



Clinical Trials Study

Early postoperative complications after transverse colostomy closure, a retrospective study

Fei Liu, Xiao-Juan Luo, Zi-Wei Li, Xiao-Yu Liu, Xu-Rui Liu, Quan Lv, Xin-Peng Shu, Wei Zhang, Dong Peng

Specialty type: Gastroenterology and hepatology

Provenance and peer review:

Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B
Grade C (Good): 0
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Baryshnikova NV, Russia

Received: October 24, 2023

Peer-review started: October 24, 2023

First decision: December 15, 2023

Revised: January 13, 2024

Accepted: February 7, 2024

Article in press: February 7, 2024

Published online: March 27, 2024



Fei Liu, Zi-Wei Li, Xiao-Yu Liu, Xu-Rui Liu, Quan Lv, Xin-Peng Shu, Wei Zhang, Dong Peng, Department of Gastrointestinal Surgery, The First Affiliated Hospital of Chongqing Medical University, Chongqing 400016, China

Xiao-Juan Luo, Endoscopy Center, The First Affiliated Hospital of Chongqing Medical University, Chongqing 400012, China

Corresponding author: Dong Peng, FAASLD, Academic Editor, Department of Gastrointestinal Surgery, The First Affiliated Hospital of Chongqing Medical University, No. 1 Youyi Road, Yuanjiagang, Yuzhong District, Chongqing 400016, China. carry_dong@126.com

Abstract

BACKGROUND

Ostomy is a common surgery usually performed to protect patients from clinical symptoms caused by distal anastomotic leakage after colorectal cancer (CRC) surgery and perforation or to relieve intestinal obstruction.

AIM

To analyze the complications after transverse colostomy closure.

METHODS

Patients who underwent transverse colostomy closure from Jan 2015 to Jan 2022 were retrospectively enrolled in a single clinical center. The differences between the complication group and the no complication group were compared. Logistic regression analyses were conducted to find independent factors for overall complications or incision infection.

RESULTS

A total of 102 patients who underwent transverse colostomy closure were enrolled in the current study. Seventy (68.6%) patients underwent transverse colostomy because of CRC related causes. Postoperative complications occurred in 30 (29.4%) patients and the most frequent complication occurring after transverse colostomy closure was incision infection (46.7%). The complication group had longer hospital stays ($P < 0.01$). However, no potential risk factors were identified for overall complications and incision infection.

CONCLUSION

The most frequent complication occurring after transverse colostomy closure

surgery in our center was incision infection. The operation time, interval from transverse colostomy to reversal, and method of anastomosis might have no impact on the postoperative complications. Surgeons should pay more attention to aseptic techniques.

Key Words: Transverse colostomy closure; Surgery; Complications; A single clinical centre; Risk factors

©The Author(s) 2024. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: The current study was conducted to analyze the complications after transverse colostomy closure. A total of 102 patients who underwent transverse colostomy closure were enrolled in the current study. The complication group had longer hospital stay. However, no potential risk factor was identified for overall complications and incision infection. The most frequent complication occurring after transverse colostomy closure surgery in our center was incision infection. Operation time, interval from transverse colostomy to reversal and methods of anastomosis might have no impact on the postoperative complications. Surgeons should pay more attention to aseptic techniques.

Citation: Liu F, Luo XJ, Li ZW, Liu XY, Liu XR, Lv Q, Shu XP, Zhang W, Peng D. Early postoperative complications after transverse colostomy closure, a retrospective study. *World J Gastrointest Surg* 2024; 16(3): 807-815

URL: <https://www.wjgnet.com/1948-9366/full/v16/i3/807.htm>

DOI: <https://dx.doi.org/10.4240/wjgs.v16.i3.807>

INTRODUCTION

Ostomy is a common surgery usually performed to protect patients from clinical symptoms caused by distal anastomotic leakage after colorectal cancer (CRC) surgery and perforation or to relieve intestinal obstruction[1-3]. Given the convenience and validity of preventing anastomotic leakage, some experts have also suggested performing prophylactic ostomy[4-7]. A temporary stoma was usually recommended to be reversed at nearly 3 months after primary surgery[8,9]. However, several studies have reported a high rate of complications after ostomy closure, especially surgical site infections, with the highest rate reaching 40%[10]. Postoperative complications can lengthen hospital stays and cause heavy financial burdens, and severe complications can lead to death[11,12]. For better management of complications, several risk factors for complications have been reported, such as the interval from ostomy to reversal, operation time, blood transfusion and stapled anastomosis[13-17].

Previous studies have compared the incidence of postoperative complications between ileostomy and colostomy closure and found that patients who underwent colostomy closure were more likely to suffer from complications[18-20]. Most studies reporting complications after colostomy closure were conducted at the end of the last century, and the sample sizes were relatively small[21-23]. Furthermore, which factors, such as the time to stoma closure, affect the incidence of complications remains controversial[24-26].

Currently, colostomy, especially transverse colostomy, is still a commonly used type of ostomy. As a result, the purpose of the current study was to analyse complications after transverse colostomy closure and identify relevant risk factors for complications.

MATERIALS AND METHODS

Patients

Patients who underwent transverse colostomy closure surgery from Jan 2015 to Jan 2022 at a single clinical centre were retrospectively enrolled. The ethics committee of the First Affiliated Hospital of Chongqing Medical University approved this study (number K2024-008-01), and the data used in this study were obtained from public databases. No informed consent was needed. This study was conducted in accordance with the World Medical Association Declaration of Helsinki.

Inclusion and exclusion criteria

Patients who underwent transverse colostomy closure surgery for different diseases were included in this study ($n = 140$). The exclusion criteria were as follows: (1) Incomplete clinical records ($n = 15$); and (2) patients who had distant metastasis ($n = 22$); and 102 patients enrolled in this study (Figure 1).

Surgical procedure

The skin and subcutaneous tissue were first incised along the stoma margin, after which the colon was dissociated from the abdominal wall, the scar tissue around the stoma margin was removed, and the bowel was trimmed. Next, the two ends of the stoma were anastomosed with an anastomosis. Finally, the abdominal wall incision was sutured intermit-

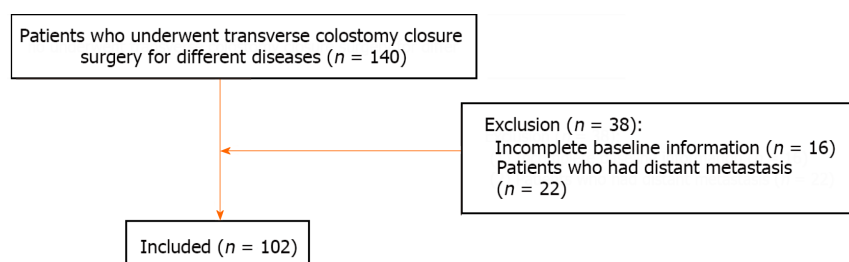


Figure 1 Flow chart of patient selection.

tently with silk threads (Figure 2).

Data collection

The clinical characteristics included age, sex, body mass index, smoking status, drinking status, hypertension, type 2 diabetes mellitus (T2DM), preoperative haemoglobin, preoperative albumin, interval from transverse colostomy to reversal, method of anastomosis, operation time, blood loss, hospital stay, cause of transverse colostomy and complications were obtained from the electronic medical record system. Postoperative complications were classified on the basis of the Clavien-Dindo classification[27].

Statistical analysis

Continuous variables are expressed as the mean \pm SD, and an independent sample *t* test was used to compare the differences between the complication group and the no complication group. Categorical variables are expressed as absolute values and percentages, and the chi-square test or Fisher's exact test was used. Logistic regression analyses were also conducted to identify independent factors for overall complications and incisional infection. The data were analysed using SPSS (version 22.0) statistical software. A bilateral *P* value < 0.05 was considered to indicate statistical significance.

RESULTS

Baseline characteristics of included patients

A total of 102 patients who underwent colostomy closure surgery were enrolled in the current study. The average age of those patients was 57.7 years. Sixty-one (59.8%) patients were males, and 40 (40.2%) patients were females. Postoperative complications occurred in 30 (29.4%) patients. More information is provided in Table 1.

In terms of the causes of transverse colostomy, 70 (68.6%) patients underwent surgery because of CRC-related causes, including anastomotic leakage after CRC surgery (32.4%), prophylactic transverse colostomy after CRC surgery (29.4%), and obstruction of CRC (3.9%). Other related causes involved perforation because of trauma (15.7%), obstruction (6.8%) and so on (Table 2).

The most frequent complication occurring after colostomy closure surgery was incision infection (46.7%), followed by pulmonary infection (13.3%), ileus (13.3%), anastomotic leakage (10%), abdominal infection (10%), and bleeding (6.7%). Moreover, 4 (13.3%) patients had complications \geq grade III (requiring surgical, endoscopic or radiological intervention), including severe ileus (6.6%) and anastomotic leakage (6.6%; Table 3).

Comparison between the complication group and the no complication group

The complication group had longer hospital stays ($P < 0.01$). However, there were no differences in terms of the method of anastomosis ($P = 0.63$), preoperative haemoglobin concentration ($P = 0.32$), preoperative albumin concentration ($P = 0.17$), operation time ($P = 0.69$), blood loss ($P = 0.61$) or other characteristics ($P > 0.05$; Table 4).

Logistic regression of overall complications and incisional infection

Univariate logistic regression analysis was also conducted to identify potential risk factors for overall complications and incision infection. However, no potential risk factors were identified in this study ($P > 0.05$; Table 5).

DISCUSSION

In this study, a total of 102 patients who underwent transverse colostomy closure surgery were enrolled. Postoperative complications occurred in 30 (29.4%) patients. The most frequent complication occurring after colostomy closure surgery was incision infection, with an incidence of 13.7%. The complication group had longer hospital stays than did the no complication group. Furthermore, logistic regression analyses included factors such as operation time, interval from transverse colostomy to reversal, and method of anastomosis; however, no potential risk factors were identified for overall complications or incision infection.

Table 1 Clinical characteristics, *n* (%)

Characteristics	No. (<i>n</i> = 102)
Age, yr	57.7 ± 12.7
Sex	
Male	61 (59.8)
Female	41 (40.2)
BMI, kg/m ²	22.4 ± 3.2
Smoking	42 (41.2)
Drinking	36 (35.3)
Hypertension	21 (20.6)
T2DM	9 (8.8)
Pre-operative hemoglobin, g/L	129.6 ± 17.4
Pre-operative albumin, g/L	42.4 ± 4.4
Interval from transverse colostomy to reversal, month	7.3 ± 4.5
Methods of anastomosis	
End-to-end anastomosis	25 (24.5)
End-to-side anastomosis	27 (26.5)
Side-to side anastomosis	50 (49.0)
Operation time	132.8 ± 64.0
Blood loss	43.8 ± 46.7
Hospital stay	9.4 ± 9.7
Complications	30 (29.4)

Variables are expressed as the mean ± SD, *n* (%). BMI: Body mass index; T2DM: Type 2 diabetes mellitus.

Table 2 The causes of transverse colostomy, *n* (%)

Characteristics	No. (<i>n</i> = 102)
CRC related causes	70 (68.6)
Perforation of CRC	1 (1.0)
Obstruction of CRC	4 (3.9)
Anastomotic leakage after CRC surgery	33 (32.4)
Prophylactic transverse colostomy after CRC surgery	30 (29.4)
Rectovaginal fistula after CRC surgery	1 (1.0)
Anastomotic bleeding after CRC surgery	1 (1.0)
Other related causes	32 (31.4)
Colorectal benign tumors	3 (2.9)
Perforation because of trauma	16 (15.7)
Rectovesical fistula	6 (5.9)
Obstruction	7 (6.8)

CRC: Colorectal cancer.

Table 3 Complications of the included patients, *n* (%)

Characteristics	No. (<i>n</i> = 30)
Grade I-II complications	26 (86.7)
Pulmonary infection	4 (13.3)
Abdominal infection	3 (10.0)
Incision infection	14 (46.7)
Anastomotic leakage	1 (3.3)
Ileus	2 (6.7)
Bleeding	2 (6.7)
≥ Grade III complications	4 (13.3)
Anastomotic leakage	2 (6.7)
Ileus	2 (6.7)

Table 4 Comparison between the complication group and the no complication group, *n* (%)

Characteristics	Complications (<i>n</i> = 30)	No complications (<i>n</i> = 72)	<i>P</i> value
Age, yr	58.3 ± 11.3	57.5 ± 13.3	0.756
Sex			0.677
Male	17 (56.7)	44 (61.1)	
Female	13 (43.3)	28 (38.9)	
BMI, kg/m ²	22.3 ± 2.9	22.4 ± 3.3	0.85
Smoking	12 (40.0)	30 (41.7)	0.876
Drinking	13 (43.3)	23 (31.9)	0.273
Hypertension	6 (20.0)	15 (20.8)	0.924
T2DM	2 (6.7)	7 (9.7)	1
Pre-operative hemoglobin, g/L	126.9 ± 20.0	130.7 ± 16.2	0.322
Pre-operative albumin, g/L	41.5 ± 4.1	42.8 ± 4.5	0.174
Interval from transverse colostomy to reversal, month	7.8 ± 6.2	7.1 ± 3.6	0.452
Methods of anastomosis			0.633
End-to-end anastomosis	8 (26.7)	27 (37.5)	
End-to-side anastomosis	6 (20.0)	21 (29.7)	
Side-to side anastomosis	16 (53.3)	24 (33.3)	
Operation time	133.0 ± 57.3	132.7 ± 67.0	0.979
Blood loss	47.4 ± 54.9	42.3 ± 43.1	0.617
Hospital stay	15.4 ± 16.0	6.9 ± 2.7	< 0.01 ^a

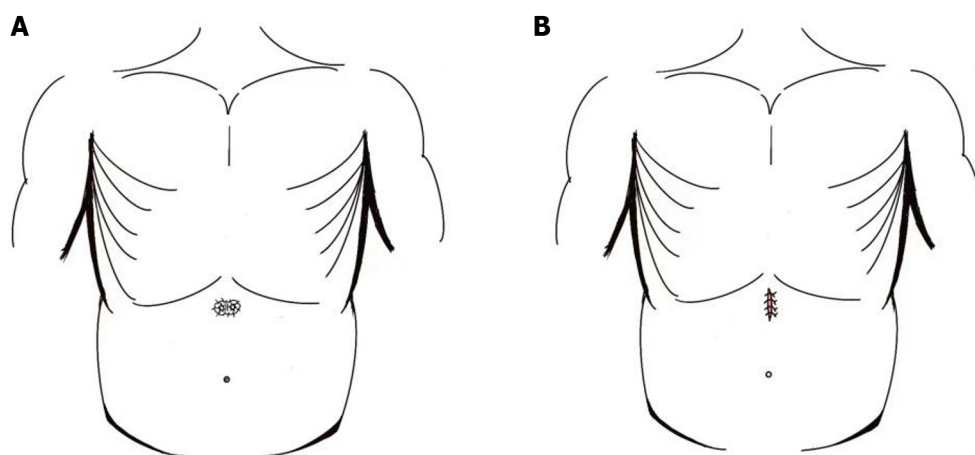
^a*P* value < 0.05.Variables are expressed as the mean ± SD, *n* (%). BMI: Body mass index; T2DM: Type 2 diabetes mellitus.

Previous studies have reported complications after transverse colostomy closure surgery. Aston and Everett[24] enrolled 100 patients who had a temporary transverse loop colostomy closed between 1969 and 1982; they found that the most frequent complication was faecal fistula (10%) and stressed that closing the stoma within 3 wk was as safe as closing it within 8 wk. Henry and Everett[21] reported that fistula formation at the site of closure was the most frequent complication. However, with the development of surgical techniques and clinical management, the incidence of complications in recent years has changed. Pokorny *et al*[16] and Rullier *et al*[18] reported that wound infection was the most frequent complication, with incidences of 9.0% and 8.9%, respectively, which was in accordance with our studies. In our study, the incidence of incision infection was 13.7%. Although incisional infection after transverse colostomy closure is

Table 5 Univariate logistic regression analysis of overall complications and incision infection

Risk factors	Univariate analysis of overall complications		Univariate analysis of incision infection	
	OR (95%CI)	P value	OR (95%CI)	P value
Age, yr	1.005 (0.972-1.040)	0.754	0.977 (0.935-1.021)	0.296
Sex (male/female)	1.202 (0.507-2.850)	0.677	0.802 (0.248-2.593)	0.713
BMI, Kg/m ²	0.987 (0.862-1.129)	0.848	0.988 (0.827-1.182)	0.898
Hypertension (yes/no)	0.950 (0.329-2.742)	0.924	1.061 (0.267-4.206)	0.933
T2DM (yes/no)	0.663 (0.130-3.394)	0.622	0.769 (0.089-6.669)	0.812
Smoking (yes/no)	0.933 (0.392-2.223)	0.876	2.118 (0.676-6.636)	0.198
Drinking (yes/no)	1.629 (0.679-3.911)	0.275	2.034 (0.652-6.349)	0.221
Pre-operative hemoglobin, g/L	0.988 (0.964-1.012)	0.320	0.989 (0.958-1.021)	0.509
Pre-operative albumin, g/L	0.934 (0.847-1.031)	0.175	0.957 (0.843-1.086)	0.494
Operation time, min	1.000 (0.993-1.007)	0.979	0.995 (0.984-1.007)	0.413
Blood loss, mL	1.002 (0.993-1.011)	0.614	0.995 (0.980-1.010)	0.528
Interval from transverse colostomy to reversal, month	1.035 (0.946-1.133)	0.454	1.033 (0.926-1.153)	0.562
Methods of anastomosis (Side-to side/end-to-side/end-to-end)	1.046 (0.622-1.761)	0.864	1.664 (0.734-3.774)	0.223

OR: Odds ratio; BMI: Body mass index; T2DM: Type 2 diabetes mellitus.

**Figure 2 Surgery procedure.** A: Image of transverse loop stoma; B: Surgical site after transverse colostomy closure.

usually not life-threatening, it increases the cost of hospitalization and pain of patients. Gonzalez *et al*[28] reported that age, operation time, and cardiac risk factors were found to be independent risk factors for surgical site infection; however, our study did not identify any risk factors, possibly because of the relatively small sample size. More measures should be taken to decrease the incidence of incision infection, including better management of T2DM, purse-string skin closure, an open incision, and a large surgeon volume[26,29,30].

Although the complication group had longer hospital stays, no significant differences were found in terms of the method of anastomosis, operation time or other characteristics, and no risk factors were found. These findings prompted us to further investigate the possible reasons for complications, such as the experience of surgeons and surgical techniques.

The interval from ostomy to reversal was the most common risk factor for postoperative complications, but this topic remains controversial. In 2019, Krebs *et al*[25] reported that the time to stoma closure was an independent risk factor for complications after diverting stoma closure, and the optimal cut-off was 240 d[25]. Conversely, a meta-analysis of 7 randomized controlled trials demonstrated that early stoma closure (4 wk) was as safe as routine surgery (8 wk)[31]. Pokorny *et al*[16] and Aston and Everett[24] reported that the interval was not an independent predictor of complications. Because stoma closure was performed at different times, the conclusions might vary. Our study showed that the interval (ranging from 1.2-14 months) from transverse colostomy closure to reversal did not seem to influence the incidence of

complications. The conclusion above might indicate that the time to perform transverse colostomy closure should be individualized and adjusted for various reasons, such as chemotherapy, primary disease, and complications after primary surgery.

To our knowledge, this is the first study to analyse postoperative complications and predictors, especially for patients who underwent transverse colostomy closure. Although several studies have reported complications after stoma closure and relevant risk factors, they did not separate ileostomy closure from colostomy closure. Because of the greater incidence of complications after colostomy closure than after ileostomy, the current study was necessary.

Some limitations of our study should be considered. First, the retrospective nature of the single-centre study indicated unavoidable selection bias. Second, only 102 patients were enrolled in this study, which was a small sample size. Moreover, additional parameters need to be included to identify risk factors. Thus, further multicentre prospective studies with large sample sizes are needed.

CONCLUSION

In conclusion, the most frequent complication occurring after colostomy closure surgery was incision infection. The operation time, interval from transverse colostomy to reversal, and method of anastomosis might have no impact on postoperative complications.

ARTICLE HIGHLIGHTS

Research background

Previous studies comparing the incidence of postoperative complications in patients with ileostomy and colostomy closure have found that patients undergoing colostomy closure are more likely to experience complications. Most of the studies reporting post-colonostomy complications were conducted at the end of the last century with relatively small sample sizes.

Research motivation

At present, colostomy, especially transverse colostomy, is still a common type of colostomy.

Research objectives

The aim of this study was to analyze complications after transverse colostomy closure and to identify risk factors associated with complications.

Research methods

This article used a retrospective study method to include 102 patients at a single clinical centre. The differences between the complication group and the no complication group were compared. Logistic regression analyses were conducted to find independent factors for overall complications or incision infection.

Research results

A total of 102 patients who underwent transverse colostomy closure were enrolled in the current study. Seventy (68.6%) patients underwent transverse colostomy because of colorectal cancer related causes. Postoperative complications occurred in 30 (29.4%) patients and the most frequent complication occurring after transverse colostomy closure was incision infection (46.7%). The complication group had longer hospital stays ($P < 0.01$). However, no potential risk factors were identified for overall complications and incision infection.

Research conclusions

Finally, we found that the most common complication after colostomy closure was wound infection. Operation time, time interval between transverse colostomy and reversal, and anastomosis method had no effect on postoperative complications.

Research perspectives

The study will conduct to analyze the overall survival after transverse colostomy closure.

FOOTNOTES

Co-first authors: Fei Liu and Xiao-Juan Luo.

Author contributions: Liu F and Luo XJ were co-first authors; Luo XJ was thanked for her significant contribution in revising the manuscript; All the authors agreed that Luo XJ was the co-first author; All authors contributed to data collection and analysis, drafting or revising the manuscript, have agreed on the journal to which the manuscript will be submitted, gave final approval of the version to be

published, and agree to be accountable for all aspects of the work.

Institutional review board statement: The ethics committee of the First Affiliated Hospital of Chongqing Medical University approved this study, No. K2024-008-01.

Clinical trial registration statement: We don't need URL registration.

Informed consent statement: Because the data used in this study were obtained from public databases, we applied for a waiver of informed consent.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Data sharing statement: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request at carry_dong@126.com.

CONSORT 2010 statement: The authors have read the CONSORT 2010 statement, and the manuscript was prepared and revised according to the CONSORT 2010 statement.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

Country/Territory of origin: China

ORCID number: Fei Liu 0000-0002-4022-0732; Zi-Wei Li 0000-0001-9759-4535; Xiao-Yu Liu 0000-0001-9448-4592; Xu-Rui Liu 0000-0002-6069-2104; Xin-Peng Shu 0000-0003-0652-4772; Wei Zhang 0000-0002-5822-9970; Dong Peng 0000-0003-4050-4337.

S-Editor: Li L

L-Editor: A

P-Editor: Cai YX

REFERENCES

- 1 Ambe PC, Kurz NR, Nitschke C, Odeh SF, Möslin G, Zirngibl H. Intestinal Ostomy. *Dtsch Arztebl Int* 2018; **115**: 182-187 [PMID: 29607805 DOI: 10.3238/arztebl.2018.0182]
- 2 Vonk-Klaassen SM, de Vocht HM, den Ouden ME, Eddes EH, Schuurmans MJ. Ostomy-related problems and their impact on quality of life of colorectal cancer ostomates: a systematic review. *Qual Life Res* 2016; **25**: 125-133 [PMID: 26123983 DOI: 10.1007/s11136-015-1050-3]
- 3 Johnston LR, Bradley MJ, Rodriguez CJ, McNally MP, Elster EA, Duncan JE. Ostomy Usage for Colorectal Trauma in Combat Casualties. *World J Surg* 2019; **43**: 169-174 [PMID: 30128770 DOI: 10.1007/s00268-018-4759-7]
- 4 Veenhof AA, van der Peet DL, Meijerink WJ, Cuesta MA. Defunctioning stoma reduces symptomatic anastomotic leakage after low anterior resection of the rectum for cancer: a randomized multicenter trial. *Ann Surg* 2008; **247**: 718-9; author reply 719 [PMID: 18362645 DOI: 10.1097/SLA.0b013e31816a7493]
- 5 Gastinger I, Marusch F, Steinert R, Wolff S, Koeckerling F, Lippert H; Working Group 'Colon/Rectum Carcinoma'. Protective defunctioning stoma in low anterior resection for rectal carcinoma. *Br J Surg* 2005; **92**: 1137-1142 [PMID: 15997447 DOI: 10.1002/bjs.5045]
- 6 Chude GG, Rayate NV, Patris V, Koshariya M, Jagad R, Kawamoto J, Lygidakis NJ. Defunctioning loop ileostomy with low anterior resection for distal rectal cancer: should we make an ileostomy as a routine procedure? A prospective randomized study. *Hepatogastroenterology* 2008; **55**: 1562-1567 [PMID: 19102343]
- 7 Fauno L, Rasmussen C, Sloth KK, Tøttrup A. Low complication rate after stoma closure. Consultants attended 90% of the operations. *Colorectal Dis* 2012; **14**: e499-e505 [PMID: 22340709 DOI: 10.1111/j.1463-1318.2012.02991.x]
- 8 Szczepkowski M, Banasiewicz T, Krokowicz P, Dziki A, Wallner G, Drews M, Herman R, Lorenc Z, Richter P, Bielecki K, Tarnowski W, Kruszewski J, Kładny J, Głuszek S, Zegarski W, Kielan W, Paśnik K, Jackowski M, Wyleżół M, Stojcev Z, Przywózka A. Polish consensus statement on the protective stoma. *Pol Przegl Chir* 2014; **86**: 391-404 [PMID: 25294711 DOI: 10.2478/pjs-2014-0071]
- 9 Mileski WJ, Rege RV, Joehl RJ, Nahrwold DL. Rates of morbidity and mortality after closure of loop and end colostomy. *Surg Gynecol Obstet* 1990; **171**: 17-21 [PMID: 2360144]
- 10 Chow A, Tilney HS, Paraskeva P, Jeyarajah S, Zacharakis E, Purkayastha S. The morbidity surrounding reversal of defunctioning ileostomies: a systematic review of 48 studies including 6,107 cases. *Int J Colorectal Dis* 2009; **24**: 711-723 [PMID: 19221766 DOI: 10.1007/s00384-009-0660-z]
- 11 Bada-Yllán O, García-Osogobio S, Zárate X, Velasco L, Hoyos-Tello CM, Takahashi T. [Morbi-mortality related to ileostomy and colostomy closure]. *Rev Invest Clin* 2006; **58**: 555-560 [PMID: 17432286]
- 12 Pittman DM, Smith LE. Complications of colostomy closure. *Dis Colon Rectum* 1985; **28**: 836-843 [PMID: 4053895 DOI: 10.1007/BF02555488]
- 13 Perez RO, Habr-Gama A, Seid VE, Proscurshim I, Sousa AH Jr, Kiss DR, Linhares M, Sapucahy M, Gama-Rodrigues J. Loop ileostomy morbidity: timing of closure matters. *Dis Colon Rectum* 2006; **49**: 1539-1545 [PMID: 16897328 DOI: 10.1007/s10350-006-0645-8]
- 14 Cheng H, Chen BP, Soleas IM, Ferko NC, Cameron CG, Hinoul P. Prolonged Operative Duration Increases Risk of Surgical Site Infections: A Systematic Review. *Surg Infect (Larchmt)* 2017; **18**: 722-735 [PMID: 28832271 DOI: 10.1089/sur.2017.089]

- 15 **Rubinkiewicz M**, Witowski J, Wysocki M, Pisarska M, Kłęk S, Budzyński A, Pędziwiatr M. Investigating Risk Factors for Complications after Ileostomy Reversal in Low Anterior Rectal Resection Patients: An Observational Study. *J Clin Med* 2019; **8** [PMID: 31581485 DOI: 10.3390/jcm8101567]
- 16 **Pokorny H**, Herkner H, Jakesz R, Herbst F. Predictors for complications after loop stoma closure in patients with rectal cancer. *World J Surg* 2006; **30**: 1488-1493 [PMID: 16855798 DOI: 10.1007/s00268-005-0734-1]
- 17 **Fonseca AZ**, Uramoto E, Santos-Rosa OM, Santin S, Ribeiro M Jr. COLOSTOMY CLOSURE: RISK FACTORS FOR COMPLICATIONS. *Arq Bras Cir Dig* 2017; **30**: 231-234 [PMID: 29340543 DOI: 10.1590/0102-6720201700040001]
- 18 **Rullier E**, Le Toux N, Laurent C, Garrelon JL, Parneix M, Saric J. Loop ileostomy versus loop colostomy for defunctioning low anastomoses during rectal cancer surgery. *World J Surg* 2001; **25**: 274-277; discussion 277 [PMID: 11343175 DOI: 10.1007/s002680020091]
- 19 **Chudner A**, Gachabayov M, Dyatlov A, Lee H, Essani R, Bergamaschi R. The influence of diverting loop ileostomy vs. colostomy on postoperative morbidity in restorative anterior resection for rectal cancer: a systematic review and meta-analysis. *Langenbecks Arch Surg* 2019; **404**: 129-139 [PMID: 30747281 DOI: 10.1007/s00423-019-01758-1]
- 20 **Bell C**, Asolati M, Hamilton E, Fleming J, Nwariaku F, Sarosi G, Anthony T. A comparison of complications associated with colostomy reversal versus ileostomy reversal. *Am J Surg* 2005; **190**: 717-720 [PMID: 16226946 DOI: 10.1016/j.amjsurg.2005.07.009]
- 21 **Henry MM**, Everett WG. Loop colostomy closure. *Br J Surg* 1979; **66**: 275-277 [PMID: 454998 DOI: 10.1002/bjs.1800660418]
- 22 **Parks SE**, Hastings PR. Complications of colostomy closure. *Am J Surg* 1985; **149**: 672-675 [PMID: 3993852 DOI: 10.1016/S0002-9610(85)80153-7]
- 23 **Livingston DH**, Miller FB, Richardson JD. Are the risks after colostomy closure exaggerated? *Am J Surg* 1989; **158**: 17-20 [PMID: 2742044 DOI: 10.1016/0002-9610(89)90306-1]
- 24 **Aston CM**, Everett WG. Comparison of early and late closure of transverse loop colostomies. *Ann R Coll Surg Engl* 1984; **66**: 331-333 [PMID: 6486667]
- 25 **Krebs B**, Ivanecz A, Potrc S, Horvat M. Factors affecting the morbidity and mortality of diverting stoma closure: retrospective cohort analysis of twelve-year period. *Radiol Oncol* 2019; **53**: 331-336 [PMID: 31553701 DOI: 10.2478/raon-2019-0037]
- 26 **Goret NE**, Goret CC, Cetin K, Agachan AF. Evaluation of risk factors for complications after colostomy closure. *Ann Ital Chir* 2019; **90**: 324-329 [PMID: 31144673]
- 27 **Clavien PA**, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, de Santibañes E, Pekolj J, Slankamenac K, Bassi C, Graf R, Vonlanthen R, Padbury R, Cameron JL, Makuuchi M. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg* 2009; **250**: 187-196 [PMID: 19638912 DOI: 10.1097/SLA.0b013e3181b13ca2]
- 28 **Gonzalez DO**, Ambeba E, Minneci PC, Deans KJ, Nwomeh BC. Surgical site infection after stoma closure in children: outcomes and predictors. *J Surg Res* 2017; **209**: 234-241 [PMID: 28032565 DOI: 10.1016/j.jss.2016.10.029]
- 29 **Wada Y**, Miyoshi N, Ohue M, Noura S, Fujino S, Sugimura K, Akita H, Motoori M, Gotoh K, Takahashi H, Kobayashi S, Ohmori T, Fujiwara Y, Yano M. Comparison of surgical techniques for stoma closure: A retrospective study of purse-string skin closure versus conventional skin closure following ileostomy and colostomy reversal. *Mol Clin Oncol* 2015; **3**: 619-622 [PMID: 26137277 DOI: 10.3892/mco.2015.505]
- 30 **Murtaza G**, Nuruddin R, Memon AA, Chawla T, Azam I, Mukhtar Y. Does primary closure increase surgical site infection after intestinal stoma reversal? A retrospective cohort study. *Surg Infect (Larchmt)* 2014; **15**: 58-63 [PMID: 24283765 DOI: 10.1089/sur.2012.165]
- 31 **Guo Y**, Luo Y, Zhao H, Bai L, Li J, Li L. Early Versus Routine Stoma Closure in Patients With Colorectal Resection: A Meta-Analysis of 7 Randomized Controlled Trials. *Surg Innov* 2020; **27**: 291-298 [PMID: 32100636 DOI: 10.1177/1553350620907812]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

Telephone: +1-925-3991568

E-mail: office@baishideng.com

Help Desk: <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

