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REVIEW

Outcomes following colonic stenting for malignant left-sided bowel obstruction: a systematic review of randomised controlled trials

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Abstract

Purpose Malignant bowel obstruction is a common presentation and is associated with high morbidity and mortality. Emergency resection is the traditional treatment modality. In recent years, colonic stenting as a bridge to surgery has become more prevalent. However, there is considerable debate surrounding its use. The aim of this review was to examine the technical and clinical success of self-expanding metal stent (SEMS) as a bridge to surgery for obstructing colorectal tumours.

Methods We systematically reviewed randomised controlled trials using PubMed, Cochrane and SCOPUS databases. Included studies must have compared outcomes in SEMS as a bridge to surgery with those proceeding straight to emergency resection.

Results A total of 1245 studies were identified. After removal of duplicates and non-relevant studies, we identified seven articles which met the predefined criteria. This review observed that 81% of SEMS were technically successful, with 76% of patients having restoration of gastrointestinal function. Iatrogenic perforation rate was 5%. One-fifth of patients required emergency surgery following stent placement, and permanent stoma rate was 8.7%.

Conclusion This study observed that SEMS as a bridge to surgery is associated with good technical and clinical success, with low rates of perforation and permanent stoma. SEMS should be part of the treatment armamentarium for obstructing colorectal neoplasms, but careful patient selection and institutional expertise are important factors for success.

Keywords Emergency surgery · Colorectal neoplasm · Surgical outcomes · Self-expanding stents

Introduction

Acute colonic obstruction is a common surgical presentation, complicating up to 20% of colorectal malignancies [1]. The outcomes for these patients often involve high morbidity (40–50%) and mortality (15–20%) [2, 3]. There are several management options for patients that present with malignant bowel obstruction, and therefore considerable debate on which is the best treatment strategy. Possible options include emergency resection (with/without stoma), placement of a self-expanding metal stent (SEMS), defunctioning stoma or palliation [4].

The use of SEMS has been reported as a viable option to deal with acute obstruction and facilitate a bridge to surgery in a select cohort of patients [5]. The use of SEMS in acute colonic obstruction was first described by Tejero et al. in 1994 [6].

They showed that SEMS facilitates early decompression of acute malignant large bowel obstruction, allowing for full staging, patient stabilisation and correction of any nutritional/electrolyte imbalance, prior to definitive surgery.

The use of SEMS as a bridge to surgery has also been advocated as it may increase the potential for elective laparoscopic resection [7] and/or restorative surgery that otherwise would be contraindicated in most emergent resections [8, 9]. Cheung et al. noted that primary anastomosis rates were almost doubled in SEMS/Bridge to surgery group versus emergency resection (67% versus 38%) [7]. In addition, SEMS can also offer excellent palliative relief in frail patients or those with advanced (unresectable) local/distal disease [9].

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The World Society of Emergency Surgery (WSES) has advocated the use of SEMS in patients presenting acutely with left-sided malignant bowel obstruction, especially in centres with considerable expertise [10]. However, there remains a concern over potential iatrogenic tumour perforation at time of SEMS placement [11, 12]. Studies have observed a perforation rate ranging from 3.73 to 4.8% [8, 13, 14]. Other early adverse events from acute SEMS placement include stent migration (12%), recurrent obstruction (7%) and associated bleeding [8].

Two recent multi-centre randomised controlled trials (RCTs), both of which were discontinued early, have cited concerns over routine SEMS use [15, 16]. Despite this, SEMS is still recognised as a viable option, especially in institutions that have experience of its use as a bridge to surgery. The aim of this review was to report on technical and clinical success of SEMS placement, and associated morbidity from the current RCT evidence that compares SEMS as a bridge to surgery versus emergency resection for obstructing colonic tumours.

Methods

Search strategy

This review was performed according to Cochrane handbook for systematic reviews of interventions [17] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement [18].

We conducted a comprehensive search using PubMed, the Cochrane library database and Scopus in order to identify RCTs comparing SEMS and emergency surgery (ES) between January 2000 and June 2019.The last date of search was the 27th June 2019.

We searched for papers published in English using the following search headings: large bowel obstruction or colonic obstruction, stent or colorectal stent or bridge.

All titles were initially evaluated and suitable abstracts were extracted. In addition, each of the eligible publication reference list was also screened for further potential articles.

Inclusion and exclusion criteria

Only RCTs examining SEMS as a bridge to surgery versus emergency resection in adult populations were considered for this analysis. To be included in this review studies must (a) compare outcomes for SEMS as a bridge to surgery versus urgent operative management, (b) be written in English, (c) report on technical and clinical success of stent deployment.

Studies were excluded if (a) they did not compare management strategies, (b) were from non-randomised data, (c) were not involving the left colon or rectum, (d) report on non-malignant obstruction, (e) reported on use of palliative stenting, (f) were not written in English; and (g) if the methodology was not clearly reported.

Data extraction and statistical analysis

The following data were retrieved from the selected publications: year published, number of patients, site of malignancy, intervention which followed, time elapsed between stenting and subsequent surgery, technical success of stenting, clinical efficacy of stenting and data relevant to the pre-defined outcomes.

All data were entered independently by two investigators (PAB, NED) and compared only at the end of the reviewing process to reduce the selection bias. A third author (MK) eventually reviewed the database. Duplicates were erased and the discrepancies clarified.

Statistical analysis was completed as per the guidelines of the PRISMA statement and the Cochrane Handbook for systematic reviews. A formula devised by Hozo et al. was utilised to estimate mean and standard deviation for studies that expressed values in terms of median and range [19].

Primary and secondary outcomes

For the purpose of this review, the following primary outcomes were included: Technical success of stent deployment and clinical success of decompression of the obstruction.

Secondary outcomes included: perforation rate, complications, overall mortality, median time to surgery, laparoscopic surgery, stoma formation, permanent stoma, progression to elective surgery.

Assessment of risk of bias

The Cochrane Collaboration's tool [17] was used by two authors separately to assess risk of bias. Trials were graded as follows: L = low risk, H = high risk, U = unclear risk. Thus, each RCT was graded as having low, moderate, or high risk of bias. Disagreements were resolved by discussion. The results of this assessment are depicted in the appendix.

Results

Literature search and study characteristics

A total of 1245 publications were found using the aforementioned search criteria. After duplicates were removed, 875 publications were further reviewed. Following screening of titles, abstracts and full-texts, seven studies were found to meet the predefined inclusion criteria [7, 16, 20–24]; these

Table 1 Included studies

Author	Country	Journal	Year	SEMS	ES	Total
Alcantara [21]	Spain	World J Surg	2011	15	13	28
Ghazal [23]	Egypt	J Gastrointest Surg	2013	30	30	60
Cheung [7]	China	Arch Surg	2009	24	24	48
Sloothaak [22]	Netherlands	BJS	2014	26	32	58
Arezzo [20]	Italy/Spain	Surg Endosc	2017	56	59	115
Ho [24]	Singapore	Int J Colorectal Dis	2012	20	19	39
Pirlet [16]	France	Surg Endosc	2011	30	30	60
			Total	201	207	408

are listed in Table 1. The PRISMA flowchart is illustrated in Fig. 1.

Patient characteristics

A total of 408 patients were included in the selected studies. Of these, 201 (49.3%) were randomised to treatment with SEMS as a bridge to surgery versus 207 (50.7%) in the ES arm.

Of the SEMS cohort, there were 100 (49.8%) males versus 101 (50.2%) female with a mean age of 64.2 years. Within the ES cohort, there were 110 (53.1%) males versus 97 (46.9%) females, with a mean age of 65. A total of eight patients within the SEMS group had stage IV malignancy at presentation, in contrast 23 of the ES group had stage IV disease. A total of 117 tumours (28.7%) were located at the sigmoid colon, 104 (25.5%) within the descending colon, 48 (11.8%) within rectosigmoid, 31 (7.6%) at splenic flexure, one (0.2%) rectal and 107 (26.2%) not specified. Demographics data are illustrated in Table 2.

Technical and clinical success

Technically successful stent deployment was 81.1% ($n = 201$), ranging from 46.7 to 100%.

Clinically successful stenting, which was defined as a return to function of the colonic tract, occurred in 76.1% of patients ($n = 201$). This ranged from 40 to 100%.

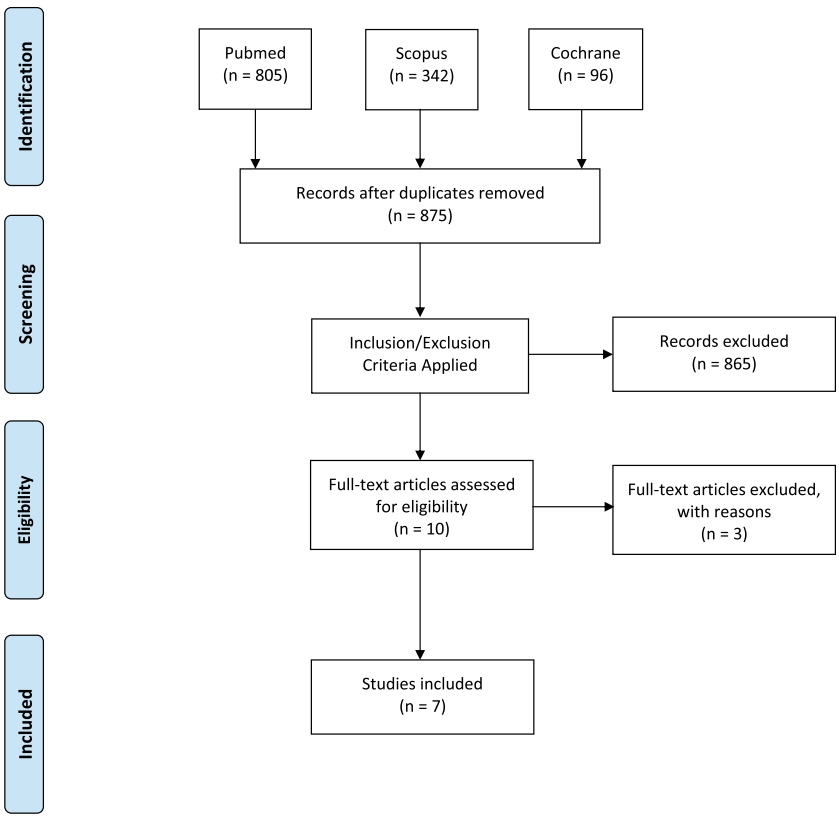

Fig. 1 PRISMA flowchart

Table 2 Demographics

	Alcantara		Ghazal		Cheung		Sloothaak		Arezzo		Ho		Pirlet		**Total**	
	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES
Number	$n=15$	$n=13$	$n=30$	$n=30$	$n=24$	$n=24$	$n=26$	$n=32$	$n=56$	$n=59$	$n=20$	$n=19$	$n=30$	$n=30$	201	207
Mean age (SD)	71.9 (8.96)	71.15 (9)	52.25 (7.75)	51 (7.75)	59 (7.25)	62.5 (14.75)	63.5 (1.75)	70 (4.5)	66.5 (11.75)	64 (8.33)	68 (8.5)	65.75 (8.75)	70.4 (10.3)	74.7 (11.3)	64.2	65
Sex M:F	5:10	7:6	12:18	19:11	14:10	12:12	12:14	18:14	28:28	32:27	13:7	9:10	16:14	13:17	100:101	110:97
No. stage IV	2	2	0	0	2	11	1	3	0	0	3	7	0	0	8	23
Location:																
Splenic	2	4	0	0	0	0	0	0	5	13	2	2	0	3	9	22
Descending	1	2	4	3	0	0	0	0	43	34	3	6	6	2	57	47
Sigmoid	11	4	14	17	0	0	0	0	8	12	10	8	15	18	58	59
Rectosigmoid	0	3	12	10	0	0	0	0	0	0	5	3	8	7	25	23
Rectum	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Not specified	0	0	0	0	24	24	26	32	0	0	0	0	1	0	51	56

Table 3 Stent-related outcomes

	Alcantara	Ghazal	Cheung	Sloothaak	Arezzo	Ho	Pirlet	Total
Technical success	100% ($n=15$)	96.7% ($n=30$)	83.3% ($n=24$)	80.1% ($n=26$)	87.5% ($n=56$)	75% ($n=20$)	46.67% ($n=30$)	81.1% ($n=201$)
Clinical success	100% ($n=15$)	96.7% ($n=30$)	83.3% ($n=24$)	76.9% ($n=26$)	76.8% ($n=56$)	70% ($n=20$)	40% ($n=30$)	76.1% ($n=201$)
Clinical perforation	0% ($n=15$)	0% ($n=30$)	0% ($n=24$)	11.5% ($n=26$)	8.9% ($n=56$)	0% ($n=20$)	6.67% ($n=30$)	5.0% ($n=201$)
Stent-related complications	0% ($n=15$)	0% ($n=30$)	0% ($n=24$)	NS	14.3% ($n=56$)	0% ($n=20$)	NS	5.5% ($n=145$)
Mean time to surgery (SD)	5–7 days	7–10 days	9.5 days (3.5)	NS	5.25 days (1.25)	16.75 days (7.25)	9.5 days (3.5)	8.8 days
Elective surgery	100% ($n=15$)	96.7% ($n=30$)	83.3% ($n=24$)	76.9% ($n=26$)	76.7% ($n=56$)	70% ($n=20$)	40% ($n=30$)	76.1% ($n=201$)
Acute surgery	0% ($n=15$)	3.3% ($n=30$)	16.7% ($n=24$)	23.1% ($n=26$)	19.6% ($n=56$)	30% ($n=20$)	60% ($n=30$)	22.9% ($n=201$)
Refused surgery	0% ($n=15$)	0% ($n=30$)	0% ($n=24$)	0% ($n=26$)	3.6% ($n=56$)	0% ($n=20$)	0% ($n=30$)	1% ($n=201$)
Laparoscopic resection (SEMS)	NS	Open	79.2% ($n=24$)	NS	30.3% ($n=56$)	25% ($n=20$)	Open	41% ($n=100$)

NS, not specified

Open, trial protocol described a straight to open approach

Other stent-related outcomes

All seven studies reported on perforation rate. Overall perforation was 5%, ranging from 0 to 11.5%. Two studies also reported a total of eleven subclinical perforations which were not obvious until histopathological examination of the resected specimen. These were considered to be "silent" perforations [16, 22].

Stent-related complications, including clinical perforation, were reported in five studies. The overall reported complication rate was 5.5% ($n = 145$). Complications included perforation in five patients, bleeding in one patient, pain in one patient and aspiration pneumonia in one patient.

Time between SEMS placement and elective surgical resection was reported in four studies. Overall mean time to surgery from SEMS placement was 8.8 days.

Seven studies observed that 76.1% ($n = 201$) of patients successfully proceeded to elective surgery. Acute/emergency surgical intervention was required for 22.9%, and two patients (1%) ultimately declined surgery after stent placement [20].

Only three studies reported on successful laparoscopic resection following SEMS placement, which was 41% ($n = 100$); however, two RCT's had laparotomy and resection as part of their study protocol. Within the ES cohort, laparoscopic surgery was either not specified or not attempted. Stent-related outcomes are illustrated in Table 3.

Comparable outcomes

Overall stoma formation was 20.1% in the SEMS group versus 37.1% in the ES group, while permanent stoma rates were 8.7% and 20% respectively. The overall post-operative mortality rate was 4% ($n = 174$) for SEMS versus 4.6% ($n = 175$) for ES.

Table 4 illustrates comparable outcomes.

Discussion

Patients presenting with obstructing colorectal neoplasms have increased morbidity and mortality [1]. This review shows that SEMS is associated with good technical success (81.1%), and the majority of those have restoration of gastrointestinal function. It is also associated with low perforation rates (5.0%). SEMS is a useful bridge to surgery in appropriately selected cases, offering the chance to complete oncological staging and optimizing patients prior to surgery. In addition, stenting also can be a useful palliative option in some patients. Alcantara et al. discontinued their study prematurely due to poor outcomes within the emergency surgery cohort. Their study observed a significant difference in overall morbidity, with emergency surgery having higher complication rates than the SEMS group (53.8% versus 13.3%) [21].

Table 4 Comparable outcomes

	Alcantara		Ghazal		Cheung		Sloothaak		Arezzo		Ho		Pirlet		Total	
	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES	SEMS	ES
Overall stoma Formation	6.7% ($n = 15$)	30.8% ($n = 13$)	0% ($n = 29$)	0% ($n = 30$)	33.3% ($n = 24$)	62.5% ($n = 24$)	NS		19.6% ($n = 56$)	40% ($n = 59$)	10% ($n = 20$)	31.6% ($n = 19$)	43.3% ($n = 30$)	56.7% ($n = 30$)	20.1% ($n = 174$)	37.1% ($n = 175$)
Permanent stoma Formation	6.7% ($n = 15$)	30.8% ($n = 13$)	0% ($n = 29$)	0% ($n = 30$)	0% ($n = 24$)	25% ($n = 24$)	NS		16.1% ($n = 56$)	25.4% ($n = 59$)	5% ($n = 20$)	10.5% ($n = 19$)	30% ($n = 30$)	26.7% ($n = 30$)	8.7% ($n = 174$)	20% ($n = 175$)
Overall postoperative Mortality	0% ($n = 15$)	7.7% ($n = 13$)	0% ($n = 29$)	0% ($n = 30$)	0% ($n = 24$)	0% ($n = 24$)	NS		7.1% ($n = 56$)	5.1% ($n = 59$)	0% ($n = 20$)	15.8% ($n = 19$)	10% ($n = 30$)	3.3% ($n = 30$)	4% ($n = 174$)	4.6% ($n = 175$)

NS, not specified
Open, trial protocol described a straight to open approach
SEMS, self-expanding metal stents cohort
ES, emergency surgery cohort

While the data regarding the peri-operative safety of SEMS would support its use in the BTS setting, increased concerns have been expressed regarding the possibility of local or distant metastasis following the employment of SEMS. Gorissen et al. reported increased local recurrence amongst patients treated with SEMS as a bridge to surgery [25]. Perforation during stent deployment may result in seeding of neoplastic cells into the peritoneum [26, 27]. There are concerns that silent perforations may occur at time of stenting and be contributing to higher local recurrence rates. This review did find that on final histopathological assessment that 11 of the SEMS as a bridge to surgery group had silent perforation evident.

In contrary, Matusda et al. argue that mechanical compression from metallic stenting may serve to supress local cancer cell proliferation. Their study showed decreased levels of VEGF, EGFR and Ki-67 in specimens following SEMS insertion [28]. Furthermore, the improved short-term outcomes associated with SEMS [29] provide a fitter patient, whom is more likely to complete full courses of neoadjuvant/adjuvant chemotherapy.

The two trials included in this review that were prematurely terminated due to high perforation rate amongst the SEMS groups have both faced criticism for the varying levels of experience in those performing emergency stenting [30]. Recent retrospective and prospective studies from centres with specialist experience have observed technical and clinical success of > 95%, and perforation rates below 1% [30, 31].

At present, the European Society of Gastrointestinal Endoscopy (ESGE) clinical guidelines suggest surgery within 5–10 days of stenting [32]. SEMS in conjunction with neoadjuvant chemotherapy may provide more time for physiological optimisation [33], while also potentially improving survival outcomes [34].

The short-term benefits of SEMS are already well-established and supported by this review. Some of the important long-term benefits which are often overlooked including permanent stoma rates, which was 8.7% in this review, versus 20% for the ES group.

We acknowledge that this review has some limitations. Included patients are from RCT data only and therefore intrinsic selection bias is evident. In addition, there is little data on histopathological quality, long-term survival, or patient-reported outcomes.

However, this study does show that SEMS as a bridge to surgery is associated with good technical and clinical success with low rates of iatrogenic perforation. One-fifth of patients required emergency surgery following stent placement and permanent stoma rates were 8.7%. Overall SEMS is a useful option in the treatment armamentarium of managing obstructing colorectal cancer, but there remains debate on which centres and level of expertise of those providing this option.

Appendix

Author	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other source of bias
Alcantara [21]	Unclear	Adequate	Adequate	Adequate	Inadequate	Adequate	Premature ending
Ghazal [23]	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Unclear
Cheung [7]	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Unclear
Sloothaak [22]	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Premature ending
Arezzo [20]	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Unclear
Ho [24]	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Unclear
Pirlet [16]	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Premature ending

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