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Long-Term Outcomes of the Obstruction Treatment in Benign and Malignant Colonic Obstruction: A Multicentre Study

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Abstract

Introduction Patients with colonic obstruction are at risk for emergency resection, which is a risk factor for increased mortality and morbidity. In left-sided obstructive colon cancer, the principle of bridge-to-surgery is already recommended to reduce complications. From this treatment strategy, the obstruction treatment is derived. In this treatment strategy, bowel wall distention is reduced by minimizing stool production through laxatives and dietary measures. Short-term outcomes have already shown promising results. This study aims to evaluate long-term outcomes in patients treated with this obstruction treatment.

Methods This is a multicenter prospective study that included patients who presented with symptomatic colonic obstruction and radiologic confirmation of obstruction between May 2019 and August 2020 in the contributing hospitals. Patients with malignant and benign colonic obstruction were included. Follow-up in this study consisted of at least 36 months. Endpoints of the study included 1- and 3-year stoma and mortality rates.

Results Ninety-eight patients were included in this study. For the overall cohort complication, reoperation, and readmission rates after one year were 37%, 14%, and 10% respectively. Overall, 3-year mortality was 21%. The presence of a stoma after 1 year was 18%, and after 3 years 17% in this cohort.

Conclusion Long-term results of this study indicate that obstruction treatment has acceptable long-term outcomes in terms of mortality and stoma rates, compared to literature on emergency surgery and bridge-to-surgery alternatives. Permanent stoma rates are lower, compared to the literature on other treatment strategies in bowel obstruction.

Keywords
- colorectal
- bowel obstruction
- obstructive
- elective surgery

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Introduction

Incidence of colonic obstruction ranges from 10-30% in patients with colorectal cancer.[1] Also patients with benign conditions, such as inflammatory bowel and diverticular disease, may present with colonic obstruction. If treated with emergency resection, these patients have an increased risk of mortality and morbidity.[2] Guidelines for left-sided obstructive colon cancer (LSOCC) already recommend the use of bridge-to-elective surgery (BTS) treatment strategies in older patients to reduce perioperative morbidity and mortality.[3] This bridge-to-surgery approach can be performed by techniques such as a self-expandable metal stent (SEMS) or a diverting stoma (DS).[4,5] Although the results of current treatment strategies have yielded favorable outcomes compared to emergency surgery, both self-expandable stents, and diverting stoma require invasive interventions for patients in an acute setting. Besides, there have been some concerns about the oncological outcomes of SEMS, although a recent meta-analysis did not confirm the association between SEMS and decreased survival.[6–8]

From the concept of bridging to surgery approach, the obstruction treatment derived. This treatment strategy is based on the theory that the reduction of stool production will facilitate easier passage through the obstructed bowel segment. Consequently, this will decrease pre-stenotic bowel wall distention, followed by a reduction of symptoms such as abdominal pain and nausea. The reduction of stool is achieved using laxatives and dietary measures, ranging from a low-residue diet to total parenteral nutrition. Since the obstruction treatment allows decompression of the colon without surgical intervention, surgical trauma in the acute setting is limited, which possibly results in reduced postoperative morbidity and mortality. Low short-term morbidity and mortality have already been demonstrated in earlier pilot studies.[9,10] Short-term outcomes of the obstruction treatment have been described as well, showing successful treatment in 86% of patients.[9,10]

Since previous studies only describe short-term outcomes of the obstruction treatment, this study aims to analyze long-term outcomes, in terms of mortality and long-term stoma rates, in patients who were treated according to the obstruction treatment.

Methods

This is a prospective multicenter observational study in two large non-academic hospitals in the Netherlands. Ethical approval was obtained from the Medical Research Ethics Committees United and informed consent was obtained from all included patients (W19.041, AW22.009).

Patients

Patients were screened and underwent obstruction treatment between May 2019 and August 2020 in the contributing hospitals.[10] Patients were included if they presented with symptomatic colonic obstruction (abdominal distention, nausea, or vomiting) and had radiologic confirmation of obstruction on computed tomography, defined as a stenotic segment with no visible lumen on the scan and with or without distension of the bowel. Patients with malignant and benign diseases were included in this study, as well as right- and left-sided obstruction. Follow-up consisted of at least 36 months after the first presentation.

Obstruction Treatment

Patients were treated as described by Fahim et al.[10] Patients were categorized in one of the four stages, according to radiologic and clinical findings. Stage 1 consisted of a residue-low diet; stage 2 comprised a diet consisting of nutritional drinks only; stage 3 consisted of total parental nutrition (TPN) and stage 4 consisted of surgery where patients received a diverting stoma or emergency resection, depending on per-operative findings. As part of the obstruction treatment, all patients underwent prehabilitation, consisting of twice daily exercise for thirty minutes (e.g. walking or cycling) in outpatient or clinical settings. Besides, smoking cessation was advised and alcohol was strongly discouraged. All patients were prescribed osmotic laxative (Macrogol) or magnesium hydroxide. Reassessment for stage one and two took place at the outpatient department. Since stage three patients were hospitalized to receive Total Parental Nutrition (TPN), reassessment took place twice daily. If there was no symptom relief, the obstruction stage was increased. Patients who responded well to treatment and showed relief of symptoms were treated according to a lower stage. The timing to elective surgery ideally consisted of three weeks. This was based on earlier studies on the time frame for prehabilitation and preoperative nutritional support.[11–13] The obstruction treatment is summarized in ►**Table 1**.

Endpoints

Study endpoints were 3-year mortality, 3-year stoma rates, long-term complications (e.g. stoma prolapse, stoma necrosis, high output stoma, incisional herniation), long-term re-operation, 1-year hospital stay and permanent stoma rates at the end of follow-up. Overall survival was defined as the interval between first presentation until death or last follow-up. Total complication rate included obstruction treatment-related, long-term resection-related and long-term stoma-related complications. Permanent stomas were defined as a stoma presence at the end of follow-up.

Statistical Analysis

Categorical or dichotomous variables were presented as absolute numbers with percentages and were compared using the χ^2 test. Continuous variables were shown as mean (standard deviation) or median (interquartile range, IQR) and were compared using independent Student's *t* test or Mann–Whitney *U* test, according to their distribution. A p-value of <0.05 was significant. All analyses were performed using R studio version 3.1.

Results

Baseline Outcomes

A total of 98 patients were included in this study. The initial number of evaluated patients consisted of 101 patients.[10]

Table 1 Overview of obstruction treatment

	Clinical	Radiologic	Treatment	Reassessment	Timing of surgery
Stage 1	Symptomatic obstruction	Stenotic segment No bowel distention proximal to the obstruction	- Residue low diet (no large fibers, seeds, and peels) - Laxatives	Every seven days	Three weeks
Stage 2	Symptomatic obstruction	Segmental bowel distention proximal to the obstruction	- Complete diet of nutritional drinks (orally or through a nasogastric tube) Laxatives	Every three days	Three weeks
Stage 3	Symptomatic obstruction	Bowel distention proximal to the obstruction of the entire large bowel	- Total parenteral nutrition - Oral intake of clear fluids - Nasogastric tube - Laxatives	One to twice daily	Seven to ten days
Stage 4	Symptomatic obstruction Sepsis	Signs of near-blowout Perforation	Emergency surgery consisting of diverting stoma or resection	—	—

Three patients were lost to follow-up (3%). All patients presented with symptomatic obstruction (abdominal distention, nausea, or vomiting) and confirmed obstruction on Computer Tomography scan, with or without dilation proximal from the stenotic segment. Colorectal carcinoma was the cause of obstruction in 67 patients (68%). Baseline characteristics are summarized in ►**Table 2**.

Treatment Outcomes

In this cohort 47 patients (48%) were treated according to stage 1, 25 patients (26%) according to stage 2, 21 patients (22%) according to stage 3, and 5 patients (4%) according to stage 4. The obstruction treatment was successful in 79 patients (81%), meaning that no emergency resection or diverting stoma was required. Patients who did not respond

Table 2 Baseline outcomes and first presentation of included patients, all variables are in median [25%-75%] of number (%)

n		98
Age, years		69 [57-79]
Male		50 (51)
Body Mass Index, km/m^2		27 [23-32]
ASA classification	1	7 (7)
	2	47 (48)
	3	41 (42)
	4	3 (3)
MUST score	0	45 (46)
	1-3	50 (51)
	3-6	3 (3)
Abdominal pain		68 (69)
Nausea		36 (37)
Changed stool		79 (81)
Bowel dilatation present on radiologic imaging		48 (49)
Small bowel dilatation on radiologic imaging		23 (24)
Location obstruction	Caecum	13 (14)
	Ascending colon	18 (18)
	Transverse colon	2 (2)
	Descending colon	15 (15)
	Rectal/sigmoid	50 (51)

well to the obstruction protocol had a short interval until a stoma was placed (median 2 days IQR [1-4]). Bridging interval to resection was shorter in patients who had a successful treatment (successful treatment median 21 days IQR [14-31] vs. non-successful treatment 40 days [25-57]), suggesting that the interval to elective resection elongated when a diverting stoma was necessary. Six patients (6%) in this cohort did not undergo resection of disease. Reasons for palliative treatment were the absence of desire for curative treatment, unfavorable clinical conditions, or the extent of disease.

As for 90-day outcomes, complications occurred in 27 patients (28%), and in 6 patients (6%) the complication was classified as Clavien Dindo $\geq$2. Three patients (3%) died within 90 days in the overall cohort. The cause of death was related to colon carcinoma in all patients, wherein either the patient did not desire curative treatment or resection was not feasible.

The 1-year complication, reoperation, and readmission rates were 37%, 14% and 10% respectively, for the overall cohort. The most common 1-year complications were abscess formation, wound infection, and ileus. There was a difference in 1-year reoperation rates (successful 8 (10%) vs. non-successful 6 (32%)) and 1-year readmission (successful 5 (7%) vs. non-successful 5 (26%)) between successful and non-successful obstruction treatment. In the sub-analysis for stages 2 and 3 (where all patients have symptomatic obstruction with pre-stenotic dilatation), thirteen (28%) patients needed to undergo a diverting stoma, because the obstruction treatment was not successful. Treatment outcomes are described in ►**Table 3** and a subset analysis for stage 2 and 3 is summarized in ►**Supplementary Material Table 1**.

Long-term Mortality and Stoma Presence

Overall, the 3-year mortality was 21%, but if the obstruction treatment was not successful, the 3-year mortality was 32% (6 of 19 patients). Overall, 3-year mortality related to colon carcinoma was 15%. Other causes of death included other malignancies (e.g. pancreatic or ovarian malignancy), complications of other co-morbidities (e.g. encapsulating peritoneal sclerosis) or death by natural causes. Overall presence of a stoma after 1-year was 18%, and 17% after 3-years. If treatment was not successful, there was a stoma presence of 37% after three years. Treatment outcomes and pathology are summarized in ►**Table 3**.

In a subset analysis for malignant disease, there was a 1-year mortality of 6% and 3-year mortality of 18%. Besides a stoma was present in 14% of these patients of 1 year and in 12% after 3 years. Subset analysis for malignant disease is depicted in ►**Table 4**.

Discussion

This study demonstrates that the obstruction treatment resulted in favorable long-term morbidity and mortality rates in patients with bowel obstruction. Results of this study also suggest low 3-year stoma rates after obstruction treatment.

Mortality rates of the obstruction treatment are in line with literature on other described bridge-to-surgery treatment strategies in colonic obstruction, which describes long-term mortality percentages ranging from 9% to 40%.[4,14] In emergency surgery long-term mortality rates range from 27% to 34%, with elderly patients and patients with co-morbidities (ASA $\geq$3) being especially at risk to suffer from complications.[14–16] This study also showed low long-term complications compared to other literature on treatment strategies for colonic obstruction.[4] More importantly, these patients did not have to undergo an emergency intervention (such as emergency resection, diverting stoma, or SEMS), which contributes to lower surgical trauma in the acute setting. This is in line with earlier literature which already describes the potential benefit of less surgical trauma on immune status and long-term survival.[17–19]

As for long-term stoma rates, previous studies on bridge-to-surgery techniques describe an incidence of permanent stoma between 16% and 29%.[4,20] The obstruction treatment even shows the suggestion of lower long-term stoma rates compared to some bridge-to-surgery strategies, such as a diverting stoma.[4] Long-term complications such as incisional herniation and stoma revisions were rare in this study and literature on these complications varies, which may be caused by underreporting.[4,21,22] Also in patients where obstruction treatment was not successful and an acute intervention was necessary, long-term mortality and stoma presence were in line with current literature on alternative strategies in obstructive malignancies.[4,14,16]

Most studies on treatment strategies for colonic obstruction only include patients who underwent resection of the obstruction.[4] A strength of this current study is that it includes follow-up of all patients who underwent obstruction treatment, instead of including only patients who underwent resection. Thereby providing a more complete view of the outcomes of the obstruction treatment, since patients who underwent palliative treatment were also included in this study. This study is limited by a relatively smaller sample size. However, early studies on the use of diverting stoma or self-expandable stents as a bridge-to-surgery strategy, have similar sample sizes.[15,23,24] Another limitation is that direct comparison between the bridge-to-surgery alternatives and outcomes of obstruction treatment is difficult since most bridge-to-surgery treatment strategies only focus on malignant colorectal pathology and only include patients with radiologic pre-stenotic dilatation.[4] The obstruction treatment is used in patients with benign as well as malignant disease and not all patients have pre-stenotic dilatation. This results in a patient cohort with various degrees of bowel obstruction. However, we tried to place this research in the context of existing literature, by conducting a subset analysis for malignant disease and a subset of obstruction treatment stages 2 and 3, characterized by the presence of pre-stenotic dilatation in all patients. Both subset analyses showed promising clinical outcomes.[4,14] Lastly, the results of this study are influenced by the learning curve and insights during the development and implementation of the obstruction treatment.

Table 3 Overall treatment and pathology outcomes; all variables are in median [25%-75%] of number (%)

		Overall	Successful	Not successful
n		98	79	19
Treatment stage	Stage 1	47 (48)	46 (58)	1 (5)
	Stage 2	25 (26)	19 (24)	6 (32)
	Stage 3	21 (22)	14 (18)	7 (37)
	Stage 4	5 (4)	–	5 (26)
Performance of semi-elective resection		92 (94)	78 (99)	14 (74)
Bridging interval to resection, days		22 [14-37]	21 [14-31]	40 [25-57]
Emergency surgery		17 (18)	0 (0)	17 (100)
Bowel perforation		0 (0)	0 (0)	1 (5)
Conversion		6 (6)	4 (5)	2 (11)
Anastomosis initially performed		62 (63)	61 (78)	1 (5)
Procedure	Right hemicolectomy	26 (27)	23 (29)	3 (16)
	Left hemicolectomy	13 (13)	12 (15)	1 (5)
	Ileocoecal	4 (4)	4 (5)	0 (0)
	LAR	17 (17)	17 (22)	0 (0)
	APR	2 (2)	2 (3)	0 (0)
	Sigmoid resection	15 (15)	15 (19)	0 (0)
	Enterostomy	17 (17)	3 (4)	14 (74)
	Other	4 (4)	3 (4)	1 (5)
Stoma during resection	Deviating ileostomy	7 (7)	4 (5)	3 (16)
	End ileostomy	1 (1)	–	1 (5)
	Deviating colostomy	13 (13)	1 (1)	12 (63)
	End colostomy	10 (10)	9 (12)	1 (5)
Pathology disease	Malignant	66 (67)	55 (70)	11 (58)
	Benign	26 (27)	21 (27)	5 (26)
	Unknown	6 (6)	3 (4)	3 (16)
pT-stage [a.]	1	2 (3)	2 (4)	–
	2	5 (7)	5 (7)	–
	3	34 (51)	28 (51)	6 (50)
	4	26 (39)	20 (36)	6 (50)
pN-stage [a.]	0	31 (46)	29 (53)	2 (16)
	1	18 (27)	12 (22)	6 (50)
	2	16 (24)	13 (24)	3 (25)
pM-stage [a.]	1	4 (4)	1 (2)	2 (17)
Adjuvant chemotherapy		8 (12)	6 (11)	2 (17)
90-day mortality		3 (3)	2 (3)	1 (5)
90-day complication		27 (28)	24 (31)	3 (16)
90-day Clavien Dindo $\geq$2		6 (6)	3 (4)	3 (16)
1-year anastomotic leakage		2 (3)	2 (3)	0 (0)
1-year complication [b.]		36 (37)	29 (37)	7 (37)
	Abscess	5 (5)	3 (4)	2 (11)
	Wound infection	6 (6)	6 (8)	0 (0)
	Ileus	5 (5)	5 (6)	0 (0)

(*Continued*)

Table 3 (*Continued*)

		Overall	Successful	Not successful
	Incisional herniation	2 (2)	1 (1)	1 (6)
	High output stoma	2 (2)	1 (1)	1 (5)
	Stoma bleeding	1 (1)	1 (1)	0 (0)
	Stoma prolapse	1 (1)	1 (1)	0 (0)
	Stoma necrosis	1 (1)	0 (0)	1 (1)
1-year reoperation [c.]		14 (14)	8 (10)	6 (32)
1-year readmission		10 (10)	5 (7)	5 (26)
1-year stoma presence		18 (18)	11 (14)	7 (37)
3-year permanent stoma presence		17 (17)	10 (13)	7 (37)
1-year mortality		12 (12)	6 (8)	6 (32)
3-year mortality		21 (21)	15 (19)	6 (32)
3-year mortality related to colorectal carcinoma		15 (15)	10 (13)	5 (26)

[a]As percentage of malignant cases.
[b]Combination of complications after bridging and resection including stoma-related complications during follow-up.
[c]Excluding reoperation for stoma reversal.

Table 4 Subset analysis: overall outcomes patients with malignant disease; all variables are in median [25%-75%] of number (%)

		Overall	Successful	Not successful
n		66	55	11
Treatment stage	Stage 1	39 (59)	38 (69)	1 (9)
	Stage 2	13 (20)	11 (20)	2 (18)
	Stage 3	10 (15)	6 (11)	4 (36)
	Stage 4	4 (6)	–	4 (36)
Interval to deviating enterostomy, days			–	2 [1-4]
Bridging interval to resection, days			21 [15-31]	40 [31-57]
Emergency surgery		11 (17)	0 (0)	11 (100)
Bowel perforation		1 (2)	0 (0)	1 (9)
Conversion		4 (6)	3 (5)	1 (9)
Anastomosis after resection		45 (68)	44 (73)	1 (9)
Procedure	Right hemicolectomy	21 (32)	19 (35)	2 (18)
	Left hemicolectomy	10 (14)	10 (18)	1 (9)
	LAR	13 (19)	12 (22)	0 (0)
	APR	2 (3)	2 (4)	0 (0)
	Sigmoid resection	10 (14)	10 (18)	0 (0)
	Enterostomy	8 (14)	1 (2)	7 (70)
	Other	2 (3)	1 (2)	1 (9)
Type of stoma during resection	Deviating ileostomy	5 (8)	3 (5)	2 (18)
	End ileostomy	1 (2)	–	1 (9)
	Deviating colostomy	5 (8)	–	5 (45)
	End colostomy	7 (11)	6 (11)	1 (9)
pT-stage	1	2 (3)	2 (4)	–
	2	5 (8)	5 (9)	–
	3	34 (52)	28 (51)	6 (55)

Table 4 (*Continued*)

		Overall	Successful	Not successful
	4	24 (36)	20 (36)	5 (45)
pN-stage	x	1 (2)	1 (2)	0 (0)
	0	31 (47)	29 (53)	2 (18)
	1	18 (27)	12 (22)	6 (55)
	2	15 (23)	13 (24)	2 (18)
pM-stage	1	3 (5)	1 (2)	2 (18)
Completeness of resection	R0	65 (98)	54 (98)	11 (100)
	R1	1 (2)	1 (2)	0 (0)
Adjuvant chemotherapy		7 (11)	5 (9)	2 (18)
1-year anastomotic leakage		1 (2)	1 (2)	0 (0)
1-year complication		22 (33)	20 (36)	2 (18)
1-year reoperation		7 (11)	5 (9)	2 (18)
1-year readmission		8 (12)	5 (9)	3 (27)
1-year stoma presence		9 (14)	8 (15)	1 (9)
3-year stoma presence		8 (12)	7 (13)	1 (9)
1-year mortality		4 (6)	3 (5)	1 (9)
3-year mortality		12 (18)	11 (20)	1 (9)

a. Excluding reoperation for stoma reversal.

This is the first study on long-term outcomes of the obstruction treatment. It strengthens initial positive outcomes and suggests obstruction treatment to be a safe treatment strategy for colonic obstruction. Long-term mortality rates are similar compared to the literature on bridge-to-surgery strategies, while invasive and costly interventions (emergency resection, deviating stoma, SEMS) are spared. Furthermore, this study implies a potential advantage compared to other treatment strategies. For future research, it would be interesting to compare (long-term) healthcare use between different treatment strategies in patients with colonic obstruction.

Authors' Contributions

Smalbroek, Dijksman, Bloemen, Smits

Substantial contributions to the conception and design of the work: Smalbroek, Smits

Drafting the article: Smalbroek

Revising the article critically for important intellectual content: Dijksman, Bloemen, Smits

Final approval of the version to be published: Smalbroek, Dijksman, Bloemen, Smits

All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Data Availability Statement

The data to support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest

Dr. Bo P. Smalbroek, Dr. Lea M Dijksman, Dr. Johanne Bloemen, Dr. Anke B. Smits reported.

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