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RESEARCH

After stent placement in patient with left colon cancer with intestinal obstruction safety and efficacy analysis

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Abstract

Purpose This study aimed to evaluate the safety and efficacy of intestinal stent placement as a bridge to surgery in patients with left colon cancer complicated by intestinal obstruction (LCCO).

Methods A retrospective cohort analysis was conducted on 111 patients diagnosed with LCCO at The Second Affiliated Hospital of Chongqing Medical University between January 2015 and August 2019. Patients were divided into two groups: the stent group (SG, n = 41) and the emergency surgery group (EG, n = 70). Primary endpoints included 3-year progression-free survival (PFS), local recurrence, and distant metastasis rates. Secondary endpoints encompassed 3-year overall survival (OS), intraoperative parameters (lymph node dissection, blood loss, operative time), enterostomy rate, postoperative complications, and hospital stay duration.

Results No significant differences were observed between SG and EG in 3-year PFS (59% vs. 41%, P = 0.091), OS (61% vs. 44%, P = 0.051), or metastasis rates (19.5% vs. 20%, P = 0.95). However, SG demonstrated superior short-term outcomes, including reduced intraoperative blood loss (60 mL vs. 78 mL, P = 0.02), shorter hospital stay (10.2 vs. 16.1 days, P < 0.001), lower enterostomy rate (0% vs. 100%, P < 0.001), and fewer postoperative complications (14.6% vs. 24.3%, P = 0.012).

Conclusion Stenting in patients with left colon cancer with obstruction can relieve the symptoms of intestinal obstruction in time. Compared with emergency open surgery, it has better short-term results and does not affect the long-term curative effect of the tumor.

Keywords Colon cancer · Intestinal obstruction · Stent · PFS · Metastasis · Recurrence

Introduction

Colorectal cancer (CRC) is the third most frequently diagnosed malignancy and the second leading cause of cancer-related death (Mauro et al. 2024), accounting for about 10% of all cancer and cancer-related deaths diagnosed annually worldwide (Dekker et al. 2019).

Acute intestinal obstruction has been reported as the first symptom in 15%–20% of colorectal cancers (Bayraktar et al. 2015; Gavriilidis et al. 2021; Wu et al. 2024a). Compared with the right colon, the intestinal cavity of the left colon is relatively narrow, and most of the intestinal contents in this area have been absorbed, so it is often in the semi-solid or solid state, moreover, left colon cancer is often invasive, making it more prone to intestinal obstruction than right colon cancer (Mu and Chen 2023; Morino et al. 2021).

Patients diagnosed with colon cancer with obstruction often require emergency surgery to alleviate the obstruction (Han et al. 2021; McKechnie et al. 2023). Conversely, the

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high postoperative morbidity and mortality of emergency surgery presents significant challenges (Zaafouri et al. 2023; Shapaer et al. 2024; Canny et al. 2024). Furthermore, many patients are unable to undergo primary anastomosis, leading to an increased reliance on enterostomy and subsequent surgeries, ultimately impacting the patients' quality of life (Ko et al. 2023; Shayimu et al. 2024). For patients with left colon cancer with obstruction, the use of intestinal stents offers several advantages over traditional emergency surgery. Intestinal stents effectively relieve obstruction, providing valuable time for surgical preparation and comprehensive patient evaluation (Wong et al. 2025). This approach also allows for the consideration of alternative treatment options, such as transitioning from emergency open surgery to minimally invasive procedures (Pattarajierapan et al. 2022), resulting in smaller abdominal incisions and lower incisional hernia rates (Skelton et al. 2020). Recently, colonic stent placement as a transitional treatment before surgery in patients with colon cancer with acute obstruction has been proven to be effective in reducing the rate of enterostomy, postoperative pain, and wound complications, with excellent short-term effects (Endo et al. 2021; Wu et al. 2024b; Zeng and Pan 2024; Kanaka et al. 2024; Cardoso and Rodrigues-Pinto 2024).

Nevertheless, the placement of an intestinal stent may lead to potential risks such as perforation, pain, tumor cell shedding, and implant metastasis (Walayat et al. 2023; Zhang et al. 2024). We evaluate the long-term treatment effect of tumors through a 3-year follow-up after surgery.

Methods

Data source and study patients

This study involved 41 patients who were diagnosed with left colon cancer with intestinal obstruction (LCCO) following stent implantation at the Department of Gastro-Anorectal Surgery of the Second Affiliated Hospital of Chongqing Medical University. The period of study was from January 2015 to August 2019. This study was performed in line with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of The Second Affiliated Hospital of Chongqing Medical University (approval number: 2023-137).

Inclusion and exclusion criteria

Inclusion criteria: (1) Patients with one or more symptoms of abdominal pain, bloating, vomiting, and cessation of bowel movements; (2) Patients not requiring emergency surgery; (3) Imaging showing a left colon tumor causing obstruction. Exclusion criteria: (1) Patients showing obvious signs of peritonitis, necessitating emergency surgery; (2) Preoperative examination revealing right colon or rectal tumors causing obstruction; (3) Obstruction caused by factors other than tumors, such as inflammation, adhesion, or external compression; (4) Preoperative examination uncovering distant organ metastasis. The study also included a comparison group of 70 patients with LCCO who underwent emergency surgery during the same time period (Fig. 1).

Research procedures

Following the diagnosis of LCCO, emergency surgery may be necessary based on the patient's condition and personal preferences. If the patient is eligible and agrees to undergo intestinal stent implantation, a highly experienced associate chief physician or above should conduct the procedure. Stent selection was based on tumor length and anatomical suitability. Covered stents were preferred for tumors with a high risk of perforation, while uncovered stents were used for lesions requiring longer-term patency. The stent length was chosen to extend at least 2 cm beyond the proximal and distal margins of the tumor (Juakiem et al. 2024) (Figs. 2 and 3). Patients requiring emergency surgery for stent-related complications, such as perforation and bleeding, were excluded from the study (total of two cases: one case of stent perforation was found to be caused by intestinal adhesions at the site of obstruction during surgery, and the other case involved stent slip due to incorrect insertion into the obstructed proximal intestinal cavity. The success rate was 95%).

After successful stent placement, patients were advised to gradually transition from a liquid to a semi-liquid diet once their symptoms and signs were relieved or disappeared. The recommended diet mainly comprised of a low-residue or non-residue diet. Additionally, patients received parenteral nutrition support, laxative agents, and intestinal preparation. Throughout this period, close attention was given to the patients' nutritional status, changes in water and electrolyte levels, and the suitability of laparoscopic surgery, which was assessed 7–10 days later.

For the stent group (SG), laparoscopic left half colon (or sigmoid colon) resection along with primary anastomosis was conducted 7–10 days after stent implantation. None of the cases required a stoma. In the emergency operation group, open exploration along with left half colon (or sigmoid colon) resection and transverse/descending colostomy was performed after excluding surgical contraindications following admission. Secondary stoma reduction was performed as necessary. Informed consent was obtained from all patients and their families before the operation.

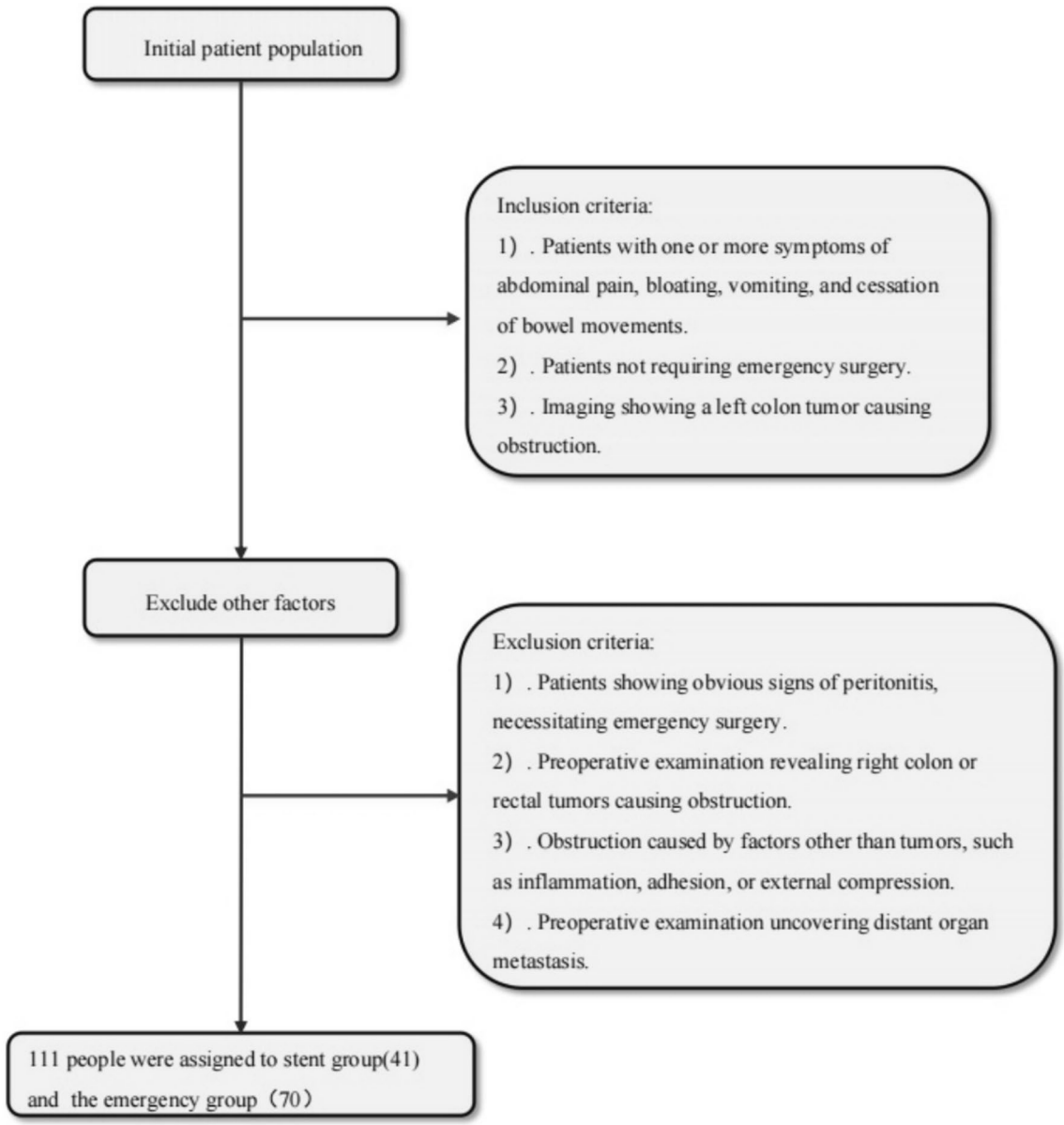

Fig. 1 Patient enrollment flowchart

Endpoint

Primary endpoints: (1) 3-year progression-free survival (PFS); (2) 3-year rate of local recurrence or distant organ metastasis. Secondary endpoints: (1) 3-year overall survival (OS); (2) intraoperative lymph node dissection; (3) intraoperative blood loss; (4) operative time; (5) enterostomy rate; (6) postoperative complications; (7) postoperative length of hospital stay.

Follow-up

After excluding the lost patients, a total of 111 valid data was obtained, with 41 in the SG and 70 in the emergency group (EG). After the surgery, patients received chest and full abdominal CT enhancement every 3 months in the first year, followed by regular re-examinations 6–12 months later, and a yearly colonoscopy. The results of these examinations were used as evidence for follow-up.

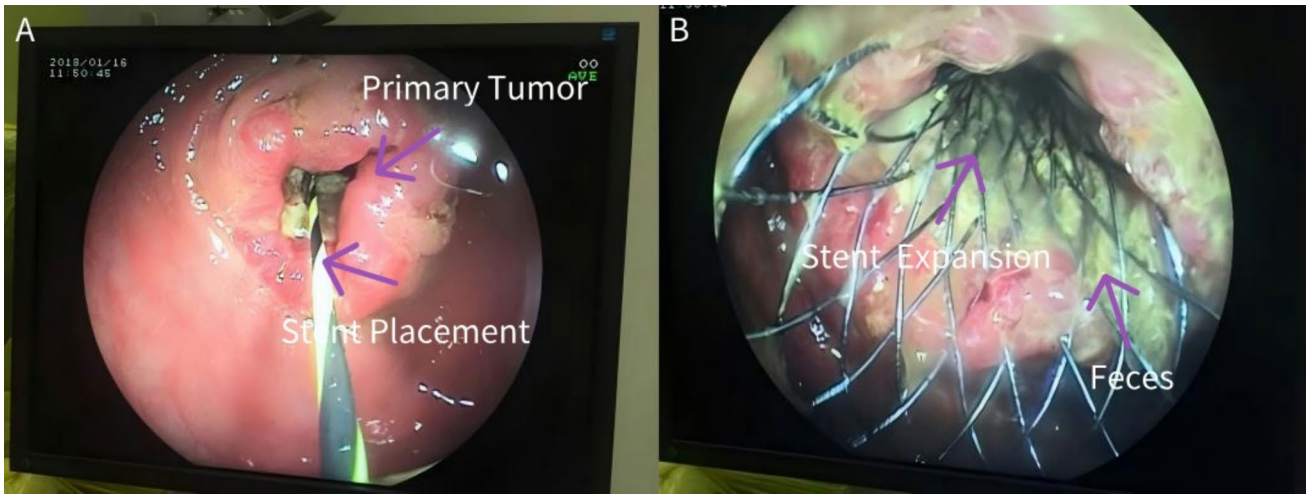

Fig. 2 Endoscopic stent placement and expansion process under fluoroscopic guidance. **A** Initial obstruction site and guidewire placement; **B** stent expansiont

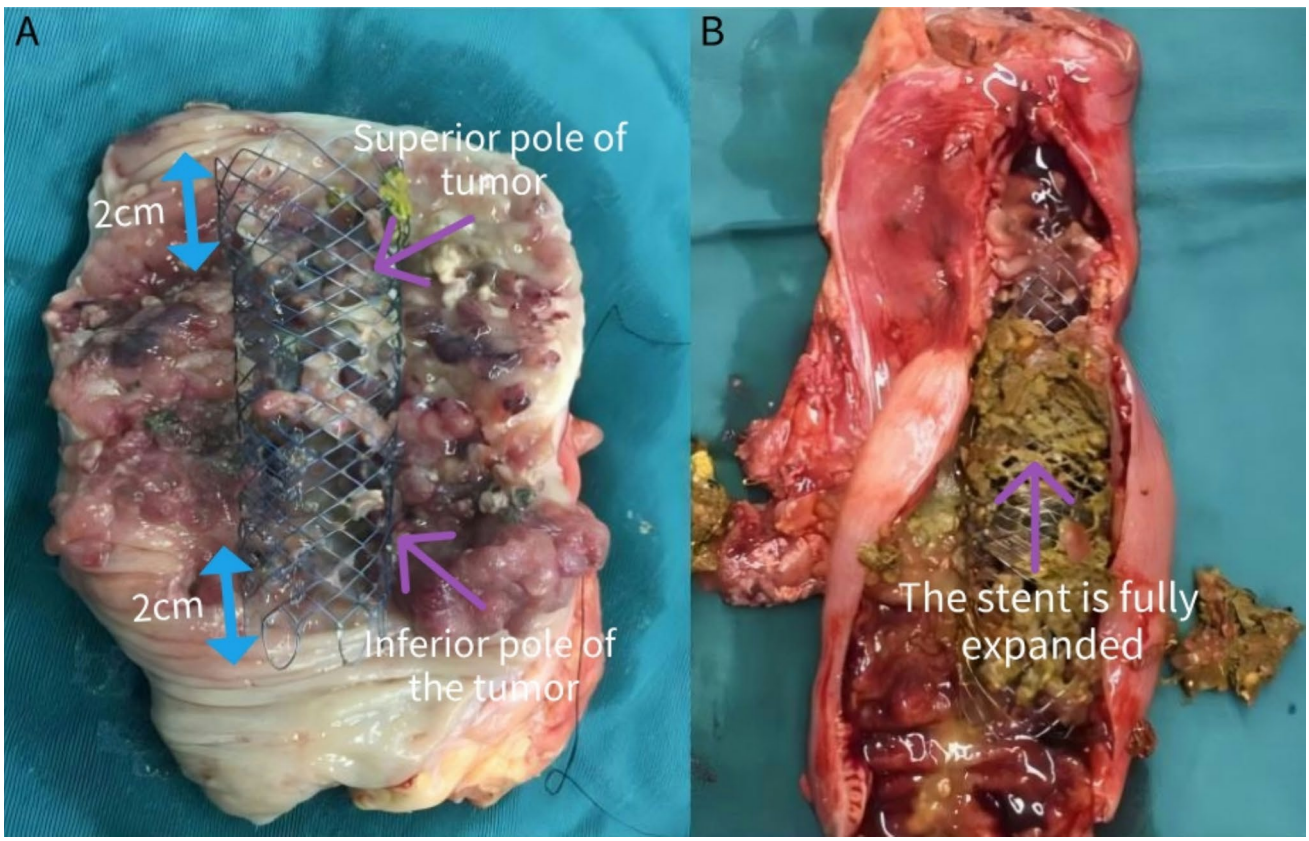

Fig. 3 **A**, **B** Shows that the appearance of the stent in the tumor after resection

Table 1 Patient baseline characteristics

Variable baseline	SG (n = 41)	EG (n = 70)	P
Age, average, year	68	70	0.158
Gender			0.900
Male	25	46	
Female	16	24	
By stages			0.013
II	14	39	
III	27	31	
Tumor location			0.001
Colon sigmoideum	30	30	
Colon descendens	11	40	

SG stent group, *EG* emergency group

Statistical methods

SPSS 26.0 software was used to analyze the basic information of the samples. For continuous variables, if the data are normally distributed with homogeneity of variance, an independent samples t-test can be applied (e.g., blood loss, postoperative hospital stay, white blood cell count WBC, and procalcitonin PCT et al.). If these assumptions are violated, the Mann–Whitney U test should be used instead (e.g., operative time and C-reactive protein CRP). For categorical variables (e.g., stoma formation rate), either the chi-square test or Fisher's exact test is appropriate. The difference in 3-year PFS and 3-year OS between the two groups was examined using survival analysis techniques, and a P-value of less than 0.05 was considered as statistically significant.

Results

Baseline characteristics of patients

Both groups underwent successful operations, with no conversions in the SG group or perioperative deaths reported in either group. The baseline clinical characteristics, including age and stage, were comparable between both groups ($P > 0.05$); however, the EG group included a higher proportion of patients with stage II and sigmoid colon tumors compared to the SG group ($P < 0.05$) (Table 1). The entire study was followed up for 36 months.

Surgical complications

The occurrence of postoperative complications during hospitalization is shown in the table below (Table 2). Out of 111 patients, 23 (20.7%) experienced postoperative complications: 6 (14.6%) in the SG and 17 (24.3%) in the EG.

Table 2 Surgical complications

Variable	SG (n = 41)	EG (n = 70)	P
Total complication, n (%)	6 (14.6%)	17(24.3%)	0.012
Gastrointestinal complication, n			–
Iliac passion	2	3	
Anastomotic leakage	1	0	
Necrosis of the stoma	0	1	
Peritonitis	0	1	
Intra-abdominal abscess	0	1	
General complications			–
Haemorrhage	0	0	
Infection of incisional wound	1	4	
Respiratory system complications			–
Pneumonia	2	5	
Failure of respiration	0	2	
Cardiac complication	0	0	–
Major complications[a], n	1	3	0.315
Death toll, n	0	0	–
Re-operation, n	1	0	–
Re-hospitalization within 30 days, n	0	0	–

–, the sample size is too small to make a comparison

[a]The surgical complications were recorded and classified according to the Clavien–Dindo system. Major complications includes grade III or IV complications

SG stent group, *EG* emergency group

In terms of the overall complication rate, the SG was significantly less than the EG ($P = 0.012$). The most common surgical complications were intestinal obstruction (4.5%), incision infection (5.4%) and pneumonia (6.3%). There was no significant difference in Major complications between the two groups ($P = 0.315$).

Surgical results and short-term results

Table 3 presents the intraoperative and postoperative short-term results. The average operation time in the SG was 31.85 min longer than that in the emergency department (224.75 vs. 210.9 min), with statistical significance ($P < 0.05$), which was consistent with the research results of Yokoyama et al. (Yokoyama et al. 2022). The mean blood loss during the operation in the SG was 60 ml, significantly lower than the 78 ml in the EG ($P = 0.02$). The SG had a 0% stoma rate, while the EG had a 100% stoma rate, which was statistically significant ($P < 0.05$). The average hospital stay in the SG was 10.2 days, 5.9 days shorter than that in the EG ($P < 0.05$). In terms of postoperative infection indicators such as white blood cell (WBC), serum C-reactive protein (CRP), and procalcitonin (PCT) levels, the infection indicators in the SG were lower than those in the EG ($P < 0.05$), except for CRP on the 5th day after surgery.

Table 3 Surgical results and short-term results

Variable	SG (n = 41)	EG (n = 70)	P
The number of intraoperative dissected lymph nodes, average, n	15.45	13.70	0.044
Time of surgery, average, min	242.75	210.90	< 0.001
Blood loss, average, mL	60	78	0.02
The stoma rate, %	0	100	< 0.001
Postoperative infection index, average			
WBC, 10^9/L			
Day 1	9.52	12.31	< 0.001
Day 3	7.82	9.20	0.003
Day 5	6.81	8.35	0.002
CRP, mg/L			
Day 1	72.12	97.53	0.001
Day 3	73.98	135.25	< 0.001
Day 5	56.74	75.73	0.058
PCT, ng/mL			
Day 1	1.38	2.32	< 0.001
Day 3	1.21	1.74	0.002
Day 5	0.53	0.91	0.001
Postoperative length of hospital stay, average, days	10.20	16.10	< 0.001

WBC white blood cells, *CRP* C-reactive protein, *PCT* procalcitonin, *SG* stent group, *EG* emergency group

Table 4 3-year rate of local recurrence or distant organ

Variable	SG (n = 41)	EG (n = 70)	P
Local recurrence (anastomosis)	1	0	–
Distance metastasis			0.95
Lymphatic metastasis	6	11	
Hepatic metastasis	3	4	
Lung metastasis	2	4	
Osseous metastasis	0	1	
Peritoneal metastasis	1	2	
Omentum metastasis	1	2	
Pelvic metastasis	1	1	

–, the sample size is too small to make a comparison

SG stent group, *EG* emergency group

Long-term results

In Table 4, the long-term outcomes are provided, detailing the occurrences of local recurrence or distant metastasis 3 years following the surgery. Across all follow-up groups, a total of 22 patients experienced treatment failure, which was defined as distant metastasis, local recurrence, or death. Specifically, there was 1 case of local anastomosis recurrence and 7 cases of distant metastasis in the SG. Distant metastases were observed in 14 patients in the EG (19.5% in the SG versus 20% in the EG, with a P-value of 0.95), and no significant difference was found between the two groups.

Kaplan–Meier survival curves

At 3-year follow-up, SG and EG showed comparable rates of local recurrence (2.4% vs. 0%, P = NS) and distant metastasis (19.5% vs. 20%, P = 0.95). Kaplan–Meier analysis revealed no significant differences in PFS (HR = 1.63, 95% CI: 0.91–2.93) or OS (HR = 1.76, 95% CI: 0.98–3.16) (Figs. 4 and 5). The study by Zhang J et al. also yielded similar results in terms of 3-year OS (71.91% VS 76.60%, P > 0.05) (Zhang et al. 2022).

Subgroup comparison

In the Cox regression model, we found that the surgical method and the presence of postoperative complications did not have a significant impact on survival time (P > 0.05). On the other hand, we observed that patients with stage II tumors had a higher survival time compared to those with stage III tumors. Additionally, patients with tumors in the descending colon had a higher survival time than those with tumors in the sigmoid colon. Furthermore, patients without local recurrence or distant metastasis had a significantly higher survival time compared to those with recurrence or metastasis (P < 0.001). After performing stratified analysis with Pearson's chi—square test, the results showed that tumor stages and anatomical locations were comparable

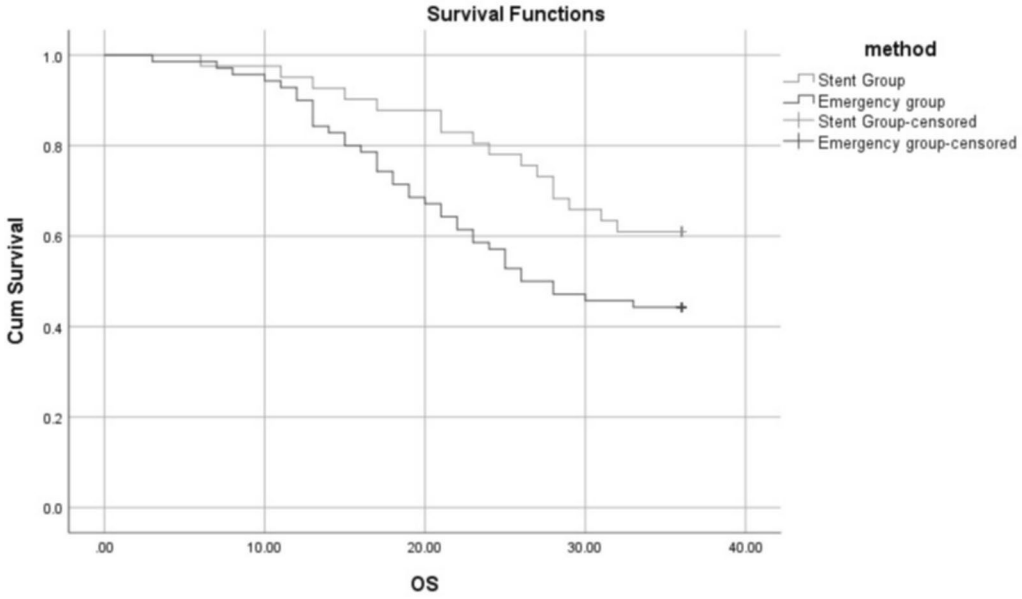

Fig. 4 3-year OS. The x-axis is the follow-up time, the y-axis is the cumulative survival rate, and the 3-year overall survival rate was 61% in the SG and 44% in the emergency surgery group, P = 0.051. HR = 1.76, 95% CI 0.98–3.16. *OS* overall survival, *HR* hazard ratio

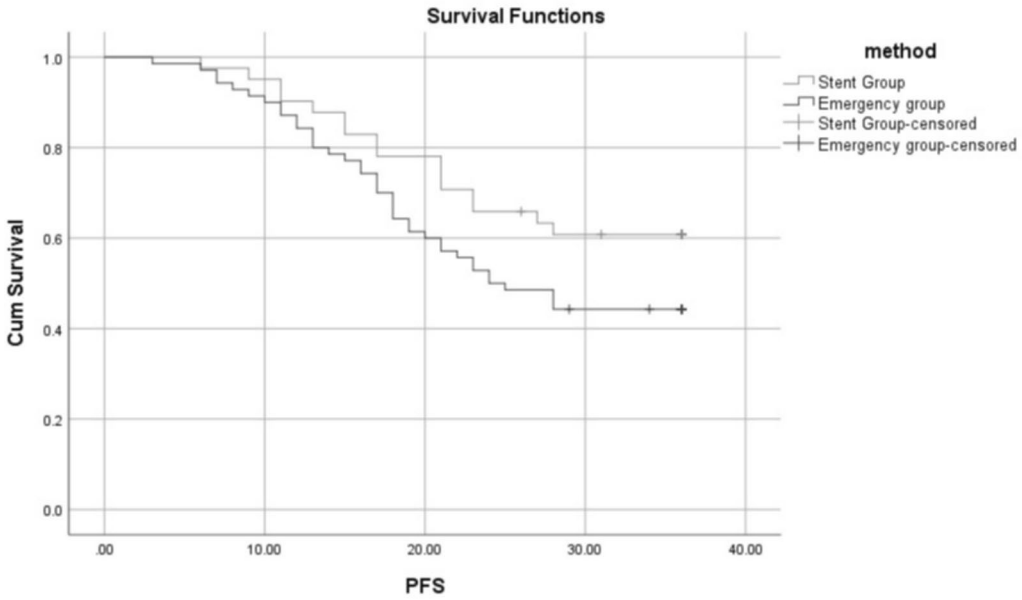

Fig. 5 3-year PFS. The x-axis is the follow-up time, the y-axis is the cumulative survival rate, and the 3-year PFS rate was 59% in the SG and 41% in the emergency surgery group, P = 0.091. HR = 1.63, 95% CI 0.91–2.93. *PFS* progression-free survival, *HR* hazard ratio

between the stent group and the emergency surgery group, with more pronounced benefits observed in the stent group for sigmoid colon tumors (P = 0.002) and stage II tumors (P = 0.028), though statistical power was limited due to small sample sizes.

Discussion

In the 1990s, the application of intestinal stents emerged, which was also a watershed in the treatment of gastrointestinal emergency patients (Verstock et al.2018; Wan et al. 2024; Wang et al. 2022; Lee et al. 2018). Intestinal

stents help in relieving patients from surgical emergencies, improving their physical condition. They are utilized for colon decompression, preoperative intestinal preparation, and systemic condition assessment before surgery, which ultimately reduces the risk of complications and mortality in emergency surgery (Di Saverio et al. 2018; Wang et al. 2023; Zhu et al. 2023; Furuke et al. 2018). Patients can then undergo minimally invasive surgery, such as laparoscopic surgery and one-stage anastomosis.

Compared to emergency surgery, laparoscopic surgery offers advantages such as a wider field of vision, less trauma, reduced postoperative pain, and faster recovery, consequently lowering the risk of intraoperative bleeding, pain, and incision infection while shortening the postoperative recovery time (Liu et al. 2024).

In contrast, the use of stents also involves certain risks. Studies have indicated that increased tumor mass interstitial pressure can lead to cell diffusion, cell detachment, and tumor embolism into lymphatic vessels, potentially affecting the long-term oncological outcomes of patients. Although some studies have not found differences in the 3- or 5-year survival rates between patients with stents and those without (Mauro et al. 2024), a Meta-analysis suggested that stents as a surgical transition group may have a higher local recurrence rate, but the results were not statistically significant (40.5%vs, 26.6%, P = 0.09) (Arezzo et al. 2017; Zeng and Pan 2024).

The use of self-expanding metal stents (SEMS) for malignant colonic obstruction effectively relieves acute symptoms but carries risks, particularly perforation. Recent studies demonstrate significant variability in perforation rates. Cochrane Evaluation showed a perforation rate of 5.88% (Sagar et al. 2011). In this study, there were two cases of stent placement failure: one due to perforation and the other due to stent migration, yielding a perforation rate of 2.3% (1/43). The 2020 ESGE recommends that colonic stenting should be performed or directly supervised by an operator who can demonstrate competence in both colonoscopy and fluoroscopic techniques and who performs colonic stenting on a regular basis (Van Hooft et al. 2020; Cirocchi et al. 2021). Clinicians should interpret these results cautiously and adhere to risk-adapted strategies, such as using covered stents for friable tumors, to minimize perforation risk in real-world practice.

The continuous advancement in endoscopy technology and the increasing expertise of endoscopists in intestinal stenting have led to an improved success rate of this procedure. According to international guidelines, stenting has been the recommended first-line treatment since 2014 for relieving obstruction in patients with metastatic disease. The latest guidelines suggest that stenting can serve as a bridge to radical surgery in centers with expertise in stenting (Ho et al. 2023).

The study was conducted to explore the benefits of intestinal stents in treating colon cancer with intestinal obstruction. The study compared the safety and effectiveness of intestinal stents versus emergency surgery in 41 and 70 patients, respectively. It also examined the impact on tumor recurrence and metastasis. The results showed that the SG had better short-term outcomes. Regarding long-term oncology outcomes, although no statistically significant differences were observed in 3-year OS (61% vs. 44%, P = 0.051) and PFS (59% vs. 41%, P = 0.091) between the stent and EGs, the numerical trends suggest a potential survival benefit with stenting. In statistical power analysis, a post-hoc power analysis ($\alpha = 0.05$, $\beta = 0.20$) using observed 15% OS difference: achieved power = 68% (G*Power 3.1), Required sample size for 80% power = 156 patients. The study was underpowered to detect survival differences < 20%. Larger prospective studies are warranted to validate these findings.

While PSM was considered, its implementation was precluded by the cohort size (SG = 41, EG = 70), as matching would have further reduced statistical power. Instead, we: Conducted stratified subgroup analyses confirming comparable baseline characteristics between groups for key variables (age, ASA score, comorbidities; Table 1). Performed multivariate Cox regression identifying tumor stage (HR = 2.14, 95% CI 1.32–3.47, P = 0.002) and metastasis status (HR = 3.02, 95% CI 1.65–5.53, P < 0.001) as primary survival determinants, with no significant treatment effect (P = 0.12).

The equivalence in long-term outcomes may be attributed to reduced systemic inflammation following obstruction relief, potentially delaying tumor progression. Further studies should explore biomarkers (e.g., CRP, IL-6) to validate this hypothesis.

The study has some limitations. Firstly, it was a single-center retrospective study, possibly leading to regional or institutional selection bias. Secondly, the small sample size may have affected the expected results. Thirdly, the study used different types of stents, and the decision to place the stents was based on individual cases without specific standards. Additionally, excluding stent placement failure cases limits the generalizability of the research results. This design may obscure the true risks of stent therapy (e.g., the impact of perforation on long-term prognosis) and make the conclusions more applicable to technically proficient centers or specific patient subgroups. To enhance external validity, future studies should include failed cases to analyze their independent effects, while validating the universality of the findings through multicenter, large-sample studies.

Conclusion

In summary, intestinal stenting is a safe and effective treatment method. It yields good short-term results and no adverse impact on long-term oncological outcomes was observed, recommended option for obstructive left colon cancer.

Author contributions Yaxu Wang and Dengliang Liu contributed to the study conception and design. Material preparation, data collection and analysis were performed by Xin Yan, Teng Long, Yi Xiao, Haitao Gu and Linglong Peng. The first draft of the manuscript was written by Xin Yan and Teng Long and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

Ethical approval This study was performed in line with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of The Second Affiliated Hospital of Chongqing Medical University (approval number: 2023-137).

Informed consent Informed consent was obtained from all participants included in this study.

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