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Effectiveness of colonic stent placement for obstructive colorectal cancers: An analysis of short-term results using a nationwide database in Japan

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Key words
obstructive colorectal cancer, self-expandable metallic stent, urgent surgery.

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Ethical approval: The study protocol was reviewed and approved by the Ethics Committee of Tohoku University Graduate School of Medicine (2019-1-415).

Abstract

Background and Aims: Self-expandable metallic stent (SEMS) is widely used for obstructive colorectal cancer (OCC). Both SEMS and urgent surgery have several merits and demerits. This study aimed to clarify the efficacy of SEMS by comparing the mortality rate after the hospitalization between SEMS and urgent surgery for OCC.
Methods: We collected OCC patients' data using the Diagnosis Procedure Combination (DPC) database system. We divided eligible patients into the SEMS and urgent surgery groups using propensity score matching and compared in-hospital death rates, length of hospitalization, and medical costs. We also conducted logistic regression analysis to identify clinical factors affecting in-hospital deaths.
Results: We enrolled 17 140 cases after propensity score matching. SEMS reduced the in-hospital death rate compared with urgent surgery (2.0% *vs* 3.6%, $P < 0.0001$). Length of hospitalization was shorter in the SEMS group than in the urgent surgery group (16 *vs* 25 days, $P < 0.0001$). Medical costs were lower in the SEMS group than in the urgent surgery group (1 663 550 *vs* 2 424 082 JPY, $P < 0.0001$). Multivariate analysis also showed that SEMS reduced in-hospital death (odds ratio = 0.58, 95% confidence interval: 0.50–0.70, $P < 0.0001$).
Conclusion: Self-expandable metallic stent placement for OCC might reduce the mortality rate in short term and shorten the length of hospitalization. These results facilitate considering SEMS with careful judgment for its indication when treating OCC patients.

Informed consent: Owing to the anonymous nature of the data, informed consent was waived for the approval.

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[1]Rintaro Moroi and Kunio Tarasawa contributed equally to this work.

Introduction

Obstructive colorectal cancer (OCC) is an emergency situation that requires immediate decompression and also shows high mortality and morbidity rates in the short and long term.[1] Approximately 10–30% of colorectal cancers develop colonic obstruction.[2–5] One can select self-expandable metallic stent (SEMS) or urgent surgery when treating OCC. There are two major indications for placing SEMS: bridge to surgery (BTS) and palliation. SEMS placement demonstrates several merits, exhibiting good efficacy to release obstruction and safety in both BTS and palliation.[6–8]

On the contrary, the clinical guidelines from the European Society of Gastrointestinal Endoscopy recommend stenting as a BTS to be discussed.[8] They also stated that BTS was a treatment option in patients with potentially curable left-sided OCC as an alternative to emergency resection.[8] There are several randomized control trials (RCTs) that directly compared SEMS placement as BTS and urgent surgery in left-sided OCC.[9–15] One RCT reported that the morbidity and 3-year overall survival rates were not different in the two groups, while stoma creation rate in the BTS group was lower compared with the urgent surgery group.[15] Other RCTs also reported that there were no differences in the mortality rate[10] and

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the length of hospitalization[13] between SEMS and urgent surgery. Furthermore, another RCT concluded that SEMS has no clinical advantages over urgent surgery.[12] However, these studies consisted of relatively small number of patients. It might be difficult to conduct an RCT that contains enough number of patients to compare SEMS and urgent surgery because OCC is a severe disease that requires immediate intervention to release obstruction.

There is a national database of hospitalization in Japan, named the Diagnosis Procedure Combination (DPC). This database contains data of a large number of patients and could be an alternative method to investigate which strategy is preferable for OCC because of its high volume of data[16,17] and by conducting propensity score-matched analysis, instead of RCT.[18]

This study aimed to investigate the efficacy of SEMS by comparing the mortality rate, stoma creation rate, length of hospitalization, and medical costs in the short term, between SEMS and urgent surgery for OCC using a nationwide database in Japan.

Methods

Diagnosis Procedure Combination system. The DPC database, which has been in place since 2003, is a medical claims database of admissions to acute-care hospitals in Japan. The DPC system was adopted at 1730 hospitals in 2018 and covers approximately 83% of the acute-care beds in Japan.[19] There are six distinct categories of diagnosis, namely, "main diagnosis," "main disease triggering admission," "most resource-consuming diagnosis," "second most resource-consuming diagnosis," "comorbidities at admission," and "complications after admission," in the DPC database. The DPC database also contains patients' demographics, medical costs, procedures (including stent placement, colectomy, and ileostomy), and condition at discharge.[20,21] The physicians input patients' diagnosis into the DPC database according to International Classification of Diseases, 10th revision (ICD-10). The DPC database has been used for various clinical studies,[16,18] including those for colorectal cancer,[17] and its diagnostic validity is confirmed.[20,22]

The DPC database cannot identify the patients who discharged after SEMS placement and subsequently readmitted another hospital to undergo surgery.

Patients. This study includes the administrative claims data for all inpatients discharged from more than 1100 participating hospitals, as well as for patients with OCC who were admitted to DPC-participating hospitals from April 2012 through March 2020 (Fig. 1). Colorectal cancer was identified using the ICD-10 code C18.0–18.9, C19, and C20, which indicates colon cancer or rectal cancer, as the most resource-consuming diagnosis. Entries of colorectal cancer suspicious cases containing the word "suspicious" were excluded. We included patients with the following characteristics, (i) primary colorectal cancer, (ii) not scheduled or urgent admissions, (iii) containing the phrase "ileus" as main disease triggering admission or comorbidities at admission, and (iv) first intervention (SEMS placement or surgery including colectomy and stoma creation) within 2 days after admission. We selected conditions with urgent or not scheduled admissions to exclude patients who were discharged after stent placement and underwent radical surgery after being readmitted. We finally excluded patients with the following characteristics, (i) T1 category based on TNM classification and (ii) containing the phrases

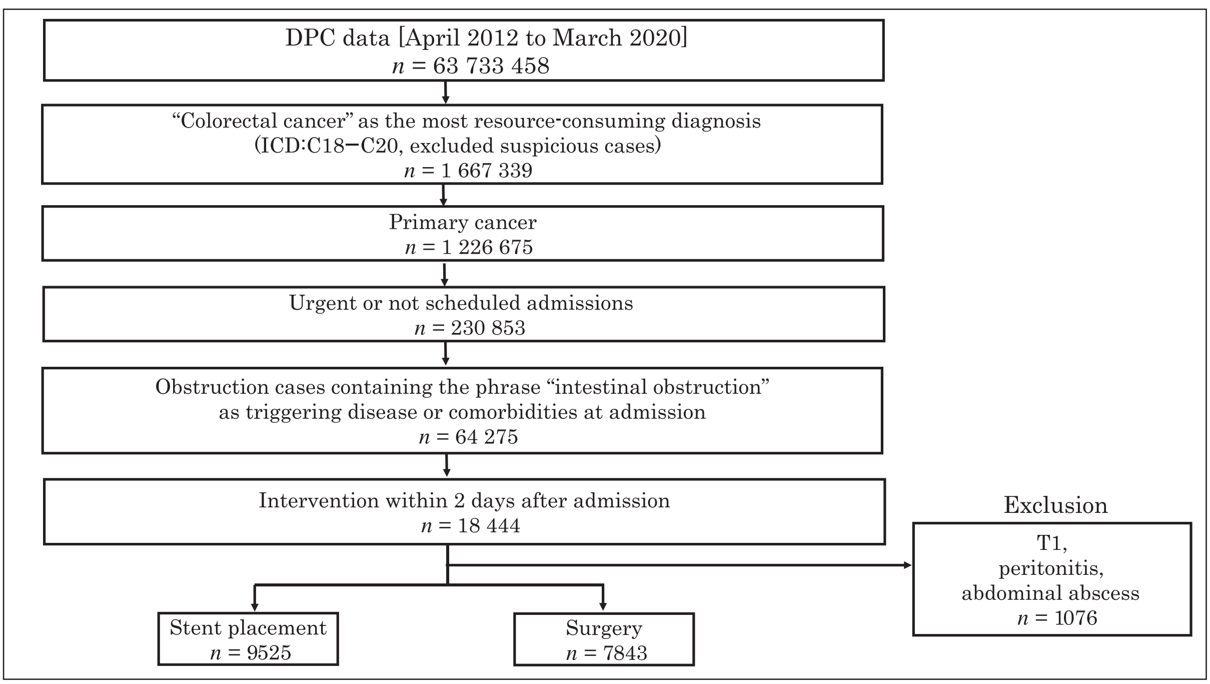

Figure 1 The flowchart of patient extraction. The eligible patients were extracted as per this flow. DPC, Diagnosis Procedure Combination; ICD, International Classification of Diseases.

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"peritonitis" and "abdominal abscess" in their comorbidities at admission because the T1 cancer is not thought to develop an OCC, and we have to select surgery superior to SEMS in patients with peritonitis or abdominal abscess.

Data collection. We collected the following data on patients and clinical characteristics, procedures, and condition at discharge from the DPC database: age, sex, body mass index (BMI), smoking history, Charlson comorbidity index (CCI),[23] hospital type (academic hospital or not), primary tumor (T), lymph node (N), and distant metastasis (M) categories based on TNM classification,[24] disease location (including cecum, ascending colon, transverse colon, descending colon, sigmoid colon, and rectum), condition at discharge (in-hospital death), medical costs (available data from 2016 to 2020), length of the hospital stay, and interventions to release obstruction such as SEMS placement and surgery (including colectomy and/or stoma creation). We defined in-hospital death, medical costs, and the length of the hospital stay as clinical endpoints to evaluate the efficacy of SEMS.

Data analysis. We classified the eligible patients into five categories according to their age (≤ 49, 50–59, 60–69, 70–79, and ≥ 80 years) and into three categories according to BMI (underweight: < 18.5 kg/m^2, normal range: 18.5–24.9 kg/m^2, and overweight: > 25.0 kg/m^2) based on the World Health Organization classification.[25] The eligible patients were also divided into two groups according to the first intervention to release obstruction due to OCC, as follows: SEMS group (stent placement) and surgery group (colectomy and/or stoma creation). The DPC database does not include the time of admission; thus, only the date of admission was recorded. Therefore, we extracted interventions that were conducted within 2 days after admission.

We conducted propensity score matching analysis to compare the efficacy of stent placement with that of surgery. We used the following variables for propensity score matching: sex, age categories, and BMI categories as described earlier, CCI, smoking history, hospital type, TNM categories, and disease location. We subsequently compared them using rates of in-hospital death and stoma creation during the admission between the SEMS and surgery groups, using χ^2 tests, and the length of hospitalization and medical costs of hospital stay, using Wilcoxon's signed-rank test. The eligible patients after propensity score matching were divided into two groups based on the disease location, as follows: right-sided colon consisted of cecum, ascending and transverse colon, and left-sided colon consisted of descending and sigmoid colon and rectum. We then compared the rate of in-hospital death, length of hospitalization, and medical costs in each group as well. We also performed a multivariate analysis using logistic regression analysis with the data before propensity score matching to identify clinical factors that affect in-hospital death and stoma creation.

Statistics. The threshold for statistical significance was $P < 0.05$. All analyses were performed using JMP Pro14 (SAS Institute, Tokyo, Japan) software.

We calculated C-statistics and standardized difference in each variable described earlier when we conduct propensity score matching. C-statistics is preferable if it is between 0.7 and 0.8. However, after matching, the SEMS and surgery groups are comparable for all standardized difference < 0.1.

All authors had access to the study data and reviewed and approved the final manuscript.

Ethics. The study protocol was reviewed and approved by the Ethics Committee of Tohoku University Graduate School of Medicine (2019-1-415). Owing to the anonymous nature of the data, informed consent was waived for the approval.

Results

Patient characteristics. We finally included 17 368 eligible cases, of whom 9525 were assigned to the SEMS group, and the remaining 7843 to the surgery group (Fig. 1). After propensity score matching, 6804 pairs of patients were selected. The C-statistic was 0.63, and the standardized difference in each variable was < 0.1. The characteristics of the study population are summarized in Table 1. The characteristics of both groups were similar after propensity score matching.

Comparisons of clinical endpoints between self-expandable metallic stent and surgery groups after propensity score matching. The relationship between intervention type and clinical endpoints is summarized in Table 2. The rate of in-hospital death was lower in the SEMS group than in the surgery group (2.0% *vs* 3.3%, $P < 0.0001$). The rate of stoma creation in the SEMS group was also lower compared with the surgery group (3.3% *vs* 56.0%, $P < 0.0001$). The median length of hospital stay in the SEMS group was shorter than that in the surgery group (16 *vs* 24 days, $P < 0.0001$). The medical costs of hospital stay in the SEMS group were lower than those in the surgery group (1 640 370 *vs* 2 394 540 JPY, $P < 0.0001$).

Comparisons of clinical endpoints between self-expandable metallic stent and surgery in the left-sided and right-sided colon. The relationship between intervention type and clinical endpoints in the left-sided and right-sided colon is summarized in Table 3. The rates of in-hospital death and stoma creation in the SEMS group were lower than those in the surgery group in each-sided colon. The SEMS group also demonstrated better clinical outcomes compared with the surgery group in the duration of hospital stay and medical costs in each-sided colon.

Multivariate analysis for in-hospital death and stoma creation before propensity score matching. The results of multivariate analysis for in-hospital death are summarized in Table 4. On multivariate analysis, younger age, academic hospital (odds ratio [OR] = 0.6, 95% confidence interval [CI]: 0.37–0.99, $P = 0.043$), and stent placement (OR = 0.58, 95% CI: 0.50–0.70, $P < 0.0001$) were identified as the clinical factors that decrease in-hospital death. Conversely, underweight (OR = 1.51, 95% CI: 1.24–1.85, $P < 0.0001$) and metastasis (OR = 2.31, 95% CI: 1.78–2.99, $P < 0.0001$) were identified as the clinical factors that increase in-hospital death.

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Table 1 Comparison of clinical characteristics of study population between before and after propensity score matching

	Before propensity score matching Total n = 17 368			After propensity score matching Total n = 13 608			
	SEMS group n = 9525	Surgery group n = 7843	P value	SEMS group n = 6804	Surgery group n = 6804	P value	Standardized difference
Sex (male/female)	5253/4272	3989/3854	< **0.0001**	3598/3206	3598/3206	1.00	0
Age (mean ± SD), years	73.3 ± 12.3	73.4 ± 12.8	0.17	73.5 ± 12.4	73.3 ± 12.5	0.41	0.016
Age categories							
≥ 80 years	3182	2818		2392	2345		
70–79 years	2888	2165		1938	1967		
60–69 years	2295	1823		1613	1633		
50–59 years	759	698		593	588		
≤ 49 years	401	339		268	271		
Body mass index (mean ± SD), kg/m^2	21.4 ± 5.0	20.7 ± 3.9	< **0.0001**	21.1 ± 4.9	20.9 ± 3.9	0.06	0.045
BMI categories							
Overweight (> 25.0 kg/m^2)	1347	831		763	796		
Normal range (18.5–24.9 kg/m^2)	5737	4508		4066	4013		
Underweight (< 18.5 kg/m^2)	1840	1933		1512	1531		
Charlson comorbidity index score (mean ± SD)	1.5 ± 2.2	1.6 ± 2.3	**0.0024**	1.5 ± 2.2	1.6 ± 2.3	0.052	0.044
Smoking history (yes/no)	3042/6483	2331/5512	**0.0017**	2079/4725	2099/4705	0.72	0.012
Academic hospital (yes/no)	344/9181	499/7344	< **0.0001**	335/6469	321/6483	0.6	0.0096
T categories			< **0.0001**			0.95	
T2	563	418		354	341		0.0086
T3	3848	3204		2758	2765		0.002
T4	3199	2828		2442	2458		0.0049
TX	1915	1393		1250	1240		0.0038
N categories			0.058			0.99	
N0	3488	2897		2467	2479		0.0037
N1	2797	2219		1980	1959		0.0068
N2	1267	1036		893	908		0.0065
N3	201	215		173	175		0.019
NX	1772	1476		1291	1283		0.003
M categories			0.39			0.88	
M0	6052	5048		4336	4310		0.0079
M1	2345	1913		1690	1714		0.0081
MX	1128	882		778	780		0.0092
Disease location			< **0.0001**			1.00	
Cecum	84	697		84	84		0
Ascending colon	844	1043		823	829		0.0027
Transverse colon	1636	1219		1190	1191		0.00039
Descending colon	1643	840		837	837		0
Sigmoid colon	3687	2422		2391	2389		0.00062
Rectum	1631	1622		1479	1474		0.0018

(Continues)

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Table 1 (Continued)

	Before propensity score matching Total n = 17 368			After propensity score matching Total n = 13 608			
	SEMS group n = 9525	Surgery group n = 7843	*P* value	SEMS group n = 6804	Surgery group n = 6804	*P* value	Standardized difference
Colectomy during the admission (yes/no)	2398/6296	6296/3229 (only creating stoma)	< **0.0001**				
						C-statistics	0.63

BMI, body mass index; SEMS, self-expandable metallic stent.

Table 2 Comparison of clinical outcomes between stent placement and surgery in study population

Clinical outcomes	After propensity score matching Total (n = 13 608)		
	SEMS group (n = 6804)	Surgery group (n = 6804)	*P* value
In-hospital death, n (%)	134 (2.0%)	225 (3.3%)	< **0.0001**†
Stoma creation during hospital stay, n (%)	225 (3.3%)	3810 (56.0%)	< **0.0001**†
Median days of hospital stay (interquartile range), days	16 (9–29)	24 (16–38)	< **0.0001**‡
Median medical costs of hospital stay (interquartile range), JPY	1 640 370 (965 988–2 737 261) (n = 4857)	2 394 540 (1 542 322–3 580 820) (n = 3103)	< **0.0001**‡

† χ^2 test.
‡ Wilcoxon's signed-rank test.
SEMS, self-expandable metallic stent.

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Table 3 Comparison of clinical outcomes between stent placement and surgery in patients with obstructive right-sided colon cancer

Clinical outcomes	Left-sided colorectal cancer admissions after propensity score matching (*n* = 9407)			Right-sided colon cancer admissions after propensity score matching (*n* = 4201)		
	SEMS group (*n* = 4707)	Surgery group (*n* = 4700)	*P* value	SEMS group (*n* = 2097)	Surgery group (*n* = 2104)	*P* value
In-hospital death, *n* (%)	98 (2.1%)	151 (3.2%)	**0.0006**†	36 (1.7%)	74 (3.5%)	**0.0003**†
Stoma creation during hospital stay, *n* (%)	209 (4.4%)	3160 (67.2%)	**< 0.0001**†	16 (0.76%)	650 (30.9%)	**< 0.0001**†
Median days of hospital stay (interquartile range), days	16 (9–30)	26 (17–40)	**< 0.0001**‡	15 (9–27)	21 (14–35)	**< 0.0001**‡
Median medical costs of hospital stay (interquartile range), JPY	1 645 500 (959 475–2 761 586) (*n* = 3317)	2 395 836 (1 536 547–3 688 212) (*n* = 2154)	**< 0.0001**‡	1 637 614 (989 599–2 653 835) (*n* = 1540)	2 390 050 (1 549 076–3 384 074) (*n* = 949)	**< 0.0001**‡

†χ^2 test.
‡Wilcoxon's signed-rank test.
SEMS, self-expandable metallic stent.

The results of multivariate analysis for stoma creation are summarized in Table 5.

Advanced stage of TNM classification (T4, N3, and M1) and surgery (OR = 58.9, 95% CI: 51.4–67.5, $P < 0.0001$) demonstrated increased high OR of creating stoma, meanwhile right-sided location showed lower risk of creating stoma (OR = 0.17, 95% CI: 0.16–0.19, $P < 0.0001$).

Discussion

In this study, we investigated the efficacy of SEMS comparing with urgent surgery for OCC using a nationwide database in Japan. Our propensity score-matched analysis revealed that the in-hospital death and stoma creation rates of the SEMS group were lower than those of urgent surgery. The length of the hospitalization and medical costs of the SEMS group were shorter and lower than those of urgent surgery as well. This study also showed the same results in both right-sided and left-sided OCC. Multivariate analysis using the data before propensity score matching also showed lower OR of SEMS compared with urgent surgery in the in-hospital death and stoma creation.

Obstructive colorectal cancer is an emergency disease that requires immediate intervention to release bowel obstruction. Both SEMS and urgent surgery have several merits and demerits. Therefore, it is important to investigate which treatment is preferable as a first intervention for OCC. Our study, which consisted of a large number of patients and used propensity score-matched analysis, showed the lower rate of in-hospital death in the SEMS group compared with the urgent surgery group. The χ^2 test after propensity score matching and multivariate analysis before propensity score matching demonstrated lower in-hospital death in the SEMS group. Our results indicate that SEMS might reduce mortality rate due to OCC in the short term. However, we investigated only short-term outcomes. We need to conduct prospective and long-term study to clarify the impact of SEMS on the clinical course in OCC cases. On the contrary, previous RCTs comparing SEMS and urgent surgery in left-sided OCC[9–15] showed that their results were inconsistent regarding the priority of SEMS to urgent surgery. Although RCT is the best investigation method to clarify which treatment is preferable, these studies contain small number of patients. The discrepancy among these studies might be because of the relatively small number of patients included in each study. A meta-analysis demonstrated tendencies similar to our results.[26] To the best of our knowledge, no previous study has reported an association between SEMS placement and reduction of in-hospital death. A nationwide database like DPC would be useful for investigations of rare complications and diseases with a large number of patients. Furthermore, urgent surgery is associated with higher rates of morbidity and mortality compared with the elective surgery.[27–29] SEMS placement as a BTS could reduce such unfavorable events with releasing obstruction that contribute to avoid urgent surgery.

The impact of the difference of obstruction site on the clinical outcome is still unclear. Our data also showed that SEMS placement reduced the rates of the in-hospital death in both right-sided and left-sided OCC. This result could indicate that SEMS placement for left-sided OCC could, in turn, reduce the mortality rate in the short term as well as for right-sided OCC. Therefore, we should consider SEMS placement for left-sided OCC. Furthermore, studies about SEMS placement for the right-sided OCC are rare. Our results

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Table 4 Multivariate analysis† of the association among clinical factors and in-hospital death

Clinical factors	Number of patients (before propensity score matching)	In-hospital death		
		Odds ratio	95% CI	*P* value
Sex	Male: 9242	1		0.13
	Female: 8126	0.85	0.68–1.05	
Age categories	≥ 80 years: 6000	1		
	70–79 years: 5053	**0.51**	**0.40–0.65**	**< 0.0001**
	60–69 years: 4118	**0.35**	**0.26–0.47**	**< 0.0001**
	50–59 years: 1457	**0.26**	**0.16–0.44**	**< 0.0001**
	≤ 49 years: 740	**0.28**	**0.14–0.56**	**0.0003**
BMI classification	Overweight: 2178	1.21	0.88–1.69	0.24
	Normal: 10 245	1		
	Underweight: 3773	**1.48**	**1.17–1.87**	**0.0011**
Smoking history	Yes: 5373	1.04	0.81–1.32	0.77
	No: 11 995	1		
Academic hospital	Yes: 843	**0.56**	**0.32–0.98**	**0.044**
	No: 16 525	1		
Charlson comorbidity index score (2 or more points)	Yes: 5120	1.22	0.99–1.50	0.069
	No: 12 248	1		
T classification	T2: 981	0.94	0.56–1.58	0.82
	T3: 7052	1		
	T4: 6027	1.03	0.80–1.32	0.84
	TX: 5223	1.31	0.93–1.86	0.12
N classification	N0: 6385	1		
	N1: 5016	0.76	0.57–1.02	0.072
	N2: 2303	1.17	0.83–1.64	0.36
	N3: 416	0.93	0.47–1.83	0.83
	NX: 3198	**1.47**	**1.02–2.12**	**0.037**
M classification	M0: 11 100	1		
	M1: 4258	**2.31**	**1.78–2.99**	**< 0.0001**
	MX: 2010	1.40	0.96–2.05	0.083
Intervention	Stent placement: 9525	1		**0.0006**
	Surgery: 7843	**1.56**	**1.21–2.01**	
Disease location	Right-sided: 5523	0.99	0.80–1.24	0.95
	Left-sided: 11 845	1		
Stoma creation during hospital stay	Yes: 4325	1.21	0.93–1.58	0.16
	No: 13 043	1		

†Logistic regression analysis.
BMI, body mass index; CI, confidence interval.

also demonstrated clinical effectiveness of SEMS for right-sided OCC. Even if an OCC is located in both sides, SEMS placement could be worth of considering.

Self-expandable metallic stent placement has another benefit enabling us to avoid creating stoma. Our results showed lower rate of stoma creation in the SEMS group compared with the surgery group. Several RCTs comparing SEMS placement and urgent surgery reported lower stoma creation rate in SEMS groups.[11,12,15] Our result and these studies indicate that the patients with OCC will not need to undertake stoma creation due to the success of decompression using SEMS. In terms of quality of life, intervention without creating stoma is favorable.

The guideline of European Society of Gastrointestinal Endoscopy recommends stenting as a BTS in left-sided colon to be discussed.[8] We agree with this opinion because SEMS placement is not suitable for all OCC cases. For instance, urgent surgery should be performed in OCC cases with perforation, abscess formation, and obstructive colitis. However, we think SEMS placement should be proactively considered for the OCC cases without such complication because SEMS placement could reduce in-hospital death.

The length of the hospitalization and medical costs of SEMS were shorter and lower than those of urgent surgery. Several studies showed similar tendency as well.[10] A retrospective study in Japan reported that SEMS showed lower complication rates compared with urgent surgery.[30] These results indicate SEMS could reduce complication after intervention compared with urgent surgery, which contribute to shorten the length of hospitalization and to decrease the medical costs. As described earlier, the DPC database cannot identify the patients who discharged from the

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Table 5 Multivariate analysis† of the association among clinical factors and in-hospital death

Clinical factors	Number of patients (before propensity score matching)	Stoma creation		
		Odds ratio	95% CI	*P* value
Sex	Male: 9242	1		**0.0068**
	Female: 8126	**0.86**	**0.79–0.96**	
Age categories	≥ 80 years: 6000	1		
	70–79 years: 5053	**1.20**	**1.07–1.35**	**0.0024**
	60–69 years: 4118	**1.26**	**1.11–1.43**	**0.0005**
	50–59 years: 1457	1.08	0.91–1.29	0.38
	≤ 49 years: 740	1.13	0.89–1.43	0.31
BMI classification	Overweight: 2178	1.04	0.90–1.21	0.58
	Normal: 10 245	1		
	Underweight: 3773	1.01	0.90–1.13	0.90
Smoking history	Yes: 5373	1.03	0.92–1.15	0.60
	No: 11 995	1		
Academic hospital	Yes: 843	**1.21**	**1.00–1.48**	**0.048**
	No: 16 525	1		
Charlson comorbidity index score (2 or more points)	Yes: 5120	1.09	0.98–1.21	0.12
	No: 12 248	1		
T classification	T2: 981	0.82	0.66–1.01	0.065
	T3: 7052	1		
	T4: 6027	**1.27**	**1.14–1.12**	< **0.0001**
	TX: 5223	**1.38**	**1.15–1.67**	**0.0007**
N classification	N0: 6385	1		
	N1: 5016	1.02	0.91–1.15	0.68
	N2: 2303	1.09	0.93–1.27	0.29
	N3: 416	**1.70**	**1.26–2.30**	**0.0005**
	NX: 3198	**2.28**	**1.86–2.79**	< **0.0001**
M classification	M0: 11 100	1		
	M1: 4258	**1.57**	**1.39–1.78**	< **0.0001**
	MX: 2010	**0.70**	**0.56–0.87**	**0.0014**
Intervention	Stent placement: 9525	1		< **0.0001**
	Surgery: 7843	**58.9**	**51.4–67.5**	
Disease location	Right-sided: 5523	**0.17**	**0.16–0.19**	< **0.0001**
	Left-sided: 11 845	1		

†Logistic regression analysis.
BMI, body mass index; CI, confidence interval.

hospital after SEMS placement and readmitted another hospital to undertake subsequent surgery. Therefore, the total medical costs of SEMS could be more expensive than our results.

Although SEMS placement for OCC has several benefits, its indication should be discussed adequately. As described earlier, OCC cases with complications such as complex or elongated stenosis, hemorrhage, perforation, or severe inflammation that indicate obstructive colitis should undertake urgent surgery rather than SEMS placement[31] because such cases are expected to go to fatal results. Obstructive colitis due to colon cancer develops ulcero-inflammatory lesions, which might be a cause of septicemia, perforation, and subsequent peritonitis.[32] Therefore, we excluded the cases with peritonitis and abdominal abscess. Urgent surgery is preferable to SEMS for such cases.

There are several limitations in this study. First, the DPC database does not contain details of the patients' condition, such as endoscopic findings, laboratory data, and computed tomography findings. Peritonitis and abdominal abscess are diagnosed using such clinical data, and we usually select urgent surgery instead of SEMS placement for such cases. As described earlier, we excluded the patients with the phrase "peritonitis" and "abdominal abscess" in their complications at admission. Although we conducted a propensity score match to make the patients' backgrounds between the two groups, the possibility of selection bias cannot be denied. Second, the DPC database does not contain long-term data. We herein analyzed the short-term results; we need to conduct a prospective or retrospective study to clarify the long-term prognosis. Third, the DPC database cannot distinguish the purpose of SEMS placement between BTS and palliation, and thus, our analysis contains both BTS and palliation cases. Furthermore, as described earlier, the DPC database does not contain the patients' detailed condition such as performance status, which may affect the strategy of treating OCC. Although we performed a

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propensity score-matched analysis, we could not fully adjust the patient deviation. However, our results demonstrated that SEMS placement could contribute to decrease in mortality rate, whether the case is BTS or palliation. Although there are several limitations in this study, our results indicate that when both SEMS placement and urgent surgery are suitable for OCC, SEMS placement might be better than urgent surgery.

In conclusion, SEMS placement for OCC might reduce the mortality in short-term and stoma creation rates and shorten the length of hospitalization. These results facilitate considering SEMS with careful judgment for its indication when we treat OCC. Further investigations are warranted.

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