

Short- and Long-Term Survival Associated With Laparoscopic Versus Open Colectomy in Early-Stage Colon Cancer: Findings From a Retrospective Cohort Study

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INTRODUCTION

- Previous randomized trials and observational studies have shown comparable survival benefits for patients with colon cancer undergoing colectomy with laparoscopic versus conventional open surgery.^{1,4}
- With substantial increase in the utilization over past two decades, laparoscopic surgery has currently become a preferred approach for colectomy in the United States.⁵
- However, its survival benefits have not been adequately examined in a recent cohort of patients with colon cancer.

OBJECTIVE

- To assess in a real-world Medicare population short- and long-term survival among patients with early-stage colon cancer treated with laparoscopic-assisted colectomy (LAC) versus open colectomy (OC).

METHODS

Data Source and Patient Selection

- In this retrospective observational cohort study, data for the analysis were obtained from the Surveillance Epidemiology and End Results (SEER)–Medicare linked database.
- The SEER population-based cancer registries are nationally representative and collect information on nearly all (98%) newly diagnosed cancer cases, including colorectal cancer, among individuals residing in 20 SEER registry areas in the United States.
- The SEER-Medicare data also include information on vital status (which is derived from Medicare enrollment database and is updated daily from the Social Security Administration), providing a unique opportunity for researchers to examine survival outcomes among cancer patients at a population level.
- Patients with an incident diagnosis of early-stage colon cancer (aged ≥ 65 years) from 2004 to 2009 were selected from SEER data and were linked with their Medicare claims data from 2003 to 2010. Data on the date of death were available through 2011.
- The SEER Summary Staging system was used to identify patients with early-stage colon cancer, defined as those with localized or regional-stage cancer.
- Early-stage colon cancer patients who received colectomy (either LAC or OC) within 6 months of diagnosis were selected for analysis.
- Patients were further required to have continuous Medicare Part A and Part B (with no health maintenance organization) enrollment for at least 12 months prior to incident diagnosis—to allow estimation of baseline comorbid conditions.

Statistical Analysis

- All programming and analyses were conducted in SAS statistical software (version 9.3; SAS Institute, Inc.; 2011).
- Patients undergoing LAC were propensity matched to those receiving OC on demographic characteristics (including age, sex, race, rural/urban status, and geographic region), year of diagnosis, and clinical characteristics (including stage at diagnosis, tumor size, and comorbidities).
- Propensity scores were estimated using PROC LOGISTIC, and the nearest neighbor technique was used to perform a one-to-one matching (Table 1).
- Patients were followed from the receipt of colectomy to death or end of study follow-up (December 31, 2011).
- Short-term (1-year) and long-term (5-year) overall survival rates and survival times were assessed using Kaplan-Meier methods, using PROC LIFETEST, for the overall cohort and separately for patients diagnosed with a local- versus regional-stage cancer.

LIMITATIONS

- As inherent in studies based on claims databases, an important limitation of this study was the inability to adequately account for factors that may have contributed to selection of LAC versus OC as the surgical approach (e.g., patient/physician preference).
- However, we attempted to minimize selection bias to a certain extent with the use of propensity score matching technique, a method frequently used in observational studies to achieve balance between groups on observed demographic and clinical characteristics.
- Further, without access to patients' actual medical records, we could not sufficiently assess the severity of disease and cancer progression, which may have influenced the overall survival differences observed in this study, especially towards the end of follow-up where curves appear to close in toward each other.
- The approach of using the combination of ICD-9 procedure codes for colectomy and laparoscopy on the same date to define laparoscopic colectomy has not been validated; however, this approach has been used in several studies.^{3,6}

RESULTS

- A total of 36,980 patients with early-stage colon cancer met the initial study inclusion criteria, including 5,615 patients receiving LAC and 31,365 patients receiving OC from whom comparison patients were matched.
- In the matched sample, demographic and clinical characteristics were observed to be closely balanced, with the exception of tumor size that differed marginally between the two groups (Table 1).
- The analytic cohort comprised 11,230 patients with an average age of 78 years; a majority were white (86%) and female (55%).
- The short-term (1-year) and long-term (5-year) survival rates were found to be significantly higher among patients receiving LAC versus OC (Table 2).
- For patients diagnosed with regional-stage cancer, a nearly 10 percentage point difference was observed in the 5-year survival rate between LAC and OC (57.5% vs. 47.7%, $P < 0.0001$).
- Significant differences in survival time were observed in the patient subgroups by cancer stage; however, the magnitude of difference between LAC and OC was much higher among patients with regional-stage cancer (6.4 vs. 4.6 years; $P < 0.0001$), as shown in Figure 1(c).

Table 1. Characteristics of Patients With Colon Cancer Receiving LAC Versus OC After Propensity Score Matching

	LAC (n = 5,615)		OC (n = 5,615)		P Value ^a
	N	%	N	%	
Age at diagnosis (years)					
65-74	2,066	36.79	2,012	35.83	0.5302
75-84	2,511	44.72	2,564	45.66	
≥ 85	1,038	18.49	1,039	18.50	
Sex					
Male	2,570	45.77	2,546	45.34	0.6493
Female	3,045	54.23	3,069	54.66	
Race					
White	4,824	85.91	4,858	86.52	0.6234
Black	405	7.21	393	7.00	
Other	386	6.87	364	6.48	
Rural/urban status					
Big metro	3,267	58.18	3,338	59.45	0.6822
Metro	1,660	29.56	1,604	28.57	
Urban	234	4.17	224	3.99	
Less urban	355	6.32	344	6.13	
Rural	99	1.76	105	1.87	
Geographic region					
Northeast	1,378	24.54	1,404	25.00	0.8827
Midwest	545	9.71	559	9.96	
West	2,557	45.54	2,535	45.15	
South	1,135	20.21	1,117	19.89	
Year of diagnosis					
2004	410	7.30	412	7.34	0.9706
2005	572	10.19	558	9.94	
2006	669	11.91	681	12.13	
2007	715	12.73	735	13.09	
2008	1,139	20.28	1,152	20.52	
2009	2,110	37.58	2,077	36.99	
Charlson comorbidity index score (mean [SD])	3.40	[2.60]	3.33	[2.60]	0.1678
Tumor size (in centimeters)	2.42	[1.04]	2.45	[0.96]	0.0056
Stage at diagnosis					
Localized	3,325	59.22	3,252	57.92	0.1620
Regional	2,290	40.78	2,363	42.08	

^a P values based on chi-square test for categorical variables and Wilcoxon signed rank sum test for continuous variables.

CONCLUSIONS

- Results of this study indicate that LAC was associated with greater short-term (1-year) and long-term (5-year) overall survival rates, as well as longer survival time compared with OC among elderly patients with early-stage colon cancer.
- The magnitude of differences observed in survival rate and time to death between LAC and OC were particularly greater among patients diagnosed with regional-stage cancer.
- LAC has previously shown to reduce hospital stay and intensive care use; the increased survival observed in our study indicate that LAC may be a superior surgical approach in elderly patients with early-stage colon cancer.
- Future research may be needed to explore factors contributing to increased survival with LAC and confirm the findings of this study.

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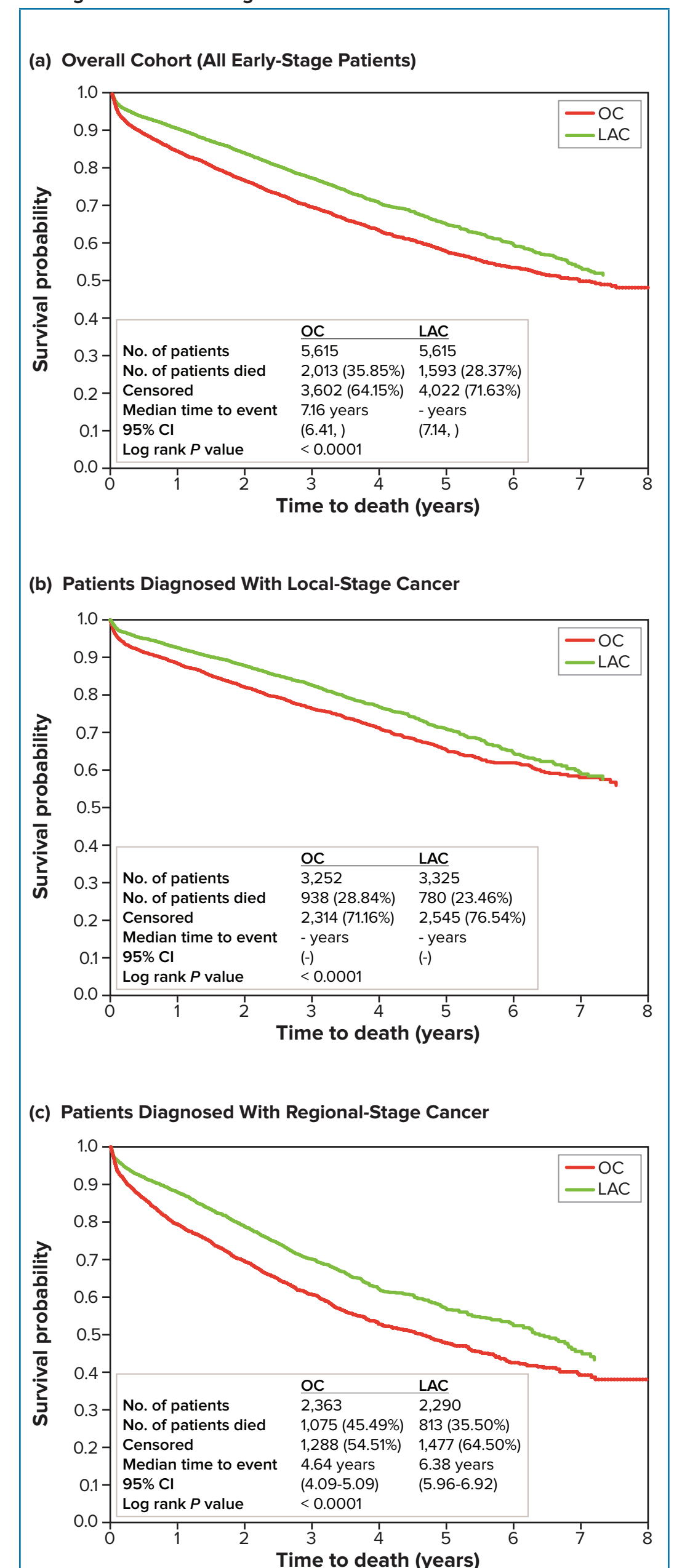


Table 2. Comparison of Short- and Long-Term Survival Rates Between Colon Cancer Patients Receiving LAC Versus OC

	Short-term Survival (1 Year)			Long-term Survival (5 Years)		
	LAC	OC	P Value ^a	LAC	OC	P Value ^a
Overall cohort (n = 11,230)	90.7%	84.6%	< 0.0001	65.7%	58.0%	< 0.0001
Localized stage (n = 6,577)	92.6%	88.4%	< 0.0001	71.2%	65.5%	< 0.0001
Regional stage (n = 4,653)	87.9%	79.4%	< 0.0001	57.5%	47.7%	< 0.0001

^a P values are based on the Z test for difference of proportions; Z statistics were derived using standard errors obtained from the LIFETEST procedure.

Figure 1. Kaplan-Meier Curves Showing Difference in Survival Times Among Patients Receiving LAC Versus OC



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