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Surgical Site Infection and Validity of Staged Surgical Procedure in Emergent/Urgent Surgery for Ulcerative Colitis

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Although restorative proctocolectomy is recognized as a standard procedure for ulcerative colitis, infectious complications after surgery cannot be disregarded. The aim of this study was to define predictors of surgical site infection (SSI) in urgent/emergent surgery for ulcerative colitis. We performed prospective SSI surveillance for 90 consecutive patients. Possible risk factors were analyzed by logistic regression analyses. Incidences of incisional SSI (i-SSI) and organ/space SSI were 31.1% and 6.9%, respectively, and increased significantly with higher wound class ($P < 0.01$). Multivariate analysis showed wound class ≥3 as an independent risk factor for i-SSI. In univariate analysis, although the mucous fistula procedure was a risk factor for i-SSI (odds ratio, 3.45; $P < 0.01$), Hartmann procedure also represented a risk factor for o-SSI (odds ratio, 12.8; $P < 0.01$). Urgent restorative proctocolectomy for patients without high wound class and emergent total colectomy with mucous fistula for patients with high wound class appear to represent feasible options.

Key words: Ulcerative colitis – Surgical wound infection – Emergency medicine – Abdominal abscess

Ulcerative colitis (UC) is characterized by inflammation of unknown cause, affecting the colorectal mucosa beginning from the rectum and extending proximally within the colon. Since the first description in 1978 by Parks and Nicholls,[1] restorative proctocolectomy with ileal pouch anal anastomosis (IPAA) has been considered the standard surgical procedure. Although that procedure is

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recognized to be associated with relatively high quality of life and favorable long-term outcomes, complications after surgery cannot be disregarded.[2–4] Surgical site infection (SSI) is a frequent complication, and pelvic sepsis reportedly occurs in up to 23% of patients.[5–7] Several methods are applied after surgery to prevent pelvic sepsis, including diversion with ostomy, placement of pelvic drains, and placement of transanal drainage tubes.[5–7] Prevention of pelvic complications requires not only various surgical techniques, but also proper evaluation of the staged surgical procedure.

Indications for surgical treatment of UC can be divided into emergent, urgent, and elective situations. Emergent indications include perforation and massive hemorrhage.[8] Urgent indications include fulminant or severe colitis that is unresponsive to medical therapy, with or without toxic megacolon.[8] Staged surgical procedures can be divided into 3-stage, 2-stage, or 1-stage procedures according to the surgical indications. Most 3-stage procedures for emergent surgery and toxic megacolon include initial total colectomy with end ileostomy and second-stage procedures include restorative proctocolectomy with diverting ileostomy. From the perspective of SSI, the incidence of incisional SSI (i-SSI) would seem likely to increase with higher wound class in emergent/urgent surgery. Although the same could be said for pelvic sepsis as organ space SSI (o-SSI), 3-stage surgical procedures should be selected to prevent sepsis.

The primary aim of this study was to evaluate the influence of surgical indications and wound class on the occurrence of SSI in patients with UC restricted to emergent/urgent surgery. The secondary aim was to evaluate the proper procedure for remnant rectal stump to avoid pelvic sepsis as an SSI.

Materials and Methods

Patients and data collection

Ninety consecutive patients with UC (50 men, 40 women) who underwent urgent or emergent surgery at Hyogo College of Medicine between January 2008 and December 2010 were included in this study. Prospectively collected SSI surveillance data for patients with UC were evaluated. Possible risk factors for SSI (age, sex, duration from onset of UC, disease activity worse than severe, fulminant disease activity, total prednisolone dose ≥10,000 mg, preoperative prednisolone dose ≥50 mg/d, immunosuppressant administration, wound classification, American Society of Anesthesiologists (ASA) score ≥3, type of surgery (colonic or rectal), treatment for rectal stump using Hartmann procedure or mucous fistula, blood transfusion, prolonged surgery (operation time ≥190 minutes), blood loss ≥160 mL, serum albumin level ≥2.5 g/dL, and postoperative blood sugar level on the morning of postoperative day 1 ≥180 mg/dL) were analyzed using univariate and multivariate logistic regression analyses to determine their predictive significance. National Nosocomial Infection Surveillance (NNIS) risk index, which comprises ASA score ≥3, wound classification ≥3, and prolonged surgery, was also used for comparison.[9] Although no laparoscopic surgery was performed in this series, the risk index was divided into 4 grades, ranging from 0 to 3.

Preoperative prednisolone dose, serum albumin level, blood sugar level, prolonged surgery, and excessive blood loss were defined at the 75th percentile level in this series (50 mg/d, 2.5 g/dL, 180 mg/dL, 190 minutes, and 160 mL, respectively). Total prednisolone dose was calculated based on the steroid dose (converted to prednisolone-equivalents) administered since the initial diagnosis. Based on those results, we justified a total prednisolone dose of 10,000 mg as the cut off value, as this represented the median dose for 1000 UC surgery cases at our institution.[10] The surgical site was classified as colonic surgery (COLN) or rectal surgery (REC), defined as procedures including manipulation above or below the peritoneal reflection, respectively.

All variables were gathered from the electronic records, anesthesia records, and inpatient medical charts. ASA scoring was determined by the anesthesiologist on admission. Wound classification was assigned intraoperatively by the attending surgeons, according to the guidelines adopted by the Centers for Disease Control and Prevention (CDC).[1] Surgical wounds were also classified into class 2 (clean-contaminated: an operative wound in which the alimentary, genital, or urinary tracts were entered under controlled conditions and without unusual contamination). Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major breaks in technique was encountered. Most elective or urgent procedures without gastrointestinal breaks were classified into this category. Class 3 was defined as contaminated: open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered were included in this category. Surgical procedures with intraoperative major gastrointestinal breaks or toxic megacolon without perforation were also classified into this category. Class 4 was defined as dirty/infected: old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were already present in the operative field before operation. Emergent surgeries for perforative peritonitis were classified into this category. All study protocols were approved by the institutional review board at Hyogo College of Medicine, and informed consent was obtained before admission.

Outcome measurement

The major outcome of interest in this study was incidence of SSI. All SSIs were diagnosed by our infection control team designated staff, who have been trained in applying the surveillance methods and definitions of SSI based on guidelines issued by the NNIS system of the CDC.[12] Data for each SSI patient were collected separately according to the CDC classification, as i-SSI or o-SSI.[12] The criteria for diagnosis of SSI were an infection occurring within 30 days postoperatively and at least one of following: (1) purulent discharge from the incision or from a drain placed through a stab wound into the organ/space; (2) organisms isolated from cultures of fluid or tissue from the incision or organ/space; (3) open wound with signs and symptoms of infection; or (4) abscess or other evidence of infection found on examination of the incision or organ/space.[13] The decision on whether SSI was present in 75 patients (83.3%) was performed during hospitalization. The remaining 15 patients (16.7%) were followed in an outpatient clinic. None of the patients in this series were lost to follow-up.

Surgical indications and procedures

In this study, disease activities in patients with UC were assessed primarily on the basis of clinical features using the criteria of Truelove and Witts.[8] Absolute indications for emergency surgery were exsanguinating hemorrhage or perforation. Indications for urgent surgery performed within 12 hours of admission were severe or fulminant colitis, with or without toxic megacolon that was unresponsive to conventional maximal medical therapy, or less-severe colitis that was medically intractable or showed intolerable side effects of pharmacotherapy with progressively worsening general condition. Patients without a progressively worsening general condition or with carcinoma or dysplasia were indicated for elective surgery. Standard surgical procedures for UC in this study included total colectomy, mucosal proctectomy, and hand-sewn IPAA with or without ileostomy. Total colectomy with mucous fistula and end ileostomy before IPAA were mainly performed as emergency surgeries, including for cases with perforation, toxic megacolon or fulminant colitis with progressive worsening to severe sepsis, septic shock, or disseminated intravascular coagulation.[14] Conversely, IPAA was scheduled for patients with exsanguinating hemorrhage or comparatively mild toxic megacolon without disseminated intravascular coagulation or without any other infectious complications such as pneumonia, severe sepsis, or intra-abdominal abscess. Overall, IPAA was performed for patients within wound class 3 and severe activity with feasible general condition as a 2-stage restorative proctocolectomy, classified as REC. Total colectomy without pelvic procedure was also performed for patients with class 4 wounds, fulminant activity, or severe general condition as a 3-stage procedure, classified as COLN.

Although the rectal stump in the 3-stage procedure was basically treated using mucous fistula in principle, patients for whom the stump could not reach the abdominal wall for anatomic or physical reasons were treated using Hartmann procedure. All surgical procedures were performed by a certified surgeon as the main operator.

The patients who underwent urgent or emergent surgeries for UC did not receive mechanical or chemical preparation with antibiotics, oral laxatives, or glycerin enemas before surgery. Povidone-iodine was used for skin preparation (2% chlorhexidine in 70% isopropyl alcohol is unavailable in Japan). The surgical wound was irrigated with >500 mL of saline solution after the completion of fascia closure and the skin was closed using a skin stapler without subcutaneous suture. A transanal drain was placed in the remnant rectum or ileal pouch after surgery in all patients.

According to our hospital protocol for urgent surgery, a second-generation cephalosporin (20 mg/kg) was administered as a prophylactic antibiotic 30 minutes before the incision, with this dose repeated every 3 hours during surgery, then stopped at 24 hours postoperatively. For emergent surgery, a third-generation cephalosporin or calbapenem was administered using the same schedule and de-escalation was performed according to the pathogens isolated after surgery.

Statistical analysis

Categoric variables were compared using a χ^2 test or Fisher's exact test. Continuous variables are expressed as the median and range, and were compared using the Mann-Whitney *U* test. We used stepwise logistic regression models to investigate associations between potential risk factors and SSI. We first investigated all potential risk factors in univariate analysis. Variables associated with increased risk for SSI with a P value < 0.2 were analyzed in multivariate analysis. The level of statistical significance was set at $P < 0.05$. SPSS version 15.0 software (SPSS, Tokyo, Japan) was used to perform all analyses.

Results

Patient demographics and surgical background are shown in Table 1. Of those, 92.2% (83/90) had severe or fulminant disease activity, including 58 patients (64.4%) with ASA score ≥3 and 55 patients (61.1%) with NNIS index ≥2. Median age at surgery and body mass index were 41.0 years (range, 11–81 years) and 22.4 kg/m^2 (range, 12.6–31.6 kg/m^2), respectively. Median total prednisolone dose was 4900 mg (range, 0–55,000 mg).

SSI incidence, surgical details including COLN/REC surgery, treatment of the rectal stump, and surgical indications are shown in Table 2. Overall incidence of SSI was 33.3% (30/90), whereas the incidence of i-SSI was 31.1% (28/90) and that of o-SSI was 6.7% (6/90) (4 patients had reoperation). Incidences of overall, i-SSI, and o-SSI increased significantly with higher wound class ($P < 0.01$). Incidence of i-SSI was significantly higher in emergent surgery than in urgent surgery ($P < 0.01$). With regard to o-SSI, incidences were significantly higher in COLN and emergent surgery ($P < 0.01$). Two cases of o-SSI were caused by anastomotic failure at the site of the ileal J pouch in a class 2 wound and mucous fistula in a class 3 wound. Three of the 4 cases of o-SSI in class 4 wounds were caused by anastomotic failure at the site of remnant rectal stump with Hartmann procedure, with the remaining case occurring with mucous fistula. Rectal surgery was performed for 0 of 14 class 4 wounds, 34 of 57 class 2 wounds (59.6%), and 8 of 19 class 3 wounds (42.1%). Surgical indications also clearly differed between each wound class. Almost all patients with urgent/emergent surgery had undergone ostomy creation, excluding only 1 patient with a class 2 wound.

Results of univariate analyses for risk factors potentially associated with overall SSI are presented in Table 1. Preoperative prednisolone dose ≥50 mg/d, wound class ≥3 or 4, ASA score ≥3, NNIS risk index ≥2 or 3, and procedure for mucous fistula creation were identified as significant risk factors for overall SSI. In addition, duration from onset of UC ≥2 years was subjected to multivariate analysis. REC surgery (odds ratio [OR], 0.24; 95% confidence interval [CI] 0.09–0.61; $P < 0.01$) and serum albumin level <2.5 g/dL (OR, 0.14; 95% CI 0.05–0.38; $P < 0.01$) were significantly associated with low risk of overall SSI.

Results of univariate and multivariate analyses for factors potentially associated with i-SSI are presented in Table 3. Preoperative prednisolone dose ≥50 mg/d, wound class ≥3 or 4, ASA score ≥3, NNIS risk index ≥2 or 3, and mucous fistula creation were shown to be significant risk factors for i-SSI. In addition, duration from onset of UC ≥2 years was subjected to multivariate analysis. In this analysis, REC surgery (OR, 0.29; 95% CI 0.11–0.74; $P = 0.01$), and serum albumin level <2.5 g/dL (OR, 0.15; 95% CI 0.05–0.41; $P < 0.01$) were significantly associated with low risk of i-SSI. In multivariate analysis, only class 3 wound was selected as an independent risk factor for i-SSI.

In the results of risk factors potentially associated with o-SSI, wound class ≥3 (OR, 10.0; 95% CI 1.11–89.75; $P = 0.04$) or 4 (OR, 14.8; 95% CI 2.40–91.43; $P < 0.01$) and Hartmann procedure (OR, 12.83; 95% CI 2.12–77.88; $P < 0.01$) were identified as significant risk factors for o-SSI in univariate analysis. In this analysis, duration of surgery ≥190 minutes (OR, 0.17; 95% CI 0.03–0.99; $P = 0.049$) was significantly associated with low risk of o-SSI. In stepwise logistic regression analysis, class 3 wound (OR, 8.05; 95% CI 2.57–25.19; $P < 0.01$) and Hartmann procedure (OR, 15.7; 95% CI 2.01–122.72; $P < 0.01$) were represented as independent risk factors for o-SSI.

Incidence of SSI according to status of the rectal stump is shown in Table 2. Although no significant differences in SSI incidence were found between mucous fistula and Hartmann procedure (values for overall SSI and i-SSI: $P = 0.94$ and $P = 0.71$, respectively), o-SSI tended to be more frequent with Hartmann procedure (33.3%) than with mucous

Table 1 Patients' characteristics and risk factors for all SSI (univariate)

Risk factors	Total (n = 90)	No. of patients with SSI (n = 30)	No. of patients without SSI (n = 60)	*P* value	OR (95% CI)
Age (median and range)	41 (11–81)	40.5 (18–78)	41 (11–81)	0.80	
<41 years	43	15	28		
≥41 years	47	15	32	0.77	0.88 (0.36–2.10)
Gender					
Male	50	13	37	0.95	0.97 (0.40–2.36)
Female	40	17	23		
Duration from onset (median and range)	2.0 (0.1–38.1)	1.3 (0.1–20.1)	2.8 (0.1–38.1)	0.35	
<2 years	54	21	33	0.16	1.97 (0.77–5.01)
≥2 years	36	9	27		
Disease activity					
Mild, moderate	7	2	5		
≥ Severe	83	28	55	0.35	2.15 (0.43–10.84)
Fulminant	10	8	2	0.25	4.21 (0.37–48.46)
Total PSL dose (median and range)	4900 (0–55,000)	3800 (390–30,000)	5000 (0–55,000)	0.71	
<10,000 mg	58	20	38		
≥10,000 mg	32	10	22	0.76	0.86 (0.34–2.17)
Preoperative PSL dose (median and range)	50 (0–80)	60 (20–80)	50 (0–80)	< 0.01	
<50 mg/d	49	11	38		
≥50 mg/d	41	19	22	0.02	2.98 (1.20–7.41)
Immunosupressant administration					
(−)	61	21	40		
(+)	29	9	20	0.71	0.84 (0.32–2.16)
Wound class					
2	57	8	49		
≥3	33	22	11	< 0.01	12.3 (4.33–34.7)
4	14	11	3	< 0.01	11.0 (2.77–43.64)
ASA score					
1, 2	32	3	29		
≥3	58	27	31	< 0.01	8.13 (2.22–29.76)
NNIS risk index					
0, 1	35	4	31		
≥2	55	26	29	< 0.01	6.72 (2.09–21.66)
3	14	10	4	< 0.01	6.88 (1.94–24.42)
Type of surgery					
COLN	43	21	22		
REC	47	9	38	< 0.01	0.24 (0.09–0.61)
Mucous fistula	34	17	17	< 0.01	3.51 (1.40–8.84)
Hartmann procedure	9	4	5	0.48	1.66 (0.41–6.71)
Transfusion					
(−)	69	21	48		
(+)	21	9	12	0.42	0.60 (0.17–2.11)
Duration of surgery (median and range)	189 (83–433)	180 (97–295)	153.5 (83–433)	0.19	
<190 min	26	13	13		
≥190 min	64	17	47	0.04	0.36 (0.14–0.93)
Blood loss (median and range)	120 (20–2270)	100 (20–2270)	120 (40–510)	0.92	
<160 mL		22	40		
≥160 mL		8	20	0.52	0.73 (0.28–1.92)
Serum albumin (median and range)	2.5 (1.6–3.3)	2.4 (1.6–3.0)	2.5 (1.6–3.3)	0.28	
<2.5 g/dL		14	52	< 0.01	0.14 (0.05–0.38)
≥2.5 g/dL		16	8		
Blood sugar (median and range)	178 (86–363)	190 (89–363)	156 (86–286)	0.04	
< 180 mg/dL		21	46		
≥ 180 mg/dL		9	14	0.5	1.41 (0.53–3.77)

ASA, American Society of Anesthesiologists; CI, confidence interval; COLN, colonic surgery; NNIS, National Nosocomial Infection Surveillance; PSL, prednisolone; REC, rectal surgery; SSI, surgical site infection.

Table 2 SSI incidence and surgical details

	All patients (n = 90)	Wound class			SSI	
		2 (n = 57)	3 (n = 19)	4 (n = 14)	Incisional	Organ/space
Overall SSI	30 (33.3)	8 (14.0)	11 (57.9)	11 (78.6)		
Incisional SSI	28 (31.1)	7 (12.3)	11 (57.9)	10 (71.4)		
Organ/space SSI	6 (6.7)	1 (1.8)	1 (5.3)	4 (28.6)		
COLN/REC	48/42	23/34	11/8	14/0	19 (39.6)/9 (21.4)	5 (11.9)/1 (2.4)
Mucous fistula/Hartmann procedure	34/9	13/5	11/0	10/4	16 (47.1)/3 (33.3)	2 (5.9)/3 (33.3)
Urgent/emergent surgery	72/18	55/2	17/2	0/14	12 (35.3)/16 (88.9)	1 (1.4)/5 (27.8)
Indication of surgery						
Hemorrhage	25 (27.8)	20 (35.1)	5 (26.3)	0 (0)	6 (24.0)	1 (4.2)
Perforation	14 (15.6)	0 (0)	0 (0)	14 (100)	11 (78.6)	3 (21.4)
Severe or fulminant colitis	37 (41.1)	34 (59.6)	3 (15.8)	0 (0)	5 (14.7)	0 (0)
Toxic megacolon	14 (15.6)	3 (5.3)	11 (57.9)	0 (0)	6 (42.9)	2 (14.3)
Ostomy creation	89 (98.9)	56 (98.2)	19 (100)	14 (100)	28 (31.5)	6 (6.7)

Values represent number with percentages in parentheses.
COLN, colonic surgery; REC, rectal surgery; SSI, surgical site infection.

fistula (5.9%, $P = 0.05$). All patients with o-SSI after Hartmann procedure showed class 4 wounds.

Discussion

We have previously reported total prednisolone dose ≥10,000 mg and ASA score ≥3 as independent risk factors for i-SSI in UC patients with class 2 wounds.[9] The incidence of i-SSI was 12.5% in UC patients with class 2 wounds, similar to that for other rectal surgeries.[15] However, higher incidence of SSI was frequently recognized with a clinical status of emergent surgery or infected surgery. Higher disease activity and emergent surgery might exert considerable influence in UC surgery and represent independent risk factors for SSI in surgery for inflammatory bowel disease.[16] This study analyzed SSI surveillance data restricted to urgent/emergent UC surgery. Some of the extensively described conditions in reports for SSI include higher wound class, higher ASA score, blood transfusion, malnutrition, and ostomy creation, whereas colorectal surgery is also known to be associated with increased risk of SSI, particularly among patients undergoing rectal surgery.[17,18] Higher wound class and ASA score were risk factors for SSI in this series, similar to those results.

The finding in this study that rectal surgery was significantly associated with low risk of SSI appears counter to general perceptions, proving that adequate selection of surgical indications and the validity of 2 or 3 staged surgical procedures were appropriately and intentionally decided. From the perspective of SSI, IPAA with diverting ileostomy could be feasibly performed for patients with exsanguinating hemorrhage or comparatively mild toxic megacolon without disseminated intravascular coagulation, which included all conditions within wound class 3. Conversely, in patients with exsanguinating hemorrhage, total colectomy with rectal stump could be associated with higher risk of postoperative bleeding, as the remnant rectum would probably include the most severe UC lesion and part of the area with exsanguinating hemorrhage. Above all, we recommend IPAA with ileostomy for urgent/emergent surgery for UC, particularly in patients with hemorrhage without severe general condition or fulminant activity.

The key aim of urgent/emergent surgery for severe UC is to restore the general status of the patient and to preserve restorative reconstruction options for anal function in further surgery. Total colectomy with end ileostomy is generally recognized as a feasible and effective procedure for severe or fulminant UC.[19,20] Comparing intraperitoneal closure of the rectal stump as in Hartmann procedure or extrafascial placement of the rectosigmoid stump as in mucous fistula, the latter may be associated with lower risk of pelvic sepsis and facilitation of subsequent pelvic dissection.[21] However, some reports have suggested that mucous fistula is not usually recommendable, as dehiscence of the stump will result in wound infection rather than pelvic sepsis and transanal drainage of the distal stump may further decrease the risk of pelvic sepsis.[21,22] For these infectious complications, placement of the rectal stump into subcutaneous tissue has been recommended.[23] Mucous fistula was a risk factor

Table 3 Risk factors for incisional SSI (univariate and multivariate)

Risk factors	No. of patients with incisional SSI (n = 28)	No. of patients without incisional SSI (n = 62)	Univariate analysis		Multivariate analysis	
			P value	OR (95% CI)	*P* value	OR (95% CI)
Age						
<41 years	13	30				
≥41 years	15	32	0.86	0.92 (0.38–2.26)		
Gender						
Male	13	37	0.74	1.17 (0.48–2.87)		
Female	15	25				
Duration from onset						
<2 years	20	34	0.13	2.12 (0.81–5.55)	0.65	0.73 (0.18–2.91)
≥2 years	8	28				
Disease activity						
Mild, moderate	2	5				
≥Severe	26	57	0.43	1.93 (0.38–9.72)		
Fulminant	7	3	0.22	4.69 (0.41–54.05)		
Total PSL dose						
<10,000 mg	19	39				
≥10,000 mg	9	23	0.65	0.80 (0.31–2.07)		
Preoperative PSL dose						
<50 mg/d	10	39				
≥50 mg/d	18	23	0.02	3.05 (1.21–7.73)	0.06	3.06 (0.94–10.02)
Immunosuppressant administration						
(+)	8	21	0.76	0.76 (0.29–2.02)		
(−)	20	41				
Wound class						
2	4	53				
≥3	24	9	< 0.01	12.5 (4.32–36.17)	< 0.01	10.04 (2.91–34.63)
4	10	4	< 0.01	8.06 (2.25–28.82)	0.89	1.14 (0.20–6.56)
ASA score						
1, 2	5	30				
≥3	23	32	< 0.01	7.07 (1.93–25.92)	0.22	2.55 (0.58–11.23)
NNIS index						
0, 1	2	33				
≥2	26	29	< 0.01	5.81 (1.80–18.74)	0.32	0.32 (0.03–2.99)
3	10	4	< 0.01	7.92 (2.21–28.33)	0.79	0.79 (0.15–4.15)
Type of surgery						
COLN	19	24				
REC	9	38	0.01	0.29 (0.11–0.74)	0.97	0.98 (0.23–4.06)
Mucous fistula	16	18	< 0.01	3.45 (1.36–8.79)	0.96	0.94 (0.09–9.43)
Hartmann procedure	3	6	0.9	1.10 (0.25–4.76)		
Transfusion						
(−)	19	50				
(+)	9	12	0.63	0.74 (0.21–2.60)		
Duration of surgery						
<190 min	12	14				
≥190 min	16	48	0.05	0.39 (0.15–1.01)	0.85	0.34 (0.30–5.95)
Blood loss						
<160 mL	20	42				
≥160 mL	8	20	0.73	0.84 (0.32–2.23)		
Serum albumin						
<2.5 g/dL	15	9	< 0.01	0.15 (0.05–0.41)	0.18	2.74 (0.63–12.02)
≥2.5 g/dL	13	53				
Blood sugar						
<180 mg/dL	20	47				
≥180 mg/dL	8	15	0.66	1.25 (0.46–3.42)	0.66	1.25 (0.46–3.42)

ASA, American Society of Anesthesiologists; CI, confidence interval; COLN, colonic surgery; NNIS, National Nosocomial Infection Surveillance; OR, odds ratio; PSL, prednisilone; REC, rectal surgery; SSI, surgical site infection.

for i-SSI in this series according to univariate analysis. This SSI could lead to decreased quality of life, increased hospital costs, and longer hospitalization, as generally suggested, but appears less likely to result in severe complications.[11,15] However, Hartmann procedure was an independent risk factor for o-SSI, as pelvic sepsis could be associated with subsequent severe general septic complications and higher mortality and morbidity rates. Therefore, although risk of i-SSI may be increased with mucous fistula, priority should be given to avoiding pelvic sepsis and securing feasible prognosis, at least in patients with class 4 wounds.

Several limitations must be considered with respect to the present data. This study involved a review of prospectively collected data. Differences in assignments for surgical indications that would overlap in some patients, such as between hemorrhages and medically intractable cases with severe colitis, were finally dependent on the judgment of the attending surgeon, which may represent a source of bias. Decisions to perform 2- or 3-stage procedures were often made on the basis of the specific condition of the patient, which was not clearly numerically identified. In terms of treatment of the rectal stump, performing a randomized controlled study between Hartmann procedure and mucous fistula would be difficult. In addition, it should be considered that decisions regarding surgical procedures or indications that involved some degree of selection bias could have influenced the incidence of SSI in this series. In particular, priority must be given to saving life and preserving subsequent anal function, even in compromised hosts, and randomized group allocations that might increase morbidity and mortality rates in patients with perforation cannot be considered. The small number of patients in this series also represents a limitation. Few class 4 wounds due to perforation were encountered in patients with UC.[8] This might have influenced various results in this series, particularly for o-SSI. In addition, analysis for o-SSI in this series might have been unsuitable because of the very small number of cases.

In conclusion, urgent restorative proctocolectomy could be feasible for patients without higher wound class, toxic megacolon, or perforation. Although the creation of a mucous fistula for the rectal stump may lead to increased risk of i-SSI, we recommend this procedure to avoid severe septic complications and maximize preservation of anal function, at least in patients with class 4 wounds.

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