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Wound closing method with 2-octyl cyanoacrylate after single-incision laparoscopic surgery for colorectal cancer

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Summary

Background The use of 2-octyl cyanoacrylate (CA) for the umbilical wound after single-incision laparoscopic surgery (SILS) for colorectal cancer has not been described.

Methods A consecutive experience of SILS for colorectal cancer is presented. Three hundred sixty-four patients (172 women) were treated with SILS for colorectal cancer between December 2010 and December 2015. Our institution introduced CA in September 2012. The data of patients treated with CA were compared to a historical group who underwent standard sutured skin closure with thin adhesive strips (AS) at our institution. The Centers for Disease Control and Prevention criteria were used for the diagnosis of superficial surgical site infection (SSI).

Results Of these 364 patients, 20 patients (5.5%) were converted to laparotomy including the extension of the skin incision longer than 3 cm. In 344 patients completed with SILS, CA was used in 247 patients. Superficial SSI occurred in two patients (0.81%) with CA and one (1.03%) with AS. No patients completed with SILS suffered wound dehiscence in this series. There were no significant differences in wound-related complication rate between the two groups.

Conclusions CA provides sufficient wound closure in SILS for colorectal cancer. SILS with CA has the possibility to provide a lower superficial SSI rate in patients with colorectal cancer.

Introduction

Surgical site infections (SSI) are the most common nosocomial infection in surgical patients, contributing to perioperative morbidity, prolonged length of postoperative hospital stay, and increased hospital costs. Colorectal surgery has been associated with the highest risk of SSI, predominantly because of the heavy bacterial load of the colon and rectum. The incidence of incisional SSI following colorectal surgery has been reported to range from 3 to 26% [1, 2].

The use of 2-octyl cyanoacrylate (Dermabond advanced, Ethicon, Somerville, NJ, USA) for wound closure has been widely described before. Since its introduction, numerous applications have been described. The use of 2-octyl cyanoacrylate (CA) potentially has a number of advantages and benefits compared with conventional surgical wound closure techniques, including effective wound closure, cosmesis, noninvasive and less tissue trauma, no requirement for secondary dressing, ease of bathing, and no requirement for suture/staple removal [3]. CA spontaneously sloughs off in a short time period (5–10 days), therefore not requiring clinician removal [4]. However, the use of CA for the umbilical wound after even conventional laparoscopic colorectal surgery has not been described.

Our institution began performing single-incision laparoscopic surgery (SILS) for colorectal disease in August 2010 as a standard procedure. Our initial experiences with over 300 cases showed that SILS can

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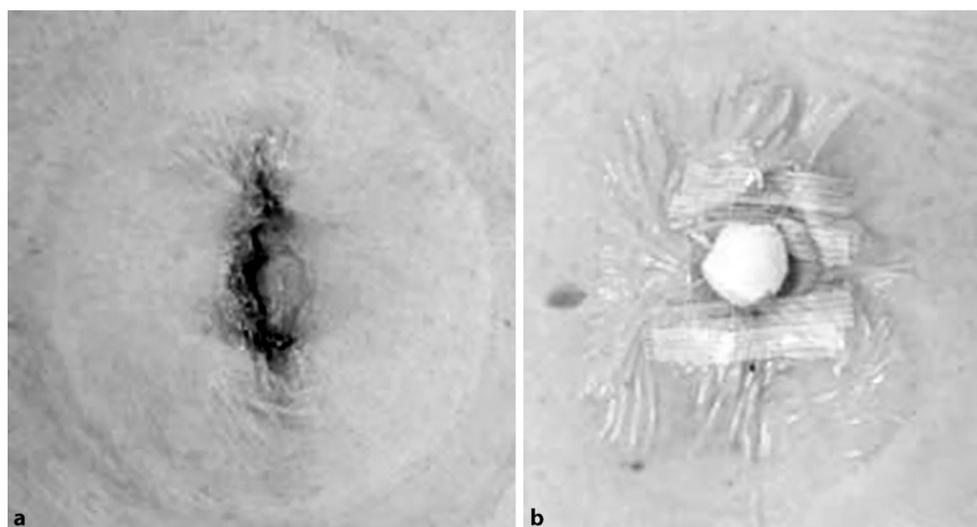
be applied to colon cancer at any anatomical location with preferable short-term outcomes.

The objective of this study was to determine the clinical applicability of CA for umbilical incision in SILS for colorectal cancer.

Patients and methods

A consecutive experience of SILS for colorectal cancer without planned additional port insertion is presented. Three hundred sixty-four patients (172 women) with a median age of 71.1 years (range, 29–93 years) and a median body mass index of $22.1\,kg/m^2$ (range, 14.0–$35.3\,kg/m^2$) were treated with SILS for colorectal cancer between December 2010 and December 2015. One hundred forty-four patients (42.2%) had undergone prior abdominal surgery. Their primary tumor sites included the appendix vermiformis ($n=2$), cecum ($n=67$), ascending colon ($n=104$), transverse colon ($n=57$), descending colon ($n=31$), sigmoid colon ($n=93$), and rectum ($n=4$). Six patients had two primary colon tumors. In all cases, the patient's consent for SILS was obtained.

Our institution introduced CA in September 2012. The data of patients treated with CA (Fig. 1a) were compared with the data of patients with standard sutured skin closure with thin adhesive strips (Steri-Strips™ (3M, Two Harbors, MN, USA); Fig. 1b). The patient demographics of two groups are shown in Table 1. The Centers for Disease Control and Prevention criteria were used for the diagnosis of SSI. Post-operative follow-up was performed according to the Japanese Guidelines for treatment of colorectal cancer [5].

Surgical technique

Under general anesthesia, the patients were placed in the modified lithotomy position. First, a Lap protector (LP; Hakkou Shoji, Japan) was inserted through a 2.5 cm transumbilical incision, which protected the wound. Next, an EZ access (Hakko Medical, Nagano, Japan) was mounted onto the LP, and three ports were introduced through it. Almost all procedures were performed with standard laparoscopic instruments, and the operative procedures were similar to those employed in the standard laparoscopic colorectal surgical procedure using a flexible tip laparoscope.

Drains were not inserted in all cases, and wound closure was performed with CA in all cases after its introduction. After placing subcutaneous absorbable sutures for wound adaptation, CA was applied for skin adhesion. After crushing the inner ampoule, CA was pumped into the applicator and finally applied to the adapted wound edges. Its liquid form polymerized to the solid form after 2–3 min. The wound was then left uncovered. The patients were allowed to take a shower on the first postoperative day. For the group of patients before introduction of CA, thin adhesive strips (AS) were used for skin adhesion after placing the above-mentioned subcutaneous sutures. The wound was covered with an adhesive dressing (Band-Aid).

Statistical analysis

Comparisons between patient groups were made using the χ² test and the Student's t-test. *P*-values of less than 0.05 were considered significant.

Results

Of these 364 patients, 20 patients (5.5%) were converted to laparotomy including the extension of the skin incision longer than 3 cm.

In 344 patients completed with SILS, CA was used in 247 patients. 97 patients were treated with standard sutured skin closure with thin adhesive strips (AS) at our institution.

For CA patients, the mean skin incision length was 2.7 cm. The mean operative time was 147.5 min

Table 1 Patients demographics

	CA (*n* = 247)	AS (*n* = 97)	*P*-value
Age (years)	71.4	69.2	0.088
Sex			
Male	123	59	0.065
Female	124	38	–
BMI (kg/m^2)	22.0	22.9	0.033
Previous abdominal surgery	105 (42.5%)	38 (39.2%)	0.481
Tumor location			
Appendix vermiformis	2	0	0.324
Cecum	43	22	–
Ascending colon	68	30	–
Transverse colon	43	10	–
Descending colon	17	14	–
Sigmoid colon	66	21	–
Rectum	2	0	–
Multiple lesion	6	0	–

CA 2-octyl cyanoacrylate, *AS* thin adhesive strips, *BMI* body mass index.

Table 2 Operative outcomes

	CA (*n* = 247)	AS (*n* = 97)	*P*-value
Skin incision (cm)	2.70	2.74	0.554
Operative time (min)	147.5	193.4	<0.01
Estimated blood loss (mL)	34.0	66.7	<0.01
Harvested lymph nodes	24.6	25.9	0.40
Post-operative complication (%)	7.3	5.2	0.636
Hospital stay (days)	12.0	11.3	0.350
TMN classification			
0	14	4	0.725
I	50	24	–
II	73	28	–
III	67	30	–
IV	43	11	–

CA 2-octyl cyanoacrylate, *AS* thin adhesive strips.

and was significantly shorter than the patients with AS. The mean estimated blood loss was 34.0 mL and was significantly less than the AS groups. The mean number of harvested lymph nodes was 24.6. The pathological stages included stage 0 (*n* = 14), stage I (*n* = 50), stage II (*n* = 73), stage III (*n* = 67), and stage IV (*n* = 43). Intra-operative injury occurred in five patients. Post-operative complications occurred in 18 patients (7.3%), and the patients were discharged after a mean period of 12.0 postoperative days (Table 2).

Table 3 presents a retrospective comparison between the patients with CA and AS. Superficial inci-

sional SSI occurred in two patients (0.81%) in the CA group and one (1.03%) in the AS group. All three infections were grade I in the Clavien–Dindo classification. No patients suffered wound dehiscence in this series. There were no significant differences in wound-related complication rates between two groups.

Discussion

2-octyl cyanoacrylate (CA) has no disadvantages with regards to tissue regeneration and no histotoxicity when used as a tissue adhesive for surgical procedures [5]. Regarding patients' comfort, CA theoretically offers several advantages. There is no need for Band-Aids or waterproof Band-Aids for showering, and no requirement for removal of sutures or staples. Since its introduction, numerous applications have been described including traumatic laceration [6], facial surgery [7], craniotomy and craniectomy [8], pediatric neurosurgery [9], corneal surgery [10], orthopedic surgery [11], and breast surgery [12]. Wilson and Mercer compared the use of CA with AS in unilateral cleft lip repair, and they found that the use of CA brought a lower infection and revision rate and a similar hypertrophic scar rate [13]. The low infection rate of wounds closed with CA is possibly a result of antibacterial effects, particularly against gram-positive organisms [14], and the creation of an effective barrier to microbial penetration by gram-positive and gram-negative motile and non-motile species [15].

Superficial incisional SSI is a postoperative infection in which the incisional skin or subcutaneous tissue is affected. It occurs within 30 days post-operatively and must fulfill one of the following additional criteria: purulent drainage from incision with or without diagnostic laboratory testing (culture), isolated organisms from aseptically obtained fluid or tissue culture in incision, at least one sign or symptom of clinical infection or the superficial incision is deliberately opened by a surgeon or diagnosis of a superficial incisional SSI by a surgeon or attending physician.

Colorectal surgery has been associated with the highest risk of SSI, and the incidence of superficial incisional SSI after colorectal surgery has been reported to range from 3 to 26% [1, 2]. Laparoscopic surgery has been widely documented as a safe and minimally invasive management for patients with colorectal cancer. Esemuede IO et al. [16] reported that laparoscopic colectomy was associated with a significantly lower rate of superficial incisional SSI than open colectomy. However, superficial incisional SSI remains an unresolved complication, occurring in

Table 3 Wound related complications

	CA (*n* = 247)	AS (*n* = 97)	Open (*n* = 20)	*P*-value (CA vs. SS)
Total (%)	2 (0.81)	1 (1.03)	4 (20.0)	0.656
Wound dehiscence (%)	0	0	2 (10.0)	1
SSI (%)	2 (0.81)	1 (1.03)	2 (10.0)	0.656

CA 2-octyl cyanoacrylate, *AS* thin adhesive strips, *SSI* surgical site infection.

about 5% of patients after laparoscopic colorectal surgery. In our series, the rate of superficial SSI was only 0.86%. We could not definitively prove that this low infection rate was attributable to the use of CA. However, the possibility that SILS with CA brought a lower superficial incisional SSI rate in patients with colorectal cancer was demonstrated in our series.

In the present study, the mean operative time was significantly shorter and mean estimated blood loss was significantly less in the CA group. These results could be mainly due to the increased experience of our surgical team. In this study, a Lap protector was used to perform SILS in all cases. The low infection rate in our series might be attributed to the use of this device.

The strengths of the present study are the non-selective inclusion of consecutive patients with SILS for colorectal cancer in our hospital and the prospective data collection. The major limitation is that the comparison of the infection rate in the present series was only possible with an institutional historical series and we did not assess the patients' satisfaction. A randomized trial is needed to underline the convincing results of the present study.

Compliance with ethical guidelines

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