

Role of colonic stents in the management of colorectal cancers

Jayesh Sagar

Jayesh Sagar, Department of Surgery, Medway Maritime Hospital, Gillingham ME7 5NY, United Kingdom

Author contributions: Sagar J conceived the issues which formed the contents of the manuscript and wrote the manuscript.

Conflict-of-interest statement: The author has no conflict of interests.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Correspondence to: Dr. Jayesh Sagar, DNB, FRCS (Ed), MD, Surgeon, Department of Surgery, Medway Maritime Hospital, Windmill Rd, Gillingham ME7 5NY, United Kingdom. jsagar_2001@yahoo.com
Telephone: +44-7875-104480

Received: August 14, 2015

Peer-review started: August 22, 2015

First decision: October 13, 2015

Revised: December 7, 2015

Accepted: December 18, 2015

Article in press: December 21, 2015

Published online: February 25, 2016

Abstract

Colorectal cancer is one of the commonly encountered cancers across the Western World. In United Kingdom, this constitutes third most common ranked cancer and second most common ranked cause of cancer related deaths. Its acute presentation as a malignant colonic obstruction imposes challenges in its management. Colonic stent has been used for many years to alleviate

acute obstruction in such cases allowing optimisation of patient's physiological status and adequate staging of cancer. In this review, current literature evidence regarding use of colonic stent in acute malignant colonic obstruction is critically appraised and recommendations on the use of colonic stent are advocated.

Key words: Colorectal; Cancer; Surgery; Emergency; Stent

© **The Author(s) 2016.** Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: Although colonic stents have been used for years to treat acute malignant colonic obstructions, current evidence based on the systematic review and randomised controlled trials do raise concerns about its impact on the long term outcomes. Its use has not been recommended in acute suspected malignant colonic obstruction as a bridge to surgery due to evidence of its impact on recurrence rates; however there is enough evidence to suggest its use as a palliation. In patients with multiple co-morbidities with high American Society of Anaesthesiologists grades, colonic stent may be considered as an alternative option to emergency surgical procedure as a bridge.

Sagar J. Role of colonic stents in the management of colorectal cancers. *World J Gastrointest Endosc* 2016; 8(4): 198-204
Available from: URL: <http://www.wjgnet.com/1948-5190/full/v8/i4/198.htm> DOI: <http://dx.doi.org/10.4253/wjge.v8.i4.198>

BACKGROUND

Colorectal cancer is one of the commonly encountered cancers across the Western World. In United Kingdom, it constitutes third most common ranked cancer and second most common ranked cause of cancer

related deaths. Although surgical intervention remains the mainstay of treatment for colorectal cancers, radiotherapy and chemotherapy do have role especially in locally advanced and metastatic disease. With the implementation of colorectal screening programme, presentation at an early stage is expected with better outcome. However, about 8%-13% of patients with colorectal cancers presents with acute colonic obstruction^[1-3]. In elective settings, individual would undergo adequate staging of cancer before initiation of treatment in a controlled environment, but acutely presenting patients with colonic obstruction need immediate intervention to relieve the obstruction. Thus this group of patients represents challenges to the colorectal team as emergency surgery in these patients either in the form of defunctioning stoma or primary resection is related with significantly high complications and mortality and in some cases, inadequate treatment. The alternative approach would be to stent the obstructing lesion to alleviate the obstruction. This would allow adequate time to stage the disease, achieve best optimal health status of the patient and initiation of any neoadjuvant treatment. However, there have been controversies about the use of stent in the management of acute suspected malignant colonic obstruction. Recently, European Society of Gastrointestinal Endoscopy has published the guidelines regarding the use of colonic stent in acute malignant colorectal obstruction^[4].

ANATOMICAL LIMITATIONS

Although colonic stents can be placed in any part of colon, considering the alternative surgical approach in the form of primary resection and anastomosis, colonic stents are usually preferred in left sided colonic obstructions. Until recently, the reported randomised controlled studies (RCT) comparing stenting vs emergency surgery for malignant colonic obstruction omitted colonic lesions proximal to splenic flexure except one^[5]. Similarly, all published RCTs except one^[5] had excluded rectal cancers from their study population due to known higher failure rates and complication rates. Apart from colonic obstruction from colorectal pathology, extra colonic pathology including carcinomatosis peritonei can also cause colonic obstruction. In these cases, colonic stenting may be considered for palliative purposes but this is associated with lower technical and clinical success rates and higher complication rates^[6-8]. Regarding presence of inflammatory bowel disease (IBD) in conjunction with malignant colonic obstruction requiring colonic stent, there is no evidence as IBD would change approach to deal with malignant colonic obstruction as management of malignant obstruction would override the management of IBD, however one needs to be aware of existing disease in proximal or distal colon when considering surgical or stent option in these cases. This review mainly focused on the obstruction caused by primary colonic malignant pathology.

COLONIC STENT

Although there is much published regarding the use of colonic stents in suspected malignant colonic obstruction, there is no evidence of colonic stenting as prophylaxis in asymptomatic patients. Prophylactic stenting is not recommended due to potential risks associated with stenting. There have been reports suggesting less effectiveness of colonic stents in peritoneal carcinomatosis cases although there has not been any major study published looking at the role of colonic stenting in these cases. There are generally no contraindications for the colonic stenting except perforation of colon. The only absolute contraindication for colonic stenting is colonic perforation. Outcomes following stent placement are not affected by patient's age and American Society of Anaesthesiologists (ASA)/physiological status^[9-14] as they are the main two risk factors predicting mortality and morbidity with any procedure. Pre-stenting investigation in the form of computed tomography (CT) with contrast enhancement is the investigation of choice with a sensitivity of 96% and specificity of 93%. It also helps to define the aetiology in 81% of cases and level of stenosis in 94% of cases. There is an added advantage of local lymphovascular and distant staging of tumour. Flexible sigmoidoscopy may be added in dubious diagnosis on CT scans. Synchronous colonic tumours are present in around 3%-4% of patients with colonic cancers^[15-18]. Knowledge of these synchronous lesions may change the definitive treatment of colonic cancers. However, routine adequate imaging with CT colonography or visualisation with colonoscopy to detect these synchronous lesions is not feasible in acute presentations and is not recommended. If patient receives successful colonic stent, colonoscopy through stent or CT colonography can be considered as a safe procedure^[19-22] to look for any synchronous lesions. In cohort of patients diagnosed with suspected malignant colonic obstructions, there would be few patients with benign cause of their obstructions. In two RCTs, the benign obstructive lesion was found in 4.6%^[23] and 8.2%^[24] of patients suspected of malignant obstructions. As definitive pathological confirmation in acute situation is not feasible, if indicated, stenting should be performed in suspected malignant obstruction without waiting for pathological diagnosis. Brush cytology or tissue biopsy can be obtained during stent placement if possible, however if there is any risk of obscuring views due to bleeding following biopsy, it can be deferred for a later time. In contrast to malignant pathology, stenting should be avoided in suspected diverticular strictures or obstruction due to high risk of perforation^[25]. However, the risk of having underlying malignant lesion in patients with diagnosed diverticulitis on CT scan was quoted to be 2.1% in one systematic review^[26].

Bowel preparation is debatable before stent placement considering the obstructive nature of the disease and there are no published reports related with the use of bowel preparation in such cases. In most of these

patients, although colon distal to obstruction is usually empty due to peristaltic movements, an enema can be used to facilitate visualisation before stent procedure. Antibiotic prophylaxis during stent placement is not indicated due to very low incidence of clinical manifestation of bacteraemia^[13,27]. Colonic stent placement can be achieved either endoscopically or radiologically but combination of endoscopy and fluoroscopy is recommended. Retrospective studies have reported similar success rates following endoscopic and radiologically placed stents but have shown greater technical success rates with combination technique^[14,28-30]. There is also definitive learning curve for an endoscopist to perform colonic stents. Couple of noncomparative studies suggested performance of at least 20 procedures with increased technical success rate and reduction in the number of used stents by endoscopist^[31,32]. There is some suggestion that endoscopists experienced in therapeutic endoscopic retrograde cholangiopancreatography would benefit from translating skills in stent placement procedures^[13]. Dilatation of colonic obstructing stricture is not recommended due to high risk of perforation^[29,33,34] but this recommendation is based on retrospective studies only.

The available colonic stents can be divided broadly in to two groups, covered and bare or uncovered stents. The potential factors responsible for success of stent insertion also include length and diameter of stent. Two met analysis comparing covered stents against bare stents showed no difference in technical and clinical success and complication rates, however, bare stents had significantly higher tumour ingrowth rates but had lower migration rates^[35,36]. Smaller body diameter stents (< 24 mm) are associated with higher migration rates^[13,37-39]. Considering the shortening after stent deployment, it is recommended to use long enough stent, in addition to the length of obstruction, to cover at least 2 cm on either ends^[40]. There is evidence of no difference in outcomes among different stent designs^[41-46]. The other major factor that affects stent outcomes is stentability of the obstruction. There is evidence that success rates are high in short segment obstructions with higher technical and clinical failures in obstructions > 4 cm^[38,47]. Similarly, although the clinical and technical success rates were similar in complete and impending (subtotal) obstruction, complication rates, especially perforation were higher in complete obstruction^[48].

COLONIC STENTS AS A BRIDGE TO SURGERY

Although colonic stenting seems to be an apparent management option for acute large bowel obstruction in potentially curable and resectable cases, there has always been controversy about their use as a bridge to surgery. Due to an ability to convert an emergency condition to elective situation permitting opportunities for staging and optimisation of patient's condition, stent

seems a viable option, however current evidence failed to show its superiority over traditional surgical options. Eight systematic reviews^[49-56] and seven randomised controlled trials^[23,24,57-61] have been published in last few years comparing emergency surgery with pre-operative colonic stenting for acute suspected malignant colonic obstruction. Two of the randomised controlled trials were closed prematurely due to higher complication rate in the stent group^[23,24] while one was closed early due to high complication rate in the surgical patients^[60].

The most recently published systematic review performed meta-analysis of all published seven randomised controlled trials covering more than 180 patients in each group^[49]. Mean technical success rate of 76.9% was achieved following stent placement. There was no difference in post procedure/surgical mortality in either group but overall complication rate and permanent stoma rate were noted to be lower in the stent group. The primary anastomosis rate was also high in stent group. The outcomes regarding cost effectiveness of stents were unclear. From this systematic review, it is clear that colonic stenting in acute setting has some definitive advantages compared to emergency surgery. However, one needs to consider long term impact of colonic stent insertion in terms of oncological outcomes, especially in cases of curable and resectable cancers at presentation.

There has been some trepidation raised regarding the impaired oncological outcomes following placement of colonic stents in patient having potentially curable cancer. This concern increases more so with potential complication in the form of perforation. Three randomised controlled trials have compared the medium term oncological outcomes subsequent to stent placement till the surgery vs primary surgical resection^[58,60,62]. All of these trials were of small sample size and comparatively shorter follow-up periods. The Chinese study included 48 patients; 24 offered stents till the surgery and 24 offered emergency surgical procedure^[58]. In this study, two of 13 patients in surgery arm and 11 of 22 patients in stent arm who had curative resection developed recurrent disease. However there was wide gap in the median follow-up period; 32 mo in open surgery group and 65 mo in stent group, this difference did not reach statistical significance. The 5-year overall survival rate was 27% and 48% in open surgery and stent groups respectively although it was statistically insignificant. The Spanish study included 28 patients; 15 in stent arm and 13 in surgery arm^[60]. Although this study was closed prematurely due to high rate of complications in the form of anastomotic leak in the surgical group, the disease recurrence was noted in eight out of 15 cases in stent arm and two out of 13 cases in surgical group at mean follow-up of 37.6 mo but this was not statistically significant. The third study represents outcomes of Dutch stent in 2 trial^[62]. This included follow-up of patients who had only curative treatment. It had 32 patients in emergency surgery arm and 26 in stent arm. The median follow-up was 36 and 38 mo respectively. Five-

year overall recurrence rate was 25% (8 patients of 32) in surgery arm and was 42% (11 of 26) in stent group. Local recurrence rate was 9% (3 out of 32) in surgery group and was 19% (5 out of 26) in stent group. Although overall five-year recurrence rate was statistically significant, local recurrence rate failed to reach that. The cumulative overall recurrence rate was 83% in patients with clinical or subclinical stent related perforation and was statistically significantly higher compared to emergency surgery group and non-perforated stent group.

The above findings made one to rethink about the use of these stent in acute suspected malignant colonic obstruction as a bridge till surgery in cases with potentially resectable and treatable tumours. Although the above studies had small number of patients and the follow-up period was variable and not long, it seems obvious that placement of these stent is not without its potential adverse impact in form of higher local and overall recurrence rates. These findings were supported by another large comparative prospective study showing higher local recurrence rates in stented patients aged ≤ 75 years^[63]. Until we have results from large number of patients with adequately designed randomised controlled trial, the oncological outcomes of stents needs to be weighed against the outcomes following emergency surgical intervention. As published studies did not reveal any significant difference in postoperative mortality and morbidity in either group, colonic stent cannot be recommended as a bridge till surgery in acute suspected malignant colonic obstruction. However, if surgical risks outweighs the long term benefits as in patients with increasing age, multiple co-morbidities and increasing ASA, stents can be considered as an alternative option. If colonic stent is used as a bridge till surgery, optimal time interval of five to ten days should be considered between stent placement and resection surgery^[52]. This is based on the facts that this time would allow patient to recover his/her physical and nutritional status. If resection surgery is delayed longer, it would impose more challenges performing surgical resection due to maturing of scar tissues, especially when considering laparoscopic resections.

COLONIC STENT AS A PALLIATION

It is getting clearer from above discussion that although colonic stent is not recommended as a bridge to surgery, it obviously has a role in the palliation. Two published meta-analysis including randomised and non-randomised comparative studies compared the colonic stent and emergency surgery as palliation^[64,65]. The clear advantages of lower postoperative mortality, reduced intensive and overall hospital stay with earlier start of chemotherapy were evident in the stent arm but the clinical success rate was statistically significantly higher in surgery arm. There was no statistically significant difference in the post-operative complications; early complications were more common in surgery arm while late complications were reported more frequently in stent arm. Although the

technical success rate in stent arm was 88% to 100%, colonic perforation, stent migration and re-obstruction were reported complications. These findings favour colonic stents in a palliative setting in acutely presented suspected malignant large bowel obstruction.

Successful deployment of colonic stents in these cases allows the advantage of starting chemotherapy at an earlier stage. However, chemotherapy also raises the suspicion of increased complication rates of stent placement, especially of colonic perforation. Several retrospective studies have reported increased stent related colonic perforation in patients who were treated with bevacizumab^[13,38,66]. Single meta-analysis published significantly higher rate of colonic perforation in patients who were on bevacizumab in comparison to those who were on chemotherapy without bevacizumab or not on chemotherapy at all^[34]. As the newer anti-angiogenic drugs such as regorafenib and aflibercept work alike bevacizumab, colonic stenting is not recommended in patients who are considered for treatment with anti-angiogenic agents. Clinically, this may impose difficulty as presentation of acute large bowel obstruction may be patients' first clinical presentation and it would be difficult to assess their suitability for chemotherapy with antiangiogenic agents at that time. However, patients presenting as an acute large bowel obstruction with known colonic cancer and on anti-angiogenic agents are not recommended to have colonic stent. There is limited evidence of increased stent related complications in patients who are already on chemotherapy without anti-angiogenic agents before stent placement however tumour shrinkage leading to stent migration due to chemotherapy may be a concern. Apart from stent related perforation, stent failure, re-obstruction and stent migration, other common potential complications include pain, tenesmus, incontinence and fistula formation. When used as a palliation, re-stenting is a viable option in expert hands in cases of stent migration or obstruction.

CONCLUSION

Colonic stents are associated with lower mortality and morbidity compared to emergency surgery in cases of acute suspected malignant large bowel obstruction. However, current evidence does not recommend use of colonic stent as a bridge till surgery in these cases but it is a preferred treatment to relieve obstruction in palliative settings. In patients with multiple medical co-morbidities, poor performance status and increased ASA, colonic stent can be considered as an alternative option as a bridge till surgery but careful discussion with patients about potential adverse impact on long term oncological outcomes is recommended.

REFERENCES

- 1 Winner M, Mooney SJ, Hershman DL, Feingold DL, Allendorf JD, Wright JD, Neugut AI. Incidence and predictors of bowel

- obstruction in elderly patients with stage IV colon cancer: a population-based cohort study. *JAMA Surg* 2013; **148**: 715-722 [PMID: 23740130 DOI: 10.1001/jamasurg.2013.1]
- 2 **Jullumstrø E**, Wibe A, Lydersen S, Edna TH. Colon cancer incidence, presentation, treatment and outcomes over 25 years. *Colorectal Dis* 2011; **13**: 512-518 [PMID: 20128833 DOI: 10.1111/j.1463-1318.2010.02191.x]
 - 3 **Cheyne N**, Cortet M, Lepage C, Benoit L, Faivre J, Bouvier AM. Trends in frequency and management of obstructing colorectal cancers in a well-defined population. *Dis Colon Rectum* 2007; **50**: 1568-1575 [PMID: 17687610 DOI: 10.1007/s10350-007-9007-4]
 - 4 **van Hooft JE**, van Halsema EE, Vanbiervliet G, Beets-Tan RG, DeWitt JM, Donnellan F, Dumonceau JM, Glynne-Jones RG, Hassan C, Jiménez-Perez J, Meisner S, Muthusamy VR, Parker MC, Regimbeau JM, Sabbagh C, Sagar J, Tanis PJ, Vandervoort J, Webster GJ, Manes G, Barthet MA, Repici A. Self-expandable metal stents for obstructing colonic and extracolonic cancer: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. *Gastrointest Endosc* 2014; **80**: 747-761.e1-e75 [PMID: 25436393 DOI: 10.1016/j.gie.2014.09.018]
 - 5 **Fiori E**, Lamazza A, De Cesare A, Bononi M, Volpino P, Schillaci A, Cavallaro A, Cangemi V. Palliative management of malignant rectosigmoidal obstruction. Colostomy vs. endoscopic stenting. A randomized prospective trial. *Anticancer Res* 2004; **24**: 265-268 [PMID: 15015606]
 - 6 **Kim JY**, Kim SG, Im JP, Kim JS, Jung HC. Comparison of treatment outcomes of endoscopic stenting for colonic and extracolonic malignant obstruction. *Surg Endosc* 2013; **27**: 272-277 [PMID: 22773238 DOI: 10.1007/s00464-012-2439-5]
 - 7 **Dronamraju SS**, Ramamurthy S, Kelly SB, Hayat M. Role of self-expanding metallic stents in the management of malignant obstruction of the proximal colon. *Dis Colon Rectum* 2009; **52**: 1657-1661 [PMID: 19690497 DOI: 10.1007/DCR.0b013e3181a8f4af]
 - 8 **Keswani RN**, Azar RR, Edmundowicz SA, Zhang Q, Ammar T, Banerjee B, Early DS, Jonnalagadda SS. Stenting for malignant colonic obstruction: a comparison of efficacy and complications in colonic versus extracolonic malignancy. *Gastrointest Endosc* 2009; **69**: 675-680 [PMID: 19251009 DOI: 10.1016/j.gie.2008.09.009]
 - 9 **Abbott S**, Eglinton TW, Ma Y, Stevenson C, Robertson GM, Frizelle FA. Predictors of outcome in palliative colonic stent placement for malignant obstruction. *Br J Surg* 2014; **101**: 121-126 [PMID: 24301218 DOI: 10.1002/bjs.9340]
 - 10 **Meisner S**, González-Huix F, Vandervoort JG, Goldberg P, Casellas JA, Roncero O, Grund KE, Alvarez A, García-Cano J, Vázquez-Astray E, Jiménez-Pérez J. Self-expandable metal stents for relieving malignant colorectal obstruction: short-term safety and efficacy within 30 days of stent procedure in 447 patients. *Gastrointest Endosc* 2011; **74**: 876-884 [PMID: 21855868 DOI: 10.1016/j.gie.2011.06.019]
 - 11 **Choi JH**, Lee YJ, Kim ES, Choi JH, Cho KB, Park KS, Jang BK, Chung WJ, Hwang JS. Covered self-expandable metal stents are more associated with complications in the management of malignant colorectal obstruction. *Surg Endosc* 2013; **27**: 3220-3227 [PMID: 23494513 DOI: 10.1007/s00464-013-2897-4]
 - 12 **Donnellan F**, Cullen G, Cagney D, O'Halloran P, Harewood GC, Murray FE, Patchett SE. Efficacy and safety of colonic stenting for malignant disease in the elderly. *Int J Colorectal Dis* 2010; **25**: 747-750 [PMID: 20213457 DOI: 10.1007/s00384-010-0917-6]
 - 13 **Small AJ**, Coelho-Prabhu N, Baron TH. Endoscopic placement of self-expandable metal stents for malignant colonic obstruction: long-term outcomes and complication factors. *Gastrointest Endosc* 2010; **71**: 560-572 [PMID: 20189515 DOI: 10.1016/j.gie.2009.10.012]
 - 14 **Geraghty J**, Sarkar S, Cox T, Lal S, Willert R, Ramesh J, Bodger K, Carlson GL. Management of large bowel obstruction with self-expanding metal stents. A multicentre retrospective study of factors determining outcome. *Colorectal Dis* 2014; **16**: 476-483 [PMID: 24506142 DOI: 10.1111/codi.12582]
 - 15 **Kodeda K**, Nathanaelsson L, Jung B, Olsson H, Jestin P, Sjövall A, Glimelius B, Pahlman L, Syk I. Population-based data from the Swedish Colon Cancer Registry. *Br J Surg* 2013; **100**: 1100-1107 [PMID: 23696510 DOI: 10.1002/bjs.9166]
 - 16 **Mulder SA**, Kranse R, Damhuis RA, de Wilt JH, Ouwendijk RJ, Kuipers EJ, van Leerdam ME. Prevalence and prognosis of synchronous colorectal cancer: a Dutch population-based study. *Cancer Epidemiol* 2011; **35**: 442-447 [PMID: 21470938 DOI: 10.1016/j.canep.2010.12.007]
 - 17 **Latournerie M**, Jooste V, Cottet V, Lepage C, Faivre J, Bouvier AM. Epidemiology and prognosis of synchronous colorectal cancers. *Br J Surg* 2008; **95**: 1528-1533 [PMID: 18991301 DOI: 10.1002/bjs.6382]
 - 18 **Papadopoulos V**, Michalopoulos A, Basdanis G, Papapolychroniadis K, Paramythiotis D, Fotiadis P, Berovalis P, Harlaftis N. Synchronous and metachronous colorectal carcinoma. *Tech Coloproctol* 2004; **8** Suppl 1: s97-s100 [PMID: 15655657 DOI: 10.1007/s10151-004-0124-y]
 - 19 **Park SH**, Lee JH, Lee SS, Kim JC, Yu CS, Kim HC, Ye BD, Kim MJ, Kim AY, Ha HK. CT colonography for detection and characterisation of synchronous proximal colonic lesions in patients with stenosing colorectal cancer. *Gut* 2012; **61**: 1716-1722 [PMID: 22115824 DOI: 10.1136/gutjnl-2011-301135]
 - 20 **Cha EY**, Park SH, Lee SS, Kim JC, Yu CS, Lim SB, Yoon SN, Shin YM, Kim AY, Ha HK. CT colonography after metallic stent placement for acute malignant colonic obstruction. *Radiology* 2010; **254**: 774-782 [PMID: 20177092 DOI: 10.1148/radiol.09090842]
 - 21 **Lim SG**, Lee KJ, Suh KW, Oh SY, Kim SS, Yoo JH, Wi JO. Preoperative colonoscopy for detection of synchronous neoplasms after insertion of self-expandable metal stents in occlusive colorectal cancer: comparison of covered and uncovered stents. *Gut Liver* 2013; **7**: 311-316 [PMID: 23710312 DOI: 10.5009/gnl.2013.7.3.311]
 - 22 **Vitale MA**, Villotti G, d'Alba L, Frontespezi S, Iacopini F, Iacopini G. Preoperative colonoscopy after self-expandable metallic stent placement in patients with acute neoplastic colon obstruction. *Gastrointest Endosc* 2006; **63**: 814-819 [PMID: 16650544 DOI: 10.1016/j.gie.2005.12.032]
 - 23 **Pirlet IA**, Slim K, Kwiatkowski F, Michot F, Millat BL. Emergency preoperative stenting versus surgery for acute left-sided malignant colonic obstruction: a multicenter randomized controlled trial. *Surg Endosc* 2011; **25**: 1814-1821 [PMID: 21170659 DOI: 10.1007/s00464-010-1471-6]
 - 24 **van Hooft JE**, Bemelman WA, Oldenburg B, Marinelli AW, Lutke Holzik MF, Grubben MJ, Sprangers MA, Dijkgraaf MG, Fockens P. Colonic stenting versus emergency surgery for acute left-sided malignant colonic obstruction: a multicentre randomised trial. *Lancet Oncol* 2011; **12**: 344-352 [PMID: 21398178 DOI: 10.1016/S1470-2045(11)70035-3]
 - 25 **Currie A**, Christmas C, Aldean H, Mobasher M, Bloom IT. Systematic review of self-expanding stents in the management of benign colorectal obstruction. *Colorectal Dis* 2014; **16**: 239-245 [PMID: 24033989 DOI: 10.1111/codi.12389]
 - 26 **Sai VF**, Velayos F, Neuhaus J, Westphalen AC. Colonoscopy after CT diagnosis of diverticulitis to exclude colon cancer: a systematic literature review. *Radiology* 2012; **263**: 383-390 [PMID: 22517956 DOI: 10.1148/radiol.12111869]
 - 27 **Chun YJ**, Yoon NR, Park JM, Lim CH, Cho YK, Lee IS, Kim SW, Choi MG, Choi KY, Chung IS. Prospective assessment of risk of bacteremia following colorectal stent placement. *Dig Dis Sci* 2012; **57**: 1045-1049 [PMID: 22057286 DOI: 10.1007/s10620-011-1962-x]
 - 28 **Kim JW**, Jeong JB, Lee KL, Kim BG, Jung YJ, Kim W, Kim HY, Ahn DW, Koh SJ, Lee JK. Comparison of clinical outcomes between endoscopic and radiologic placement of self-expandable metal stent in patients with malignant colorectal obstruction. *Korean J Gastroenterol* 2013; **61**: 22-29 [PMID: 23354346]
 - 29 **Sebastian S**, Johnston S, Geoghegan T, Torreggiani V, Buckley M. Pooled analysis of the efficacy and safety of self-expanding metal stenting in malignant colorectal obstruction. *Am J Gastroenterol* 2004; **99**: 2051-2057 [PMID: 15447772 DOI: 10.1111/j.1572-0241.2004.40017.x]

- 30 **de Gregorio MA**, Laborda A, Tejero E, Miguelena JM, Carnevale FC, de Blas I, Gimenez M, Maynar M, D'Agostino H. Ten-year retrospective study of treatment of malignant colonic obstructions with self-expandable stents. *J Vasc Interv Radiol* 2011; **22**: 870-878 [PMID: 21514839 DOI: 10.1016/j.jvir.2011.02.002]
- 31 **Williams D**, Law R, Pullyblank AM. Colorectal stenting in malignant large bowel obstruction: the learning curve. *Int J Surg Oncol* 2011; **2011**: 917848 [PMID: 22312531 DOI: 10.1155/2011/917848]
- 32 **Lee JH**, Yoon JY, Park SJ, Hong SP, Kim TI, Kim WH, Cheon JH. The learning curve for colorectal stent insertion for the treatment of malignant colorectal obstruction. *Gut Liver* 2012; **6**: 328-333 [PMID: 22844560 DOI: 10.5009/gnl.2012.6.3.328]
- 33 **Khot UP**, Lang AW, Murali K, Parker MC. Systematic review of the efficacy and safety of colorectal stents. *Br J Surg* 2002; **89**: 1096-1102 [PMID: 12190673 DOI: 10.1046/j.1365-2168.2002.02148.x]
- 34 **van Halsema EE**, van Hooft JE, Small AJ, Baron TH, García-Cano J, Cheon JH, Lee MS, Kwon SH, Mucci-Hennekinne S, Fockens P, Dijkgraaf MG, Repici A. Perforation in colorectal stenting: a meta-analysis and a search for risk factors. *Gastrointest Endosc* 2014; **79**: 970-982.e7; quiz 983.e2, 983.e5 [PMID: 24650852 DOI: 10.1016/j.gie.2013.11.038]
- 35 **Zhang Y**, Shi J, Shi B, Song CY, Xie WF, Chen YX. Comparison of efficacy between uncovered and covered self-expanding metallic stents in malignant large bowel obstruction: a systematic review and meta-analysis. *Colorectal Dis* 2012; **14**: e367-e374 [PMID: 22540666 DOI: 10.1111/j.1463-1318.2012.03056.x]
- 36 **Yang Z**, Wu Q, Wang F, Ye X, Qi X, Fan D. A systematic review and meta-analysis of randomized trials and prospective studies comparing covered and bare self-expandable metal stents for the treatment of malignant obstruction in the digestive tract. *Int J Med Sci* 2013; **10**: 825-835 [PMID: 23794946 DOI: 10.7150/ijms.5969]
- 37 **Kim BC**, Han KS, Hong CW, Sohn DK, Park JW, Park SC, Kim SY, Baek JY, Choi HS, Chang HJ, Kim DY, Oh JH. Clinical outcomes of palliative self-expanding metallic stents in patients with malignant colorectal obstruction. *J Dig Dis* 2012; **13**: 258-266 [PMID: 22500788 DOI: 10.1111/j.1751-2980.2012.00564.x]
- 38 **Manes G**, de Bellis M, Fuccio L, Repici A, Masci E, Ardizzone S, Mangiavillano B, Carlino A, Rossi GB, Occhipinti P, Cennamo V. Endoscopic palliation in patients with incurable malignant colorectal obstruction by means of self-expanding metal stent: analysis of results and predictors of outcomes in a large multicenter series. *Arch Surg* 2011; **146**: 1157-1162 [PMID: 22006874 DOI: 10.1001/archsurg.2011.233]
- 39 **Im JP**, Kim SG, Kang HW, Kim JS, Jung HC, Song IS. Clinical outcomes and patency of self-expanding metal stents in patients with malignant colorectal obstruction: a prospective single center study. *Int J Colorectal Dis* 2008; **23**: 789-794 [PMID: 18443807 DOI: 10.1007/s00384-008-0477-1]
- 40 **Baron TH**, Wong Kee Song LM, Repici A. Role of self-expandable stents for patients with colon cancer (with videos). *Gastrointest Endosc* 2012; **75**: 653-662 [PMID: 22341111 DOI: 10.1016/j.gie.2011.12.020]
- 41 **Yoon JY**, Jung YS, Hong SP, Kim TI, Kim WH, Cheon JH. Clinical outcomes and risk factors for technical and clinical failures of self-expandable metal stent insertion for malignant colorectal obstruction. *Gastrointest Endosc* 2011; **74**: 858-868 [PMID: 21862005 DOI: 10.1016/j.gie.2011.05.044]
- 42 **Kim JH**, Song HY, Li YD, Shin JH, Park JH, Yu CS, Kim JC. Dual-design expandable colorectal stent for malignant colorectal obstruction: comparison of flared ends and bent ends. *AJR Am J Roentgenol* 2009; **193**: 248-254 [PMID: 19542421 DOI: 10.2214/AJR.08.2003]
- 43 **Cheung DY**, Kim JY, Hong SP, Jung MK, Ye BD, Kim SG, Kim JH, Lee KM, Kim KH, Baik GH, Kim HG, Eun CS, Kim TI, Kim SW, Kim CD, Yang CH. Outcome and safety of self-expandable metallic stents for malignant colon obstruction: a Korean multicenter randomized prospective study. *Surg Endosc* 2012; **26**: 3106-3113 [PMID: 22609981 DOI: 10.1007/s00464-012-2300-x]
- 44 **Park JK**, Lee MS, Ko BM, Kim HK, Kim YJ, Choi HJ, Hong SJ, Ryu CB, Moon JH, Kim JO, Cho JY, Lee JS. Outcome of palliative self-expanding metal stent placement in malignant colorectal obstruction according to stent type and manufacturer. *Surg Endosc* 2011; **25**: 1293-1299 [PMID: 20976501 DOI: 10.1007/s00464-010-1366-6]
- 45 **Small AJ**, Baron TH. Comparison of Wallstent and Ultraflex stents for palliation of malignant left-sided colon obstruction: a retrospective, case-matched analysis. *Gastrointest Endosc* 2008; **67**: 478-488 [PMID: 18294511 DOI: 10.1016/j.gie.2007.08.043]
- 46 **García-Cano J**, González-Huix F, Juzgado D, Igea F, Pérez-Miranda M, López-Rosés L, Rodríguez A, González-Carro P, Yuguero L, Espinós J, Ducóns J, Orive V, Rodríguez S. Use of self-expanding metal stents to treat malignant colorectal obstruction in general endoscopic practice (with videos). *Gastrointest Endosc* 2006; **64**: 914-920 [PMID: 17140898 DOI: 10.1016/j.gie.2006.06.034]
- 47 **Jung MK**, Park SY, Jeon SW, Cho CM, Tak WY, Kweon YO, Kim SK, Choi YH, Kim GC, Ryeon HK. Factors associated with the long-term outcome of a self-expandable colon stent used for palliation of malignant colorectal obstruction. *Surg Endosc* 2010; **24**: 525-530 [PMID: 19597776 DOI: 10.1007/s00464-009-0604-2]
- 48 **Song HY**, Kim JH, Shin JH, Kim HC, Yu CS, Kim JC, Kang SG, Yoon CJ, Lee JY, Koo JH, Lee KH, Kim JK, Kim DH, Shin TB, Jung GS, Han YM. A dual-design expandable colorectal stent for malignant colorectal obstruction: results of a multicenter study. *Endoscopy* 2007; **39**: 448-454 [PMID: 17516352 DOI: 10.1055/s-2007-966270]
- 49 **Huang X**, Lv B, Zhang S, Meng L. Preoperative colonic stents versus emergency surgery for acute left-sided malignant colonic obstruction: a meta-analysis. *J Gastrointest Surg* 2014; **18**: 584-591 [PMID: 24170606 DOI: 10.1007/s11605-013-2344-9]
- 50 **Cennamo V**, Luigiano C, Coccolini F, Fabbri C, Bassi M, De Caro G, Ceroni L, Maimone A, Rossi GB, Ansaloni L. Meta-analysis of randomized trials comparing endoscopic stenting and surgical decompression for colorectal cancer obstruction. *Int J Colorectal Dis* 2013; **28**: 855-863 [PMID: 23151813 DOI: 10.1007/s00384-012-1599-z]
- 51 **Cirocchi R**, Farinella E, Trastulli S, Desiderio J, Listorti C, Boselli C, Parisi A, Noya G, Sagar J. Safety and efficacy of endoscopic colonic stenting as a bridge to surgery in the management of intestinal obstruction due to left colon and rectal cancer: a systematic review and meta-analysis. *Surg Oncol* 2013; **22**: 14-21 [PMID: 23183301 DOI: 10.1016/j.suronc.2012.10.003]
- 52 **De Ceglie A**, Filiberti R, Baron TH, Ceppi M, Conio M. A meta-analysis of endoscopic stenting as bridge to surgery versus emergency surgery for left-sided colorectal cancer obstruction. *Crit Rev Oncol Hematol* 2013; **88**: 387-403 [PMID: 23845505 DOI: 10.1016/j.critrevonc.2013.06.006]
- 53 **Tan CJ**, Dasari BV, Gardiner K. Systematic review and meta-analysis of randomized clinical trials of self-expanding metallic stents as a bridge to surgery versus emergency surgery for malignant left-sided large bowel obstruction. *Br J Surg* 2012; **99**: 469-476 [PMID: 22261931 DOI: 10.1002/bjs.8689]
- 54 **Ye GY**, Cui Z, Chen L, Zhong M. Colonic stenting vs emergent surgery for acute left-sided malignant colonic obstruction: a systematic review and meta-analysis. *World J Gastroenterol* 2012; **18**: 5608-5615 [PMID: 23112555 DOI: 10.3748/wjg.v18.i39.5608]
- 55 **Zhang Y**, Shi J, Shi B, Song CY, Xie WF, Chen YX. Self-expanding metallic stent as a bridge to surgery versus emergency surgery for obstructive colorectal cancer: a meta-analysis. *Surg Endosc* 2012; **26**: 110-119 [PMID: 21789642 DOI: 10.1007/s00464-011-1835-6]
- 56 **Sagar J**. Colorectal stents for the management of malignant colonic obstructions. *Cochrane Database Syst Rev* 2011; **(11)**: CD007378 [PMID: 22071835 DOI: 10.1002/14651858.CD007378.pub2]
- 57 **Ghazal AH**, El-Shazly WG, Bessa SS, El-Riwini MT, Hussein AM. Colonic endolumenal stenting devices and elective surgery versus emergency subtotal/total colectomy in the management of malignant obstructed left colon carcinoma. *J Gastrointest Surg* 2013; **17**: 1123-1129 [PMID: 23358847 DOI: 10.1007/s11605-013-2152-2]
- 58 **Tung KL**, Cheung HY, Ng LW, Chung CC, Li MK. Endo-

- laparoscopic approach versus conventional open surgery in the treatment of obstructing left-sided colon cancer: long-term follow-up of a randomized trial. *Asian J Endosc Surg* 2013; **6**: 78-81 [PMID: 23601995 DOI: 10.1111/ases.12030]
- 59 **Ho KS**, Quah HM, Lim JF, Tang CL, Eu KW. Endoscopic stenting and elective surgery versus emergency surgery for left-sided malignant colonic obstruction: a prospective randomized trial. *Int J Colorectal Dis* 2012; **27**: 355-362 [PMID: 22033810 DOI: 10.1007/s00384-011-1331-4]
 - 60 **Alcántara M**, Serra-Aracil X, Falcó J, Mora L, Bombardó J, Navarro S. Prospective, controlled, randomized study of intraoperative colonic lavage versus stent placement in obstructive left-sided colonic cancer. *World J Surg* 2011; **35**: 1904-1910 [PMID: 21559998 DOI: 10.1007/s00268-011-1139-y]
 - 61 **Cheung HY**, Chung CC, Tsang WW, Wong JC, Yau KK, Li MK. Endolaparoscopic approach vs conventional open surgery in the treatment of obstructing left-sided colon cancer: a randomized controlled trial. *Arch Surg* 2009; **144**: 1127-1132 [PMID: 20026830 DOI: 10.1001/archsurg.2009.216]
 - 62 **Sloothaak D**, van den Berg MM, Dijkgraaf M. Recurrences after endoscopic stenting as treatment for acute malignant colonic obstruction in the Dutch Stent-In 2 trial. Presented at the 21st UEG Week, Berlin, 2013
 - 63 **Gorissen KJ**, Tuynman JB, Fryer E, Wang L, Uberoi R, Jones OM, Cunningham C, Lindsey I. Local recurrence after stenting for obstructing left-sided colonic cancer. *Br J Surg* 2013; **100**: 1805-1809 [PMID: 24227368 DOI: 10.1002/bjs.9297]
 - 64 **Liang TW**, Sun Y, Wei YC, Yang DX. Palliative treatment of malignant colorectal obstruction caused by advanced malignancy: a self-expanding metallic stent or surgery? A system review and meta-analysis. *Surg Today* 2014; **44**: 22-33 [PMID: 23893158 DOI: 10.1007/s00595-013-0665-7]
 - 65 **Zhao XD**, Cai BB, Cao RS, Shi RH. Palliative treatment for incurable malignant colorectal obstructions: a meta-analysis. *World J Gastroenterol* 2013; **19**: 5565-5574 [PMID: 24023502 DOI: 10.3748/wjg.v19.i33.5565]
 - 66 **Cennamo V**, Fuccio L, Mutri V, Minardi ME, Eusebi LH, Ceroni L, Laterza L, Ansaloni L, Pinna AD, Salfi N, Martoni AA, Bazzoli F. Does stent placement for advanced colon cancer increase the risk of perforation during bevacizumab-based therapy? *Clin Gastroenterol Hepatol* 2009; **7**: 1174-1176 [PMID: 19631290 DOI: 10.1016/j.cgh.2009.07.015]

P- Reviewer: Sergi C S- Editor: Ji FF
L- Editor: A E- Editor: Li D





Published by **Baishideng Publishing Group Inc**

8226 Regency Drive, Pleasanton, CA 94588, USA

Telephone: +1-925-223-8242

Fax: +1-925-223-8243

E-mail: bpgoffice@wjgnet.com

Help Desk: <http://www.wjgnet.com/esps/helpdesk.aspx>

<http://www.wjgnet.com>

