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BRIEF ARTICLE

Managing acute colorectal obstruction by "bridge stenting" to laparoscopic surgery: Our experience

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Abstract

AIM: To verify the clinical results of the endoscopic stenting procedure for colorectal obstructions followed by laparoscopic colorectal resection with "one stage anastomosis".

METHODS: From March 2003 to March 2009 in our surgical department, 48 patients underwent endoscopic stenting for colorectal occlusive lesion: 30 males (62.5%) and 18 females (37.5%) with an age range from 40 years to 92 years (median age 69.5). All patients enrolled in our study were diagnosed with an intestinal obstruction originating from the colorectal tract without bowel perforation signs. Obstruction was primitive colorectal cancer in 45 cases (93.7%) and benign anastomotic stricture in 3 cases (6.3%).

RESULTS: Surgical resection was totally laparoscopic in 69% of cases (24 patients) while 17% (6 patients) of cases were video-assisted due to the local extension of cancer with infiltrations of surrounding structures (urinary bladder in 2 cases, ileus and iliac vessels in the others). In 14% of cases (5 patients), resection was performed by open surgery due to the high American Society of Anesthesiologists score and the elderly age of patients (median age of 89 years). We performed a terminal stomy in only 7 patients out of 35, 6 colostomies and one ileostomy (in a total colectomy). In the other 28 cases (80%), we performed bowel anastomosis at the same time as resection, employing a temporary ileostomy only in 5 cases.

CONCLUSION: Colorectal stenting transforms an emergency operation in to an elective operation performable in a totally laparoscopic manner, limiting the confection of colostomy with its correlated complications.

Key words: Colorectal cancer; Laparoscopy; Colonic stenting; Intestinal obstruction; Endoscopy

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INTRODUCTION

Colorectal obstruction represents a common problem due to pelvic neoplasms, such as gynecological, prostatic, colorectal and urinary bladder in 90% of cases[1-3] or due to bowel inflammatory conditions, such as Crohn's disease and ischemic or diverticular stenosis. Colorectal cancer causes a complete or incomplete obstruction in 8%-29% of cases[4-8] and obstruction represents 85% of surgical emergencies for colon cancer[9]. Bowel obstruction leads to some complications like dehydration, hypo-

volemic shock, renal or pulmonary acute failure, intestinal perforation, peritonitis *etc*. These conditions are a worse prognostic factor for elderly patients with high American Society of Anesthesiologists (ASA) or Acute Physiology and Chronic Health Evaluation score or with locally advanced or metastatic cancer (almost 40% of this kind of patients) above all[6,10-13]. For these reasons, emergency management of this kind of condition is characterized by a high morbidity (40%-60%) and mortality rate (3%-19%)[14] but, for some authors, also 27%-40%[1,9,15-19], considering that the mortality rate for the same operation performed electively ranges from 0.9%-6%[1,13,20]. In addition, it is peremptory to stress that these conditions are correlated to a high temporary or definitive colostomy rate (24%-40%), with negative impact on the quality of life for the patient (in terms of limited social and sexual life), on the social costs and with the consequent necessity for the patient to undergo one or more operations to re-establish intestinal continuity[1,6,21,22]. Consequently, these reasons have promoted research for alternative therapeutic ways; contemporaneously, the encouraging results of a stenting procedure achieved in esophageal, duodenal, biliary and vascular districts have led to experimental use of endoscopic stenting initially as palliative treatment of tumoral colonic stenosis and subsequently as preparation for curative colonic surgery ("bridge to surgery")[23,24].

In fact, the possibility of not performing a surgical decompression of the bowel using an endoscopic stent allows for a palliation therapy in patients with severe comorbidity or advanced cancer, avoiding a surgical emergency and allowing elective surgery with several benefits. This procedure allows improvement in the general condition of patients who are often wasted and dehydrated, reducing post operative mortality and morbidity; it allows diagnostic procedures with complete staging and the optimal pre-operative cleansing of the large bowel, allowing anastomosis in one stage and avoiding a temporary ileo or colostomy (one stage procedure). Although an intestinal stent is expensive, its use decreases the overall cost because it reduces the costs of surgery, hospital stay and intensive therapy from 19.7% to 28.8%, as reported by some authors[25-27], and the costs of ileo or colostomy with its correlated complications (prolapse, stenosis, cutaneous irritation). In some studies, the cost of palliative stenting is less than surgical palliation by 50% and the cost of the "bridge to surgery treatment " is less than surgery, from 12%-20%[26,28-30].

Since Dohmoto *et al*[31] first described the successful stenting of a rectal occlusive tumor in inoperable patients in 1991, several studies have been performed to evaluate the safety and the efficacy of the new promising procedure[32-34].

During these years, techniques and devices were modified; from rigid and plastic endoprosthesis commonly used in the tracheobronchial, esophageal and vascular district[27,35] (with a perforation rate of 22%[36] and increased risk of dislocation, obstruction and inhibition of peristalsis) to modern self expanding flexible metal stents easier to use in flexure and tight stenosis and with a considerably lower rate of complications[37].

The only disadvantage of this kind of stent is the neoplastic growth through the mesh; for this reason, polyurethane covered stents have been successively proposed.

At the beginning, the flexure or descending colon localization was a contraindication to the stenting procedure but actually any anatomic site is precluded. In fact, although at least 70% of obstructive lesions occur in the left colon, similar lesions of other colonic segments, including the ascendant colon, are successfully treated[26,38]. Right sided occlusions might be managed by an emergency operation with a limited morbidity and mortality rate compared to left sided resections. Other than site lesion, the length also does not constitute a contraindication to stenting, even if lesions less than 3 cm are technically more manageable[26]. The success rate reported in the literature ranges from 64% to 100%[10,34,35,39].

The stenting procedure is considered the first line treatment for neoplastic stenosis, both as a bridge to surgery and as palliative therapy in patients not amenable for surgery for oncological reasons, poor general conditions or in the case of no informed consent[21,25,32,38,40].

This approach has been recently criticized in the palliative use of a stent because, except for occlusion, it does not solve symptoms like pain, rectal tenesmus, bleeding and anemia; despite that, it has been approved by the FDA[21].

The only contraindication is the presence of colic perforation which requires an immediate laparotomy or laparoscopy.

The use of a stent in benign pathology has sporadic confirmation in the literature[41-44] but is controversial due to the lack of randomization studies and there being other ways of avoiding occlusion. For example, dilatation is considered a valid alternative in Crohn's stenosis, with a success rate of 80%-90%[45,46] but with short-term results.

MATERIALS AND METHODS

The aim of our study was to verify the clinical results of the endoscopic stenting procedure for colorectal obstructions followed by laparoscopic colorectal resection with "one stage anastomosis".

From March 2003 to March 2009 in our surgical department, 48 patients underwent endoscopic stenting for colorectal occlusive lesions: 30 males (62.5%) and 18 females (37.5%) with an age range of 40-92 years (median age 69.5). All patients enrolled in our study were diagnosed with an intestinal obstruction originating from the colorectal tract without bowel perforation signs. Diagnosis of intestinal obstruction was made on the basis of clinical history, symptoms and physical examination of the patient, who underwent radiological examinations like abdominal X-ray, colon X-ray evaluation with

Table 1 Site of obstruction

Patients	Site of obstruction
2	Transver secolon
3	Splenic flexure
29	Descending/sigmoidcolon
9	Upper rectum
5	Middle rectum

Table 2 Type of resections

	Laparoscopic	Open	Assisted
Right colectomy	3	-	-
Segmentary resection	3	2	-
Left colectomy	9[1]	-	1[1]
Proctectomy	7[1]	-	2[1]
Hartmann	2[2]	1[2]	3[2]
Total colectomy	-	2[3]	-

[1]End to end colorectal anastomosis Knight Griffen; [2]Vascular deficit in 1 case, peritoneal carcinomatosis in 2 cases, local advanced rectal cancer in 3 cases; [3]Left sided obstruction with cecal diastatic rupture.

a water-soluble gastrografin enema and, in some cases, an abdominal computed tomography scan. The obstruction was primitive colorectal cancer in 45 cases (93.7%) and benign anastomotic stricture in 3 cases (6.3%). All patients underwent a cleansing enema before the endoscopic procedure and had a pre-medication intravenous injection of 2 mg of Midazolam® (Midazolam-hameln pharmaceuticals gmbh, Hameln, Germany) during the examination without anesthetic assistance. The procedure was done using an endoscope because it allowed easier prosthetic placement, mainly for tumor obstruction located above the rectal peritoneal reflection, allowing visualization in real time of the successfully stenting and allowing the biopsy of the lesion. Stents positioned endoscopically are limited in their gauge because they have to pass inside the endoscope.

The procedure was always performed using a guidewire inserted through the endoscope duct, moving it beyond the obstruction and then inserting the stent using Seldinger's technique. We have never performed any kind of dilatation or laser treatment of the obstruction to allow stenting. We have always utilized the same Wallflex® system (Boston Scientific Corporation) of 25 mm gauge, with variable length according to the site and the extension of the obstruction, provided with a releasing device through the scope through-the-scope. This kind of stenting system costs about 1630 Euro.

Twenty-four hours after stenting, we performed an abdominal X-ray to evaluate the correct placement of prosthesis and the absence of free intra abdominal air. Then the patient can resume oral intake, a half liquid diet, and can complete the diagnostic course and eventually have pre-surgical preparation.

The technical success rate (correct placement and expansion of prosthesis) of our series was about 95.8%

Table 3 Histological characteristics of specimen *n* (%)

Grading and TNM (UICC system)	
G2	22 (62.9)
G2/3	8 (22.8)
G3	5 (14.3)
T2	2 (5.7)
T3	21 (60)
T4	12 (34.3)
N^+	18 (51.4)
N1	9 (25.7)
N2	9 (25.7)
M^+	8 (22.8)

TNM: Tumor node metastasis; UICC: Union for International Cancer Control.

and clinical success rate was about 100% (relief of occlusion and abdominal deflating). The only two failures occurred in a patient affected by obstructed stenosis that was not amenable to be crossed by a ground wire; therefore, he underwent an emergency operation. Complications occurred in 2 patients (4.2%): one dislocation and one perforation. The latter case was caused by a cecal break due to air insufflation during stenting. In 13 cases (27%), the stenting procedure represented the only therapeutic and palliative option because the patients were in a poor clinical condition, were old and affected by serious comorbidity. The remnant of 35 patients (73%) consequently underwent surgical bowel resection and the median time of bridge to surgery was 9.2 d, ranging from 2 to 78 d. Of these patients, twenty were male (57.1%) and fifteen female (42.9%), with a median age of 69 years. Sixteen were ASA Ⅱ, thirteen ASA Ⅲ and six ASA Ⅳ. The site of obstruction is shown in Table 1.

Surgical resection was totally laparoscopic in 69% of cases (24 patients) while 17% (6 patients) of cases were video-assisted due to the local extension of cancer with infiltrations of surrounding structures (urinary bladder in 2 cases, ileus and iliac vessels in the others). In 14% of cases (5 patients), resection was performed by open surgery due to the high ASA score and the elderly age of patients (median age of 89 years). We performed a terminal stomy in only 7 of 35 patients, 6 colostomies and one ileostomy (in a total colectomy). In the other 28 cases (80%), we performed bowel anastomosis at the same time of resection, employing a temporary ileostomy only in 5 cases; the latter presented a higher than 3 risk factor for anastomotic leakage.

The type of surgical resection is shown in Table 2. Mean operative time was 220 min for laparoscopic surgery and 183 min for open surgery. The histological characteristics of cancer are represented in Table 3.

At the time of diagnosis, 22.8% of patients had distant metastasis. 51.4% of cases were found to have a metastatic lymph node (25.7% N1 and 25.7% N2) with a median of 18.2 lymph nodes isolated for specimen (range 7-35). The number of lymph nodes removed during laparoscopic resection was mild major of that removed in open surgery, 19.1 *vs* 17.9.

Table 4 Complications

Complications	*n*
Major complications	
Acute myocardial infarction	1
Anastomotic leak[1]	1
Anastomotic dehiscence	1
Minor complications (fever, anemia requiring blood transfusion, prolonged post surgical ileus, wound infection)	5
Total (%)	8 (22.8%)

[1]Subclinical anastomotic leak in patient with ileostomy.

The margin free from disease was on average 4.4 cm (range: 2-8.5 cm) without any significant difference between the open and laparoscopic approach (4.1 cm open *vs* 4.8 cm laparoscopic).

Median hospital stay after laparoscopic resection was 8.3 d and 12.1 d after open surgery. Median time of flatus was 3 d, resumption of oral intake was within 4 d, bladder catheter was usually removed on the fourth day and drainage tube on the sixth day (range: 4-8) and in these cases, the laparoscopic approach highlighted a short mean time. Complications occurred in 8 patients (22.8%), as shown in Table 4, and there was no mortality in our series.

DISCUSSION

In the last decade, the high mortality and morbidity rate occurring after emergency colorectal resection for intestinal obstructions have become well-known as complications related to colostomy, including alterations of the sexual and quality of life[19]. These events can be limited by performing the "one stage resection" technique with an intra-operating wash out[47], but it extends the surgical time and does not reduce complications due to bacterial migration, paralytic ileus, colonic handling etc. Other palliative procedures, such as endoscopic dilatation, laser, electrocauterization, cryo and photodynamic therapy[27,48], require repeated applications without immediately resolving the stenosis like the stenting procedure does.

Seventeen years after the intuition of Dohmoto, following the earlier studies by Spinelli *et al*[49] in 1992, Itabashi *et al*[50] in 1993 and Saida *et al*[51] in 1996, and after the multicenter trials conducted by Mainar *et al*[52] in 1999, colorectal stenting has been demonstrated to be a safe and useful procedure, with a success rate ranging from 64% to 100%[11,27]. This procedure allows resolution of a bowel obstruction, a unique palliative treatment in cases of inoperable patients, and as preparation for surgery to reduce complications and colostomies related to an emergency operation. Endoscopic stenting manages a critical bowel occlusion by performing a suitable intestinal cleansing, a colonic decompression and, in the same breath, balances the general clinical condition of the patient with correct hydration, nutrition and antibiotic therapy in order to perform a colonic resection in safe conditions. The stenting procedure increases the primary anastomosis rate and reduces the colostomy rate[47,53,54]. Recent meta-analysis trials[6,17,55] have demonstrated that endoscopic stenting significantly reduces the mean length of hospital stay by at least of 6-8 d, reduces the recourse to the intensive care unit, the morbidity and mortality rate and the colostomy rate from 24% to 8.2%.

Patients who underwent endoscopic stenting before surgery had ileus and consequently oral intake resumed earlier, a mean of 5 d earlier compared to patients who underwent emergency colonic resection without a preventative endoscopic procedure[56,57].

Some authors[58] claim that stent expansion could promote a local or distal diffusion of neoplastic cells due to a squeezing out effect or to possible bowel perforation (risk of 4%), but other recent studies[6,55,59,60] have demonstrated statistically significant differences of about 3 and 5 years survival rate between the use or not of a stenting procedure.

Complications due to stenting occur in about 30% of cases[10,34] and they are divided into early or late, depending on if they occur within or over 30 d. Early complications are more frequent in malignant neoplastic stenosis, while in benign stenosis, they are later[11,44].

Major complications are: dislocation or migration, perforation, break, re-obstruction with "cheesewiring" (cancer growth through the spaces of a metallic uncovered stent), fistulization, anorectal pain, incontinence and bleeding. Minor complications are intestinal hematoma and ulcerations.

Dislocation, reported in 4%-40% of cases[21,23,34,61], frequently occurs in benign pathology because tumoral growth maintains the stent in situ, otherwise it becomes malignant pathology, chemo treated or after employing laser therapy because the cancer reduction causes increase of the bowel lumen, promoting stent dislocation[10,21,38,44,62]. Another cause of migration may be the presence of hard feces or the diameter and type of stent employed.

Perforation, reported in 1%-17% of cases[6,10,21,38,44,51,63], is due to dilatation being performed before stent positioning and is also due to insertion, expansion and mucosal erosion caused by the stent. Perforation represents the most serious complication and it may spread tumor cells and result in a prompt emergency operation. A bowel stenosing lesion localized in the upper peritoneal reflection has a major risk of being perforated during the stenting procedure.

Late obstruction is a complication reported in the literature, with a rate ranging from 7% to 30%[38,44], is caused by the cancer growth through the stent (cheesewiring) and the use of a covered stent reduces this kind of complication but increases the migration risk[64].

Tumoral growth, both inside and around the stent, is a potential limiting factor of palliation therapy because it requires periodical substitution of the stent associated with Argon laser treatment[33,59,65]. To avoid pain, it is essential that the terminal portion of the stent is positioned at least above the dentate line. For this reason, it is difficult to stent a tumoral lesion located within 5 cm

from the anal margin, considering an overlap of 1 cm is required.

The cumulative mortality rate due to the stenting procedure ranges from 0.4 % to 1%[10-39].

Even with the best results and limited complication rate, the colonic stenting procedure is still not widely accepted because it may be problematic to institute an emergency multidisciplinary approach and achieve a suitable training level. It is most common to perform a Hartmann colic resection or colostomy alone in high risk patients because large and controlled randomized trials are being waited for before introducing this approach in clinical practice.

In the last decade, the laparoscopic approach has been also extended to oncological colorectal surgery, maintaining the specific advantages of laparoscopy as a minor surgical trauma, major comfort for patients (minor pain and minor analgesic needs), best esthetic result, minor hospital stay and minor post recovery complications but, at the same time, showing its safety, feasibility and oncological radicality available with the open approach.

Same randomized trials demonstrate the superiority of laparoscopic colectomy for cancer *vs* an open colectomy in terms of relapse and disease free survival[47,66,67].

In our experience, other than the above mentioned advantages, the stenting procedure has allowed us to do laparoscopic colorectal resection.

For the last decade in our surgical department, we have preferred the laparoscopic approach, whether to manage elective colorectal cancer or an emergency, to perform about 80% of total abdominal operations. One limit to advise against laparoscopy in managing intestinal occlusion is the distension of the small bowel resulting in a decreasing field of view. The stenting procedure allows avoidance of this problem.

In our study, we performed laparoscopic colon resection in 24 of 35 cases. Our results confirm stenting is a safe and feasible procedure, with an open conversion rate of 20% and without any intra-operating complications.

In conclusion, the treatment of stenotic colorectal obstruction by endoscopic decompression and subsequent laparoscopic resection with anastomosis represents a safe procedure, joining the advantages of respective mini invasive maneuvres with excellent clinical results.

Colorectal stenting transforms an emergency operation burdened with remarkable risks, complications and mortality to an elective operation performable in a totally laparoscopic manner, limiting the confection of colostomy with its correlated complications.

COMMENTS

Background

Colorectal cancer causes a complete or incomplete obstruction in 8%-29% of cases and the obstruction represents 85% of surgical emergencies in colon cancer. Bowel obstruction leads to some complications, like dehydration, hypovolemic shock, renal or pulmonary acute failure, intestinal perforation, peritonitis etc. that increases the morbidity and mortality rate. For this reason, the encouraging results of a stenting procedure achieved in esophageal, duodenal, biliary and vascular districts have led to experimental use of endoscopic stenting initially as palliative treatment of tumoral colonic stenosis and subsequently as preparation to curative colonic surgery, "bridge to surgery".

Research frontiers

Since Dohmoto *et al*[31] first described the successful stenting of a rectal occlusive tumor in an inoperable patient in 1991, several studies have been performed to evaluate the safety and efficacy of the new promising procedure. During these years, techniques and devices were modified; from rigid and plastic endoprothesis commonly used in the tracheobronchial, esophageal and vascular district to modern self expanding flexible metal stents easier to use, even in flexure and tight stenosis. The only disadvantage of this kind of stent is the neoplastic growth through the mesh; for this reason, polyurethane covered stents are successively proposed.

Innovations and breakthroughs

Colorectal stenting transforms an emergency operation burdened with remarkable risks, complications and mortality to an elective operation performable in a totally laparoscopic manner, limiting the confection of colostomy with its correlated complications.

Applications

Endoscopic stenting manages a critical bowel occlusion, performing a suitable intestinal cleansing, colonic decompression and, in the same breath, balancing the general clinical condition of the patient with correct hydration, nutrition and antibiotic therapy in order to perform a colonic resection in safe conditions. The stenting procedure increases the primary anastomosis rate, reduces the colostomy rate and significantly reduces the mean length of hospital stay, the recourse to an intensive care unit, the morbidity and mortality rate and the colostomy rate.

Peer review

This is a good study in which the authors analyze the effective safety and utility of the endoscopic colorectal stenting procedure, transforming an emergency operation to an elective operation performable in a laparoscopic manner.

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