Original Article

Complications of Loop Transverse Colostomy and Loop Ileostomy Closure in Patients with Mid-to-low Rectal Cancer Undergoing Sphincter-preserving Surgery

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Key Words
Rectal cancer;
Ileostomy;
Colostomy;
Stoma closure

Purpose. Diverting stoma is a common additional procedure for patients undergoing curative surgery for rectal cancer to reduce the risk of symptomatic anastomotic leakage. This study aimed to compare the outcomes of loop ileostomy closure and loop transverse colostomy.
Methods. This single-center, retrospective cohort study included patients who underwent curative resection for mid-to-low rectal cancer with diverting stoma and subsequent stoma reversal between January 2006 and December 2015. Detailed information was retrieved from the Colorectal Section Tumor Registry of Chang Gung Memorial Hospital.
Results. Overall, 104 patients underwent loop ileostomy closure, and 524 patients underwent loop transverse colostomy closure. No significant difference in operation time was observed between the two groups (99 vs. 106; $p = 0.116$). Post-closure wound infections occurred more frequently in the loop transverse colostomy group than that in the ileostomy group (8.9% vs. 2.8%, $p = 0.036$). The incidence of anastomotic leakage was higher in the ileostomy group than in the loop transverse colostomy group (3.8 vs. 1.1; $p = 0.044$). The length of hospital stay was similar between the two groups (9.81 vs. 9.22; $p = 0.49$).
Conclusions. In this study, the most common complications after stoma reversal in patients with low rectal cancer are postoperative ileus, post-closure wound infection, anastomosis leakage, and incisional hernia. More patients in the transverse colostomy group experienced post-closure wound infection than those in the ileostomy group. Closure of ileostomy was associated with higher risk of anastomotic leakage compared with closure of colostomy.

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With the development of rectal cancer surgery, an increasing number of patients undergo sphincter-preserving surgery. Anastomotic leakage is a severe complication of rectal surgery. The incidence of clinical anastomotic leakage ranges from 3% to 30% of resections for low rectal cancer. The mortality rate associated with symptomatic anastomotic leaks ranges from 6% to 22% and is particularly high when

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the lower rectum is involved.[1] Moreover, anastomotic leakage treatment has significant cost implications. Several randomized controlled trials have confirmed that proximal diverting stoma closure is beneficial in some patients. Although proximal diverting stoma closure cannot eliminate the risk of anastomosis, it can lower the rate of symptomatic leakage and thereby reduce the impact of pelvic sepsis in rectal surgery. Published literature has demonstrated that diverting the stoma with either a transverse colostomy or ileostomy reduces the serious consequences of anastomotic leakage.[2-4] Nevertheless, further stoma reversal surgery is required, resulting in a longer hospital stay, financial burden, and associated complications. The most frequent complications associated with stoma closure include wound infection, ileus, anastomotic leakage, and incisional hernia. Three published meta-analyses have revealed that more incisional hernias occurred after colostomy than after ileostomy.[5-7] Wound infections are reportedly higher in colostomy cohorts.[5,7] Previous studies have indicated that postoperative ileus is more common in the ileostomy group than in the colostomy group,[7] although more recent studies have reported favorable results in the ileostomy group.[5] However, three published meta-analyses failed to determine the superiority of one procedure to another. This study aims to compare the morbidity associated with stoma closure of ileostomy or colostomy in patients with mid-to-low rectal cancer.

Material and Methods

Records of patients who received elective surgery for primary mid-to-low rectal cancer from 2006 to 2015 were collected. The data were prospectively collected from the Colorectal Section Tumor Registry of Chang Gung Memorial Hospital and retrospectively analyzed. The inclusion criteria for this study were as follows: histologically proven adenocarcinoma, tumor located within 10 cm from anal verge, stage I to stage III disease, elective surgery, and creation of loop transverse colostomy or loop ileostomy during the period of primary resection. Patients who did not receive subsequent stoma closure surgery were excluded. Closure of each type of stoma involved an elliptical incision and either excision of both limbs and completed with an end-to-end anastomosis or trimming of the edges and closure of the anterior wall. Stapled or hand-sutured technique were either used for anastomosis. The skin at these wounds were closed by linear sutures. Placement of drainage was determined by the surgeons.

The demographic data included sex, age, body mass index (BMI), comorbidities, clinical stage, and neoadjuvant treatment. Treatment modalities, including surgical techniques of rectal cancer (open or laparoscopy-assisted) and adjuvant chemotherapy, were also investigated. The intraoperative data collected included stoma type, operation duration, and time between the initial operation and stoma reversal. Data on 30-day postoperative complications of stoma reversal were collected. Postoperative ileus was defined as the inability to tolerate a diet requiring nasogastric tube decompression and intravenous hydration. Surgical site infections included superficial and deep incisional wound infections with purulent discharge from the stoma site, and open wound care was performed. In our study, anastomotic leakage at the stoma closure site was detected clinically or radiologically. A stoma site hernia was defined as a protrusion of intra-abdominal contents in the area of the previous stoma closure, which is perceptible by clinical examination or imaging.

Data are reported as mean ± standard deviation for continuous variables and as numbers (percentages) for categorical variables. The analysis was conducted using the SPSS Statistics software (version 24.0; SPSS Inc., Chicago, IL, USA). Patient characteristics with categorical variables are presented as numbers and percentages and were compared using the chi-square test or Fisher's exact test. For continuous variables, such as age, BMI, and interval to stoma reversal, Student's t-test was used for analysis, and data are expressed as means with standard deviation. Statistical significance was set at $p < 0.05$.

Results

From the oncological database of our hospital,

798 patients diagnosed with rectal cancer 10 cm from the anal verge who underwent elective sphincter-preserving surgery and stoma surgery over a ten-year period (2006-2015) were selected. Of these 708 patients, 80 were excluded because they did not undergo stoma reversal surgery. The final analysis included a total of 628 patients. The demographic data of the study population are summarized in Table 1. Patients predominantly underwent colostomy, with 524 patients (83.4%) undergoing loop colostomy and 104 patients (16.5%) undergoing loop ileostomy. The mean age at which patient received initial stoma surgery was not statistically significant between the loop T colostomy group (61.57 ± 12.46) and the loop ileostomy group (60.25 ± 11.91). Both groups comprised mainly male patients (68.3% in the loop T colostomy group and 58.6% loop ileostomy group). No significant differences in American Society of Anesthesiologists scores or comorbidities, including hypertension, cardiac disease, stroke, or diabetes mellitus were observed between the two groups. The mean BMI of the study population was 24.43 ± 3.34 in the colostomy group and 24.07 ± 2.96 in the ileostomy group. The percentage of patients with obesity (BMI > 30) was not significantly different between the two groups.

Operative outcomes of primary tumor resection

The results are summarized in Table 2. No significant difference in tumor height from the anal verge was identified between the two groups. The mean tumor height from the anal verge was 6.19 ± 2.02 cm in the colostomy group and 5.93 ± 1.91 cm in the ileostomy group ($p = 0.229$). The percentage of low rectal cancer, defined as cancer located 5 cm from the anal verge, was similar between the two groups: 43.1% in the colostomy group and 48.0% in the ileostomy group ($p = 0.353$). However, more patients in the ileostomy group than in the colostomy group were diagnosed at an advanced stage ($p = 0.044$). The proportion of patients who received neoadjuvant radiotherapy (RT) was 37.2% in the colostomy group and 44.2% in the ileostomy group, which was not statistically significant. A higher percentage of patients received short course RT in the ileostomy group than in the colostomy group (33.6% vs. 19.2%, $p = 0.003$). A significantly lower percentage of patients received a laparoscopic approach in the initial surgery in the colostomy group than in the ileostomy group (19.6% vs. 78.8%, $p < 0.001$).

Short-term perioperative outcome

The results are summarized in Table 3. The interval to stoma closure was not significantly different be-

Table 1. Demographic data

	Loop T colostomy ($n = 524$)	Loop ileostomy ($n = 104$)	p-value
Age (year)	61.57 ± 12.46	60.25 ± 11.91	0.320
Sex			0.056
Male	358 (68.3)	61 (58.6)	
Female	166 (31.7)	43 (41.4)	
BMI (kg/m^2)	24.43 ± 3.34	24.07 ± 2.96	0.314
BMI> 27	108 (20.6)	14 (13.4)	0.092
BMI > 30	25 (4.8)	3 (2.9)	0.395
Comorbidities			
Hypertension	174 (33.2)	31 (29.8)	0.500
Cardiac disease	27 (5.1)	10 (9.6)	0.077
Stroke	15 (2.8)	2 (1.9)	0.590
Diabetes mellitus	71 (13.5)	16 (15.3)	0.621
ASA ≥ III	161 (30.7)	30 (28.8)	0.231

BMI, body mass index; ASA, American Society of Anesthesiologists.

Table 2. Operative outcomes of primary tumor resection

	Loop T colostomy ($n = 524$)	Loop ileostomy ($n = 104$)	p-value
Tumor height (cm)	6.19 ± 2.02	5.93 ± 1.91	0.229
Tumor height ≤ 5cm, n	226 (43.1)	50 (48.0)	0.353
Tumor stage, n			0.044
Stage I	129 (24.6)	15 (14.4)	
Stage II	170 (32.4)	33 (31.7)	
Stage III	225 (42.9)	56 (53.8)	
Neoadjuvant RT, n	195 (37.2)	46 (44.2)	0.179
Short course	101 (19.2)	35 (33.6)	0.003
Long course	94 (17.9)	11 (10.5)	
Laparoscopy-assisted, n	103 (19.6)	82 (78.8)	< 0.001
Adjuvant chemotherapy, n	184 (35.1)	45 (43.2)	0.115

RT, radiotherapy.

tween the two groups (185.69 ±136.90 vs. 166.63 ± 93.85, $p = 0.175$). Moreover, no significant differences in operative duration and length of hospital stay were identified between both groups. Blood loss during surgery was slightly less in the ileostomy group than in the colostomy group. Nevertheless, the overall complication rates were similar between both groups (19.6% vs. 24.0%, $p = 0.311$). The colostomy group had a significantly higher rate of wound infection (8.9% vs. 2.8%, $p = 0.036$) and lower rate of anastomotic leakage (1.1% vs. 3.8%, $p = 0.044$) than those of the ileostomy group. More patients in the ileostomy group received subsequent repair surgery for stoma closure hernias than in the colostomy group (7.6% vs. 2.8%, $p = 0.017$). The stoma recreation rate after stoma closure complications was 0.7% in the colostomy group and 1.9% in the ileostomy group ($p = 0.267$).

Discussion

In our study, surgical site infections occurred in 8.9% and 2.8% of the patients in the colostomy and ileostomy groups, respectively. Previous studies have reported no significant difference in wound infection after stoma reversal between the procedures.[8] An earlier meta-analysis included seven studies, three of which compared the wound infection rate and recorded a higher risk of wound infection in the colostomy group.[7] A recent meta-analysis of eight studies involving 1451 patients has reported a higher surgical site infection rate in the loop colostomy group than in the ileostomy group.[9] Our study demonstrated that wound infection after stoma closure occurred in 2.8% of the patients in the ileostomy group. This finding is similar to those previous studies that have reported a 5%-7.8% of wound infection in the ileostomy group.[10-13] We reported that wound infection after stoma closure occurred in 7.8% of the patients in the colostomy group. This was similar to the findings of previous studies reporting a rate of 5%-27%.[12,13]

Anastomotic leakage is one of the most troublesome bowel-related complications of stoma reversal because it may require additional laparotomy. The overall incidence of anastomotic leakage after stoma reversal is approximately 0%-4%.[5,10,12-15] Gavriilidis et al. conducted a meta-analysis in which five studies, with a total of 1140 patients, recorded no significant difference in the incidence of anastomotic leakage rate between ileostomy and colostomy reversal.[5] However, in this study, a higher rate of anastomotic leakage was observed in the ileostomy group. The anastomotic leakage rate was 1.1% in the T loop colostomy group and 3.8% in the loop ileostomy group ($p = 0.044$). This finding can be attributed to the smaller entry into the abdomen at the ileostomy closure site, as mentioned in a previous study.[14] A smaller entry into the abdomen makes stoma closure more technically demanding. The bowel walls often adhere to the abdominal wall and adjacent bowel loops. Adhesiolysis and enterolysis are often required during stoma closure, and the smaller incision in the ileostomy group may increase the risk of bowel damage.

Table 3. Operative outcomes of stoma closure

	Loop T colostomy (n = 524)	Loop ileostomy (n = 104)	*p*-value
Days to stoma closure (day)	185.69 ± 136.90	166.63 ± 93.85	0.175
Daysto stoma closure ≤ 90 days (n)	76 (14.5)	14 (13.5)	0.095
Operation time (min)	106 ± 41	99 ± 31	0.116
Blood loss (ml)	14.55 ± 15.11	10.04 ± 13.56	0.003
Hospital stay (day)	9.22 ± 5.04	9.81 ± 8.33	0.490
Overall complication (n)	103 (19.6%)	25 (24.0%)	0.311
Postoperative ileus (n)	29 (5.5%)	8 (7.6%)	0.393
Wound infection (n)	47 (8.9%)	3 (2.8%)	0.036
Anastomosis leakage (n)	6 (1.1%)	4 (3.8%)	0.044
Hernia (n)	15 (2.8%)	8 (7.6%)	0.017
Mortality	0	0	0
Stoma recreation within 3 months	4 (0.7%)	2 (1.9%)	0.267

Closure site hernia is another frequent complication of stoma reversal. One meta-analysis investigated three studies and reported that the incidence of incisional hernia was higher in the colostomy group than in the ileostomy group.[16] The greater wound contamination was considered a risk factor for an incisional hernia that occurred more during colostomy reversal than during ileostomy reversal. Murray et al. have reported that patients with incisional hernia were 1.9 times more likely to develop surgical-site infections after colorectal surgery.[17] The percentage of patients with closure site hernias who underwent subsequent hernia repair was higher in the ileostomy group than that in the colostomy group. This findingis consistent with previous study findings and may be attributed to the diagnostic methods. Claes et al. investigated the incidence of incisional hernias in patients operated on for colorectal cancer and reported that computed tomography follow-up could identify significantly more incisional hernias than clinical examination alone, particularly if the radiologist focuses on incisional hernia development.[18] In our institution, an incisional hernia is diagnosed mainly based on clinical examination, which may result in an underestimation of the true incidence of incisional hernia.

In our study, a significantly higher percentage of patients in the ileostomy group underwent laparoscopy-assisted surgery. Several studies have indicated that the laparoscopic technique for colostomy and ileostomy creation is safe, and fecal diversion may be achieved with non-inferior results compared to open surgery.[19-22] However, data on postoperative outcomes comparing ileostomy and colostomy are limited. We speculated that the decision to perform a colostomy or ileostomy after laparoscopic low anterior resection depends mostly on the surgeon's preference. In laparoscopic surgery, an ileostomy may be constructed to accommodate the trocar site, and an additional wound may be required to create a colostomy. Therefore, in the laparoscopic approach, an ileostomy is easier to construct because the small bowel has better mobility than the colon.

Six patients (0.96%) underwent stoma recreation within 1 year after stoma closure: four patients in the colostomy group and two patients in the ileostomy group. Stoma recreation was required because of rectal anastomotic stenosis (2 patients), adhesive intestinal obstruction (3 patients), and rectal anastomotic fistula (1 patient). Song et al. have reported that 9.8% of patients who underwent low anterior resection or intersphincteric resection (ISR) underwent stoma reconstruction, and the risk factors were anastomotic leakage, postoperative RT, and ISR.[23] In the present study, the most common cause of stoma reconstruction was anastomotic complications after primary surgery.

This study had several limitations. First, this study had a retrospective design, which is generally associated with selection bias, surgeon preference, and loss to follow-up. Second, preoperative preparation and surgical techniques for anastomosis and closure of incisions varied among cases. Third, patient number in the colostomy group were substantially greater than the ileostomy group and unequal sample size is more susceptible to bias. Further prospective studies with larger sample sizes are needed to confirm the superiority of ileostomy to colostomy using the current data.

Conclusion

In this study, the most common complications after stoma reversal in patients with low rectal cancer are postoperative ileus, post-closure wound infection, anastomosis leakage, and incisional hernia. More patients in the transverse colostomy group experienced post-closure wound infection than those in the ileostomy group. Closure of ileostomy was associated with higher risk of anastomotic leakage compared with closure of colostomy.

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原　著

中低位直腸癌病患接受根除性手術合併迴腸造口或結腸造口其造口關閉手術的預後

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目的　中低位直腸癌的病患於接受根除性手術時，常同時接受暫時性腸造口手術，以減少吻合不全的症狀，這篇研究是比較迴腸造口關閉手術和結腸造口關閉手術的預後。

方法　這是一篇回顧性單中心研究，包括 2006 年一月至 2015 年十二月進行根除性手術治療且接受暫時性腸造口手術及造口關閉手術的中低位直腸癌病患，研究分析取自於林口長庚醫院大腸直腸外科癌症資料庫。

結果　研究收錄 104 位接受迴腸造口手術的病患以及 524 位接受結腸造口的病患，手術時間兩組無統計差異 (99 vs. 106; $p = 0.116$)，接受結腸造口關閉手術的病患有較高比率併發傷口感染比率 (8.9% vs. 2.8; $p = 0.036$)，而接受迴腸造口關閉手術的病患有較高比率併發吻合不全 (3.8 vs. 1.1; $p = 0.044$)，兩組在住院天數無達到統計上的顯著差異 (9.81 vs. 9.22; $p = 0.49$)。

結論　中低位直腸癌患者接受腸造口關閉手術常發生的併發症包括發術後腸阻塞、手術傷口感染、吻合不全、以及切口疝氣，關閉結腸造口有較高比率併發手術傷口感染，而關閉迴腸造口有較高比率併發吻合不全。

關鍵詞　直腸癌、迴腸造口、結腸造口、造口關閉。