

Oncological outcomes and recurrence patterns of obstructive colon cancer managed with self-expandable metallic stent as a bridge to surgery: A retrospective cohort study

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Abstract

Purpose

Self-expandable metallic stent (SEMS) placement as a bridge to surgery (BTS) for obstructive colorectal cancer (OCRC) has been increasingly adopted, offering higher primary anastomosis and lower stoma rates. However, its long-term oncological safety remains debated. We evaluated long-term outcomes and recurrence patterns of SEMS-BTS in real-world practice.

Methods

This single-center retrospective study included patients who underwent radical resection for pStage II/III colon adenocarcinoma without neoadjuvant therapy between January 2014 and December 2025. Site-specific recurrence was compared using Fisher's exact test. Recurrence-free survival (RFS) and overall survival (OS) were assessed by Kaplan–Meier and multivariable Cox regression.

Results

This study included 382 eligible patients, divided into the SEMS (n = 47) and non-SEMS (n = 335) groups. Baseline characteristics were largely comparable, except for higher preoperative carcinoembryonic antigen in the SEMS group ($p < 0.001$). Overall recurrence was higher in the SEMS group (23.4% vs 11.0%, $p = 0.031$), with this difference largely attributable to liver recurrence (17.0% vs 5.7%, $p = 0.010$). SEMS was independently associated with worse 5-year RFS (adjusted hazard ratio 2.26, 95% CI 1.12–4.57, $p = 0.022$) but not OS ($p = 0.716$).

Conclusion

SEMS-BTS for OCRC was associated with worse RFS and a higher rate of liver recurrence, whereas OS was comparable. While obstruction itself is a known adverse prognostic factor, our findings suggest SEMS may further contribute to this risk through site-specific dissemination during stent dwell time. These findings might support close postoperative follow-up after SEMS-BTS for OCRC, including vigilance for liver recurrence.

Introduction

Colorectal cancer (CRC) is the third most common malignant tumor worldwide [1, 2], and 10–20% of patients present with clinical bowel obstruction at the time of diagnosis: obstructive colorectal cancer (OCRC) [3, 4]. Although emergency surgery has been the conventional treatment, operating on a dilated, edematous bowel carries substantial perioperative morbidity, mortality, and stoma rates [3–6].

To address these challenges, self-expandable metallic stent (SEMS) placement as a bridge to surgery (BTS) has been increasingly adopted, permitting optimization of the patient's general condition, preoperative colonoscopy for synchronous lesion assessment, and transition to elective laparoscopic resection, with higher primary anastomosis rates and lower stoma formation [4–12]. The guidelines also recognize benefits such as a reduction in short-term complications and list stents as a treatment option [5, 9, 13, 14]. Whether SEMS adds long-term oncological risk on top of the burden imposed by obstruction itself, however, remains debated.

Preclinical and translational data suggest that SEMS has been shown in humans to shed viable circulating tumor cells (CTCs) into the bloodstream and to elevate circulating cell-free tumor DNA [15–17], while experimental studies in murine models have demonstrated increased peritoneal carcinomatosis and hepatic metastases after stent deployment across obstructive colonic tumors [18]. Clinically, however, the available evidence remains inconsistent: several meta-analyses [19–21] and a large nationwide propensity-matched cohort study [22] have reported comparable long-term outcomes between SEMS and emergency surgery, whereas a randomized trial [23], a propensity-matched analysis [24] and population-based cohorts [25] have suggested inferior long-term outcomes after SEMS.

In our hospital, SEMS is the first-line preoperative decompression strategy for OCRC, with transanal or nasointestinal decompression tubes and diverting stomas reserved for anatomically unsuitable lesions. The present study therefore aimed to evaluate the long-term oncological outcomes of SEMS as BTS at our institution, with a particular focus on site-specific recurrence pattern in real-world practice.

Methods

Study Design

This was a single-center retrospective cohort study conducted at Fukushima Medical University Hospital. Consecutive patients who underwent surgical resection for histopathologically confirmed Stage II or III colon adenocarcinoma between January 2014 and December 2025 were screened for eligibility. Tumors were staged according to the 8th edition of the UICC TNM classification [26]. The inclusion criteria were: (i) histopathologically confirmed primary adenocarcinoma of the colon; (ii) pathological Stage (pStage) II or III; and (iii) R0 (microscopically margin-negative) resection of the primary tumor. The exclusion criteria were: (i) primary tumor located in the rectum; (ii) receipt of any neoadjuvant chemotherapy or radiotherapy; and (iii) incomplete clinical or pathological data required for the planned analyses.

This study was approved by the Institutional Ethics Committee of Fukushima Medical University (approval number 30148) for a retrospective analysis of the collected data in accordance with the ethical standards of the Declaration of Helsinki of the World Medical Association. The requirement for written informed consent was waived because of the retrospective nature of the analysis, with an opt-out disclosure provided on the institutional website.

Preoperative decompression strategy

At our institution, SEMS placement is the first-line preoperative decompression strategy for OCRC and is selected whenever the tumor is anatomically amenable to stenting. When SEMS placement is attempted but technically unsuccessful — most often due to complete luminal obstruction precluding guidewire passage — emergency surgery is performed, consisting of either primary tumor resection or diverting stoma creation, according to the patient's vital signs, severity of bowel dilatation, and intraoperative findings.

Data collection

The following variables were retrospectively extracted from electronic medical records: patient demographics (age at surgery, and sex); tumor characteristics (primary tumor location, histological subtype, pStage, lymphatic invasion, and venous invasion); preoperative tumor markers (carcinoembryonic antigen [CEA], and carbohydrate antigen 19 – 9 [CA19-9]); and details of preoperative decompression. For the primary analysis, patients were dichotomized according to preoperative decompression strategy into the SEMS group and non-SEMS group, the latter included patients who underwent upfront surgery, transanal or nasointestinal tube decompression, or decompressive stoma creation. For the SEMS group, the time interval from decompression to primary tumor resection was calculated as the number of days from SEMS placement to the date of radical resection. The primary tumor location was categorized as either right-sided colon (cecum, ascending colon, or transverse colon) or left-sided colon (descending or sigmoid colon).

Statistical Analysis

Continuous variables are summarized as median and interquartile range (IQR), and categorical variables as counts and percentages. Between-group comparisons used the Mann–Whitney U test for continuous variables, and the chi-squared or Fisher's exact test for categorical variables, as appropriate.

Site-specific first recurrence was compared between the SEMS and non-SEMS groups using Fisher's exact test. Because patients with multiple recurrence sites were counted in every applicable category, these comparisons were considered exploratory and were not adjusted for multiple testing. The 5-year liver recurrence rate was estimated using the Kaplan–Meier method, with the event defined as the first liver recurrence and follow-up administratively censored at 60 months.

Kaplan–Meier curves were generated for 5-year recurrence-free survival (RFS) and overall survival (OS), and between-group differences were evaluated with the log-rank test. Cox proportional hazards regression was used to estimate hazard ratios (HRs) with 95% confidence intervals (CIs) for RFS and OS. The multivariable model included the following pre-specified covariates: group (SEMS vs non-SEMS), age (< 70 vs $\geq$ 70 years), sex, primary tumor location (right-sided colon vs left-sided colon), pStage (II vs III), and preoperative CEA ($\geq$ 5 vs < 5 ng/mL). A complete-case approach was used, in which patients with

missing values for any of the included covariates were excluded from the adjusted analyses. The median follow-up duration was estimated using the reverse Kaplan–Meier method.

All statistical analyses were performed using R software (version 4.5.3). The significance threshold was set at $p < 0.05$.

Results

Patient Characteristics

A total of 382 patients with pStage II or III colon adenocarcinoma (rectum excluded) who underwent R0 resection without neoadjuvant chemotherapy or radiotherapy met the eligibility criteria and were included in the cohort. Of these, 47 patients (12.3%) received SEMS placement as preoperative decompression. In the non-SEMS group, 329 patients underwent no preoperative decompression and 6 underwent alternative decompression (transanal/nasal ileus tube or stoma). Baseline characteristics stratified by decompression strategy are summarized in Table 1.

The two groups were largely comparable with respect to age (median 73.0 years [IQR 65.0–78.5] vs 72.0 years [IQR 64.0–77.5], $p = 0.405$), sex (male 46.8% vs 60.9%, $p = 0.066$), tumor location (left-sided colon, 59.6% vs 51.0%, $p = 0.273$), pStage (pStage III 46.8% vs 51.0%, $p = 0.586$), histological differentiation (well/moderately differentiated 85.1% vs 87.8%, $p = 0.385$), lymphatic invasion (positive 53.2% vs 53.0%, $p = 0.980$), venous invasion (positive 76.6% vs 82.6%, $p = 0.314$), and adjuvant chemotherapy administration (53.2% vs 48.1%, $p = 0.510$). The median interval from SEMS placement to definitive resection was 29 days (IQR 21.5–40.0). The most pronounced baseline difference was in preoperative CEA, which was substantially higher in the SEMS group (median 4.9 ng/mL [IQR 2.8–17.9] vs 2.9 ng/mL [IQR 1.6–6.0], $p < 0.001$); CA19-9 levels did not differ significantly between groups (median 13.5 U/mL [IQR 5.1–27.0] vs 9.6 U/mL [IQR 4.0–22.4], $p = 0.294$).

Site-specific recurrence patterns

During follow-up, 11 SEMS patients (23.4%) and 37 non-SEMS patients (11.0%) developed recurrence, and the difference in any-recurrence rate reached statistical significance ($p = 0.031$). Site-specific analysis revealed a significantly higher incidence of liver recurrence in the SEMS group (17.0% vs 5.7%, $p = 0.010$), whereas the rates of lung (4.3% vs 2.7%, $p = 0.632$), locoregional (2.1% vs 0.3%, $p = 0.231$), peritoneal (2.1% vs 2.4%, $p = 1.000$), distant lymph node (0% vs 0.6%, $p = 1.000$), and other (0% vs 0.3%, $p = 1.000$) recurrences did not differ significantly between groups (Table 2).

In a time-to-event analysis restricted to first liver recurrence within 5 years, the cumulative incidence of liver recurrence was 18.2% in the SEMS group versus 7.5% in the non-SEMS group (log-rank $p = 0.007$; Fig. 1), and SEMS placement was associated with an unadjusted HR of 2.95 (95% CI 1.29–6.75; $p = 0.010$) for liver recurrence (Fig. 1). Within the SEMS group, the cumulative incidence of liver recurrence

was numerically lower among patients with stent-to-surgery intervals ≤ 29 days (the cohort median) than among those with longer intervals (14.7% vs 22.8%; log-rank $p = 0.355$; Supplementary Figure S1).

Survival analyses

Kaplan–Meier curves for 5-year RFS and OS in the survival cohort are shown in Fig. 2. The RFS curves separated early in favor of the non-SEMS group, with 5-year RFS estimates of approximately 75% in the SEMS group and approximately 85% in the non-SEMS group, and the difference reached statistical significance (log-rank $p = 0.023$; Fig. 2a). In contrast, the 5-year OS curves were essentially superimposable (log-rank $p = 0.649$; Fig. 2b). The median follow-up duration was 48.9 months (54.2 months in the SEMS group and 48.9 months in the non-SEMS group).

Results of Cox regression are summarized in Table 3, and displayed as forest plots in Fig. 3. In the multivariable model for 5-year RFS ($n = 370$, events = 47), SEMS placement was independently associated with worse 5-year RFS (adjusted hazard ratio [aHR] 2.26, 95% CI 1.12–4.57, $p = 0.022$) (Table 3a, Fig. 3a). pStage III was also independently associated with worse RFS (aHR 2.01, 95% CI 1.09–3.71, $p = 0.025$), whereas age, sex, and tumor location were not significantly associated with RFS in the adjusted model (Table 3a, Fig. 3a).

In the multivariable model for 5-year OS ($n = 370$, events = 43), SEMS placement was not significantly associated with mortality (aHR 1.17, 95% CI 0.50–2.73, $p = 0.716$) (Table 3b, Fig. 3b). Age ≥ 70 years was the only variable independently associated with worse OS (aHR 2.78, 95% CI 1.36–5.71, $p = 0.005$), while sex, tumor location, and pStage had no independent prognostic impact on OS within this cohort (Table 3b, Fig. 3b).

Discussion

In this single-center retrospective cohort, two findings are noteworthy. First, SEMS placement was associated with a significantly higher overall recurrence rate, with the excess largely attributable to liver recurrence; the rates of lung, locoregional, peritoneal, and nodal recurrence did not reach statistical significance, although the limited number of events at these sites precludes confident exclusion of between-group differences. Second, SEMS group emerged as an independent adverse factor for 5-year RFS but was not associated with 5-year OS. Notably, a similar pattern with a higher proportion of liver recurrence has been previously described as a feature of obstructive colorectal cancer itself [27], independent of stent use, raising the question of whether the present findings primarily reflect the biology of obstruction or an additional impact of SEMS placement.

In the present study design, the worsening of RFS cannot be attributed solely to SEMS placement and cannot be disentangled from the prognostic impact of obstruction itself, because the non-SEMS group in our cohort consisted predominantly of non-obstructed elective resections (329 of 335 patients). Preoperative obstruction has been consistently associated with worse OS and disease-free survival

(DFS) independently of conventional staging variables [28, 29]. Notably, in a pre-stenting era stage III cohort, Kato et al. reported a strikingly similar anatomical signature to that observed in our study: preoperative obstruction was specifically associated with liver recurrence (19.4% vs 9.3%, $p = 0.019$), whereas peritoneal recurrence rates were unchanged (11.1% vs 15.4%, $p > 0.999$) [27] – a pattern that closely parallels our findings (liver 17.0% vs 5.7%, peritoneal 2.1% vs 2.4%). This concordance, despite differences in cohort era and adjuvant regimens, suggests that the liver-predominant signature is an intrinsic feature of obstructive biology shared by both pre-stenting and SEMS-managed populations.

Nonetheless, an additional contribution from SEMS placement on top of the obstruction-related risk cannot be excluded. Endoscopic stent insertion has been shown to acutely elevate circulating tumor cells, cytokeratin-20 mRNA, and cell-free or tumor DNA in the perioperative period [15–17]. In an orthotopic murine model, stent deployment across an obstructive colon tumor was shown to increase the metastatic burden [18]. Because the colon drains into the portal venous circulation, mechanical compression of the tumor by the expanding stent provides a plausible substrate for tumor-cell embolization through invaded venules, with the hepatic sinusoids serving as the first-pass capillary bed – a mechanism compatible with the higher rate of liver recurrence observed in the SEMS group. Whether such peri-procedural dissemination contributes meaningfully to clinical recurrence – over and above the dissemination already attributable to obstruction itself – remains an open question that our observational design cannot resolve. In either case, these findings may inform postoperative follow-up strategies after SEMS-BTS for OCRC, including vigilance for liver recurrence.

In our cohort, the rates of pathologically documented lymphatic and venous invasion did not differ significantly between the SEMS and non-SEMS groups (Table 1), in contrast, previous analyses have reported a significant SEMS-associated increase in lymphatic invasion [30]. This null finding likely reflects both limited statistical power ($n = 47$ in the SEMS group) and the extensive peritumoral changes induced by stent expansion. Previous reports have documented frequent stent-induced tissue alterations including necrosis, ischemia, and fibrosis [31] – which by the time of definitive resection, performed a median of 29 days later in our cohort, may obscure the invasive front and render residual microvascular tumor emboli difficult to identify even with adjunctive immunostaining. Thus, our findings cannot substantiate or disprove the mechanical-dissemination hypothesis histopathologically, but rather demonstrate the limitations of routine pathology in this setting.

The interval from SEMS placement to definitive resection in our cohort (median 29 days, IQR 21.5–40.0) exceeded the approximately 2-week interval recommended by the 2020 ESGE guideline [9], and several pivotal clinical trials have adopted even shorter intervals of 5–10 days between stent placement and resection [11, 23, 32]. In clinical practice, such intervals reflect several real-world constraints, including limited operating room availability for semi-elective procedures, the time required for adequate bowel decompression and resolution of mucosal edema, and the routine performance of preoperative total colonoscopy for synchronous lesion screening. The optimal interval between stent placement and definitive resection remains a subject of ongoing debate [33, 34]. Shorter intervals carry the disadvantages of incomplete bowel decompression and limited time for optimization of the patient's

general condition, potentially increasing the risk of anastomotic leakage secondary to residual mucosal edema [34, 35]. Conversely, longer intervals raise oncologic concerns: the peri-procedural tumor-cell shedding described earlier may be amplified by extended stent dwell time, providing a mechanistic rationale linking interval duration to the elevated hepatic recurrence observed in our cohort. Beyond these oncologic concerns, prolonged intervals have also been associated with denser fibrotic adhesions that complicate operative dissection and with a higher cumulative risk of late stent-related complications such as perforation and reobstruction [33]. On balance, many reports recommend early surgery to limit both oncologic and SEMS-related risks [10, 32, 33, 36], and intervals exceeding approximately 2–3 weeks have been associated with worse oncologic outcomes [10, 36]. Consistent with this, an exploratory within-SEMS analysis in our cohort stratified by the median interval (29 days) showed a numerically lower 5-year cumulative incidence of liver recurrence in patients with shorter intervals (14.7% vs 22.8%; Supplementary Figure S1).

Several limitations should be acknowledged. First, as a retrospective single-center analysis, the findings carry inherent risks of selection bias and limited generalizability, since institutional decompression and management patterns may differ from other centers. Second, the non-SEMS comparator was heterogeneous, comprising predominantly upfront elective resections and a small number of cases managed by tube decompression or diverting stoma. Third, although the median follow-up of 48.9 months and the numbers at risk at 60 months ($n = 114$ non-SEMS, $n = 19$ SEMS) are sufficient to support 5-year estimates, projections beyond this horizon should be made with caution. These limitations are balanced by the strengths of a consecutive, well-characterized 12-year single-institution cohort with uniform pathological staging and standardized follow-up, which enabled detailed site-specific recurrence pattern analysis that remains infrequently reported in the existing literature.

Conclusion

SEMS placement as a BTS was associated with worse 5-year RFS in our cohort, with liver recurrence being the most frequent site of recurrence, rather than a uniform increase across all recurrence sites. However, the contribution of obstructive tumor biology itself could not be excluded. While obstruction itself is a known adverse prognostic factor, our findings suggest that SEMS may further contribute to this risk through site-specific dissemination during stent dwell time. Although future studies are needed to elucidate the underlying biological mechanisms, these findings may inform postoperative follow-up strategies after SEMS-BTS for OCRC, including vigilance for liver recurrence.

Abbreviations

aHR
adjusted hazard ratio
BTS
bridge to surgery
CA19-9

carbohydrate antigen 19 – 9
CEA
carcinoembryonic antigen
CI
confidence interval
CRC
colorectal cancer
CTCs
circulating tumor cells
DFS
disease-free survival
HR
hazard ratio
IQR
interquartile range
OCRC
obstructive colorectal cancer
OS
overall survival
pStage
pathological Stage
RFS
recurrence-free survival
SEMS
self-expandable metallic stent.

Declarations

Ethics approval and consent to participate:

This study was approved by the Institutional Ethics Committee of Fukushima Medical University (approval number 30148; approved on 9 October 2018) for a retrospective analysis of the collected data in accordance with the ethical standards of the Declaration of Helsinki of the World Medical Association. Because of the retrospective nature of the study, the requirement for written informed consent was waived, and an opt-out informed consent procedure was used for the collection and use of participant data for research purposes; the opt-out procedure was reviewed and approved by the same committee under the same approval number.

Consent for publication:

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

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Author Contribution

M.H., H.O., and J.T. collected the data. M.H. analyzed the data and drafted the manuscript. M.H., T.M., J.T., T.K., C.T., S.F., T.S., M.I., D.U., S.C., H.O., M.S., W.S., and K.K. contributed to patient management, discussed the results, critically revised the manuscript, and approved the final version.

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Data Availability

The data underlying this study are available on reasonable request, subject to institutional and ethical restrictions. Further enquiries can be directed to the corresponding author.

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Figures

Cumulative incidence of liver recurrence: SEMS vs Non-SEMS

Stage II/III, R0, no neoadjuvant, colon only. n = 47 (SEMS) vs 335 (Non-SEMS)

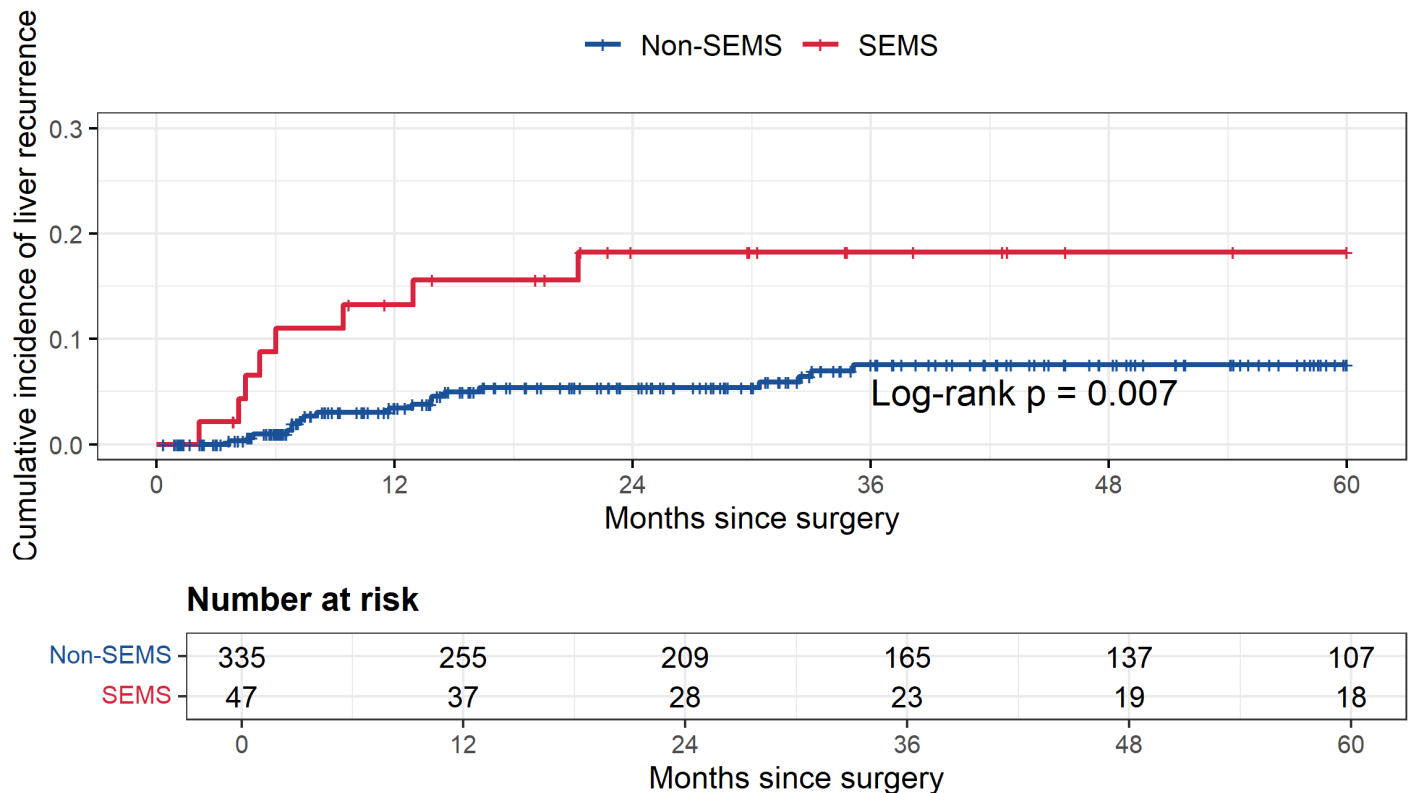


Figure 1

Kaplan–Meier estimate of the cumulative incidence of first liver recurrence within 5 years, comparing the SEMS group (n = 47) with the pooled non-SEMS group (n = 335). The log-rank p-value is shown on the plot; numbers at risk are displayed below.

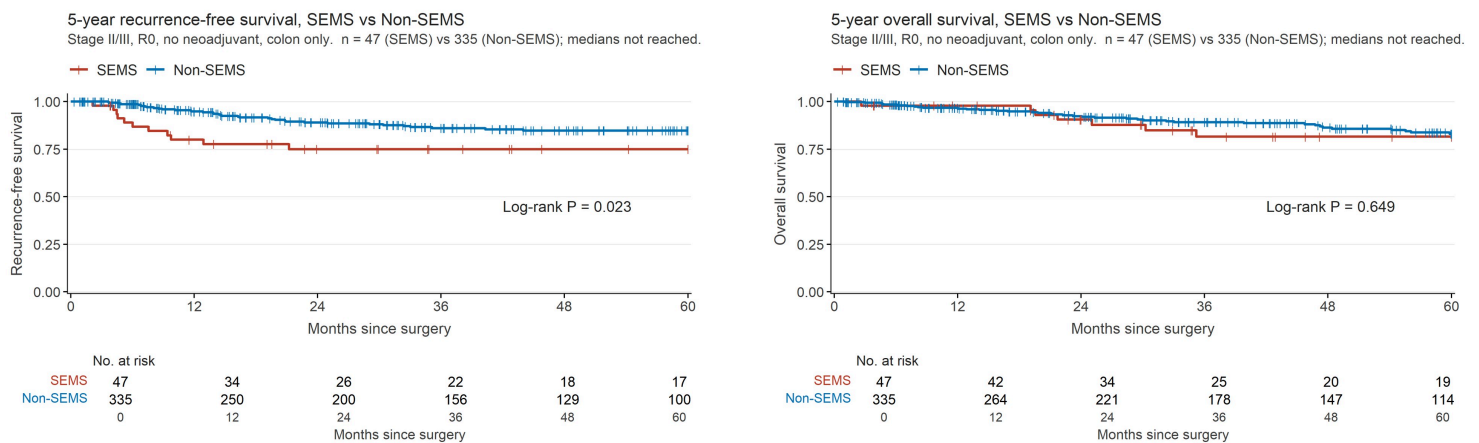


Figure 2

Kaplan–Meier estimates of (a) 5-year recurrence-free survival (RFS) and (b) 5-year overall survival (OS), comparing the SEMS group (n = 47) with the pooled non-SEMS group (n = 335). Log-rank p-values are

shown on the plots; numbers at risk are displayed below.

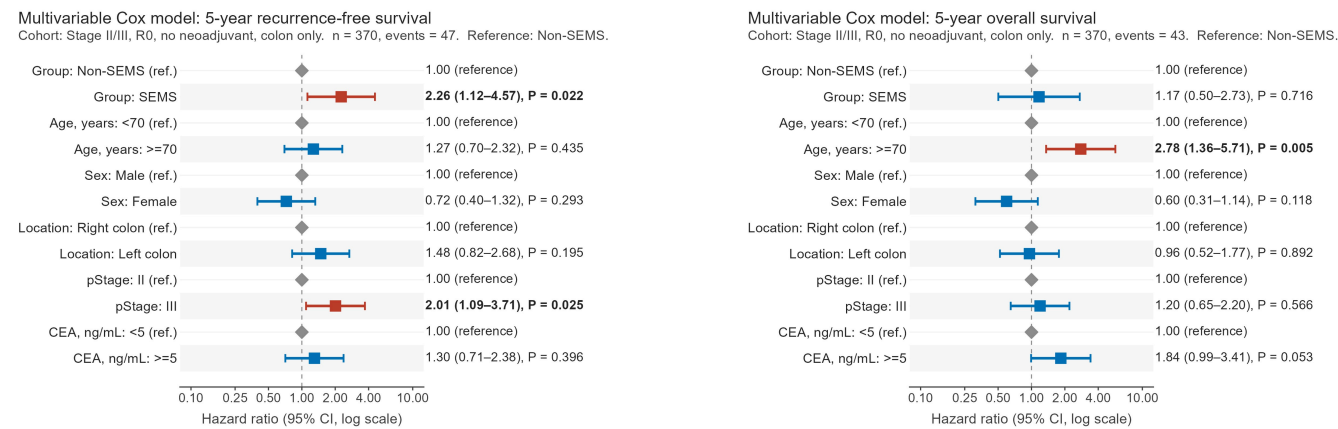


Figure 3

Forest plots of adjusted hazard ratios (aHR) with 95% confidence intervals from multivariable Cox proportional hazards models in the Stage II/III, R0, no-neoadjuvant, colon-only cohort (n = 370). (a) Model for 5-year recurrence-free survival (47 events). (b) Model for 5-year overall survival (43 events). Each model included group (SEMS vs pooled non-SEMS [reference]), age (≥70 vs <70 years [reference]), sex (female vs male [reference]), tumor location (left sided vs right sided colon [reference]), pathological stage (III vs II [reference]), and CEA (≥5 vs <5 ng/mL [reference]). Red points denote statistically significant associations (p < 0.05); blue, non-significant; grey diamonds, reference categories.

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