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Original Article

Use of ileostomy *versus* colostomy as a bridge to surgery in left-sided obstructive colon cancer: retrospective cohort study

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Abstract

Background: Colorectal cancer causes the majority of large bowel obstructions and surgical resection remains the gold standard for curative treatment. There is evidence that a deviating stoma as a bridge to surgery can reduce postoperative mortality rate; however, the optimal stoma type is unclear. The aim of this study was to compare outcomes between ileostomy and colostomy as a bridge to surgery in left-sided obstructive colon cancer.

Methods: This was a national, retrospective population-based cohort study with 75 contributing hospitals. Patients with radiological left-sided obstructive colon cancer between 2009 and 2016, where a deviating stoma was used as a bridge to surgery, were included. Exclusion criteria were palliative treatment intent, perforation at presentation, emergency resection, and multivisceral resection.

Results: A total of 321 patients underwent a deviating stoma; 41 (12.7 per cent) ileostomies and 280 (87.2 per cent) colostomies. The ileostomy group had longer length of stay (median 13 (interquartile range (i.q.r.) 10–16) *versus* 9 (i.q.r. 6–14) days, $P = 0.003$) and more nutritional support during the bridging interval. Both groups showed similar complication rates in the bridging interval and after primary resection, including anastomotic leakage. Stoma reversal during resection was more common in the colostomy group (9 (22.0 per cent) *versus* 129 (46.1 per cent) for ileostomy and colostomy respectively, $P = 0.006$).

Conclusion: This study demonstrated that patients having a colostomy as a bridge to surgery in left-sided obstructive colon cancer had a shorter length of stay and lower need for nutritional support. No difference in postoperative complications were found.

Introduction

Colorectal cancer is one of the leading causes of cancer-related death worldwide[1]. Large bowel obstruction is a common consequence of locally advanced colorectal tumours, with reported incidence rates ranging between 10 and 30 per cent[2]. Emergency resection in patients with acute large bowel obstruction has proven to be a high-risk procedure, with reported mortality rates as high as 41 per cent[3]. Recently, it has been shown that a deviating stoma as a bridge to (elective) surgery reduces 90-day mortality and permanent stoma rates compared with emergency surgery[4]. In addition, this approach has been shown to be oncologically safe in terms of disease-free survival and loco-regional recurrence[5,6]. For left-sided obstructive colon carcinoma, either a colostomy or an ileostomy can be made to deviate the faecal stream. Both techniques pose advantages and disadvantages. An advantage of an ileostomy could be that it is generally easier and quicker to create due to the longer and more mobile mesentery. The proposed benefits of a colostomy compared with an ileostomy are prevention of caecal perforation due to decompression distal to the ileocecal valve and a lower risk of a high-output stoma. However, due to anatomical reasons, a colostomy is not always easy or even feasible without major dissection or conversion to laparotomy and parastomal herniation is more prevalent[7]. Debate remains about whether a diverting colostomy increases anastomotic leakage when performing primary anastomosis. Previously, ileostomy and colostomy have been compared in postoperative diversion after low anterior resection or defunctioning of colorectal anastomosis[7,8]. However, a diverting enterostomy as a bridge to surgery is being used for a different purpose with a different timeframe, which may influence outcomes and the incidence of complications. Comparisons of colostomy *versus* ileostomy during the bridging interval of obstructive colon cancer in (international) practice are lacking and the choice of stoma is mostly dependent on surgeons' preference in current daily practice. The aim of this study was to retrospectively compare the use of ileostomy with colostomy as a bridge to surgery in left-sided obstructive colon cancer in the Netherlands.

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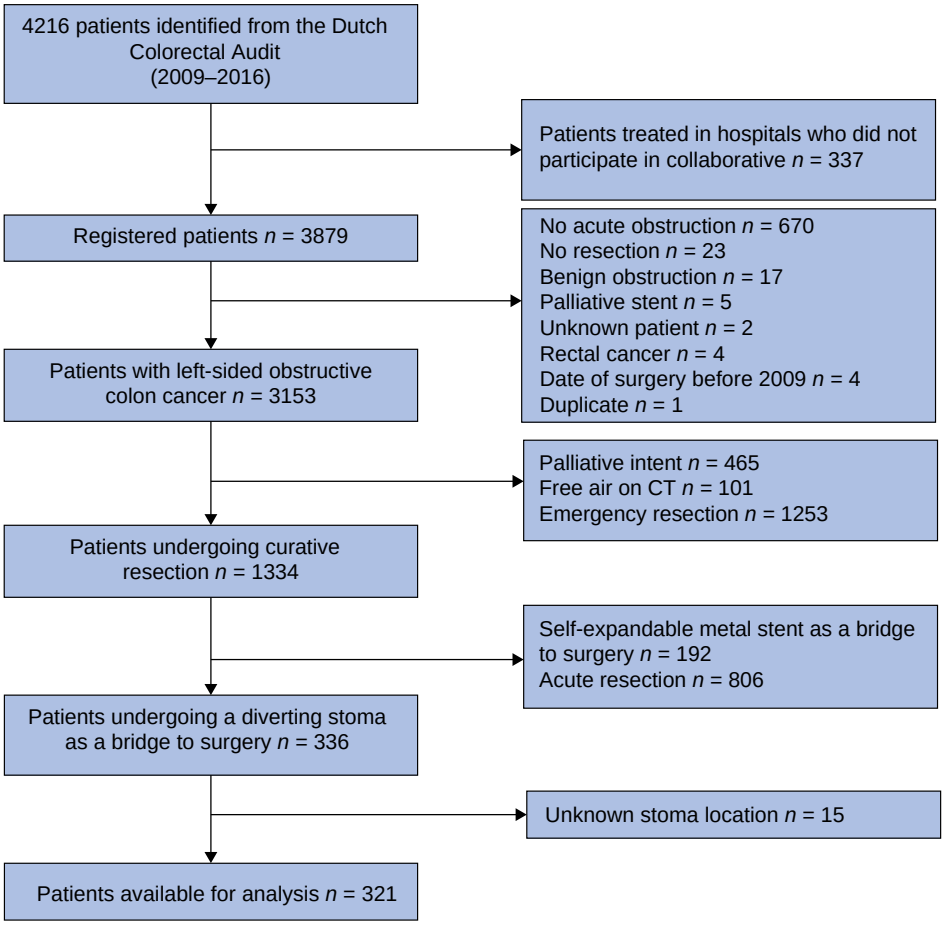

Fig. 1 Flow chart of patient inclusion

Methods

This is a retrospective cohort selected from a population-based cohort study, which was led by the Dutch Snapshot Research Group conforming to the STROBE guidelines for reporting cohort studies (*supplementary material*). This nationwide cohort study was performed at 75 hospitals in the Netherlands according to a predefined protocol, including patients treated for left-sided obstructive colon cancer treated from 1 January 2009 to 31 December 2016[9]. The cohort identified patients who had resection of left-sided obstructive colonic carcinoma through the Dutch Colorectal Audit (DCRA). Patients were included when a deviating stoma was created as a bridge to surgery for a radiologically confirmed symptomatic colonic obstruction (for example abdominal distention, nausea, and/or vomiting) caused by a malignant tumour in the distal colon (sigmoid, descending colon, or splenic flexure). Exclusion criteria were: treatment with palliative treatment intent, perforation at initial presentation, emergency resection of the malignant tumour, and multivisceral *en bloc* resections[6].

Study endpoints

The primary endpoint was the total length of hospital stay during the interval between stoma formation and primary resection. Secondary endpoints were: complications in the interval until resection (such as stoma necrosis (percentage), high-output stoma (percentage), abscess formation (percentage), perforation (percentage), incidence of readmission (percentage), and re-intervention (percentage)), duration of the interval between stoma formation and primary resection, complications during resection, conversion rate, incidence of primary anastomosis, reversal of a deviating stoma during primary resection, complications after resection, anastomotic leakage of anastomosis after primary resection, and hospital stay. Long-term outcomes included permanent stoma rates. The specific reason behind the choice of stoma was not recorded, due to the retrospective nature of this study.

Statistical analysis

Categorical or dichotomous variables are presented as absolute numbers with percentages and were compared using the χ^2 test. Continuous variables are shown as mean(s.d.) or median (interquartile range (i.q.r.)) and were compared using an independent Student's *t* test or a Mann–Whitney *U* test, according to their distribution. Univariable logistic regression was used to assess for possible confounding and the odds ratio was used to depict associations. Log rank transformation was used to correct for positive skew and unequal variances. A *P* value of <0.050 was considered to be significant. All analyses were performed using R studio version 3.1.

Results

Patient characteristics

From the total cohort of 3153 patients, 321 patients who met the inclusion criteria were included; 41 (12.7 per cent) underwent an

Table 1 Baseline characteristics, clinical presentation, and pathology outcomes

	Ileostomy (*n* = 41)	Colostomy (*n* = 280)	*P*
Age (years), mean(s.d.)	69(10.4)	67(11.8)	0.347
Male	25 (61.0)	162 (57.9)	0.835
BMI (kg/m^2), mean(s.d.)	24.8(5.3)	25.2(3.9)	0.549
ASA classification III–IV	14 (34.1)	56 (20.0)	0.065
Tumour location			
Splenic flexure	6 (14.6)	46 (16.4)	0.522
Descending colon	9 (22.0)	42 (15.0)	
Sigmoidal colon	26 (63.4)	192 (68.6)	
pT stage			
2	2 (4.9)	13 (4.7)	0.994
3	25 (61.0)	172 (61.9)	
4	14 (34.1)	93 (33.5)	
Synchronous tumour	3 (7.3)	6 (2.1)	0.171
cM1 stage	5 (13.2)	27 (9.7)	0.703
Previous abdominal surgery	18 (43.9)	103 (36.8)	0.480
Interval from presentation to enterostomy (days), median (i.q.r.)	1 (0–4)	1 (0–2)	0.063
Abdominal pain at presentation	23 (76.7)	217 (84.8)	0.379
Vomiting at presentation	16 (57.1)	176 (67.7)	0.361
Patient reported weight loss >10%	7 (25.9)	45 (19.2)	0.568
Time since no oral intake at presentation (days), median (i.q.r.)	0 (0–1)	0 (0–1)	0.423
Time since not passing a stool at presentation (days), median (i.q.r.)	3 (1–5)	3 (1–6)	0.630
Ileus at CT imaging at presentation	18 (62.1)	175 (71.7)	0.388
Max diameter of colon at presentation (cm), median (i.q.r.)	9 (8–10)	9 (8–10)	0.955
Leucocyte level at presentation (10^9/l), median (i.q.r.)	10.2 (7.9–13.5)	11.2 (8.6–13.7)	0.425
C-reactive protein level at presentation (mg/l), median (i.q.r.)	20.0 (9.5–48.0)	14.0 (6.0–36.0)	0.246

Values are *n* (%) unless otherwise indicated. i.q.r., interquartile range.

Table 2 Postoperative outcomes after a diverting stoma

	Ileostomy (*n* = 41)	Colostomy (*n* = 280)	*P*
Initial length of stay after stoma (days), median (i.q.r.)	13 (9–25)	8 (5–17)	0.008*
Hospital discharge before resection	33 (84.6)	247 (90.5)	0.407
Stoma complications during the interval	5 (12.2)	21 (7.5)	0.470
High-output stoma	1 (2.4)	4 (1.4)	0.999
Skin-complication stoma	1 (2.4)	1 (0.4)	0.607
Stoma herniation	1 (2.4)	0 (0.0)	0.266
Stoma prolapse	0 (0.0)	6 (2.1)	0.738
Stoma necrosis	0 (0.0)	3 (1.1)	0.999
Ileus caused by stoma	2 (4.9)	2 (0.7)	0.138
Abscess formation	0 (0.0)	1 (0.4)	0.999
Readmission during the interval	4 (9.8)	17 (6.1)	0.589
Re-intervention during the interval	1 (2.4)	9 (3.0)	0.999
Stoma revision due to prolapse	0 (0.0)	0 (0.0)	NA
Reoperation due to perforation	0 (0.0)	2 (0.7)	0.999

Values are *n* (%) unless otherwise indicated. *Significant *P* value. i.q.r., interquartile range; NA, not applicable.

ileostomy and 280 (87.2 per cent) underwent a colostomy (*Fig. 1*). A total of 75 hospital centres contributed to this cohort; ileostomy patients were included from 24 different centres and colostomy patients from 58 centres. Only three centres solely performed deviating ileostomies. Centres who performed an ileostomy ranged from large university hospitals to small regional hospitals. The median follow-up was 32 (i.q.r. 15–57) months[6]. In this data set less than 2 per cent of data were missing per variable, except for body mass index (4.5 per cent) and cT staging (66 per cent). Therefore pT staging was used in baseline characteristics instead of cT staging. Baseline variables, clinical presentation, and pathology are summarized in *Table 1*. Baseline and pathology-related characteristics were not significantly different between the two groups. The percentage of patients with a high ASA classification of III and IV was 20.0 per cent in the colostomy group *versus* 34.1 per cent in the ileostomy group ($P = 0.065$).

Table 3 Bridging-to-surgery interval outcomes

	Ileostomy (*n* = 41)	Colostomy (*n* = 280)	*P*
Total length of stay until resection (including readmission) (days), median (i.q.r.)	13 (10–16)	9 (6–14)	0.003*
Time to resection (days), median (i.q.r.)	56 (29–107)	35 (22–63)	0.020*
Supplementary feeding	11 (26.8)	24 (8.6)	0.001*
Enteral supplemental feeding	5 (12.2)	10 (3.6)	0.042*
Parenteral supplemental feeding	7 (17.1)	20 (7.1))	0.066
Neoadjuvant treatment	11 (26.8)	41 (14.6)	0.080
Neoadjuvant radiotherapy	5 (12.2)	14 (5.0)	0.142
Duration of radiotherapy (days), median (i.q.r.)	31 (18–32)	35 (28–36)	0.235
Neoadjuvant systemic therapy	11 (26.8)	37 (13.2)	0.029*
Duration of systemic therapy (days), median (i.q.r.)	64 (39–118)	62 (36–105)	0.658
Neoadjuvant metastases resection	3 (7.3)	3 (1.1)	0.033*

Values are *n* (%) unless otherwise indicated. *Significant *P* value. i.q.r., interquartile range.

First presentation and nutritional status

Both groups presented with similar symptoms and nutritional status (*Table 1*). There were no significant differences in maximum bowel diameter (median of 9 (i.q.r. 8–10) *versus* 9 (i.q.r. 8–10) cm for ileostomy and colostomy respectively, $P = 0.955$), presence of vomiting (57 *versus* 67 per cent for ileostomy and colostomy respectively, $P = 0.361$), abdominal pain (77 *versus* 85 per cent for ileostomy and colostomy respectively, $P = 0.379$), or greater than 10 per cent weight loss (26 *versus* 19 per cent for ileostomy and colostomy respectively, $P = 0.568$).

Post-deviating enterostomy outcome

All patients underwent loop stomas. The initial length of stay after a deviating enterostomy was 5 days shorter in the colostomy group (median of 13 (i.q.r. 9–15) *versus* 8 (i.q.r. 5–17) days for ileostomy and colostomy respectively, $P = 0.008$). Complication rates during the interval were 12 per cent in the ileostomy group *versus* 8 per cent in the colostomy group ($P = 0.479$). Readmission (9.8 *versus* 6.1 per cent for ileostomy and colostomy respectively, $P = 0.589$) and re-intervention (2.4 *versus* 3.0 per cent for ileostomy and colostomy respectively, $P = 0.999$) rates did not significantly differ between the two groups. Postoperative outcomes after a deviating stoma are described in *Table 2*.

Table 4 Univariable and multivariable regression analysis of confounders for length of stay

Preoperative and perioperative risk factors	Univariate linear		Multivariable linear	
	Odds ratio (95% c.i.)	P	Odds ratio (95% c.i.)	P
Sex (male *versus* female)	1.02 (0.87,1.19)	0.718	0.87 (1.02,1.20)	0.798
Age (continuous, years)	1.00 (0.99,1.01)	0.990	1.59 (0.99,1.01)	0.946
BMI (continuous, per increasing kg/m^2)	0.99 (0.97,1.08)	0.342	0.99 (0.97,1.01)	0.345
ASA classification (categorical, I–IV)	8.19 (9.21,10.4)	0.001*	1.21 (1.06,1.21)	0.006*
Surgical abdominal history (yes *versus* no)	1.15 (0.98,1.35)	0.071	1.09 (0.08,417.80)	0.317
Stoma type (ileostomy *versus* colostomy)	0.79 (0.63,1.01)	0.045*	0.83 (0.92,1.29)	0.153

*Significant *P* value.

Table 5 Procedural and postoperative outcomes after tumour resection

	Ileostomy (*n* = 41)	Colostomy (*n* = 280)	P
Type of surgery			0.495
Sigmoid resection	22 (53.7)	174 (62.1)	
Left hemicolectomy	14 (34.1)	84 (30.0)	
Subtotal colectomy	3 (7.3)	14 (5.0)	
Extended left hemicolectomy	1 (2.4)	7 (2.5)	
Transverse colectomy	1 (2.4)	1 (0.4)	
Primary anastomosis	39 (95.1)	236 (84.6)	0.124
Reversal of diverting stoma during resection	9 (22.0)	129 (46.1)	0.006*
New stoma during resection	2 (4.9)	32 (11.4)	0.311
Stoma present directly after resection	33 (80.5)	1780 (63.8)	0.061
Minimally invasive approach	12 (29.3)	148 (52.9)	0.008*
Conversion	0 (0)	27 (9.60)	0.074
No perioperative complications	40 (97.6)	270 (96.4)	0.999
Perioperative transfusion	0 (0.0)	1 (0.4)	
Perioperative iatrogenic damage	0 (0.0)	3 (1.1)	
Perioperative bladder damage	1 (2.4)	0 (0.0)	
Other operative complications	0 (0.0)	6 (2.1)	
Length of stay after resection (days), median (i.q.r.)	6 (5–11)	7 (5–10)	0.883
ICU days, median (i.q.r.)	0 (0–1)	0 (0–0)	0.003*
30-day mortality rate	2 (4.9)	4 (1.4)	0.297
Anastomotic leakage	4 (9.8)	12 (4.3)	0.269
Abscess formation	3 (7.3)	10 (3.6)	0.406
90-day surgical complication	9 (23.1)	53 (19.1)	0.731
30-day readmission	7 (17.1)	41 (14.7)	0.884
Stoma present at the end of follow-up	11 (27.5)	79 (28.4)	0.999
Adjuvant chemotherapy	14 (36.8)	116 (41.9)	0.683
R0 resection	37 (90.2)	259 (92.5)	0.858

Values are *n* (%) unless otherwise indicated. *Significant *P* value. i.q.r., interquartile range.

Interval between a deviating enterostomy and resection

The time to resection appeared to be almost 3 weeks longer in the ileostomy group (median of 56 (i.q.r. 29–107) *versus* 35 (i.q.r. 22–63) days for ileostomy and colostomy respectively, $P = 0.020$). The total length of hospital stay until resection (consisting of initial stay and adding potential readmission) was significantly longer in the ileostomy group (median of 13 (i.q.r. 10–16) *versus* 9 (i.q.r. 6–14) days for ileostomy and colostomy respectively, $P = 0.003$). The incidence of overall neoadjuvant treatment was not significantly different between the two groups (26.8 *versus* 14.6 per cent for ileostomy and colostomy respectively, $P = 0.080$). However, neoadjuvant chemotherapy was more common in the ileostomy group (26.8 *versus* 13.2 per cent for ileostomy and colostomy respectively, $P = 0.029$).

To adjust for the difference in neoadjuvant treatment, the 52 patients who received neoadjuvant treatment were excluded in a sub-analysis. The median interval from a deviating stoma to resection remained longer in the ileostomy group (44 (i.q.r. 21–75) *versus* 30 (i.q.r. 20–47) days for ileostomy and colostomy respectively, $P = 0.048$) and the total length of stay after a deviating stoma (including readmission) also remained longer (median of 15 (i.q.r. 13–16) *versus* 9 (i.q.r. 6–14) days for ileostomy and colostomy respectively, $P < 0.001$). In addition, the need for supplementary feeding (enteral and total parenteral feeding) remained higher in the ileostomy group (36.7 *versus* 9.2 per cent for ileostomy and colostomy respectively, $P < 0.001$). Interval outcomes are described in *Table 3*.

The length of stay was adjusted for right skew distribution through log transformation. Age, sex, body mass index, surgical abdominal history, ASA classification, and stoma type were included in the univariable and multivariable analyses (*Table 4*). Univariable linear analysis showed ASA classification and stoma type as confounders for length of stay. In the multivariable linear analysis, ASA classification remained a significant confounding factor for length of hospital stay.

Primary resection and postoperative outcome

No differences were observed regarding the performance of primary anastomosis (95.1 *versus* 84.6 per cent for ileostomy and colostomy respectively, $P = 0.124$). However, stoma closure during primary resection was more common in the colostomy group (22.0 *versus* 46.1 per cent for ileostomy and colostomy respectively, $P = 0.006$), with no higher rate of construction of a new stoma (4.9 *versus* 11.4 per cent for ileostomy and colostomy respectively, $P = 0.311$). The presence of a stoma after primary resection was 81 per cent in the ileostomy group and 64 per cent in the colostomy group. The length of stay after primary resection was comparable between the two groups (median of 6 (i.q.r. 5–11) *versus* 7 (i.q.r. 5–10) days for ileostomy and colostomy respectively, $P = 0.883$). As for complications, intraoperative complication rates (2.4 *versus* 3.6 per cent for ileostomy and colostomy respectively, $P = 0.999$) and conversion rates (0 *versus* 9.6 per cent for ileostomy and colostomy respectively, $P = 0.074$) did not differ significantly. Furthermore, postoperative complications were comparable between the two groups: anastomotic leakage (9.8 *versus* 4.3 per cent for ileostomy and colostomy respectively, $P = 0.269$), 30-day readmission (17.1 *versus* 14.7 per cent for ileostomy and colostomy respectively, $P = 0.884$), and 90-day surgical complications (23.1 *versus* 19.1 per cent for ileostomy and colostomy respectively, $P = 0.731$). Procedural and postoperative outcomes are summarized in *Table 5*.

Discussion

In this study, a diverting ileostomy was associated with a higher need for supplementary feeding and a longer hospital stay during the bridging-to-surgery interval. Despite the theoretical discussions on specific complications of both types of enterostomies, no differences were found in postoperative complications during the bridging interval or after resection of the primary tumour. This suggests that both approaches are safe as a bridge to surgery in left-sided obstructive colon carcinoma, but may suggest a clinical preference for a colostomy over an ileostomy in daily practice based on these results. An unexpected observation was that reversal of the enterostomy during primary resection was more common in the colostomy group.

There was longer length of stay and longer interval to primary resection in the ileostomy group. The shortened length of stay suggests a possible advantage for a colostomy as a bridge to surgery from financial and logistical perspectives, but also from a patient perspective. A possible reason for the elongated length of stay in the ileostomy group could be the significantly higher incidence of systemic neoadjuvant treatment. The optimal duration of neoadjuvant treatment is not consistent internationally, which may contribute to a longer hospitalization or interval to resection[10,11]. Nevertheless, the observed longer length of stay and the longer interval between a deviating enterostomy and primary resection remained significant after exclusion of neoadjuvant treatment. The incidence of neoadjuvant treatment alone does not seem to provide sufficient cause for differences in length of stay and interval between the two groups. Another possible alternative reason for the longer length of stay in the ileostomy group could be due to a higher proportion of co-morbidities in the ileostomy group[12]. In this study, ASA classification was indeed defined as a confounding factor for extended stay, although baseline characteristics did not significantly differ.

There was a significantly higher need for nutritional support in the ileostomy group, which remained significantly higher in the ileostomy group after exclusion of neoadjuvant treatment. This suggests slower recovery in the ileostomy group in terms of intake and maintenance of weight, requiring nutritional support. This supports the previous literature, which describes an increased risk for nutritional deficiencies in ileostomy patients, especially in the first interval after ileostomy placement[13–15].

Outcomes of this study suggest that both approaches can be used safely in all patients with left-sided obstructive colon cancer in terms of complications during the bridging interval and after primary resection. Prior studies reporting on complications in both types of enterostomy in a permanent or long-term setting show conflicting results[16,17]. However, this study showed a lower incidence of stoma prolapse in the colostomy group compared with previous studies[17,18]. A possible explanation could be that the current literature reports on permanent and long-term stomas, compared with the bridge-to-surgery stomas reported in this study (35-day interval to surgery). Finally, stoma reversal during resection was more common in the colostomy group.

Although the longer length of stay in the ileostomy group is notable, there is a need for cautious interpretation of this study because of the risk of bias, the retrospective nature of the study, and the small number of ileostomy patients. Futhermore, the reason for specific choice of a type of enterostomy was not recorded, due to the retrospective nature of the study, which poses a risk of selection bias. The authors tried to minimize this risk by comparing baseline and clinical symptoms at first presentation, which showed no significant differences between the groups. Another limitation of this study is that it only reported outcomes in the first interval from diagnosis up to 90 days after primary resection. To address the lack of evidence in this area, it would be interesting for future research to assess the differences between both enterostomy types in an international, prospective setting to confirm the outcomes of this study[19,20].

A shorter length of stay during the bridging interval and a lower need for nutritional support were observed in the colostomy group compared with the ileostomy group. This may suggest a preference for a colostomy as a bridge to surgery in left-sided obstructive colon cancer from logistical, financial, and patient perspectives. This study shows equal complication rates in the ileostomy and colostomy groups in the bridging interval and after resection. However, as the sample size of the ileostomy group is especially small, there is a need for good-quality, international, higher-volume, prospective studies in the future to strengthen the results of this study.

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Supplementary material

Supplementary material is available at *BJS Open* online.

Data availability

The Dutch Snapshot Research Group has full access to all the data in the study and takes responsibility for the integrity of the data. The data that support the findings of this study are available from the Dutch Snapshot Research Group upon reasonable request.

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