SCIENTIFIC ARTICLE

Survival outcomes in right-sided versus left-sided colon cancer in a South Asian population- a retrospective cohort study

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Abstract

Introduction

Large bowel cancer is among the most common cancers in Sri Lanka, ranking second in men and third in women. Rectal and colon cancers behave differently. It is postulated that right colon cancers (RCC) have a poorer survival due to poor response to adjuvant therapy and different molecular properties. This study evaluated survival outcomes between left colon cancers (LCC) and RCC in a Sri Lankan cohort.

Methodology

A retrospective cohort study was conducted, including 785 adult patients who underwent curative resection for colon cancer at a tertiary care centre from 1997 to August 2025. Patients were followed up and entered into a database. Five-year overall survival (OS) and disease-free survival (DFS) were compared between LCC and RCC. Cox proportional hazards models were used to assess prognostic factors. Propensity score matching based on age and sex was performed to reduce baseline differences.

Results

LCC accounted for 84.5% of cases, while RCC accounted for 15.2%. Median age at diagnosis was 60 years, and 24.1% had young-onset disease. No significant difference was observed between LCC and RCC in 5-year OS (43.2% vs. 40.0%, p=0.783) or DFS (p=0.292). Similar results were observed in propensity score-matched analysis. Survival was unaffected by sex or preoperative albumin but was influenced by age, lymph node status, and tumour stage (pT).

Conclusion

A lower proportion of RCC was observed compared with the West. Tumour sidedness was not associated with survival outcomes in Sri Lankan cohort. Larger multicentre studies are required to evaluate the significance of tumour location in South Asian populations.

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Introduction

Large bowel cancer (LBC) ranks as the third most commonly diagnosed malignancy worldwide. [1] In Sri Lanka, its incidence has risen over the past decade to be the second commonest cancer amongst males and the third commonest amongst females. A noticeable increase in young and early-onset LBC is also of particular concern. [2,3] LBC refers to a malignancy that originates at any location from the caecum to the anorectal junction. Whereas, a colon cancer (CC) arises from the caecum up to the rectosigmoid junction. The classification of the origin of CC as right-sided and left-sided is based on their embryological development. Structures derived from the midgut include the cecum, appendix, ascending colon, hepatic flexure, and the proximal two-thirds of the transverse colon, considered as the right colon. In contrast, the hindgut derivatives, the distal one-third of the transverse colon, splenic flexure, descending colon and sigmoid colon are considered as the left colon. [4] Rectal cancer is best considered a separate entity owing to its anatomical arrangement, tumour behaviour, molecular genetics and management strategies. [5,6] Existing data suggest that a majority of the large bowel cancer in the Sri Lankan population is left-sided. [7] Over 75% of the LBC in the Sri Lankan population occur in the rectum and rectosigmoid region, whereas over 85% are left-sided. Similarly, more rectal cancers were observed in the South-Asian migrant population in Britain as opposed to the higher incidence of right-sided large bowel cancers in the Western population. [7-10] There is evidence to suggest that right and left colon cancers behave differently. There is growing evidence of differences in their underlying genetic alterations, as well as in their histological types, morphological growth patterns and clinical features. [11,12] Right-sided CC are mostly associated with microsatellite instability (MSI), while left-sided CC are frequently observed with chromosomal instability (CI). Tumours classified as MSI -high are associated with poor differentiation, a

mucinous histological phenotype, and increased peritumoral and intratumoral lymphocytic infiltration. [13] Among stage I–III patients, five-year overall survival has been shown to be poor in right-sided colorectal cancer compared to left-sided disease. In stage III patients specifically, both overall survival and disease-free survival have been found to be significantly worse in right-sided CC than in left-sided CC. [14] Some studies have shown that increased sensitivity of MSI-positive tumours to chemotherapy is reflected in improved survival among patients receiving such treatment for right-sided CC. However, in stage III CC, MSI status was not prognostic in patients who did not receive adjuvant therapy. [15] Given that tumour biology, environmental factors, genetic predispositions, and healthcare accessibility can vary significantly across populations, the findings from other countries may not be directly applicable to Sri Lanka. In previous similar studies, age, sex, race, marital status, tumour stage and size, histologic grade, the number of lymph nodes examined, and year of diagnosis were considered as statistically significant confounding factors. [16] Another previous study has found that hypoalbuminemia is a poor prognostic factor for long-term survival of colon cancer after curative operation. [17] The current study aims to assess the survival outcomes between left-sided and right-sided colon cancer in a prospectively followed-up colorectal cancer patient cohort from Sri Lanka.

Methodology

Seven hundred and eighty-five adult patients who have undergone curative resection for colon cancers at a single tertiary care unit from 1997 to 2025 August were included. Patients who were alive at the end of follow-up or lost to follow-up before experiencing the event of interest were treated as censored observations at the date of their last known contact. Patients with neuroendocrine tumours of the colon and those who have undergone palliative procedures for colon cancers were excluded. Right-sided colon cancers are defined as cancers situated in the caecum, ascending colon and proximal two-thirds of the transverse colon, while left-sided colon cancers are defined as the cancers that develop in the distal one-third of the transverse colon, descending colon and sigmoid colon. Data collection was conducted using a pro forma based on a continually updated prospective database. Study was approved by the ethical review committee of the Faculty of Medicine, University of Kelaniya, Sri Lanka. In this study, age, sex, preoperative albumin level, Lymph node status and histological staging of the surgical specimen were considered as confounding variables that affect survival according to the knowledge gained from similar previous studies. [23] The cutoff age to define young versus old cancers was 50 years, Hypalbuminaemia was defined as a serum albumin level less than 3.5 g/dL. Based on this value, we defined two groups: preoperative serum albumin less than 3.5 g/dL and greater than 3.5 g/dL. Histological staging was based on the American Joint Committee on Cancer TNM classification of malignant tumours, 8th edition, 2016. [24] Chi-square test was used to calculate p-values for the descriptive analysis. We compared 5-year overall survival and disease-free survival between the LCC and RCC groups. Statistical analyses were performed using IBM SPSS V22.0. Survival outcomes were analysed using the Kaplan–Meier method and compared by the log-rank test. A P- value of less than 0.05 was regarded as significant. The effect of confounding variables on overall and disease-free survival in the RCC and LCC groups was separately evaluated with the Cox proportional hazard model. Given the marked disparity in group sizes, with right-sided colon cancers representing a relatively small proportion of the study population compared with left-sided colon cancers, propensity score matching was performed to minimise baseline differences and enhance comparability of the two cohorts. Propensity scores were calculated using binary logistic regression with age and sex as predictors. The right-sided colon cancer cohort was manually matched with the left-sided cohort, randomly matching propensity scores, age and sex. Survival analysis was done using the Kaplan-Meier method for the matched groups.

Result

The baseline characteristics are presented in Table 1. Among the study population (N=785), the majority of patients (84.5%) belong to the LCC group. In this study, 394 female and 363 male patients (47.9%) were included. The youngest age of diagnosis of colorectal cancer was 19 years, and the oldest was 89 years. Median age of diagnosis was 60 years, and the age range was 70 years. The proportion of the young-onset cancer group (< 50 years) was 24.1%. The mean preoperative serum albumin level was 3.79g/dL. Most (395, 71.2%) of the study population had normal serum albumin levels (>3.5g/dL).

Individuals in the LCC group are more likely to be younger (<50 years) than those in the RCC group. There was a statistically significant difference in the distribution of cancer among the two age groups across the location of the tumour. (p- value= 0.022). No significant difference in the distribution of the cancer location was observed among sexes (p=0.365). There was no significant difference in the distribution of albumin values among the two groups (p = 0.081). The

majority of the patients with both right and left colon cancers had stage III disease at presentation (LCC 39.5%, RCC 39.8%) and were comparable (p=0.314). The nodal status (N stage) of the resected specimens was also comparable between the two groups (p= 0.466).

Table 1: Descriptive analysis

		LCC	RCC	P -value
Total population		663 (84.5%)	119 (15.2%)	
Age	< 50 years	170 (25.6%)	19 (15.8%)	0.022
	> 50 years	495 (74.4%)	101 (84.2%)	
Mean age		58.64	59.8	0.929
Sex	Female	327 (51.3%)	67 (55.8%)	0.365
	Male	310 (48.7%)	53 (44.2%)	
Pre-operative serum albumin level	<3.5g/dL	148 (30.0%)	12 (19.4%)	0.081
	>3.5g/dL	345 (70.0%)	50 (80.6%)	
Histological staging	Stage 1	101 (19.2%)	19 (18.4%)	0.314
	Stage 2	158 (30.0%)	37 (35.9%)	
	Stage 3	208 (39.5%)	41 (39.8%)	
	Stage 4	60 (11.4%)	6 (5.8%)	
Lymph node status	LN positive	361 (62.2%)	59 (58.4%)	0.466
	LN negative	219 (37.8%)	42 (41.6%)	

There was no statistically significant difference in 5-year overall survival between LCC and RCC ($\chi^2 = 0.076$, df = 1, p = 0.783) as shown in Table 2 and Figure 1.

Table 2: Comparison of 5-year Overall and disease-free survival between Left and Right colonic cancers

	Median survival		χ^2	95% CI	df	P value
	LCC	RCC				
5-year OS	45 months	42 months	0.076	39-48.9	1	0.783
5-year DFS	36 months	31 months	1.108	29.7-42.2	1	0.292

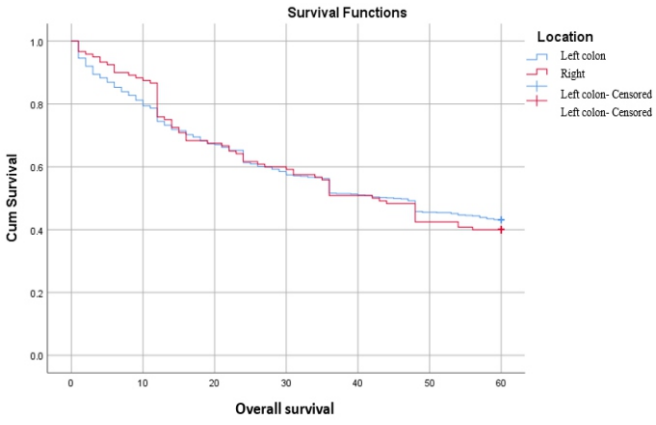

Figure 1: Comparison of 5-year overall survival between LCC and RCC

The 5-year overall survival rates for the LCC and RCC groups are 43.2% and 40.0%, respectively. Similarly, there is no statistically significant difference in 5-year disease-free survival distributions between the LCC and RCC groups (χ^2 = = 1.108, df=1, p = 0.292) (Table 3 and Figure 2).

In the right-sided colon cancer (RCC) group, neither age nor sex was significantly associated with overall survival. Similarly, preoperative albumin level and lymph node status did not significantly influence survival outcomes in this group. Histological stage was a significant determinant of overall survival in RCC. Patients with stage I disease demonstrated a lower hazard of mortality compared with those with Stage IV disease. In contrast, age was a significant prognostic factor in the left-sided colon cancer (LCC) group. Each additional year of age was associated with a 1.2% increase in the hazard of mortality (HR = 1.012, p = 0.002). Sex and preoperative albumin level were not significantly associated with overall survival in LCC patients. Lymph node status significantly affected survival in the LCC group. Patients without lymph node involvement had a 30.5% lower risk of mortality compared to those with lymph node-positive disease (HR = 0.695, p = 0.001). Similar findings were noted with histological staging for the LCC group compared to the RCC group.

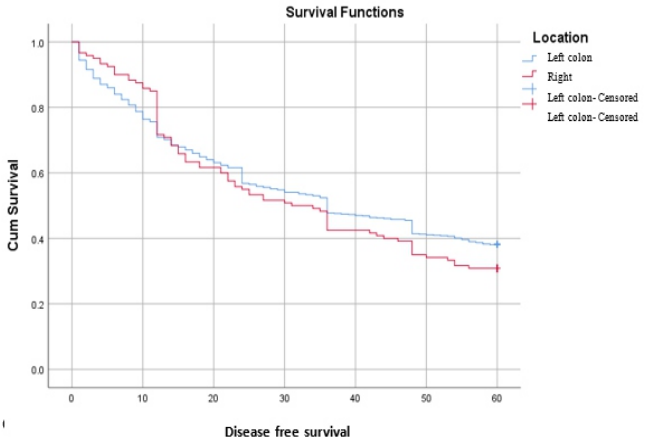

Figure 2: Comparison of 5-year disease-free survival between LCC and RCC

No significant difference in overall and disease-free survival was detected between the propensity score-matched RCC and LCC groups, as shown in Table 5.

Discussion

In this study, left-sided colon cancers (LCC) predominate, consistent with findings from previous Sri Lankan studies. [9,10] This distribution differs from several Western population-based studies, where right-sided colon cancers (RCC) account for a higher proportion. [7,8,18] In our population, young-onset colon cancer is common in the left colon, consistent with previous studies from the West. [18] Male-to-female distribution among the locations of the

Table 3: Comparison of effect of confounding variables on overall survival between Left and Right colon cancers.

		RCC				LCC			
		df	**P value**	**Exp (B)**	**95% CI**	**df**	**P value**	**Exp (B)**	**95% CI**
Age		1	0.135	1.016	1.00-1.04	1	0.005	1.011	1.00-1.03
Sex		1	0.345	0.812	0.80-1.90	1	0.302	0.901	0.74-1.10
Pre-operative albumin category		1	0.262	0.609	0.26-1.45	1	0.124	1.207	0.95-1.53
Lymph node status		1	0.730	0.920	0.68-1.74	1	0.000	0.654	0.53-0.81
Histological staging	Stage 1	1	0.092	0.437	0.17-1.15	1	0.000	0.328	0.22-0.50
	Stage 2	1	0.015	0.327	0.13-0.80	1	0.000	0.491	0.35-0.70
	Stage 3	1	0.043	0.398	0.16-0.97	1	0.044	0.716	0.52-0.10

Table 4: Comparison of effect of confounding variables on disease-free survival between Left and Right colon cancers.

		RCC				LCC			
		df	**P value**	**Exp (B)**	**95% CI**	**df**	**P value**	**Exp (B)**	**95% CI**
Age		1	0.107	1.018	1.00-1.04	1	0.002	1.012	1.00-1.02
Sex		1	0.254	0.763	0.48-1.21	1	0.518	0.934	0.77-1.15
Pre-operative albumin category		1	0.059	0.367	0.13-1.04	1	0.422	1.109	0.85-1.24
Lymph node status		1	0.797	1.069	0.64-1.78	1	0.001	0.695	0.56-0.87
Histological staging	Stage 1	1	0.070	0.406	0.15-1.08	1	0.000	0.331	0.22-0.51
	Stage 2	1	0.005	0.268	0.11-0.68	1	0.000	0.466	0.32-0.67
	Stage 3	1	0.016	0.329	0.13-0.82	1	0.024	0.678	0.48-0.95

Table 5: Comparison of overall and disease-free survival of the age, sex and propensity scores matched sample of both groups

	Median survival		χ^2	95% CI	df	P value
	LCC	RCC				
5-year OS	48 months	42 months	0.424	35.1-52.9	1	0.515
5-year DFS	38 months	31 months	2.201	27.4-44.6	1	0.138

cancer is comparable in our study, studies contradicting previous studies which demonstrated a higher male-to-female ratio in left-sided CC. [14] The majority of the population had normal albumin levels consistent with previous local studies.[21] The predominance of LCC in our cohort may reflect regional, genetic, environmental, dietary, or referral-pattern differences and highlights the importance of generating local evidence to guide clinical decision-making. Despite previous studies demonstrating biologically and prognostically distinct behaviour between LCC and RCC, our study did not demonstrate a statistically significant difference in either overall survival or disease-free survival at 5-year follow-up. [14,17] Multivariable analysis demonstrated distinct prognostic patterns between RCC and LCC. Histological stage was the primary determinant of overall survival in both groups, while increasing age and lymph node positivity were additional independent predictors of poorer survival only in LCC. Previous local studies in rectal cancer populations have identified hypoalbuminemia as a significant factor affecting survival, highlighting an

important distinction between colon and rectal cancer cohorts in Sri Lanka. [21] Comprehensive Cancer Network (NCCN) recommends molecular testing to detect MSI positivity for all newly diagnosed colon cancer cases to provide prognostic information and guide decision-making. [22] However, in Sri Lanka, it is not routinely tested due to the cost. As there is no survival difference between the two locations, if confirmed by further studies from the local populations, investing public funds in routine testing for MSI, which predominates in RCC, would need to be reviewed thoroughly. This suggests that, within this study population, conventional pathological and demographic factors have a stronger influence on prognosis than tumour sidedness alone. This study provides one of the few comprehensive local analyses comparing left-sided and right-sided colorectal cancers with long-term survival outcomes. This study has several strengths. It included a large cohort of over 700 patients from a prospectively maintained database, ensuring high-quality and comprehensive data collection. The prolonged follow-up period of more than five years enabled robust assessment of long-term survival outcomes. In addition, the right- and left-sided colon cancer groups had comparable stage distributions, and propensity score matching for age and sex was performed to improve group comparability and minimise the effects of confounding. Although this was a single-centre study, which may limit the generalizability of the findings, it allowed standardised diagnostic, surgical, pathological, and follow-up protocols, thereby reducing variations in patient management and minimising institutional and clinician-related bias. The most important limitation of this study is the unequal distribution of tumour location, with right-sided colon cancers comprising only approximately 15% of the study population. This imbalance may have reduced the statistical power to detect survival differences between tumour locations. However, this limitation was partially mitigated by propensity score matching for age and sex, which improved the comparability of the two groups and reduced the potential influence of confounding. The absence of treatment-related variables, such as chemotherapy regimens and adherence and the radiological staging for metastatic disease also limits the ability to assess their potential impact on survival outcomes. Incorporating additional factors such as co-morbidities and the presence of metastatic disease would allow for a more comprehensive assessment of variables influencing survival outcomes. Furthermore, molecular studies investigating tumour behaviour at each anatomical location could provide valuable insights into the biological mechanisms underlying these differences, potentially guiding more tailored therapeutic strategies in the future.

Conclusion

This study demonstrates that left-sided colorectal cancers predominate in the local study population, with most patients diagnosed after 50 years of age. Both the LCC and RCC groups had comparable lymph node positivity, and most of the patients in both groups belonged to the histological stage I-III. Tumour location showed no significant association with overall or disease-free survival at 5-year follow-up. Multivariable analysis confirmed that tumour location does not independently influence survival even after adjustment for key prognostic factors. The lack of observed survival difference between LCC and RCC may be attributed to the relatively small proportion of RCC cases, similar stage distribution between groups, and limited follow-up duration. Larger, multicentre studies with longer follow-up are needed to better assess the prognostic significance of tumour-sidedness in the local context.

Ethical approval

Ethic review committee, Faculty of Medicine, University of Kelaniya, Ragama (P/216/10/2025)

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