



Management of obstructed colorectal carcinoma in an emergency setting: An update

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Abstract

Colorectal carcinoma is common, particularly on the left side. In 20% of patients, obstruction and ileus may be the first clinical manifestations of a carcinoma that has advanced (stage II, III or even IV). Diagnosis is based on clinical presentation, plain abdominal radiogram, computed tomography (CT), CT colonography and positron emission tomography/CT. The best management strategy in terms of short-term operative or interventional and long-term oncological outcomes remains unknown. For the most common left-sided obstruction, the first choice should be either emergency surgery or endoscopic decompression by self-expandable metal stents or tubes. The operative plan should be either one-stage or two-stage resection. One-stage resection with on-table bowel decompression and irrigation can be accompanied or not accompanied by proximal defunctioning stoma (colostomy or ileostomy). Primary anastomosis is more convenient but has increased risks of anastomotic leakage and morbidity. Two-stage resection (Hartmann's procedure) is safer and the most widely used despite temporally affecting quality of life. Damage control surgery in high-risk frail patients is less frequently performed since it can be successfully substituted with endoscopic stenting or tubing. For the less common right-sided obstruction, one-stage surgical resection is more beneficial than endoscopic decompression. The role of minimally invasive surgery (laparoscopic or robotic) is a subject of debate. Emergency laparoscopic-assisted management is advantageous to some extent but requires much expertise due to inherent difficulties in dissecting the distended colon and the risk of rupture and subsequent septic complications. The decompressing stent as a bridge to elective surgery more substantially decreases the risks of morbidity and mortality than emergency surgery for decompression and has equivalent medium-term overall survival and disease-free survival rates. Its combination with neoadjuvant chemotherapy or radiation may have a positive effect on long-term oncological outcomes. Management plans are crucial and must be individualized to better fit each case.

Key Words: Acute abdomen; Obstructive ileus; Colorectal carcinoma; Emergency surgery; Colectomy; Intraluminal metal stents

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Core Tip: Acute obstruction is common in patients with more advanced colorectal carcinoma and may be the first manifestation mainly of left-sided obstruction and in elderly individuals. Emergency decompression is mandatory. Emergency surgical resection and primary anastomosis accompanied or not accompanied by proximal defunctioning stoma must be the first treatment choice for fit patients under 70 years. Hartmann's two-stage procedure, although more preferable, must be the second alternative choice. Emergency endoscopic self-expandable metal stents must be preferred in unfit patients as a bridge to surgery and for palliative treatment in all inoperable cases. However, these basic management principles constitute a general direction. Decision-making is important and should be individualized.

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INTRODUCTION

Colorectal carcinoma is common, with its incidence increasing in young adults, and left-sided obstruction being the most common. It is the third most common carcinoma, after lung, and breast or prostate carcinoma and the second leading cause of cancer-related deaths, after lung carcinoma, in the United States and Western Europe, causing more than 50000 deaths annually in the United States[1-3]. Early detection and proper management improves survival and avoids complications (mainly obstruction, perforation, bleeding, and fistula)[4-8].

In 20%-30% of patients, mainly geriatrics, obstruction and ileus may be the first clinical manifestations of carcinoma that has advanced (stage II, III, or even IV)[2,9-12]. It is a potentially fatal condition that requires emergency intestinal decompression[3,13], and various models that predict the risk of mortality have been developed[14]. On the other hand, obstruction is the most common cause (75%-80%) of presentation to the emergency department among patients with colorectal carcinoma[15]. Younger age (under 50 years), males, and those with ascending colon obstruction have a greater possibility of presenting to the emergency department for care[3,8]. Subsequently, colorectal cancer screening is necessary to prevent obstruction. Screening is recommended, particularly for those with predisposing factors such as a family history of colorectal cancer or sleep apnea[2].

Strategies for the emergency management of left-sided obstruction in patients with colorectal cancer have been described in various guidelines[16], however, strategies for the management of right-sided obstruction in colorectal carcinoma patients are somewhat different, clearly advising one-stage resection[17-20].

The growth pattern of colorectal carcinoma has been estimated. The median doubling time was 211 d, and the median rate of increase in tumor volume was 34.1% per 62 d[21].

The best management strategy in terms of short-term operative or interventional and long-term oncological outcomes remains unknown[16,22,23]. Early decompression is crucial because it prevents further bowel distention, ischemia and perforation, leading to fecal peritonitis and septic shock[23,24].

For left-sided obstruction, the first choice should be either emergency surgery or endoscopic decompression by self-expandable metal stent placement[10,22,25-27] or rectal tubes[19,28-31] as a bridge to surgery. However, there have been conflicting aspects. Stenting is not considered to be the gold standard. It may be related to possible perforation that causes septic subsequences leading to severe sepsis and septic shock. In addition, micro-perforation may promote cancer cell diffuse dissemination and distant metastasis. For rectal carcinoma, stenting is associated with technical difficulties and more stent migration[17,32].

The operative plan should be either one-stage or two-stage resection or, rarely, three-stage resection. One-stage resection with on-table bowel decompression and irrigation could be accompanied or not accompanied by proximal defunctioning stoma (colostomy or ileostomy)[16,22,23]. For obstructions in patients with low rectal carcinoma, major resections, even extensive pelvic surgery, may be performed in selected cases[33] despite the increased risk of morbidity, including empty pelvic syndrome (mainly small intestinal obstruction) and subsequent mortality[34].

Operative management of such emergency cases, regardless of preoperative multimorbidity or not, is related to higher risks of mortality and morbidity than nonoperative interventional management[35]. It is well known that both diabetes mellitus and liver cirrhosis increase the risks of postoperative morbidity and mortality, especially in patients treated with colorectal surgery and in those requiring emergency treatment. Thus, such morbidities should be considered when selecting the type of surgery[11,36].

A model was recently constructed that could accurately predict the risk of 30-day mortality after emergency operation for acute abdomen, including colorectal obstruction. It is based on a scoring system including 13 preoperative factors and may be valuable in deciding to perform an emergency operation, considering its kind, duration, and intensity[37].

Choosing the best management strategy can be challenging, and the choice should be evaluated under careful consideration of the patient's physical status and the condition caused by the present disease, taking into account that for colorectal operative interventions, the risk of inpatient mortality is increased by 6.9%, as has been assessed recently. This indicates that more conservative and interventional treatment may be more favorable in severe cases[38].

One-stage resection with primary anastomosis is more convenient but has increased risks of anastomotic leakage and morbidity[24]. Subtotal or total resection is a less common alternative[17].

Two-stage resection (Hartmann's procedure) is safer and the most widely used procedure worldwide despite temporally negatively affecting quality of life. It has been preferred over the three-stage procedure[16,17,24].

Damage control surgery in high-risk frail patients has been less frequently performed since it can be successfully substituted with metal stent or drainage tubing placement[39,40].

The role of minimally invasive surgery (laparoscopic or robotic) is still a subject of debate. Initial emergency laparoscopic management has been performed in approximately 20% of cases[41]; after initial stenting as a bridge to surgery, elective laparoscopic management has been performed in 32% of cases[24]. However, although emergency laparoscopic-assisted management is advantageous to some extent, it requires much expertise due to inherent difficulties in dissecting the distended colon and the risks of rupture and subsequent septic complications[41].

The decompressing stent as a bridge to elective surgery more substantially reduces the risks of morbidity and mortality than emergency surgery for decompression and has equivalent medium-term overall and disease-free survival rates[42]. Its combination with neoadjuvant chemotherapy or radiation for rectal cancer may have a positive effect on oncological outcomes[43].

Genetic studies may be needed mainly to prevent and, less commonly, diagnose colorectal carcinoma in cases of anorectal outlet obstruction that causes persistent constipation, since many studies have found a correlation between them [44].

This narrative review evaluates the current knowledge on severe obstruction in patients with colorectal carcinoma, emphasizing proper diagnosis and emergency management. This study was based on a large body of literature published in PubMed until September 2023, focusing particularly on full-text papers published only in the English language over the last five years.

Diagnosis

Large bowel obstruction may be predominantly located on the left side (65%) but also the right side (35%)[45], as the boundary is considered to be the splenic flexure. They have the same clinical manifestation of obstructive ileus but somewhat different management[17].

Diagnosis is based on clinical examination and imaging. The onset is characterized by suspension of gas and feces, abdominal distension, deep pain or fullness, and nausea or possible vomiting. Vomiting is more apparent and earlier on the right side, while the distention is more obvious on the left side[15].

Plain abdominal radiogram shows marked colon dilation with possible small bowel dilation and air-fluid levels[46].

Computed tomography (CT) is needed to confirm tumor existence and its precise location. CT is the first choice imaging technique for the evaluation of colorectal obstruction and perforation[40].

Colonoscopy can assess the entire colon and confirm the presence of a tumor in cases requiring differentiation from pseudo-obstruction (Ogilvie's syndrome)[2,12,47-49].

This need for complete colon evaluation in patients with left-sided obstruction is mandatory because it may reveal another proximal synchronous neoplastic lesion in 3%-11% of cases, which modifies the management policy. However, this is often impossible because the endoscope cannot pass through the obstruction caused by the tumor or provides limited view of an unprepared colon. In such cases, CT colonography or even positron emission tomography/CT could be a valuable imaging modality influencing the operative strategy[47].

A large retrospective study conducted in China including 1474 patients operated on for obstructed colorectal carcinoma found, by multivariate analysis, several prediction factors for diagnosis and better management of obstruction. They include neutrophil to lymphocyte ratio, albumin and total protein levels, gamma-glutamyl transpeptidase, alkaline phosphatase, carbohydrate antigen 19-9, carcinoembryonic antigen, and carbohydrate antigen 125[50].

Another study conducted in China including 472 patients evaluated a new serum biomarker of chemokine ligand-7 that has been proposed for the diagnosis and prognosis of obstructed colorectal carcinoma[51].

Liquid biopsy could detect circulating cancer cells or their parts in serum before and after stenting mainly for prospective research efforts[52,53].

The surgical risk score has been found to be a reliable independent factor for predicting morbidity and mortality, which could be helpful in management decision-making[54]. The diagnostic steps are shown schematically in Figure 1.

MANAGEMENT

Applicable guidelines

In the World Society of Emergency Surgery guidelines, right colectomy is the treatment method of choice for right-sided obstruction. Self-expandable metallic stents are related to better short-term outcomes than emergency surgery for decompression of a left-sided obstruction. However, they may have unclear long-term oncological outcomes, particularly in patients appropriate for curative resection. Subsequently, the recommendation of self-expandable metallic stents (SEMS) as a bridge to surgery must be limited in selected cases and by expertise. Primary anastomosis is preferred over Hartmann's two-stage procedure for suitable patients by experienced surgeons[40].

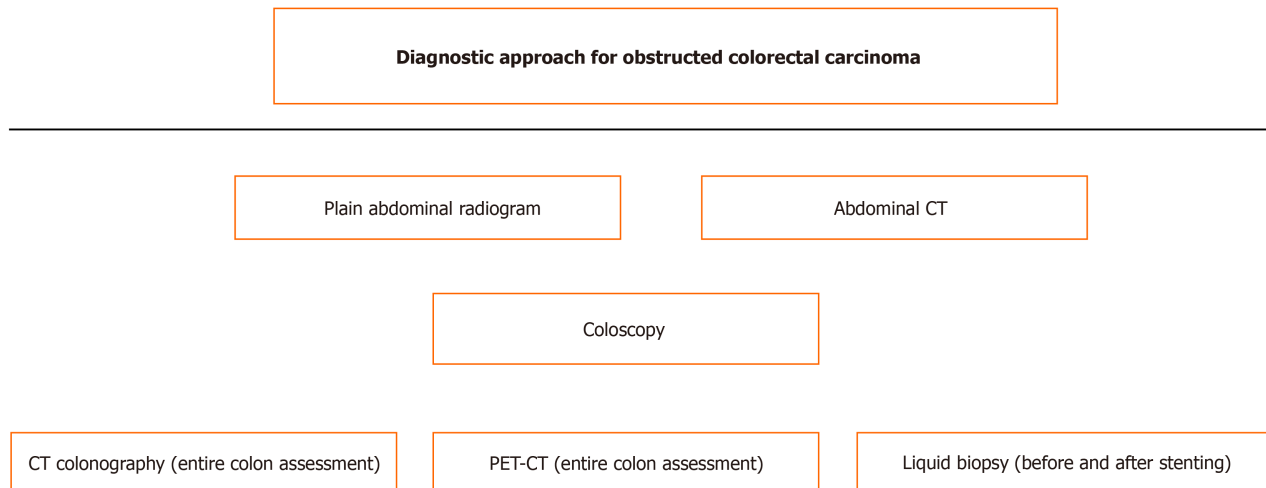


Figure 1 Scheme of diagnostic steps for obstructed colorectal carcinoma. CT: Computed tomography; PET-CT: Positron emission tomography/computed tomography.

According to the European Society of Gastrointestinal Endoscopy, although initially in 2014, the use of self-expandable metallic stents as a bridge to surgery was strongly discouraged but, since 2020, has been recommended after discussion and decision sharing with patients highly likely to be cured by surgical intervention. The time interval until surgical intervention must not exceed 2 wk. Stenting is indicated as the method of choice for palliation in patients with inoperable tumors[55].

In the American Society of Colon and Rectal Surgeons guidelines, either emergency therapeutic radical resection or SEMS as a bridge-to-surgery mainly laparoscopic resection, are recommended. The choice of management should be individualized according to patient-related factors, equipment availability and expertise of the center. The rate of successful stent placement fluctuates between 77% and 81%, and the perforation rate fluctuates between 2% and 9% but is accompanied by an increased recurrence risk. Tumors at other locations (synchronous) may be managed either by two segmental colon resections or subtotal colectomy[56].

Other general considerations

The current management policy depends on the location of acute obstruction. For right-sided curable obstruction, a therapeutic surgical intervention is indicated in most cases[18]. For left-sided obstruction, various choices exist, including curative resection accompanied or not accompanied by primary anastomosis, endoscopic stent placement usually or drainage placement, and diverting stoma formation[15,22,24,57]. It should be individualized in most cases[23] and according to a reliable scoring system[58]. The management options are shown schematically in Figure 2.

A large study conducted in Denmark and the United Kingdom (Yorkshire) assessed the trends in the surgical management of colorectal carcinoma in both elective and emergency settings. Emergency resection rates were similar in both countries (15%), increasing with age and disease stage. Emergency resection rates decreased in Denmark mainly for left-sided obstruction, whereas the rate of endoscopic stenting has increased, but it was less than 2% for right-sided obstruction. There was a slight increase in the incidence of endoscopic stenting in the United Kingdom for left-sided obstruction. The mortality rate reduced significantly over time in both elective and emergency settings and in both countries[59].

Emergency decompression, either decompressing stoma or endoscopic stenting as a bridge to subsequent surgical resection on an elective basis, is considered to be highly beneficial for high-risk patients, particularly in geriatric frail patients equal to or above 70 years[60].

A large retrospective multicenter study conducted in the Netherlands including almost all hospitals (75 out of 77) and 2587 patients with curative resection of obstructed left-sided colorectal carcinoma (among them, 345 cases of decompressing stoma and 229 cases of endoscopic stenting) showed a decreasing trend in the incidence (from 86.2% to 69.6%) of reversal of emergency resection and an increasing trend in the incidence (from 1.3% to 7.8%) of self-expandable metal stent implantation along with a continuing increase (from 5.2% to 22.7%) in the incidence of decompressing stoma creation. The latter was related to more subsequent laparoscopic resections (66% vs 35.5%), more two-stage operations (41.5% vs 28.6%, respectively), and fewer permanent stoma creations (14.7% vs 29.5%, respectively). Despite these favorable progressions, the rates of morbidity (40%) and mortality (7%) in these high-risk patients remained rather high[61].

Another debatable issue concerns the optimal time interval between acute decompression and second-time curative resection. A comparative study conducted in the Netherlands including 168 patients with a time between decompression and repeat resection less than and more than 4 wk found a decrease in mortality (1.8% vs 12.3%) and an increase in 5-year survival (75% vs 51.4%)[62].

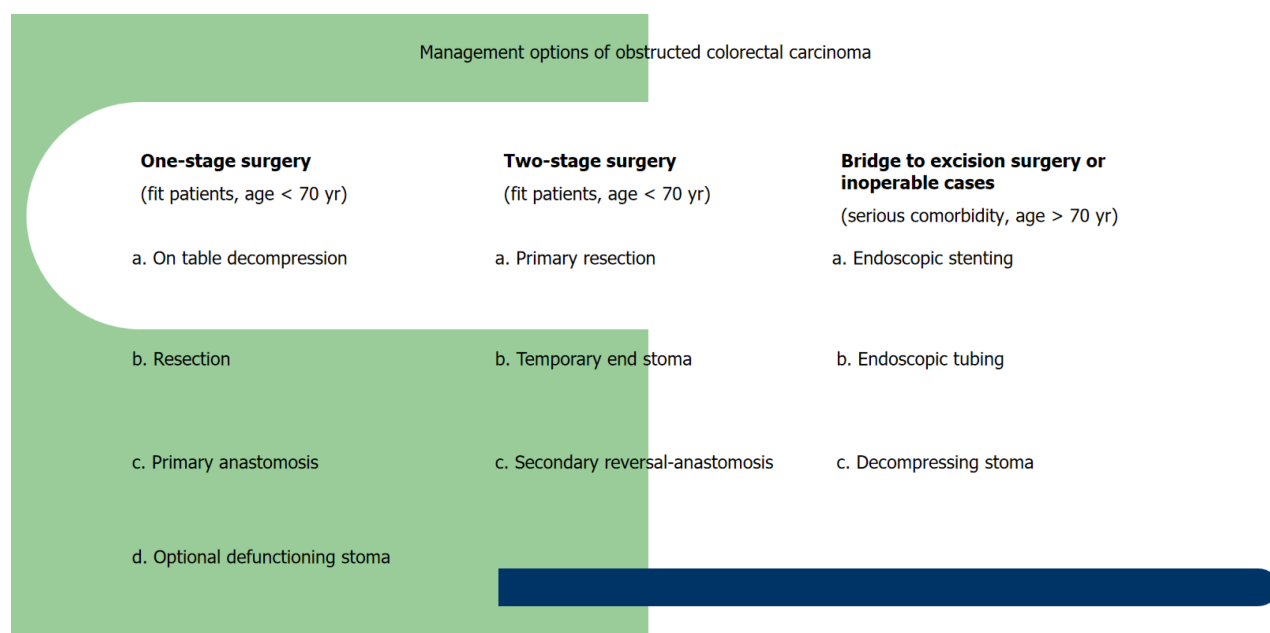


Figure 2 Scheme of management options for obstructed colorectal carcinoma.

Endoscopic stenting

Self-expandable metal stents were introduced almost 20 years ago to relieve left-sided colorectal carcinoma stenosis. Since then, much progress has been made in improving the quality of equipment material, interventional techniques and expertise. There is no disagreement for their use in inoperable cases for palliative treatment[32,63-66], which in addition is more cost-effective and has shorter hospitalization than emergency surgery[67]. However, whether they should be applied as a bridge to surgery in suitable patients with potentially curable tumors, who could undergo therapeutic surgical intervention initially without any delay, remains a subject of debate.

The main argument in favor of stenting is based on the high possibility of a subsequent elective resection procedure instead of a high-risk emergency resection that has increased risks of morbidity and mortality[25,66,68-70]. Furthermore, it may increase the possibility of primary anastomosis limiting the creation of stomas and the chance for laparoscopic operations[1,32,39,65,71].

On the other hand, fears and reservations have to do with the risk of perforation and mainly microperforations that facilitate the spread of cancer cells. "Do not touch", a basic postulate of traditional oncological surgery, means avoiding any manipulations of the tumor to prevent its dissemination. Notably, manipulations are not extrinsically high-risk but rather intrinsically high-risk (endoluminal) as there is a risk of partially fragmenting the tumor, thus opening the lumen [13,31,32,52,53].

Two cycles of preoperative chemotherapy with fluorouracil, leucovorin and oxaliplatin have been recommended to manage any cancer cell dissemination after stenting as a bridge to surgery restricting any potential unwilling effect of stent application[72]. It seems reasonable, but there are not survival data supporting this choice.

Self-expandable metal stents may be covered or uncovered and have diameters ranging between 10 and 25 mm and lengths between 60 and 12 mm[32,63,73]. A covered stent exhibited a higher migration rate and lower obstruction rate than an uncovered stent. Among the most commonly used are WallFlex, Niti-S, HANAROSTENT Naturfit, and JE-NTLLY. Complications may occur in less than 5% of cases, including bleeding, perforation, migration and obstruction. Given that stenting takes place under endoscopic and fluoroscopic guidance, sufficient experience in both colonoscopy and fluoroscopy is needed[32,48].

The use of super-flexible metal stents has been proposed for the management of acute obstruction, where passing the stent through the right and left colonic curve may be difficult as it may be highly tortuous[74].

An interesting case in which a fully covered self-expandable metal stent was used for cecostomy to relieve an inoperable ascending colon malignant obstruction after failed percutaneous cecum catheterization was previously reported [75].

A systematic review and meta-analysis revealed that uncovered metal stents were related to fewer complications, tumor overgrowth, stent migration or need for reinsertion, and more stent patency; thus, they are more preferable to covered metal stents[76].

Migration is the main disadvantage of covered stents, which may occur in up to 40% of cases. A recent prospective randomized control trial conducted in Korea including 60 patients compared two types of covered stents, *i.e.*, Flare and ComV. They found the following acceptable and comparable short-term results: (1) Technical success of 90% *vs* 96.7%; (2) clinical success of 85.2% *vs* 75.9%; and (3) stent migration of 11.1% *vs* 13.8%[77].

Perforation and peritonitis are more likely to occur after stenting in cases of benign acute obstructions. Thus, in benign cases, careful stenting is required due to an inherent high risk of perforation (22.4%), as suggested by a large nationwide study conducted in the United States including 4257 patients with self-expandable metal stent placement for relief of

acute large bowel obstruction[78]. The evaluation of short-term stenting outcomes is shown in Table 1.

Balloon dilatation is not recommended before stenting. Plain abdominal radiogram after stenting is necessary to assess the stent position and to exclude perforation based on the absence of intraabdominal free-air[48,79]. A multicenter retrospective study conducted in Japan including 129 patients with therapeutic surgery after stenting found that patients with postoperative infection had worse oncological outcomes, affecting relapse-free survival[48]. While the short-term outcomes are well studied and not conflicting, the long-term oncological outcomes remain unclear[13,32,80].

A nationwide retrospective cohort study conducted in the United States including 9706 patients with left-sided obstructed colorectal carcinoma found that a minority of 9.7% underwent stenting as a bridge to surgery, while most of them underwent emergency surgery. The bridging rate increased from 7.7% in 2010 to 16.4% in 2016. It was related to a lower incidence of stoma formation than emergency surgery and had comparable short-term outcomes in terms of morbidity and mortality rates. There were no long-term oncological outcomes[1].

There have been conflicting aspects about the safety and long-term oncological outcomes of self-expendable metal stents used as a bridge to surgery for left-sided acute obstruction in patients with colorectal carcinoma. A recent study conducted in Spain including 110 such patients showed a technical success rate of 95.7% and clinical effectiveness rate of 91.3%; a perforation rate of 13% and migration, occlusion rate of 2.9%; a higher rate following laparoscopic colectomy; a lower rate of colostomy, morbidity and mortality than emergency curative resection; and similar rates with the latter of overall survival and disease-free survival[39].

Another recent study conducted in Spain including 92 patients with obstructed left-sided colorectal carcinoma (two-thirds as bridging and one-third for palliation of inoperable tumor) reported a technical success rate of 92.4%, clinical effectiveness rate of 89.1% and perforation rate of 9.8%[63].

Another recent study conducted in Japan assessing the use of self-expendable metal stents with low axial force in 202 patients for the management of left-sided obstruction in patients with colorectal carcinoma, the technical success rate was 97.5%, clinical effectiveness rate was 96%, stent migration rate was 1%, stent occlusion rate was 1.5%, and there was no perforation attributed to that type of stent[81].

A retrospective study conducted in China including 434 patients using a two-person method reported a technique success rate of 98.6%, clinical effectiveness rate of 94.9% and complication rate of 4.4%. These included mainly bowel perforation (1.4%), stent migration (0.5%), stent detachment (0.7%) and stool impaction (1.4%)[49].

In a retrospective comparative study conducted in Japan including 48 patients with left-sided colorectal carcinoma, as a bridge to surgery, decompression by self-expendable metal stents or transanal tubes had similar complication and 5-year survival rates but the stenting group had better clinical success rates, shorter time to oral intake and better albumin levels [28]. Likewise, a systematic review and meta-analysis showed results in favor of metal stents, even in obstructions located in the right colon[29]. The comparison of results between stenting and tubing as a bridge to surgery is shown in Table 2.

A retrospective comparative study conducted in Egypt including 65 patients with American Society of Anesthesiologists (ASA) scores $\geq$ III, acute obstruction and an inoperable case of colorectal carcinoma stage IV located in the rectosigmoid region assessed the short-term outcomes of both stenting and Hartmann's operation. They reported technical success for all stenting cases, indicating similar effectiveness and safety for operable cases but better recovery and shorter hospitalization[82].

A retrospective study conducted in the United States including 199 patients who underwent stenting for obstructed inoperable colorectal carcinoma stage IV found a high technical success rate but not proportional clinical effectiveness. The perforation rate was comparable in patients treated with and without bevacizumab[83].

Another retrospective comparative study conducted in Spain including 95 patients with obstructed inoperable colorectal carcinoma stage IV underwent stenting or emergency surgical resection. They found that both were effective, but surgery did not influence survival; thus, it is not recommended[84].

A recent systematic review and meta-analysis including 10 studies and 1273 patients found higher perineural and lymphatic invasion after stenting as a bridge to surgery that led to worse overall survival than initial surgery[85].

Another recent systematic review and meta-analysis including 27 studies and 3894 patients after stenting as a bridge to surgery found similar results for initial surgery, 3-year and 5-year disease-free survival and overall survival[86]. Comparison results of emergency resection and endoscopic stenting as bridge to surgery is shown in Table 3.

In a recent multicenter prospective study conducted in 46 Japanese hospitals, WallFlex stents were implanted in 208 patients with left-sided obstruction of colorectal carcinoma (stage II and III) and not only were short-term outcomes evaluated but also long-term oncological outcomes. They found interesting rates: (1) Overall survival: 1-year of 94.1%, 3-year of 77.4%, 5-year of 67.4%; (2) relapse free survival: 1-year of 81.6%, 3-year of 65.6%, 5-year of 57.9%; (3) technical success of 99% and clinical success rate of 92.8%; (4) perforation of 1.9% and migration, occlusion rate of 1.3%; and (5) overall recurrence of 31% and it was poorer in four perforation cases. These long-term outcomes have been considered satisfactory and attributed to a notably low perforation rate[87].

A retrospective nationwide comparative study conducted in Sweden including 196 patients with acute obstruction colorectal carcinoma assessed the long-term outcomes between stenting and colostomy as a bridge to surgery. They found comparable long-term outcomes but less permanent colostomy, more surgical resections, and shorter hospitalization in the stenting group[88].

Endoscopic tube drainage

Endoscopic transanal drainage tubes (retrograde bowel drainage tubes or Dennis colorectal tubes) have been used as alternatives to endoscopic self-expendable metal stents as bridges to surgery for decompression of acute left-sided colorectal obstruction, thus avoiding the need for a high-risk emergency surgery and stoma formation[28,29,31,53].

Table 1 Evaluation of endoscopic stenting short-term outcomes

Ref.	Patients (Nu)	Study	Tech success (%)	Clin success (%)	Perforation (%)	Migration occlusion (%)
Recuenco <i>et al</i> [39]	69	Single center retrospective Spain	97.5	91.3	13	2.9
Angulo McGrath <i>et al</i> [63]	92	Single center retrospective Spain	92.4	89.1	9.8	-
Sasaki <i>et al</i> [81]	202	Single center retrospective Japan	97.5	96	0	2.5
Yan <i>et al</i> [49]	434	Single center retrospective China	98.6	94.9	1.4	0.5
Kuwai <i>et al</i> [87]	208	Multicenter prospective Japan	99	92.8	1.9	1.3
Lee <i>et al</i> [77]	60	Single center retrospective Korea	93.3	80.5	5.3	12.5

Table 2 Comparison results of endoscopic stenting and endoscopic tubing

Ref.	Patients (Nu)	Study	Clin success	Complications	Survival
Inoue <i>et al</i> [28]	48	Single center retrospective Japan	Better in stenting (100% vs 80.6%)	Similar (0 vs 4%)	Equivalent (5-yr: 69.5% vs 38.4%)
Xu <i>et al</i> [29]	704	Meta-analysis China	Better in stenting (94.5% vs 86.1%)	Fewer in stenting (6.9% vs 12.4%)	-
Kagami <i>et al</i> [30]	53	Single center retrospective Japan	Better in stenting (100% vs 81.8%)	Fewer in stenting (0 vs 18.2%)	Equivalent (3-yr: 73% vs 80.9%)
Matsuda <i>et al</i> [89]	581	Meta-analysis Japan	Better in stenting (93.2% vs 77.3%)	Equivalent (5.5% vs. 11.7%)	-
Numata <i>et al</i> [31]	225	Multicenter prospective Japan	Better in stenting (92.6% vs 75.3%)	Fewer post-operative in stenting (21.1% vs 33.3%)	Similar (3 yr: 87.1% vs 90.5%)
Takahashi <i>et al</i> [53]	35	Single center prospective Japan	Similar (88% vs 90%)	Similar (12% vs 10%)	¹ Increased circulating DNA on day 7 in stenting (992 vs 308 ng/mL)
Suzuki <i>et al</i> [18]	40	Single center retrospective Japan	Similar (89.5% vs 85.7%)	Similar (10.5% vs 14.2%)	Better in tubing (5 yr: 79.5% vs 32%)

¹Highlight of importance.

However, metal stents have been proven to be more effective and related to fewer complications than drainage tubes [28,29]. Likewise, a study conducted in Japan including 53 patients with obstructed left-sided colorectal carcinoma compared endoscopic transanal tubes and endoscopic self-expandable metal stents for decompression as a bridge to surgery. They found better short-term outcomes for stenting and equivalent long-term outcomes (3-year overall survival of 80.9% for tubing and 73% for stenting)[30].

A meta-analysis including 581 patients compared the short-term outcomes between endoscopic transanal tubes and self-expandable metal stents for decompression as a bridge to surgery in obstructed colorectal carcinoma. They found that stenting and tubing had equivalent morbidity and mortality after surgery[89].

A recent multicenter study conducted in Japan including 10 hospitals and 225 patients with obstructed colorectal carcinoma compared transanal decompression tubes and self-expandable metal stents. They found similar long-term outcomes, *i.e.*, 3-year relapse-free survival (66.7% vs 69.9%) and 3-year overall survival (90.5% vs 87.1%), between the tubing and stenting groups. However, the short-term outcome showed that stenting was favored over tubing regarding less stoma formation, fewer complications and shorter hospitalization[31].

Another study conducted in Japan including 35 patients with obstructed colorectal carcinoma performed genomic analysis (liquid biopsy) in addition to clinical outcome assessment and compared transanal tubes and self-expandable metal stents. They found similar short-term outcomes, but stenting increased the levels of circulating cell-free DNA and circulating tumor DNA in plasma, in contrast to no increase in the tubing group. This was attributed to mechanical compression causing tumor injury and could have a negative effect on the long-term oncological outcome[53].

Otherwise, for right-sided obstructed colorectal carcinoma, although the method of choice must be emergency curative surgical resection, a study conducted in Japan including 40 patients compared endoscopic tubes (transanal or transnasal) and endoscopic self-expandable metal stents as the choice for bridging to surgery and found similar morbidity, clearly

Table 3 Comparison results of emergency resection and endoscopic stenting as bridge to surgery

Ref.	Patients (Nu)	Study	Morbidity	Mortality	Long-term outcome
McKechnie <i>et al</i> [24]	9403	Meta-analysis Canada	Similar (27.2% vs 27.8%)	Improved in stenting (4.4% vs 6.1%)	Equivalent (insufficient data)
Paniagua García-Señoráns <i>et al</i> [42]	251	Single centre Retrospective Spain	Improved in stenting (36% vs 62.5%)	Equivalent (5.3% vs 6.3%)	Equivalent (3-yr DFS: 31.4.6% vs 33.4%, 3-yr OS: 37.5% vs 36.1%)
Wang <i>et al</i> [70]	78	Single centre Retrospective China	Similar (16.2% vs 26.8%)	Similar (0 vs 4.9%)	Similar (median overall survival: 36 months for both groups)
Hadaya <i>et al</i> [1]	9706	Nation-wide United States	Similar (12.2% vs 14.4%)	Similar (1.2% vs 3.4%)	Undetermined
Balciscueta <i>et al</i> [85]	1273	Meta-analysis Spain	-	-	Worse in stenting; ¹ Higher risk of perineural (45.6% vs 32.6%)- lymphatic (47.4 % vs 42%) invasion
Spannenburg <i>et al</i> [86]	3894	Meta-analysis Australia	Improved in stenting (26.09% vs 41.4%)	Improved in stenting (6.5% vs 8.1%)	Similar recurrence (31% vs 25%)
Boeding <i>et al</i> [101]	600	Meta-analysis Netherlands	Improved in stenting (30% vs 42%)	Improved in stenting (1.2% vs 7.2%)	Similar (5-yr DFS: 65.6% vs 63.1%, 5-yr OS: 66.9% vs 64%)

¹Highlight of importance.

DFS: Disease-free survival; OS: Overall survival.

better 5-year overall survival (79.5% vs 32%), and 3-year disease-free survival (68.9% vs 45.9%) rates in the tubing group than in the stenting group[18]. The advantages and disadvantages of tubing and stenting are shown in Table 4.

SURGERY

General considerations

Surgery constitutes the main treatment option for obstructed colorectal carcinoma stage II or III, aiming for a potent sustainable or permanent cure[17,19,24,90]. For right-sided obstruction involving the cecum, ascending colon, hepatic flexure, and transverse colon, the operative plan is clear and depends basically on therapeutic right colectomy with extended lymphadenectomy that includes complete transverse mesocolon excision and primary anastomosis. The addition of a defunctioning loop ileostomy is optional according to the assessment of local intraoperative conditions[17,19,40,91].

A recent nationwide retrospective study conducted in the Netherlands including 525 patients with obstructed right-sided colon carcinoma found that primary resection and anastomosis were performed in 88% of patients with defunctioning ileostomy (25%), and staged resection after stenting or tubing was used as a bridge to surgery in 5% of cases[20].

A French nationwide retrospective study including 776 patients with right obstructed colon cancer showed primary resection 92% accompanied by anastomosis 82% with added defunctioning loop ileostomy 3.6% or accompanied by double-end stoma 18%; diverting stoma 8% or ileocolic bypass 1.7% as palliation. They found postoperative morbidity 51%, anastomotic leakage 10%, mortality 10%, 5-year overall survival of 42%, disease-free survival of 42% and cancer-specific survival of 62%. By multivariate analysis, the following predictive factors were found for severe morbidity: Age > 70 years, ASA score ≥ 3, and hemodynamic instability; for reduced overall survival: peritonitis, synchronous metastases, and no adjuvant chemotherapy. The high morbidity and mortality may indicate staged management in high-risk patients[19].

In addition to radical traditional right colectomy, extended right colectomy removes the entire transverse colon with both flexures when the carcinoma involves the transverse colon, and primary ileocolic anastomosis is the method of first choice. A defunctioning proximal loop ileostomy may sometimes be preferred. Additionally, excision without anastomosis but an end ileostomy is sometimes needed[17].

For left-sided obstruction involving the splenic flexure, descending colon, sigmoid, and rectum, there are several different operative plans, but the optimal management is conflicting. Wide resection with extended lymphadenectomy, including total mesocolon or mesorectal excision, primary anastomosis or Hartmann's procedure, is the most widely used. Other operative options include subtotal or total colectomy with ileorectal anastomosis, when large dilatation and ischemic changes of the colon exist, urgent decompressing colostomy followed by surgical resection in the first stage and anastomosis in the second stage (two-stage procedure) and colostomy reversal in the third stage (three-stage procedure) [16].

The French nationwide study including 1500 patients with obstructed left-sided colorectal carcinoma found that their primary management was based on endoscopic stenting in 18% of cases. Emergency surgical management consists of diverting colostomy (38%), segmental colectomy (27%), Hartmann's procedure (20%), and subtotal colectomy (15%). By

Table 4 Advantages and disadvantages of stenting and tubing

Method	Advantages	Disadvantages
Endoscopic stenting	Higher clinical success; fewer complications	More expensive
Endoscopic tubing	Lower cost	Lower clinical success; more complications

multivariate analysis, diverting colostomy and segmental colectomy had a better prognosis than the other two operative options. They advocated, as surgical options, diverting colostomy in high-risk patients, and Hartmann's procedure or subtotal colectomy in cases with ischemia or perforation[90].

For left-sided acute obstruction, the choice of emergency decompression colostomy or endoscopic stenting depends on the management plan. The former is preferable in operable cases, while the latter is preferable in inoperable cases as palliative treatment[92].

A systematic review and meta-analysis showed primary anastomosis was more frequent in patients with decompressing stoma, with higher costs (2000 \$), and higher recurrence rates found in patients with stenting as a bridge to surgery; subsequently, these findings advocate in favor of stoma instead of stenting for emergency decompression[93].

Total mesocolon excision, which is of great importance for harvested lymph node extended dissection and determines the radicality of surgical resection affecting the oncological outcome, has been found that after sigmoidectomy for carcinoma, it is not related to remote bowel dysfunction or impairment in quality of life[91].

Various methods have been applied for stoma creation, either ileostomy or colostomy, to avoid the main complication of parastomal hernia. It may occur in 40% of cases within 2 years, affecting quality of life and causing obstructive ileus [94].

Pelvic exenteration even in the emergency setting, such as acute obstruction of rectal carcinoma, could be performed safely in terms of radicality, offering satisfactory results with a 3-year overall survival of 54.4%[33].

For splenic flexure location (5%), there are operative difficulties, which increase morbidity and mortality; thus, much attention must be paid during surgery. Similar technical difficulties may be encountered with stent placement in such locations. A recent large French multicenter study including 58 centers and 2325 patients with obstructed colorectal carcinoma, among whom 11% had splenic flexure obstruction and stenting in only 11.4%, found the following surgical interventions: (1) Decompressing stoma (39%); (2) segmental colectomy (39%); (3) subtotal colectomy (17%); and (4) left colectomy (5%). The rate of intraoperative complications was 3% and that of anastomotic leakage was 4%, without differences among the surgical procedures in terms of postoperative complications and oncological outcomes[46].

The previously mentioned French nationwide study including all 1957 patients with obstructive colorectal cancer recently compared the results of 56 centers with different hospital volumes. They found that it did not affect the outcomes of emergency management alone, but when the outcome of overall management was assessed, it influenced the morbidity and mortality without affecting the oncological outcome[95].

A retrospective study conducted in China including 839 patients with emergency surgery for obstructed colorectal carcinoma evaluated a modified ERAS protocol (enhanced recovery after surgery). They found faster bowel movements, fewer complications and shorter hospitalization[96].

The incidence of surgical site infections, the main cause of nosocomial infections, is increased after emergency surgery for obstructed colorectal carcinoma[97].

It has been reported that in inoperable obstructed carcinoma with peritoneal metastases, debulking surgery could improve symptom relief and survival without increasing morbidity and mortality[98].

One-stage procedure

One-stage resection with on-table bowel decompression and irrigation accompanied by primary anastomosis must be the preferred choice in younger (under 70 years), fit patients without major comorbidities, with ASA score I or II[17,40,99,100]. A recent systematic review including 9 studies and 600 patients with obstructed right-sided colorectal carcinoma found that one-stage surgery had more complications (42% *vs* 30%) and higher mortality (7.2% *vs* 1.2%) but similar 5-year overall and disease-free survival when compared to staged treatment[101].

A distended colon without any preparation discourages many surgeons from performing primary anastomosis, thus preferring Hartmann's procedure. However, the performance of anastomosis and the addition of a defunctioning stoma may overcome these fears. Given Hartmann's procedure reversal can occur at least 3-6 months after the initial operation, or even never, sometimes disturbing the quality of life[102], it is often more complicated and copious than reversal within one month of a right-sided loop transverse colostomy or loop ileostomy; thus, this addition could be a reasonable alternative to Hartmann's procedure[16,22,23,40].

A recent retrospective multicenter study conducted in Japan including 520 patients with obstructed colorectal carcinoma who had a primary surgical resection compared the outcomes of elderly patients 75 years and older (resection rate of 79%) with nonelderly patients (resection rate of 90%). They found similar short-term outcomes and recurrence-free survival but higher 90-d mortality in the elderly group. This finding may indicate urgent primary decompression followed by elective surgery in elderly patients[103].

Although the routine use of prophylactic intraabdominal drainage for colorectal anastomosis is not recommended in general, for emergency primary anastomosis due to obstructed colorectal carcinoma, it is a justifiable choice[104].

Two-stage procedure

This approach basically avoids the need for primary anastomosis and includes: (1) The most widely applicable Hartmann's procedure since its first introduction in 1920, in which primary rectosigmoid resection is performed, but without primary anastomosis, accompanied by temporary end sigmoid colostomy, with secondary anastomosis and its reversal; and (2) primary decompressing proximal colostomy, secondary resection and anastomosis abolishing the primary stoma [22,46,82,105,106].

Emergency stoma for urgent decompression may be either transverse colostomy (right-left) and sigmoid colostomy or loop ileostomy of the terminal ileum. Second, elective surgical resection and anastomosis can be performed in operable cases[46].

The site of colostomy depends on the tumor location and preference of the surgeon. Comparing transverse colostomy to sigmoid colostomy, no other difference was found, but the latter had a lower risk of prolapse than the former[7].

A recent study conducted in Taiwan including 191 patients with left-sided obstructed colorectal carcinoma showed that the two-stage procedure had more complications (57.1% *vs* 36%) than the three-stage procedure, including mainly surgical site infection and wound dehiscence. In addition, they found similar rates of anastomotic leakage, 5-year overall survival (33% *vs* 35%), and 5-year disease-free survival (60% *vs* 58.4%)[16]. There are well-defined incriminating factors for wound dehiscence after colorectal carcinoma surgery[107], which must be considered, particularly in emergency surgery.

Decompressing colostomy as a bridge to surgery for left-sided obstructed colorectal carcinoma is being more frequently performed. A recent nationwide study conducted in 75 Dutch hospitals including 236 patients who underwent emergency decompression colostomy and 472 patients who underwent emergency resection for left-sided obstructed colorectal carcinoma compared the results of these two management options. They found that primary decompression colostomy was accompanied by more subsequent laparoscopic resections and anastomoses (56.8% *vs* 9.2%) than primary resection, lower 90-d mortality (1.7% *vs* 7.2%) and permanent stoma (23.4% *vs* 42.4%) rates, and higher 3-year overall survival rates (79.4% *vs* 73.3%). This two-stage surgical management approach could be followed to improve outcomes, particularly in elderly individuals over 70 years[108].

It has been found that the reversal of Hartmann's procedure is associated with a notable morbidity of 34%, including mainly surgical site infection (22%) and anastomotic leakage (5%), and mortality of 8.3%, especially in patients with obesity and a high ASA score (≥ 3)[106].

Neoadjuvant chemotherapy after emergency decompressing stoma creation and before subsequent elective resection may be an option that could improve the prognosis[109].

Three-stage procedure

This approach has not gained wide acceptance and follows a two-stage procedure, the primary decompressing stoma was created, which was left in site for possible protection of secondary anastomosis and would be closed a third time[16].

Minimally invasive surgery

The applicability of emergency laparoscopic surgery for left-sided obstructed colorectal carcinoma is limited[24]. A nationwide study conducted in the Netherlands compared the results of 158 patients who underwent emergency laparoscopic surgery and 474 patients who underwent emergency open surgery. They found that the laparoscopic approach was favored over open surgery. It was associated with fewer 90-d complications (26.6% *vs* 38.4%), similar 90-d mortality, increased 3-year overall survival (81% *vs* 69.4%) and disease-free survival (68.3% *vs* 52.3%). Laparoscopic surgery in an emergency setting exhibits lower morbidity and higher 3-year survival rates but requires expertise and equipment to overcome the difficulties of a distended bowel to avoid causing iatrogenic perforation injury[41]. Endoscopic incision and dilation of the anastomotic stricture after colectomy can be used [110].

Prognosis

It is well known that emergency surgery reduces long-term survival in cancer patients. It has also been confirmed in emergency colorectal resection[111]. A recent study conducted in Austria including 59 patients (4.5%) who underwent emergency colectomy for colorectal carcinoma among 1297 patients treated with elective colectomy for colorectal carcinoma found that emergency resection reduced 5-year overall survival (35.6% *vs* 64.4%) and disease-free survival (54.2% *vs* 75.4%) and increased 1-year recurrence (47.5% *vs* 25.4%) rates. The 5-year overall survival rate for elective cases was higher in laparoscopic than open colectomy (71.4% *vs* 62.2%)[4]. Right-sided obstruction, despite more primary resections and anastomoses, is related to a worse prognosis than left-sided obstruction[45].

A recent nationwide retrospective study conducted in the Netherlands including 525 patients managed for obstructed (7%) and 6891 patients managed for nonobstructive (93%) right-sided colon carcinoma found that in all stages, obstruction was associated with worse 90-d mortality (10% *vs* 3%) and 5-year overall survival (42% *vs* 73%) than no obstruction [20].

Mortality after emergency surgery for obstructed colorectal carcinoma reaches up to 11.72%. Various high-risk predictive factors were identified, including right-sided location, age 70 years or more, cachexia, obesity, septic conditions, and increased creatinine and platelet levels[112].

Obstructions involving the splenic flexure have a worse prognosis than those in other locations[46]. Obese patients with obstructive colorectal cancer exhibit more severe clinical presentation than those without obesity and similar postoperative morbidity but more colostomy complications in left-sided cases[113].

Comorbidities such as cardiovascular, cerebral, chronic obstructive disease and diabetes mellitus may affect the oncological outcome of colorectal carcinoma patients, including acute obstruction[114].

After emergency surgery for obstructed colorectal carcinoma, elderly patients have increased morbidity and reduced survival, mainly those over 84 years[105]. The finding of an obstructive colorectal carcinoma on colonoscopy predicts more advanced stage and reduced overall survival[115]. Some prognostic systems, such as the modified inflammation marker Glasgow score, may predict the long-term oncological outcome in obstructed colorectal carcinoma[116].

CONCLUSION

Obstructed colorectal carcinoma is common in the emergency setting and is the main cause of colon-related obstructive ileus mainly in elderly patients. It requires emergency decompression to prevent more severe complications. For right-sided obstructions, one-stage emergency resection surgery and primary anastomosis are widely accepted. For left-sided obstructions, there are conflicting aspects. Emergency one-stage on-table bowel decompression, surgical resection and primary anastomosis accompanied or not, by loop right transverse colostomy or loop ileostomy, must be the method of choice for fit patients under 70 years. However, in daily clinical practice, the two-stage Hartmann's procedure is favored worldwide. In unfit patients, emergency decompression by endoscopic self-expandable metal stents mainly or decompressing tubes as a bridge to surgery must be the first choice. The alternative second choice is decompressing colostomy. Stenting is also indicated in all inoperable cases as palliation. Laparoscopic management requires considerable relevant experience but is associated with better short-term and possibly long-term outcomes. Management plans are crucial, and decision-making must be individualized to better fit each case, covering all needs and thus improving the results.

FOOTNOTES

Author contributions: Pavlidis TE designed research, contributed new analytic tools, analyzed data and review; Galanis IN analyzed data and review; Pavlidis ET performed research, analyzed data, review and wrote the paper.

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