

Effect of Continuous Double-Lumen Irrigation Drainage at Constant Temperature on the Control of Abdominal Infection After Surgery

Junlu Lin*

Department of General Surgery, Wendeng People's Hospital, Weihai, Shandong 264400, China

*Corresponding author: Junlu Lin, lin1509811@139.com

Copyright: © 2024 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* To investigate the effect of continuous double-lumen irrigation drainage at constant temperature on the control of abdominal infection after surgery, providing a reference for clinical treatment. *Methods:* From December 2022 to August 2023, 100 patients with abdominal infections after surgery were selected from Wendeng People's Hospital in Weihai. They were randomly divided into a control group (50 cases, using conventional single-hole rubber irrigation drainage) and an observation group (50 cases, using continuous double-lumen irrigation drainage at constant temperature). The inflammatory and immune indicators of the two groups were compared after different interventions, and the specific conditions of abdominal infection were statistically analyzed. *Results:* There was no significant difference in inflammatory indicators between the two groups before intervention ($P > 0.05$). After the intervention, the inflammatory indicators of the observation group were significantly lower ($P < 0.05$). There was no significant difference in immune function indicators between the two groups before intervention ($P > 0.05$). After intervention, the immune function indicators of the observation group showed significant improvement ($P < 0.05$). The control of abdominal infection in the observation group was better than in the control group ($P < 0.05$). *Conclusion:* Continuous double-lumen irrigation drainage at constant temperature has a better effect on controlling abdominal infection after surgery, improving the infection condition, and enhancing the immune function of patients.

Keywords: Continuous double-lumen irrigation drainage; Surgery; Abdominal infection

Online publication: July 18, 2024

1. Introduction

Postoperative abdominal infection is a common complication and one of the leading causes of postoperative mortality^[1]. Abdominal infections are often caused by external pathogenic microorganisms invading the abdominal cavity, with many pathogens severely damaging tissues and organs, leading to a worsening of the patient's condition^[2]. Common causes of abdominal infection include improper surgical procedures, inadequate postoperative care, and perforations of the intestines and digestive tract. Symptoms mainly manifest as fever, vomiting, diarrhea, abdominal tenderness, rebound tenderness, and abnormal laboratory results such as elevated

white blood cell counts ^[3,4]. Current clinical treatments include comprehensive approaches such as drainage, anti-infection measures, nutritional support, immune function improvement, and surgical treatment ^[5]. During surgical open drainage, continuous flushing and drainage with a thermostatic double-cannula can promptly remove accumulated blood and pus within the abdominal cavity, and antimicrobial drugs can be administered through the cannula to effectively control the infection ^[6]. This study investigates the effect of continuous thermostatic double-cannula flushing drainage on the control of abdominal infection after surgery.

2. Materials and methods

2.1. Study subjects

A prospective selection of 100 patients with postoperative abdominal infections, admitted to Wendeng District People's Hospital in Weihai from December 2022 to August 2023, was made for basic evaluation and analysis. The patients were divided into an observation group and a control group using a comprehensive random number table method, with 50 cases in each group. Causes of abdominal infection included: perforation of abdominal organs (18 cases), residual foreign bodies in the abdominal cavity (11 cases), intra-abdominal bleeding (28 cases), intra-abdominal effusion (22 cases), and wound infection (21 cases). The observation group consisted of 28 males and 22 females, aged 18 to 60 years, with an average age of 45.39 ± 3.17 years. Causes of infection in the observation group included: perforation of abdominal organs (10 cases), residual foreign bodies in the abdominal cavity (6 cases), intra-abdominal bleeding (14 cases), intra-abdominal effusion (10 cases), and wound infection (10 cases). The control group consisted of 31 males and 19 females, aged 18 to 58 years, with an average age of 45.16 ± 3.16 years. Causes of infection in the control group included: perforation of abdominal organs (8 cases), residual foreign bodies in the abdominal cavity (5 cases), intra-abdominal bleeding (14 cases), intra-abdominal effusion (12 cases), and wound infection (11 cases). The comparison of general data between the two groups showed no statistically significant differences ($P > 0.05$), indicating comparability between the groups. During the study, the specific content was approved by the Medical Ethics Committee of Wendeng District People's Hospital in Weihai. Inclusion criteria were: (1) clear diagnosis of abdominal infection ^[7]; (2) no prior treatment with antimicrobial or steroid medications; (3) complete medical records. Exclusion criteria were: (1) combined infections at other sites; (2) mental disorders; (3) presence of immune diseases; (4) severe liver or kidney dysfunction.

2.2. Methods

Both groups received basic anti-infection interventions, with physicians providing nutritional support and anti-infection treatment plans based on the patient's conditions. The control group received routine single-lumen catheter flushing: 150 mL/h of saline, 2,500 mL/day, every 2 hours, ensuring the patency of the drainage tube to prevent blockage or dislodgement. Regular checks of the drainage fluid were performed, recording its color, nature, and quantity, and any abnormalities were promptly addressed. The drainage tube was removed once the patient's condition stabilized, the abdominal infection was controlled, and the abdominal incision healed well.

The observation group received continuous thermostatic double-cannula flushing and drainage: a 26-gauge abdominal silicone tube (with two side holes at both ends) was set within a regular infusion tube, with a 4–5 mm gap between the inner and outer tubes (manufacturer: Jiangsu Yuyue Medical Equipment Co., Ltd.). A small incision was made in an appropriate position on the abdomen, and the drainage tube was inserted into the abdominal cavity. The end of the drainage tube was connected to the double-cannula device. A thermostatic control device was used to maintain the temperature of the double-cannula at 30–40°C to keep the drainage fluid's temperature stable. The drainage negative pressure value was 10–15 kPa, with 100 mL/h of saline used

for flushing, 2,500 mL/day, ensuring the patency of the drainage tube to prevent blockage or dislodgement. Regular checks of the drainage fluid in the double-cannula were performed, recording its color, nature, and quantity, and any abnormalities were promptly addressed. The drainage tube was removed once the patient's condition stabilized, the abdominal infection was controlled, and the abdominal incision healed well.

2.3. Observation indicators

- (1) Inflammatory indicator levels: Blood was collected from fasting patients in the morning, left at room temperature to clot, then centrifuged to separate the serum, and stored in a refrigerated environment at 2–8°C. Blood samples were centrifuged at low speed (3,000–4000 rpm for 5–10 minutes). IL-6 was measured using enzyme-linked immunosorbent assay (ELISA), and CRP was measured using immunoturbidimetry with a fully automatic biochemical analyzer (Beijing Ruierda Biotechnology Co., Ltd., Beijing Medical Device Registration Certificate No. 20222220357, Model: 4040AC). NLR was measured using a fully automatic blood cell analyzer (Beijing Baolingmanyang Technology Co., Ltd., Beijing Medical Device Registration Certificate No. 20162401107, Model: BM21B).
- (2) Immune function indicator levels: Blood was collected from fasting patients in the morning, left at room temperature to clot, then centrifuged to separate the serum, and stored in a refrigerated environment at 2–8°C. Blood samples were centrifuged at low speed (3,000–4,000 rpm for 5–10 minutes). Immune function indicators were measured using a fully automatic immunoassay analyzer and immunoturbidimetry.
- (3) Abdominal infection control: (a) Marked efficacy: symptom improvement, abdominal ultrasound, CT, or other imaging tests showing resolution of abdominal inflammation, no signs of effusion or pus accumulation, and stable patient temperature with no high or low fever; (b) Effective: some symptom improvement, abdominal ultrasound, CT, or other imaging tests showing partial resolution of abdominal inflammation, relatively stable patient temperature with ≤ 2 episodes of high or low fever per week; (c) Ineffective: no symptom improvement, abdominal ultrasound, CT, or other imaging tests showing persistent abdominal inflammation, presence of effusion or pus accumulation, and episodes of high or low fever. Control rate = (marked efficacy + effective) / total cases $\times 100\%$.

2.4. Statistical analysis

SPSS 23.0 statistical software was used for data processing. Measurement data were expressed as mean \pm standard deviation (SD) and analyzed using *t*-tests; count data were expressed as [*n* (%)] and analyzed using χ^2 tests; ordinal data were analyzed using rank-sum tests. A *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of the level of inflammatory indicators between the two groups of patients

There was no significant difference between the inflammatory indicators of the two groups of patients before the intervention, and the difference was not statistically significant ($P > 0.05$); the inflammatory indicators of the study group were significantly lower after the intervention, and the difference was statistically significant ($P < 0.05$), see **Table 1**.

Table 1. Comparison of the levels of inflammatory indicators between the two groups of patients before and after treatment (mean \pm SD)

| Group | n | IL-6 (ng/L) | | CRP (mg/L) | | NLR | |
|-------------------|----|------------------|-------------------|-----------------|------------------|-----------------|------------------|
| | | Before | After | Before | After | Before | After |
| Observation group | 50 | 13.51 \pm 2.94 | 9.01 \pm 1.13* | 7.69 \pm 3.15 | 5.13 \pm 0.50* | 2.77 \pm 0.37 | 2.04 \pm 0.63* |
| Control group | 50 | 13.91 \pm 4.16 | 12.00 \pm 3.25* | 7.57 \pm 2.67 | 6.33 \pm 0.40* | 2.75 \pm 0.41 | 2.67 \pm 0.46* |
| t-value | | 0.555 | 6.145 | 0.205 | 13.252 | 0.256 | 5.711 |
| P-value | | 0.580 | 0.000 | 0.838 | 0.000 | 0.798 | 0.000 |

Compared with the same group before the intervention, * $P < 0.05$. Abbreviation: IL-6, interleukin-6; CRP, C-reactive protein; NLR, neutrophil to lymphocyte ratio.

3.2. Comparison of the levels of immune function indicators between the two groups of patients

There was no significant difference between the immune function indexes of the two groups of patients before intervention, and the difference was not statistically significant ($P > 0.05$); the advantage of immune function indexes of the study group after intervention was obvious, and the difference was statistically significant ($P < 0.05$), see **Table 2**.

Table 2. Comparison of the levels of immune function indexes between the two groups of patients before and after treatment (mean \pm SD)

| Group | n | IgA (g/L) | | IgG (g/L) | | IgM (g/L) | |
|-------------------|----|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| | | Before | After | Before | After | Before | After |
| Observation group | 50 | 2.43 \pm 0.16 | 1.53 \pm 0.16 | 0.76 \pm 0.21 | 1.24 \pm 0.19 | 9.98 \pm 1.16 | 11.19 \pm 2.24 |
| Control group | 50 | 2.46 \pm 0.24 | 2.29 \pm 0.22 | 0.75 \pm 0.23 | 0.95 \pm 0.26 | 9.88 \pm 1.46 | 16.16 \pm 3.33 |
| t-value | | 0.735 | 19.755 | 0.227 | 6.368 | 0.379 | 8.757 |
| P-value | | 0.464 | 0.000 | 0.821 | 0.000 | 0.705 | 0.000 |

Compared with the same group before the intervention, * $P < 0.05$. Abbreviation: IgA, immunoglobulin A; IgG, immunoglobulin G; IgM, immunoglobulin M.

3.3. Comparison of infection control between the two groups of patients

After the intervention, the control of abdominal cavity infection in the observation group was better than that in the control group, and the difference was statistically significant ($P < 0.05$), see **Table 3**.

Table 3. Comparison of the control of abdominal cavity infection in the two groups [n (%)]

| Group | n | Very effective | Effective | Ineffective | Total effective |
|---------------------|----|----------------|------------|-------------|-----------------|
| Observation group | 50 | 45 (90.00) | 5 (10.00) | 0 (0.00) | 50 (100.00) |
| Control group | 50 | 33 (66.00) | 10 (20.00) | 7 (14.00) | 43 (86.00) |
| z / χ^2 -value | | | -3.030 | | 7.527 |
| P-value | | | 0.002 | | 0.023 |

4. Discussion

Abdominal infection is a common complication after surgery and is associated with various factors. It can lead to severe consequences such as peritonitis and organ failure, increasing patient suffering and even endangering life. Therefore, effectively controlling abdominal infection is crucial for patient recovery^[8]. In recent years, with the continuous advancement of medical technology, thermostatic continuous double-cannula flushing drainage has emerged as a new drainage technique. By maintaining the patency of the drainage tube and a constant temperature, this method effectively enhances drainage, providing a new solution for controlling abdominal infections^[9].

The results of this study showed that the levels of inflammatory indicators in the observation group were lower than those in the control group after the intervention, indicating that thermostatic continuous double-cannula flushing drainage has significant advantages in controlling inflammation. The reason is that this technique maintains the stability of the drainage fluid temperature through a thermostatic regulation device^[10]. During the inflammatory process, the production and release of inflammatory mediators are influenced by temperature; maintaining an appropriate temperature can reduce the activity of inflammatory mediators, thereby alleviating the inflammatory response^[11,12]. Thermostatic continuous double-cannula flushing drainage can continuously and stably drain intra-abdominal fluid, including inflammatory substances and bacteria. Effective drainage can quickly remove substances causing inflammation, reducing the inflammatory response^[13]. Continuous drainage also helps maintain a low-pressure state within the abdominal cavity, reducing bacterial proliferation and translocation, and further controlling the occurrence and progression of inflammation^[14]. Abdominal infection can lead to increased intra-abdominal pressure, affecting intestinal peristalsis and venous return. Thermostatic continuous double-cannula flushing drainage can promptly drain intra-abdominal fluid and gas, reducing intra-abdominal pressure, and improving intestinal peristalsis and venous return^[15]. This helps reduce the inflammatory response, promotes the recovery of intestinal function, and further controls the development of inflammation.

In summary, compared to conventional single-lumen rubber drainage tubes, thermostatic continuous double-cannula flushing drainage can better control the inflammatory response, improve immune function indicators, and increase the control rate of abdominal infections. This provides a new effective method in clinical practice to control the occurrence and progression of postoperative abdominal infections.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Wu Di, Yan Yuping, Wang Zhixia, et al., 2022, Effect of Thermostatic Continuous Double-Cannula Flushing Drainage on Fistula Healing in Patients with Intestinal Fistula after Colorectal Cancer Surgery. *Tumor Foundation and Clinic*, 35(5): 418–421.
- [2] Ma P, Li S, Cao Y, et al., 2023, Surgical Treatment of Duodenal Fistula with Abdominal Infection. *Chinese Journal of General Surgery*, 38(2): 101–104.
- [3] Deng Z, Zhu H, Du W, et al., 2023, Abdominal Infection Combined with Pneumoperitoneum after Renal Transplantation: A Case Report. *Medicine (Baltimore)*, 102(5): e32836. <https://doi.org/10.1097/MD.00000000000032836>

- [4] Wang P, 2020, Progress in the Treatment of Abdominal Anaerobic Bacterial Infections. *Chinese Journal of Gastrointestinal Surgery*, 23(11): 1028–1031.
- [5] Che Y, Ma B, Yang X, et al., 2021, Effect Analysis of CT-Guided Abdominal Double-Cannula Negative Pressure Drainage Aspiration for Treating Intestinal Fistula. *Gansu Medicine*, 40(12): 1084–1085.
- [6] Misky A, Hotouras A, Ribas Y, et al., 2016, A Systematic Literature Review on the Use of Vacuum-Assisted Closure for Enterocutaneous Fistula. *Colorectal Dis*, 18(9): 846–851. <https://doi.org/10.1111/codi.13351>
- [7] Mazuski JE, Tessier JM, May AK, et al., 2017, The Surgical Infection Society Revised Guidelines on the Management of Intra-Abdominal Infection. *Surg Infect (Larchmt)*, 18(1): 1–76. <https://doi.org/10.1089/sur.2016.261>
- [8] Li M, 2019, Application Research of Continuous Double-Cannula Flushing Negative Pressure Suction Method in Treating Patients with Acute Intestinal Fistula after Surgery. *Medical Diet Therapy and Health*, 2019(5): 41.
- [9] Che M, Zhu L, Huang H, 2014, Effect and Nursing of Continuous Double-Cannula Flushing Negative Pressure Suction Method in Treating Patients with Acute Intestinal Fistula after Surgery. *Chinese Journal of Modern Nursing*, 20(9): 1091–1093.
- [10] Barie PS, Kao LS, Moody M, et al., 2023, Infection or Inflammation: Are Uncomplicated Acute Appendicitis, Acute Cholecystitis, and Acute Diverticulitis Infectious Diseases. *Surg Infect (Larchmt)*, 24(2): 99–111. <https://doi.org/10.1089/sur.2022.363>
- [11] Wang J, Gao J, Hu P, et al., 2014, Analysis of Diagnosis and Treatment of Severe Abdominal Infection after Abdominal Trauma in 37 Cases. *Journal of Trauma Surgery*, 2014(3): 212–214.
- [12] Surgical Infection and Critical Care Medicine Group of the Surgery Branch of the Chinese Medical Association, Professional Committee of Intestinal Fistula Surgeons of the Chinese Society of Surgeons, 2020, Guidelines for the Diagnosis and Treatment of Abdominal Infections in China (2019 Edition). *Chinese Journal of Practical Surgery*, 40(1): 1–16.
- [13] Sartelli M, Chichom-Mefire A, Labricciosa FM, et al., 2017, The Management of Intra-Abdominal Infections from a Global Perspective: 2017 WSES Guidelines for Management of Intra-Abdominal Infections. *World J Emerg Surg*, 12: 29. <https://doi.org/10.1186/s13017-017-0141-6>
- [14] Qiu W, Zhang Y, 2021, Effect of Double-Cannula Drainage Combined with Continuous Low-Pressure Flushing of the Anorectal Double-Cannula in Preventing and Controlling Anastomotic Fistula in Patients with Low and Mid-Rectal Cancer after Surgery. *Henan Medical Research*, 30(35): 6601–6604.
- [15] Sartelli M, Coccolini F, Kluger Y, et al., 2021, WSES/GAIS/SIS-E/WSIS/AAST Global Clinical Pathways for Patients with Intra-Abdominal Infections. *World J Emerg Surg*, 16(1): 49. <https://doi.org/10.1186/s13017-021-00387-8>

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.