Original Article

Effects of enhanced hygiene measures on severe diarrhea and anastomotic leak after colorectal cancer surgery: the experience of a tertiary referral hospital in China

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Background: The 2019 novel coronavirus (COVID-19) global pandemic has greatly changed the mode of hospital admissions. This study summarized and analyzed the incidence of severe diarrhea and anastomotic leakage during different periods for colorectal cancer surgery.

Methods: From January 2017 to September 2020, 2,619 colorectal operations were performed in Peking Union Medical College Hospital. In contrast with previous years, enhanced hand hygiene training, more frequent ventilation of the wards, and separate bed treatments for patients were implemented in 2020. Data on incidence of severe diarrhea and anastomotic leakage were retrieved and collected.

Results: The number of cases of severe diarrhea after colorectal surgery was 32 (4.60%), 24 (3.33%), 32 (3.83%), and 11 (2.99%) in 2017, 2018, 2019, and 2020 respectively, while the incidence of anastomotic leakage was 3.30% (23/696), 3.75% (27/720), 2.87% (24/835), and 2.17% (8/368), respectively. There was no significant difference in the incidence of postoperative severe diarrhea or anastomotic leakage across the various years.

Conclusions: The number of colorectal surgeries in 2020 was significantly decreased due to the COVID-19 pandemic. Among the different years, no difference was observed regarding the incidence of postoperative flora disorder or anastomosis leakage. Enhanced hygiene measures during the COVID-19 epidemic partially contributed to the decrease of severe diarrhea and anastomotic leakage.

Keywords: Hand hygiene; separate bed admission; colorectal cancer surgery; gut dysbiosis; anastomotic leak

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Introduction

Severe diarrhea and anastomotic leak are common complications after colorectal surgery (1). The incidence of postoperative dysbiosis can be as high as 21.0% (2). Postoperative severe diarrhea is associated with surgical site infection, which can contribute to morbidity and mortality in postsurgical patients (3). The main manifestations are severe postoperative intestinal infectious diarrhea and fulminant enteritis, which can lead to serious disruption of homeostasis and even death. Several factors, such as

unreasonable use of antibiotics, changing lifestyle, and deteriorating environment, contribute to the disruption of intestinal flora. Pathogenic bacteria can produce enterotoxins and cytotoxins that act on the small intestine and colon. These bacteria can be antibiotic-resistant and include *Clostridium difficile* and methicillin-resistant *Staphylococcus aureus*, among others. In the perioperative period of colorectal surgery, anesthesia and surgical stress usually result in gastrointestinal motility disorder, and partially contribute to the incidence of severe diarrhea. Pseudomembranous intestinal enteritis is common in those patients with postoperative severe diarrhea. Moreover, severe diarrhea can weaken the immune system and interrupt homeostasis. As a consequence, fatal enteritis and other dangerous complications can also occur, which can result in a prolonged recovery and higher costs. Anastomotic leak is another common complication of colorectal surgery, which not only increases the expense and hospital-stay period, but can also lead to the increased mortality of patients (4). Related studies reported that the frequency of postoperative anastomotic leakage varied from 1.8% to 19.2%. The main risk factors are male sex, older age, a lower site of anastomosis, and malnutrition before surgery (5,6). Reintervention for anastomotic leakage is usually needed when antiseptic therapy or drainage is unviable. Otherwise, the leakage can result in delayed recovery and deteriorated nutrition status, and subsequent abdominal infection can complicate the patient's condition.

The recent 2019 novel coronavirus (COVID-19) epidemic has greatly changed the mode of hospital admissions. For example, Fangcang shelter hospitals during the epidemic contributed to the successful disease control and treatment of patients (7). During the COVID-19 epidemic, most hospitals adopted a series of measures to monitor and prevent the infection rates. In terms of nursing care, medical institutions habitually implemented a stricter sanitation check system and were more standardized and meticulous in nursing operations. In Peking Union Medical College Hospital, major measures to control infection rates include enhanced hand hygiene training, more frequent ventilation of the wards, and separate bed treatments for inpatients. Evidence has indicated that hospital infection prevention can improve patient safety and contribute to a better clinical outcome (8). However, whether the altered treatment and admission mode could affect the postoperative complications in patients undergoing colorectal surgeries remains unknown. Severe diarrhea and anastomotic leak are 2 major complications that affect the disease course of patients with colorectal tumors. It is a joint effort in which both surgeons and nurses contribute to disease recovery. Therefore, our study analyzed the incidence rates of severe diarrhea and anastomotic leak after colorectal surgery in Peking Union Medical College Hospital and evaluated the effects of strict medical and health management practices on severe diarrhea and anastomotic leakage during the epidemic. We present the following article in accordance with the STROBE reporting checklist (available at https://tcr.amegroups.com/article/view/10.21037/tcr-22-1952/rc).

Methods

Collection of patient information

Clinical data of patients undergoing colorectal malignant tumor surgery in the Department of General Surgery of Peking Union Medical College Hospital from January 2017 to September 2020 were collected. Patient inclusion criteria were the following: (I) resection or anastomosis of the colon or rectum; (II) pathologically confirmed malignant tumor; and (III) no liver cirrhosis, Crohn's disease, or inflammatory bowel disease before operation. Meanwhile, the exclusion criteria were the following: (I) emergency surgery; (II) preoperative bowel or systematic infections; (III) reduced immunity or being treated with immunosuppressive agents; and (IV) patients with chronic diarrhea, constipation, or functional dyspepsia. A total of 2619 patients were enrolled, and their demographic, surgical method, and postoperative complication data were collected and recorded. All patients underwent preoperative bowel preparation. From 2017 to 2019, the treatment and nursing team provided routine care for patients during the perioperative period.

During the 2020 COVID-19 epidemic, the nursing team adopted a new standard of patient management, aiming to decrease the infectious disease rates. The detailed new management standard includes wearing medical surgical masks throughout the process, increasing the frequency of hand hygiene, regularly opening windows for ventilation more than 3 times a day, and using 75% alcohol to disinfect the surfaces of patient wards more than 3 times a day. For ward arrangement, the bed spacing was doubled compared with that in previous years (2 meters *vs.* 1 meter).

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional ethics board of Peking Union Medical College Hospital (approval No. 39410) and

Table 1 The information of the patients operated between 2017 and 2020

Variables	2017	2018	2019	2020
Number	747	767	894	368
Age (year), mean [interquartile range]	63 [47, 79]	62 [47, 77]	63 [49, 77]	62 [46, 78]
Sex (male), n (%)	438 (58.6)	436 (56.8)	523 (58.5)	217 (59.0)
Diagnosis, n (%)				
Rectal cancer	402 (53.8)	430 (56.1)	434 (48.5)	207 (56.3)
Colon cancer	345 (46.2)	337 (43.9)	460 (51.5)	161 (43.8)

individual consent for this retrospective analysis was waived.

Diagnostic criteria for severe diarrhea

Severe diarrhea was considered when the following clinical manifestations or laboratory findings occurred:

It was defined as either an increase of more than or equal to 7 stools per day over baseline, and severe increase in ostomy output compared to baseline or limiting self-care activities of daily living (ADL). Toxicity events of grade 3 or higher were defined as severe diarrhea. Grade 1 and grade 2 diarrhea were defined as an increase of fewer than 4 stools and an increase of 4 to 6 stools over baseline, respectively (9).

In laboratory examination, inflammatory indices such as white blood cell, neutrophil, and calcitonin levels may increase in the early stage of severe diarrhea. Computed tomography (CT) may show edema, dilatation, and fluid accumulation in the digestive tract, and there may be ascites. A large number of positive cocci may be found in Gram stain of stool smear.

Diagnostic criteria for postoperative anastomotic leakage

Anastomotic leakage can be suddenly detected but is usually a process that takes 1 or more days. The following items usually indicate that there may be anastomotic leakage for postoperative patients.

The definition of anastomotic leakage is a defect of the integrity of the intestinal wall at the anastomotic site (including leakage originating from suture and staple lines of neorectal reservoirs) leading to a communication of the intra- and extraluminal compartments. A pelvic abscess adjacent to the anastomosis has also been considered anastomotic leakage, even if no communication can be demonstrated with the colonic lumen at the site of anastomosis (10).

Statistical methods

SPSS 21.0 software (IBM Corp.) was used for statistical analysis. The technical data were evaluated with chi-square test and Fisher exact probability method. A P value <0.05 was considered statistically significant.

Results

Comparison of general information from 2017 to 2020

The results showed that the number of patients from 2017 to 2020 were 747, 767, 894, and 368, respectively, suggesting that the number of patients undergoing surgery increased year by year from 2017 to 2019, but the number of operations decreased significantly in 2020. In 2017 and 2018, there were more patients diagnosed with rectal tumors than with colon tumors. However, in 2019, the number of patients with colon tumor was greater than that with rectal tumor (460 *vs.* 434), indicating the incidence of colon carcinoma is increasing (*Table 1*). The chi-square test showed that there was no significant difference in sex ratio, age, or primary tumor site between years.

The occurrence of postoperative severe diarrhea in patients undergoing colorectal surgery from 2017 to 2020

The results showed that the incidence of severe diarrhea from 2017 to 2020 was 4.60%, 3.33%, 3.83%, and 2.99%, respectively (*Figure 1*). Moreover, in recent years, the incidence of severe diarrhea in patients after colorectal tumor surgery exhibited an overall downward trend. The chi-square test showed that there was no significant difference in the incidence of severe diarrhea between years, and there was no

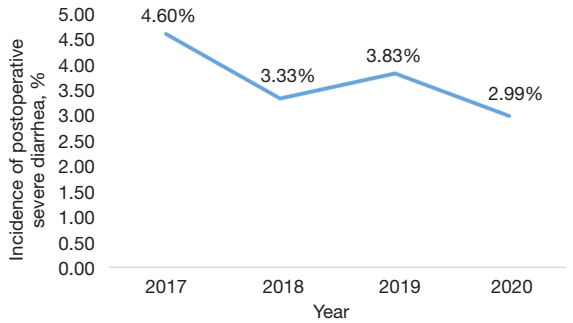

Figure 1 Incidence of postoperative severe diarrhea from 2017 to 2020.

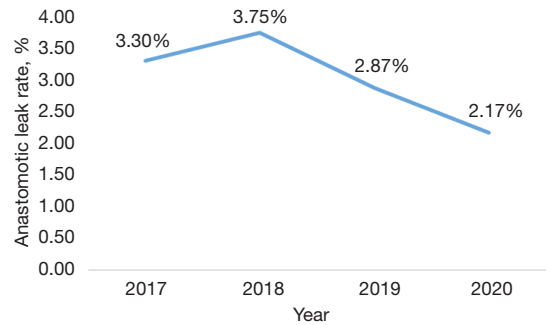

Figure 2 Postoperative anastomotic leak rate from 2017 to 2020.

significant statistical difference between 2020 and 2017–2019.

The occurrence of postoperative anastomotic leakage in patients undergoing colorectal surgery from 2017 to 2020

As shown in *Figure 2*, the incidence of anastomotic leakage has been decreasing year by year since 2018. Chi-square test showed that there was no significant difference in the incidence of anastomotic leakage between years. Nursing practices such as hand hygiene and wound nursing were strengthened in 2020, and we further compared the anastomotic leakage incidence between 2020 and 2017–2019. No significant statistical difference was found between these 2 periods. We propose that the TNM (tumor, the extent of spread to the lymph nodes, and the presence of metastasis) stage of primary tumors, nutrition status, and the surgical skills of surgeons, may have a greater effect on the incidence of postoperative intestinal leakage.

Discussion

The incidence of colorectal cancer is increasing and imposes a heavy public health burden around the world (11). Surgery is currently the only potential curative therapy. However, local recurrence and metastasis are major problems for achieving long-term survival. A large population of microbiota are located in proximity to the colorectal epithelium and play important roles in various physiological processes. Dysregulation of colorectal microbiota also participate in carcinogenesis. Studies have shown that imbalance of colorectal flora is closely related to the occurrence of colorectal tumors (12-14). For patients with colorectal cancers who undergo curative surgeries, postoperative severe diarrhea indicates a recurrent gut microbiota imbalance. Moreover, the physical displacement of the intestinal flora caused by resection and reconstruction both contribute to the occurrence of postoperative flora displacement. Furthermore, since patients with colorectal tumors often have nutritional disorders, perioperative bowel preparation and limited enteral nutrition during postoperative recovery may further promote the occurrence of intestinal flora imbalance.

Anastomotic leakage is another severe complication after colorectal surgery and is usually associated with the patient's nutritional status, tumor stage, location, and surgical operations. Anastomotic leakage can remain unhealed for an extended period and may even require reintervention surgery. More importantly, evidence indicates that anastomotic leakage is associated with unfavorable clinical outcomes. Studies have shown anastomotic leakage to be a prognostic factor for local or distal recurrence after curative resection (15-17). A delayed or cancelled adjuvant chemotherapy caused by anastomotic leakage partially accounts for these poor oncologic outcomes (18). There is evidence that postoperative diarrhea and flatulence caused by intestinal flora disturbance are related to the occurrence of anastomotic leakage (19).

The COVID-19 epidemic remains a challenging threat to global health. To reduce the probability of human-to-human transmission of virus and bacteria, a series of epidemic prevention measures were adopted in Peking Union Medical College Hospital. These measures mainly include separate bed admission for inpatients, enhanced hand hygiene, and more frequent ventilation of the wards. Since the patients with colorectal cancer usually present with gut symptoms that are related to severe diarrhea, we postulate that the enhanced hygiene measures may also reduce the chance of intestinal infection. Intriguingly, the effects of enhanced hygiene measures on those postoperative complications associated with gut microbiota

have not been examined.

Our data analysis based on a single center showed that the number of colorectal surgeries in 2020 was significantly decreased compared to previous years. Although there was no statistical difference, it was observed that the incidence of postoperative flora disorder and postoperative anastomoses had a downward trend. The above results are related to the implementation of strict ward admission policies and stricter ward environmental sanitation strategies during the COVID-19 epidemic, suggesting that the series of hygiene measures brought about by the epidemic will affect the incidence of colorectal surgery complications to a certain extent. In fact, these measures have been proven to be effective in controlling the spread of infectious disease (20). To impede the route of transmission among patients, Peking Union Medical College Hospital highly emphasized the environmental sanitation in the wards. Patients with colorectal cancer can experience gut infection to various degrees. Preventing the underlying transmission among patients and healthcare personnel is important for favorable clinical outcomes. However, our data suggested that the postoperative complications were related to multiple factors. Enhanced hygiene measures did not significantly affect the incidence of postoperative flora disorder or postoperative anastomoses. The results of our study indicate that normal hand hygiene measures are sufficient to manage postoperative complications after colorectal surgery, while enhanced hygiene measures may increase the financial burden and the workload of nursing staff and, therefore, may not be suitable as a long-term model for the ward. The specific roles of nursing hygiene measures and reinforced nursing treatment on surgical complications need to be further explored.

Several limitations should be noted in this study. First, the decreasing frequency of surgical procedures might have affected the patient selection during the COVID-19 pandemic, which in turn might have decreased the incidence of gut dysbiosis and anastomotic leakage. Specifically, patients operated on during the COVID-19 pandemic might have received more attention from doctors, thus resulting in fewer postoperative complications. Second, other factors could have also influenced the incidence of postoperative diarrhea, such as nerve injury of autonomous nerves in radical mesocolic excision, continence function, length of the remaining colon, and concomitant exocrine pancreas function. These factors were not examined in the study, as we believe they did not change between years.

Conclusions

Our study did not find enhanced hygiene measures during the COVID-19 epidemic to have a significant impact on the incidence of severe diarrhea or anastomotic leak after colorectal cancer surgery.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tcr.amegroups.com/article/view/10.21037/tcr-22-1952/rc

Data Sharing Statement: Available at https://tcr.amegroups.com/article/view/10.21037/tcr-22-1952/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tcr.amegroups.com/article/view/10.21037/tcr-22-1952/coif). All authors report that this work was supported by National Natural Science Foundation of China (project No. 62172437). The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional ethics board of Peking Union Medical College Hospital (Approval No. I-22PJ398) and individual consent for this retrospective analysis was waived.

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