Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Stage-Specific Comparative Effectiveness of Diverting Stoma as a Bridge to Surgery Versus Emergency Resection for Obstructive Colorectal Cancer: A Nationwide Target Trial Emulation

Ching-Wei Wu
Kaohsiung Veterans General Hospital
Chih-Chien Wu
Kaohsiung Veterans General Hospital
Hsiao-Ching Kuo
Kaohsiung Veterans General Hospital
Yi-Chia Su
jia.love70@gmail.com
Kaohsiung Veterans General Hospital

Research Article

Keywords: colorectal cancer, intestinal obstruction, diverting stoma, emergency resection, target trial emulation

Posted Date: August 3rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10428452/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

To evaluate the stage-specific comparative effectiveness of diverting stoma as a bridge to surgery (DS-BTS) versus emergency resection (ER) in obstructive colorectal cancer. Summary Background Data: Bridge-to-surgery approaches relieve obstruction before elective resection, but most evidence concerns self-expanding metal stents and pools outcomes across stages. Diverting stoma is a relevant alternative where stenting is restricted, yet stage-specific DS-BTS versus ER comparisons remain limited.

We performed a nationwide target trial emulation using the linked Taiwan National Health Insurance Research Database and Cancer Registry (2016–2022; follow-up through 2023). Patients with obstructive colorectal cancer undergoing primary tumor resection were classified as DS-BTS, ER, or same-admission diversion with resection (Both). The primary outcome was 90-day all-cause mortality. Inverse probability of treatment weighting was applied within each stage cohort, with propensity-score matching for sensitivity. Among 17,162 patients (DS-BTS, 1,135; ER, 14,594; Both, 1,433), associations were stage- and endpoint-dependent. In stage IV, DS-BTS was associated with lower 90-day mortality than ER (weighted OR, 0.54; 95% CI, 0.33–0.88) without long-term benefit. In stage III, DS-BTS was associated with worse long-term mortality (3-year weighted HR, 1.28; overall weighted HR, 1.32). In stage I–II, DS-BTS was associated with fewer postoperative complications without a mortality benefit. DS-BTS showed stage-dependent, endpoint-specific associations in obstructive colorectal cancer, with a short-term survival benefit in stage IV, fewer complications in stage I–II, but worse long-term mortality in stage III. These findings argue against uniform bridge-to-surgery use and support selective, stage-specific management.

Introduction

Colorectal cancer (CRC) is among the most common malignancies worldwide and a leading cause of cancer-related death [1]. A meaningful subset of patients presents with acute large-bowel obstruction, a challenging emergency that requires prompt decompression alongside definitive oncologic management [2–5].

For obstructive CRC requiring primary tumor resection (PTR), management options include emergency resection (ER) and bridge-to-surgery (BTS) decompression followed by interval colectomy. Guidelines endorse BTS for selected patients with left-sided obstruction, including stent decompression or diverting colostomy before interval colectomy, although concerns remain regarding stent-related perforation and oncologic safety.[2],[6] Most BTS evidence involves self-expanding metal stents (SEMS), which improve short-term outcomes compared with ER in systematic reviews and meta-analyses [2, 7]. However, SEMS use varies across health systems. In Taiwan, reimbursement is largely limited to palliative indications, restricting curative-intent use and limiting the generalizability of SEMS-based comparisons [8–10]. In this setting, diverting stoma as bridge to surgery (DS-BTS) is a clinically relevant alternative that provides decompression without direct tumor manipulation and may allow physiologic optimization before elective resection [11, 12].

Direct evidence comparing DS-BTS with ER remains limited. Two national cohort studies from the Netherlands and Sweden reported favorable outcomes with diverting stoma, but were largely restricted to nonmetastatic disease and did not evaluate stage-specific effects. [11],[12] Meta-analyses have similarly pooled outcomes across stages, with diverting-stoma estimates derived largely from sparse or indirect evidence [7, 13]. Data are particularly limited for right-sided obstruction, which is usually treated with ER because primary ileocolic anastomosis is considered safe and diversion may be anatomically constrained by a competent ileocecal valve [2, 14–17]. Thus, whether the comparative effectiveness of DS-BTS versus ER differs by stage or sidedness remains unclear.

We therefore conducted a nationwide population-based cohort study using a target-trial emulation framework to compare DS-BTS with ER in patients with obstructive CRC undergoing PTR, with analyses stratified by stage and exploratory subgroup analyses by tumor sidedness.

Materials and Methods

Data Sources

This population-based retrospective cohort study used linked data from the National Health Insurance Research Database and the Taiwan Cancer Registry (Table S1), all of which are maintained by the Health and Welfare Data Science Center, Ministry of Health and Welfare (HWDC, MOHW), Taiwan [18, 19]. Patients were identified from January 1, 2016, through December 31, 2022, with outcome follow-up available through December 31, 2023. The study was approved by the Institutional Review Board of Kaohsiung Veterans General Hospital (KSVGH25-EM6-01), with waiver of informed consent because deidentified secondary data were used. The study followed STROBE reporting guidelines.

Emulation of the Target Trial

We emulated a prespecified pragmatic target trial comparing operative strategies for adults with obstructive CRC eligible for PTR [20, 21]. The strategies were initial diverting stoma followed by interval PTR, immediate PTR, and same-admission diverting stoma with PTR; the latter was analyzed separately because it represents a distinct clinical pathway. In the observational emulation, patients were classified according to the observed sequence and timing of decompression and resection (Table S1).

Study Population and Treatment Strategies

We identified patients aged ≥ 20 years with obstructive CRC who underwent PTR during the study identification period. Exclusion criteria were bowel perforation or peritonitis within 3 months before the index date, prior stoma creation or colonic stenting within 12 months before CRC diagnosis, and tumor perforation recorded in the Taiwan Cancer Registry (Table S2). Patients were assigned to three mutually exclusive strategies: diverting stoma as bridge to

surgery (DS-BTS), emergency resection (ER), or same-admission diversion with resection (Both). DS-BTS denoted diverting stoma creation during a hospitalization preceding the resection admission; ER, immediate resection without prior diverting stoma or colonic stenting; and Both, diverting stoma creation and resection during the same hospitalization. The index date was the date of PTR. The stoma-to-resection interval in DS-BTS patients was summarized separately (Figure S1).

Study Outcomes and Follow-up

The primary outcome was 90-day all-cause mortality after PTR. Secondary outcomes included 3-year and overall all-cause mortality, length of stay for the resection admission, and 30- and 90-day postdischarge complications. Mortality follow-up began on the index date and continued through 90 days, 3 years, or until death, loss to follow-up, or December 31, 2023, as applicable. Complication follow-up began at discharge from the index hospitalization and continued through the prespecified 30- and 90-day windows. Complications were identified from inpatient discharge records and outpatient claims using prespecified ICD-9-CM and ICD-10-CM diagnosis codes; mortality was ascertained from claims-based follow-up. Outcome definitions are provided (Table S3).

Causal Contrast and Covariates

The primary contrast was DS-BTS versus ER, comparing staged decompression with interval resection against immediate resection. The secondary contrast was DS-BTS versus Both, comparing staged diversion with delayed resection against same-admission diversion and resection. The estimand approximated a treatment-strategy effect based on the strategy observed in routine practice. Because claims data do not capture the intended operative plan before treatment initiation and groups were defined by procedures received, no separate per-protocol analysis was performed.

Baseline covariates were prespecified based on clinical relevance, prior literature, and database availability (Table S4). This included age, sex, calendar year of resection, stage, sidedness/location, histology, grade, size, receipt of radiotherapy, chemotherapy, or targeted therapy, Charlson Comorbidity Index (CCI) [22], hypertension, and hyperlipidemia. Because treatment effects were expected to vary by cancer stage, primary weighted analyses were performed separately for stage I–II, stage III, and stage IV; stage was used to define analytic strata rather than solely as a propensity-score covariate.

Statistical Analysis

Baseline characteristics were summarized by treatment strategy as mean (SD), median (IQR), or number (%). Covariate balance before and after weighting was assessed using standardized mean differences (SMDs), with an absolute SMD < 0.10 indicating acceptable balance. Kaplan–Meier curves and log-rank tests compared overall survival across treatment groups overall and within stage strata.

Stabilized inverse probability of treatment weighting (SIPTW) was applied separately within each stage stratum for the prespecified contrasts of DS-BTS versus ER and DS-BTS versus Both. Propensity scores were estimated using logistic regression with prespecified baseline covariates. Weighted logistic regression estimated weighted odds ratios (wORs) and 95% confidence intervals (CIs) for 90-day mortality and 30- and 90-day postdischarge complications. Weighted Cox proportional hazards models estimated weighted hazard ratios (wHRs) and 95% CIs for 3-year and overall mortality. Length of stay for the resection admission was summarized descriptively.

Sensitivity analyses used propensity-score matching within stage strata, with the same covariates as the SIPTW models (Table S6), for both treatment contrasts. Additional subgroup analyses were performed by clinically relevant tumor characteristics, including sidedness and size, when sample size allowed. A further sensitivity analysis refit the propensity-score models after excluding chemotherapy and targeted therapy (Table S9).

All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC). Two-sided P values < 0.05 were considered statistically significant.

Results

Study Population and Baseline Characteristics

Among 17,162 patients with obstructive CRC undergoing PTR, 1,135 were classified as DS-BTS, 14,594 as ER, and 1,433 as Both (Fig. 1). Baseline characteristics are shown in Table 1. After SIPTW, covariate balance was generally acceptable within stage strata; residual imbalance is detailed (Table S6).

Table 1
Baseline characteristics by treatment strategy.

		DS-BTS (n = 1135)		ER (n = 14594)		Both (n = 1433)		
	N	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***P*-value**
Age at index date (years)								
Mean (SD)		67.27	(13.22)	68.01	(13.72)	69.34	(13.81)	0.0003
Median (25th, 75th)		67.90	(57.87, 77.89)	68.70	(58.82, 78.98)	70.24	(59.63, 80.30)	0.0001
< 65 yrs	6848	474	(41.76)	5851	(40.09)	523	(36.50)	0.0124
≥ 65 yrs	10314	661	(58.24)	8743	(59.91)	910	(63.50)	
Sex								< .0001
Male	9365	686	(60.44)	7830	(53.65)	849	(59.25)	
Female	7797	449	(39.56)	6764	(46.35)	584	(40.75)	
Year of resection								0.0010
2016	2326	115	(10.13)	2035	(13.94)	176	(12.28)	
2017	2355	137	(12.07)	2024	(13.87)	194	(13.54)	
2018	2485	162	(14.27)	2121	(14.53)	202	(14.10)	
2019	2521	155	(13.66)	2143	(14.68)	223	(15.56)	
2020	2506	181	(15.95)	2111	(14.46)	214	(14.93)	
2021	2481	180	(15.86)	2097	(14.37)	204	(14.24)	
2022	2488	205	(18.06)	2063	(14.14)	220	(15.35)	
Tumor sidedness								< .0001
Right	8248	198	(17.44)	7614	(52.17)	436	(30.43)	
Left	8634	912	(80.35)	6757	(46.30)	965	(67.34)	
Missing	280	25	(2.20)	223	(1.53)	32	(2.23)	
Histologic type								0.0043
Adenocarcinoma	15961	1080	(95.15)	13542	(92.79)	1339	(93.44)	
Signet ring cell carcinoma	137	6	(0.53)	113	(0.77)	18	(1.26)	
Mucinous	1064	49	(4.32)	939	(6.43)	76	(5.30)	
Tumor size								< .0001
< 4cm	4380	294	(25.90)	3696	(25.33)	390	(27.22)	
4-5cm	3566	258	(22.73)	3000	(20.56)	308	(21.49)	
> 5cm	8839	510	(44.93)	7615	(52.18)	714	(49.83)	
Missing	377	73	(6.43)	283	(1.94)	21	(1.47)	
Tumor differentiation grade								0.0007
Well-differentiated	811	40	(3.52)	719	(4.93)	52	(3.63)	
Moderately differentiated	9898	675	(59.47)	8347	(57.19)	876	(61.13)	
Poorly differentiated	1263	60	(5.29)	1099	(7.53)	104	(7.26)	
Undifferentiated or anaplastic	112	3	(0.26)	102	(0.70)	7	(0.49)	
Missing	5078	357	(31.45)	4327	(29.65)	394	(27.49)	
Stage								< .0001
I-II	6377	300	(26.43)	5609	(38.43)	468	(32.66)	
III	6307	422	(37.18)	5328	(36.51)	557	(38.87)	

Abbreviations: DS-BTS, diverting stoma as a bridge to surgery; ER, emergency resection; SD, standard deviation.

		DS-BTS (n = 1135)		ER (n = 14594)		Both (n = 1433)		
	N	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	***P*-value**
IV	4379	413	(36.39)	3564	(24.42)	402	(28.05)	
Missing	99	0	(0.00)	93	(0.64)	6	(0.42)	
Radiotherapy								< .0001
No	17058	1078	(94.98)	14552	(99.71)	1428	(99.65)	
Yes	104	57	(5.02)	42	(0.29)	5	(0.35)	
Chemotherapy								< .0001
No	16366	765	(67.40)	14222	(97.45)	1379	(96.23)	
Yes	796	370	(32.60)	372	(2.55)	54	(3.77)	
Targeted therapy								< .0001
No	16697	881	(77.62)	14397	(98.65)	1419	(99.02)	
Yes	465	254	(22.38)	197	(1.35)	14	(0.98)	
Charlson comorbidity index								< .0001
2	2501	150	(13.22)	2006	(13.75)	345	(24.08)	
3–5	7262	472	(41.59)	6272	(42.98)	518	(36.15)	
> 5	7399	513	(45.20)	6316	(43.28)	570	(39.78)	
Hypertension	9743	613	(54.01)	8391	(57.50)	739	(51.57)	< .0001
Hyperlipidemia	6528	370	(32.60)	5740	(39.33)	418	(29.17)	< .0001

Abbreviations: DS-BTS, diverting stoma as a bridge to surgery; ER, emergency resection; SD, standard deviation.

Primary Outcome

Stage-stratified Kaplan–Meier curves are shown in Fig. 2. Crude 90-day mortality was highest in the Both group overall (9.07% vs 3.61% for DS-BTS and 4.38% for ER), with similar patterns across stages. After SIPTW, DS-BTS was associated with lower 90-day mortality than Both in all stage strata (Table 2). Compared with ER, DS-BTS was associated with lower 90-day mortality only in stage IV (wOR, 0.54; 95% CI, 0.33–0.88; crude risk, 5.08% vs 8.64%; absolute difference, 3.56 percentage points), with no significant difference in stage I–II or stage III.

Table 2. Primary and secondary outcomes by treatment strategy, overall and stratified by cancer stage.

	DS-BTS (n = 1135)		ER (n = 14594)		Both (n = 1433)		DS-BTS vs. ER				DS-BTS vs. Both		
	n	(%)	n	(%)	n	(%)	P-value	wOR/ wHR	95% CI	P-value	wOR/ wHR	95% CI	
Overall													
Length of stay during admission for resction													
Mean (SD)	14.88	(8.29)	16.79	(46.22)	23.74	(12.20)	< .0001						
Median (25th, 75th)	13.00	(10.00, 17.00)	14.00	(11.00, 19.00)	21.00	(16.00, 28.00)	< .0001						
90-day mortality	41	(3.61)	639	(4.38)	130	(9.07)	< .0001						
3-year mortality	409	(36.04)	4390	(30.08)	612	(42.71)	< .0001						
All-cause mortality	515	(45.37)	5699	(39.05)	733	(51.15)	< .0001						
Postoperative complications within 30 days	41	(3.61)	828	(5.67)	135	(9.42)	< .0001						
Postoperative complications within 90 days	76	(6.70)	1257	(8.61)	201	(14.03)	< .0001						
Stage I-II													
Length of stay during admission for resection													
Mean (SD)	14.29	(7.44)	17.13	(73.64)	23.06	(10.54)	0.1475						
Median (25th, 75th)	12.00	(10.00, 17.00)	13.00	(11.00, 19.00)	21.00	(16.00, 27.00)	< .0001						
90-day mortality (wOR)	10	(3.33)	154	(2.75)	39	(8.33)	< .0001	1.41	(0.76	, 2.62)	0.2764	0.34	(0.17
3-year mortality (wHR)	53	(17.67)	849	(15.14)	125	(26.71)	< .0001	1.12	(0.84	, 1.49)	0.4591	0.57	(0.41
All-cause mortality (wHR)	79	(26.33)	1336	(23.82)	170	(36.32)	< .0001	1.14	(0.90	, 1.43)	0.2869	0.62	(0.47
Postoperative complications within 30 days (wOR)	6	(2.00)	332	(5.92)	42	(8.97)	0.0003	0.27	(0.11	, 0.67)	0.0045	0.19	(0.07
Postoperative cowmplications within 90 days (wOR)	21	(7.00)	539	(9.61)	70	(14.96)	0.0002	0.59	(0.36	, 0.97)	0.0373	0.41	(0.24
Stage III													
Length of stay during admission for resection													
Mean (SD)	13.79	(7.95)	15.97	(8.90)	23.72	(11.33)	< .0001						
Median (25th, 75th)	12.00	(9.00, 15.00)	14.00	(11.00, 18.00)	21.00	(17.00, 27.00)	< .0001						
90-day mortality (wOR)	10	(2.37)	175	(3.28)	34	(6.10)	0.0011	1.07	(0.62	, 1.85)	0.8020	0.43	(0.21

Abbreviations: DS-BTS, diverting stoma as a bridge to surgery; ER, emergency resection; wHR, weighted hazard ratio; wOR, weighted odds ratio; CI, confidenc standard deviation.

Table 2. Primary and secondary outcomes by treatment strategy, overall and stratified by cancer stage.

	DS-BTS (n = 1135)		ER (n = 14594)		Both (n = 1433)		DS-BTS vs. ER				DS-BTS vs. Both		
3-year mortality (wHR)	117	(27.73)	1297	(24.34)	216	(38.78)	< .0001	1.28	(1.06	, 1.54)	0.0118	0.69	(0.55
All-cause mortality (wHR)	170	(40.28)	1770	(33.22)	264	(47.40)	< .0001	1.32	(1.12	, 1.55)	0.0009	0.80	(0.66
Postoperative complications within 30 days (wOR)	20	(4.74)	288	(5.41)	56	(10.05)	< .0001	1.40	(0.95	, 2.06)	0.0923	0.59	(0.36
Postoperative cowmplications within 90 days (wOR)	27	(6.40)	390	(7.32)	79	(14.18)	< .0001	1.12	(0.78	, 1.62)	0.5455	0.49	(0.31
Stage IV													
Length of stay during admission for resection													
Mean (SD)	16.43	(8.98)	17.47	(9.51)	24.52	(14.87)	< .0001						
Median (25th, 75th)	14.00	(11.00, 19.00)	15.00	(11.00, 20.00)	22.00	(16.00, 30.00)	< .0001						
90-day mortality (wOR)	21	(5.08)	308	(8.64)	57	(14.18)	< .0001	0.54	(0.33	, 0.88)	0.0127	0.56	(0.33
3-year mortality (wHR)	239	(57.87)	2224	(62.40)	270	(67.16)	0.0235	1.09	(0.95	, 1.24)	0.2088	0.95	(0.80
All-cause mortality (wHR)	266	(64.41)	2561	(71.86)	298	(74.13)	0.0029	1.08	(0.95	, 1.22)	0.2243	0.96	(0.81
Postoperative complications within 30 days (wOR)	15	(3.63)	196	(5.50)	35	(8.71)	0.0055	0.88	(0.53	, 1.45)	0.6050	0.53	(0.30
Postoperative cowmplications within 90 days (wOR)	28	(6.78)	311	(8.73)	50	(12.44)	0.0133	0.79	(0.52	, 1.20)	0.2779	0.65	(0.40

Abbreviations: DS-BTS, diverting stoma as a bridge to surgery; ER, emergency resection; wHR, weighted hazard ratio; wOR, weighted odds ratio; CI, confidenc standard deviation.

Secondary Outcomes

The Both group had the longest resection-admission length of stay overall (median, 21 days vs 13 days for DS-BTS and 14 days for ER; Table 2), with similar patterns across stages. DS-BTS was associated with fewer 30- and 90-day postdischarge complications than Both across most stages. Compared with ER, DS-BTS had lower complication rates only in stage I–II, with similar rates in stages III and IV (Table 2). The composite complication outcome was driven mainly by anastomotic leak, surgical site infection, and postoperative ileus, with crude rates lowest in DS-BTS and highest in Both (Table S5).

After SIPTW, DS-BTS was associated with lower 3-year and overall mortality than Both in stage I–II and stage III. In contrast, compared with ER, DS-BTS was associated with higher 3-year mortality (wHR, 1.28; 95% CI, 1.06–1.54) and overall mortality (wHR, 1.32; 95% CI, 1.12–1.55) in stage III, with similar outcomes in stage I–II and stage IV.

Subgroup and Sensitivity Analyses

In stage IV, analyses suggested heterogeneity in the association between DS-BTS and 90-day mortality (Fig. 3). Compared with ER, DS-BTS was associated with lower mortality among patients with tumors ≤ 5 cm (wOR, 0.21; 95% CI, 0.06–0.66) and well/moderately differentiated tumors (wOR, 0.16; 95% CI, 0.05–0.54), with significant interactions by size and grade. Compared with Both, DS-BTS was associated with lower mortality in patients with right-sided but not left-sided, with significant interaction by sidedness. Propensity-score matching yielded results consistent with the primary SIPTW analysis (Table S7).

Discussion

In this nationwide population-based cohort of patients with obstructive CRC undergoing PTR, associations between DS-BTS and outcomes were stage- and endpoint-specific. In stage IV, DS-BTS was associated with lower 90-day all-cause mortality than ER (absolute difference, 3.56 percentage points), finding consistent across SIPTW and PSM analyses, but this early advantage did not translate into lower 3-year or overall mortality. In stage III, DS-BTS was not associated with lower 90-day mortality and was associated with higher long-term mortality compared with ER. In stage I–II, DS-BTS was associated primarily with fewer 30- and 90-day postoperative complications, without a mortality advantage. The Both group had the highest short-term mortality, complication burden, and length of stay, likely reflecting heterogeneous high-acuity phenotype rather than a discrete elective treatment strategy.

The lower 90-day post-resection mortality associated with DS-BTS in stage IV is clinically plausible. Acute malignant large-bowel obstruction is often accompanied by dehydration, electrolyte derangements, bowel distension, and nutritional compromise, increasing the risk of emergency colorectal surgery [23–26]. Decompression before resection may convert an unprepared emergency operation into a more controlled elective procedure, allowing resuscitation, staging, multidisciplinary planning, and physiologic optimization [11, 12, 27]. These benefits may be particularly relevant in metastatic disease, where safe relief of obstruction and recovery from the acute episode may take precedence over urgent colectomy under adverse physiologic conditions. Our findings extend prior national cohorts reporting favorable outcomes after decompressive stoma, which were largely limited to nonmetastatic or non-stage-stratified populations [11, 12, 28]. Importantly, this early benefit did not translate into improved long-term survival. Adjusted 3-year and overall mortality were comparable between DS-BTS and ER in stage IV, suggesting that DS-BTS primarily reduces early post-resection hazard rather than altering the underlying oncologic trajectory. Long-term survival in metastatic CRC is likely driven by metastatic burden, tumor biology, performance status, molecular profile, and response to systemic therapy rather than by the initial decompression strategy alone. Thus, DS-BTS should be viewed not as oncologically superior to ER, but as a potentially safer short-term pathway for selected metastatic patients at high physiologic risk.

Stage IV analyses suggested that the early mortality association favoring DS-BTS was more evident in patients with smaller tumors and well- or moderately differentiated tumors, with significant interactions for size and grade. These findings may reflect lower local tumor burden or less aggressive biology, but should be considered exploratory because of residual imbalance and incomplete grade data. Sidedness modified the comparison between DS-BTS and the Both group, but not DS-BTS versus ER. The interaction appeared comparator-driven: 90-day mortality was markedly high in right-sided patients in the Both group (25.3%), whereas DS-BTS mortality was similar between right- and left-sided (6.3% vs 4.9%). Thus, the low mortality observed in left-sided DS-BTS patients supports [29–31] that the finding was not right-sided protective effect of DS-BTS, but rather reflected excess risk among right-sided Both-group. Given the small right-sided DS-BTS subgroup and the anatomic complexity of right-sided diversion in the presence of a competent ileocecal valve, these findings should be viewed as hypothesis-generating [16, 25].

The most clinically provocative finding was the worse long-term mortality associated with DS-BTS in stage III. Unlike stage IV, stage III CRC remains a potentially curable setting in which timely definitive resection and adjuvant chemotherapy can influence survival. Oxaliplatin-based adjuvant chemotherapy provides a well-established survival benefit in stage III CRC [32], and delayed initiation of adjuvant chemotherapy has been associated with worse survival [33, 34]. A staged strategy may delay definitive tumor resection, final pathologic staging, recovery from colectomy, and initiation of adjuvant treatment. This delay may be less consequential in stage I–II, where adjuvant therapy is less uniformly indicated, and in stage IV, where long-term prognosis is dominated by metastatic burden and systemic therapy response. In stage III, however, delay in definitive resection and adjuvant therapy could plausibly compromise long-term outcomes. These observations raise the possibility that the unfavorable stage III association may be modifiable rather than inherent to diversion itself. Whether this disadvantage can be mitigated by optimizing management during the interval between decompression and resection, including appropriate timing of definitive resection, enhanced physiologic optimization, or incorporation of neoadjuvant systemic therapy in selected patients, warrants further prospective investigation [30, 35, 36]. Nevertheless, stage III finding must be interpreted cautiously. Observational data cannot fully capture factors influencing treatment selection, including obstruction severity, physiologic instability, nutritional compromise, local inflammatory burden, technical feasibility, and surgeon judgment. Patients selected for staged diversion may have been less suitable for immediate resection in ways not captured by claims or registry data. However, the association between DS-BTS and worse long-term mortality persisted after stage-specific SIPTW and PSM sensitivity analyses. Moreover, immortal-time bias would be expected to favor DS-BTS because patients must survive the bridge interval to undergo subsequent resection [20, 37]; therefore, this bias is unlikely to explain the worse long-term mortality observed in stage III, although it may have inflated the apparent 90-day mortality advantage in stage IV.

In stage I–II, DS-BTS was associated with lower post-resection morbidity rather than mortality benefit. Compared with ER, DS-BTS was associated with fewer 30-day and 90-day postoperative complications, whereas 90-day mortality, 3-year mortality, and overall all-cause mortality were not clearly different. This pattern is consistent with the expected effect of decompression in lower-stage obstruction: converting emergency surgery into elective resection may reduce bowel distension, contamination risk, technical difficulty, and physiologic stress, thereby lowering postoperative complications. However, because baseline mortality risk is relatively low in stage I–II, a survival advantage may be small or absent. Length of stay should also be interpreted narrowly, as this study measured the PTR hospitalization rather than cumulative hospital days across decompression, interval care, resection, and possible stoma reversal.

The Both group requires cautious interpretation. Because claims data do not record the exact sequence of procedures within the same hospitalization, this group may include planned stoma followed by resection during the same admission, simultaneous resection with stoma creation, or resection complicated by deterioration, leak, reoperation, or later stoma formation. These pathways have distinct clinical meanings and should not be combined into a single causal treatment strategy. The consistently poor outcomes in this group likely identify a clinically complex, high-acuity population rather than demonstrate inferiority of any specific operative sequence.

These findings support stage-specific rather than uniform use of DS-BTS. In stage IV, DS-BTS may be reasonable when technically feasible and when reducing early post-resection mortality risk is the priority. In stage III, DS-BTS should be used cautiously, and immediate oncologic resection should remain strongly considered when technically and physiologically feasible. In stage I–II, DS-BTS may be considered when the goal is to reduce postoperative complications, but it should not be expected to improve survival. These findings are particularly relevant in healthcare systems where SEMS are unavailable,

unsuitable, or not routinely reimbursed for curative-intent obstruction. Current guidelines recognize bridge-to-surgery approaches, including stent decompression or diverting stoma, in selected patients [2, 6]. Prior head-to-head data suggest that decompressing stoma and SEMS may have broadly comparable oncologic outcomes but different trade-offs in procedure-related complications, stoma burden, and additional interventions [38, 39].

This study has several strengths. Nationwide linked claims and cancer registry data provided a large population-based cohort with tumor-stage information and follow-up through December 31, 2023. The target-trial emulation framework improved design transparency by prespecifying eligibility criteria, treatment strategies, index date, covariates, and follow-up. Stage-stratified analyses using SIPTW and PSM further allowed assessment of clinically relevant heterogeneity while addressing measured confounding. However, several limitations merit consideration. Residual confounding and confounding by indication remain possible because claims and registry data lack granular information on obstruction severity, physiologic and nutritional status, operative findings, treatment intent, molecular profile, systemic therapy regimen, and timing of adjuvant chemotherapy. The emulation was not anchored at presentation with acute obstruction; treatment groups were defined by procedures ultimately received, and the index date was PTR. Patients who underwent stoma creation but never proceeded to resection were excluded from the DS-BTS cohort, which may have selected for patients who survived and remained candidates for interval resection. However, exploratory analysis showed substantial stage missingness and poor survival in this stoma-only population, suggesting a distinct nonresection or palliative-intent group (Table S8). Covariates assessed before the index date may have included bridge-interval events in DS-BTS patients, although the median interval from post-stoma discharge to resection readmission was short (37 days), and findings were unchanged after excluding chemotherapy and targeted therapy from the propensity-score models (Table S9). Finally, the Both group could not be resolved into clinically meaningful operative sequences, and Taiwan's SEMS reimbursement restrictions may limit generalizability to settings where stenting is routinely used as the dominant bridge strategy.

In obstructive CRC, the association of DS-BTS versus ER varied by stage and endpoint. DS-BTS was associated with lower 90-day post-resection mortality in stage IV and fewer postoperative complications in stage I–II, but with higher long-term mortality in stage III. These findings do not support a uniform bridge-to-surgery approach and instead favor selective, stage-specific use. Prospective studies anchored at obstruction presentation and capturing obstruction severity, treatment intent, systemic therapy, and stoma-related outcomes are needed.

Declarations

Conflict of interest statement:

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author contribution statement:

Research idea and study design: CWW, CCW and YCS; data acquisition HCK; statistical analysis: HCK; data analysis and interpretation: CWW, HCK and YCS; supervision or mentorship: CCW and YCS.

Each author contributed important intellectual content during manuscript drafting or revision and agrees to be personally accountable for the individual's own contributions and to ensure that questions pertaining to the accuracy or integrity of any portion of the work, even one in which the author was not directly involved, are appropriately investigated and resolved, including with documentation in the literature if appropriate.

Funding statement:

This research was funded by Kaohsiung Veterans General Hospital

(KSVGH115-D03-1, KSVGH114-124)

Acknowledgement

The authors are grateful to the Center for Medical Informatics and Statistics of Kaohsiung Medical University for providing administrative support.

Data Availability

This population-based retrospective cohort study used linked data from the National Health Insurance Research Database and the Taiwan Cancer Registry, all of which are maintained by the Health and Welfare Data Science Center, Ministry of Health and Welfare (HWDC, MOHW), Taiwan

References

1. (2024) Global cancer burden growing, amidst mounting need for services. Saudi Med J 45:326–327
2. Vogel JD, Felder SI, Bhama AR et al (2022) The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Management of Colon Cancer. Dis Colon Rectum 65:148–177
3. Veld JV, Beek KJ, Consten ECJ et al (2021) Definition of large bowel obstruction by primary colorectal cancer: A systematic review. Colorectal Dis 23:787–804

4. Mohd Suan MA, Tan WL, Soelar SA et al (2015) Intestinal obstruction: predictor of poor prognosis in colorectal carcinoma? Epidemiol Health 37:e2015017
5. Guo MG, Feng Y, Liu JZ et al (2014) Factors associated with mortality risk for malignant colonic obstruction in elderly patients. BMC Gastroenterol 14:76
6. van Hooft JE, Veld JV, Arnold D et al (2020) Self-expandable metal stents for obstructing colonic and extracolonic cancer: European Society of Gastrointestinal Endoscopy (ESGE) Guideline - Update 2020, vol 52. Endoscopy, pp 389–407
7. McHugh FT, Ryan ÉJ, Ryan OK et al (2024) Management Strategies for Malignant Left-Sided Colonic Obstruction: A Systematic Review and Network Meta-analysis of Randomized Controlled Trials and Propensity Score Matching Studies. Dis Colon Rectum 67:878–894
8. Lam J, Chauhan V, Lam I et al (2020) Colorectal stenting in England: a cross-sectional study of practice. Ann R Coll Surg Engl 102:451–456
9. Cirocchi R, Arezzo A, Sapienza P et al (2021) Current Status of the Self-Expandable Metal Stent as a Bridge to Surgery Versus Emergency Surgery in Colorectal Cancer: Results from an Updated Systematic Review and Meta-Analysis of the Literature. Medicina57:268.
10. National Health Insurance Administration
11. Veld JV, Amelung FJ, Borstlap WAA et al (2020) Decompressing Stoma a s Bridge to Elective Surgery is an Effective Strategy for Left-sided Obstructive Colon Cancer: A National, Propensity-score Matched Study. Ann Surg 272:738–743
12. Rosander E, Holm T, Sjövall A et al (2021) Emergency resection or diverting stoma followed by elective resection in patients with colonic obstruction due to locally advanced cancer: a national cohort study. Colorectal Dis 23:2387–2398
13. Tan L, Liu ZL, Ran MN et al (2021) Comparison of the prognosis of four different treatment strategies for acute left malignant colonic obstruction: a systematic review and network meta-analysis. World J Emerg Surg 16:11
14. Kitaguchi D, Forgione A, Innocenzi C et al (2026) Initial management strategies for right-sided malignant colonic obstruction: a systematic review and bayesian network meta-analysis. World J Surg Oncol24.
15. Boeding JRE, Elferink MAG, Tanis PJ et al (2023) Surgical treatment and overall survival in patients with right-sided obstructing colon cancer-a nationwide retrospective cohort study. Int J Colorectal Dis 38:248
16. Boeding JRE, Ramphal W, Rijken AM et al (2021) A Systematic Review Comparing Emergency Resection and Staged Treatment for Curable Obstructing Right-Sided Colon Cancer. Ann Surg Oncol 28:3545–3555
17. Baker DM, Aimar K, Jacobs S et al (2025) Management of right-sided obstructing colon cancers: scoping review. BJS Open9.
18. Hsieh CY, Su CC, Shao SC et al (2019) Taiwan's National Health Insurance Research Database: past and future. Clin Epidemiol 11:349–358
19. Chiang CJ, You SL, Chen CJ et al (2015) Quality assessment and improvement of nationwide cancer registration system in Taiwan: a review. Jpn J Clin Oncol 45:291–296
20. Hernán MA, Robins JM (2016) Using Big Data to Emulate a Target Trial When a Randomized Trial Is Not Available. Am J Epidemiol 183:758–764
21. Desai RJ, Wang SV, Sreedhara SK et al (2024) Process guide for inferential studies using healthcare data from routine clinical practice to evaluate causal effects of drugs (PRINCIPLED): considerations from the FDA Sentinel Innovation Center. Bmj384:e076460
22. Charlson ME, Charlson RE, Peterson JC et al (2008) The Charlson comorbidity index is adapted to predict costs of chronic disease in primary care patients. J Clin Epidemiol 61:1234–1240
23. Baer C, Menon R, Bastawrous S et al (2017) Emergency Presentations of Colorectal Cancer. Surg Clin North Am 97:529–545
24. Johnson WR, Hawkins AT (2021) Large Bowel Obstruction. Clin Colon Rectal Surg 34:233–241
25. Cazelles A, Pasinato G, Aubert M et al (2025) Obstructed colon cancer: Review and perspectives. J Visc Surg 162:431–441
26. Tanis PJ, Paulino Pereira NR, van Hooft JE et al (2015) Resection of Obstructive Left-Sided Colon Cancer at a National Level: A Prospective Analysis of Short-Term Outcomes in 1,816 Patients. Dig Surg 32:317–324
27. Pisano M, Zorcolo L, Merli C et al (2018) 2017 WSES guidelines on colon and rectal cancer emergencies: obstruction and perforation. World J Emerg Surg 13:36
28. Amelung FJ, Consten ECJ, Siersema PD et al (2016) A Population-Based Analysis of Three Treatment Modalities for Malignant Obstruction of the Proximal Colon: Acute Resection Versus Stent or Stoma as a Bridge to Surgery. Ann Surg Oncol 23:3660–3668
29. Jiang JK, Lan YT, Lin TC et al (2008) Primary vs. delayed resection for obstructive left-sided colorectal cancer: impact of surgery on patient outcome. Dis Colon Rectum 51:306–311
30. Pecqueux M, Distler M, Radulova-Mauersberger O et al (2023) COMPASS: deCOMPressing stomA and two-Stage elective resection vs. emergency reSection in patients with left-sided obstructive colon cancer, vol 24. Trials, p 641
31. McKechnie T, Springer JE, Cloutier Z et al (2023) Management of left-sided malignant colorectal obstructions with curative intent: a network meta-analysis. Surg Endosc 37:4159–4178
32. Costas-Chavarri A, Nandakumar G, Temin S et al (2019) Treatment of Patients With Early-Stage Colorectal Cancer: ASCO Resource-Stratified Guideline. J Glob Oncol5:1–19
33. Biagi JJ, Raphael MJ, Mackillop WJ et al (2011) Association between time to initiation of adjuvant chemotherapy and survival in colorectal cancer: a systematic review and meta-analysis, vol 305. Jama, pp 2335–2342
34. Gao P, Huang XZ, Song YX et al (2018) Impact of timing of adjuvant chemotherapy on survival in stage III colon cancer: a population-based study. BMC Cancer 18:234
35. Bridoux V, Fernandez B, Sabbagh C et al (2026) Neoadjuvant chemotherapy for obstructive colon cancer derived by a stoma: Study protocol of the FRENCH-01 randomized phase III trial (COnCERTO Trial). Dig Liver Dis 58:759–764

36. Veld JV, Kumcu A, Amelung FJ et al (2021) Time interval between self-expandable metal stent placement or creation of a decompressing stoma and elective resection of left-sided obstructive colon cancer, vol 53. Endoscopy, pp 905–913
37. Hernán MA, Sauer BC, Hernández-Díaz S et al (2016) Specifying a target trial prevents immortal time bias and other self-inflicted injuries in observational analyses. J Clin Epidemiol 79:70–75
38. Veld JV, Amelung FJ, Borstlap WAA et al (2020) Comparison of Decompressing Stoma vs Stent as a Bridge to Surgery for Left-Sided Obstructive Colon Cancer. JAMA Surg 155:206–215
39. US National Comprehensive Cancer Network (NCCN) (2026) NCCN guidelines for colon cancer. NCCN

Figures

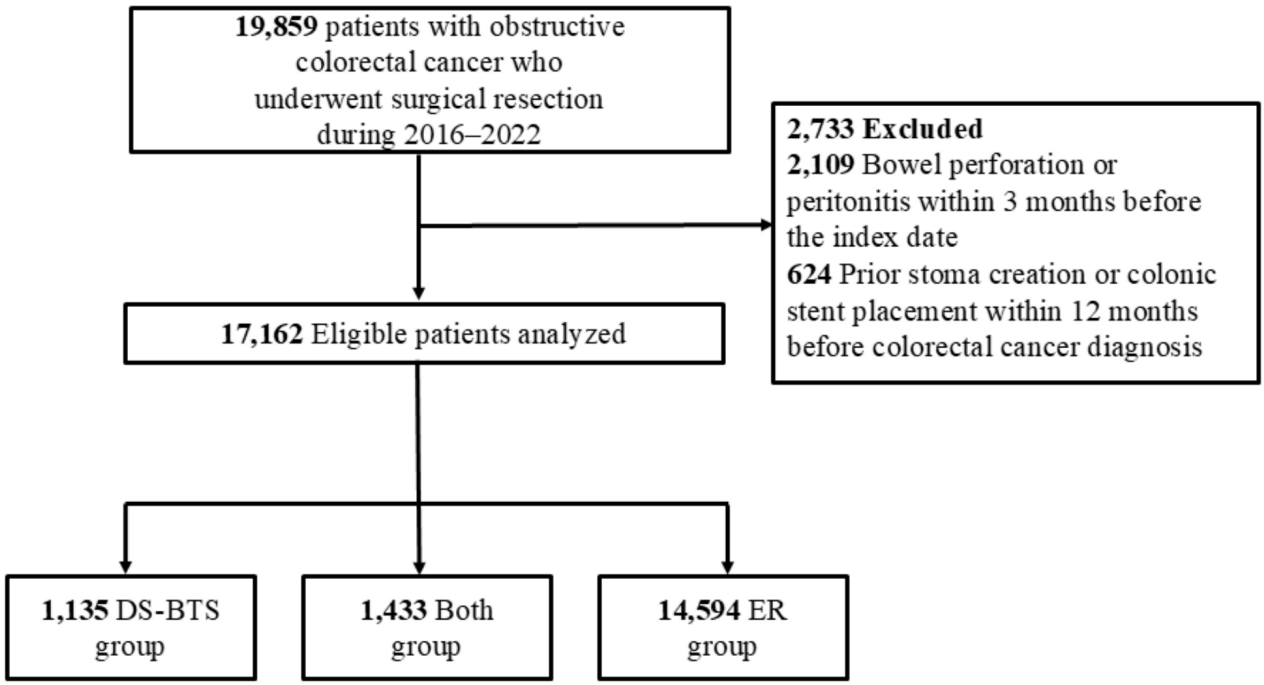


Figure 1

Flow diagram of study population selection.

Abbreviations: DS-BTS, diverting stoma as a bridge to surgery; ER, emergency resection.

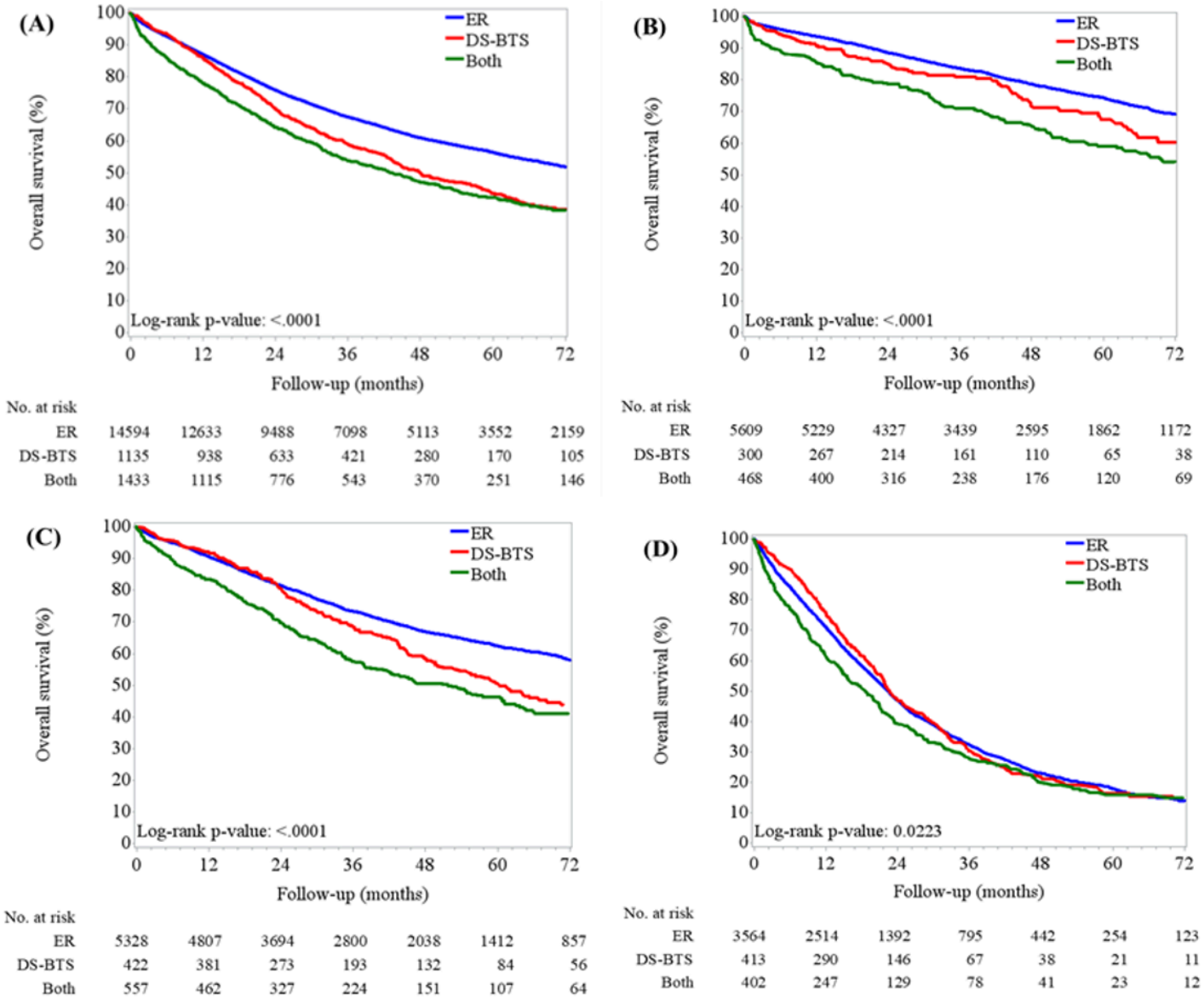


Figure 2

Kaplan–Meier survival curves by treatment strategy, stratified by cancer stage.

(A) overall; (B) stage I-II; (C) stage III; (D) stage IV.

Abbreviations: DS-BTS, diverting stoma as a bridge to surgery; ER, emergency resection.

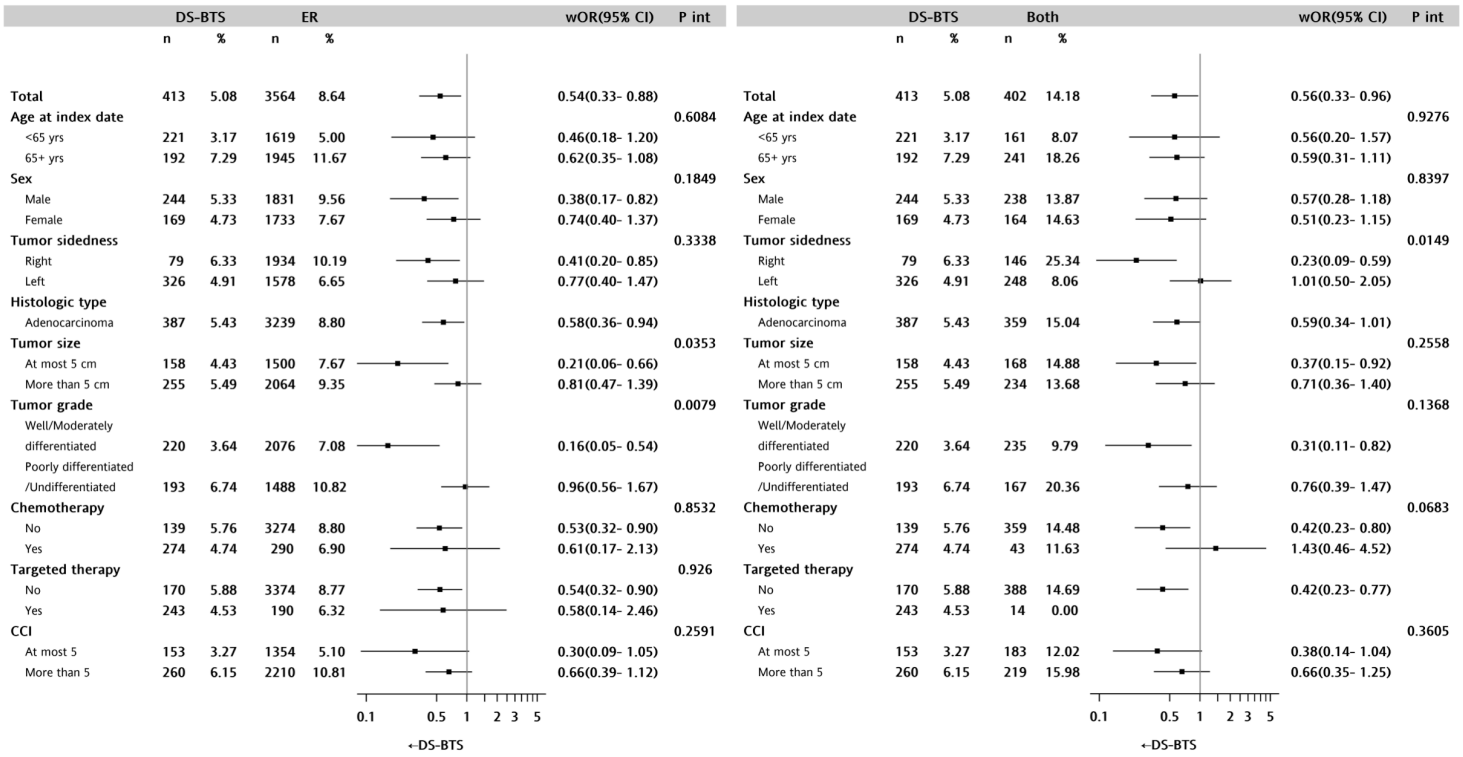


Figure 3

Subgroup analysis of 90-day mortality in stage IV disease (DS-BTS vs ER and DS-BTS vs Both).

Abbreviations: DS-BTS, diverting stoma as a bridge to surgery; ER, emergency resection; CCI, Charlson comorbidity index.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SUPL260710.docx