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Short-term and long-term oncologic outcomes of self-expandable metallic stent compared with tube decompression for obstructive colorectal cancer: a systematic review and meta-analysis

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Purpose: Patients with obstructive colorectal cancer managed by emergency surgery show high morbidity, mortality, and stoma formation rates. Decompression modalities, including the self-expandable metallic stent (SEMS) and tube drainage (TD), have been used to improve surgical outcomes. However, there have been limited studies comparing the 2 modalities. We performed a meta-analysis on short- and long-term outcomes between SEMS and TD.
Methods: PubMed, EMBASE, Cochrane Library, and Google Scholar were searched. Data were pooled, and the overall effect size was calculated using random effect models. Outcome measures were perioperative short-term and 3-year survival outcomes.
Results: We included 20 nonrandomized studies that examined 2,047 patients in the meta-analysis. The meta-analysis showed SEMS had better short-term outcomes in clinical success rate, decompression-related complications, laparoscopic surgery rate, stoma formation rate, and postoperative complication rate with a relative risk (RR) of 0.36 (95% confidence interval [CI], 0.24–0.54; I^2 = 20%), 0.32 (95% CI, 0.20–0.50; I^2 = 0%), 0.47 (95% CI, 0.34–0.66; I^2 = 87%), 0.34 (95% CI, 0.24–0.49; I^2 = 52%), and 0.70 (95% CI, 0.54–0.89, I^2 = 28%), respectively. However, there was no significant difference between the 2 groups in 3-year overall survival (RR, 0.99; 95% CI, 0.77–1.27; I^2 = 0%).
Conclusion: Although the long-term oncologic impact of SEMS is still unclear compared with TD, the results of this meta-analysis may suggest that SEMS insertion can be performed more successfully and safely and may have benefits for short-term perioperative outcomes compared with TD. Further studies are warranted to provide more definitive survival results.
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Key Words: Colorectal neoplasms, Decompression tube, Intestinal obstruction, Stents, Survival

INTRODUCTION

Malignant colorectal obstruction occurs in approximately 10%–20% of patients with colorectal cancer [1,2]. Conventionally, it has been managed with emergency surgery, which is associated with high morbidity, mortality, and stoma formation rates [3,4]. Since the development of the self-expandable metallic stent (SEMS) and tube drainage (TD), the clinical efficacy of their use as a bridge to surgery has been reported in patients with obstructive colorectal cancers. Thus, both

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decompression modalities have been used to improve surgical outcomes, TD is still considered as another bridge to surgery option for obstructive colorectal cancers, especially in Japan and China. Furthermore, TD may have benefits for patients with rectal cancer obstruction. In patients with rectal cancer obstruction, SEMS is not usually suitable. The decompression procedures are similar for both modalities. After a guidewire is inserted under fluoroscopic and endoscopic guide, stent or tube can be inserted over the guide wire.

Some studies have compared SEMS to emergency surgery [5,6] or TD to emergency surgery [7,8], but there have been limited studies comparing SEMS and TD as a bridge to surgery, particularly in terms of long-term survival outcomes. Therefore, we performed a comprehensive meta-analysis on perioperative short-term outcomes and long-term survival outcomes, including 3-year overall survival (OS) and 3-year relapse-free survival (RFS), to compare clinical and oncologic benefits between SEMS and TD.

METHODS

This meta-analysis followed the recommendations of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement [9]. Multiple comprehensive databases were searched for studies that assessed the perioperative short-term outcomes and long-term oncologic outcomes of SEMS compared with TD in patients with obstructive colorectal cancer. The study protocol used Cochrane Review Methods [10]. Approval from the Institutional Review Board was not needed for this article.

Data and literature sources

On September 30, 2023, studies were identified from PubMed, EMBASE, the Cochrane Central Register of Controlled Trials (CENTRAL), and Google Scholar. There were no restrictions regarding the year of publication, but only articles in English were permitted for review. The search terms were "colorectal cancer," "obstruction," "stent," and "decompression tube." After the preliminary electronic search, a further search was conducted to manually retrieve additional relevant articles missed by the electronic search. All articles then were assessed individually for inclusion.

Study selection and data extraction

Article titles and abstracts were screened and full texts were independently reviewed by 2 reviewers according to the selection criteria. Any differences in judgment regarding inclusion were resolved through discussion between the reviewers.

The included studies assessed perioperative and survival outcomes in patients with obstructive colorectal cancer whose initial treatment was performed with SEMS or TD, followed by resection surgery. Studies were excluded if they: (i) assessed patients with non-colorectal cancer, (ii) assessed survival outcomes including patients with stage IV colorectal cancer, (iii) had no extractable data and authors were unavailable to provide additional information, (iv) were case series with fewer than 10 patients, or (v) were not published in English.

All eligible studies were reviewed and all relevant data were extracted by the 2 reviewers independently using a data extraction form designed before the review. The variables recorded were: (i) standard publication information, including year of publication, name of the first author, and number of patients; (ii) clinical and demographic characteristics of included studies; (iii) perioperative outcomes such as clinical success rate, decompression-related complications, time interval to surgery, laparoscopic surgery rate, stoma formation rate, postoperative complication rate, and length of postoperative hospital stay; and (iv) survival outcomes such as 3-year OS and RFS.

Assessment of methodological quality

The methodological quality of the studies included in the meta-analysis was assessed using the Newcastle-Ottawa quality scale (NOS), which attributes a maximum of 9 points to each study and categorizes a study with a score of 6 or more as "high quality" [11]. The quality of the included studies was determined by examining the following 3 categories: patient selection, comparability, and outcome assessment.

Statistical analysis

The meta-analysis determined relative risk (RR) for dichotomous outcomes using the Mantel-Haenszel statistical method and mean difference for continuous outcomes using the inverse-variance statistical method. Pooled estimates were presented with 95% confidence intervals (CI). The presence and amount of heterogeneity were assessed using the Q test and I^2 index, respectively; a P-value less than 0.1 was considered statistically significant [12]. The DerSimonian-Laird random effects model was used to pool data in anticipation of cross-study heterogeneity [13]. Sensitivity analyses were performed to assess the robustness of the meta-analysis findings as follows [14,15]. First, analysis including studies assessed patients with obstructive left-sided colorectal cancer was performed. Second, an analysis excluding studies with large outlying effects was performed. Third, an analysis of high-quality studies with a score greater than 6 on the NOS scale was performed. Fourth, the trim-and-fill method and analysis with an alternative effects size were performed.

Funnel plots were used to determine the presence of publication bias by visual inspection of funnel plots and the Egger weighted linear regression test; a P-value less than 0.1

was considered statistically significant [16,17]. Data analyses were performed using Review Manager software (ver. 5.3) from the Cochrane Collaboration and Comprehensive Meta-Analysis software (ver. 4).

RESULTS

Description of studies

The predefined search strategy identified 118 potentially relevant articles. We excluded 39 articles to remove duplicate studies, and 47 articles because their titles and abstracts did not fulfill the selection criteria. After a full text review of the remaining 32 articles, we excluded 12 articles because of the exclusion criteria of this study. Therefore, we included 20 nonrandomized studies that examined 2,047 patients for qualitative analysis and for the quantitative meta-analysis (Fig. 1).

Twenty studies evaluated perioperative short-term outcomes [18-37]. Nine studies evaluated 3-year OS [18-22,26,30-32], and 12 studies evaluated 3-year RFS [10-15,17,18,21-24]. All studies determining OS and RFS evaluated patients with stage II or III colorectal cancers. Eleven studies evaluated patients with left-sided obstructive colorectal cancers [20,22-25,27,28,32,33,35,36]. One study evaluated patients with right-sided obstructive colorectal cancers [31]. Eight studies evaluated patients with both right- and left-sided obstructive colorectal cancers [18,19,21,26,29,30,34,37]. Evaluation of methodological quality showed all studies scored 6 points on the NOS. Tables 1 and 2 summarize the demographic and clinical characteristics of included studies.

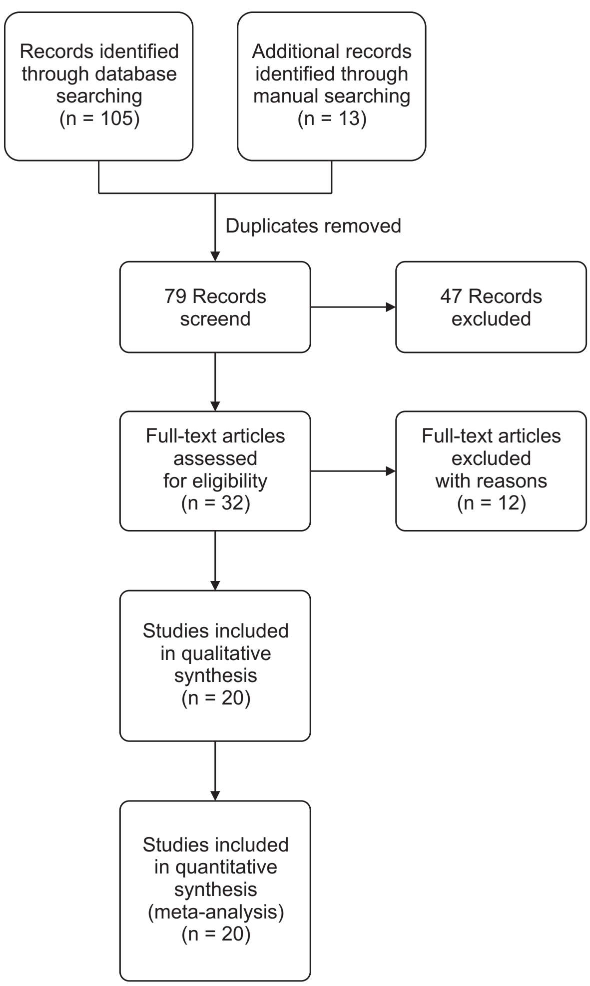


Fig. 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram.

Perioperative short-term outcomes of self-expandable metallic stent compared with tube drainage

Three meta-analyses analyzed preoperative short-term outcomes. Analysis of clinical success rate of SEMS in patients with obstructive colorectal cancers compared with TD showed that there were 18 studies involving 1,760 patients. Patients who received SEMS had better a clinical success rate than patients who received TD (risk ratio [RR], 0.36; 95% CI, 0.24–0.54; I^2 = 20%) (Fig. 2A). Clinical success was defined as radiologic resolution of the obstruction with no complications or no need for reintervention or emergency surgery. Analysis of the decompression-related complication rate of SEMS in patients with obstructive colorectal cancers compared with TD showed that there were 16 studies involving 1,680 patients. Patients who received SEMS had a lower decompression-related complication rate than patients who received TD (RR, 0.32; 95% CI, 0.20–0.50; I^2 = 0%) (Fig. 2B). Analysis of the time interval to surgery of SEMS in patients with obstructive colorectal cancers compared with TD showed that there were 13 studies involving 1,478 patients. Patients who received SEMS had longer days to surgery than patients who received TD (mean difference [MD], 5.63; 95% CI, 2.53–8.73; I^2 = 99%) (Fig. 2C). Sensitivity analysis using predefined methods indicated that all of the results of these meta-analyses for the preoperative short-term outcomes were robust.

Four meta-analyses were performed for the postoperative short-term outcomes. Analysis of laparoscopic surgery rate of SEMS in patients with obstructive colorectal cancers compared with TD showed that there were 15 studies involving 1,687 patients. Patients who received SEMS had a lower open surgery rate than patients who received TD (RR, 0.47; 95% CI, 0.34–0.66; I^2 = 87%) (Fig. 2D). Analysis of the stoma formation rate of SEMS in patients with obstructive colorectal cancer compared with TD showed that there were 15 studies involving 1,760 patients. Patients who received SEMS had a lower stoma formation rate than patients who received TD (RR, 0.34; 95% CI, 0.24–0.49; I^2 = 52%) (Fig. 2E). Analysis of the postoperative complication rate of SEMS in patients with obstructive colorectal cancers compared with TD showed that there were

Table 1. Summary of the included studies

Study	Year	Design	Country	Period	No. of patients		Age (yr)[a]		Sex (M/F)		Follow-up, median (mo)		NOS
					SEMS	TD	SEMS	TD	SEMS	TD	SEMS	TD	
Matsuda et al. [18]	2023	Retro, single center	Japan	2005. 2–2019. 12	137	150	71 (65–80)	70 (60–78)	78/59	90/60	36.7		6
Numata et al. [19]	2023	Retro, 10 centers	Japan	2008. 1–2020. 12	148	77	NR	NR	49/99	34/43	40.8		6
Okuda et al. [20]	2023	Retro, 8 centers	Japan	2010. 1–2019. 12	65	115	71 (66–78)	72 (65–78)	37/28	66/49	NR		6
Yamane et al. [21]	2023	Retro, single center	Japan	2007. 1–2021. 5	53	27	76 (46–91)	76 (50–95)	34/19	15/12	28	36	6
Kondo et al. [22]	2022	Retro, 14 centers	Japan	2008. 1–2018. 12	65	133	73 (67–79)	72 (66–79)	46/27	82/51	30		6
Sato et al. [23]	2022	Retro, single center	Japan	2005. 4–2019. 9	60	18	69.5 (52–88)	65.5 (48-85)	31/29	8/10	40.8		6
Zhang et al. [24]	2022	Retro, single center	China	2013. 2–2019. 3	32	30	63.2 ± 14.2	64.8 ± 10.4	20/12	18/12	NR		6
Endo et al. [25]	2021	Retro, 27 centers	Japan	2010. 1–2014. 12	113	85	69 (48–80)	69 (52–80)	69/44	43/42	46.2	48.9	6
Inoue et al. [26]	2021	Retro, single center	Japan	2007. 1–2019. 12	23	25	72 (47–91)		12/11	16/9	35.5		6
An et al. [27]	2020	Retro, single center	China	2014. 12–2017. 10	139	67	67.9 ± 12.5	65.9 ± 11.0	85/54	43/24	NR		6
Xu et al. [28]	2020	Retro, single center	China	2014. 9–2018. 9	28	35	65.2 ± 7.3	63.7 ± 12.5	17/10	19/13	NR		6
Hosono et al. [29]	2019	Retro, single center	Japan	2010. 1–2017. 2	20	22	74 (57–96)	74 (42–86)	12/10	10/10	17.2	33.1	6
Sato et al. [30]	2019	Retro, single center	Japan	2009. 1–2018. 12	53	23	70.8 ± 1.7	76 ± 2.4	28/25	12/11	30		6
Suzuki et al. [31]	2019	Retro, single center	Japan	2007. 1–2017. 4	19	21	66.5 (62.5–78.5)	68 (62.5–78.5)	8/11	11/10	36.24		6
Kagami et al. [32]	2018	Retro, single center	Japan	2003. 1–2015. 12	26	33	70 (50–85)	68 (46–90)	17/9	23/10	20.3	50.5	6
Kawachi et al. [33]	2018	Retro, single center	Japan	2006. 4–2016. 5	19	12	69.4 ± 12.3	74.1 ± 10.5	8/11	5/7	NR		6
Matsuda et al. [34]	2016	Retro, single center	Japan	2005. 1–2014. 11	28	45	66 (60–73)	70 (56–77)	17/11	29/16	NR		6
Takeyama et al. [35]	2016	Retro, single center	Japan	2010. 1–2015. 6	22	17	71.3 ± 10.3	68.5 ± 10	8/14	10/7	NR		6
Li et al. [36]	2014	Retro, single center	China	2005. 1–2010. 12	16	13	73.3 ± 8.5	72.6 ± 4.7	10/6	8/5	NR		6
Moroi et al. [37]	2014	Retro, single center	Japan	2007. 12–2014. 4	21	16	75.4		9/12	13/3	NR		6

SEMS, self-expandable metallic stent, TD, tube drainage; M, male; F, female; NOS, Newcastle-Ottawa scale; Retro, retrospective observational study; NR, not reported.
[a]Ages are presented as median (range), mean ± standard deviation, or mean only.

Table 2. Clinical characteristics of the included studies

Study	Year	Tumor location (Rt/Lt)		Clinical success rate, n (%)		Decompression-related complications, n (%)		Interval to surgery, median (day)		Pathologic stage (%)		Postoperative short-term outcomes	Oncologic outcomes[a)]
		SEMS	TD	SEMS	TD	SEMS	DT	SEMS	TD	SEMS	TD		
Matsuda et al. [18]	2023	40/97	20/130	128 (93.4)	112 (74.7)	1 (0.7)	8 (5.3)	20	8	II: 31.4 III: 41.6 IV: 2.0	II: 33.3 III: 37.3 IV 29.3	A, B, C, D	3-yr OS, RFS
Numata et al. [19]	2023	44/104	9/68	NR		NR		NR		II: 54.1 III: 45.9	II: 49.4 III: 50.6	A, B, C, D	3-yr OS, RFS
Okuda et al. [20]	2023	0/65	0/115	62 (95.4)	103 (89.6)	4 (6.2)	12 (10.4)	15	12	II: 60.0 III: 40.0	II: 57.4 III: 42.6	A, B, C, D	3-yr OS, RFS
Yamane et al. [21]	2023	14/39	10/17	51 (96.2)	24 (88.9)	2 (3.8)	4 (14.8)	19	11	II: 52.8 III: 47.2	II: 59.3 III: 40.7	A, B, C, D	3-yr OS, RFS
Kondo et al. [22]	2022	0/65	0/133	61 (94)	122 (92)	2 (3.0)	3 (2.0)	18	9	II: 36.9 III: 38.5 IV: 23.1	II: 33.8 III: 39.8 IV: 25.6	A, B, C, D	3-yr OS, RFS
Sato et al. [23]	2022	0/60	0/18	59 (98.3)	14 (77.8)	0 (0)	2 (11.0)	15	7.5	II: 46.7 III: 53.3	II: 55.6 III: 44.4	A, B, C, D	3-yr RFS
Zhang et al. [24]	2022	0/32	0/30	NR		NR		8	9	II: 50.0 III: 50.0	II: 40.0 III: 60.0	A, D	NR
Endo et al. [25]	2021	0/113	0/85	110 (97.3)	73 (85.9)	3 (2.7)	11 (12.9)	17	10	II: 56.6 III: 43.4	II: 43.5 III: 56.5	A, B, C, D	3-yr RFS
Inoue et al. [26]	2021	5/18	6/19	23 (100)	25 (80.6)	NR		14		II: 26.0 III: 43.5 IV: 30.5	II: 12.0 III: 48.0 IV: 40.0	A, B, C, D	3-yr OS, RFS
An et al. [27]	2020	0/139	0/67	129 (92.8)	58 (86.6)	6 (4.4)	9 (14.1)	11.85 ± 8.59[b)]	9.11 ± 4.91[b)]	II: 19.4 III: 60.4 IV: 20.1	II: 17.9 III: 52.2 IV: 29.9	B, C, D	NR
Xu et al. [28]	2020	0/27	0/32	23 (85.2)	29 (90.6)	2 (7.4)	1 (3.1)	NR		II: 18.5 III: 59.3 IV: 22.2	II: 28.1 III: 56.3 IV: 15.6	B, C	NR
Hosono et al. [29]	2019	6/14	9/13	19 (95.0)	21 (95.5)	1 (5.0)	2 (9.0)	12	11.5	II: 35.0 III: 40.0 IV: 25.0	II: 27.3 III: 45.5 IV: 27.3	A, B, C, D	3-yr RFS
Sato et al. [30]	2019	15/38	3/20	50 (95.0)	21 (91.0)	1 (1.9)	2 (8.7)	16.5 ± 1.2[b)]	13 ± 1.4[b)]	II: 45.3 III: 54.7	II: 43.5 III: 56.5	A, B, C, D	3-yr OS, RFS
Suzuki et al. [31]	2019	19/0	21/0	17 (89.5)	18 (85.7)	2 (10.5)	3 (14.3)	23	8	II: 47.4 III: 26.3 IV: 26.3	II: 38.0 III: 57.1 IV: 4.9	A, C	3-yr OS, RFS
Kagami et al. [32]	2018	0/26	0/33	26 (100)	27 (81.8)	0 (0)	6 (18.2)	17	9	II: 42.3 III: 23.0 IV: 34.7	II: 33.3 III: 33.3 IV: 33.3	A, B, C	3-yr OS, RFS

Table 2. Continued

Study	Year	Tumor location (Rt/Lt)		Clinical success rate, n (%)		Decompression-related complications, n (%)		Interval to surgery, median (day)		Pathologic stage (%)		Postoperative short-term outcomes	Oncologic outcomes[a)]
		SEMS	TD	SEMS	TD	SEMS	DT	SEMS	TD	SEMS	TD		
Kawachi et al. [33]	2018	0/19	0/12	17 (89.4)	5 (41.7)	NR		NR		II: 42.1 III: 36.8 IV: 21.1	II: 58.4 III: 16.6 IV: 25.0	B, C	NR
Matsuda et al. [34]	2016	7/21	2/43	27 (96.4)	38 (84.4)	0 (0)	4 (8.9)	15	12	II: 25.0 III: 50.0 IV: 25.0	II: 24.4 III: 35.6 IV: 40.0	A, B, C, D	NR
Takeyama et al. [35]	2016	0/22	0/19	22 (100)	12 (70.5)	0 (0)	5 (29.4)	NR		II: 27.3 III: 20.0 IV: 22.2	II: 47.0 III: 41.2 IV: 11.8	A, B, C, D	NR
Li et al. [36]	2014	0/16	0/13	13 (81.3)	11 (84.6)	0 (0)	3 (23.0)	6 ± 2[b)]	8 ± 2[b)]	III: 81.3 IV:18.7	III: 84.6 IV: 15.4	NR	NR
Moroi et al. [37]	2014	9/12	9/7	20 (100)	10 (62.5)	1 (5.0)	4 (25.0)	23.8		NR		NR	NR

Rt, right; Lt, left; SEMS, self-expandable metallic stent; TD, tube drainage; A, rate of laparoscopic surgery; B, rate of stoma formation; C, postoperative complication rate; D, length of postoperative hospital stay; OS, overall survival; RFS, relapse-free survival; NR, not reported.
[a)]All survival outcomes were measured excluding stage IV patients. [b)]Mean value.

17 studies involving 1,831 patients. Patients who received SEMS had a lower postoperative complication rate than patients who received TD (RR, 0.70; 95% CI, 0.54–0.89; I^2 = 28%) (Fig. 2F). Analysis of the postoperative length of hospital stay of SEMS in patients with obstructive colorectal cancers compared with TD showed that there were 14 studies involving 1,702 patients. Patients who received SEMS had a shorter length of hospital stay than patients who received TD (MD, –6.73; 95% CI, –8.90 to –4.56; I^2 = 97%) (Fig. 2G). Sensitivity analysis using predefined methods indicated that all of the results of these meta-analyses for the postoperative short-term outcomes were robust.

Long-term oncologic outcomes of self-expandable metallic stent compared with tube drainage

Analysis of oncologic outcomes of SEMS compared with TD in patients with obstructive colorectal cancer indicated that 9 studies (1,089 patients) reported data on 3-year OS; there were no significant survival differences between SEMS and TD (RR, 0.99; 95% CI, 0.77–1.27; I^2 = 0%) (Fig. 3A). Sensitivity analysis using predefined methods indicated that the result of this meta-analysis was robust.

Analysis of oncologic outcomes of SEMS compared with TD in patients with obstructive colorectal cancer indicated that 12 studies (1,382 patients) reported data on 3-year RFS; patients who received SEMS had better survival than patients who received TD (RR, 0.82; 95% CI, 0.68–0.98; I^2 = 28%) (Fig. 3B). Sensitivity analysis using predefined methods indicated that the result of this meta-analysis was robust, except for analysis of studies assessed patients with obstructive left-sided colorectal cancer alone. In this sensitivity analysis, there were no significant differences between SEMS and TD in the analysis of 3-year RFS with an RR of 0.77 (95% CI, 0.54–1.12; I^2=65%).

Publication bias

Publication bias was determined by visual inspection of funnel plots and the Egger weighted linear regression test to assess the asymmetry of funnel plots. The results showed that the funnel plots for analysis of laparoscopic surgery rate (P = 0.01), stoma formation rate (P = 0.059), and postoperative length of hospital stay (P = 0.056) were asymmetrical, indicating the presence of publication bias. The funnel plots for the other analyses indicated no publication bias.

DISCUSSION

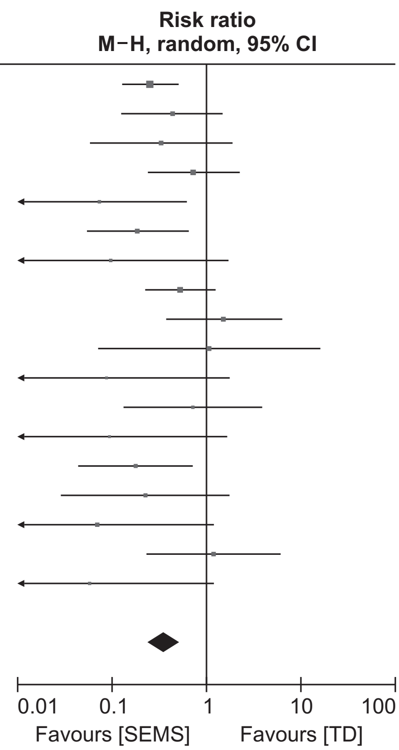
For patients with obstructive colorectal cancer, preoperative decompression modalities such as SEMS or TD have been alternatives to emergency surgery. Improved techniques and devices may explain this trend in treatment strategy. There have been studies including meta-analyses to determine perioperative short-term outcomes and long-term oncologic

A

Study or subgroup	SEMS Events	SEMS Total	TD Events	TD Total	Weight	Risk ratio M−H, random, 95% CI
Matsuda 2023	9	137	38	150	16.1%	0.26 [0.13, 0.52]
Okuda 2023	3	65	12	115	8.0%	0.44 [0.13, 1.51]
Yamane 2023	2	53	3	27	4.6%	0.34 [0.06, 1.91]
Kondo 2022	4	65	11	133	9.3%	0.74 [0.25, 2.25]
Sato 2022	1	60	4	18	3.2%	0.07 [0.01, 0.63]
Endo 2021	3	113	12	85	7.9%	0.19 [0.05, 0.65]
Inoue 2021	0	23	5	25	1.9%	0.10 [0.01, 1.69]
An 2020	10	139	9	67	12.9%	0.54 [0.23, 1.26]
Xu 2020	4	27	3	32	6.5%	1.58 [0.39, 6.45]
Hosono 2019	1	20	1	22	2.1%	1.10 [0.07, 16.45]
Sato 2019	0	53	2	23	1.7%	0.09 [0.00, 1.78]
Suzuki 2019	2	19	3	21	4.9%	0.74 [0.14, 3.95]
Kagami 2018	0	26	6	33	1.9%	0.10 [0.01, 1.64]
Kawachi 2018	2	19	7	12	6.6%	0.18 [0.04, 0.73]
Matsuda 2016	1	28	7	45	3.5%	0.23 [0.03, 1.77]
Takeyama 2016	0	22	5	17	1.9%	0.07 [0.00, 1.20]
Li 2014	3	16	2	13	5.1%	1.22 [0.24, 6.24]
Moroi 2014	0	21	6	16	1.9%	0.06 [0.00, 0.98]
Total (95% CI)		**906**		**854**	**100.0%**	**0.36 [0.24, 0.54]**
Total events	45		136			

Heterogeneity: $Tau^2 = 0.14$; $Chi^2 = 21.26$, df = 17 (P = 0.21); $I^2 = 20\%$

Test for overall effect: Z = 4.99 (P < 0.00001)



B

Study or subgroup	SEMS Events	SEMS Total	TD Events	TD Total	Weight	Risk ratio M−H, random, 95% CI
Matsuda 2023	1	137	8	150	4.7%	0.14 [0.02, 1.08]
Okuda 2023	3	65	12	115	13.3%	0.44 [0.13, 1.51]
Yamane 2023	2	53	4	27	7.5%	0.25 [0.05, 1.30]
Kondo 2022	2	65	3	133	6.4%	1.36 [0.23, 7.96]
Sato 2022	0	60	2	18	2.2%	0.06 [0.00, 1.24]
Endo 2021	3	113	11	85	12.9%	0.21 [0.06, 0.71]
An 2020	6	139	9	67	20.4%	0.32 [0.12, 0.87]
Xu 2020	2	27	1	32	3.6%	2.37 [0.23, 24.74]
Hosono 2019	1	20	2	22	3.7%	0.55 [0.05, 5.61]
Sato 2019	1	53	2	23	3.6%	0.22 [0.02, 2.28]
Suzuki 2019	2	19	3	21	7.1%	0.74 [0.14, 3.95]
Kagami 2018	0	26	6	33	2.5%	0.10 [0.01, 1.64]
Matsuda 2016	0	28	4	45	2.4%	0.18 [0.01, 3.15]
Takeyama 2016	0	22	5	17	2.5%	0.07 [0.00, 1.20]
Li 2014	0	16	3	13	2.4%	0.12 [0.01, 2.09]
Moroi 2014	1	20	4	16	4.6%	0.20 [0.02, 1.62]
Total (95% CI)		**863**		**817**	**100.0%**	**0.32 [0.20, 0.50]**
Total events	24		79			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 12.04$, df = 15 (P = 0.68); $I^2 = 0\%$

Test for overall effect: Z = 5.00 (P < 0.00001)

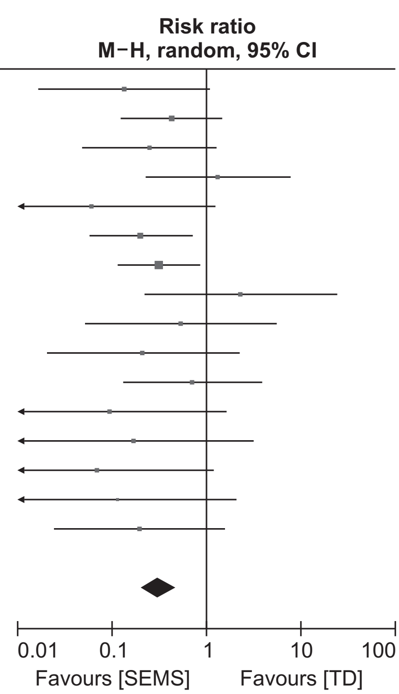
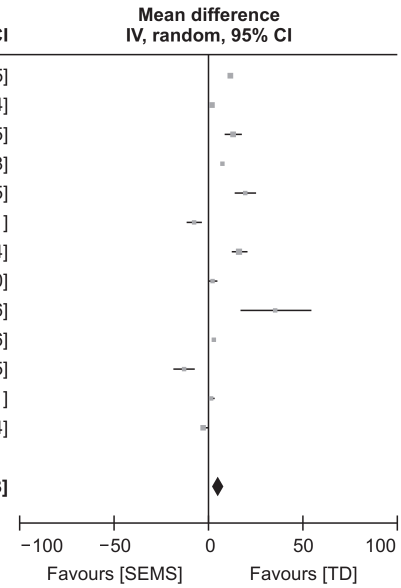


Fig. 2. Forest plot of data in patients with self-expandable metallic stent (SEMS) compared with tube drainage (TD). (A) Clinical success rate. (B) Decompression-related complication rate. (C) Time interval to surgery. (D) Laparoscopic surgery rate. (E) Stoma formation rate. (F) Postoperative complication rate. (G) Length of hospital stay. CI, confidence interval; df, degree of freedom; SD, standard deviation.

C

Study or subgroup	SEMS Mean	SEMS SD	SEMS Total	TD Mean	TD SD	TD Total	Weight	Mean difference IV, random, 95% CI
Matsuda 2023	20.66667	3.27575	137	8.33333	1.81837	150	8.7%	12.33 [11.71, 12.95]
Okuda 2023	16	2.08329	65	13.66667	2.73301	115	8.7%	2.33 [1.62, 3.04]
Yamane 2023	26.33333	12.03246	53	12.66667	6.99827	27	7.6%	13.67 [9.49, 17.85]
Kondo 2022	17.66667	3.0092	65	9.66667	1.64509	133	8.7%	8.00 [7.22, 8.78]
Sato 2022	30	15.74215	60	10.16667	6.59043	18	7.1%	19.83 [14.82, 24.85]
Zhang 2022	9	4.56319	32	16	8.99715	30	7.9%	−7.00 [−10.59, −3.41]
Endo 2021	34.33333	17.28606	113	17.66667	9.49342	85	7.8%	16.67 [12.89, 20.44]
An 2020	11.85	8.59	72	9.11	4.91	44	8.3%	2.74 [0.28, 5.20]
Hosono 2019	53	40.42913	20	17.16667	11.23847	22	2.2%	35.83 [17.50, 54.16]
Sato 2019	16.5	1.2	53	13	1.4	23	8.7%	3.50 [2.84, 4.16]
Kagami 2018	13.33333	8.19753	26	25.66667	12.79073	33	6.9%	−12.33 [−17.72, −6.95]
Matsuda 2016	14	1.38678	28	12	2.98526	45	8.7%	2.00 [0.99, 3.01]
Li 2014	6	2	16	8	2	13	8.6%	−2.00 [−3.46, −0.54]
Total (95% CI)			**740**			**738**	**100.0%**	**5.63 [2.53, 8.73]**

Heterogeneity: $Tau^2 = 28.47$; $Chi^2 = 941.30$, df = 12 (P < 0.00001); $I^2 = 99\%$
Test for overall effect: Z = 3.56 (P = 0.0004)



D

Study or subgroup	SEMS Events	SEMS Total	TD Events	TD Total	Weight	Risk ratio M−H, random, 95% CI
Matsuda 2023	33	137	122	150	9.7%	0.30 [0.22, 0.40]
Numata 2023	67	148	49	77	10.0%	0.71 [0.56, 0.91]
Okuda 2023	23	65	65	115	9.4%	0.63 [0.43, 0.90]
Yamane 2023	14	53	18	27	8.4%	0.40 [0.23, 0.67]
Kondo 2022	27	65	100	133	9.7%	0.55 [0.41, 0.75]
Sato 2022	0	60	8	18	1.2%	0.02 [0.00, 0.30]
Zhang 2022	19	32	12	30	8.4%	1.48 [0.88, 2.51]
Endo 2021	57	113	64	85	10.2%	0.67 [0.54, 0.83]
Inoue 2021	4	23	8	25	5.0%	0.54 [0.19, 1.57]
Hosono 2019	1	20	9	22	2.2%	0.12 [0.02, 0.88]
Sato 2019	42	53	21	23	10.3%	0.87 [0.72, 1.05]
Suzuki 2019	0	19	8	21	1.2%	0.06 [0.00, 1.05]
Kagami 2018	6	26	33	33	7.4%	0.24 [0.12, 0.48]
Matsuda 2016	1	28	44	45	2.3%	0.04 [0.01, 0.25]
Takeyama 2016	3	22	9	19	4.6%	0.29 [0.09, 0.91]
Total (95% CI)		**684**		**823**	**100.0%**	**0.47 [0.34, 0.66]**
Total events	297		570			

Heterogeneity: $Tau^2 = 0.26$; $Chi^2 = 104.64$, df = 14 (P < 0.00001); $I^2 = 87\%$
Test for overall effect: Z = 4.48 (P < 0.00001)

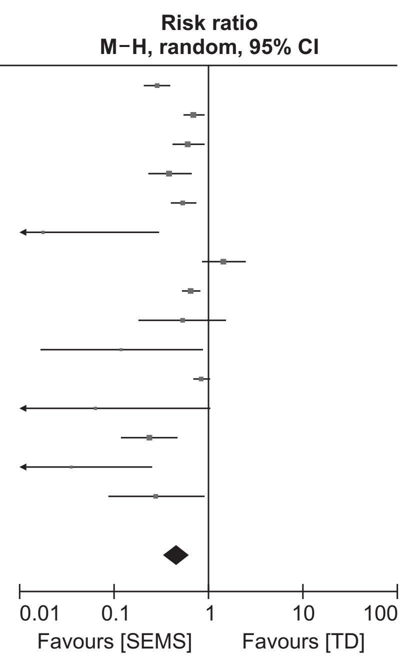


Fig. 2. Continued 1.

outcomes of SEMS compared with TD. However, to our knowledge, these previous meta-analyses are missing studies and data on these outcomes [18,38-40]. Therefore, we searched studies and collected data more comprehensively, and we performed a meta-analysis of these data regarding preoperative and postoperative outcomes, along with survival outcomes such as 3-year OS and 3-year RFS.

This meta-analysis showed better outcomes for SEMS in terms of clinical success rate, decompression-related complication rate, and laparoscopic surgery rate. Furthermore, patients who received SEMS had a lower rate of stoma formation, a lower incidence of postoperative complications, and a shorter length of postoperative hospital stay. There was no significance between the 2 groups in the analysis of 3-year overall survival, but patients who received SEMS had better survival than patients who received TD in the analysis of 3-year RFS.

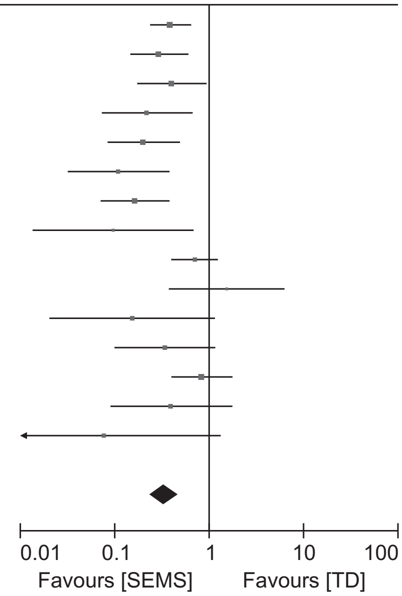
SEMS with a higher rate of clinical success than TD

E

Study or subgroup	SEMS Events	SEMS Total	TD Events	TD Total	Weight	Risk ratio M−H, random, 95% CI
Matsuda 2023	18	137	50	150	11.7%	0.39 [0.24, 0.64]
Numata 2023	11	148	19	77	9.7%	0.30 [0.15, 0.60]
Okuda 2023	6	65	26	115	8.4%	0.41 [0.18, 0.94]
Yamane 2023	4	53	9	27	6.4%	0.23 [0.08, 0.67]
Kondo 2022	5	65	50	133	8.0%	0.20 [0.09, 0.49]
Sato 2022	3	60	8	18	5.6%	0.11 [0.03, 0.38]
Endo 2021	6	32	27	85	8.3%	0.17 [0.07, 0.39]
Inoue 2021	1	113	11	25	2.8%	0.10 [0.01, 0.71]
An 2020	19	23	16	44	11.1%	0.73 [0.42, 1.26]
Xu 2020	4	20	3	32	4.6%	1.58 [0.39, 6.45]
Hosono 2019	1	53	7	22	2.7%	0.16 [0.02, 1.17]
Sato 2019	4	19	5	23	5.6%	0.35 [0.10, 1.18]
Kagami 2018	8	26	12	33	9.3%	0.85 [0.41, 1.76]
Kawachi 2018	2	28	8	45	4.3%	0.40 [0.09, 1.76]
Takeyama 2016	0	22	5	19	1.5%	0.08 [0.00, 1.34]
Total (95% CI)		**912**		**848**	**100.0%**	**0.34 [0.24, 0.49]**
Total events	92		256			

Heterogeneity: $Tau^2 = 0.23$; $Chi^2 = 29.34$, df = 14 (P = 0.009); $I^2 = 52\%$
Test for overall effect: Z = 5.78 (P < 0.00001)

Risk ratio M−H, random, 95% CI



F

Study or subgroup	SEMS Events	SEMS Total	TD Events	TD Total	Weight	Risk ratio M−H, random, 95% CI
Matsuda 2023	22	137	49	150	13.7%	0.49 [0.31, 0.77]
Okuda 2023	5	65	12	115	4.9%	0.74 [0.27, 2.00]
Numata 2023	31	148	26	77	13.8%	0.62 [0.40, 0.97]
Yamane 2023	13	53	15	27	10.5%	0.44 [0.25, 0.79]
Kondo 2022	10	65	18	133	8.1%	1.14 [0.56, 2.32]
Sato 2022	4	60	0	18	0.7%	2.80 [0.16, 49.74]
Endo 2021	23	113	25	85	12.5%	0.69 [0.42, 1.13]
Inoue 2021	1	23	6	25	1.4%	0.18 [0.02, 1.39]
An 2020	0	72	1	44	0.6%	0.21 [0.01, 4.94]
Xu 2020	4	27	2	32	2.1%	2.37 [0.47, 11.96]
Hosono 2019	1	20	4	22	1.3%	0.28 [0.03, 2.26]
Sato 2019	11	53	4	23	4.7%	1.19 [0.42, 3.36]
Suzuki 2019	2	19	6	21	2.5%	0.37 [0.08, 1.61]
Kagami 2018	9	26	5	33	5.2%	2.28 [0.87, 6.00]
Kawachi 2018	9	19	6	12	7.7%	0.95 [0.45, 1.98]
Matsuda 2016	4	28	8	45	4.2%	0.80 [0.27, 2.42]
Takeyama 2016	5	22	10	19	6.0%	0.43 [0.18, 1.04]
Total (95% CI)		**950**		**881**	**100.0%**	**0.70 [0.54, 0.89]**
Total events	154		197			

Heterogeneity: $Tau^2 = 0.07$; $Chi^2 = 22.14$, df = 16 (P = 0.14); $I^2 = 28\%$
Test for overall effect: Z = 2.85 (P = 0.004)

Risk ratio M−H, random, 95% CI

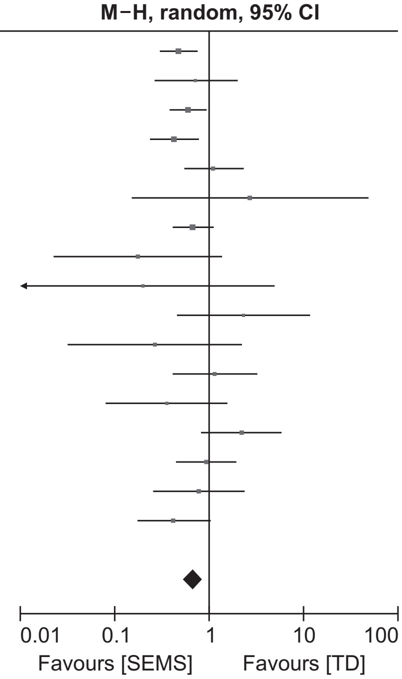


Fig. 2. Continued 2.

indicates that SEMS is more effective in providing sufficient decompression for laparoscopic and stoma-free surgery. Our analysis supported this conclusion. SEMS with a lower rate of decompression-related complications including perforation indicates that SEMS may provide more favorable oncologic outcomes than TD. Because decompression-related complications such as perforation are considered as risk factors for poor oncologic outcomes [41]. However, tumor compression is an additional consideration of oncologic outcomes. TD does not expand, thus TD TD-induced mechanical compression of

G

Study or subgroup	SEMS Mean	SEMS SD	SEMS Total	TD Mean	TD SD	TD Total	Weight	Mean difference IV, random, 95% CI
Matsuda 2023	12.66667	1.22841	137	19.66667	3.63675	150	10.8%	−7.00 [−7.62, −6.38]
Numata 2023	11	1.2146	148	14.6667	2.24558	77	10.8%	−3.67 [−4.21, −3.13]
Okuda 2023	33.66667	19.01129	65	64.33333	45.06886	115	3.6%	−30.67 [−40.11, −21.22]
Yamane 2023	33.66667	19.01129	53	64.33333	45.06886	27	1.3%	−30.67 [−48.42, −12.91]
Kondo 2022	16	2.08329	65	20.66667	3.29019	133	10.7%	−4.67 [−5.42, −3.91]
Sato 2022	27.33333	15.27223	60	21.66667	11.92554	18	5.3%	5.67 [−1.06, 12.40]
Zhang 2022	18.66667	6.44215	32	16.66667	4.08961	30	9.3%	2.00 [−0.67, 4.67]
Endo 2021	26	12.01592	113	62.33333	35.54512	85	4.5%	−36.33 [−44.21, −28.46]
Inoue 2021	22.66667	11.39235	23	28.33333	15.13692	25	4.7%	−5.67 [−13.21, 1.88]
An 2020	12.66667	0.90892	72	13.43333	1.67465	44	10.8%	−0.77 [−1.30, −0.23]
Hosono 2019	19.33333	7.90344	20	29	16.26621	22	4.6%	−9.67 [−17.30, −2.04]
Sato 2019	19.5	1.6	53	24.2	4.5	23	10.1%	−4.70 [−6.59, −2.81]
Matsuda 2016	12.66667	1.10942	28	22.33333	4.97543	45	10.3%	−9.67 [−11.18, −8.16]
Takeyama 2016	12.9	8.8	22	18.5	20.3	17	3.1%	−5.60 [−15.93, 4.73]
Total (95% CI)			**891**			**811**	**100.0%**	**−6.73 [−8.90, −4.56]**

Heterogeneity: $Tau^2 = 11.27$; $Chi^2 = 422.46$, df = 13 (P < 0.00001); $I^2 = 97\%$

Test for overall effect: Z = 6.08 (P < 0.00001)

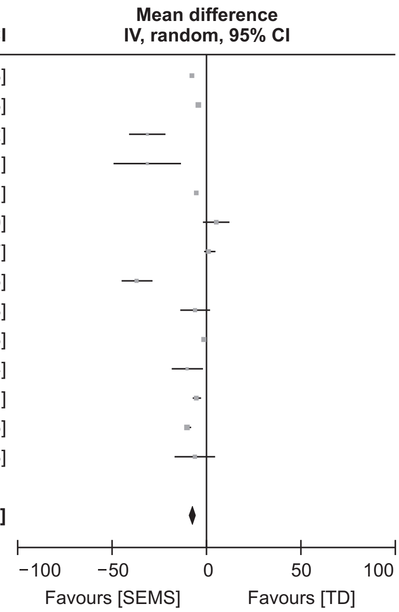


Fig. 2. Continued 3.

the tumor might be negligible owing to the tubular structure of the tube. In contrast, an inserted metallic stent could make compression of the tumor which leads to poor survival outcomes. It can be supported by results that cell-free DNA and circulating tumor DNA were significantly increased in patients who received SEMS compared with patients who received TD [42]. Furthermore, it was reported that factors related to tumor progression were not significantly upregulated, and the marker of cell proliferation was downregulated in patients with SEMS insertion [43]. Therefore, as supported by the results of this meta-analysis, the oncologic impacts of SEMS compared with TD are still unclear.

One of the concerns related to short-term outcomes is the appropriate interval from decompression to elective surgery. An appropriate time interval may be required to stabilize the patient. It was reported that a shorter interval was associated with higher postoperative complication rates compared with a longer interval [44]. In this meta-analysis, patients with TD had a shorter interval from decompression to elective surgery, and they had a higher postoperative complication rate. In a similar fashion, patients with TD had a lower rate of laparoscopic surgery, but a higher rate of stoma formation. These results may be attributed to insufficient decompression due to a shorter time interval and a lower clinical success rate in patients who received TD. Furthermore, it could be related to a longer length of postoperative hospital stay. Among the perioperative short-term results, postoperative complications have been considered as negative prognostic factors in colorectal cancer surgery [45,46]. Thus, theoretically, TD might be related to poor oncologic outcomes compared with SEMS insertion in patients with obstructive colorectal cancers. However, as mentioned above, the oncologic outcomes of this meta-analysis were inconsistent, as they showed no significance in the analysis of 3-year OS but a better survival for SEMS in the analysis of 3-year RFS. The reasons for the difference in those survival outcomes and the oncologic impacts of SEMS and DT are unclear; thus, further research that focuses on tumor biology and clinical aspects is warranted to provide more evidence and to evaluate these conflicting findings.

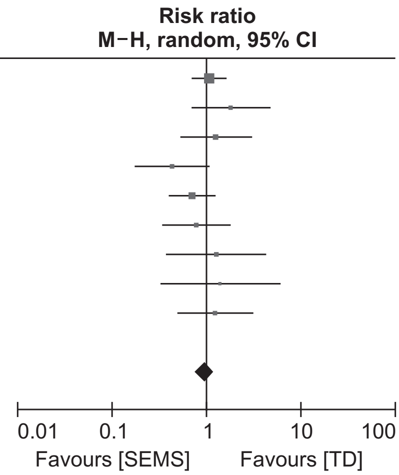
There are some limitations to our study. This analysis has a lack of large randomized trials, and most of the included studies have a small number of patients. In addition, baseline patient characteristics and the details of patient management are various among the studies. Especially, the choice of decompression modality may be associated with a selection bias. Furthermore, even though we performed a sensitivity analysis, there may be potential heterogeneity among included studies.

In conclusion, although the long-term oncologic impact of SEMS is still unclear compared with TD, SEMS insertion could be performed more successfully and safely and may have benefits for the short-term perioperative outcomes compared with TD. Therefore, SEMS may become a preferred decompression modality for patients with obstructive colorectal cancer. Well-designed large randomized trials are warranted to provide more definitive survival results.

A

Study or subgroup	SEMS Events	SEMS Total	TD Events	TD Total	Weight	Risk ratio M–H, random, 95% CI
Matsuda 2023	32	100	31	106	35.6%	1.09 [0.73, 1.65]
Numata 2023	18	148	5	77	6.6%	1.87 [0.72, 4.85]
Okuda 2023	8	65	11	115	8.2%	1.29 [0.55, 3.04]
Yamane 2023	7	53	8	27	7.4%	0.45 [0.18, 1.10]
Kondo 2022	13	65	37	133	19.3%	0.72 [0.41, 1.26]
Inoue 2021	6	16	7	15	8.7%	0.80 [0.35, 1.85]
Sato 2019	9	53	3	23	4.1%	1.30 [0.39, 4.37]
Suzuki 2019	3	14	3	20	2.9%	1.43 [0.34, 6.07]
Kagami 2018	7	26	7	33	7.2%	1.27 [0.51, 3.16]
Total (95% CI)		**540**		**549**	**100.0%**	**0.99 [0.77, 1.27]**
Total events	103		112			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 7.56$, df = 9 (P = 0.48); $I^2 = 0\%$
Test for overall effect: Z = 0.08 (P = 0.94)



B

Study or subgroup	SEMS Events	SEMS Total	TD Events	TD Total	Weight	Risk ratio M–H, random, 95% CI
Matsuda 2023	29	100	29	106	11.1%	1.06 [0.69, 1.64]
Numata 2023	39	148	23	77	11.1%	0.88 [0.57, 1.36]
Okuda 2023	18	65	26	115	8.8%	1.22 [0.73, 2.06]
Yamane 2023	15	53	13	27	7.4%	0.59 [0.33, 1.05]
Kondo 2022	25	65	47	133	13.0%	1.09 [0.74, 1.60]
Sato 2022	15	60	11	18	7.6%	0.41 [0.23, 0.73]
Endo 2021	35	113	38	85	13.8%	0.69 [0.48, 1.00]
Inoue 2021	5	14	3	10	2.2%	1.19 [0.37, 3.87]
Hosono 2019	6	8	8	10	9.1%	0.94 [0.57, 1.56]
Sato 2019	17	53	9	23	6.3%	0.82 [0.43, 1.56]
Suzuki 2019	6	19	11	21	4.6%	0.60 [0.28, 1.31]
Kagami 2018	7	26	14	33	5.0%	0.63 [0.30, 1.34]
Total (95% CI)		**724**		**658**	**100.0%**	**0.82 [0.68, 0.98]**
Total events	217		232			

Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 15.31$, df = 11 (P = 0.17); $I^2 = 28\%$
Test for overall effect: Z = 0.08 (P = 0.03)

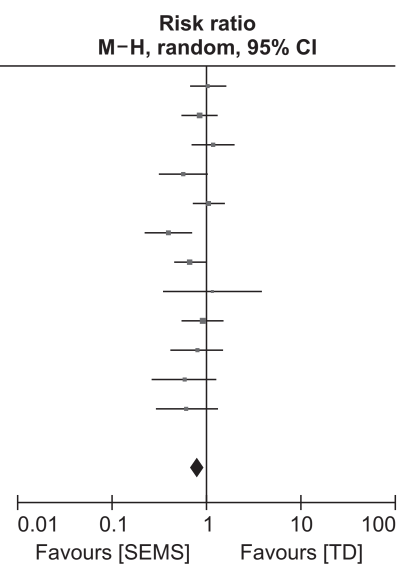


Fig. 3. Forest plot of data in patients with self-expandable metallic stent (SEMS) compared with tube drainage (TD). (A) Three-year overall survival. (B) Three-year relapse-free survival.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Author Contribution

Conceptualization, Formal Analysis, Project Administration: GWH
Investigation, Methodology: GWH, MRL
Writing – Original Draft: GWH
Writing – Review & Editing: GWH, MRL

REFERENCES

1. McArdle CS, McMillan DC, Hole DJ. The impact of blood loss, obstruction and perforation on survival in patients undergoing curative resection for colon cancer. Br J Surg 2006;93:483-8.
2. Yeo HL, Lee SW. Colorectal emergencies: review and controversies in the management of large bowel obstruction. J Gastrointest Surg 2013;17:2007-12.
3. Zorcolo L, Covotta L, Carlomagno N, Bartolo DC. Safety of primary anastomosis in emergency colo-rectal surgery. Colorectal Dis 2003;5:262-9.
4. Tekkis PP, Kinsman R, Thompson MR, Stamatakis JD; Association of Coloproctology of Great Britain, Ireland. The Association of Coloproctology of Great Britain and Ireland study of large bowel obstruction caused by colorectal cancer. Ann Surg 2004;240:76-81.
5. Arezzo A, Forcignanò E, Bonino MA, Balagué C, Targarona E, Borghi F, et al. Long-term oncologic results after stenting as a bridge to surgery versus emergency surgery for malignant left-sided colonic obstruction: a multicenter randomized controlled trial (ESCO Trial). Ann Surg 2020;272:703-8.
6. CReST Collaborative Group. Colorectal Endoscopic Stenting Trial (CReST) for obstructing left-sided colorectal cancer: randomized clinical trial. Br J Surg 2022;109:1073-80.
7. Shingu Y, Hasegawa H, Sakamoto E, Komatsu S, Kurumiya Y, Norimizu S, et al. Clinical and oncologic safety of laparoscopic surgery for obstructive left colorectal cancer following transanal endoscopic tube decompression. Surg Endosc 2013;27:3359-63.
8. Shigeta K, Baba H, Yamafuji K, Kaneda H, Katsura H, Kubochi K. Outcomes for patients with obstructing colorectal cancers treated with one-stage surgery using transanal drainage tubes. J Gastrointest Surg 2014;18:1507-13.
9. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann Intern Med 2009;151:264-9, W64.
10. Higgins JP, Green S. Cochrane handbook for systematic reviews of interventions. Version 5.1.0, vol. 5. Wiley; 2011.
11. Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Losos M, et al. The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses [Internet]. Ottawa Hospital Research Institute; c2021 [cited 2023 Nov 1]. Available from: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp
12. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ 2003;327:557-60.
13. DerSimonian R, Laird N. Meta-analysis in clinical trials. Control Clin Trials 1986;7:177-88.
14. Thabane L, Akhtar-Danesh N. Guidelines for reporting descriptive statistics in health research. Nurse Res 2008;15:72-81.
15. Patsopoulos NA, Evangelou E, Ioannidis JP. Sensitivity of between-study heterogeneity in meta-analysis: proposed metrics and empirical evaluation. Int J Epidemiol 2008;37:1148-57.
16. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ 1997;315:629-34.
17. Sutton AJ, Duval SJ, Tweedie RL, Abrams KR, Jones DR. Empirical assessment of effect of publication bias on meta-analyses. BMJ 2000;320:1574-7.
18. Matsuda A, Yamada T, Yokoyama Y, Takahashi G, Yoshida H. Long-term outcomes between self-expandable metallic stent and transanal decompression tube for malignant large bowel obstruction: a multicenter retrospective study and meta-analysis. Ann Gastroenterol Surg 2023;7:583-93.
19. Numata K, Numata M, Shirai J, Sawazaki S, Okamoto H, Godai T, et al. Short- and long-term outcomes of transanal decompression tube and self-expandable metallic stent for obstructive colorectal cancer based on a multicenter database (KYCC2110). J Surg Oncol 2023;128:1372-9.
20. Okuda Y, Shimura T, Uno K, Yamada T, Nukui T, Mizushima T, et al. A multicenter case-control study of self-expanding metallic stent versus trans-anal colorectal tube for stage II/III non-right-sided obstructive colon cancer. J Gastroenterol 2023;58:217-28.
21. Yamane K, Umino Y, Nagami T, Tarumoto K, Hattori K, Maemoto R, et al. Comparison of oncological and perioperative outcomes between self-expanding metal stents and decompression tubes for stages II and III obstructive colorectal cancer: a retrospective observational study. World J Surg 2023;47:2279-86.
22. Kondo A, Kumamoto K, Kobara H, Nagahara T, Wato M, Shibatoge M, et al. Outcomes of patients with left-sided obstructive colorectal cancer: comparison between self-expandable metallic stent and other treatment methods. Dig Surg 2022;39:117-24.
23. Sato K, Imaizumi K, Kasajima H, Kurushima M, Umehara M, Tsuruga Y, et al. Short- and long-term outcomes of a self-expandable metallic stent versus a transanal decompression tube for pathological stage II and III left-sided obstructive colorectal cancer: a retrospective observational study. Surg Today 2022;52:268-77.
24. Zhang S, Liu G, Wu GH, Zhang SW, Zhao YJ, Xu J. Transanal decompression tube is superior to self-expandable metallic colonic stent for malignant colorectal obstruction: a retrospective study. ANZ J Surg 2022;92:140-5.
25. Endo S, Kumamoto K, Enomoto T, Koizumi K, Kato H, Saida Y. Comparison of survival and perioperative outcome of the colonic stent and the transanal decompression tube placement and emergency surgery for left-sided obstructive colorectal cancer: a

retrospective multi-center observational study "The CODOMO study". Int J Colorectal Dis 2021;36:987-98.
26. Inoue H, Arita T, Kuriu Y, Shimizu H, Kiuchi J, Yamamoto Y, et al. Emergency management of obstructive colorectal cancer: a retrospective study of efficacy and safety in self-expanding metallic stents and trans-anal tubes. In Vivo 2021;35:2289-96.
27. An Y, Wang N, Yang Z, Li Y, Xu B, Guo G, et al. Efficacy of transanal drainage tube and self-expanding metallic stent in acute left malignant colorectal obstruction. Ann Palliat Med 2020;9:1614-21.
28. Xu YS, Fu YF, Li DC, Song T. Preoperative colonic decompression with decompression tube insertion versus stent insertion in patients with malignant left colonic obstruction. Surg Laparosc Endosc Percutan Tech 2020;30:183-6.
29. Hosono M, Matsuda T, Yamashita K, Hasegawa H, Yamamoto M, Kanaji S, et al. Successful single-stage laparoscopic surgery using a preoperative self-expanding metallic stent in patients with obstructive colorectal cancer. Asian J Endosc Surg 2019;12:401-7.
30. Sato R, Oikawa M, Kakita T, Okada T, Oyama A, Abe T, Yazawa T, Tsuchiya H, Akazawa N, Ohira T, Harada Y, Tanaka M, Okano H, Ito K, Tsuchiya T. Comparison of the long-term outcomes of the self-expandable metallic stent and transanal decompression tube for obstructive colorectal cancer. Ann Gastroenterol Surg 2019;3:209-16.
31. Suzuki Y, Moritani K, Seo Y, Takahashi T. Comparison of decompression tubes with metallic stents for the management of right-sided malignant colonic obstruction. World J Gastroenterol 2019;25:1975-85.
32. Kagami S, Funahashi K, Ushigome M, Koike J, Kaneko T, Koda T, et al. Comparative study between colonic metallic stent and anal tube decompression for Japanese patients with left-sided malignant large bowel obstruction. World J Surg Oncol 2018;16:210.
33. Kawachi J, Kashiwagi H, Shimoyama R, Isogai N, Fukai R, Miyake K, et al. Comparison of efficacies of the self-expandable metallic stent versus transanal drainage tube and emergency surgery for malignant left-sided colon obstruction. Asian J Surg 2018;41:498-505.
34. Matsuda A, Miyashita M, Matsumoto S, Sakurazawa N, Takahashi G, Matsutani T, et al. Comparison between metallic stent and transanal decompression tube for malignant large-bowel obstruction. J Surg Res 2016;205:474-81.
35. Takeyama H, Kitani K, Wakasa T, Tsujie M, Fujiwara Y, Mizuno S, et al. Self-expanding metallic stent improves histopathologic edema compared with transanal drainage tube for malignant colorectal obstruction. Dig Endosc 2016;28:456-64.
36. Li CY, Guo SB, Wang NF. Decompression of acute left-sided malignant colorectal obstruction: comparing transanal drainage tube with metallic stent. J Clin Gastroenterol 2014;48:e37-42.
37. Moroi R, Endo K, Ichikawa R, Nagai H, Shinkai H, Kimura T, et al. The effectiveness of self-expandable metallic stent insertion in treating right-sided colonic obstruction: a comparison between SEMS and decompression tube placement and an investigation of the safety and difficulties of SEMS insertion in right colons. Gastroenterol Res Pract 2014;2014:372918.
38. Ma W, Zhang JC, Luo K, Wang L, Zhang C, Cai B, et al. Self-expanding metal stents versus decompression tubes as a bridge to surgery for patients with obstruction caused by colorectal cancer: a systematic review and meta-analysis. World J Emerg Surg 2023;18:46.
39. Chen F, Dong Q, Zhang F. Is self-expandable metallic stents superior to transanal decompression tubes for the treatment of malignant large-bowel obstruction: a meta-analysis. Ann Palliat Med 2021;10:7378-87.
40. Wang FG, Bai RX, Yan M, Song MM, Yan WM. Short-term outcomes of self-expandable metallic stent versus decompression tube for malignant colorectal obstruction: a meta-analysis of clinical data. J Invest Surg 2020;33:762-70.
41. Sloothaak DA, van den Berg MW, Dijkgraaf MG, Fockens P, Tanis PJ, van Hooft JE, et al. Oncological outcome of malignant colonic obstruction in the Dutch Stent-In 2 trial. Br J Surg 2014;101:1751-7.
42. Takahashi G, Yamada T, Iwai T, Takeda K, Koizumi M, Shinji S, et al. Oncological assessment of stent placement for obstructive colorectal cancer from circulating cell-free DNA and circulating tumor DNA dynamics. Ann Surg Oncol 2018;25:737-44.
43. Matsuda A, Miyashita M, Matsumoto S, Sakurazawa N, Kawano Y, Yamahatsu K, et al. Colonic stent-induced mechanical compression may suppress cancer cell proliferation in malignant large bowel obstruction. Surg Endosc 2019;33:1290-7.
44. Matsuda Miyashita M, Matsumoto S, Sakurazawa N, Kawano Y, Yamada T, et al. Optimal interval from placement of a self-expandable metallic stent to surgery in patients with malignant large bowel obstruction: a preliminary study. Surg Laparosc Endosc Percutan Tech 2018;28:239-44.
45. Lawler J, Choynowski M, Bailey K, Bucholc M, Johnston A, Sugrue M. Meta-analysis of the impact of postoperative infective complications on oncological outcomes in colorectal cancer surgery. BJS Open 2020;4:737-47.
46. Ha GW, Kim JH, Lee MR. Oncologic impact of anastomotic leakage following colorectal cancer surgery: a systematic review and meta-analysis. Ann Surg Oncol 2017;24:3289-99.