ORIGINAL RESEARCH

Early Postoperative Mortality Among Patients Aged 75 Years or Older With Stage II/III Rectal Cancer

Helmneh M. Sineshaw, MD, MPH[1]; K. Robin Yabroff, PhD[1]; V. Liana Tsikitis, MD, MCR[2]; Ahmedin Jemal, DVM, PhD[1]; and Timur Mitin, MD, PhD[2]

ABSTRACT

Background: Elderly patients with rectal cancer have been excluded from randomized studies, thus little is known about their early postoperative mortality, which is critical for informed consent and treatment decisions. This study examined early mortality after surgery in elderly patients with locally advanced rectal cancer (LARC). **Methods:** Using the National Cancer Database, we identified patients aged ≥75 years, diagnosed with clinical stage II/III rectal cancer who underwent surgery in 2004 through 2015. Descriptive analyses determined proportions and trends and multivariable logistic regression analyses were performed to determine factors associated with early mortality after rectal cancer surgery. **Results:** Among 11,794 patients with rectal cancer aged ≥75 years, approximately 6% underwent local excision and 94% received radical resection. Overall 30-day, 90-day, and 6-month postoperative mortality rates were 4.2%, 7.8%, and 11.5%, respectively. Six-month mortality varied by age (8.4% in age 75–79 years to 18.3% in age ≥85 years), and comorbidity score (10.1% for comorbidity score 0 to 17.7% for comorbidity score ≥2). Six-month mortality declined from 12.3% in 2004 through 2007 to 10.2% in 2012 through 2015 (P_{trend}=.0035). Older age, higher comorbidity score, and lower facility case volume were associated with higher 6-month mortality. Patients treated at NCI-designated centers had 30% lower odds of 6-month mortality compared with those treated at teaching/research centers. **Conclusions:** Six-month mortality rates after surgery among patients aged ≥75 years with LARC have declined steadily over the past decade in the United States. Older age, higher comorbidity score, and care at a low-case-volume facility were associated with higher 6-month mortality after surgery. This information is necessary for informed consent and decisions regarding optimal management of elderly patients with LARC.

J Natl Compr Canc Netw 2020;18(4):443–451
doi: 10.6004/jnccn.2019.7377

[1]American Cancer Society, Atlanta, Georgia; and [2]Oregon Health and Science University, Portland, Oregon.

Background

Rectal cancer accounts for approximately one-third of patients newly diagnosed with colorectal cancer in the United States.[1,2] The incidence of rectal cancer peaks at age ≥75 years and its management is complex.[3] Results of several important randomized clinical trials have shaped the current management of rectal cancer, which is built around trimodal therapy: preoperative chemoradiation therapy and total mesorectal excision (TME).[4–6] Most randomized clinical trials, however, specifically exclude patients aged >75 years,[6] complicating the application of randomized trial evidence in the management of elderly patients. The International Society of Geriatric Oncology issued a statement of recognition of special considerations and development of guidelines for elderly patients who are frequently excluded from many practice-establishing large randomized clinical trials.[7]

Previously, we reported that trimodal therapy was associated with the best survival outcomes for patients diagnosed with locally advanced rectal cancer (LARC) in the United States using data from the National Cancer Database (NCDB).[8] Patients who received concurrent chemoradiation therapy without surgery had lower survival rates.[8] Others, however, used institutional data and reported that >20% of patients may achieve clinical response (no observation of cancer) after undergoing chemoradiation therapy. These patients may consider a watchful waiting approach instead of immediate surgery, without worsening their survival outcomes.[9,10] Observation after complete clinical response or transanal local excision of a small residual primary tumor avoiding extensive surgery is a viable clinical pathway gaining popularity in many countries, especially for elderly patients.[11] However, treatment decision-making for these elderly patients is difficult. For example, a Dutch population-based study showed considerably higher 6-month mortality rates after TME among patients aged ≥75 years (14%)

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than in those aged <75 years (4%).[12] These observed higher rates may be attributed to potential clinical factors that, if addressed in a timely fashion, may decrease. Furthermore, clinical advances in elderly patient care and implementation of programs such as the American College of Surgeons National Surgical Quality Improvement Program may also decrease postoperative early-mortality rates.[13] However, data are lacking on contemporary trends and factors associated with early mortality after surgery among this unique population of elderly patients with LARC in the United States. In this study, we fill this research gap by examining trends of and factors associated with early mortality after surgery in elderly patients with LARC in a large national sample. We hypothesize that there would be changes in early mortality over time, and age and comorbidity would be associated with early mortality differences after surgery among elderly patients with LARC.

Methods

Data Source and Patient Cohorts

We used data from the NCDB, a national, hospital-based cancer registry database jointly sponsored by the American College of Surgeons and the American Cancer Society, which captures approximately 70% of newly diagnosed cancer cases in the United States.[14] We included patients diagnosed in 2004 through 2015 with single or first primary, invasive (behavior = 3), primary site (C20.9), ICD-O-3 histology codes for rectal cancer (supplemental eTable 1, available with this article at JNCCN.org), AJCC clinical stage II or III (pathologic stage used if clinical stage was missing), and who were aged ≥75 years and received surgical resection. Patients with missing/unknown values for insurance (including those with government insurance other than Medicare/Medicaid), area-level median income, chemotherapy, and radiotherapy were excluded. The final analytic cohort included 11,794 patients (Figure 1). Variables were coded according to the 2016 Facility Oncology Registry Data Standards Manual.[15] Our study received exempt status from the Morehouse School of Medicine Institutional Review Board.

Primary End Points

Primary end points were 30-day, 90-day, and 6-month mortality from any cause among all patients with LARC after undergoing surgery.

Independent Variables and Control Variables

Our primary independent variable of interest was age at diagnosis, categorized as 75 to 79, 80 to 84, and ≥85 years. We also evaluated comorbidity score and type of surgery (local excision, resection/total surgery). Local excision included local tumor excision, polypectomy, laser excision, or curette and fulguration; resection/total surgery included wedge or segmental resection, partial proctectomy, TME, total proctectomy, or total proctocolectomy. Comorbidity score was categorized as 0, 1, or ≥2 based on the sum of weighted Charlson-Deyo score.[16] Control variables were categorized as follows: race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), sex (male, female), facility type (community cancer program, comprehensive community cancer program, teaching/research program, NCI-designed program/network, other programs), facility case volume (low, medium, high; ranked using tertiles by counting the number of cases reported by each facility during the study year by diagnosis year), area-level median income quartiles (<$38,000, $38,000–$47,999, $48,000–$62,999, ≥$63,000), area-level median educational attainment (≥21.0%, 13%–20.9%, 7.0%–12.9%, or <7.0% without high school diploma), clinical stage (II, III), and tumor size (<2 cm, 2 cm to <5 cm, ≥5 cm; size on pathologic report when patient did not receive radiation or systemic treatment before surgery, or size before surgery if patient received preoperative treatment). Facility case volume was categorized as low, medium, and high based on the number of rectal cancer cases reported by the facility over the study period by diagnosis year.

Statistical Analysis

We conducted descriptive analyses for patient characteristics by age group. We calculated the proportion of patients who died within 30 days, 90 days, and 6 months after surgical treatment by age, comorbidity score, facility type, and surgery type, and assessed trends using the Cochrane-Armitage trend test. Furthermore, we examined trends in 6-month mortality, adjusting for comorbidity score, because comorbidity score was significantly associated with trends in 6-month mortality.

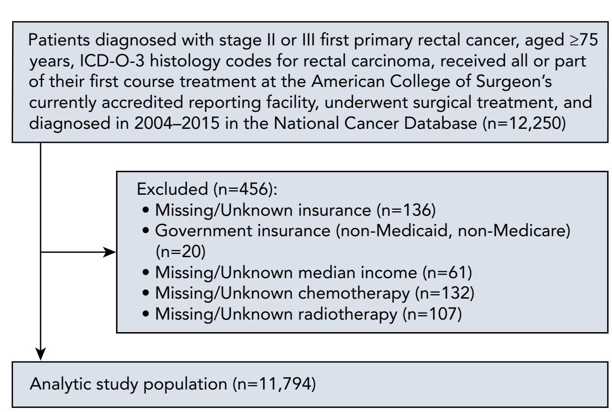

Figure 1. Flowchart of cohort inclusion/seclusion criteria for patients aged ≥75 years diagnosed with stage II/III rectal cancer in the National Cancer Database (2004–2015).

Table 1. Patient Characteristics

Variable	Total n (%)	Age 75–79 y n (%)	Age 80–84 y n (%)	Age ≥85 y n (%)	*P* Value
Total, n	11,794	5,540	3,825	2,429	
Race/Ethnicity					<.0001
Non-Hispanic white	9,437 (80)	4,365 (46.3)	3,060 (32.4)	2,012 (21.3)	
Non-Hispanic black	637 (5.4)	338 (53.1)	210 (33)	89 (14.0)	
Hispanic	523 (4.4)	279 (53.3)	161 (30.8)	83 (15.9)	
Other/Unknown	1,197 (10.1)	558 (46.6)	394 (32.9)	245 (20.5)	
Diagnosis year					.7100
2004–2007	4,375 (37.1)	2,084 (47.6)	1,408 (32.2)	883 (20.2)	
2008–2011	3,776 (32.0)	1,746 (46.2)	1,228 (32.5)	802 (21.2)	
2012–2015	3,643 (30.9)	1,710 (46.9)	1,189 (32.6)	744 (20.4)	
Sex					<.0001
Male	6,067 (51.4)	3,152 (52)	1,892 (31.2)	1,023 (16.9)	
Female	5,727 (48.6)	2,388 (41.7)	1,933 (33.8)	1,406 (24.6)	
Clinical stage[a]					.0550
II	6,370 (54.0)	2,948 (46.3)	2,059 (32.3)	1,363 (21.4)	
III	5,424 (46.0)	2,592 (47.8)	1,766 (32.6)	1,066 (19.7)	
Comorbidity score					.0470
0	7,917 (67.1)	3,748 (47.3)	2,515 (31.8)	1,654 (20.9)	
1	2,767 (23.5)	1,308 (47.3)	923 (33.4)	536 (19.4)	
≥2	1,110 (9.4)	484 (43.6)	387 (34.9)	239 (21.5)	
Facility type					.0002
Community cancer program	1,093 (9.3)	518 (47.4)	356 (32.6)	219 (20)	
Comprehensive community cancer program	5,576 (47.3)	2,564 (46.0)	1,793 (32.2)	1,219 (21.9)	
Teaching/Research program	2,351 (19.9)	1,120 (47.6)	764 (32.5)	467 (19.9)	
NCI-designated program	920 (7.8)	491 (53.4)	290 (31.5)	139 (15.1)	
Other programs	1,854 (15.7)	847 (45.7)	622 (33.5)	385 (20.8)	
Facility case volume					.3000
Low	3,761 (31.9)	1,760 (46.8)	1,252 (33.3)	749 (19.9)	
Medium	1,200 (10.2)	540 (45)	399 (33.3)	261 (21.8)	
High	6,833 (57.9)	3,240 (47.4)	2,174 (31.8)	1,419 (20.8)	
Median income, $USD[b]					.4100
<38,000	1,949 (16.5)	936 (48)	638 (32.7)	375 (19.2)	
38,000–47,999	3,003 (25.5)	1,442 (48)	961 (32)	600 (20)	
48,000–62,999	3,259 (27.6)	1,501 (46.1)	1,060 (32.5)	698 (21.4)	
≥63,000	3,583 (30.4)	1,661 (46.4)	1,166 (32.5)	756 (21.1)	
No high school diploma, %[c]					.008
≥21.0	1,948 (16.5)	980 (50.3)	606 (31.1)	362 (18.6)	
13.0–20.9	3,011 (25.5)	1,407 (46.7)	1,002 (33.3)	602 (20)	
7.0–12.9	4,059 (34.4)	1908 (47)	1,301 (32.1)	850 (20.9)	
<7.0	2,776 (23.5)	1,245 (44.8)	916 (33)	615 (22.2)	
Tumor size, cm					<.0001
<2	925 (7.8)	484 (52.3)	284 (30.7)	157 (17)	
2 to <5	5,243 (44.5)	2,476 (47.2)	1,691 (32.3)	1,076 (20.5)	
≥5	4,088 (34.7)	1,767 (43.2)	1,350 (33)	971 (23.8)	
Missing/Unknown	1,538 (13)	813 (52.9)	500 (32.5)	225 (14.6)	
Surgery					<.0001
Local excision	720 (6.1)	234 (32.5)	231 (32.1)	255 (35.4)	
Resection/Total surgery	1,1074 (93.9)	5,306 (47.9)	3,594 (32.5)	2,174 (19.6)	

[a]Pathologic stage used if clinical stage was missing.
[b]Area-level median household income quartiles from the 2012 American Community Survey.
[c]Area-level quartiles for percentage of adults without a high school diploma from the 2012 American Community Survey.

Table 2. Proportions of Early Postoperative Mortality

Early Mortality	Total n (%)	Age 75–79 y n (%)	Age 80–84 y n (%)	Age ≥85 y n (%)
Overall, n	11,794	5,540	3,825	2,429
30-d	491 (4.2)	154 (2.9)	141 (3.7)	196 (8.1)
90-d	917 (7.8)	290 (5.2)	305 (8.0)	322 (13.3)
6-mo	1,352 (11.5)	466 (8.4)	441 (11.5)	445 (18.3)
Comorbidity score				
0, n	7,917	3,748	2,515	1,654
30-d	286 (3.6)	88 (2.4)	82 (3.3)	116 (7)
90-d	536 (6.8)	171 (4.6)	174 (6.9)	191 (11.6)
6-mo	802 (10.1)	282 (7.5)	251 (10)	269 (16.3)
1, n	2,767	1,308	923	536
30-d	124 (4.5)	37 (2.8)	37 (4)	50 (9.3)
90-d	241 (8.7)	68 (5.2)	82 (8.9)	91 (17)
6-mo	254 (9.2)	111 (8.5)	123 (13.3)	120 (22.4)
≥2, n	1,110	484	387	239
30-d	81 (7.3)	29 (6)	22 (5.7)	30 (12.6)
90-d	140 (12.6)	51 (10.5)	49 (12.7)	40 (16.7)
6-mo	196 (17.7)	73 (15.1)	67 (17.3)	56 (23.4)
Facility type				
Community cancer program, n	1,093	518	356	219
30-d	60 (5.5)	22 (4.3)	17 (4.8)	21 (9.6)
90-d	107 (9.8)	39 (7.5)	34 (9.6)	34 (15.5)
6-mo	151 (13.8)	58 (11.2)	44 (12.4)	49 (22.4)
Comprehensive community cancer program, n	5,576	2,564	1,793	1,219
30-d	265 (4.8)	84 (3.3)	76 (4.2)	105 (8.6)
90-d	475 (8.5)	147 (5.7)	160 (8.9)	168 (13.8)
6-mo	675 (12.1)	223 (8.7)	223 (12.4)	229 (18.8)
Teaching/Research program, n	2,351	1,120	764	467
30-d	74 (3.1)	25 (2.2)	17 (2.2)	32 (6.9)
90-d	160 (6.8)	50 (4.5)	51 (6.7)	59 (12.6)
6-mo	260 (11.1)	91 (8.1)	87 (11.4)	82 (17.6)
NCI-designated program, n	920	491	290	139
30-d	19 (2.1)	5 (1.0)	8 (2.8)	6 (4.3)
90-d	42 (4.6)	12 (2.4)	17 (5.9)	13 (9.4)
6-mo	69 (7.5)	25 (5.1)	27 (9.3)	17 (12.2)
Other programs, n	1,854	847	622	385
30-d	73 (3.9)	18 (2.1)	23 (3.7)	32 (8.3)
90-d	133 (7.2)	42 (5.0)	43 (6.9)	48 (12.5)
6-mo	197 (10.6)	69 (8.2)	60 (9.7)	68 (17.7)
Surgery type				
Local excision, n	720	234	231	255
30-d	22 (3.1)	8 (3.4)	2 (0.9)	12 (4.7)
90-d	50 (6.9)	12 (5.1)	16 (6.9)	22 (8.6)
6-mo	77 (10.7)	19 (8.1)	28 (12.1)	30 (11.8)
Resection/Total surgery, n	11,074	5,306	3,594	2,174
30-d	469 (4.2)	146 (2.8)	139 (3.9)	184 (8.5)
90-d	867 (7.8)	278 (5.2)	289 (8)	300 (13.8)
6-mo	1,275 (11.5)	447 (8.4)	413 (11.5)	415 (19.1)

We used multivariable logistic regression analysis to examine factors associated with 6-month mortality after surgery. Statistical significance was determined based on the 2-sided $P<.05$. All statistical analyses were conducted using SAS 9.4 (SAS Institute Inc.).

Results

Table 1 shows descriptive characteristics for the 11,794 patients in the study cohort. Of these, 47% were aged 75 to 79 years, 32.4% were aged 80 to 84 years, and 20.6% were aged ≥85 years. Most were non-Hispanic white (80%), with a higher proportion aged ≥85 years compared with non-Hispanic black (21% vs 14%). Nearly half (47.3%) of all patients were treated in comprehensive community cancer programs versus only 7.8% treated at NCI-designated cancer programs. Most patients were treated in high-case-volume facilities (57.9%).

The proportions of patients who experienced early postoperative mortality are displayed in Table 2 by age, comorbidity, facility type, and surgery type are displayed in Table 2. Overall proportions of 30-day, 90-day, and 6-month mortality were 4.2% 7.8%, and 11.5%, respectively. Six-month mortality varied by age group and comorbidity score, with the highest rate in the oldest age group (18.3% for age ≥85 years vs 8.4% for age 75–79 years) and among patients with higher comorbidity score (17.7% for comorbidity score ≥2 vs 10.1% for comorbidity score 0). There was marked difference in 6-month mortality by facility type among patients aged ≥85 years, ranging from 12.2% in those treated at NCI-designated cancer programs to 22.4% in those treated at community cancer programs. Six-month mortality after local excision versus radical surgery was different only in the group of patients aged ≥85 years (11.8% vs 19.1%, respectively).

Trends in 30-day or 90-day postoperative mortality did not change significantly. Six-month mortality steadily declined from 12.3% in 2004–2007 to 10.2% in 2012–2015 (P_{trend}=.0035) (Figure 2, Table 3). Specifically, a significant decline in 6-month mortality occurred over time among patients aged 75 to 79 years, from 9.3% in 2004–2007 to 6.8% in 2012–2015 (P_{trend}=.0063). A significant decline in 6-month mortality was also seen among patients with a comorbidity score of 1 (from 14.7% in 2004–2007 to 9.8% in 2012–2015; P_{trend}=.0020), those treated at comprehensive community cancer programs (P_{trend}=.0420), and those who received surgical resection/total surgery (P_{trend}=.0069). Six-month mortality rates declined significantly across age groups even after adjusting for comorbidity score (supplemental eTable 2).

Table 4 shows adjusted odds ratios (ORs) of 6-month postoperative mortality. Patients aged 80 to 84 years (OR, 1.42; 95% CI, 1.24–1.63) and those ≥85 years (OR, 2.51; 95% CI, 2.17–2.89) had higher odds of 6-month mortality compared with those aged 75 to 79 years. Patients with a comorbidity score of ≥2 had higher 6-month mortality (OR, 1.84; 95% CI, 1.55–2.19) compared with those with no comorbid conditions. Patients treated at NCI-designated cancer programs had lower 6-month mortality (OR, 0.70; 95% CI, 0.53–0.93) compared with those treated at teaching/research cancer programs. Treatments performed at low-volume facilities were also associated with higher 6-month mortality (OR, 1.23%; 95% CI, 1.08–1.40) compared with those performed at high-volume facilities.

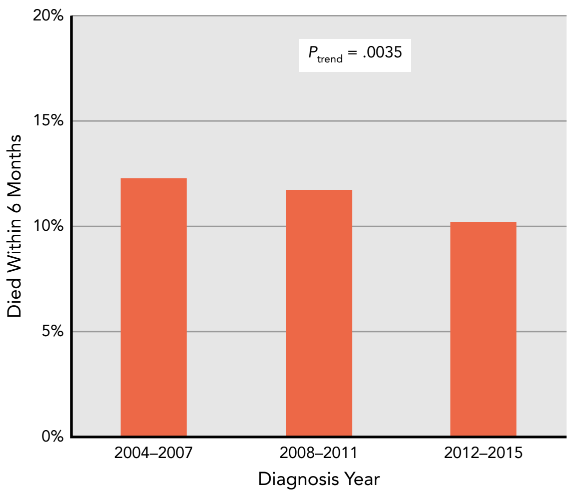

Figure 2. Trends in 6-month mortality among patients aged ≥75 years diagnosed with locally advanced rectal cancer who underwent surgical treatment.

Discussion

Trimodality therapy (preoperative chemoradiation therapy followed by TME) is the standard of care for management of patients with LARC,[17] established by evidence from large prospective randomized clinical trials.[4–6] Unfortunately, patients aged ≥75 years were specifically excluded from these trials, making the application of this standard of care in elderly patients less certain. Moreover, over the past decade the management of LARC has changed dramatically, with more personalized management based on tumor and patient characteristics. For patients with clinical response to neoadjuvant therapy, watchful waiting rather than immediate TME is gaining popularity based on large prospective studies. Omission of radiation therapy from preoperative treatment in select patients who experience response to chemotherapy is currently being studied in the large PROSPECT trial.[18]

To better inform patients about their treatment options, physicians need to know expected outcomes not only from randomized trials that include the most fit

Table 3. Trends in Early Postoperative Mortality

Early Mortality	Diagnosis Year, % 2004–2007	2008–2011	2012–2015	P_{trend}
Overall				
30-d	4.1	4.3	4.0	.8433
90-d	8.3	7.7	7.3	.0784
6-mo	12.3	11.7	10.2	.0035
Age group				
75–79 y				
30-d	2.8	3.1	2.5	.5787
90-d	5.9	5.6	4.2	.0216
6-mo	9.3	8.9	6.8	.0063
80–84 y				
30-d	3.6	3.3	4.1	.5261
90-d	8.3	7.2	8.4	.9732
6-mo	12.4	10.8	11.3	.3320
≥85 y				
30-d	8.2	8.5	7.5	.6625
90-d	14.0	13.1	12.5	.3568
6-mo	19.3	19.1	16.4	.1477
Comorbidity score				
0				
30-d	3.4	3.7	3.8	.4193
90-d	7.1	6.6	6.5	.3658
6-mo	10.9	10.1	9.3	.0601
1				
30-d	5.1	4.6	3.6	.1347
90-d	10.1	8.5	7.1	.0248
6-mo	14.7	13.3	9.8	.0020
≥2				
30-d	6.9	7.9	7.0	.9162
90-d	11.9	12.7	13.4	.5472
6-mo	16.5	18.3	18.5	.4513
Facility type				
Community cancer program				
30-d	5.7	6.8	3.6	.3058
90-d	10.7	11.7	6.0	.0663
6-mo	14.4	15.7	10.6	.2156
Comprehensive community cancer program				
30-d	4.6	4.6	5.0	.5915
90-d	9.3	7.9	8.3	.2320
6-mo	13.4	11.3	11.3	.0420
Teaching/Research program				
30-d	4.0	2.0	3.4	.4535
90-d	7.8	6.1	6.5	.3049
6-mo	12.4	11.2	9.5	.0626

(continued)

Table 3. Trends in Early Postoperative Mortality (cont.)

Early Mortality	Diagnosis Year, % 2004–2007	2008–2011	2012–2015	P_{trend}
NCI-designated program				
30-d	1.8	2.2	2.3	.6789
90-d	4.5	4.0	5.1	.6927
6-mo	8.7	6.9	6.8	.3541
Other programs				
30-d	2.8	5.8	3.1	.6695
90-d	6.1	8.4	7.0	.5106
6-mo	9.3	13.0	9.5	.7666
Surgery type				
Local excision				
30-d	4.2	4.1	0.5	.0245
90-d	7.6	7.8	5.2	.3293
6-mo	12.5	10.3	9.0	.2089
Resection/Total surgery				
30-d	4.1	4.3	4.3	.7832
90-d	8.3	7.7	7.4	.1141
6-mo	12.3	11.8	10.3	.0069

and generally younger patients but also from real-practice data in elderly patients with comorbid conditions. Our study provides information about 30-day, 90-day, and 6-month mortality following surgery for LARC among the unique population of elderly patients aged ≥75 years. Mortality is likely the result of causes other than rectal cancer progression, because patients with stage II or III rectal cancer selected for surgery generally undergo a thorough evaluation to rule out the presence of distant metastasis. Development of metastatic disease, even if it occurs within 6 months of surgery, is unlikely to lead to rectal cancer–related mortality. Moreover, the mortality rates that we report do not solely reflect surgical mortality, but instead reflect risk of death from a complex interplay of advanced age, comorbid conditions, and the impact of a major surgery on these patients; this is supported by comparison of relatively low 30- and 90-day mortality versus the more substantial 6-month mortality.

We observed a significant declining trend in 6-month postoperative mortality among patients aged ≥75 years with LARC in the United States during the most recent period, which may in part reflect improvements in quality of care over the past decade.[19] Advances in surgical skills and facilities, better anesthesia, fewer emergency procedures, improved access to healthcare services, and greater availability of effective treatments

Table 4. Adjusted ORs Determining Odds of 6-Month Postoperative Mortality

Variable	OR (95% CI)[a]
Age group, y	
75–79	Ref
80–84	1.42 (1.24–1.63)
≥85	2.51 (2.17–2.89)
Race/Ethnicity	
Non-Hispanic white	Ref
Non-Hispanic black	1.16 (0.90–1.51)
Hispanic	1.06 (0.79–1.42)
Other/Unknown	1.16 (0.96–1.39)
Diagnosis year	
2004–2007	Ref
2008–2011	0.95 (0.82–1.10)
2012–2015	0.82 (0.70–0.96)
Sex	
Female	Ref
Male	1.26 (1.12–1.42)
Clinical stage[b]	
II	Ref
III	1.09 (0.97–1.22)
Tumor size, cm	
<2	Ref
2 to <5	1.09 (0.86–1.39)
≥5	1.35 (1.06–1.72)
Missing/Unknown	1.14 (0.86–1.50)
Comorbidity score	
0	Ref
1	1.30 (1.13–1.48)
≥2	1.84 (1.55–2.19)
Facility type	
Teaching/Research program	Ref
Community cancer program	1.17 (0.93–1.47)
Comprehensive community cancer program	1.06 (0.90–1.23)
NCI-designated program	0.70 (0.53–0.93)
Other programs	0.92 (0.75–1.12)
Facility case volume	
High	Ref
Medium	1.10 (0.89–1.35)
Low	1.23 (1.08–1.40)
Median income, $USD[c]	
≥63,000	Ref
<38,000	1.09 (0.87–1.37)
38,000–47,999	1.18 (0.98–1.42)
48,000–62,999	1.10 (0.93–1.31)

(continued)

Table 4. Adjusted ORs Determining Odds of 6-Month Postoperative Mortality (cont.)

Variable	OR (95% CI)[a]
No high school diploma, %[d]	
<7	Ref
7.0–12.9	0.97 (0.82–1.15)
13.0–20.9	0.95 (0.77–1.16)
≥21.0	0.98 (0.77–1.24)

Abbreviation: OR, odds ratio.
[a]Adjusted for age, race/ethnicity, diagnosis year, sex, clinical stage, tumor size, comorbidity score, facility type, facility case volume, area-level median income, area-level percent of persons with no high school diploma.
[b]Pathologic stage used if clinical stage was missing.
[c]Area-level median household income quartiles from the 2012 American Community Survey.
[d]Area-level quartiles for percentage of adults without a high school diploma from the 2012 American Community Survey.

and postoperative care could contribute to this declining trend.[20–22] Furthermore, we found that the largest significant decline in 6-month mortality was in patients with lower comorbidity score, those treated at comprehensive community cancer programs, those who received surgical resection/total surgery, and those aged 75 to 79 years. Advances in perioperative management may allow patients in this group to receive the standard of care and expect similar outcomes to patients enrolled in large randomized clinical trials. Lower comorbidity score and relatively younger age among these elderly patients could also lead to a favorable assessment for preoperative treatment, which may increase the chance of surgical resection/total surgery and improve early mortality. In a previous study from Europe, Rutten et al[12] did not find decreases in postoperative mortality over time among patients aged ≥75 years with LARC. In contrast, our findings suggest progress toward reducing postoperative mortality and future opportunities to mitigate early postoperative mortality. Although more evidence is needed, some of these elderly patients could receive standard of care, and those with more advanced age or higher comorbidity score could be counseled regarding alternative treatment options, such as watchful waiting in the case of clinical response to preoperative treatment or local excision of residual lesions—a practice that has been adopted in some European centers.

Our findings of significant associations between early mortality and cancer treatment facility type and case volume correspond with those of other studies.[23,24] After accounting for differences in age composition and other factors, we found that patients treated at high-volume and NCI-designated facilities had lower odds of early postoperative mortality, suggesting that expert care provided by surgical teams, nursing staff, and rehabilitation programs at these facilities may account for better outcomes in elderly patients with medical comorbidities. Efforts such as implementation of surgical quality improvement programs, care coordination, or streamlining referral systems to centers of excellence that improve access to high-quality care could lower early postoperative mortality in this group of patients.[13,25] In addition, patients with rectal cancer require specialized management, and centralizing care could improve postoperative outcome.

A strength of our study is the use of a large contemporary nationwide oncologic outcomes database, which includes 70% of patients newly diagnosed with cancer in the United States. The NCDB also implements stringent data quality and ascertainment methods.[15] We acknowledge several limitations as well. The NCDB is hospital-based, and participating hospitals may differ from those that do not participate; therefore, findings may lack generalizability. In addition, the NCDB does not collect information on cause of death, and all estimates are based on all-cause mortality. We were also unable to account for performance status, quality of life, symptoms, postoperative complications, and patient/physician preferences that may influence treatment decisions, because the NCDB does not capture these variables.

Conclusions

Although 6-month postoperative mortality among patients aged ≥75 years with LARC declined steadily in the United States over the past decade, the odds of postsurgical mortality remains a significant challenge in management of these patients. In addition to older age and higher comorbidity score, receipt of treatment at low-volume or non–NCI-designated facilities were associated with higher 6-month postoperative mortality. Improving prevention and management of comorbid conditions and specialized postoperative care could improve surgical outcome in the oldest of these patients. To achieve the best outcomes, treatment recommendations provided by expert multidisciplinary care providers could be personalized to individual patients, and applying aggressive surgical treatment should be approached with great care in patients aged ≥75 years with LARC. More innovative research is needed pertaining to early postoperative mortality in patients aged ≥75 years, using observational data because these patients are excluded from randomized control trials.

Submitted August 19, 2019; accepted for publication October 31, 2019.

Previous presentation: Preliminary findings were presented at the 2019 ASCO Annual Meeting; June 3, 2019; Chicago, Illinois. Abstract 248295.

Author contributions: *Study concept and design:* All authors. *Data acquisition:* Sineshaw. *Data interpretation:* All authors. *Drafting of manuscript:* Sineshaw, Mitin. *Critical revision of manuscript for important intellectual content:* All authors. *Administrative, technical, or material support:* Sineshaw, Yabroff, Jemal. *Study supervision:* Sineshaw, Yabroff, Jemal, Mitin.

Disclosures: Dr. Mitin has disclosed that he has received grant/research support from Novocure, Inc; is a scientific advisor for Novocure and Janssen; and receives royalties from UpToDate, Inc. The remaining authors have disclosed that they have not received any financial consideration from any person or organization to support the preparation, analysis, results, or discussion of this article.

Funding: This work was supported by the American Cancer Society Intramural Research (no grant number applicable to H.M.S., Y.K.R., and A.J.).

Disclaimer: The data used in the study are derived from a limited data set of the National Cancer Database. The authors acknowledge the efforts of the American College of Surgeons, the Commission on Cancer, and the American Cancer Society in the creation of the National Cancer Database. The American College of Surgeons and the Commission on Cancer have not verified and are not responsible for the analytic or statistical methodology used, or the conclusions drawn from these data by the authors.

Correspondence: Helmneh M. Sineshaw, MD, MPH, American Cancer Society, 250 Williams Street NW, Atlanta, GA 30303. Email: helmneh.sineshaw@cancer.org

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Early Postoperative Mortality Among Patients Aged 75 Years or Older With Stage II/III Rectal Cancer

Helmneh M. Sineshaw, MD, MPH; K. Robin Yabroff, PhD; V. Liana Tsikitis, MD, MCR; Ahmedin Jemal, DVM, PhD; and Timur Mitin, MD, PhD

J Natl Compr Canc Netw 2020;18(4):443–451

eTable 1. Rectal Cancer Topography and Histology Codes

ICD-O-3 Topography Codes	ICD-O-3 Histology Codes
C20.9	8000, 8001, 8002, 8003, 8004, 8005, 8010, 8011, 8012, 8013, 8014, 8015, 8020, 8021, 8022, 8030, 8031, 8032, 8033, 8034, 8035, 8041, 8043, 8050, 8051, 8052, 8070, 8071, 8072, 8073, 8074, 8075, 8076, 8078, 8120, 8121, 8122, 8123, 8124, 8140, 8141, 8143, 8145, 8147, 8210, 8211, 8220, 8221, 8230, 8231, 8255, 8260, 8261, 8262, 8263, 8430, 8440, 8480, 8481, 8490, 8510, 8550, 8551, 8560, 8562, 8570, 8571, 8572, 8573, 8574, 8575, 8576

eTable 2. Comorbidity Score–Adjusted ORs Determining Trends in Odds of 6-Month Postoperative Mortality

	OR (95% CI)		
Diagnosis Year	Age 75–79 y	Age 80–84 y	Age ≥85 y
2004–2007	Ref	Ref	Ref
2008–2011	0.96 (0.77–1.19)	0.85 (0.67–1.08)	0.99 (0.78–1.26)
2012–2015	0.71 (0.56–0.90)	0.89 (0.70–1.14)	0.82 (0.64–1.06)
	P_{trend}=.0130	P_{trend}=.3813	P_{trend}=.2648
2004–2007[a]	Ref	Ref	Ref
2008–2011[a]	0.96 (0.77–1.19)	0.85 (0.67–1.08)	0.99 (0.78–1.27)
2012–2015[a]	0.72 (0.57–0.92)	0.90 (0.71–1.14)	0.83 (0.64–1.07)
	P_{trend}≤.0001	P_{trend}=.0001	P_{trend}=.0017

Abbreviation: OR, odds ratio.
[a]Adjusted for comorbidity score.