Abstract

Introduction: Acute malignant large bowel obstruction (MBO) occurs in 8%–15% of colorectal cancer patients. Self-expandable metal stents (SEMS) have progressed from a palliative modality to use as bridge to surgery (BTS). We aimed to assess the safety and efficacy of SEMS for MBO in our institution.

Methods: The data of patients undergoing SEMS insertion for MBO were reviewed. Technical success was defined as successful SEMS deployment across tumour without complications. Clinical success was defined as colonic decompression without requiring further surgical intervention. Rates of complications, median time to surgery, types of surgery and rates of recurrence were studied.

Results: Seventy-nine patients underwent emergent SEMS placement from September 2013 to February 2020. Their mean age was 68.8 ± 13.8 years and 43 (54%) patients were male. Mean tumour length was 4.2 cm ± 2.2 cm; 89.9% of malignant strictures were located distal to the splenic flexure. Technical and clinical success was 94.9% and 98.7%, respectively. Perforation occurred in 5.1% of patients, with none having stent migration or bleeding. Fifty (63.3%) patients underwent SEMS insertion as BTS. Median time to surgery was 20 (range 6–57) days. Most (82%) patients underwent minimally invasive surgery. Primary anastomosis rate was 98%. Thirty-nine patients had follow-up beyond 1-year posttreatment (median 34 months). Local recurrence and distant metastasis were observed in 4 (10.3%) and 5 (12.8%) patients, respectively.

Conclusion: Insertion of SEMS for acute MBO has high success rates and a good safety profile. Most patients in this audit underwent minimally invasive surgery and primary anastomosis after successful BTS.

Keywords: Acute malignant bowel obstruction, bridge to surgery, colonic stenting, colorectal cancer, SEMS

INTRODUCTION

Colorectal cancer (CRC) is one of the most common cancers worldwide.[1] In Singapore, CRC had become the leading cancer in males over the last decade and has ranked consistently among the top cancers diagnosed in females for the last 50 years.[2] Approximately 8%–15% of patients with CRC present with acute malignant large bowel obstruction (MBO).[3,4] While intervention for acute MBO in CRC has traditionally involved emergency surgery, this is associated with higher postoperative mortality independent of age and tumour stage.[4] Emergency surgery in this context also carries a high morbidity rate of up to 70%, which is significantly higher than that for elective CRC surgery.[7–10]

Self-expandable metal stents (SEMS) were first reported as a strategy for acute MBO in 1994.[11] From its early indications as
a palliative modality in patients with advanced or unresectable CRC.\textsuperscript{[12‑14]} Numerous trials have been conducted to evaluate SEMS as a bridge to surgery (BTS) in the management of acute MBO.\textsuperscript{[15‑20]} The advantages of SEMS as BTS lie in the effective decompression of the large bowel in a timely fashion, obviating the need for emergency surgery and its associated morbidity and mortality. It also allows time for nutritional and physiological optimisation before definitive surgery. However, these benefits need to be balanced against the potential complications of SEMS placement in acute MBO, which include perforation, stent migration and stent obstruction.\textsuperscript{[21]}

As reported in recent meta-analyses, concerns remain about the oncological outcomes when SEMS is employed.\textsuperscript{[22,23]} While peritoneal seeding can result from an overt perforation, microscopic perforations or the pressure from stent deployment can potentially also result in haematogenous spread, local tumour seeding and perineural invasion.\textsuperscript{[24‑26]} These mechanisms account for an increased risk of CRC dissemination and relapse, potentially negating the benefits offered by SEMS as a strategy of BTS.

The aim of this study was to evaluate the safety and efficacy of SEMS insertion for acute MBO in a tertiary referral centre in Singapore.

METHODS

This was an audit conducted on all patients who underwent SEMS insertion for relief of acute MBO at a tertiary referral centre in Singapore, for the purpose of evaluating safety, efficacy and its impact on disease recurrence. Information was retrieved from a prospectively maintained electronic database. Patient demographics such as age, gender and ethnicity were analysed. Tumour characteristics, including location, axial length and stage according to the American Joint Committee on Cancer tumour-node-metastasis system, were also recorded. The intention of SEMS insertion (for palliation or BTS) was also noted. The clinical audit was conducted in a retrospective and observational manner with anonymised patient data. As such, the Centralised Institutional Review Board deemed that the study did not require formal approval.

The primary outcomes were the rates of technical and clinical success after SEMS insertion. Technical success was defined as successful deployment of SEMS across the malignant stricture without encountering complications. Clinical success was defined as colonic decompression following SEMS placement with relief of obstructive symptoms within 24 h without the need for further surgical decompression.

Secondary outcomes included the rates of complications such as perforation, bleeding, stent migration and tumour ingrowth into SEMS. For patients who underwent SEMS placement as BTS, we also included the median number of days to definitive surgery and the details of surgery. Long-term oncological outcomes were only analysed for patients with a follow-up duration beyond 1 year after curative surgery.

All colonic SEMS placement procedures were performed in a fluoroscopy suite in the endoscopy centre of our institution. Patients received rectal enemas for bowel cleansing before the procedure. Conscious sedation was administered in all patients, who were then placed in a left lateral position for insertion of a colonoscope. Carbon dioxide insufflation was used for the procedure. After detecting the distal end of the malignant stricture [Figure 1], a guidewire was inserted across the point of stenosis into the large bowel proximal to the stricture under combined endoscopic and fluoroscopic guidance. A catheter was railroaded over the guidewire [Figure 2a], and contrast was injected via the catheter to confirm the intraluminal location of the wire, as well as to estimate the length of the stenosis [Figure 2b]. Following this, a SEMS (WallFlex® Colonic Stent; Boston Scientific, Natick, MA, USA) was inserted over the guidewire to traverse the stricture and deployed under combined endoscopic [Figure 3a] and fluoroscopic [Figure 3b] guidance.

Successful SEMS placement was confirmed from the gush of faecal material following stent deployment [Figure 4a], with concomitant clinical improvement of abdominal distension in the patient on-table, as well as from fluoroscopy in the endoscopy room [Figure 4b].
RESULTS

Seventy-nine patients underwent insertion of SEMS for acute MBO from September 2013 to February 2020. The mean age was 68.8 ± 13.8 years with equal gender distribution. The majority (72.2%) of patients were Chinese. The average tumour length was 4.2 ± 2.2 cm. The tumours were predominantly left sided, with 10.1% (8/79) of malignant strictures located proximal to the splenic flexure. Table 1 summarises the patient and tumour characteristics.

Technical success was achieved in 94.9% (75/79) of patients who underwent SEMS insertion in our centre. Of the 75 patients with successful SEMS deployment across the malignant stricture, clinical success was observed in 98.7% (n = 74) of the patients.

Perforation occurred in 5.1% (4/79) of patients. Three of these patients had undergone stenting for palliation and were not candidates for surgery. Two of them eventually died, while the third patient was successfully managed non-operatively with antibiotics, as he had a sealed perforation. The fourth perforation was successfully salvaged by an emergent laparotomy, anterior resection and defunctioning ileostomy. The ileostomy was reversed subsequently, and the patient has remained disease-free to date. In addition, one patient who underwent palliative stenting required a transverse colostomy due to tumour ingrowth into SEMS 3 months after successful placement. Another patient succumbed to an acute myocardial infarction a day after SEMS insertion. There were no bleeding complications or cases of stent migration in our series. The efficacy and complications of SEMS placement are summarised in Table 2 and Figure 5.

Of the 79 patients who underwent SEMS insertion, 50 (63.3%) had SEMS inserted as BTS [Table 1]. All BTS patients successfully underwent definitive curative surgery at a median interval of 20 (range 6–57) days. The majority of patients underwent minimally invasive surgery (MIS) — 14% (7/50) and 68% (34/50) underwent robotic and laparoscopic surgeries, respectively [Table 2]; the rate of primary anastomosis for patients undergoing surgery was 98% (49/50). Six of these
patients had a concurrent defunctioning stoma, which was reversed at a median of 253.5 (range 93–739) days from the index surgery. One patient in the BTS group had chronic liver disease with refractory ascites despite best efforts at physiological optimisation. He eventually underwent a Hartmann’s procedure and remained the only case in our series with a permanent stoma.

The histopathological stage distribution of our series is summarised in Table 2. Majority of cases were stage 3 (60%), and the rest were stage 2. Thirty-nine of these patients had a follow-up period of longer than 1 year, with a median of 34 (range 12–65) months. Local recurrence of CRC was observed in 10.3% (4/39) of these patients. Two of these patients were also found to have distant metastasis on follow-up. Separately, three patients had systemic metastasis without evidence of local recurrence [Table 3].

**Table 2. Outcomes of patients undergoing SEMS (N=50).**

| Outcome                        | n (%)   |
|--------------------------------|---------|
| Days to curative surgery<sup>a</sup> | 20 (6–57) |
| Types of surgery               |         |
| Robotic-assisted               | 7 (14)  |
| Laparoscopic                   | 34 (68) |
| Open                           | 9 (18)  |
| Rate of primary anastomosis    | 49 (98) |
| Tumour AJCC stage              |         |
| Stage 2A                       | 12 (24) |
| Stage 2B                       | 8 (16)  |
| Stage 3A                       | 1 (2.0) |
| Stage 3B                       | 16 (32) |
| Stage 3C                       | 13 (26) |

<sup>a</sup>Data presented as median (range). AJCC: American Joint Committee on Cancer, SEMS: self-expandable metal stent

**Table 3. Characteristics of patients with local recurrence and distant metastases at follow-up.<sup>a</sup>**

| AJCC stage at diagnosis | Received recommended adjuvant chemotherapy |
|-------------------------|-------------------------------------------|
| Local recurrence (n=4)   |                                           |
| Patient 1                | 3C                                        | No |
| Patient 2                | 3C                                        | No |
| Patient 3                | 2A                                        | No |
| Patient 4                | 2B                                        | Yes |
| Distant metastases (n=5) |                                           |
| Patient 1                | 3C                                        | No |
| Patient 2                | 3C                                        | No |
| Patient 5                | 2B                                        | No |
| Patient 6                | 3C                                        | Yes |
| Patient 7                | 2B                                        | No |

<sup>a</sup>There were 39 patients with follow-up for more than 1 year with a median duration of follow-up of 34 (range 12–65) months. AJCC: American Joint Committee on Cancer

**DISCUSSION**

This study represents the largest single-centre experience for SEMS insertion in acute MBO in Singapore to date. Our institution is a tertiary referral centre in Singapore where interventional gastroenterologists collaborate closely with colorectal surgeons in a multidisciplinary setting for the treatment of CRC. In cases of acute MBO presenting as an emergency to colorectal surgery, a protocol exists for expedient referral and review of suitable patients for insertion of SEMS by an interventional gastroenterologist with a view to BTS. Appropriate patient selection from this close collaboration and an established protocol may account for the relatively high technical and clinical success rates (94.9% and 98.7%, respectively) reported in our study, regardless of whether SEMS was inserted for palliative intent or as BTS. These rates are comparable to those reported in similar case series performed in tertiary academic centres<sup>27,28</sup> and indeed, higher that those reported in several other studies.<sup>29‑33</sup>

Endoscopic SEMS insertion as BTS has been shown in meta-analyses to decrease perioperative morbidity.<sup>12,24‑36</sup> In our audit, the majority of SEMS inserted were as BTS, with a median of 20 days between SEMS insertion and definitive surgery. While the interval is longer than that reported in many studies in the literature, this was due to a combination of logistical considerations and the need for patient optimisation, as most of our patients were from the geriatric age group. Notably, we did not experience a corresponding increase in stent-related complications despite the longer interval to surgery. The high clinical success rate in our series allowed
for 82% (41/50) of our patients to undergo single-stage MIS resections. The presence of SEMS did not pose a significant impediment to the successful completion of MIS, with none of our cases requiring intraoperative conversion to open surgery. The rate of primary anastomosis was also higher than that reported in earlier studies.\(^{[34‑37]}\)

While SEMS insertion as BTS enables the surgery to be converted from an emergency to a semi-elective setting, the benefits need to be balanced against the potential risks. Our audit revealed a perforation rate of 5.1%, in keeping with the rates reported in the literature, which range between 4% and 11%.\(^{[37‑39]}\) Two of our patients who eventually died were not candidates for surgery, and their demise would likely have been imminent even without the attempted SEMS insertion. The remaining two cases in our series were successfully managed despite their stent perforations. Only one patient developed tumour overgrowth into the stent after palliative SEMS — his symptoms recurred after 3 months. There were no cases of stent migration and no bleeding complications in our series. We attribute the former to our use of uncovered SEMS and a reasonably short interval to surgery in the BTS group.

Opponents to the use of SEMS as BTS used to cite oncological outcomes as a concern.\(^{[22‑24]}\) However, more recent studies have shown that SEMS as BTS has disease-free survival comparable to emergency surgery in acute MBO.\(^{[33,40]}\) The increasing acceptance of SEMS for BTS has been reflected in the 2020 update of the European Society of Gastrointestinal Endoscopy Guideline.\(^{[41]}\) In our series, 39 patients had a median follow-up duration of 34 (range 12–65) months. The rates of local recurrence and distant metastases were 10.3% and 12.8%, respectively. It should be noted that half of the patients who had local recurrence during follow-up were Stage 3C CRC at diagnosis. Similarly, 60% of patients with distant metastasis on follow-up were Stage 3C at the time of diagnosis, and the remaining 40% were Stage 2B at the time of diagnosis. Three of these patients had declined adjuvant chemotherapy and another patient was unable to tolerate the full course of chemotherapy. Therefore, our results appear to be consistent with the postoperative recurrence rates of CRC as stratified by tumour stage\(^{[42]}\) and perhaps reflect tumour biology instead of a SEMS-related phenomenon.

A recently published case series describing the experience of a single surgeon from a tertiary institution in Singapore reported a SEMS‑related phenomenon. This could have resulted in better patient selection and transition of care poststenting. The median interval to definitive curative surgery in our study was 20 (range 6–57) days, which is double that of the finding reported in the study by Tang et al.\(^{[32]}\) It is possible that the longer interval to surgery in our study allowed time for optimisation of the patient before surgery, resulting in a higher proportion of patients receiving MIS. Moreover, the oncological outcomes in patients who had SEMS inserted as BTS were reported in our study, adding to the local data available on colonic stenting for MBO in our population.

As a clinical audit, our analysis suffers from the usual limitations of a retrospective study, coupled with the lack of a comparative arm — the group of patients who underwent upfront emergency surgery. However, this is currently the largest case series of SEMS in acute MBO in Singapore and it adds valuable information in support of this multidisciplinary approach. In our institution, the availability of SEMS as a BTS has resulted in a high rate of single-stage MIS resections and primary anastomoses in this group of patients.

In conclusion, SEMS insertion in acute MBO has high technical and clinical success rates with a good safety profile. It increases the likelihood of patients benefiting from a single-stage MIS resection and primary anastomosis.

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**Conflicts of interest**

Ang TL is a member of the SMJ Editorial Board, and was thus not involved in the peer review and publication decisions of this article.

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