ORIGINAL ARTICLE

The Role of Stents as Bridge to Surgery for Acute Left-Sided Obstructive Colorectal Cancer: Meta-Analysis of Randomized Controlled Trials

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ABSTRACT

Background: The role of self-expanding metallic stents (SEMS) as a bridge to surgery for acute left-sided obstructive colorectal cancer has remained controversial. **Objective:** To study the efficacy of this approach, we performed a meta-analysis at the gastrointestinal surgery center of Sichuan Academy of Medical Sciences and Sichuan Provincial People's Hospital (Eastern Hospital). **Methods:** Two PubMed and science-direct electronic databases were searched up to December 30, 2017. Eligible studies were randomized controlled trials (RCTs). **Results:** We selected 8 RCTs articles, which included 497 cases. The directly stoma rates were significantly lower in the stent group (odds ratio [OR] = 0.46, 95% confidence intervals [CIs] = 0.30–0.70, p = 0.0003). The successful primary anastomosis rates were significantly higher in the stent group (OR = 2.29, 95% CIs = 1.52-3.45, p < 0.0001). The post-procedural complication rates were significantly lower in the stent group (OR = 0.39, 95% CI = 0.18-0.82, p = 0.01). However, tumor recurrence rates were significantly higher in the stent group (OR = 1.79, 95% CI = 1.09-2.93, p = 0.02). Conclusions This meta-analysis confirms that SEMS placement could reduce direct stoma rate and increases the successful primary anastomosis rate; however, it was associated with a seemingly higher incidence of tumor recurrence. (REV INVEST CLIN. 2018;70:269-78)

Key words: Colorectal cancer. Stent. Intestinal obstruction. Meta-analysis.

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INTRODUCTION

Colorectal cancer is a major problem worldwide with high incidence and mortality rates. In China, in 2015 the estimated incidence rate was 376.3/100,000 and mortality rate was 191.0/100,000[1]. Left-sided colonic tumors are the most common, accounting for more than 50%[2-4]. Tumors at the splenic flexure were associated with the highest risk of obstruction (in 8.4% of cases, there was complete obstruction)[5], and published literature reported that 7-29% of patients present with acute colonic obstruction at the time of diagnosis[6,7].

Patients with acute left-sided colonic obstruction have traditionally undergone emergency surgery that often leads to the formation of a stoma, and about 40% of them will never have their stoma reversed[8-10]. Those with a permanent colostomy have a lower health-related quality of life[11]. Moreover, emergency surgery for acute colonic obstruction has a high mortality rate, of 8.2-19%, and a morbidity rate of 22.3-38%[12,13].

At present, numerous studies have shown that self-expandable metal stent (SEMS) placement is an effective treatment for patients stented as a bridge to surgery or as palliation due to acute obstructive colorectal cancer[14,15]. The literature has reported colonic stent success rates ranging from 47% to 100%, and the overall stenting complication rate ranging from 7.8% to 19%[14-16]. A recent meta-analysis showed a reduction on the rate of stoma and a higher primary anastomosis rate in the colonic stent as a bridge to surgery group compared with the emergency surgery group[17]. However, the study included only three randomized trials, which led to significant publication bias. Since some new reports have been published updating this meta-analysis, we performed a revised meta-analysis, including only randomized controlled trials (RCTs).

METHODS

Literature search strategy

Search was conducted in two electronic databases, PubMed, and science direct (the last search was updated on December 30, 2017). The following terms were used: colonic or colorectal neoplasm, stents, and intestinal obstruction. The search was done on studies conducted in human subjects, without restriction of language. We did not consider abstracts or unpublished studies. The reference lists of reviews and retrieved articles were hand-searched at the same time. We performed this meta-analysis according to the Preferred Reporting Items for Systematic reviews and Meta-Analysis guidelines.

Inclusion and exclusion criteria

We reviewed abstracts of all citations and retrieved studies. The following criteria were used to include published studies: (a) they had to be RCTs; (b) studies should include patients ≥ 18 years old, of either sex, who had left-sided colonic obstruction due to colorectal cancer confirmed by abdominal computed tomography (CT) scan; (c) studies should compare patient's stenting as a bridge to surgery with emergency surgery due to acute left-sided obstructive colorectal cancer; and (d) studies should contain sufficient raw data for estimating odds ratio (OR) with 95% confidence intervals (CI). The major reasons for exclusion of studies were: (1) studies without raw data available; (2) duplicates; and (3) no usable data reported.

Data extraction

Data were extracted from each study by two reviewers (Yang P and Lin Xiu-Feng) independently according to the per specified selection criteria. Any disagreements during screening and quality assessment were resolved by discussion.

Main and secondary outcomes

We considered the following main outcomes for the two different treatment groups: successful primary anastomosis rates, directly stoma rate, and postoperative complications. The rate of tumor recurrence was recorded as a secondary outcome for the current meta-analysis. Furthermore, within the SEMS group, we considered data regarding technical success, clinical success, and stent-related complications.

Statistical analysis

Statistical analysis was performed by RevMan5.3 software, which was provided by the Cochrane

Figure 1. Studies' identification, inclusion, and exclusion.
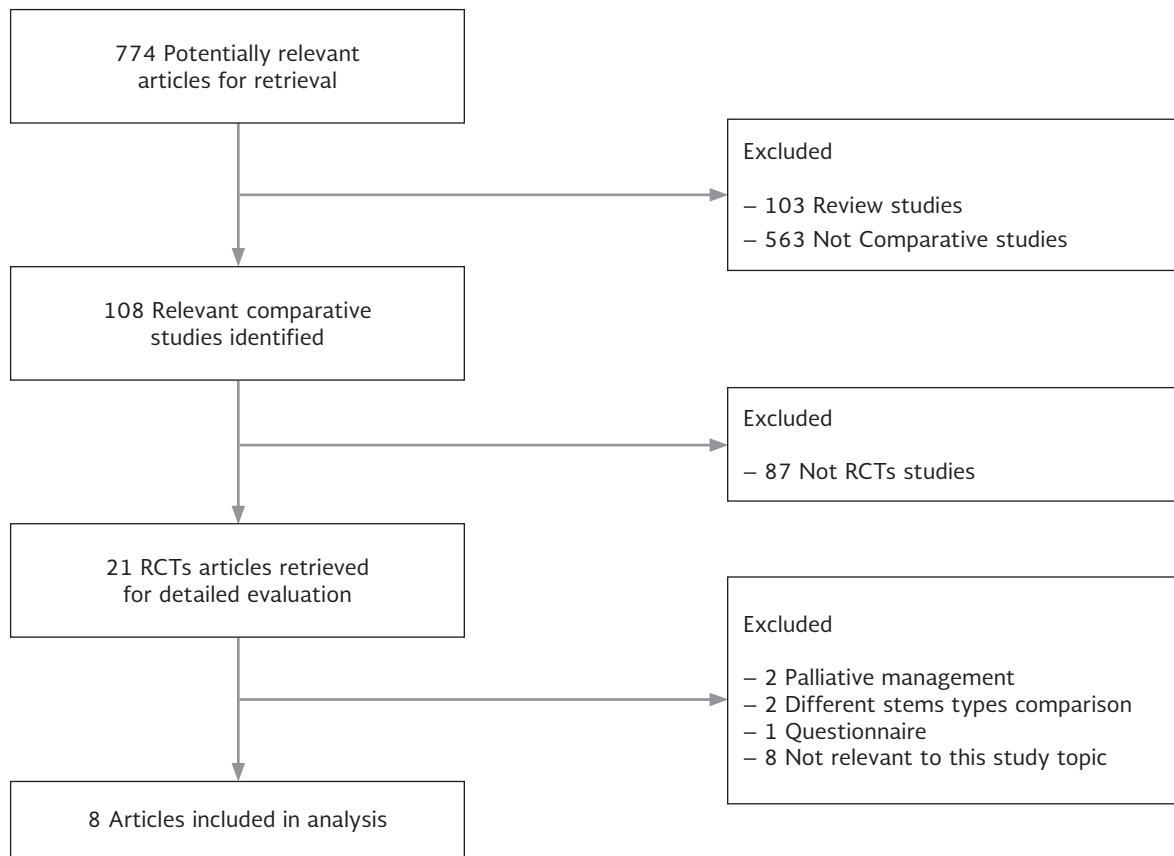
Collaboration. Heterogeneity was checked by chi-square test. If the results from the trials had heterogeneity, random effects model was used for meta-analysis. Otherwise, fixed effects model was used. *p* < 0.05 was considered statistically significant. The result was expressed with OR for the dichotomous variables with 95% CI.

Assessment of study quality

Included studies were reviewed and appraised for methodological quality using the Jadad composite scale[18]. High-quality trials scored more than 2 of a maximum possible score of 8[19].

RESULTS

Study characteristics

There were 774 articles relevant to the searching words (Fig. 1). Through the steps of filtering the title,

abstracts, and the full text, 8 papers were finally found to conform to our inclusion criteria[20-27]. From the 8 RCTs articles, which included 497 cases, 251 were randomly divided into the emergency SEMS as a bridge to surgery group, and 246 to the emergency surgery group. Technical and clinical success rates for stenting were 46.7-100% and 78.6-100%, respectively.

The clinical perforation rate was 5.6% (14 of 251) and the silent perforation rate, 14.3% (11 of 77). Two studies included rectal cancer cases[21,23]. One study[21] included one case in the stent as a bridge to surgery group only, and the other[23] did not report the number of rectal cancer cases.

The median time between stent placement and elective surgery varied in the included studies, from 3 to 10 days. Regarding the surgical approach, four studies[21,22,23,26] used laparotomy, three[20,25,27] used laparotomy and laparoscopic surgery, and one[24] used laparoscopic surgery. Characteristics of studies included in this meta-analysis are presented in table 1.

Table 1. Characteristics of RCTs studies included in this meta-analysis

Authors (year)	Country	Study period	No. SEMS/ES	Stent success (%)	Clinical success (%)	Randomization method	Stent type
Cheung et al.	China	2002.1-2005.5	24/24	100	83.3	Computer-generated lists	Wallstent
Alcántara et al.	Spain	2004.2-2006.12	15/13	95	95	Sealed envelopes	NA
Pirlet et al.	France	2002.12-2006.10	30/30	46.7	85.7	Computer-generated lists	Bard
Cui et al.	China	2005.9-2009.11	29/20	NA	100	Computer-generated lists	NA
van Hooft et al.	Netherlands	2007.3-2009.9	47/51	70.2	100	Computer-generated lists	Wallstent/ WallFlex
Ho et al.	Singapore	2004.10-2008.2	20/19	75	93.3	Computer-generated lists	WallFlex
Ghazal et al.	Egypt	2009.1-2012.5	30/30	96.7	100	Sealed envelopes	NA
Arezzo et al.	Italy, Spain	2008.3-2015.11	56/59	87.5	78.6	Computer-generated lists	WallFlex/ Hanaro

RCT: Randomized controlled study; SEMS: Self-expandable metallic stent; ES: Emergency surgery; NA: Not available.

Whether rectal cancer was included	Median time between stent placement and elective surgery (days)	Surgical approach
No	10 (2-16)	Laparoscopic and laparotomy
Yes	5-7	Laparotomy
No	7(5-19)	laparotomy
No	3,10	Laparotomy and laparoscopic
Yes	5-14	Laparotomy
No	10(9-38)	Laparoscopic
No	7-10	Laparotomy
No	5(3-8)	Laparoscopic and laparotomy

Quality of included studies

All the eight studies were randomized, non-blinded controlled trials and all of them had a detailed description of methods for randomization, six with a computer-generated list's allocation, and two with a random envelope method. The mean Jadad score of the included studies was 3 (Table 2). The main study limitations pertained to the justification of sample size, allocation concealment, and double-blinding.

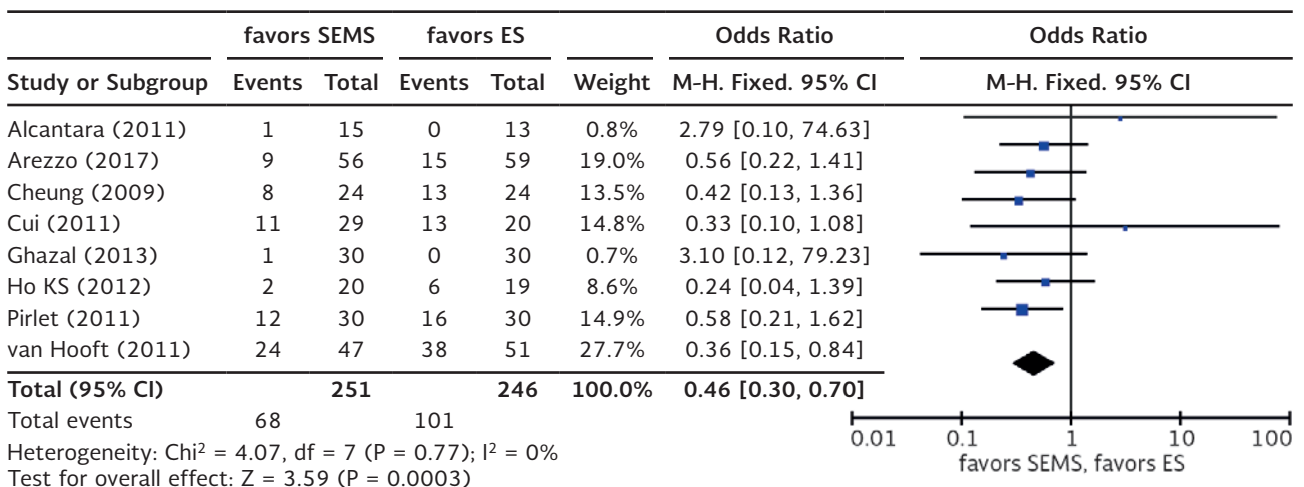## Quantitative data synthesis
Directly stoma rates

All the eight studies reported directly stoma rates. The combined results showed that the directly stoma rates were significantly lower in the stent group (OR = 0.46, 95% CI = 0.30–0.70, p = 0.002). Heterogeneity was not observed between the eight studies (χ^2 = 4.07, p = 0.77, I^2 = 0%), so the fixed effects model was used (Fig. 2).

Table 2. Jadad scores

	Cheung et al.	Alcántara et al.	Pirlet et al.	Cui et al.	van Hooft et al.	Ho et al.	Ghazal et al.	Arezzo et al.
Was the study described as randomized?	1	1	1	1	1	1	1	1
Was the method used to generate the sequence of randomization described and appropriate?	1	1	1	1	1	1	1	1
Was the study described as double-blind?	0	0	0	0	0	0	0	0
Was the method of double-blinding described and appropriate?	0	0	0	0	0	0	0	0
Was there a description of withdrawals and dropouts?	1	1	1	1	1	1	1	1
Total	3	3	3	3	3	3	3	3

Figure 2. Forest plot of directly stoma rates (SEMS vs. ES).

	favors SEMS		favors ES			Odds Ratio	Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H. Fixed. 95% CI	M-H. Fixed. 95% CI
Alcantara (2011)	1	15	0	13	0.8%	2.79 [0.10, 74.63]	
Arezzo (2017)	9	56	15	59	19.0%	0.56 [0.22, 1.41]	
Cheung (2009)	8	24	13	24	13.5%	0.42 [0.13, 1.36]	
Cui (2011)	11	29	13	20	14.8%	0.33 [0.10, 1.08]	
Ghazal (2013)	1	30	0	30	0.7%	3.10 [0.12, 79.23]	
Ho KS (2012)	2	20	6	19	8.6%	0.24 [0.04, 1.39]	
Pirlet (2011)	12	30	16	30	14.9%	0.58 [0.21, 1.62]	
van Hooft (2011)	24	47	38	51	27.7%	0.36 [0.15, 0.84]	
Total (95% CI)		**251**		**246**	**100.0%**	**0.46 [0.30, 0.70]**	
Total events	68		101				

Heterogeneity: Chi^2 = 4.07, df = 7 (P = 0.77); I^2 = 0%
Test for overall effect: Z = 3.59 (P = 0.0003)

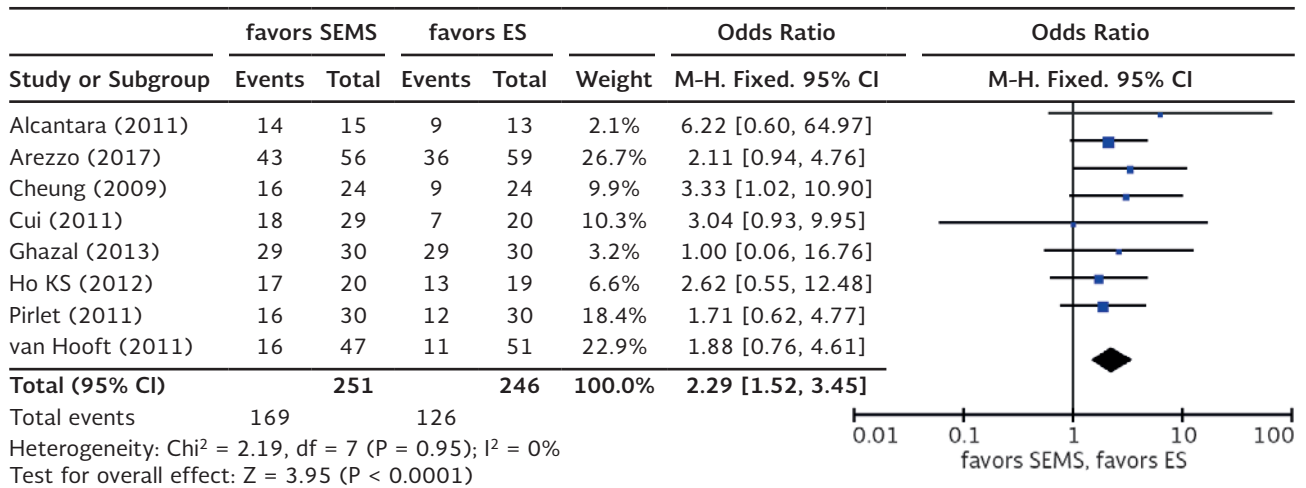SEMS: Self-expandable metallic stent; ES: Emergency surgery.

Successful primary anastomosis rates

All the eight studies reported successful primary anastomosis rates. The meta-analysis showed that the successful primary anastomosis rates were significantly higher in the stent group (OR = 2.29, 95% CI = 1.52–3.45, p < 0.0001), the finding not associated with significant heterogeneity (χ^2 = 2.19, p = 0.95, I2 = 0%) (Fig. 3).
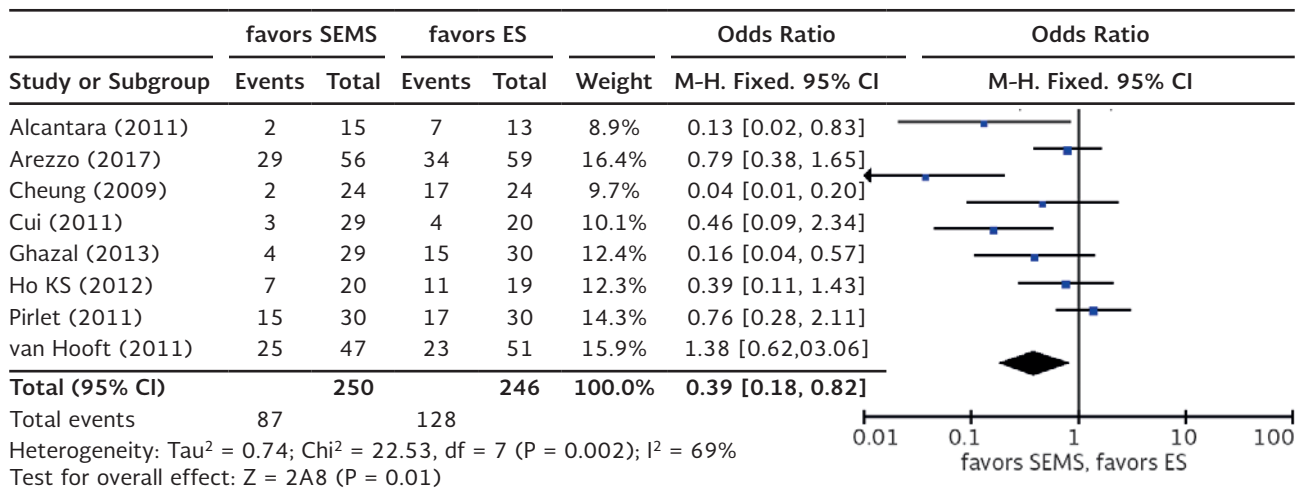
Post-operative complications

The overall complications were lower for the stent group (OR = 0.39, 95% CI = 0.18–0.82, p = 0.01), but this finding was associated with significant heterogeneity (χ^2 = 22.53, p = 0.002, I2 = 69%) (Fig. 4). This advantage has also been found in wound infections and permanent stoma. However, there was no statistically difference in mortality, anastomotic leak, intraperitoneal abscess, post-operative ileus, pulmonary infection,

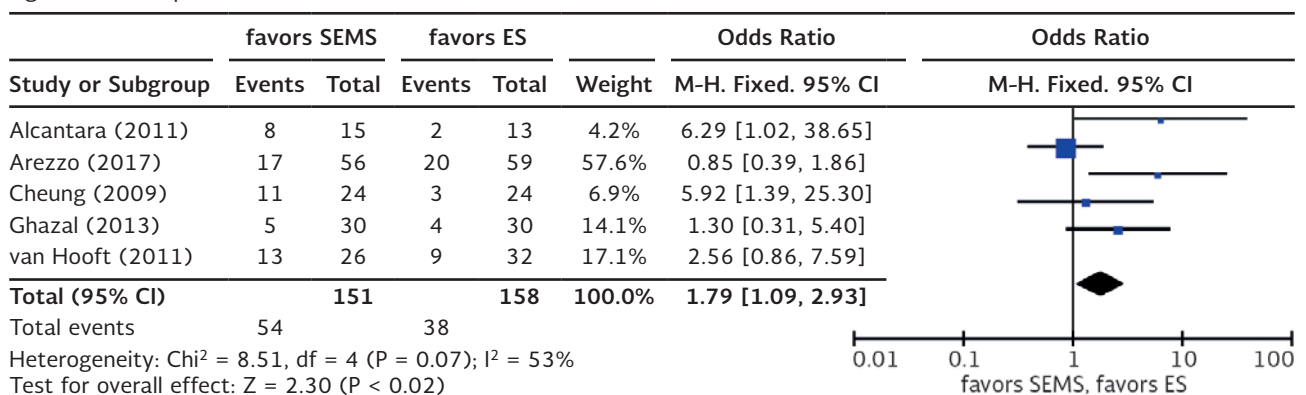Figure 3. Forest plot of successful primary anastomosis rates (SEMS vs. ES).

Study or Subgroup	favors SEMS Events	Total	favors ES Events	Total	Weight	Odds Ratio M-H. Fixed. 95% CI	Odds Ratio M-H. Fixed. 95% CI
Alcantara (2011)	14	15	9	13	2.1%	6.22 [0.60, 64.97]	
Arezzo (2017)	43	56	36	59	26.7%	2.11 [0.94, 4.76]	
Cheung (2009)	16	24	9	24	9.9%	3.33 [1.02, 10.90]	
Cui (2011)	18	29	7	20	10.3%	3.04 [0.93, 9.95]	
Ghazal (2013)	29	30	29	30	3.2%	1.00 [0.06, 16.76]	
Ho KS (2012)	17	20	13	19	6.6%	2.62 [0.55, 12.48]	
Pirlet (2011)	16	30	12	30	18.4%	1.71 [0.62, 4.77]	
van Hooft (2011)	16	47	11	51	22.9%	1.88 [0.76, 4.61]	
Total (95% CI)		**251**		**246**	**100.0%**	**2.29 [1.52, 3.45]**	
Total events	169		126				

Heterogeneity: Chi² = 2.19, df = 7 (P = 0.95); I² = 0%
Test for overall effect: Z = 3.95 (P < 0.0001)

SEMS: Self-expandable metallic stent; ES: Emergency surgery.

Figure 4. Forest plot of overall complications (SEMS vs. ES).

Study or Subgroup	favors SEMS Events	Total	favors ES Events	Total	Weight	Odds Ratio M-H. Fixed. 95% CI	Odds Ratio M-H. Fixed. 95% CI
Alcantara (2011)	2	15	7	13	8.9%	0.13 [0.02, 0.83]	
Arezzo (2017)	29	56	34	59	16.4%	0.79 [0.38, 1.65]	
Cheung (2009)	2	24	17	24	9.7%	0.04 [0.01, 0.20]	
Cui (2011)	3	29	4	20	10.1%	0.46 [0.09, 2.34]	
Ghazal (2013)	4	29	15	30	12.4%	0.16 [0.04, 0.57]	
Ho KS (2012)	7	20	11	19	12.3%	0.39 [0.11, 1.43]	
Pirlet (2011)	15	30	17	30	14.3%	0.76 [0.28, 2.11]	
van Hooft (2011)	25	47	23	51	15.9%	1.38 [0.62,03.06]	
Total (95% CI)		**250**		**246**	**100.0%**	**0.39 [0.18, 0.82]**	
Total events	87		128				

Heterogeneity: Tau² = 0.74; Chi² = 22.53, df = 7 (P = 0.002); I² = 69%
Test for overall effect: Z = 2A8 (P = 0.01)

SEMS: Self-expandable metallic stent; ES: Emergency surgery.

Figure 5. Forest plot of tumor recurrence rate (SEMS vs. ES).

Study or Subgroup	favors SEMS Events	Total	favors ES Events	Total	Weight	Odds Ratio M-H. Fixed. 95% CI	Odds Ratio M-H. Fixed. 95% CI
Alcantara (2011)	8	15	2	13	4.2%	6.29 [1.02, 38.65]	
Arezzo (2017)	17	56	20	59	57.6%	0.85 [0.39, 1.86]	
Cheung (2009)	11	24	3	24	6.9%	5.92 [1.39, 25.30]	
Ghazal (2013)	5	30	4	30	14.1%	1.30 [0.31, 5.40]	
van Hooft (2011)	13	26	9	32	17.1%	2.56 [0.86, 7.59]	
Total (95% CI)		**151**		**158**	**100.0%**	**1.79 [1.09, 2.93]**	
Total events	54		38				

Heterogeneity: Chi² = 8.51, df = 4 (P = 0.07); I² = 53%
Test for overall effect: Z = 2.30 (P < 0.02)

SEMS: Self-expandable metallic stent; ES: Emergency surgery.

Table 3. Statistical results of post-operative complications by Revman 5.0 (SEMS vs. ES)

Groups	No. of studies	OR (95% CIs)	Statistical method	P
Mortality rates	5	0.98[0.53-1.82]	Fixed	0.95
Overall complications	8	0.39[0.18-0.82]	Random	0.01
Abdominal complications				
Anastomotic leak	8	0.85[0.41-1.77]	Fixed	0.66
Permanent stoma	7	0.52[0.33-0.83]	Fixed	0.006
Intra-peritoneal abscess	7	0.66[0.28-1.56]	Fixed	0.34
Wound infection	8	0.49[0.27-0.87]	Fixed	0.01
Post-operative ileus	4	0.64[0.22-1.86]	Fixed	0.41
Extra-abdominal complications				
Pulmonary infection	6	0.66[0.28-1.52]	Fixed	0.32
Urinary tract infection	4	0.45[0.17-1.22]	Fixed	0.12
Organ failure	3	0.49[0.18-1.35]	Fixed	0.17

RCT: Randomized controlled study; SEMS: Self-expandable metallic stent; ES: Emergency surgery; NA: Not available.

Figure 6. Funnel plot of directly stoma rates.
SEMS: Self-expandable metallic stent;
ES: Emergency surgery.
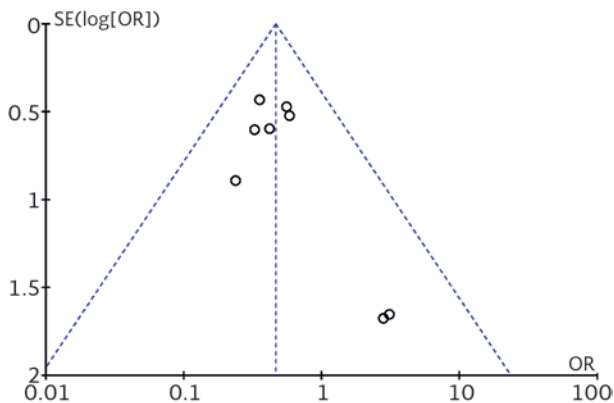
Figure 7. Funnel plot of successful primary anastomosis rates (SEMS vs. ES). SEMS: Self-expandable metallic stent; ES: Emergency surgery.
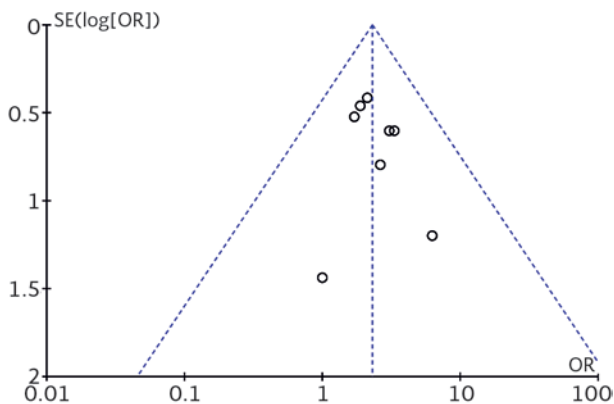
urinary tract infection, and organ failure between the two groups without heterogeneity (Table 3)

Tumor recurrence rate

Tumor recurrence was reported in five studies, with a median follow-up period of 18-65 months. The tumor recurrence rates were 35.8% (54/151) in the stent group and 24.1% (38/158) in the emergency surgery group. The meta-analysis showed that the rate was significantly higher in the stent group compared to the emergency surgery group (OR = 1.79, 95% CI = 1.09–2.93, p = 0.02), the finding not associated with significant heterogeneity (Chi^2 = 8.51, p = 0.07, I^2 = 53%) (Fig. 5).

Sensitivity analyses and publication bias

Statistically significant heterogeneity was observed only in overall complications analyses by chi-square test (χ^2 = 22.53, I^2 = 69%, p = 0.002). Removing an individual study from the list did not change the level of significance for the most important clinical outcomes (directly stoma rates, successful primary anastomosis rates, mortality rates, abdominal complications, and extra-abdominal complications). The funnel plots' shapes of directly stoma rates did not reveal any evidence of an obvious asymmetry, which means no such publication bias exists in this meta-analysis,

and the funnel plots' shapes of successful primary anastomosis rates were the same as those in figures 6 and 7.

DISCUSSION

Since colorectal SEMS introduction in the early 1990s, the SEMS as a bridge to surgery for acute left-sided obstructive colorectal cancer is a recent and appealing option. Some prior uncontrolled studies reported that it would improve the clinical condition of the patient and seemed to decrease mortality and morbidity[14,28-30]. This meta-analysis showed that using SEMS as a bridge to surgery for acute left-sided obstructive colorectal cancer did not have advantaged benefits for post-procedural overall complications and mortality. This result was different from the prior meta-analysis study[17].

The successful primary anastomosis rate and directly stoma creation rate have been frequently used to assess different treatments for acute left-sided obstructive colorectal cancer. In our meta-analysis, directly stoma rate, permanent stoma rate, and wound infection rate were significantly lower in the colonic stenting group than in the emergency surgery group. Moreover, the successful primary anastomosis rates were significantly higher for the stent group. However, this advantage was not obtained in the anastomotic leak. The reasons probably were insufficient bowel decompression so that there was no improvement in the patients' clinical condition. In addition, the emergency surgery nature and the surgeons' faith may have made the surgeons more conservative than in the SEMS as a bridge to surgery group.

Major post-procedural stent-related complications include perforation, stent migration, bleeding, and persistent obstruction. In this meta-analysis, four studies reported stent-related and procedure-related complications[22,23,26,27], and the other four studies did not report the complications with stent placement[20,21,24,25]. Pirlet et al. reported 2 (6.6%) stent-related perforations and 8 silent perforations in 30 patients randomized to colonic stenting as a bridge to surgery[22]. However, if the number of silent perforations is counted, the total perforation rate was as high as 33.3%. van Hooft et al. reported 6 (12.8%)

stent-related and post-procedural perforations[23]. The total perforation rate was 19.1% (9 perforations in 47 patients) if the number of silent colonic perforations is added. This matter of concern from an oncological aspect raises the question of tumor dissemination after stenting[31]. However, the consequences of dissemination are inconsistent if this information derived from survival data at present, ranging from no difference between colonic stenting and emergency surgery to a significantly reduced 5-year survival for patients treated with colonic stenting before elective surgery[10,32]. In our meta-analysis, the tumor recurrence rate was higher in the stent group. Due to the lack of raw data, we did not make Kaplan–Meier curves in this meta-analysis. Although stent placement was associated with a higher risk of recurrence, the numbers were too small to draw a definitive conclusion from this meta-analysis. The main reason for this difference was a stent-related perforation. The clinical perforation rate was 5.6% (14 of 251) and the silent perforation rate, 14.3% (11 of 77) in our meta-analysis. The safe use of stents already was shown by Saito et al. in a recent study, with only 1.6% risk of perforation and 1.3% risk of silent perforation[33]. Hence, the weaknesses of this meta-analysis were the variation in operator experience with stenting in the included studies. As a result, surgeons must demonstrate sufficient expertise in colonic stenting before they can perform these procedures.

The technical success rate ranged from 46.7% to 100% in the 8 articles included in this meta-analysis. Four studies described the reasons for technical failure[22-24,26]. The main reason was inability to pass the stricture with the guide-wire (13 of 16 in the study by Pirlet et al., 12 of 14 in the study by van Hooft et al., 4 of 5 in Ho et al.'s study, and 1 of 1 in the study by Ghazal et al.). In patients with complete obstruction, stent placement is more difficult, and the bowel might be less easily decompressed than in patients with incomplete obstruction[34]. Due to insufficient bowel decompression at the time of surgery, there was a fairly high leak rate in primary anastomosis without a stoma. A study reported that complete obstruction was an identified risk factor for complications[35]. However, our meta-analysis did not find the difference in anastomotic leakage between the two groups.

In this meta-analysis, only one study[23] reported the overall health status and quality of life between the two groups. Since there was no raw data, we could not do data synthesis. In their study[23], van Hooft et al. did not record any significant differences in overall health status, cancer-specific quality of life, or tumor-specific quality of life between the treatment groups, except for more stoma-related problems in the colonic stenting group than in the emergency surgery group. Two studies reported the cost-benefit analysis[21,24]. However, the two articles have reached the opposite conclusion. Alcántara et al. reported in their study that the cost was significantly higher for the colonic stenting group when the cost of material used was added in[21].

As in most meta-analysis, these results should be interpreted with caution. There are several limitations, although the research includes eight high-quality studies. First, all the eight studies included lack allocation concealment and double-blinding. Due to the obvious difference between the two methods, a completely double-blind randomized control is not possible. Therefore, there may be selection bias, implementation bias, and measurement bias. For example, the selection bias was very easy to choose in this colonic stenting group of stoma and primary anastomosis. Second, all of the eight studies included small numbers of patients; the largest number included was only 115 cases[27]. Third, differences in technical success rates, colonic stent designs, and operative techniques were associated with the confounding bias. Finally, this study did not perform an economic data synthesis due to the lack of relevant raw data on economics, as well as overall survival, progression-free survival, and quality of life.

In conclusion, this meta-analysis confirms that SEMS placement seems to reduce directly stoma rate and increases the successful primary anastomosis rate and is associated with a lower rate of overall complications, permanent stoma, and wound infection. However, it was seemingly associated with a high tumor recurrence incidence. Further large-scale studies are necessary to compare with the overall survival rate, progression-free survival rate, and quality of life in the two strategies.

REFERENCES

1. Chen W, Zheng R, Baade PD, et al. Cancer statistics in China, 2015. CA Cancer J Clin. 2016;66:115-32.
2. Roder D, Karapetis CS, Wattchow D, et al. Colorectal cancer treatment and survival: the experience of major public hospitals in south Australia over three decades. Asian Pac J Cancer Prev. 2015;16:2431-40.
3. Vermeer NC, Snijders HS, Holman FA, et al. Colorectal cancer screening: systematic review of screen-related morbidity and mortality. Cancer Treat Rev. 2017;54:87-98.
4. Zorzi M, Mangone L, Sassatelli R, et al. Screening for colorectal cancer in Italy: 2011-2012 survey. Epidemiol Prev. 2015;39: 115-25.
5. Kim CW, Shin US, Yu CS, Kim JC. Clinicopathologic characteristics, surgical treatment and outcomes for splenic flexure colon cancer. Cancer Res Treat. 2010;42:69-76.
6. Poultsides GA, Servais EL, Saltz LB, et al. Outcome of primary tumor in patients with synchronous stage IV colorectal cancer receiving combination chemotherapy without surgery as initial treatment. J Clin Oncol. 2009;27:3379-84.
7. Devon KM, Vergara-Fernández O, Victor JC, McLeod RS. Colorectal cancer surgery in elderly patients: presentation, treatment, and outcomes. Dis Colon Rectum. 2009;52:1272-7
8. Deans GT, Krukowski ZH, Irwin ST. Malignant obstruction of the left colon. Br J Surg. 1994;81:1270-6.
9. Watt AM, Faragher IG, Griffin TT, Rieger NA, Maddern GJ. Self-expanding metallic stents for relieving malignant colorectal obstruction: a systematic review. Ann Surg. 2007;246:24-30.
10. Kim JS, Hur H, Min BS, Sohn SK, Cho CH, Kim NK. Oncologic outcomes of self-expanding metallic stent insertion as a bridge to surgery in the management of left-sided colon cancer obstruction: comparison with nonobstructing elective surgery. World J Surg. 2009;33:1281-6.
11. Thyø A, Emmertsen KJ, Pinkney TD, Christensen P, Laurberg S. The colostomy impact score: development and validation of a patient-reported outcome measure for rectal cancer patients with a permanent colostomy. A population-based study. Colorectal Dis. 2017;19:25-33.
12. Sjo OH, Larsen S, Lunde OC, Nesbakken A. Short term outcome after emergency and elective surgery for colon cancer. Colorectal Dis. 2009;11:733-9.
13. Chiarugi M, Galatioto C, Panicucci S, Scassa F, Zocco G, Seccia M. Oncologic colon cancer resection in emergency: are we doing enough? Surg Oncol. 2007;16:S73-7.
14. Jiménez-Pérez J, Casellas J, García-Cano J, et al. Colonic stenting as a bridge to surgery in malignant large-bowel obstruction: a report from two large multinational registries. Am J Gastroenterol. 2011;106:2174-80.
15. Manes G, de Bellis M, Fuccio L, et al. 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;146:1157-62.
16. de Gregorio MA, Laborda A, Tejero E, et al. Ten-year retrospective study of treatment of malignant colonic obstruct ions with self-expandable stents. J Vasc Interv Radiol. 2011;22:870-8.
17. Cirocchi R, Farinella E, Trastulli S, et al. 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.
18. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials. 1996;17:1-12.
19. Moher D, Pham B, Jones A, et al. Does quality of reports of randomised trials affect estimates of intervention efficacy reported in meta-analyses? Lancet. 1998;352:609-13.
20. 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;144:1127-32.
21. 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: 1904-10.
22. 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;25:1814-21.

23. van Hooft JE, Bemelman WA, Oldenburg B, et al. Colonic stenting versus emergency surgery for acute left-sided malignant colonic obstruction: a multicentre randomised trial. Lancet Oncol. 2011;12:344-52.
24. 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;27:355-62.
25. Cui J, Zhang JL, Wang S, Sun ZQ, Jiang XL. A preliminary study of stenting followed by laparoscopic surgery for obstructing left-sided colon cancer. Zhonghua Wei Chang Wai Ke Za Zhi. 2011;14:40-3.
26. 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;17:1123-9.
27. Arezzo A, Balague C, Targarona E, et al. Colonic stenting as a bridge to surgery versus emergency surgery for malignant colonic obstruction: results of a multicentre randomised controlled trial (ESCO trial). Surg Endosc. 2017;31:3297-305.
28. Keränen I, Lepistö A, Udd M, Halttunen J, Kylänpää L. Stenting for malignant colorectal obstruction: a single-center experience with 101 patients. Surg Endosc. 2012;26:423-30.
29. Young CJ, Suen MK, Young J, Solomon MJ. Stenting large bowel obstruction avoids a stoma: consecutive series of 100 patients. Colorectal Dis. 2011;13:1138-41.
30. Park IJ, Choi GS, Kang BM, et al. Comparison of one-stage managements of obstructing left-sided colon and rectal cancer: stent-laparoscopic approach vs. intraoperative colonic lavage. J Gastrointest Surg. 2009;13:960-5.
31. Maruthachalam K, Lash GE, Shenton BK, Horgan AF Tumour cell dissemination following endoscopic stent insertion. Br J Surg. 2007;94:1151-4.
32. Saida Y, Sumiyama Y, Nagao J, Uramatsu M. Long-term prognosis of preoperative "bridge to surgery" expandable metallic stent insertion for obstructive colorectal cancer: comparison with emergency operation. Dis Colon Rectum. 2003;46:S44-9.
33. Saito S, Yoshida S, Isayama H, et al. A prospective multicenter study on self-expandable metallic stents as a bridge to surgery for malignant colorectal obstruction in Japan: efficacy and safety in 312 patients. Surg Endosc. 2016;30:3976-86.
34. Baron TH. Colonic stenting: a palliative measure only or a bridge to surgery? Endoscopy. 2010;42:163-8.
35. 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;71:560-72.