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Palliative Stent Placement for Malignant Colorectal Obstruction: extracolonic malignancy versus primary colorectal cancer

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Abstract

Palliative Stent Placement for Malignant Colorectal Obstruction: extracolonic malignancy versus primary colorectal cancer

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Purpose: To compare clinical outcomes of palliative colorectal stent placement between patients with extracolonic malignancies (ECMs) and primary colorectal cancers (CRCs).

Materials and Methods: Between January 2005 and December 2017, 85 patients underwent palliative stent placement for inoperable malignant colorectal obstructions caused either by ECMs (n = 56) or CRCs (n = 29). Technical and clinical success, re-intervention rates, and stent patency were compared between two groups. Predictive factors associated with stent failure were identified.

Results: Stent placement was technically successful in 54 patients with ECM (96.4%) and 27 patients with CRC (93.1%) (p = 0.60). ECM group required more re-interventional procedures (20.4% vs.

3.7%; $p < 0.05$) to achieve marginally lower clinical success rate, compared with CRC group (88.9% vs. 100%; $p = 0.07$). The 6- and 12-month stent patency rates were 64.2% and 22.0% in ECM and 68.4% and 31.3% in CRC group ($p = 0.89$). Long segmental (HR 1.40) and multiple obstructions (HR 4.03) were independent factors associated with stent failure.

Conclusions: Palliative colorectal stent placement is less effective and requires more re-interventions in patients with ECMs than CRCs. Long segmental and multiple obstructions were associated with stent failure.

Keywords : extracolonic malignancy, colorectal cancer, palliative care, self-expandable metallic stent, interventional radiology

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Table of contents

List of tables

List of figures

I. Introduction

Malignant colonic obstruction can occur as a terminal event of variable abdominopelvic malignancies, including colorectal cancers (CRCs) and extracolonic malignancies (ECMs) (1). Although bypass surgery is traditional approach, this option is avoided for many patients owing to disease extent, or comorbidity (2, 3). Initially introduced in 1991 (4), self-expandable metallic stent (SEMS) has been used as an alternative treatment for malignant colonic obstruction for which risks of palliative surgery presumably outweigh the benefits. Stent placement has a virtue in that it directly recanalizes obstructive segment in non-invasive manner. It has been widely used and is accepted as an established treatment for CRC-associated colonic obstruction (5, 6).

Meanwhile, efficacy of SEMS for colonic obstruction caused by ECMs has rarely been studied with debatable results. Technical and clinical success rates of SEMS placement for ECM-associated colorectal obstruction varies from 42% to 100%, and from 25% to 87.5% (7). Among them, few compared efficacy of stent between ECM- and CRC-associated colorectal obstructions, again with mixed results. While some of them demonstrated comparable technical and clinical success rates between two groups (5, 8), others showed poorer success rates for patients with ECMs (9-11). The discrepancies of the results may be attributable to many factors, including varying numbers, clinical stages, and/or

performances of the patients included, and inhomogeneous or vague definitions of technical success/failure used in the studies (12). After all, evidence level is still considered low whether SEMS placement for ECM-associated colorectal obstruction is as effective as for those with CRCs, and proper indications are yet to be established (12-15).

This study hence aims to compare technical and clinical outcomes of palliative colonic SEMS placement between patients with ECMs and CRCs, and to investigate predictive factors associated with stent failure.

II. Materials and methods

This retrospective study was approved by the Institutional Review Board of Seoul National University Bundang Hospital, with informed consent waived.

A. Patients

We searched medical records of our institution from January 2005 to December 2017, identifying 192 patients who were referred to department of radiology for fluoroscopic stent placement for malignant colorectal obstruction. All patients had obstructive symptoms, including persistent constipation, abdominal distension, pain, nausea or vomiting.

We excluded 107 patients based on the following criteria: (1) colorectal stent placement as bridge-to-surgery (n = 74), (2) concurrent obstructions in small bowel (n = 4), (3) obstructions caused by recurrent tumor after curative resection of colorectal cancers (n = 9) and (4) loss to follow-up in less than 10 days after procedure (n = 20). Finally, 85 patients (mean age: 62.9 years, range: 40–94) were included (Figure 1).

B. Procedures

SEMS placement was done under fluoroscopic guidance, by two experienced interventional radiologists (C.J.Y. and N.J.S. with 10 and 5 years of experiences, respectively). Procedures were done

with the patients under conscious sedation using intravenous administration of 1–3 mg of midazolam (Bukwang Pharm, Seoul, Korea) and 50–100 μg of fentanyl (Hana Pharm, Seoul, Korea). Via anal approach, 5-Fr angiographic catheter (Cook, Bloomington, USA) and 0.035-inch hydrophilic guidewire (Terumo, Somerset, USA) were manipulated to pass the colonic obstruction. Then, the guidewire was replaced with either 260 cm (Amplatz Super Stiff; Boston Scientific, Natick, USA) or 400 cm (Zebra; Boston Scientific, Natick, USA) long 0.035-inch stiff wire, depending on distance from the anus to the obstruction. The proximal and distal ends of obstructive segment were confirmed with contrast media, and length of obstruction was measured.

SEMS (Hercules SP; S&G Biotech, Seoul, Korea) with 22–24 mm diameter and 6–12 cm lengths were used. Stent length was chosen to cover extra 2 cm at both proximal and distal ends of obstruction. For long segmental obstruction, two or more stents were placed in overlapping fashion. In patients with multiple obstructions, stents were placed for all obstructions in a single session. When the obstruction did not allow advancement of stent delivery system, pre-stent balloon dilatation (10 mm) was performed. Post-stent balloon dilatation (12 mm) was performed when the stent expansion remained < 30% of its nominal diameter at 10 minutes after placement.

C. Post-procedural follow-up

After SEMS placement, patients were observed for defecation and alleviation of obstructive symptom. Daily abdominal radiographs were taken to monitor improvement of sign of bowel obstruction, and to exclude stent migration and bowel perforation. If patients failed to demonstrate resolution of obstructive sign and symptom in 5 days after initial procedure, they underwent catheter-directed colon study for possible re-interventions.

Patients alleviated from obstructive symptom and radiographic sign of obstruction were discharged and followed-up on outpatient clinic every 3 month. Contrast-enhanced abdominopelvic CT was performed following outpatient clinic schedule, or when recurrent obstruction was suspected. Patients with recurrent colorectal obstruction during follow-up underwent additional stent placement or bypass surgery.

D. Definitions of terms

Technical success was defined as SEMS covering whole obstructed colonic segment with patent contrast passage through stent immediately after the procedure. Clinical success was defined as alleviation of symptom and resolution of bowel obstruction on radiograph in 10 days following initial procedures (regardless of requirement of re-intervention).

Primary patency of the stent was defined as interval between

determination of clinical success and recurrent symptom or radiological evidence of obstruction. For patients who underwent additional intervention for recurrent obstruction during follow-up, prolonged stent duration added to primary patency was defined as secondary patency of the stent.

Complications were assessed according to the guidelines of the Society of Interventional Radiology (16). A major complication was defined as an event that needed a specific therapy, an increased level of care, prolonged hospital stays, permanent adverse sequelae, or death. All other complications were considered minor.

E. Statistical analysis

Patient demographics between CRC and ECM groups were compared to each other using Mann-Whitney U test for continuous, and Fisher's exact test for categorical variables.

Predictive factors for clinical failure and stent failure were investigated using binary logistic and Cox regression analyses, respectively. Patients-related variables (ECM or CRC, age, gender, ECOG performance score, prior history of surgery/chemotherapy/radiotherapy, and presence of peritoneal and nonperitoneal metastases) and procedure-related variables (stent diameter/length, use of multiple stents, pre-stent or post-stent balloon dilatation, length of obstruction, presence of multiple obstructions, requirement of re-intervention) were included in analyses. Variables with a $p < 0.10$ on univariable analyses were

included in multivariable analysis.

Kaplan–Meier (KM) estimates were calculated for stent patency and patients' survival for ECM and CRC groups, and their equivalence was tested with log–rank test. Data were considered censored for analyses if stents were kept patent until the patients experienced following conditions: (1) death, (2) loss to follow–up, and (3) surgery or interventional procedure for conditions unrelated to stent failure. Cumulative incidence function of the stent failure was presented for ECM and CRC patients using a nonparametric model of Coviello and Boggess with death as a competing risk (17), and their equivalence was tested with model of Fine and Gray (18).

Data were analyzed with Stata 14 (College Station, Tex). A difference with a p value of less than 0.05 was considered statistically significant.

III. Results

A. Patient characteristics

Patient characteristics are summarized in Table 1. Of 85 patients included in the study, 56 had ECMs, consisting of followings: gastric cancer (n = 28), pancreatic cancer (n = 15), cervical cancer (n = 3), ovarian cancer (n = 3), ampulla of Vater cancer (n = 1), cholangiocarcinoma (n = 1), gallbladder cancer (n = 1), hepatocellular carcinoma (n = 1), ureter cancer (n = 1), bladder cancer (n = 1), and malignancy of unknown origin (n = 1). The other 29 patients had CRCs.

Patients with ECM were younger (mean age ± standard deviation: 59.7 ± 12.9 years vs. 70.4 ± 12.4 years) ($p < 0.001$). Greater proportion of ECM patients had history of surgery and chemotherapy, and demonstrated peritoneal carcinomatosis ($p \leq 0.002$). On the other hand, CRC patients more often had non-peritoneal distant metastases ($p < 0.001$). There was a difference in location of colonic obstruction, in that most common locations were rectosigmoid junction in CRC group, and transverse colon in ECM group, respectively ($p = 0.015$). No significant difference was noted for gender composition, radiotherapy history, and length of obstruction ($p \geq 0.071$). Six patients in ECM group had two obstructions with marginal difference from CRC group ($p = 0.067$).

B. Technical and clinical success

Procedural and clinical outcomes were summarized in Table 2. Pre-stent balloon dilatation was required in one case for each group (p = 0.502). No significant difference was noted regarding diameter, length, and number of stents used for both groups (p > 0.100). Greater proportion of ECM patients required post-stent balloon dilatation (66.7%) than CRC patients (44.4%) (p = 0.009).

Technical success was achieved in 96.4% (54/56) of ECM and 93.1% (27/29) CRC patients, respectively (p = 0.603) (Figures 2 and 3). The causes of technical failures were failed guidewire passage through obstruction (2 of ECM and 1 of CRC groups), or redundant sigmoid colon, which precluded advancement of stent delivery (1 of CRC group) (Figure 4).

Re-intervention was required in 11 ECM patients and 1 CRC patient for insufficient stent expansion (p = 0.047) (Table 3). Among 12 patients who underwent re-interventional procedures, 10 patients (9 of 11 ECM, and 1 CRC patients) achieved clinical success (Figure 5).

Finally, clinical success was achieved in 88.9% (48/54) of ECM and 100% (27/27) of CRC patients. The difference was of marginal statistical significance (p = 0.071). Clinical failures of the ECM patients were due to decreased bowel movement related to peritoneal tumor seeding (n = 5) or perforation of stented obstruction (n = 1), which developed 8 days after stent placement.

C. Stent patency

During follow-up, 13 ECM and 12 CRC patients experienced stent failure. In ECM group, the causes of stent failure included intra-stent tumor ingrowth (n = 10; developed 24–353 days after clinical success is achieved [median: 80.5 days]), perforation of stented obstruction (n = 2; 13 and 15 days), and fecal impaction (n = 1; 11 days). Stent failures of CRC group were due to intra-stent tumor ingrowth (n = 8; developed 26–690 days [median: 273.5 days], fecal impaction within stent (n = 2; 86 and 128 days), perforation of stented obstruction (n = 1; 32 days), and intractable pain (n = 1; 19 days) which necessitated surgical removal of the rectal stent.

Six- and twelve-month primary stent patency rates were 64.2% and 22.0% in ECM group (median patency, 280 days), and 68.4% and 31.3% in CRC group (median patency, 324 days), respectively. No significant difference was noted between primary stent patency of two groups (p = 0.887) (Figure 6). Cumulative stent failure rate is graphically presented in Figure 7. No statistically significant difference was found between the two groups (p = 0.381).

Among 25 patients who experienced stent failure, 15 were indicated for additional stent placement, 7 underwent palliative surgery, and 3 refused further treatment. Additional stent was coaxially placed into the obstructed stent with same technique of initial stent placement. Surgical palliations included colostomy (n =

6), ileostomy (n = 2), and palliative low anterior resection (n = 1).

Secondary stent patency rates at 6- and 12-month were 70.0% and 58.1% in ECM group, and 77.2% and 77.2% in CRC group, respectively. No significant difference was noted between secondary stent patency of two groups (p = 0.565) (Figure 6). New obstruction other than initially stented ones developed in 3 ECM patients, at 17, 66 and 344 days following initial procedures. Those patients underwent additional stent placement (n = 2) or ileostomy (n = 1). One patient with hepatic flexure obstructionhad to undergo right hemicolectomy owing to perforated appendicitis which developed 196 days after clinical success was achieved.

D. Complications

Complications are listed and compared between the two groups in Table 4. A total of 10 patients (6 of ECM and 4 of CRC groups) patients had complications (p = 0.729). Major complications included bowel perforation and intractable abdominal pain. Besides 4 abovementioned perforations (3 of ECM and 1 of CRC groups), another ECM patient experienced perforation (42 days after initial stent placement). One patient with rectal stentcomplained intractable pain Except for one patient who refused further treatment for perforated obstruction, all major complications were managed with palliative surgeries.

Minor complications included fecal incontinence after rectal stent insertion in ECM patients (n = 2), and stent migrations in CRC

patients (n = 2). Stent migration occurred with decreased tumor burden following chemotherapy, without causing recurrent obstructive symptoms. These patients were conservatively managed on outpatient basis.

E. Patient survival

Median follow-up period was 79.5 (12–550) days for ECM, and 172 (11–804) days for CRC group. A total of 32 patients (21 of ECM and 11 of CRC groups) died during the follow-up for following causes: disease progression (n = 29), septic shock of unclear cause (n = 1), and respiratory failure due to pneumonia (n = 1). One patient died of unknown cause.

Among the rest of the patients, 50 patients were lost to follow-up: 40 (30 of ECM and 10 of CRC groups) were lost after they were transferred to hospice institutions, and 10 (4 of ECM and 6 of CRC groups) were lost during scheduled outpatient clinic follow-up. Three patients (1 of ECM and 2 of CRC groups) were still alive and on outpatient follow-up.

Median survival by KM estimates were 236 and 335 days for ECM and CRC groups, respectively (p = 0.114 on log-rank test) (Figure 8).

F. Predictors of clinical failure and stent failure

None of the patients- and procedure-related variables

demonstrated pairwise correlation coefficient exceeding 0.7, and thus multicollinearity issue was thought to be minimal (19). As clinical failures were only noted for patients with ECM, logistic regression analysis was done solely for this group. On univariable analysis, ECOG performance score (odds ratio [OR] 8.153), presence of peritoneal and nonperitoneal metastases (OR 0.150 and 5.091, respectively), length of obstruction (OR 1.395), and requirement of post-stent balloon dilatation (OR 0.196) demonstrated $p < 0.10$. Among them, ECOG performance score (OR 6.172) was the only independent predictor of clinical failure of ECM on multivariable analysis ($p = 0.033$).

For stent failure, ECOG performance score (hazard ratio [HR] 1.736), length of obstruction (HR 1.355), presence of multiple obstructions (HR 2.908), use of multiple stents (HR 2.017), and requirement of post-stent balloon dilatation (HR 3.005) demonstrated $p < 0.10$ on univariable Cox proportional hazard model. Among them, length of obstruction (HR 1.400) and presence of multiple obstructions (HR 4.028) were independently associated predictors of stent failure on multivariable analysis (Table 5).

IV. Discussion

From histological and clinical point of view, ECMs are thought to cause colonic obstruction in distinctive ways from CRCs. Colonic obstruction by ECM is induced by extrinsic invasion or compression of the colon by peritoneal mass, or colonic immobility due to post-treatment changes following surgery, chemotherapy, radiotherapy, or combination of those. Contrarily, CRC most likely causes intrinsic mechanical obstruction (9, 14, 20, 21). These factors are presumed to bring about different clinical outcomes following SEMS placement for ECM-associated colonic obstruction compared with CRC. To date, whether palliative SEMS placement is as effective for ECM-associated colonic obstruction as it is for CRC is debatable. This mainly owes to small number of prior studies on efficacy of palliative stent placement for ECM-associated colonic obstruction (12, 14, 15, 21–26), and even smaller number of comparison analyses between ECM and CRC (8, 9, 11, 20, 27–30). Moreover, some comparison analyses included CRC patients in bridge-to-curative surgery settings (11), or patients with benign or unknown etiologies of colorectal obstruction (30). Also, recurrent CRCs in postoperative settings were included in the CRC group in a comparison analysis (5). It is uncertain whether recurrent CRCs behave like mucosal lesions, or like serosal lesions as ECMs do (31). Therefore, true comparison of clinical outcomes after stent placement between ECM and CRC is presumably limited when

recurrent CRCs are included. We eliminated such confounders by exclusively including palliative cases with definitive diagnosis, while eliminating recurrent CRCs. As a result, our study included smaller number of patients in CRC group (n = 29) compared with ECM group (n = 56). However, we believe this study could more fairly compare outcomes of stent placement between ECM and CRC

In our study, technical success rate of SEMS placement of ECM group was comparably high (96.4%) to that of CRC group (93.1%). Also, proportion of tight obstruction in ECM group which required pre-procedural balloon dilatation was comparably low (1.9%) to that of CRC group (3.7%). This implies SEMS placement for ECM-associated colorectal obstruction is of little technical problem compared with CRC group. On the other hand, greater proportion of ECM patients required re-interventional procedures (20.4% vs. 3.7%) for insufficient expansion of stent. This implies ECM tends to cause harder obstruction to be recanalized by commercially available SEMS than CRC does. As a result, 6 cases of clinical failures were noted in ECM group, whereas none was identified among CRC patients. Although with marginal difference in clinical success rates (p = 0.071), these results possibly indicate that SEMS might be clinically less effective for ECM-associated colorectal obstruction.

For ECM group, high ECOG performance score was independently associated with clinical failure. Interestingly, there are studies where poor performance status of patients was

associated with adverse outcome of SEMS deployed for malignant gastroduodenal obstruction (5, 13, 32). Even after technically successful stent placement with sufficient expansion, clinical success is secured only when bowel motility is preserved. By definition, higher ECOG performance score indicates poorer ambulatory ability of the patients (33), which may adversely affect bowel motility (34). However, once clinical success was achieved, stent patency lasted for comparable period, regardless of tumor types (median duration of 280 and 324 days for ECM and CRC patients, respectively). Such a pattern was also observed in prior studies, where authors found no association between stent patency duration and tumor types (27, 28). We therefore assume unfavorable factors for stent placement in ECM-associated colorectal obstruction take effect in relatively early, peri-procedural period, with relatively less long-term effect.

Factors independently associated with stent failures were long segmental obstruction and presence of multifocal obstructions. Long segmental obstruction was a predictor for poor clinical outcome in prior studies (35, 36). Maintaining stent patency for long segmental obstruction will be challenging for following reasons: (1) stent needs to endure greater longitudinal force, for which it is not designed (37), (2) multiple stents are often required, and all of them must remain sufficiently expanded. The latter also applies to another predictor of stent failure, multifocal obstructions. Multifocal obstructions have been one of the contraindications for SEMS

placement (31), and prior studies insisted on poorer outcome of SEMS placement for patients with multiple colorectal obstructions (21, 26). Patients with long-segmental and/or multifocal obstructions would likely have greater tumor burden. They are thus more susceptible to progression of bowel obstruction, either continuous to the preexisting obstruction, or in different location. They are also exposed to greater risks of stent-related complications as they more frequently required multiple stent placement. These may explain why majority of stent failures were caused by tumor ingrowth and stent-related complications (88%) in patients with long segmental and/or multiple obstructions.

Our study has limitations. First, owing to its retrospective nature, this study is not free from selection bias. Secondly, this study included small number of patients in single institution, and therefore requires external validation. Thirdly, contrary to most prior studies where stents were endoscopically placed, fluoroscopic SEMS placement was performed in this study. However, previous studies showed comparable clinical outcome following stent placement with two methods (38). Fourthly, many patients' data were censored for both survival (59%) and stent patency (35%) analyses in our study. This is because all included patients are of terminal stage cancer, and were transferred to hospice institutions shortly after procedure. Missing long-term data was also one of the inevitable limitations in prior studies (39–41).

In conclusion, palliative colorectal stent placement is less

effective and requires more re-interventions in patients with ECMs than CRCs. Long segmental and multiple obstructions were associated with stent failure.

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Table 1. Patient characteristics compared between ECM and CRC group

Characteristics	ECM (n = 56)	CRC (n = 29)	*p* value
Age*	59.7 ± 12.9	70.4 ± 12.4	< 0.001
Gender proportion (M:F)	25:31	19:10	0.108
Prior treatments			
Surgery	40 (71.4%)	0 (0%)	< 0.001
Chemotherapy	44 (78.6%)	11 (37.9%)	0.002
Radiotherapy	4 (7.1%)	0 (0%)	0.140
Oncological status			
ECOG performance status (0:1:2:3:4)	0:1:27:20:8	0:7:8:14:0	< 0.001
Peritoneal carcinomatosis	51 (91.1%)	13 (44.8%)	< 0.001
Distant metastasis, other than peritoneum	15 (26.8%)	21 (72.4%)	< 0.001
Obstruction profile			
Length of obstruction*	7.4 ± 3.2	6.1 ± 2.1	0.071
Location of obstruction			0.006
Ascending	1	2	
Hepatic flexure	7	5	
Transverse	18	0	
Splenic flexure	9	0	
Descending	2	2	
Sigmoid	10	6	
Rectosigmoid junction	9	10	
Rectum	6	4	
Multifocal obstruction	6 (10.7%)	0 (0%)	0.067

ECM, extracolonic malignancy

CRC, colorectal cancer

ECOG, Eastern Cooperative Oncology Group

Note. – *p* values were calculated using Mann–Whitney *U* test for continuous, and Fisher's exact test for categorical variables.

*Values are presented as mean ± standard deviation.

Table 2. Procedural and clinical outcomes

	ECM	CRC	*p* value
Stent profile			
Diameter (mm)*	23.0 ± 1.5	22.8 ± 1.8	0.454
Length (cm)*	10.7 ± 1.7	9.9 ± 2.6	0.228
Multiple stents used	18/54 (33.3%)	5/27 (18.5%)	0.163
Average number of stents used*	1.5 ± 0.8	1.2 ± 0.4	0.081
Pre-stent balloon dilatation	1/54 (1.9%)	1/27 (3.7%)	0.613
Post-stent balloon dilatation	40/54 (74.1%)	12/27 (44.4%)	0.009
Technical and clinical successes †			
Technical success	54/56 (96.4%)	27/29 (93.1%)	0.603
Clinical success	48/54 (88.9%)	27/27 (100%)	0.072
Stent failure ‡	13/48 (27.1%)	12/27 (44.4%)	0.126
Additional stent for stent failure	9/13 (69.2%)	6/12 (50.0%)	0.428

ECM, extracolonic malignancy

CRC, colorectal cancer

Note. – *p* values were calculated using Mann-Whitney *U* test for continuous, and Fisher's exact test for categorical variables.

*Values are presented as mean ± standard deviation.

†Technical success was defined as SEMS covering whole obstructed colonic segment with patent contrast passage through stent immediately after the procedure. Clinical success was defined as alleviation of symptom and resolution of bowel obstruction on radiograph in 10 days following initial procedures (regardless of requirement of re-intervention).

‡Stent failure was defined as cases where patients who achieved clinical success eventually experienced non-functioning stent by recurrent obstruction or stent-related complications.

Table 3. Re-interventions after initial procedure

Re-intervention*	ECM (n = 54)	CRC (n = 27)	*p* value
Total	11 (20.4%)	1 (3.7%)	0.047
Balloon dilatation	10 (18.5%)	1 (3.7%)	0.067
Stent placement	11 (20.4%)	1 (3.7%)	0.047

ECM, extracolonic malignancy

CRC, colorectal cancer

Note. - *p* values were calculated using Fisher's exact test.

* If patients failed to demonstrate resolution of obstructive sign and symptom in 5 days after initial procedure owing to insufficient expansion of the stents, they were indicated for re-interventions: balloon dilatation, stent placement, or both.

Table 4. Major and minor complications

Complications	ECM (n = 56)	CRC (n = 29)	*p* value
Total	6 (10.7%)	4 (13.8%)	0.729
Major	4 (7.1%)	2 (6.9%)	0.966
Perforation	4 (7.1%)	1 (3.4%)	0.524
Intractable pain	0 (0%)	1 (3.4%)	0.400
Minor	2 (3.6%)	2 (6.9%)	0.603
Incontinence	2 (3.6%)	0 (0%)	0.467
Migration	0 (0%)	2 (6.9%)	0.133

ECM, extracolonic malignancy

CRC, colorectal cancer

Note. – *p* values were calculated using Fisher's exact test.

Table 5-1. Univariable and multivariable regression analyses on prediction of clinical failure and stent failure

Variables	Logistic regression analyses for clinical failure* (ECM only)			
	Univariable analysis		Multivariable analysis	
	Odds ratio	*p* value	Odds ratio	*p* value
ECOG performance score	8.153 (2.010–33.067)	0.003	6.172 (1.163–32.765)	0.033
Female gender	1.103 (0.225–5.420)	0.904	N/A	
Age	0.940 (0.866–1.023)	0.139	N/A	
Surgical history	0.813 (0.140–4.700)	0.817	N/A	
Chemotherapy	1.571 (0.171–14.449)	0.690	N/A	
Peritoneal carcinomatosis	0.150 (0.020–1.121)	0.065	1.381 (0.103–18.503)	0.807
Nonperitoneal distant metastases	5.091 (0.990–26.180)	0.051	3.506 (0.319–38.564)	0.305
Length of obstruction	1.395 (1.078–1.805)	0.011	1.270 (0.931–1.732)	0.131
Left colonic obstruction	4.966 (0.559–44.147)	0.151	N/A	
Presence of multiple obstructions	1.720 (0.291–10.182)	0.550	N/A	
Stent diameter	0.681 (0.424–1.093)	0.112	N/A	
Stent length	0.994 (0.910–1.086)	0.896	N/A	
Multiple stent use	1.720 (0.291–10.182)	0.550	N/A	
Post-stent balloon dilatation	0.196 (0.038–1.010)	0.051	0.704 (0.082–6.018)	0.748
Reintervention required	0.526 (0.105–2.638)	0.435	N/A	

ECM, extracolonic malignancy

N/A, not applied (as p value ≥ 0.10 on univariable analysis)

ECOG, Estern Cooperative Oncology Group

Note. – 95% confidence intervals for each point estimate are shown in parentheses.

* Clinical failure was defined as inability to defecate without relief on obstructive symptoms after 10 days following procedure.

Table 5-2. Univariable and multivariable regression analyses on prediction of clinical failure and stent failure

Variables	Cox proportional hazard model for stent failure †			
	Univariable analysis		Multivariable analysis	
	Hazard ratio	*p* value	Hazard ratio	*p* value
Extracolonic malignancy	1.064 (0.481–2.352)	0.879	N/A	
ECOG performance score	1.736 (1.002–3.006)	0.049	1.635 (0.923–2.900)	0.092
Female gender	0.909 (0.419–1.973)	0.810	N/A	
Age	0.992 (0.966–1.020)	0.578	N/A	
Surgical history	1.403 (0.647–3.041)	0.391	N/A	
Chemotherapy	0.785 (0.358–1.719)	0.545	N/A	
Peritoneal carcinomatosis	0.912 (0.392–2.123)	0.832	N/A	
Nonperitoneal distant metastases	1.288 (0.567–2.924)	0.545	N/A	
Length of obstruction	1.355 (1.170–1.570)	< 0.001	1.400 (1.195–1.639)	< 0.001
Left colonic obstruction	1.018 (0.882–1.178)	0.811	N/A	
Presence of multiple obstructions	2.908 (0.944–8.955)	0.063	4.028 (1.243–14.050)	0.020
Stent diameter	0.959 (0.755–1.219)	0.735	N/A	
Stent length	1.025 (0.991–1.060)	0.158	N/A	
Multiple stent use	2.017 (0.881–4.615)	0.097	0.745 (0.283–1.956)	0.549
Post-stent balloon dilatation	3.005 (1.157–7.803)	0.024	2.350 (0.847–6.515)	0.748
Reintervention required	2.389 (0.673–8.482)	0.178	N/A	

N/A, not applied (as p value ≥ 0.10 on univariable analysis)

ECOG, Estern Cooperative Oncology Group

Note. – 95% confidence intervals for each point estimate are shown in parentheses.

† Stent failure was defined as cases where patients who achieved

clinical success eventually experienced non-functioning stent by recurrent obstruction or stent-related complications.

Figure 1. Flow chart showing included and excluded patients

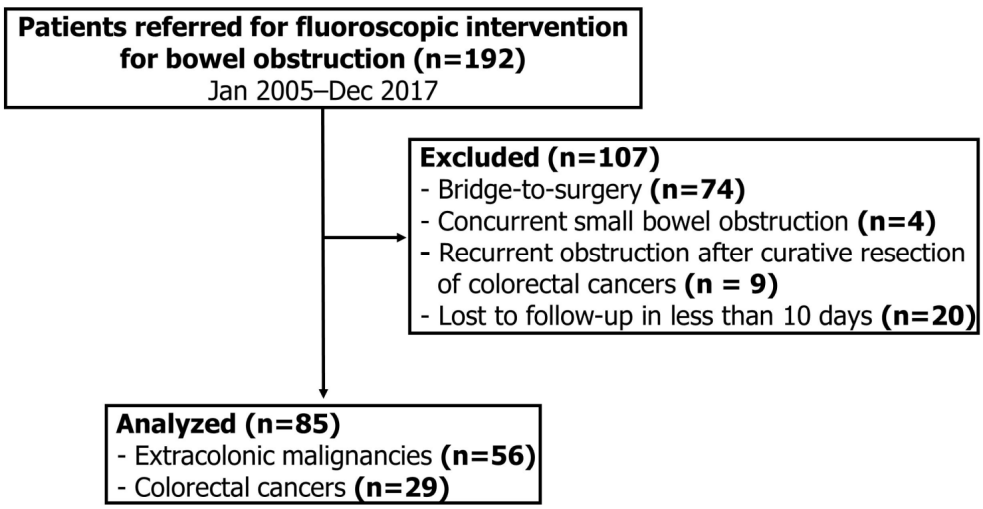
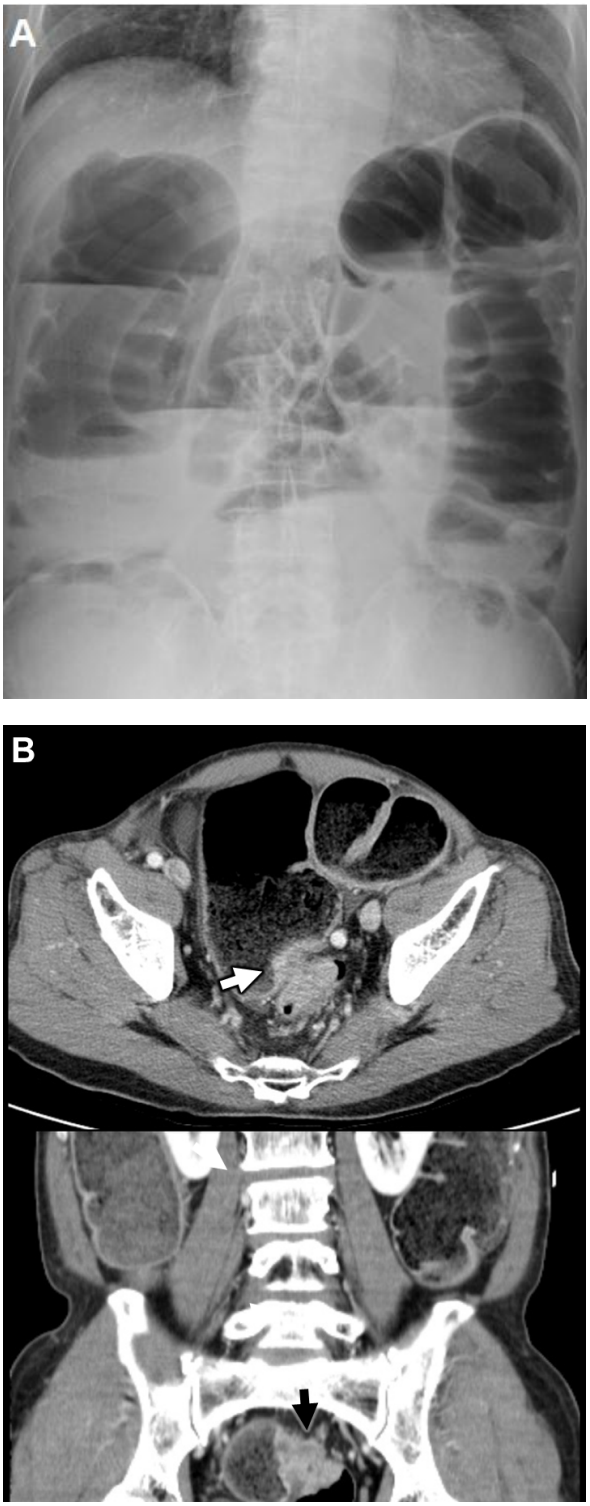
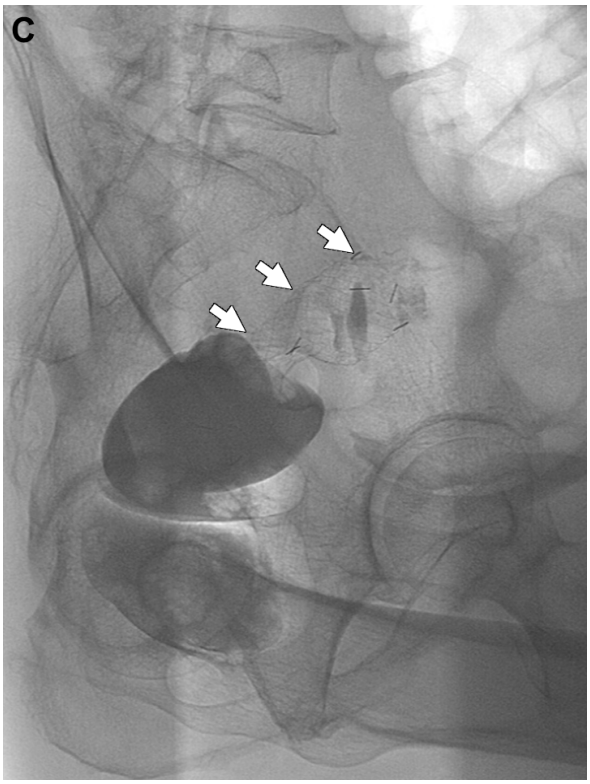


Figure 2. A 72-year-old male with rectosigmoid colon cancer.

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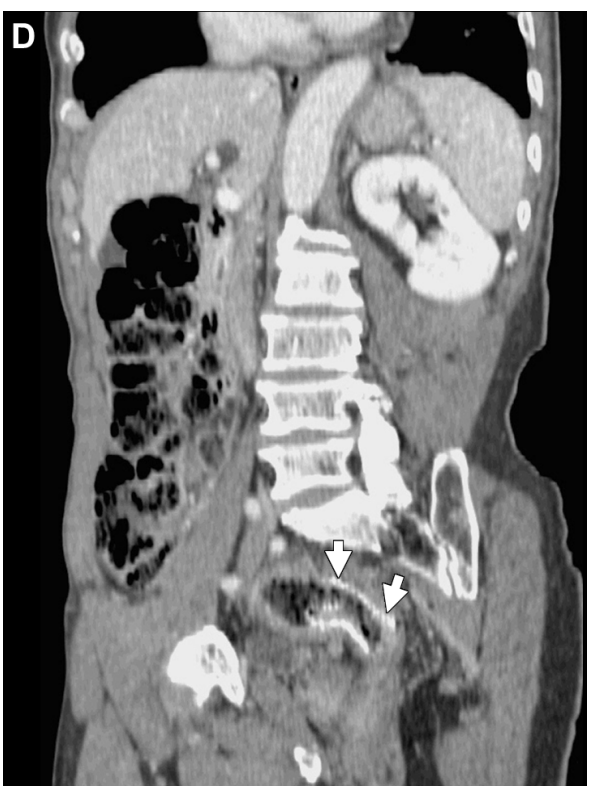
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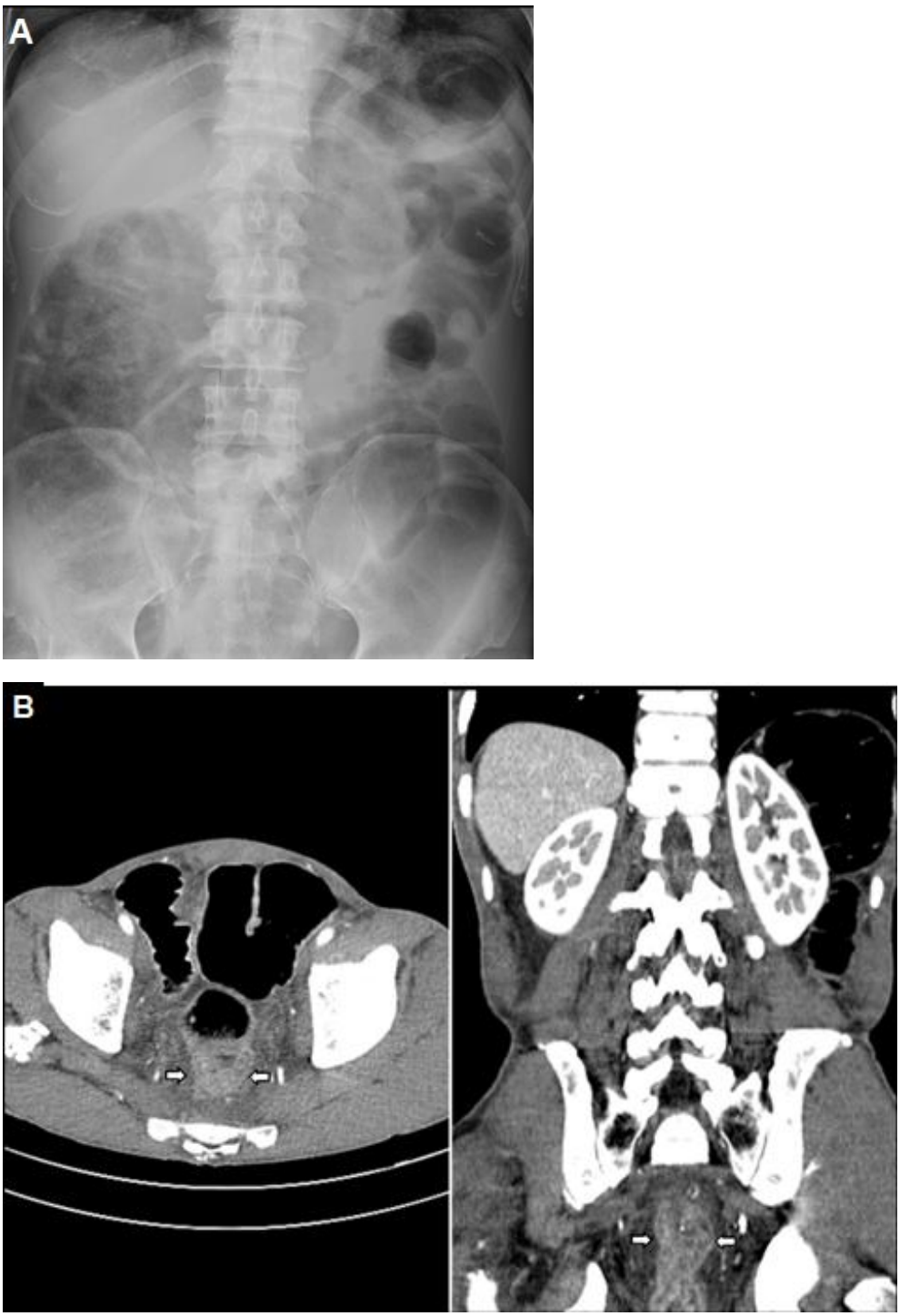
(A) An abdominal radiograph demonstrated diffusely dilated bowel loops with air fluid level.

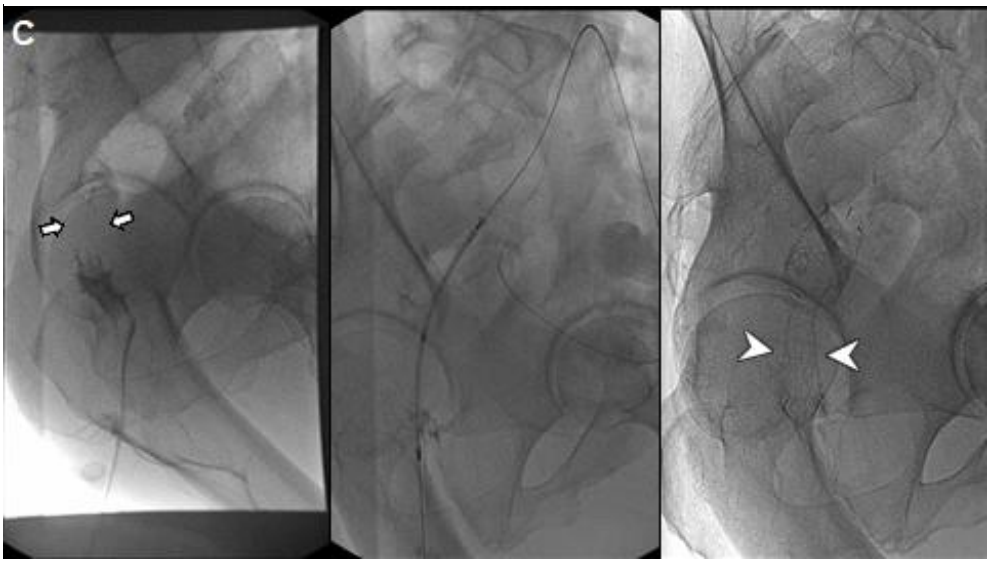
(B) Axial (upper row) and coronal (lower row) CT showed rectosigmoid colonic obstruction (arrows).

(C) Stent placement was performed (arrows). Neither pre- nor post-stent balloon dilation was required to achieve technical success. Obstructive sign and symptom of the patient was alleviated.

(D) A follow-up CT obtained 3 months after stent placement demonstrated patent stent with resolution of bowel distension.

Figure 3. A 57-year-old male with gastric cancer

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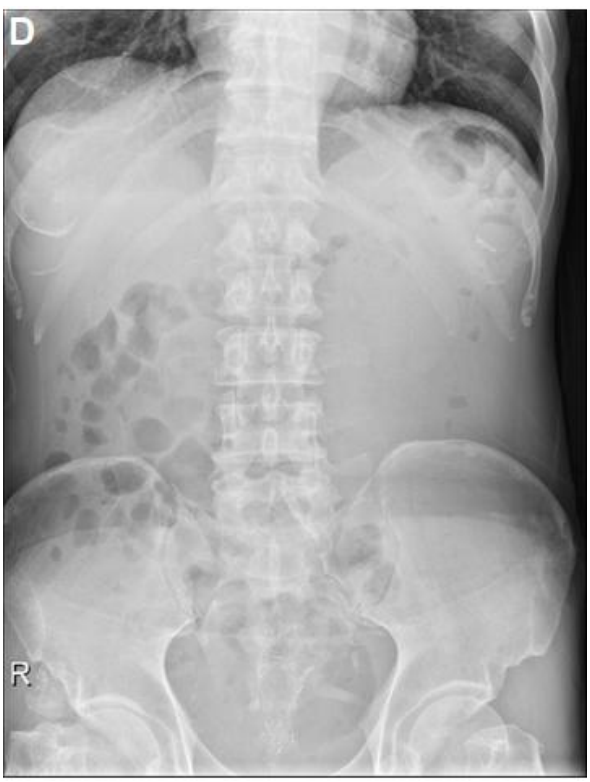
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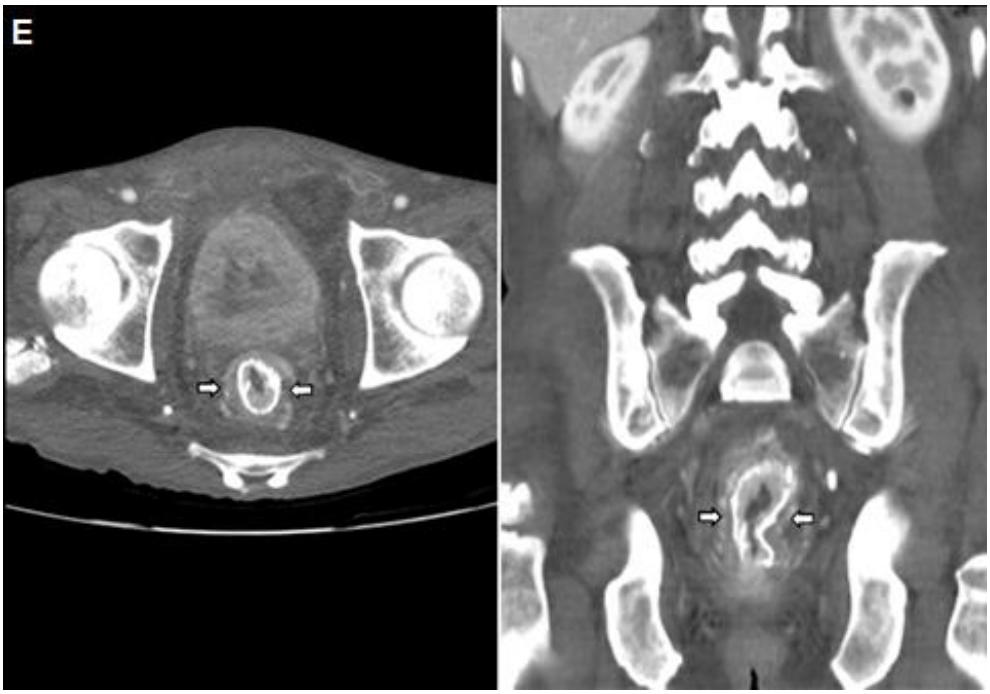


(A) An abdominal radiograph (A) demonstrated diffusely dilated colonic loops.

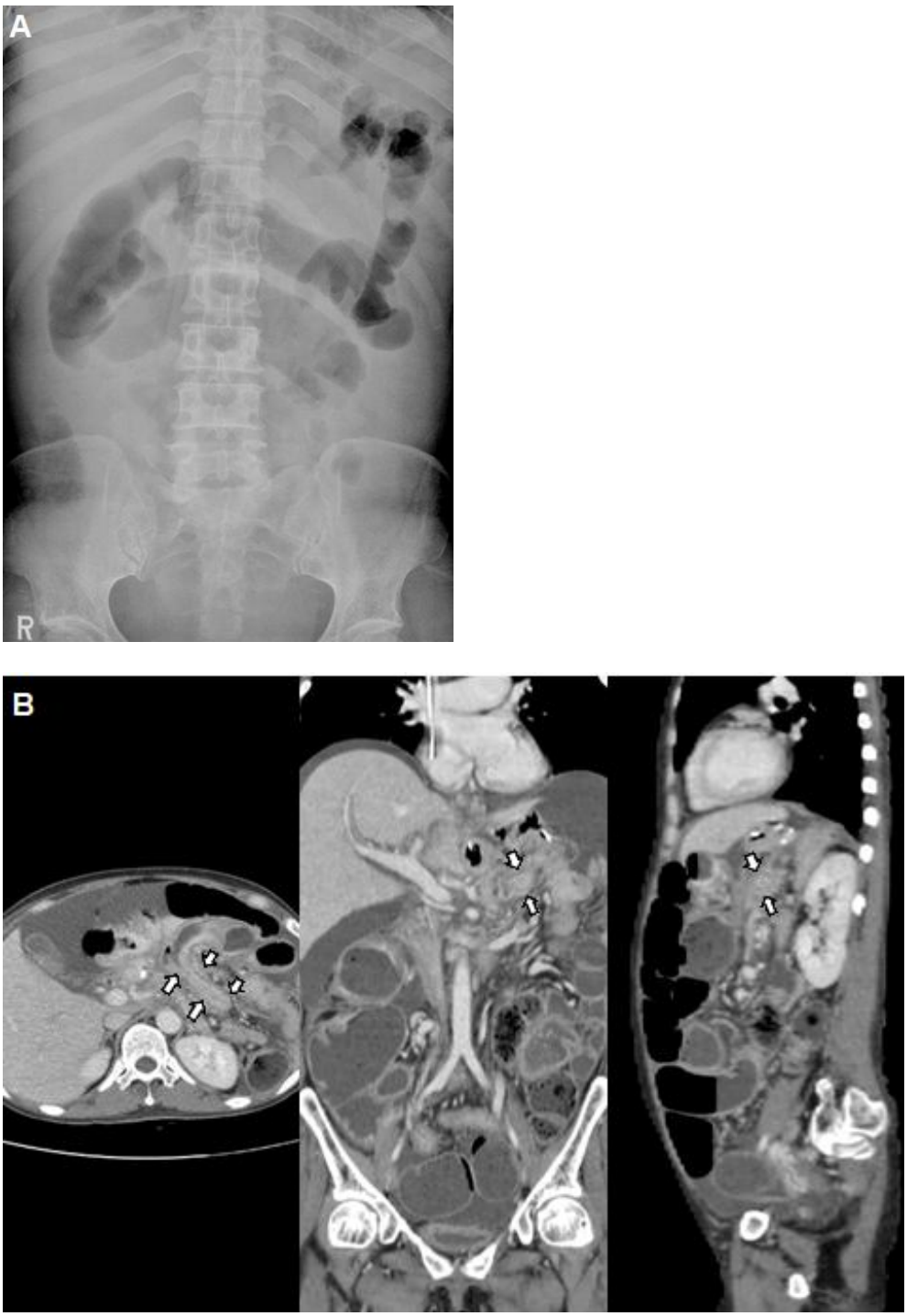
(B) Axial (left column) and coronal (right column) CT showed obstruction at upper rectum (arrows).

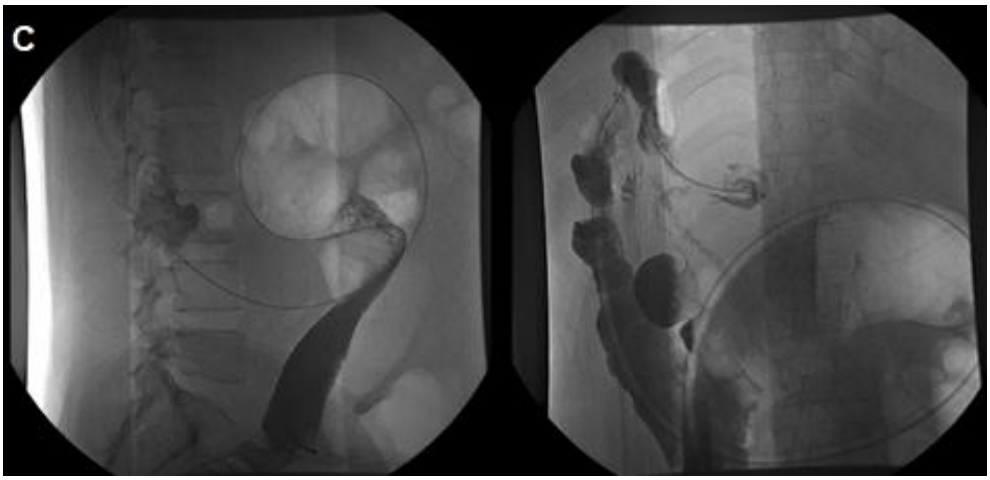
(C) After confirming obstruction on catheter directed colon study (arrows, left column), stent placement was performed (right column, arrowheads).

(D) The patient was relieved from obstructive symptom with improvement of colonic dilatation on radiograph.

(E) A 12-month follow-up CT showed patent rectal stent (arrows).

Figure 4. A 49-year-old female with gastric cancer



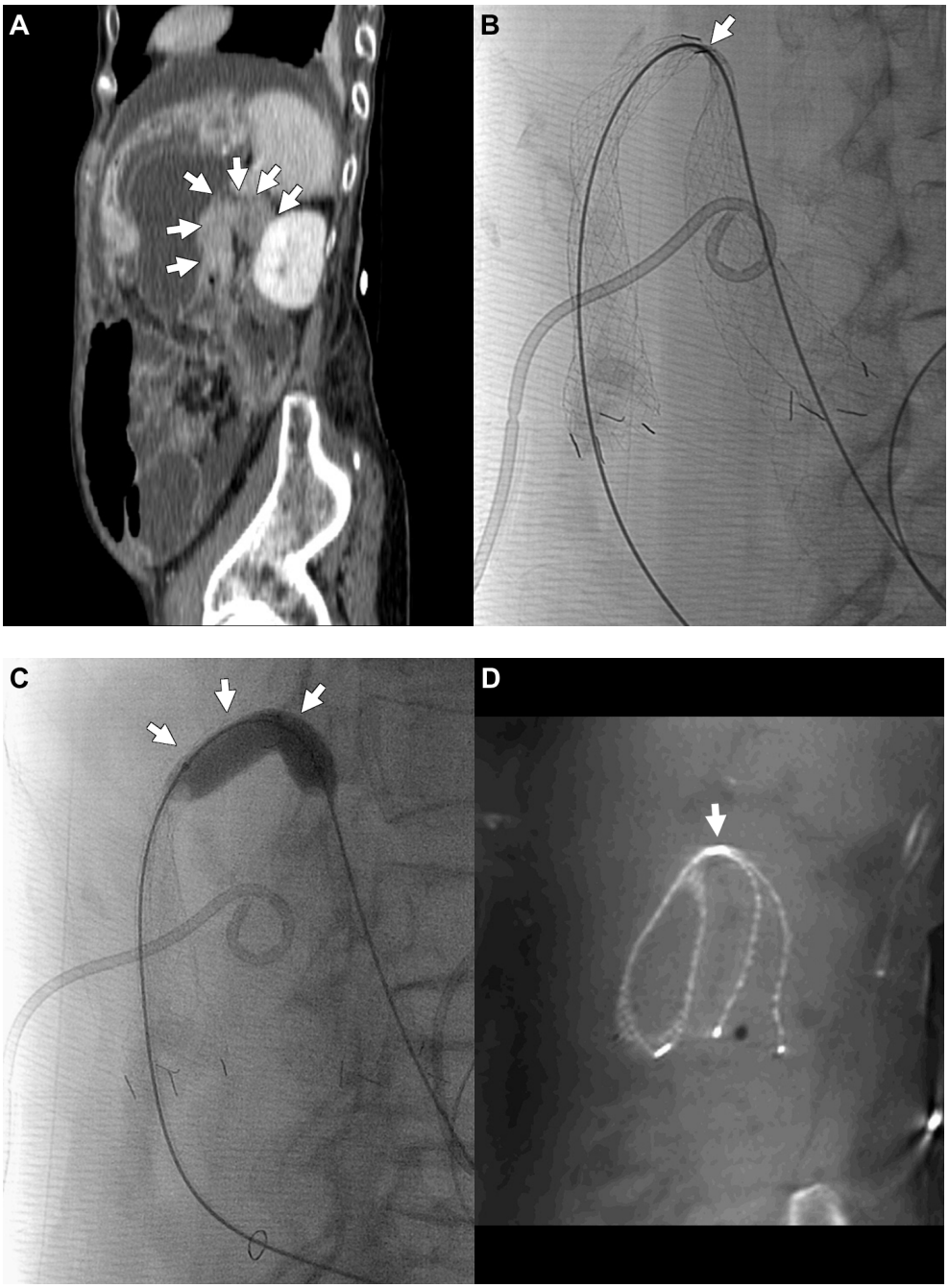


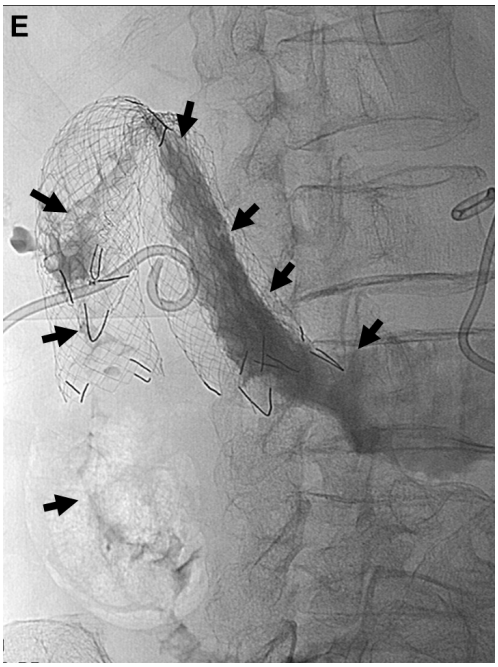
(A) An abdominal radiograph demonstrated diffuse distension of colon.

(B) Axial (left column), coronal (middle column), and sagittal (right column) CT showed obstruction (arrows) at transverse colon.

(C) Stent placement was tried, but owing to redundant sigmoid colon (arrows), stent delivery system could not be advanced along the guidewire to the target lesion. After technical failure, the patient refused further treatment and was transferred to hospice institution for end-of-life care.

Figure 5. A 74-year-old female with cholangiocarcinoma.





(A) A sagittal planar CT demonstrated a segmental colonic obstruction at splenic flexure, measuring 6-cm long (arrows).

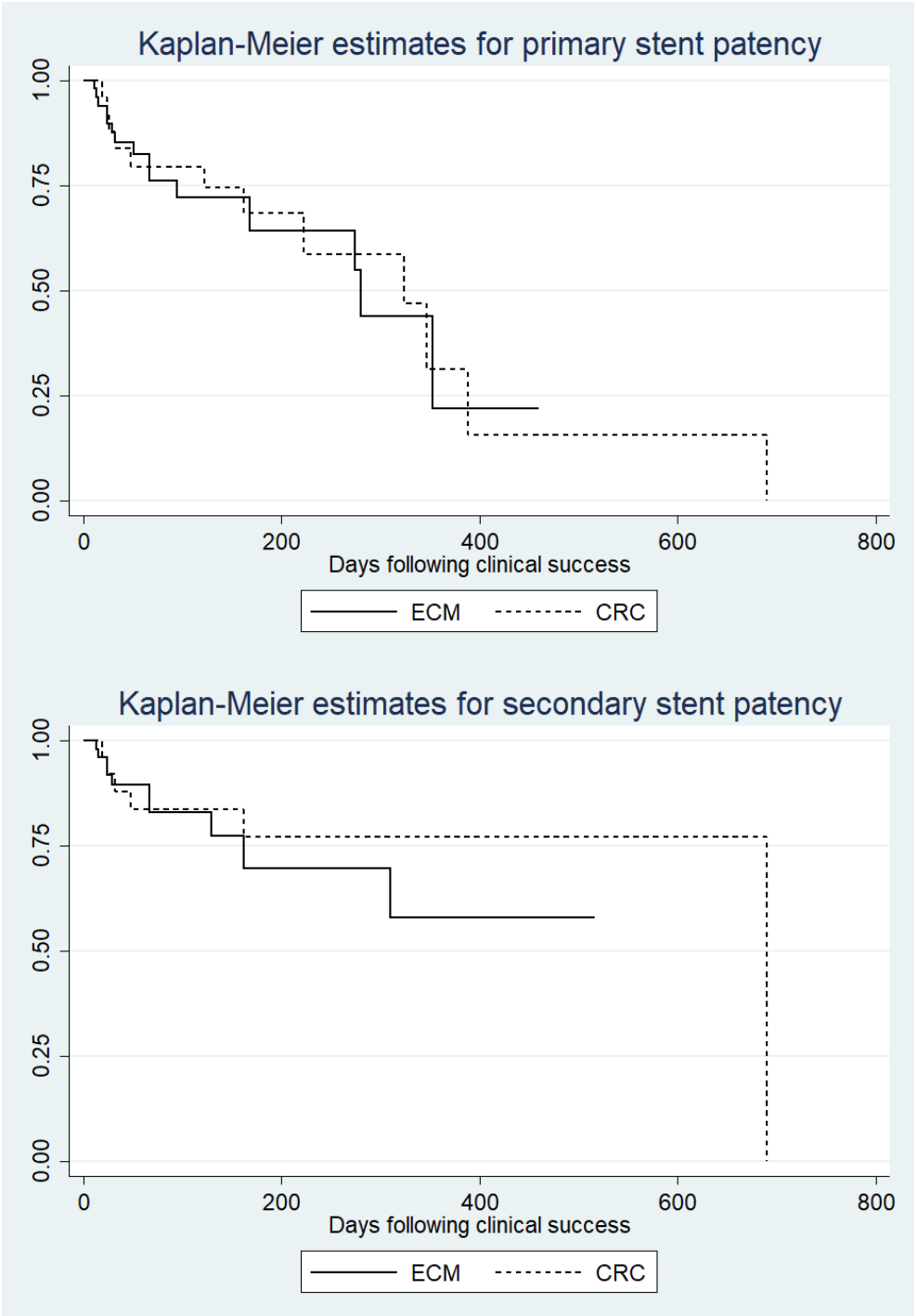
(B) A radiograph obtained 10 minutes after stent placement showed focal collapse at the mid-part of the stent (arrow).

(C) Post-stent balloon dilatation was performed (arrows).

(D) The obstructive symptom did not improve, which required re-intervention. Cone-beam CT obtained during re-intervention showed recurrent collapse of the stent (arrow).

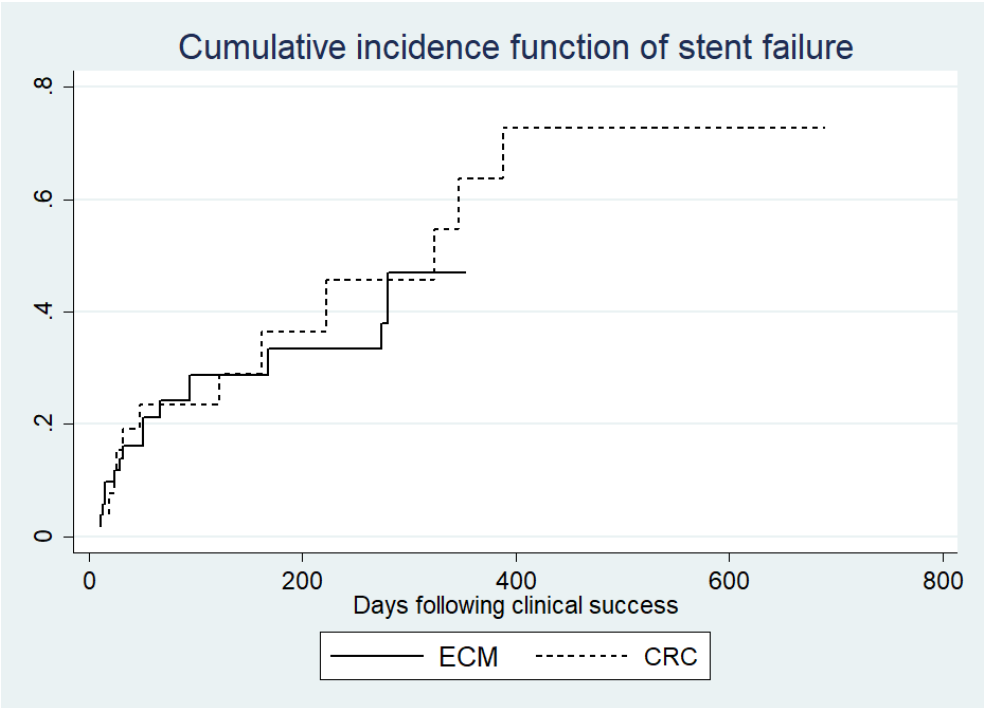
(E) Additional stent was placed coaxially into the initial stent. Stent patency was confirmed with flow of contrast media (arrows). The patient achieved clinical success after re-intervention.

Figure 6. Primary and secondary stent patency of ECM and CRC group.



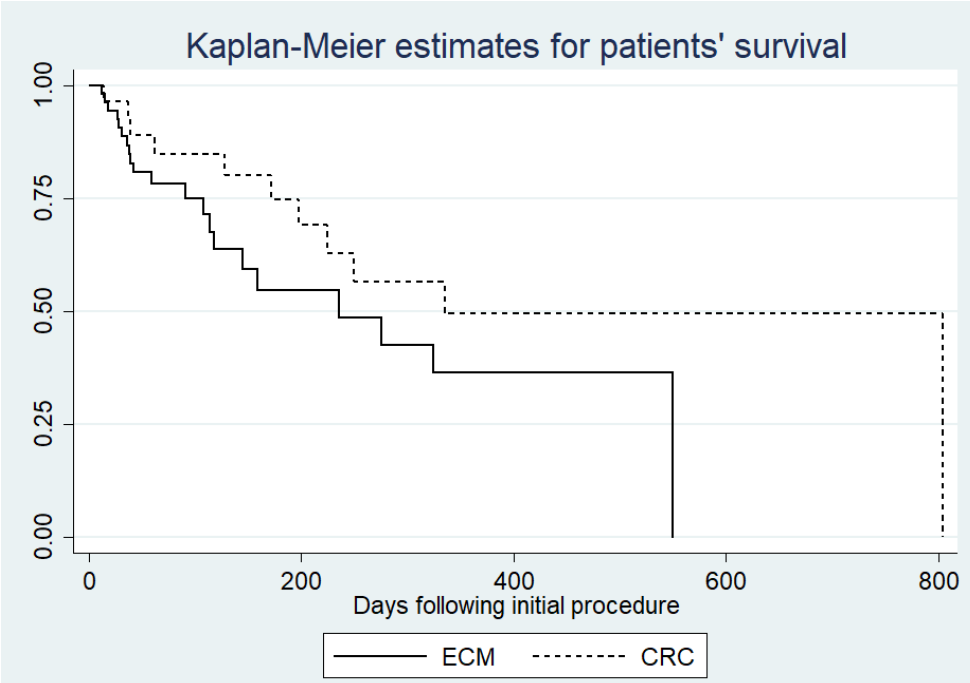
Kaplan-Meier (KM) estimates of primary (upper row) and and secondary stent patency for ECM and CRC patients. No significant difference between KM curve pairs was found (p = 0.887 and 0.565 for primary and secondary stent patency on log-rank tests).

Figure 7. Cumulative incidence function of stent failure



Cumulative incidence function (CIF) of stent failure showed no statistical difference between ECM and CRC groupon Fine and Gray test (p = 0.381).

Figure 8. Primary and secondary stent patency of ECM and CRC group.



Kaplan-Meier (KM) estimates of patients' survival demonstrated no significant difference between ECM and CRC groups (p = 0.114 on log-rank test).

초 록

목적: 대장외 종양 및 대장암으로 인한 악성 대장폐색에 대한 고식적 대장 스텐트 삽입술의 임상적 효용성을 비교하고 스텐트 폐색의 예측인자를 알아보고자 하였다.

대상 및 방법: 2005년에서 2017년 사이에 수술이 불가능한 악성 대장폐색이 있는 85명의 환자들에서 고식적인 치료로써 스텐트 삽입술이 시행되었다. (대장외 종양 56명, 대장암 29명) 기술적 및 임상적 성공률, 재시술률, 스텐트 개통율을 두군 간에 비교하였다. 스텐트 폐색의 예측인자를 알기 위하여 다변량 분석을 시행하였다.

결과: 스텐트 삽입술은 대장외 종양 환자 중 54명 (96.4%), 대장암 환자 중 27명 (93.1%) 에서 기술적으로 성공하였다 ($p = 0.60$). 대장외 종양군이 재시술률 (20.4% vs. 3.7%; $p < 0.05$)이 높았으나, 임상적 성공률은 낮은 경향을 보였다 (88.9% vs. 100%; $p = 0.07$). 6개월 및 12개월 스텐트 개통율은 대장외 종양군에서 각각 64.2%, 22.0%, 대장암군에서 68.4%, 31.3%였다 ($p = 0.89$). 긴 대장폐색 (위험비 1.40)과 다발성 대장폐색 (위험비 4.03)이 스텐트 폐색의 독립적인 예측인자였다.

결론: 악성 대장폐색에서의 고식적 스텐트 삽입술은 대장외 종양 환자에서 대장암 환자들에 비해 임상적 효과가 낮고 더 많은 재시술이 요구된다. 긴 대장폐색과 다발성 폐색이 있는 경우 스텐트 폐색의

위험이 높다.

주요어 : 대장외 종양, 대장암, 고식적 치료, 자가팽창형 금속스텐트, 인터벤션 영상의학

학 번 : 2017-27884