Changes in Management of Left-Sided Obstructive Colon Cancer: National Practice and Guideline Implementation

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ABSTRACT

Background: Previous analysis of Dutch practice in treatment of left-sided obstructive colon cancer (LSOCC) until 2012 showed that emergency resection (ER) was preferred, with high mortality in patients aged ≥ 70 years. Consequently, Dutch and European guidelines in 2014 recommended a bridge to surgery (BTS) with either self-expandable metal stent (SEMS) or decompressing stoma (DS) in high-risk patients. The implementation and effects of these guidelines have not yet been evaluated. Therefore, our aim was to perform an in-depth update of national practice concerning curative treatment of LSOCC, including an evaluation of guideline implementation. **Patients and Methods:** This multicenter cohort study was conducted in 75 of 77 hospitals in the Netherlands. We included data on patients who underwent curative resection of LSOCC in 2009 through 2016 obtained from the Dutch ColoRectal Audit. Additional data were retrospectively collected. **Results:** A total of 2,587 patients were included (2,013 ER, 345 DS, and 229 SEMS). A trend was observed in reversal of ER (decrease from 86.2% to 69.6%) and SEMS (increase from 1.3% to 7.8%) after 2014, with an ongoing increase in DS (from 5.2% in 2009 to 22.7% in 2016). DS after 2014 was associated with more laparoscopic resections (66.0% vs 35.5%; $P < .001$) and more 2-stage procedures (41.5% vs 28.6%; $P = .01$) with fewer permanent stomas (14.7% vs 29.5%; $P = .005$). Overall, more laparoscopic resections (25.4% vs 13.2%; $P < .001$) and shorter total hospital stays (14 vs 15 days; $P < .001$) were observed after 2014. However, similar rates of primary anastomosis (48.7% vs 48.6%; $P = .961$), 90-day complications (40.4% vs 37.9%; $P = .254$), and 90-day mortality (6.5% vs 7.0%; $P = .635$) were observed. **Conclusions:** Guideline revision resulted in a notable change from ER to BTS for LSOCC. This was accompanied by an increased rate of laparoscopic resections, more 2-stage procedures with a decreased permanent stoma rate in patients receiving DS as BTS, and a shorter total hospital stay. However, overall 90-day complication and mortality rates remained relatively high.

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Background

Left-sided obstructive colon cancer (LSOCC) is a challenging condition to treat in the curative setting. Good-quality oncologic resection is the main goal. However, treatment in the emergency setting is an important risk factor for postoperative morbidity and mortality.¹ Initial decompression of a distended colon as a bridge to surgery (BTS) is likely to change the risk profile of the patient, but it requires an additional intervention with its own disadvantages. The construction of a decompressing stoma (DS) or endoscopic placement of a self-expandable metal stent (SEMS) has been used for this purpose to create a time frame to optimize the patient's condition before resection, perform accurate preoperative tumor staging, and conduct the procedure with an optimal surgical team.

Colonic decompression by constructing a stoma proximal to the obstructing tumor is an effective strategy and can be performed with a small transverse incision in the upper abdomen. A recent meta-analysis showed an increased primary anastomosis rate and decreased permanent stoma rate in patients treated with DS as BTS compared with emergency resection (ER).² However, restoring continuity often requires a 3-stage procedure, which probably explains the restricted use of this approach and the limited number of studies reporting on it.³

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Arezzo et al⁴ showed lower morbidity and permanent stoma rates for SEMS as BTS than for emergency surgery (ie, ER). Disadvantages of SEMS are the related risk of perforation and unsuccessful decompression. Concerns about oncologic safety are the main hurdle for routine implementation.⁵

Tanis et al⁶ published an overview of Dutch daily practice in the treatment of LSOCC up to 2012. ER appeared to be the most frequently applied approach, with decreasing use of SEMS. Thirty-day mortality rates of up to 34% were observed after ER, with age and American Society of Anesthesiologists (ASA) physical status classification as independent risk factors. These analyses were based on the relatively limited dataset of the Dutch ColoRectal Audit (DCRA), which did not allow a more in-depth analysis of clinical decision-making. In 2014, the updated national colorectal cancer guideline explicitly recommended a bridging strategy using either DS or SEMS in patients at high operative risk, similar to the European guideline on colonic stenting.^{7,8} Adherence to and effects of these guidelines have not yet been evaluated. Therefore, the goal of our study was to provide an updated and more detailed population-based analysis of LSOCC treatment in the Netherlands, along with an evaluation of guideline implementation.

Patients and Methods

Study Design

A national retrospective study was performed using data from the DCRA, a prospective national registry of patients who underwent resection for primary colorectal cancer. This database was extended with additional data based on chart review according to methodology described in the first publication of the Dutch Snapshot Research Group (DSRG).⁹ In short, potential eligible patients were first identified through the DCRA, and collaborators in each participating hospital were provided with their own patients registered in the DCRA. Subsequently, collaborators extended baseline characteristics and short-term outcomes with additional procedural and long-term surgical and oncologic data through chart review using a web-based tool meeting Dutch privacy regulations by Medical Research Data Management.

All 77 Dutch hospitals that register patients in the DCRA were invited to participate. From August through December 2017, surgical residents extended the DCRA database using the internet-based tool under the supervision of 1 or 2 consultant surgeons. Data were subsequently analyzed on missing values and discrepancies, and participating residents were requested to correct and complete the data. The anonymized combination of DSRG and DCRA data was then sent to the study coordinator.¹⁰

This study was approved by the Institutional Review Board of the Academic Medical Center in Amsterdam, the Netherlands, with exemption status for individual informed consent due to the retrospective nature of the study with anonymized data.

Population

Patients were selected from the DCRA database based on tumor location (splenic flexure, descending colon, or sigmoid colon) and registration of clinical symptoms of obstruction or an intervention (DS or SEMS) before primary tumor resection. To verify registration as LSOCC, detailed variables on clinical presentation of the patient were added. Eligibility for analysis was defined by the following criteria: (1) symptomatic colonic obstruction (distended abdomen, nausea and/or vomiting), (2) tumor located in the distal colon (splenic flexure until rectosigmoid), (3) confirmation of the obstruction on a radiograph or CT scan based on a dilated large or small bowel loop, (4) histologically proven malignant cause of obstruction, and (5) curative treatment intent. Exclusion criteria were extracolonic malignancy and signs of bowel perforation on a CT scan. Data on patients registered in the DCRA between 2009 and 2012 have been published previously using the DCRA dataset only.⁶ Our study population contains a selection of those patients after restricting inclusion based on additional variables from the DSRG dataset.

National Guideline Recommendations

The 2008 Dutch colorectal cancer guideline recommended tumor resection during a primary surgical approach to relieve obstruction. SEMS as BTS was advised when sufficient experience was available, preferably in a trial setting. The revised 2014 guideline recommended ER in patients with low operative risk, either with end colostomy or primary anastomosis with diverting stoma. In patients with high operative risk, DS as BTS should be considered, with SEMS as the alternative approach if technically possible and an experienced endoscopist is available.⁷

Outcome Measures

Procedural indicators included primary anastomosis rate, stoma rate, laparoscopic resection rate, duration of hospital stay, adjuvant chemotherapy, time from resection until start of chemotherapy, and permanent stoma. Outcome indicators were short-term mortality and morbidity. Short-term mortality was defined as death within 90 days after resection. Overall complications included any adverse event caused by DS or SEMS or related to tumor resection within 90 days. Postresection hospital stay included hospital stay directly after resection, and total hospital stay included the cumulative duration

of hospital stay related to decompressing intervention, postresection hospital stay, readmissions within 90 days, and any (re)admission during the bridging interval in the DS and SEMS groups. Permanent stomas were stomas in situ at the end of follow-up.

Statistical Analysis

Proportions of each modality (ER, DS as BTS, SEMS as BTS) were determined per year during the study period. Baseline characteristics, procedural indicators, and outcome indicators were determined for each modality. To evaluate changes in outcomes after guideline revision in 2014, comparisons were made within treatment modalities and for the entire population between 2009 through 2014 versus 2015 through 2016. Normally distributed continuous variables were reported as mean $\pm$ SD and compared using Student *t* test. Nonnormally distributed variables were presented as median $\pm$ interquartile range (IQR) and compared using the Mann-Whitney U test. Categorical variables were presented as percentages and compared using the

chi-square or Fisher exact test. An intention-to-treat analysis was performed, wherein failed decompression was analyzed in the DS or SEMS group based on initial attempt of BTS. A 2-sided *P* value $< .05$ was considered significant. Statistical analyses were performed using SPSS Statistics, version 24.0 (IBM Corp).

Results

Patient Characteristics

Of 77 hospitals in the Netherlands, 75 participated. Using the DCRA registry, 3,879 potentially eligible patients were identified, of which 670 patients did not fulfill the predefined criteria of obstruction (ie, endoscopic impression of stenosis without clinical signs of obstruction). After exclusion due to palliative treatment intent ($n=465$) and signs of bowel perforation on a CT scan ($n=101$), 2,587 patients who underwent curative intent resection of LSOCC were included for analysis. ER was performed in 2,013 patients (77.8%), DS as BTS in 345 (13.3%), and SEMS as BTS in 229 (8.9%) (Figure 1).

Figure 1. Flowchart of patient selection.

Abbreviation: BTS, bridge to surgery.

Physician's arguments for either ER or BTS are provided in supplemental eTables 1 and 2 (available with this article at JNCCN.org). ER was performed mainly because the patient's clinical condition was considered well enough, whereas DS and SEMS were chosen mainly when the estimated operative risk was unacceptably high (28.5% and 43.8%, respectively). A relatively short length of the stenosis was the main argument for SEMS as an alternative to DS in 15% of patients, and no local availability of a physician with stenting experience was the reason for DS in 27.5%. For most patients, however, no specific rationale for treatment choice was provided.

Median patient age was 71 years (IQR, 62–79 years), which slightly differed among the 3 treatment strategies (Table 1). Overall, 31.9% of patients were categorized as ASA III or IV, with the highest proportion in the ER group (34.3%). The proportion of patients who underwent previous abdominal surgery was highest in the DS group (37.1%), as was the percentage with a pT4 tumor (34.1%).

Procedural Indicators

The median time interval between decompression and elective resection was 36 days (IQR, 22–67 days) after DS and 18 days (IQR, 8–30 days) after SEMS (Table 2).

Table 1. Baseline Characteristics

	Overall Population n (%)	Emergency Resection n (%)	Bridge to Surgery	
			DS n (%)	SEMS n (%)
Total, n	2,587	2,013	345	229
Male sex	1,404 (54.3)	1,071 (53.2)	205 (59.4)	128 (55.9)
Median age (IQR), y (n=2,358)	71 (62–79)	71 (62–79)	68 (59–76)	72 (64–80)
Mean BMI (SD), kg/m ² (n=2,173)	25.6 (6.8)	25.6 (7.4)	25.2 (4.1)	25.9 (5.0)
ASA class (n=2,562)				
I	439 (17.1)	344 (17.3)	48 (13.9)	47 (21.1)
II	1,305 (50.9)	967 (48.5)	219 (63.5)	119 (53.4)
III	718 (28.0)	592 (29.7)	73 (21.2)	53 (23.8)
IV	100/2,562 (3.9)	91/1,994 (4.6)	5/345 (1.4)	4/223 (1.8)
Comorbidity (n=2,575)	1,829/2,575 (71.0)	1,424/2,004 (71.1)	243/345 (70.4)	162/226 (71.7)
Median Charlson comorbidity score (IQR)	1.0 (0.0–2.0)	1.0 (0.0–2.0)	1.0 (0.0–2.0)	1.0 (0.0–2.0)
Previous abdominal surgery (n=2,564)	776/2,564 (30.3)	595/1,994 (29.8)	128/345 (37.1)	53/225 (23.6)
Tumor localization (n=2,587)				
Splenic flexure	343/2,587 (13.3)	274/2,013 (13.6)	54/345 (15.7)	15/229 (6.6)
Descending colon	478/2,587 (18.5)	375/2,013 (18.6)	58/345 (16.8)	45/229 (19.9)
Sigmoid	1,766/2,587 (68.3)	1,364/2,013 (67.8)	233/345 (67.5)	169/229 (73.8)
pT stage (n=2,575)				
pT1–2	105/2,575 (4.1)	78/2,007 (3.9)	15/343 (4.4)	12/225 (5.3)
pT3	1,772/2,575 (68.8)	1,399/2,007 (69.7)	211/343 (61.5)	162/225 (72.0)
pT4	698/2,575 (27.1)	530/2,007 (26.4)	117/343 (34.1)	51/225 (22.7)
pN stage (n=2,570)				
pN0	1,205/2,570 (46.9)	928/2,001 (46.4)	166/344 (48.3)	111/225 (49.3)
pN1	881/2,570 (34.3)	699/2,001 (34.9)	109/344 (31.7)	73/225 (32.4)
pN2	484/2,570 (18.8)	374/2,001 (18.7)	69/344 (20.1)	41/225 (18.2)
cM1 stage at presentation (n=2,524)	237/2,524 (9.4)	180/1,960 (9.2)	33/341 (9.7)	24/223 (10.8)
Length of stenosis (n=1,064)				
≤4 cm	575/1,064 (54.0)	428/796 (53.8)	75/157 (47.8)	72/111 (64.9)
>4 cm	489/1,064 (46.0)	368/796 (46.2)	82/157 (52.2)	39/111 (35.1)
Mean cecum diameter (SD), cm (n=1,311)	8.7 (1.97)	8.6 (1.97)	8.8 (2.12)	8.7 (1.74)
Median interval from presentation until initial intervention (IQR), d (n=2,526)	1.0 (1.0–3.0)	1.0 (1.0–3.0)	1.0 (0.0–2.0)	1.0 (0.0–1.0)

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; DS, decompressing stoma; IQR, interquartile range; SEMS, self-expandable metal stent.

Table 2. Procedural Indicators

	Overall Population n (%)	Emergency Resection n (%)	Bridge to Surgery	
			DS n (%)	SEMS n (%)
Total	2,587	2,013	345	229
Median interval from stent/stoma to resection (IQR), d (n=553)	28.0 (15.0–45.0)	—	36.0 (21.5–67.0)	18.0 (8.0–30.0) ^a
Chemotherapy or RT during BTS interval (n=549)	58/549 (10.6)	—	55/333 (16.5)	3/216 (1.4)
Laparoscopic approach for tumor resection (n=2,571)	420/2,571 (16.3)	159/2,002 (7.9)	167/344 (48.5)	94/225 (41.8)
Conversion (n=375)	98/375 (26.1)	50/145 (34.5)	28/163 (17.2)	20/67 (29.9)
Type of resection (n=2,586)				
Sigmoid resection	1,631/2,586 (63.1)	1,270/2,012 (63.1)	209/345 (60.6)	152/229 (66.4)
Left hemicolectomy	718/2,586 (27.8)	544/2,012 (27.0)	105/345 (30.4)	69/229 (30.1)
Subtotal colectomy	184/2,586 (7.1)	157/2,012 (7.8)	21/345 (6.1)	6/229 (2.6)
Extended left hemicolectomy	20/2,586 (0.8)	11/2,012 (0.5)	8/345 (2.3)	1/229 (0.4)
Combined sigmoid resection and right hemicolectomy	21/2,586 (0.8)	21/2,012 (1.0)	0/345 (0.0)	0/229 (0.0)
Transverse colectomy	12/2,586 (0.5)	9/2,012 (0.4)	2/345 (0.6)	1/229 (0.4)
Primary anastomosis (n=2,575)	1,253/2,575 (48.7)	792/2,003 (39.5)	292/344 (84.9)	169/228 (74.1)
Stoma in situ directly after resection (n=2,542)	1,578/2,542 (62.1)	1,285/1,978 (65.0)	226/343 (65.9)	67/221 (30.3)
Diverting ileostomy	53/1,511 ^b (10.1)	109/1,236 ^c (8.8)	36/208 ^d (17.3)	8/67 (11.9)
End ileostomy	101/1,511 (6.7)	89/1,236 (7.2)	8/208 (3.8)	4/67 (6.0)
Diverting colostomy	182/1,511 (12.0)	42/1,236 (3.4)	136/208 (65.4)	4/67 (6.0)
End colostomy	1,075/1,511 (71.1)	996/1,236 (80.6)	28/208 (13.5)	51/67 (76.1)
Simultaneous resection for M1 (n=2,485)	151/2,485 (6.1)	111/1,920 (5.8)	26/338 (7.7)	14/227 (6.2)
Permanent stoma (n=2,552)	1,060/2,552 (41.5)	908/1,982 (45.8)	97/342 (28.4)	55/228 (24.1)
Patients with a minimum follow-up of 12 mo	676/1,946 (38.5)	575/1,494 (38.5)	65/275 (23.6)	36/177 (20.3)
Patients with Hartmann's procedure	717/1,075 (66.7)	647/985 (65.7)	22/28 (78.6)	36/50 (72.0)

Abbreviations: BTS, bridge to surgery; DS, decompressing stoma; IQR, interquartile range; RT, radiotherapy; SEMS, self-expandable metal stent.

^aFour patients eventually received a DS in the BTS interval: 3 because of technical failure and 1 because of reobstruction after a technically successful SEMS procedure.

^bType of stoma after resection unknown in 67 patients.

^cType of stoma after resection unknown in 49 patients who underwent emergency resection.

^dType of stoma after resection unknown in 18 patients who underwent DS.

Overall, the primary tumor was resected laparoscopically in 16.3% of patients, with a conversion rate of 26.1%. Both DS and SEMS as BTS resulted in higher laparoscopy rates than ER (48.5% and 41.8% vs 7.9%, respectively) with lower conversion rates (17.2% and 29.9% vs 34.5%). In the total population, a primary anastomosis was constructed in 48.7% of patients, which was 39.5% after ER, 84.9% after DS, and 74.1% after SEMS. A stoma was constructed in 65.0% of patients undergoing ER, which was an end colostomy (Hartmann's procedure) in 80.6% of those patients. In 65.9% of patients who underwent DS, a stoma was still present after resection. After SEMS, 30.3% had a stoma after resection, which was an end colostomy (Hartmann's procedure) in 76.1%. In the entire population, the permanent stoma rate in patients with a minimum follow-up of 12 months after resection

was 38.5%. Permanent stoma rates were 38.5%, 23.6%, and 20.3% in ER, DS, and SEMS patients, respectively.

Trends in Treatment Approach Over Time

Figure 2A shows the trends in the application of the 3 treatment strategies. A slight increase in ER was observed until 2014, with a subsequent decrease from 86.2% to 69.6% at the end of the study period. DS showed a continuous increase from 5.2% in 2009 to 22.7% in 2016, whereas SEMS showed decreasing use, from 21.6% in 2009 to 1.3% in 2014. However, after guideline revision, a trend reversal occurred for SEMS, with an increase to 7.8% in 2016.

Changes in Treatment Approaches Over Time

For the entire population, an increase in laparoscopic resections was observed after 2014 compared with 2014

Figure 2. Trends in (A) treatment modalities and (B) overall complication and permanent stoma rates after resection in patients with left-sided obstructive colon cancer from 2009 through 2016. Abbreviation: BTS, bridge to surgery.

and before (25.4% vs 13.2%; $P<.001$), with a decrease in conversions (19.0% vs 31.9%; $P=.005$). Patients undergoing SEMS after 2014 were significantly older than those treated with SEMS before 2014 (75 vs 70 years; $P=.002$) and included more patients classified as ASA III and IV, although this latter finding was not significant. These changes in time were not observed in the DS group, and median age and proportion of patients classified as ASA III and IV did not decrease in the ER group after 2014, whereas an increase in laparoscopic resections was seen in the ER (10.5% vs 7.2%; $P=.020$) and DS groups (66.0% vs 35.5%; $P<.001$), and significantly fewer primary anastomoses were constructed during ER (34.6% vs 41.1%; $P=.010$). After 2014, DS was more often reversed at the time of subsequent resection (2-stage procedure), resulting in a reduction of

the proportion of stomas still present directly after resection of the primary tumor, from 71.4% in 2014 and earlier to 58.5% ($P=.012$). Furthermore, the DS group showed significantly fewer permanent stomas after 2014 (14.7% vs 29.5%; $P=.005$). Figure 2B shows changes in permanent stoma rates over time.

Changes in Outcome Indicators Over Time

Changes in outcome indicators after 2014 for the overall population and the different treatment approaches are displayed in Table 3. For the entire population, shorter total median (14 vs 15 days; $P<.001$) and postresection (9 vs 11 days; $P<.001$) hospital stays were observed after 2014. Separate analyses per treatment group also revealed shorter total hospital stays for ER (13 vs 14 days; $P<.001$) and DS (16 vs 20 days; $P=.040$) after 2014. No significant differences in 90-day mortality or complication rates were observed between the time periods for the whole population or among the individual treatment strategies. Figure 2B shows changes in overall complication rate per treatment year.

Supplemental eTable 3 shows the outcome indicators for each treatment group over the entire observation period. The 90-day mortality rates were 7.8% in the ER group, 2.3% in the DS group, and 5.7% in the SEMS group. Overall complication rates were 39.0% after ER, 34.3% after DS, and 40.7% after SEMS. DS- and SEMS-specific complications are listed in supplemental eTables 4 and 5.

Discussion

This nationwide collaborative cohort study of 2,587 patients shows notable changes in the management of LSOCC during an 8-year study period. Trend reversals were seen for the application of ER and SEMS as BTS, and guideline revision seems to have further stimulated the already observed tendency toward increasing use of DS as BTS. However, ER was still the most frequently performed strategy in the Netherlands in 2016. In contrast to procedural changes, such as an increased laparoscopic resection rate with fewer conversions, 90-day morbidity and mortality remained unchanged.

We previously reported decreased use of SEMS as BTS in the Netherlands from 2009 until 2012,⁶ and this decline continued until 2014 to a rate of only 1.3%. Factors contributing to this national trend were the early closure of the Dutch Stent-In 2 trial in 2009 due to a high SEMS-related perforation rate¹¹ and several studies since then suggesting an increased risk of tumor recurrence.^{5,12,13} However, the European Society of Gastrointestinal Endoscopy guideline states that SEMS may be considered as an alternative to ER in patients aged ≥ 70 years or classified as ASA $\geq$ III, although this is classified as a weak recommendation based on low-quality evidence.⁸

Table 3. Comparison of Patient, Procedural, and Outcome Indicators Over Time

	Overall Population (N=2,587) n (%)			Emergency Resection (n=2,013) n (%)			DS as BTS (n=345) n (%)			SEMS as BTS (n=229) n (%)		
	2014 and Earlier	After 2014	P	2014 and Earlier	After 2014	P	2014 and Earlier	After 2014	P	2014 and Earlier	After 2014	P
Median age (IQR), y (n=2,585)	71.0 (63.0–78.0)	71.0 (61.0–79.0)	.872	71.0 (63.0–79.0)	71.0 (61.5–80.0)	.959	68.0 (60.5–76.0)	68.0 (58.0–76.8)	.452	70.0 (62.0–80.0)	75.0 (71.0–82.5)	.002
ASA class (n=2,560)			.689			.500			.357			.148
I–II	1,280/1,885 (67.9)	464/675 (68.7)		987/1,509 (65.4)	324/483 (67.1)		156/197 (79.2)	111/148 (75.0)		137/179 (76.5)	29/44 (65.9)	
III–IV	605/1,885 (32.1)	211/675 (31.3)		522/1,509 (34.6)	159/483 (32.9)		41/197 (20.8)	37/148 (25.0)		42/179 (23.5)	15/44 (34.1)	
Laparoscopic resection (n=2,569)	250/1,900 (13.2)	170/669 (25.4)	<.001	109/1,522 (7.2)	50/478 (10.5)	.020	70/197 (35.5)	97/147 (66.0)	<.001	71/181 (39.2)	23/44 (52.3)	.116
Conversion (n=375)	66/207 (31.9)	32/168 (19.0)	.005	35/96 (36.5)	15/49 (30.6)	.484	15/66 (22.7)	13/97 (13.4)	.121	16/45 (35.6)	4/22 (18.2)	.144
Primary anastomosis (n=2,575)	924/1,900 (48.6)	329/675 (48.7)	.961	625/1,520 (41.1)	167/483 (34.6)	.010	161/197 (81.7)	131/147 (89.1)	.058	138/183 (75.4)	31/45 (68.9)	.371
Stoma in situ directly after resection (n=2,542)	1,151/1,875 (61.4)	427/667 (64.0)	.229	958/1,501 (63.8)	327/477 (68.6)	.059	140/196 (71.4)	86/147 (58.5)	.012	53/178 (29.8)	14/43 (32.6)	.722
Median hospital stay after resection (IQR), d (n=2,485)	11.0 (7.0–16.0)	9.0 (6.0–14.0)	<.001	11.0 (8.0–17.0)	10.0 (7.0–15.0)	.001	7.0 (5.0–12.0)	7.0 (5.0–10.0)	.043	8.0 (5.0–14.0)	7.0 (5.0–13.3)	.774
Total median hospital stay (IQR), d (n=2,420)	15.0 (11.0–22.0)	14.0 (9.0–21.0)	<.001	14.0 (10.0–21.0)	13.0 (8.0–19.0)	<.001	20.0 (14.0–29.0)	16.0 (13.0–25.0)	.040	15.0 (11.0–24.0)	13.0 (10.0–22.5)	.317
Adjuvant chemotherapy (n=2,549)	746/1,878 (39.7)	268/671 (39.9)	.921	597/1,502 (39.7)	195/480 (40.6)	.732	80/193 (41.5)	57/146 (39.0)	.654	69/183 (37.7)	16/45 (35.6)	.789
Time from resection to adjuvant chemotherapy (IQR), d (n=894)	6.0 (4.0–8.0)	6.0 (4.0–9.0)	.395	6.0 (4.0–8.0)	7.0 (5.0–9.0)	.076	6.0 (4.0–8.3)	5.0 (4.0–7.0)	.212	6.0 (4.0–9.0)	7.0 (5.0–10.0)	.443
In patients with stage III disease (IQR), d (n=518)	5.0 (4.0–7.0)	5.0 (4.0–8.0)	.868	5.0 (4.0–7.3)	6.0 (5.0–8.0)	.159	5.0 (4.0–7.0)	5.0 (4.0–5.8)	.125	5.0 (4.0–8.0)	5.5 (3.8–9.0)	.827
Overall complication rate (n=2,517)	703/1,856 (37.9)	267/661 (40.4)	.254	576/1,500 (38.4)	197/482 (40.9)	.333	62/185 (33.5)	48/136 (35.3)	.740	65/171 (38.0)	22/43 (51.2)	.117
Complications requiring reintervention (n=2,531)	258/1,866 (13.8)	83/665 (12.5)	.383	201/1,504 (13.4)	62/482 (12.9)	.749	24/184 (13.0)	15/140 (10.7)	.523	32/178 (18.0)	6/43 (14.0)	.530
Complications after tumor resection (n=2,547)	685/1,875 (36.5)	251/672 (37.4)	.706	576/1,500 (38.4)	197/482 (40.9)	.333	53/194 (27.3)	37/146 (25.3)	.683	56/181 (30.9)	17/44 (38.6)	.328
90-d mortality (n=2,585)	134/1,907 (7.0)	44/678 (6.5)	.635	122/1,526 (8.0)	35/485 (7.2)	.578	3/197 (1.5)	5/148 (3.4)	.296	9/184 (4.9)	4/45 (8.9)	.299
Permanent stoma ^b (n=1,946)	531/1,512 (35.1)	145/434 (33.4)	.510	451/1,192 (37.8)	124/302 (41.1)	.304	49/166 (29.5)	16/109 (14.7)	.005	31/154 (20.1)	5/23 (21.7)	.788

Abbreviations: ASA, American Society of Anesthesiologists; BTS, bridge to surgery; DS, decompressing stoma; IQR, interquartile range; SEMS, self-expandable metal stent.

^aComplications after SEMS; DS, or tumor resection combined.^bIn patients with a minimum follow-up of 12 months.

In addition, a national training program was initiated to reintroduce SEMS as BTS. Subsequent trend reversals in the use of SEMS and ER after 2014 were likely the result of discussion of LSOCC treatment at several national meetings, publications in national journals, and development of a research network (www.colonobstructie.nl). Together with auditing (DCRA), these measures raised awareness, which contributed to guideline implementation. It should be emphasized that our study did not focus on comparison of the treatment strategies.

Stoma as BTS has long been considered a historical option by Dutch surgeons, explaining its low use rate of only 5.2% in 2009. This was related to the additional surgical intervention, which often results in a 3-stage procedure, with subsequent resection and restoration of continuity in the third instance. Nevertheless, a 4-fold increase in the use of DS was observed. Notably, the initial stoma was increasingly closed at the time of resection, resulting in more 2-stage procedures and fewer permanent stomas since 2014.

Patients treated with SEMS after 2014 were older, but no changes in age were observed for either the ER or DS group. This observation suggests that not all Dutch physicians act according to the revised guidelines, despite increased mortality and morbidity after ER in patients aged >70 years.^{6,14–19} Our study again underlines the relatively high postoperative mortality rate reported in elderly and frail patients, especially after ER. The higher proportion of Hartmann's procedures in the emergency setting might be interpreted as another attempt to lower the postoperative mortality and suggests increased awareness of the risks of ER. Yet, this did not result in reduction of mortality rates. However, we included patients treated until 2016, 2 years after publication of the updated guidelines.^{7,8} Because guideline implementation is known to take several years, continued auditing is necessary to observe whether further shift from ER to BTS strategies occurs and whether this eventually will improve complication and mortality rates at a national level.

Strengths of our study include a high participation rate of hospitals: of 4,216 patients from the DRCA registry who underwent resection for LSOCC, 3,879 (92.0%) were registered. In addition, extensive information was collected, such as diagnostic details of colonic obstruction. In fact, we excluded 670 of 3,879 patients (17.3%) based on absence of (clinical signs of) obstruction. This discrepancy

with DCRA data was also observed by Borstlap et al,²⁰ who reported anastomotic leakage after low anterior resection in rectal cancer for 8.2% of patients in the original DCRA database versus 13.4% in the subsequent collaborative cross-sectional study of that same population.

Nonetheless, our study has limitations. Some data were still lacking because of the retrospective data collection. For example, data on the length of stenosis was known for only 1,064 of 2,587 patients (41.1%), and we did not have information on historical changes in surgical technique and postoperative care, for example. However, many of the procedural and outcome indicators were known for a large number of patients. Therefore, we do not expect this to have influenced our conclusions. Furthermore, only patients who underwent a colorectal resection were registered in the DCRA database. Those who underwent BTS and died before resection were therefore not included, which could have positively affected the results for BTS. However, no mortality in the bridging period after SEMS was reported in any of the randomized controlled trials included by Arezzo et al.⁴ Therefore, the influence of this shortcoming is expected to be negligible for this group.

Conclusions

This nationwide study shows a trend reversal in the application of ER (decrease) and SEMS (increase) after 2014, with significant procedural changes, such as an increase in the proportion of laparoscopic resections, an increase in the proportion of 2-stage procedures with decreased permanent stoma rate in the DS as BTS group, and a decrease in total hospital stay. In contrast, 90-day complication and mortality rates did not improve over time for the overall population with LSOCC.

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References

- Bakker IS, Snijders HS, Grossmann I, et al. High mortality rates after nonelective colon cancer resection: results of a national audit. *Colorectal Dis* 2016;18:612–621.
- Amelung FJ, Mulder CL, Verheijen PM, et al. Acute resection versus bridge to surgery with diverting colostomy for patients with acute malignant left sided colonic obstruction: systematic review and meta-analysis. *Surg Oncol* 2015;24:313–321.
- Kronborg O. Acute obstruction from tumour in the left colon without spread: a randomized trial of emergency colostomy versus resection. *Int J Colorectal Dis* 1995;10:1–5.

4. Arezzo A, Passera R, Lo Secco G, et al. Stent as bridge to surgery for left-sided malignant colonic obstruction reduces adverse events and stoma rate compared with emergency surgery: results of a systematic review and meta-analysis of randomized controlled trials. *Gastrointest Endosc* 2017;86:416–426.
5. Sloothaak DA, van den Berg MW, Dijkgraaf MG, et al. Oncological outcome of malignant colonic obstruction in the Dutch Stent-In 2 trial. *Br J Surg* 2014;101:1751–1757.
6. Tanis PJ, Paulino Pereira NR, van Hooft JE, et al. Resection of obstructive left-sided colon cancer at a national level: a prospective analysis of short-term outcomes in 1,816 patients. *Dig Surg* 2015;32:317–324.
7. Landelijke werkgroep Gastro Intestinale Tumoren. Colorectal carcinoma, version 3.0. Last updated: April 16, 2014. Available at: https://www.oncoline.nl/index.php?pagina=/richtlijn/item/pagina.php&id=37084&richtlijn_id=933. Accessed January 2019.
8. van Hooft JE, van Halsema EE, Vanbiervliet G, et al. Self-expandable metal stents for obstructing colonic and extracolonic cancer: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. *Endoscopy* 2014;46:990–1053.
9. Dutch Snapshot Research Group. Benchmarking recent national practice in rectal cancer treatment with landmark randomized controlled trials. *Colorectal Dis* 2017;19:O219–231.
10. Amelung FJ, Borstlap WAA, Consten ECJ, et al. Propensity score-matched analysis of oncological outcome between stent as bridge to surgery and emergency resection in patients with malignant left-sided colonic obstruction. *Br J Surg* 2019;106:1075–1086.
11. van Hooft JE, Bemelman WA, Oldenburg B, et al. Colonic stenting versus emergency surgery for acute left-sided malignant colonic obstruction: a multicentre randomised trial. *Lancet Oncol* 2011;12:344–352.
12. Tung KL, Cheung HY, Ng LW, et al. Endo-laparoscopic approach versus conventional open surgery in the treatment of obstructing left-sided colon cancer: long-term follow-up of a randomized trial. *Asian J Endosc Surg* 2013;6:78–81.
13. Alcántara M, Serra-Aracil X, Falcó J, et al. Prospective, controlled, randomized study of intraoperative colonic lavage versus stent placement in obstructive left-sided colonic cancer. *World J Surg* 2011;35:1904–1910.
14. Jullumstrø E, Wibe A, Lydersen S, et al. Colon cancer incidence, presentation, treatment and outcomes over 25 years. *Colorectal Dis* 2011;13:512–518.
15. Biondo S, Parés D, Frago R, et al. Large bowel obstruction: predictive factors for postoperative mortality. *Dis Colon Rectum* 2004;47:1889–1897.
16. Iversen LH. Aspects of survival from colorectal cancer in Denmark. *Dan Med J* 2012;59:B4428.
17. Symeonidis D, Christodoulidis G, Koukoulis G, et al. Colorectal cancer surgery in the elderly: limitations and drawbacks. *Tech Coloproctol* 2011;15(Suppl 1):S47–50.
18. Tekkis PP, Kinsman R, Thompson MR, et al. The Association of Coloproctology of Great Britain and Ireland study of large bowel obstruction caused by colorectal cancer. *Ann Surg* 2004;240:76–81.
19. Tan KK, Sim R. Surgery for obstructed colorectal malignancy in an Asian population: predictors of morbidity and comparison between left- and right-sided cancers. *J Gastrointest Surg* 2010;14:295–302.
20. Borstlap WAA, Westerduin E, Aukema TS, et al. Anastomotic leakage and chronic presacral sinus formation after low anterior resection: results from a large cross-sectional study. *Ann Surg* 2017;266:870–877.

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Changes in Management of Left-Sided Obstructive Colon Cancer: National Practice and Guideline Implementation

Joyce Valerie Veld, MD; Femke Julie Amelung, MD, PhD; Wernard Aat Antoine Borstlap, MD, PhD; Emo Eise van Halsema, MD, PhD; Esther Catharina Josephina Consten, MD, PhD; Peter Derk Siersema, MD, PhD; Frank ter Borg, MD, PhD; Edwin Silvester van der Zaag, MD, PhD; Paul Fockens, MD, PhD; Willem Adrianus Bemelman, MD, PhD; Jeanin Elise van Hooft, MD, PhD, MBA; Pieter Job Tanis, MD, PhD; and for the Dutch Snapshot Research Group

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eTable 1: Motivation for Emergency Resection as Initial Treatment

eTable 2: Motivation for BTS Procedure as Initial Treatment

eTable 3: Outcome Indicators

eTable 4: Decompressing Stoma–Specific Complications

eTable 5: SEMS-Specific Complications

eAppendix 1: Dutch Snapshot Research Group Collaborators

eTable 1. Motivation for Emergency Resection as Initial Treatment (n=2,013)

	n (%)
Clinical condition of the patient	655/1,921 (34.1)
No bridge to surgery in this hospital	14/1,921 (0.7)
According to national guidelines	74/1,921 (3.9)
High risk of SEMS-related complications	4/1,921 (0.2)
Preference of treating physician, no motivation registered	1,052/1,921 (54.8)
Other	122/1,921 (6.4)

Abbreviation: SEMS, self-expandable metal stent.

eTable 2. Motivation for BTS Procedure as Initial Treatment

	DS (n=345) n (%)	SEMS (n=229) n (%)
As an alternative to emergency resection		
Operation risk too high	97/340 (28.5)	88/201 (43.8)
No specialized surgeon available for emergency resection	3/340 (0.9)	0/201 (0.0)
Hospital protocol	58/340 (17.1)	18/201 (9.0)
Preference treating physician, no motivation registered	124/340 (36.5)	25/201 (12.4)
Other	58/340 (17.1)	58/201 (28.9)
As an alternative to DS or SEMS as BTS, respectively		
No performance of SEMS placement in this hospital	87/316 (27.5)	—
No specialized gastroenterologist available	7/316 (2.2)	—
Length of stenosis	6/316 (1.9)	30/200 (15.0)
High risk of SEMS-related complications	5/316 (1.6)	—
High risk of stoma-related complications	—	7/200 (3.5)
Preference treating physician, no motivation registered	172/316 (54.4)	117/200 (58.5)
Other	39/316 (12.3)	46/200 (23.0)

Abbreviations: BTS, bridge to surgery; DS, decompressing stoma; SEMS, self-expandable metal stent.

eTable 3. Outcome Indicators

	Overall Population n (%)	Emergency Resection n (%)	DS as BTS n (%)	SEMS as BTS n (%)
Total, N	2,587	2,013	345	229
Overall complication rate ^a (n=2,517)	970/2,517 (38.5)	773/1,982 (39.0)	110/321 (34.3)	87/214 (40.7)
Complications requiring reintervention (n=2,531)	341/2,531 (13.5)	264/1,986 (13.3)	39/324 (12.0)	38/221 (17.2)
Complications after tumor resection (n=2,547)	936/2,547 (36.7)	773/1,982 (39.0)	90/340 (26.5)	73/225 (32.4)
Anastomotic leakage	140/1,249 (11.2)	106/788 ^b (13.5)	16/292 (5.5)	18/169 (10.7)
Abscess (intra-abdominal)	135/2,580 (5.2)	109/2,008 (5.4)	13/343 (3.8)	13/229 (5.7)
Fascia dehiscence	93/2,447 (3.8)	75/1,897 (4.0)	7/328 (2.1)	11/222 (5.0)
Wound infection	267/2,476 (10.8)	217/1,921 (11.3)	34/332 (10.2)	16/223 (7.2)
Postoperative ileus	218/2,466 (8.8)	193/1,914 (10.1)	10/330 (3.0)	15/222 (6.8)
Gastroparesis	109/2,452 (4.4)	91/1,900 (4.8)	9/329 (2.7)	9/223 (4.0)
Bleeding	34/2,458 (1.4)	29/1,906 (1.5)	3/330 (0.9)	2/222 (0.9)
Abscess (abdominal wall)	30/2,446 (1.2)	25/1,896 (1.3)	2/328 (0.6)	3/222 (1.4)
90-d mortality (N=2,587)	178/2,587 (6.9)	157/2,013 (7.8)	8/345 (2.3)	13/229 (5.7)
Age <70 y	25/1,179 (2.1)	23/894 (2.6)	1/189 (0.5)	1/96 (1.0)
Age ≥70 y	153/1,408 (10.9)	134/1,119 (12.0)	7/156 (4.5)	12/133 (9.0)
ASA I–II	55/1,744 (3.2)	48/1,311 (3.7)	2/267 (0.7)	5/166 (3.0)
ASA III–IV	123/818 (15.0)	109/683 (16.0)	6/78 (7.7)	8/57 (14.0)
Age ≥70 y and ASA III–IV	106/583 (18.2)	93/489 (19.0)	6/51 (11.8)	7/43 (16.3)
Completeness of resection (n=2,518)				
R0	2,421/2,518 (96.1)	1,890/1,961 (96.4)	319/340 (93.8)	212/217 (97.7)
R1	81/2,518 (3.2)	59/1,961 (3.0)	18/340 (5.3)	4/217 (1.8)
R2	16/2,518 (0.6)	12/1,961 (0.6)	3/340 (0.9)	1/217 (0.5)
Median hospital stay after resection (IQR), d (n=2,485)	10.0 (7.0–16.0)	11.0 (8.0–16.0)	7.0 (5.0–11.0)	7.5 (5.0–14.0)
Total median hospital stay (IQR), d (n=2,420)	14.0 (10.0–22.0)	14.0 (10.0–21.0)	18.0 (13.0–27.0)	15.0 (11.0–24.0)
Postoperative chemotherapy (n=2,549)	1,014/2,549 (39.8)	792/1,982 (40.0)	137/339 (40.4)	85/228 (37.3)
Median time from resection until start of postoperative chemotherapy (IQR), wk (n=894)	6.0 (4.0–8.0)	6.0 (4.0–8.0)	5.0 (4.0–8.0)	6.0 (4.0–9.0)

Abbreviations: ASA, American Society of Anesthesiologists; BTS, bridge to surgery; DS, decompressing stoma; IQR, interquartile range; SEMS, self-expandable metal stent.

^aComplications after SEMS, decompressing stoma, or tumor resection combined.

^bData on anastomotic leakage missing from four patients.

eTable 4. Decompressing Stoma-Specific Complications (n=345)

	n (%)
Prolapse	6 (1.7)
High-output stoma	6 (1.7)
Necrosis	4 (1.2)
Retraction	1 (0.3)
Parastomal hernia	1 (0.3)
Bleeding	1 (0.3)
Intra-abdominal abscess	0 (0.0)

eTable 5. SEMS-Specific Complications (n=229)

	n (%)
Patients with SEMS-related complications	25 (10.9)
Perforation ^a	8 (3.5)
Migration	7 (3.1)
Obstruction	8 (3.5)
Abdominal or rectal pain	4 (1.7)
Bleeding	1 (0.4)
Patients with a perforation	20 (8.7)
Clinically relevant	8 (3.5)
Macroscopic during operation	6 (2.6)
Microperforation	7 (3.1)

Abbreviation: SEMS, self-expandable metal stent.

^aCombination of bowel perforation with SEMS in situ and guidewire-related perforations.

eAppendix 1.**Dutch Snapshot Research Group Collaborators**

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