac.jp (M. Yoshida), keigo.0613@yahoo.co.jp (K. Nakashima), norinori_sculler@yahoo.co.jp (N. Suzuki), imakita0626@gmail.com (T. Imakita), nobuhiro_mihoko@hotmail.com (N. Tsutsui), ohdaira@iuhw.ac.jp (H. Ohdaira), kitajima@iuhw.ac.jp (M. Kitajima), yutaka@iuhw.ac.jp (Y. Suzuki).

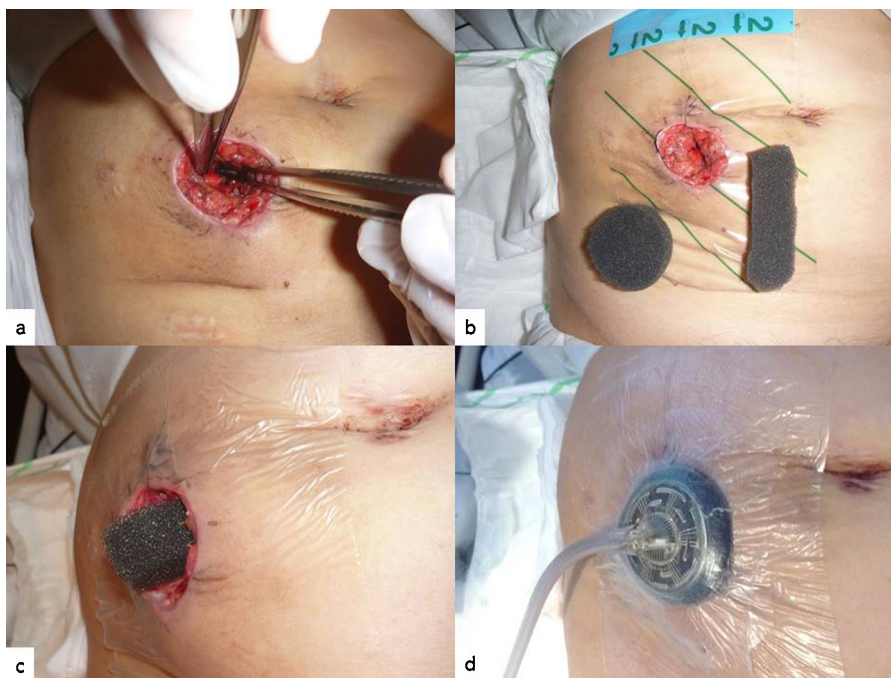


Fig. 1. (a, b) CT woundgraphy before NPWT showed that the wound was separated from the abdominal cavity and intestine by the abdominal rectus muscle. A subcutaneous pocket space around the wound was also observed. (c, d) CT woundgraphy ten days after NPWT showed that the wound had shrunk.

cular skin incision was made around the stoma with a 5 mm margin. A huge para-stomal hernia was observed with a hernia orifice of 30 mm × 48 mm. There was no adhesion in the abdominal cavity. Because the serosa of the intestine was injured, we resected 20 cm of the small bowel and reconstructed it using the functional end-to-end anastomosis technique. The thickness of the subcutaneous fat was 50 mm. The para-stomal hernia had created a large dead space under the skin. We closed the fascia of the abdominal rectus muscle with a class-1 absorbable monofilament fiber and the superficial fascia with a 3-0 absorbable multifilament fiber. We closed the skin

with a purse-string suture using a class-1 absorbable multifilament fiber. The circumstomal skin incision was approximated and it was not closed completely because the wound was classified as a dirty surgical wound. The operation time was 71 min, and blood loss was 15 ml. Six days after the surgery, we diagnosed SSI based on the redness of the wound, fever, and discharge of pus. The pus culture was negative. We opened the infected wound and found a huge subcutaneous abscess. There were no foreign bodies. Because the wound depth was deep and the pus resembled enteric fluid, we suspected ECF or intestinal injury.

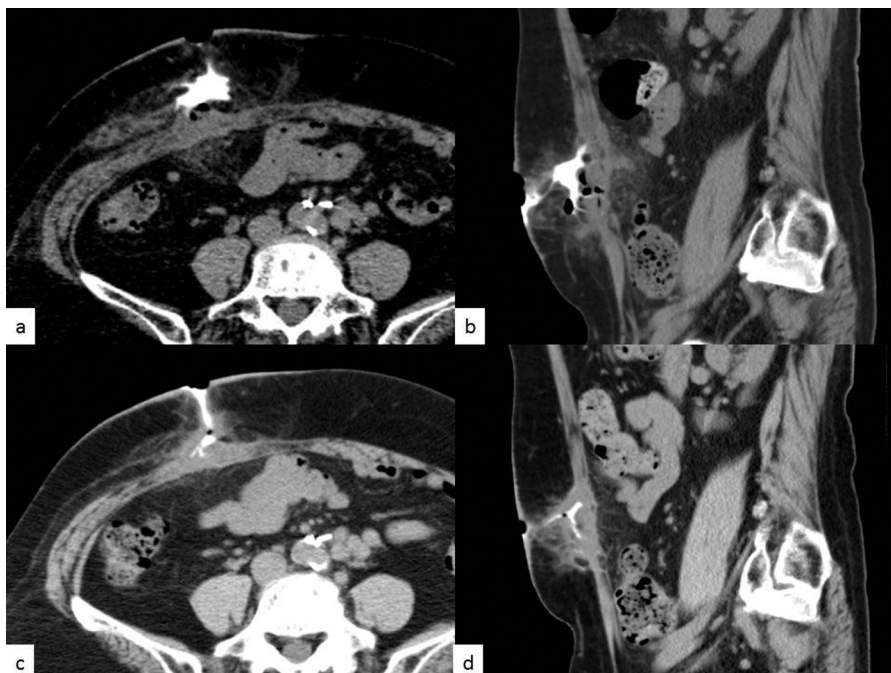


Fig. 2. (a) The thickness of the subcutaneous fat was 50 mm. (b–d) VAC® abdominal wound management system (KCI, San Antonio, TX, USA).

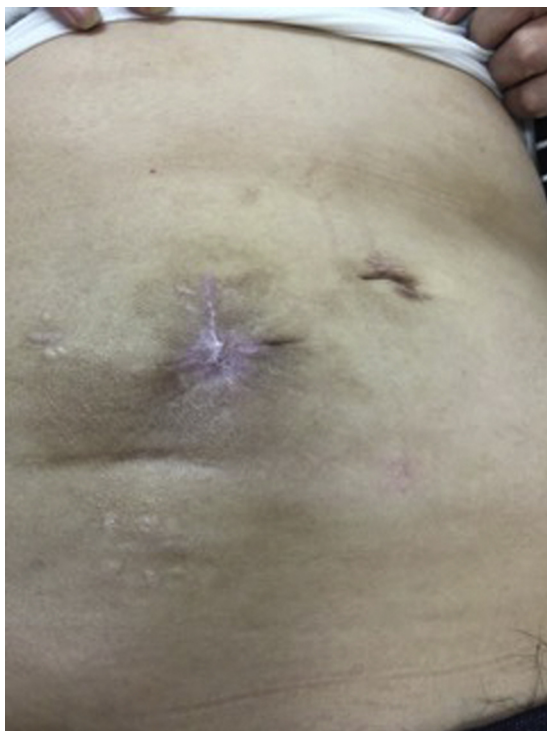


Fig. 3. One month after discharge, the wound was completely epithelialized.

The wound was deep and dirty with necrotic and infected tissue, and the wound edge was small (3 cm in diameter). We could not evaluate the wound accurately through simple visual observation. We injected 3% amidotrizoic acid into the wound, covered it with a film dressing, and performed a CT scan (Fig. 1). CT woundgraphy showed that there was no communication between the wound and the intestine, and that the wound was separated from the abdominal cavity and the intestine by the abdominal rectus muscle. CT woundgraphy also revealed a subcutaneous pocket space around the wound. One day after CT woundgraphy, we performed NPWT using the VAC[®] abdominal wound management system (KCI, San Antonio, TX, USA) (Fig. 2). The setting was continuous vacuum, the suction pressure was 125 mmHg, and the dressing was changed every 48 h. After six days on the VAC[®] system (with two changes), the volume of pus decreased (from 100 ml/day to 10 ml/day). After fifteen days on the VAC[®] system (with five changes total), the SSI was cured and the wound was well granulated. Twenty-three days after the surgery, the patient was discharged. She lavaged the wound with tap water at home. Eventually, the wound was completely epithelialized (Fig. 3).

3. Discussion

3.1. NPWT for SSI after abdominal surgery

Previously, secondary closures or delayed primary closures were performed for abdominal SSI, but these have the disadvantages of being costly and time-consuming [3]. Recently, NPWT for abdominal SSI has been reported as a superior technique [7]. Good outcomes have been reported for NPWT in open-abdomen operations [8,9]. In these operations, ECF has been reported as a complication [6]. Some authors have been attempting to treat ECF with NPWT under specific conditions [10]. When using NPWT for abdominal SSI, however, one must take steps to avoid ECF.

3.1.1. Prevention of ECF

The rate of ECF is reported to range from 2.0 to 20% when NPWT is used for abdominal sepsis [11–13]. Some authors have reported that a non-adherent silicone layer is important to protect the bowel and can prevent ECF in open-abdomen operations [14,15]. Separation of the wound from the intestine by structures such as the omentum or muscle fascia, protection of the serosa of the intestine during the operation, and low vacuum pressure are important factors in preventing ECF [11,12]. Therefore, it is important to evaluate the relationships among the wound, the fascia, and the intestine prior to treating abdominal SSI. Until now, we have had to rely on visual observation alone to check the condition of these wounds. When the abdominal wall is thick, when there is a lot of necrotic tissue, or when the wound is deep and extensive (perhaps with a large pocket), it can be difficult to interpret the condition based on visual inspection. CT fistulography has been reported for congenital branchial cleft and perianal fistula, but CT woundgraphy has not previously been reported [16,17]. CT woundgraphy can reveal the entire wound shape and expansion, as well as the relationship between the wound and the intestine. CT woundgraphy is associated with a slight risk of radiation exposure and allergy to the contrast agent, but these risks are considered to be lower than those associated with normal enhanced CT contrast agent injected into a vein. A limited range of CT scanning can reduce the radiation exposure to less than that of a plane abdominal CT scan. Moreover, there is no risk of renal damage due to the contrast agent for CT woundgraphy. CT woundgraphy can be used to evaluate the extent and depth of a wound, the closure of muscle fascia, and the relationship between the wound and the intestine, and is considered an effective tool in the treatment of abdominal SSI.

4. Conclusion

We report a case that underwent CT woundgraphy before NPWT for abdominal SSI. CT woundgraphy is a good candidate for evaluating wound condition.

Conflict of interests

The authors declare no conflict of interests related to this article.

Funding

None.

Ethical approval

Written informed consent was obtained from the patients for publication of these case reports and accompanying images.

Consent

This patient was properly informed and gave consent for her clinical information to be included in an Elsevier publication.

Author contribution

Eisaku Ito performed the procedure, wrote the manuscript and is responsible for the information. Keigo Nakashima, Norihiko Suzuki and Tomonori Imakita performed the procedure. NobuhiroTsuetsui, Hironori Ohdaira, Masashi Yoshida, Masaki Kitajima and Yutaka Suzuki critically reviewed the manuscript.

Guarantor

Eisaku Ito and Yutaka Suzuki are the guarantor of this paper.

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References

- [1] D.H. Culver, T.C. Horan, R.P. Gaynes, W.J. Martone, W.R. Jarvis, T.G. Emori, et al., Surgical wound infection rates by wound class, operative procedure, and patient risk index, *Am. J. Med.* 91 (1991) 152S–157S, National Nosocomial Infections Surveillance System.
- [2] P.J. Cruse, R. Foord, The epidemiology of wound infection. A 10-year prospective study of 62,939 wounds, *Surg. Clin. North Am.* 60 (1980) 27–40.
- [3] G.R. Tobin, An improved method of delayed primary closure, *Surg. Clin. North Am.* 64 (1984) 659–666.
- [4] A.M. Bonds, T.K. Novick, J.B. Dietert, F.Y. Araghizadeh, C.H. Olson, Incisional negative pressure wound therapy significantly reduces surgical site infection in open colorectal surgery, *Dis. Colon Rectum* 56 (2013) 1403–1408.
- [5] P. Stevens, Vacuum-assisted closure of laparostomy wounds: a critical review of the literature, *Int. Wound J.* 6 (2009) 259–266.
- [6] J.J. Dubose, J.B. Lundy, Enterocutaneous fistulas in the setting of trauma and critical illness, *Clin. Colon Rectal Surg.* 23 (2010) 182–189.
- [7] A.U. Blackham, J.P. Farrah, T.P. McCoy, B.S. Schmidt, P. Shen, Prevention of surgical site infections in high-risk patients with laparotomy incisions using negative-pressure therapy, *Am. J. Surg.* 205 (2013) 647–654.
- [8] P. Navsaria, A. Nicol, D. Hudson, J. Cockwill, J. Smith, Negative pressure wound therapy management of the open abdomen following trauma: a prospective study and systematic review, *World J. Emerg. Surg.* 8 (2013) 4.
- [9] D.E. Barker, J.M. Green, R.A. Maxwell, P.W. Smith, V.A. Mejia, B.W. Dart, et al., Experience with vacuum-pack temporary abdominal wound closure in 258 trauma and general and vascular surgical patients, *J. Am. Coll. Surg.* 204 (2007) 784–792.
- [10] G. Pepe, S. Magalini, C. Callari, R. Persiani, C. Lodoli, D. Gui, 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.* 18 (2014) 2527–2532.
- [11] M. Rao, D. Burke, P.J. Finan, P.M. Sagar, The use of vacuum-assisted closure of abdominal wounds: a word of caution, *Colorectal Dis.* 9 (2007) 266–268.
- [12] S. Richter, S. Dold, J.P. Doberauer, P. Mai, J. Schuld, Negative pressure wound therapy for the treatment of the open abdomen and incidence of enteral fistulas: a retrospective bicentre analysis, *Gastroenterol. Res. Pract.* 730829 (2013), <http://dx.doi.org/10.1155/2013/730829>.
- [13] I. Shaikh, A. Ballard-Wilson, S. Yalamarthy, A.I. Amin, Use of topical negative pressure in assisted abdominal closure does not lead to high incidence of enteric fistulae, *Colorectal Dis.* 12 (2010) 931–934.
- [14] T. Wild, P. Goetzinger, B. Telekey, VAC and fistula formation, *Colorectal Dis.* 9 (2007) 572–573.
- [15] R.R. Ivatury, Update on open abdomen management: achievements and challenges, *World J. Surg.* 33 (2009) 1150–1153.
- [16] Z. Sun, K. Fu, Z. Zhang, Y. Zhao, X. Ma, Multidetector computerized tomographic fistulography in the evaluation of congenital branchial cleft fistulae and sinuses, *Oral Surg. Oral Med. Oral Pathol. Oral Radiol.* 113 (2012) 688–694.
- [17] C. Liang, W. Jiang, B. Zhao, Y. Zhang, Y. Du, Y. Lu, CT imaging with fistulography for perianal fistula: does it really help the surgeon? *Clin. Imaging* 37 (2013) 1069–1076.

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