

# Assessment of Endoscopic Colonic Stenting outcomes in Patients with Acute Malignant Colonic Obstruction

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## Abstract

**Background:** The traditional method of treating patients with acute malignant colonic obstruction (AMCO) is emergency surgery, which is often accompanied by the development of severe complications and high mortality. Endoscopic colonic stenting with self-expandable metal stents (SEMS) is a promising way to treat such patients. However, its capabilities are not yet fully explored. We present a cross-sectional study with endoscopic colonic stenting using SEMS in AMCO patients, treated from 2016-2020 to clarify and identify the factors that may influence the result.

**Methods.** Our study included 218 patients with AMCO in whom surgeons attempted to eliminate acute colonic obstruction using endoscopic stenting. The capabilities of endoscopic stenting were assessed based on calculated technical and clinical efficacy, complications, and mortality. The patients were divided into two groups namely the clinical success group (182 patients) and the clinical failure group (36 patients).

**Results:** The results showed that the technical efficiency of endoscopic stenting of the colon was 91.7%, and its clinical efficiency was 83.5%. The incidence of intra-abdominal complications was 8.3%, the incidence of somatic complications was 11.9%, and mortality was 5%. Comparative analysis of the groups revealed significant differences ( $P < 0.05$ ) for the oncological process stage, the duration, and the severity of intestinal obstruction.

**Conclusion:** Endoscopic stenting of the colon with SEMS is an effective way to treat patients with AMCO. The success rate may vary depending on the severity of trophic disorders in the intestinal wall.

**Keywords:** Colorectal cancer, Colonic obstruction, Colorectal stenting, Endoscopic colonic stenting, Self-expandable metal stents.

## Introduction

Colorectal cancer is a pressing problem of the modern society, ranking second - third in prevalence among malignant oncological diseases. More than 1.5 million new cases of colorectal cancer and more than 800 thousand deaths directly related to this disease are registered in the world every year.<sup>1,2,3,4</sup>

Up to 30% of patients with colorectal cancer seek medical help in emergencies - with a clinical picture of acute intestinal obstruction, which causes doctors to look for immediate opportunities to save human life.<sup>5,6,7,8,9</sup>

The traditional method of treating patients with acute malignant colonic obstruction (AMCO) is a surgical

operation which in most cases consists in resection of the intestinal tube section obstructed by the tumor and introduction of egesting colostomy. The urgency to conduct a surgery usually does not allow doctors to perform a complete examination of the patient, and to fully eliminate the pathophysiological disorders caused by both acute intestinal obstruction and decompensation of chronic diseases often present in these patients. The rates of mortality and complications accompanying emergency surgical treatment of AMCO reach 40% and 64% respectively<sup>10,11</sup> and the presence of a colostomy inflicts deep moral trauma on the patient.<sup>12,13</sup>

Unsatisfactory results of AMCO treatment actively stimulate the search for alternative ways of providing care to this category of patients.

Endoscopic stenting of tumor stenosis with self-expandable metal stents (SEMS) is becoming increasingly popular in clinics all over the world. For the first time, endoscopic stenting of obstructed colon was reported by M. Dohmoto in 1991<sup>14</sup>. This report was followed by several related publications. To date, solving the AMCO problem with the endoscopic method has acquired some experience.<sup>2,15,16,17</sup>

According to modern publications, endoscopic stenting of patients with AMCO can significantly reduce hospital mortality and the rate of postoperative complications; it also saves patients from wearing a colostomy bag.<sup>18,19</sup> However, stenting of tumor stenosis with SEMS is associated with the risk of developing some complications both in the immediate and in the long-term post-manipulation periods: colon perforation, bleeding, stent migration, obstruction of the stent by feces or prolapsing mucosa, frequent loose stool, fecal incontinence, abdominal discomfort and pain, anorectal pain, etc.

Colon perforation is considered the most formidable complication of endoscopic stenting - that often requires emergency surgery and makes the prognosis uncertain. Some studies do not register the development of this complication.<sup>20,21</sup> others mention that the incidence of colon perforation is as high as 16%, which prompts discontinuation of this technique.<sup>22,23,24</sup>

The objective of this study was to clarify the outcomes of endoscopic stenting with SEMS in AMCO patients and identify the factors that influence its result.

## Methods

### Study protocol

The material for this cross-sectional study was the results of endoscopic stenting performed from 2016 till 2020 in A.K Eramishantcev City Clinical Hospital. The analysis covered all AMCO patients with an attempt to place SEMS.

Acute colonic obstruction was diagnosed based on the clinical image of the disease, the results of radiography and computed tomography of the abdominal cavity and chest, as well as data from an ultrasound examination of the abdominal cavity. The severity of intestinal

obstruction was assessed using the scale of Colorectal Obstruction Scoring System- CROSS<sup>25</sup> (Table 1).

**Table 1.** The system for assessing the severity of colonic obstruction CROSS

Gastrointestinal function	Score
Requiring continuous decompressive procedure	0
No oral intake	1
Liquid or enteral nutrient	2
Soft solids, low-residue, and full diet with symptoms of stricture (abdominal pain and distension, nausea, vomiting, constipation)	3
Soft solids, low-residue, and full diet without	4

All patients diagnosed with acute colonic obstruction underwent emergency colonoscopy after infusion of saline solutions and preparation of the colon with cleansing enemas. The endoscopic picture of tumor obstruction of the colon served as an indication for stenting.

All stenting procedures were endoscopic; they were performed under fluoroscopic control. Beyond the area of tumor stenosis, surgeons inserted a metal guide, with the help of which the stent was delivered and installed. The materials for stenting were double-coated and uncoated metal stents with a diameter of 24 mm and a length of 60 - 120 mm (EGIS S&G Biotech, The Republic of Korea).

The patients' medical records provided information that characterized the studied cohort and reflects the condition of patients before and after stenting: age, sex, the level of physical condition, duration of intestinal obstruction, localization of tumor stenosis, stage of the oncological process, the severity of colonic obstruction, clinical and instrumental-laboratory manifestations of intestinal obstruction, complications recorded after stenting, the final result of the treatment.

The capabilities of endoscopic stenting were judged on its effectiveness and safety.

The effectiveness of endoscopic stenting was determined by calculating the technical effectiveness, clinical effectiveness, and clinical failure of stenting.

The technical efficiency of stenting was defined as the ability to lead a metal guide beyond the area of tumor stenosis and place a stent.

Clinical effectiveness was determined by the combination of technical success and the elimination of symptoms of acute intestinal obstruction without

performing additional surgical interventions during the patient's hospital stay.

The clinical failure encompassed patients with technical failure (inability to pass the guide beyond the stenosis area, complications during the stenting procedure), patients with complications caused by stent placement, and patients in whom intestinal obstruction symptoms persisted.

The stenting safety was assessed by the incidence of life-threatening complications and the result of intestinal obstruction treatment.

In order to identify factors that determine prognosis of an attempt to treat AMCO with endoscopic stenting of the obstructed area using SEMS, all patients were divided into groups depending on the stenting result. The main characteristics of the obtained groups were statistically processed and subjected to comparative analysis.

### Ethical considerations

The study was approved by the Local Ethics Committee of I.M. Sechenov First Moscow State Medical University (Protocol № 05-19 of 10.04.2019) and conducted under the Declaration of Helsinki. The present study did not interfere with the process of diagnosis and treatment of patients.

### Statistical analysis

The continuous variables were expressed as the mean  $\pm$ SD and the categorical variables as a percentage. Chi-square and independent t-tests were used to compare data between the two groups. All statistical analyses were performed with SPSS (version 16.0, SPSS Inc., Chicago, IL, USA). A "P-value" less than 0.05 was considered significant.

### Results

The analysis included 218 patients with AMCO, in whom doctors attempted to perform endoscopic stenting of the colon to eliminate acute intestinal obstruction (Table 2). These patients were generally elderly (average age,  $70.7 \pm 16$  years) with a slight predominance of women (male/female - 43.1% / 56.9%), suffering from severe, life-threatening, chronic systemic diseases (ASA grade 3 - 4) and localization of obstruction at the level of the left half of the colon (right-side/ left-side - 13.8% / 86.2%). In 30.3% of these patients, the oncological process was in the final stage of development (stage 4).

Table 2. Characteristics of patients with AMCO with an attempt of colonic endoscopic stenting using SEMS

Indicator of the study	All patients
Number of patients	218
Male/Female (%)	94/124 (43.1/56.9)
Age (years)	$70.7 \pm 16$
ASA (grade)	$3.3 \pm 0.5$
Right-side / left-side (%)	30/188 (13.8/86.2)
Duration of intestinal obstruction (days)	$3.9 \pm 1.5$
CROSS (score)	$1.1 \pm 0.6$
Stage 4 of the oncological process (%)	66 (30.3)
Complications: somatic/stenting-associated/ postoperative (%)	26 / 18 / 9 (11.9 / 8.3 / 25)
Death (%)	11 (5.0)

SEMS placement was possible in 200 patients out of all 218 patients with AMCO.

In 182 cases, the placement of SEMS was accompanied by a satisfactory clinical result, manifested by restoration of the passage of intestinal contents and regression of symptoms of intestinal obstruction. In 18 patients, the attempts to place SEMS were unsuccessful due to the inability to lead the guide beyond the tumor. These patients underwent emergency surgery.

In 18 cases, the technically successful placement of SEMS did not lead to the elimination of intestinal obstruction but was accompanied by the development of life-threatening complications, which also required an emergency surgical intervention.

In 26 cases, we recorded the development of complications not directly related to stenting: pneumonia - 20 patients, myocardial infarction - two patients, pulmonary embolism - three patients, bleeding from the duodenal ulcer - two patients, multiple organ failure - five patients.

Stent-associated complications of colorectal stenting occurred in 18 cases. These complications were distributed as follows: tumor perforation with the guide - two cases, colon perforation above the obstructed area - six cases, perforation with the stent - five cases, worsening intestinal obstruction signs - four cases, stent migration - one case.

Nine out of 36 patients in whom an attempt to place SEMS was unsuccessful and ended with emergency surgery developed severe intra-abdominal or wound complications. That is 25% of all clinical failures: peritonitis - four cases (13.1%), stoma necrosis - one case

(2.8%), total suppuration of the surgical wound - nine cases (25%).

The division of the patients into groups depending on the clinical results achieved by the stenting attempt led to the formation of two groups: the group of clinical success (n=182) and the group of clinical failure (n=36). The clinical success group included 182 patients in whom stenting was accompanied by the elimination of intestinal obstruction clinical signs. The group of clinical failures included 36 patients in whom stenting failed or was accompanied by complications that required emergency surgery.

In the group with clinical success, the mean duration of intestinal obstruction was  $3.7 \pm 1.6$  days. In the group with clinical failure, the average period of intestinal obstruction was  $5.4 \pm 0.8$  days which is significantly longer than in the group with clinical success ( $p=0.041$ ). In the group of clinical success, the intestinal obstruction severity assessed on the CROSS scale was  $1.3 \pm 0.6$  points, which is significantly higher ( $p=0.033$ ) than in the group of clinical failure, where this indicator was  $0.3 \pm 0.1$  points. In the clinical success group, the percentage of patients in the terminal stage of the disease was 25.8, which is significantly less ( $p=0.037$ ) than in the group of clinical failure, in which the proportion of such patients reached 52.8%. In the clinical success group, serious somatic complications were recorded in 3.8% of cases (7/182). In the clinical failure group, somatic complications occurred in 52.8% of observations (19/36), which was significantly more frequent than the clinical success group ( $p=0.023$ ). The compared final results of treatment of patients with acute intestinal obstruction in the groups determined that mortality in the group of clinical success was 1.6% (3/182), which is 13 times lower ( $p=0.012$ ) than in the group of clinical failure, where mortality reached 22.2% (8/36) (Table 3).

**Table 3.** Comparative characteristics of groups with different clinical results of endoscopic stenting in patients with AMCO.

Indicator of the study	The group of clinical success (n=182)	The group of clinical failure (n=36)	P value
Number of patients (%)	182 (83.5)	36 (16.5)	-
Male/Female (%)	80/102 (44.4/55.6)	18/18 (50/50)	0.53
Age (years)	$70.5 \pm 16$	$71.2 \pm 15$	0.80
ASA (grade)	$3.2 \pm 0.5$	$3.9 \pm 0.4$	0.1
Right-side / left-side (%)	27/155 (14.8/85.2)	4/32 (11.1/88.9)	0.56
Duration of intestinal obstruction (days)	$3.7 \pm 1.6$	$5.4 \pm 0.8$	0.041
CROSS (score)	$1.3 \pm 0.6$	$0.3 \pm 0.1$	0.033
Stage 4 of the oncological process (%)	47 (25.8)	19 (52.8)	0.037
Complications stenting-associated (%)	0	18 (50)	0.023
somatic (%) postoperative (%)	7 (3.8)	19 (52.8) 9 (25)	
Death (%)	3 (1.6)	8 (22.2)	0.012

## Discussion

Colorectal cancer is the undisputed etiological leader of acute colonic obstruction. In most cases, AMCO is diagnosed at late stages of the oncological process in the elderly, having an entire set of frequently decompensated concomitant diseases, several days after the onset of clinical manifestations of intestinal obstruction. The complex of starting conditions described above explains the severity of these patients' condition and unsatisfactory results of surgical treatment.

Endoscopic colonic stenting with SEMS is positioned as an alternative to emergency surgery; that allows the patient to get rid of lethal intestinal obstruction without causing severe surgical trauma, continuous treatment of postoperative complications, and placement of a depressing intestinal stoma.

Analysis of the main characteristics of the study group determined that it generally consisted of elderly patients (average age;  $70.7 \pm 16$  years) with a slight predominance of women (male /female - 43.1% / 56.9%), suffering from severe, life-threatening, chronic

systemic diseases (ASA grade 3 - 4) and localization of obstruction at the level of the left half of the colon (right-side/ left-side - 13.8% / 86.2%). In 30.3% of these patients, the oncological process was in the final stage of development (stage 4).

The above characteristics are consistent with the portrait of a "typical" patient who sought help at the medical institution and had AMCO symptoms.

The most crucial information is provided by the indicators which characterize intestinal obstruction. These are the duration and severity of acute intestinal obstruction.

According to modern ideas about the pathophysiology of the disease, the average duration of intestinal obstruction, equal to  $3.9 \pm 2.0$  days, indicates the presence of severe microcirculatory disorders in the colon wall. The severity of intestinal obstruction, assessed on the CROSS scale as  $1.1 \pm 0.6$  score, reveals the spread of pathological changes beyond the colon and involvement of all parts of the gastrointestinal tract in the process.

The declared processes are usually accompanied by intoxication development and water-electrolyte disturbances that contribute to the decompensation of existing chronic diseases and aggravate the prognosis.

After an attempt to treat AMCO using endoscopic stenting of the colon with SEMs, 11 patients died; thus, the mortality rate was 5%.

The obtained result should be regarded as satisfactory since it compares favorably with the previously published results of surgical treatment of similar patients, where mortality varies within 14 - 34%<sup>26,27,28</sup> and is very close to the declared mortality rate of 0.7-4% in colonic elective surgery<sup>29</sup>.

An analytical study of complications, the development of which was recorded after a colonic stenting attempt, found that 26 out of 218 patients (11.9%) developed somatic complications that required treatment in a hospital. Pneumonia was recorded in 20 (9.1%) patients, pulmonary embolism - in three (1.2%), myocardial infarction - in two (0.9%) patients. The development of multiple organ failure occurred in five (2.3%) cases.

We associate the occurrence of general somatic complications with the age of the patients, the duration of intestinal obstruction, and the period of intra-abdominal hypertension, which usually accompanies the clinical course of colonic obstruction and can participate in the formation of such complications<sup>30,31</sup>.

The occurrence of stent-associated complications was found in 18 patients out of 218 (8.3%). The most severe and common complication was colon perforation, the development of which was recorded in 13 cases (6% of all attempts to place SEMs). In two cases (15.4%), perforation was a consequence of a colon trauma by the guide and was diagnosed immediately after the manipulation; in six patients (46.1%), it was diastatic and localized in the appropriate sections of the colon; and in five (38.5%) patients, perforation occurred during stent expansion.

In four cases (2.3%), the placement of SEMs did not permit the elimination of the acute intestinal obstruction but led to the aggravation of its symptoms and delayed surgical care.

The incidence of stent-associated complications in our study is not unique. It falls within the range of previously published results, in which this indicator reaches 4.9 - 12.4%<sup>32</sup>.

In some cases, (9 out of 36 observations - 25%), when they attempt to place a SEMs ended with emergency surgery, intra-abdominal and wound complications were combined with severe somatic complications.

An analysis of the endoscopic colonic stenting effectiveness in the 218 patients with AMCO revealed that the technical success of this method of treatment was 91.7% (200/218), the clinical success was 83.5% (182/218), and the percentage of clinical failure was equal to 16.5% (36/218).

Based on the fact that in 16.5% of patients, an attempt at endoscopic treatment ended in a clinical failure, and 11, 9% of patients had severe somatic complications, it can be assumed that the capabilities of this method are limited both by the technical capabilities of the medical staff and the physical conditions of the patient.

To identify the factors that may limit the capability of colonic endoscopic stenting and predict clinical results, we carried out a comparative analysis of the main characteristics specific for the group with clinical success and the group with clinical failure.

The comparative analysis demonstrated comparability ( $p > 0.05$ ) of the groups by gender, age, level of intestinal obstruction, as well as the physical condition of patients before the stenting attempt.

Significant differences were found in the duration of intestinal obstruction, the severity of intestinal obstruction, the stage of the oncological process, the incidence of somatic complications, and mortality rates.

In the group with clinical success, the mean period of intestinal obstruction was significantly shorter than in the group with clinical failure. Reliable differences in the duration of intestinal obstruction show that in the group of clinical success, trophic changes in the colon wall could be less frank compared with the group of clinical failure.

In clinical success group, the intestinal obstruction severity assessed on the CROSS scale was significantly higher than in the group of clinical failure ( $p=0.033$ ). A formal assessment of intestinal obstruction severity suggests that a significant proportion of the patients in the clinical success group had no signs of involvement of the small intestine in the pathological process. At that time, most of the patients in the clinical failure group showed signs of upper gastrointestinal tract distension, which required constant aspiration of intestinal contents. The study of the prevalence of the oncological process determined that in the group of clinical success, the percentage of patients in the terminal stage of the disease was significantly less than in the group of clinical failure ( $p=0.037$ ).

A comparative analysis of the severe somatic complications incidence defined that complications in the clinical success group were significantly less frequent than in the clinical failure group ( $p=0.023$ ). The somatic complications in the majority of the clinical failure group cases (18/19) were formed on the background of already developed intra-abdominal wound complications and should not be considered complications after an endoscopic stenting attempt.

The compared final results of treatment of patients with acute intestinal obstruction in the groups determined that mortality in the group of clinical success was 1.6% (3/182), which is 13 times lower ( $p=0.012$ ) than in the group of clinical failure, where mortality reached 22.2% (8/36). A significant difference in mortality rates allows us to assume that endoscopic stenting may be a preferable method of AMCO patients' treatment at the present stage of Surgical Science development.

The comparative analysis of the main characteristics of the formed groups indicates that successful treatment of AMCO patients using the endoscopic stenting method mainly depends on the severity of the colon trophic changes caused by intestinal obstruction and oncological process, rather than on the patient's physical condition.

## Conclusion

The study showed that endoscopic stenting of the colon with SEMS is an effective method for the treatment of patients with AMCO. It allows eliminating intestinal obstruction in 83.5% of patients. Its application is accompanied by the development of intra-abdominal complications in 8.3% of patients and somatic complications - in 11.9% of patients; its mortality rate is as low as 5%. The factor that helps predict successful treatment of AMCO patients via endoscopic stenting is the severity of trophic disorders in the intestinal wall.

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## Conflict of Interest Disclosures

We have no conflicts of interest to disclose.

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## Authors' Contributions

All authors pass the four criteria for authorship contribution based on the international committee of medical journal editors (ICMJE) recommendations.

## Ethical Statement

The study was approved by the Local Ethics Committee of I.M. Sechenov First Moscow State Medical University (Protocol № 05-19 of 10.04.2019) and conducted under the Declaration of Helsinki. The present study did not interfere with the process of diagnosis and treatment of patients.

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