



Measures for Preventing Wound Infections During Elective Open Surgery for Colorectal Cancer: Scrubbing With Gauze

Takanori Goi, Yuki Ueda, Toshiyuki Nakazawa, Katsuji Sawai, Mitsuhiro Morikawa, Akio Yamaguchi

First Department of Surgery, University of Fukui, Fukui, Japan

In addition to the general surgical-site infection prevention measures in colorectal cancer surgery, we performed a simple subcutaneous scrubbing procedure with gauze at the time of abdominal closure, which reduced the incidence of wound infections. There are 289 patients whose primary colon cancer lesions were removed by elective surgeries. They were divided into Group A (74 patients with no wound infection prevention measures who were treated from 2002 to 2003), Group B (76 patients with wound infection prevention measures who were treated from 2007 to 2008), and Group C (139 patients with subcutaneous scrubbing with gauze plus the measures in Group B who were treated from 2009 to 2012). The incidence in Group A was 23%, while the corresponding values in Group B and Group C were 14.5% and 2.9%, respectively. The incidence of wound infections was substantially reduced by additional subcutaneous scrubbing with a saline solution and gauze during closure of a surgical incision. This very simple procedure was considered useful for surgical site infection prevention.

Key words: Colon cancer – Surgical site infection – Wound infection

Perioperative infections occurring in surgery are referred to as surgical site infections (SSIs) by the U.S. Centers for Disease Control and Prevention (CDC); this term is also used in Japan.¹ Additionally, the CDC developed a method to determine the risk index for preoperatively predicting the incidence of SSIs through risk factor scoring. In 1999, guidelines

for preventing SSIs were published.² In Japan, various SSI prevention measures and an SSI surveillance procedure have also been introduced by referring to these examples. The Japanese Nosocomial Infection Surveillance (JNIS) system (renamed Japanese Healthcare Associated Infections Surveillance [JHAIS] in February 2008), similar to the

Reprint requests: Takanori Goi, First Department of Surgery, University of Fukui, 23-3, Eiheiji-cho, Yoshida-gun, Fukui, Japan.
Tel.: +81 776 61 3111 (Ext. 2343); Fax: +81 776 61 8113; E-mail: tgoi@u-fukui.ac.jp

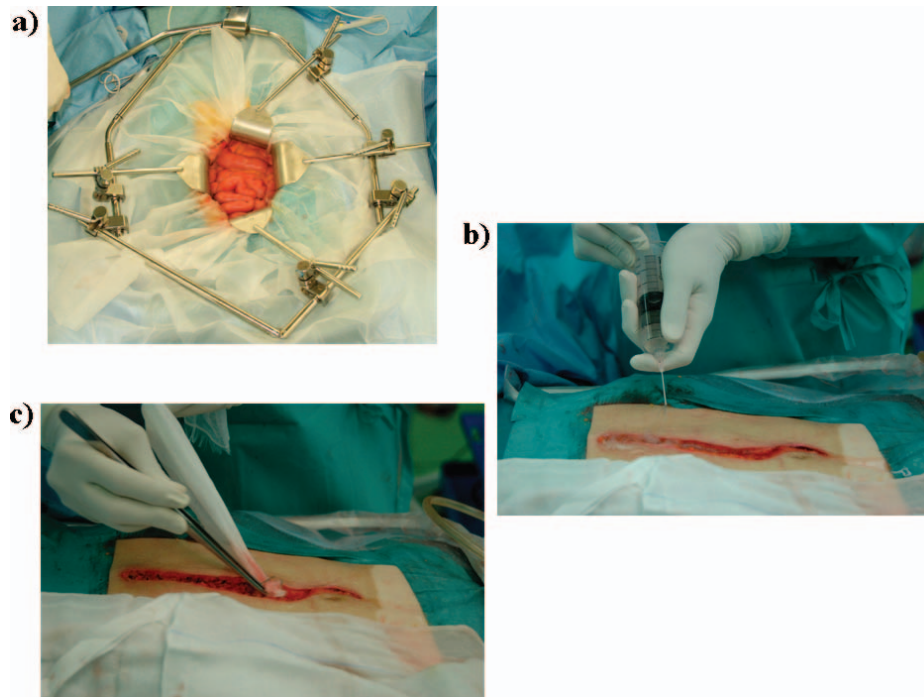


Fig. 1 (a) During surgery, wound edges were covered with drapes. (b) High-pressure subcutaneous washing with 300 mL of physiological saline. An 18-gauge needle was attached to a 50-mL injection syringe into which the saline solution was drawn, and then ejected in 1 stroke by plunger pressure and sprayed over the wound site for washing. (c) Subcutaneous scrubbing with gauze.

National Nosocomial Infection Surveillance (NNIS) system, was launched, and surgical operations were included in 2002.

According to the NNIS system report, SSIs rank third among nosocomial infections.^{3,4} In terms of nosocomial infections in surgical patients, SSIs were ranked the highest at 38%, of which wound infections accounted for two-thirds, and organ and body cavity infections accounted for one-third.⁵ Thanks to various SSI prevention measures in recent years, the incidence of wound infections has tended to decrease, but an incidence of approximately 10% has still been reported to date.^{6–11} Generally, the occurrence of SSI results in longer hospital stays and increased hospitalization costs.^{12,13} Smith *et al* reported that a wound infection would mean an additional medical cost at home, even if the patient is not staying in the hospital.¹⁴ Therefore, additional measures are important to prevent SSIs.

In the present study, in addition to the general wound infection countermeasures, we performed a subcutaneous scrubbing procedure with gauze during abdominal closure in colorectal cancer surgery to examine whether this additional step could change the incidence of wound infections.

Materials and Methods

Of the 290 colorectal cancer patients who underwent elective surgery for intestinal resection ($\geq$ D3 lymph node dissection) from 2002 to 2012 in our department, 74 were assigned to Group A (operations performed from 2002 to 2003); 76 were assigned to Group B (operations performed from 2007 to 2008); and 139 were assigned to Group C (operations performed from 2009 to 2012) to examine the incidence of SSIs. The NNIS diagnostic criteria were used to define wound infections.¹⁵ In our department, measures for wound infections in colorectal cancer surgery have been implemented stepwise since 2004. By 2007, the procedure had been documented and standardized; therefore, investigation was started. The wound infection rate was reduced in 2007 and 2008, whereas the scrubbing method with gauze was introduced in 2009 to further reduce the infection rate.

We examined patients who underwent laparoscopic surgery, including patients with T3 or lower lesion depths, N1 or lower lymph node metastasis grades and no distant metastases, and those who underwent open surgery.

Table 1 Patient characteristics

	2002–2003	2007–2008	2009–2012
No. of patients	74	76	139
Gender (M/F)	45/29	35/41	81/58
Mean age (years)	67.2	71.6	70.7
Blood transfusion	8	8	12
ASA			
>2	63	70	127
>3	9	6	12
Smoker	25	25	50
BMI	22.1	22.5	22.6
Operation time (min)	183.0	164.0	198.7
Diabetes	13	6	32

Prevention of surgical site infection

In Group A, hair was shaved at the incision site on the day prior to surgery. During the colorectal cancer surgery, after intra-abdominal manipulation for removing the intestine, the abdominal cavity was cleansed with a 3000-mL saline solution, and the fascia was closed for abdominal closure. In Group B, the incision site was treated with a hair removal cream on the day prior to surgery. Until 2006, surgery was initiated early in the morning; therefore, hair removal was performed during the previous night. However, since 2007, only the clipper procedure has been used immediately before surgery, according to necessity. During surgery, the wound edge was covered with a drape (3M Steri-Drape Wound Edge Protector 1075, Lexington, MA, USA). Then, at the time of wound closure after primary lesion resection, gloves were changed, surgical tools were replaced with new tools (no change in staff), and the abdominal cavity was cleansed with a 3000-mL saline solution. After the fascia was closed, the subcutaneous site was washed with a 300-mL high-pressure saline solution, and the skin was closed to finish the surgery. In Group C, in addition to the procedures employed in Group B, gauze was used for subcutaneous scrubbing during the high-pressure washing. For the high-pressure washing process, an 18-gauge needle was attached to a 50-mL injection syringe into which the saline solution was drawn, and then ejected in 1 stroke by plunger pressure and sprayed over the wound site for washing (Fig. 1).

Since 2002, preoperative measures included smoking cessation, nutritional state improvement, and in diabetic patients, reductions in hemoglobin A1c (HbA1c) concentration to 7% or lower. For the intraoperative procedure, the body temperature was maintained at approximately 36.5°C during surgery.

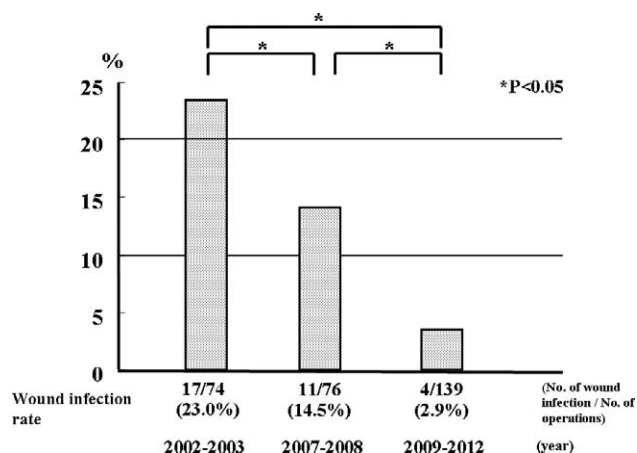


Fig. 2 Before the implementation of pre- and intraoperative preventive measures, wound infections occurred in 17 of 74 patients (23%) with colon cancer surgery. After the implementation of pre- and intra-operative preventive measures, wound infections occurred in 11 of 76 patients (14.5%) between 2007 and 2008. In Group C, wound infections occurred in 4 of 139 patients (2.9%) between 2009 and 2012. In group C, patients were with significantly fewer wound infections occurring compared with Groups A and B.

Results

Table 1 shows the breakdown of the cases in Groups A, B, and C. No significant differences were observed in gender, age, American Society of Anesthesiologists (ASA) score, primary site, stage, concurrent disease, bleeding amount, or surgery duration. In Group A, wound infections were found in 17 of the 74 (23%) patients. In Group B, wound infections were found in 11 of the 76 (14.5%) patients, all of whom received wound infection countermeasures; the incidence of infections in Group B was significantly lower than infection incidence in Group A. In Group C, which contained patients who received an additional infection countermeasure, wound infections were found in 4 of the 139 (2.9%) patients, representing a significant reduction from the levels noted in Group A and B (Fig. 2).

An additional investigation by year showed no major differences in the frequency of occurrence of wound infections in different years in Group A, but the rate in colon cancer patients was 16% in 2007, 11.5% in 2008, 3.4% in 2009, 2.8% in 2010, 2.8% in 2011, and 2.6% in 2012 in Group B, with the frequency of occurrence of wound infection declining in recent years (Fig. 3).

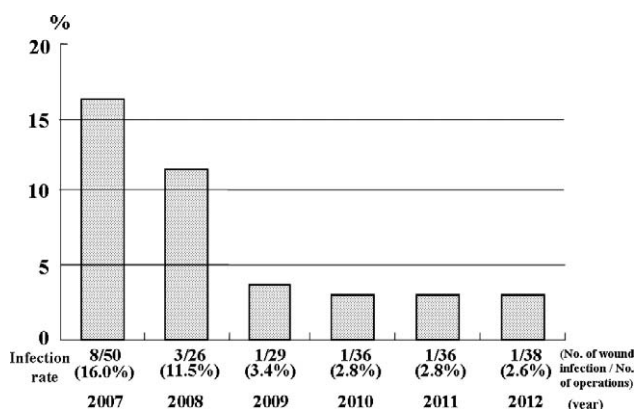


Fig. 3 The rate of wound infections in colon cancer patients was 16% in 2007, 11.5% in 2008, 3.4% in 2009, 2.8% in 2010, 2.8% in 2011, and 2.6% in 2012, after the implementation of intraoperative preventive procedure (from 2009 to 2012; in addition: subcutaneous scrubbing with gauze).

Discussion

According to the findings of SSI surveillance procedures in the United States and Japan, SSIs were frequently observed in gastrointestinal surgery cases, especially in colorectal cancer surgery patients.⁴ Even with SSI prevention measures in place, wound infections are known to occur in about 10% of patients.^{6–11} Generally, wound infections can increase hospital stay duration/costs and delay social rehabilitation; therefore, it is important to implement SSI-prevention measures. When an intestinal resection is conducted, the bacteria may fall from the resected intestine, and this may be related to wound infections. The number of bacteria in the large intestine is reported to be several thousand times that of the upper digestive tract and is considered to be a major factor for contamination of the surgical site and occurrence of an SSI. The following are possible SSI prevention measures: (1) Devise preparatory procedures to minimize contamination during surgery; (2) Prevent contamination of the surgical site during the operation; and (3) Prevent SSIs from happening even in the existence of a slight contamination by increasing the patient's resistance to infections and by eliminating contamination.⁴

Before 2003, the SSI prevention measures in Japan and in our department were just mechanical colonic irrigation and heeding precautions to minimize contamination of the surgical site during an operation; very few institutions had adopted concrete

measures. In our department, the rate of wound infection used to be quite high. Since 2004, measures for wound infections in colorectal cancer surgery have been implemented stepwise. By 2007, the procedure had been documented and standardized; therefore, investigation was started. We cover the wound edge with a drape; then, when closing the abdominal wall, the gloves were changed; the surgical tools were replaced with new ones; and high-pressure washing was conducted with a 300-mL saline solution. Thus, the incidence of wound infection could be significantly reduced in our department, reaching about 10%, which was nearly equivalent to the average level given in reports. In the present study, we aimed to further reduce the incidence of wound infection. Speculating that a reduction in the number of bacteria at the wound site would be effective, we scrubbed the subcutaneous region with gauze during the high-pressure washing before closing the wound, as an additional procedure. The idea of scrubbing with gauze was inspired by the effectiveness of brush scrubbing for contaminated injuries.¹⁶ The outcome was a reduction in the incidence of wound infection, as expected. We considered that the decrease in the bacteria under the skin possibly brought about the good result. In recent years, laparoscopy has been conducted for a better cosmetic outcome, and the incidence of wound infection from a laparoscopy has been reported to be about 6%, which was lower than that of an open abdominal surgery.^{8–10} If a wound infection occurs in a laparoscopy, the cosmetic aspect will be compromised; therefore, a wound infection should be avoided. After adopting this method, the incidence of wound infection has been reduced to 2% in our department. According to the results of the present study, subcutaneous scrubbing with gauze at the time of high-pressure washing before wound closure was found to be effective, in addition to the general SSI prevention measures. This very simple procedure was considered useful for SSI prevention.

References

1. Culver DH, Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG *et al.* Surgical wound infection rates by wound class, operative procedure, and patient risk index. National Nosocomial Infections Surveillance System. *Am J Med* 1991;**91**(3): 152–157
2. CDC. Guideline for Prevention of Surgical Site Infection, 1999. *Infect Control Hosp Epidemiol* 1999;**20**(4):247–278

3. National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004, issued October 2004. *Am J Infect Control* 2004;**32**(8):470–485
4. Tang R, Chen HH, Wang YL, Changchien CR, Chen JS, Hsu KC *et al.* Risk factors for surgical site infection after elective resection of the colon and rectum: a single-center prospective study of 2,809 consecutive patients. *Ann Surg* 2001;**234**(2):181–189
5. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection. *Infect Control Hosp Epidemiol* 1999;**20**(4):250–278
6. Morikane K, Honda H, Suzuki S, Yamagishi T, Aminaka M. Risk factors for surgical site infections in Japanese patients with gastrointestinal surgeries. Paper presented at: ID Week 2012: Advancing Science, Improving Care; October 17–21, 2012; San Diego, CA. Abstract 1682.
7. Gervaz P, Bandiera-Clerc C, Buchs NC, Eisenring MC, Troillet N, Perneger T *et al.* Scoring system to predict the risk of surgical-site infection after colorectal resection. *Br J Surg* 2012;**99**(4):589–595
8. Nakamura T, Mitomi H, Ihara A, Onozato W, Sato T, Ozawa H *et al.* Risk factors for wound infection after surgery for colorectal cancer. *World J Surg* 2008;**32**(6):1138–1141
9. Abraham NS, Young JM, Solomon MJ. Meta-analysis of short-term outcomes after laparoscopic resection for colorectal cancer. *Br J Surg* 2004;**91**(9):1111–1124
10. Braga M, Vignali A, Gianotti L, Zuliani W, Radaelli G, Gruarin P *et al.* Laparoscopic versus open colorectal surgery: a randomized trial on short-term outcome. *Ann Surg* 2002;**236**(6):759–766
11. Winslow ER, Fleshman JW, Birnbaum EH, Brunt LM. Wound complications of laparoscopic vs open colectomy. *Surg Endosc* 2002;**16**(10):1420–1425
12. Martone WJ, Nichols RL. Recognition, prevention, surveillance, and management of surgical site infections: introduction to the problem and symposium overview. *Clin Infect Dis* 2001;**33**(1):67–68
13. Gaynes RP, Culver DH, Horan TC, Edwards JR, Richards C, Tolson JS. Surgical site infection (SSI) rates in the United States, 1992–1998: the National Nosocomial Infections Surveillance System basic SSI risk index. *Clin Infect Dis* 2001;**33**(1):69–77
14. Smith RL, Bohl JK, McElearney ST, Friel CM, Barclay MM, Sawyer RG *et al.* Wound infection after elective colorectal resection. *Ann Surg* 2004;**239**(5):599–605
15. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol* 1992;**13**(10):606–608
16. Wound, Ostomy, and Continence Nurses Society. Guideline for prevention and management of pressure ulcers. WOCN Society, Glenview, IL. 2003;24.

© 2014 Goi et al.; licensee The International College of Surgeons. This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-commercial License which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non-commercial and is otherwise in compliance with the license. See: <http://creativecommons.org/licenses/by-nc/3.0>