Original Article

Radiation dose in neoadjuvant chemoradiation therapy for esophageal cancer: patterns of care and outcomes from the National Cancer Data Base

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Background: Neoadjuvant chemoradiotherapy (CRT) for locally advanced esophageal cancer (EC) may utilize a wide variety of RT doses, without clear consensus to date. This study evaluated national practice patterns between lower dose (LD) (40–41.4 Gy) or higher dose (HD) (50–50.4 Gy) therapy, in addition to differences in survival and postoperative events.

Methods: The National Cancer Data Base (NCDB) was queried [2004–2013] for patients with newly-diagnosed cT1a-T4aN0/N+M0 EC that received neoadjuvant CRT followed by esophagectomy. Multivariable logistic regression determined factors predictive of receiving LD RT. Kaplan-Meier analysis evaluated overall survival (OS), and Cox proportional hazards modeling determined variables associated with OS. Propensity score matching assessed groups in a balanced manner while reducing indication biases.

Results: Altogether, 5,025 patients met inclusion criteria; 257 (5%) received LD RT, while 4,768 (95%) received HD RT. LD RT was more likely delivered at academic centers (P=0.038), in more recent years (2009–2013, P=0.011), and to squamous cell carcinomas (P=0.001). HD RT tended to be administered with higher T stage as well as node-positive disease (P<0.05). The median OS in the LD and HD cohorts was 39.0 *vs.* 35.6 months (P=0.072), and 39.0 *vs.* 42.7 months after propensity matching (P=0.812). Dose did not independently correlate with OS on multivariate analysis (P=0.069), but treatment at academic centers correlated with improved OS (P=0.028). There were no differences between groups in the rates of 30-day readmission (P=0.182), 30-day mortality (P=0.314), or length of postoperative hospital stay (P=0.665), but the LD group experienced lower 90-day mortality (P=0.007).

Conclusions: Although neoadjuvant LD CRT has been underutilized for EC in the United States, it is rising in more recent years. Dose did not significantly impact survival before or after propensity matching, nor did it independently predict for survival. Treatment at academic facilities independently correlated with higher survival, which has implications for patient counseling.

Keywords: Bladder cancer; radiation therapy (RT); chemotherapy; bladder preservation therapy

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Introduction

Esophageal cancer (EC) is a major cause of both cancer-related mortality worldwide, with an estimated 400,000 annual deaths attributable to this disease (1). The current standard of care is neoadjuvant chemoradiation (CRT) followed by definitive surgery, based on the landmark publication of the CROSS trial in 2012, which has provided the most definitive evidence for trimodality therapy in locally advanced EC (2,3). The CROSS protocol consisted of preoperative carboplatin/paclitaxel administered concurrently with radiation therapy (RT) to a dose of 41.4 Gy. This dose was somewhat unconventional in light of many prospective trials that utilized 45 Gy (4-6). However, prospective trials have, in fact, utilized total doses as low as 35–37 Gy as part of preoperative multimodality management, with satisfactory results (7,8).

Lower dose (LD) CRT has the theoretical (albeit largely unproven) advantage of providing "cleaner" dissection planes during esophagectomy as well as reducing risks of postoperative complications and mortality. However, radiation oncologists may be hesitant to utilize LDs in clinical practice for multiple reasons. First, 45 Gy is often thought to be the "minimal" dose required to sterilize microscopic disease (especially in areas where surgical dissection may not take place, such as elective nodal treatment) based on radiotherapeutic principles (9). Second, higher doses (HDs) may be associated with higher rates of margin-free resection. Third, if a patient does not end up undergoing resection for various reasons, a dose of 50–50.4 Gy is the recommended dose for definitive CRT (2), and treatment with this dose entirely up front prevents a potential treatment gap. As such, national guidelines endorse a wide dose range of 41.4 to 50.4 Gy in the neoadjuvant setting (2).

This study is the first to date evaluating national practice patterns and outcomes of EC patients undergoing neoadjuvant CRT using LD [40–41.4 Gy (3,10)] versus HD [50–50.4 Gy (2)] RT. We specifically sought to assess trends and patterns of care in the utilization of LD versus HD CRT, evaluate whether overall survival (OS) was different between these cohorts, and whether postoperative events were affected by RT dosage changes.

Methods

This investigation analyzed the National Cancer Data Base (NCDB), which is a joint project of the Commission on Cancer (CoC) of the American College of Surgeons and the American Cancer Society, which consists of de-identified information regarding tumor characteristics, patient demographics, and patient survival for approximately 70% of the US population (11-14). The NCDB contains information not included in the Surveillance, Epidemiology, and End Results database, including details regarding use of systemic therapy and radiation dose. The data used in the study were derived from a de-identified NCDB file. The American College of Surgeons and the CoC have not verified and are neither responsible for the analytic or statistical methodology employed nor the conclusions drawn from these data by the investigators. As all patient information in the NCDB database is de-identified, this study was exempt from institutional review board evaluation.

The most recently released NCDB dataset corresponded to the years 2004–2013. Inclusion criteria for this study involved patients age >18 with newly-diagnosed cT1b-T4a N0/N+ M0 EC comprising histologic codes of adenocarcinoma [International Classification of Disease for Oncology (ICD-O-3) codes 8140, 8141, 8143, 8144, 8145, 8147, 8255, 8260, 8310, 8340, 8480, 8481] or squamous cell carcinoma (ICD-O-3 codes 8052, 8053, 8070, 8071, 8072, 8073, 8074, 8075, 8076, 8078, 8083, 8084, 8560). For inclusion, patients required histological diagnostic confirmation, receipt of neoadjuvant CRT followed by partial or complete esophagectomy {surgical procedure of the primary site codes [30, 40, 50–55, 80]}. Since the purpose of the study was to compare the effect of dose escalated neoadjuvant RT, we only included patients receiving either 40–41.4 Gy (3,10) which was classified as low dose radiation (LD) or 50–50.4 Gy (2) which was classified as high dose radiation (HD). The use of concurrent therapy was defined as receipt of chemotherapy within 15 days of radiation.

Information collected on each patient broadly included demographic data, comorbidity information, clinicopathologic tumor parameters, and treatment facility characteristics. All statistical tests were two-sided, with a threshold of $P<0.05$ for statistical significance, and were performed using STATA (version 14, College Station, TX, USA). Fisher's exact or χ^2 test analyzed categorical proportions between groups in the non-parametric and parametric settings, respectively. Multivariable logistic regression modeling was utilized to determine characteristics that were predictive for receipt of LD RT. The Kaplan-Meier method was used for survival analysis, and comparisons between the LD and HD groups were

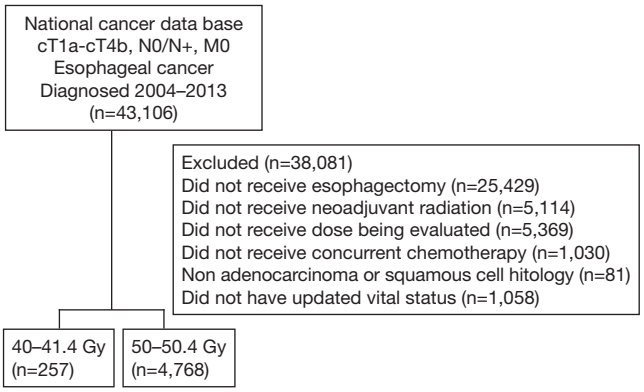

Figure 1 Patient selection diagram.

performed with the log-rank test. OS was defined as the interval between the date of diagnosis and the date of death or last contact. Univariate analysis was performed to determine which factors were associated with OS, and subsequently Cox multivariate analysis was performed including variables that were either significant or showed a strong trend to statistical significance on univariate analysis.

To account for indication bias, propensity score matching was used to compare patients treated with each of the RT dose/fractionation schemes. Propensity matching is a method that creates quasi case/control pairs using a retrospective cohort in an effort to account for the recorded and unrecorded confounding variables (15-17). Propensity scores were calculated by use of a multivariable logistic regression model with the dependent variable being receipt of treatment with LD *vs.* treatment with HD and the independent variables being those that were statistically significant for correlation with OS on multivariate analysis. Patients were matched 1:1 without replacement to avoid potential bias from many-to-one matching. In order to ensure balance, a caliper of 0.05 was selected. Standardized differences were assessed in order to ensure balance between each of the variables included in calculating the propensity score the matched cohorts with a value <0.1 signifying an inconsequential imbalance (18) (*Table S1*). Pearson's χ^2 test was subsequently performed between the matched cohorts to confirm balance amongst the variable (*Table S2*). Survival rates were then compared between the two matched groups with the log-rank test.

Results

A complete flow diagram of patient selection is provided in *Figure 1*; 5,025 patients met study criteria. Of these, 257 (5%) were treated with LD RT, and 4,768 (95%) HD RT. *Table 1* displays clinical characteristics of the analyzed patients. Of note, most patients had adenocarcinomas located in the distal esophagus and locally advanced disease.

Multivariable logistic regression analysis was performed to evaluate factors independently associated with undergoing LD therapy (*Table 2*). LDs were more likely delivered at academic centers (P=0.038), in more recent years (2009–2013, P=0.011), and to squamous cell carcinomas (P=0.001). HD RT tended to be administered in patients with higher T classification as well as node-positive disease (P<0.05 for all).

Median follow-up was 25.9 months [interquartile range (IQR), 14.5–44.3 months]. Kaplan-Meier estimates of OS between groups are illustrated in *Figure 2A*. The median OS in the LD group was 39.0 and 35.6 months in the HD cohort (P=0.071).

However, because both groups were imbalanced in terms of several variables, propensity matching was performed in order to evaluate OS between more balanced populations. When examining OS between both propensity matched cohorts (*Figure 2B*), there were no OS differences between cohorts (39.0 *vs.* 42.9 months, P=0.812).

Multivariate Cox proportional hazards modeling examining independent predictors of OS is displayed in *Table 3*. There were several factors associated with poorer OS: node-positive disease, lack of pathologic complete response (pCR), presence of comorbidities, Medicare/Medicaid insurance, and treatment at a community facility (P<0.05 for all). Of note, dose did not independently correlate with OS [hazard ratio (HR), 1.20; 95% confidence interval (CI), 0.986–1.459; P=0.069].

Lastly, the NCDB tabulates postoperative mortality, length of hospital stay, and readmission rates, which were analyzed between groups. Respective 30-day readmission rates in the LD and HD groups were 7.4% and 5.8% (P=0.182). The 30- and 90-day mortality rates were 1.6% *vs.* 3.2% (P=0.314) and 4.3% *vs.* 7.7% (P=0.007). The mean length of postoperative hospital stay was 12.8 days (95% CI: 11.4–14.3 days) *vs.* 13.2 days (95% CI: 12.8–13.5 days), respectively (P=0.665).

Discussion

Although the value of trimodality therapy in EC has now been more clearly defined, there remains a degree of controversy regarding the more practical point of RT

Table 1 Baseline characteristics of patients with esophageal cancer receiving neoadjuvant chemoradiation

Characteristic	40–41.4 Gy; n=257 (%)	50–50.4 Gy; n=4,768 (%)	P value
Age (years)			0.880
<65	151 (58.8)	2,824 (59.2)	
65+	106 (41.2)	1,944 (40.8)	
Sex			0.883
Male	217 (84.4)	4,042 (84.8)	
Female	40 (15.6)	726 (15.2)	
Race			0.711
White	233 (90.7)	4,375 (91.8)	
African American	12 (4.7)	200 (4.2)	
Hispanic	7 (2.7)	86 (1.8)	
Other/not recorded	5 (1.9)	107 (2.2)	
Histology			0.003
Squamous cell	64 (24.9)	842 (17.7)	
Adenocarcinoma	193 (75.1)	3,926 (82.3)	
T stage			<0.001
T1b	9 (3.5)	43 (0.9)	
T2	67 (26.1)	1,039 (21.8)	
T3	181 (70.4)	3,658 (76.5)	
T4a	0 (0.0)	38 (0.8)	
N stage			0.006
N0	113 (44.0)	1,690 (35.4)	
N+	144 (56.0)	3,078 (64.6)	
Pathologic complete response			
Yes	43 (16.7)	784 (16.4)	
No	214 (83.3)	3,984 (83.6)	
Charlson Deyo score			0.790
0	194 (75.5)	3,581 (75.1)	
1	54 (21.0)	978 (20.5)	
2	9 (3.5)	209 (4.4)	
Tumor location			0.574
Cervical/upper	5 (1.9)	62 (1.3)	
Thoracic/middle	32 (12.5)	584 (12.3)	
Abdominal/lower	212 (82.5)	3,902 (81.8)	
Overlapping/unknown	8 (3.1)	220 (4.6)	
Facility type			0.129
Non-academic	108 (42.0)	2,268 (47.6)	
Academic	147 (57.2)	2,433 (51.0)	
Not recorded	2 (0.8)	67 (1.4)	
Insurance			0.768
Private	122 (47.5)	2,396 (50.3)	
Medicaid	16 (6.2)	243 (5.1)	
Medicare	105 (40.9)	1,843 (38.7)	
Not insured	7 (2.7)	117 (2.5)	
Other/not recorded	7 (2.7)	169 (3.5)	
Income			0.763
<$48,000	94 (36.6)	1,798 (37.7)	
$48,000+	161 (62.6)	2,913 (61.1)	
Not recorded	2 (0.8)	57 (1.2)	
Year of diagnosis			<0.001
2004	15 (5.8)	163 (3.4)	
2005	15 (5.8)	196 (4.1)	
2006	4 (1.6)	293 (6.2)	
2007	11 (4.3)	304 (6.4)	
2008	7 (2.7)	396 (8.3)	
2009	18 (7.0)	483 (10.1)	
2010	15 (5.8)	554 (11.6)	
2011	28 (10.9)	700 (14.7)	
2012	54 (21.0)	803 (16.8)	
2013	90 (35.0)	876 (18.4)	

dosing when delivered preoperatively (19). There are numerous findings and reflections from this analysis of a contemporary national database, the largest of its kind to date. In the United States, LD RT is underutilized as compared to HD RT, but does show changes based on treatment period, treatment facility, and histology. There were no differences between cohorts in terms of survival or most postoperative outcomes, which persisted after propensity matching and multivariate adjustment. These findings have notable implications for the practical aspects of multimodal management of EC.

Table 2 Characteristics predictive for treatment to a lower dose (40–41.4 Gy) on multivariable logistic regression analysis

Characteristic	Odds ratio	95% confidence interval	P value
Age (years)			
<65	1 (reference)		
65+	0.938	0.679–1.297	0.700
Sex			
Male	1 (reference)		
Female	1.015	0.715–1.441	0.935
Race			
White	1 (reference)		
African American	1.279	0.690–2.369	0.434
Hispanic	1.698	0.766–3.762	0.192
Other/not recorded	1.594	0.484–5.247	0.443
Histology			
Squamous cell	1 (reference)		
Adenocarcinoma	0.574	0.409–0.807	0.001
T stage			
T1b	1 (reference)		
T2	0.351	0.162–0.759	0.008
T3	0.279	0.132–0.591	0.001
T4a	–	–	–
N stage			
N0	1 (reference)		
N+	0.704	0.543–0.913	0.008
Charlson Deyo score			
0	1 (reference)		
1	1.043	0.761–1.430	0.792
2	0.755	0.378–1.505	0.424
Tumor location			
Cervical/upper	1 (reference)		
Thoracic/middle	0.720	0.268–1.933	0.514
Abdominal/lower	0.996	0.381–2.603	0.994
Overlapping/unknown	0.696	0.215–2.258	0.546
Facility type			
Non-academic	1 (reference)		
Academic	1.315	1.016–1.702	0.038
Not recorded	0.425	0.066–2.718	0.366
Insurance			
Private	1 (reference)		
Medicaid	1.191	0.688–2.063	0.533
Medicare	1.132	0.805–1.594	0.476
Not insured	1.233	0.556–2.731	0.606
Other/not recorded	0.812	0.371–1.780	0.604
Income			
<$48,000	1 (reference)		
$48,000+	1.068	0.819–1.394	0.627
Not recorded	0.843	0.200–3.547	0.816
Year of diagnosis			
2004–2008	1 (reference)		
2009–2013	1.507	1.097–2.069	0.011

Although this investigation of a contemporary database excluded patients treated to a commonly-utilized dose of 45 Gy (in light of these results, it is unlikely to find differences in endpoints between regimens differing by just 2–3 fractions), it is still feasible to conclude that even LD regimens in multiple phase III trials (3,10) are clearly underutilized in the United States as compared to HD RT. However, time period (2009–2013 *vs.* 2004–2008) was independently associated with greater use of LD RT. Because the CROSS trial was published in 2012 and the final year of NCDB data collection included in the present analysis was in 2013, most recent years are unable to be analyzed. Nevertheless, these results are consistent with an unpublished survey of 274 US radiotherapy providers, revealing that 50.4 Gy was the most preferred dose in the neoadjuvant setting (20). Rationales for such included the ability to achieve margin-free resection at the cost of increased adverse events. However, whereas 86% of

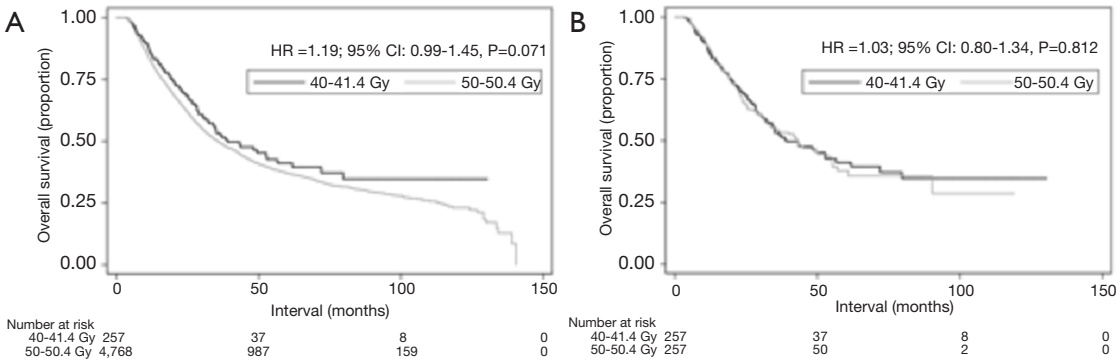

Figure 2 Kaplan-Meier overall survival curves comparing those receiving lower versus higher dose radiotherapy in all patients (A) and in the propensity-matched population (B).

Table 3 Univariate and multivariate analysis of factors predictive of overall survival for all patients

Characteristic	Univariate analysis			Multivariable analysis		
	HR	95% CI	P value	HR	95% CI	P value
Age (years)						
<65	1 (reference)			1 (reference)		
65+	1.246	1.156–1.344	<0.001	1.087	0.986–1.199	0.093
Sex						
Male	1 (reference)			–	–	–
Female	1.026	0.926–1.138	0.620	–	–	–
Race						
White	1 (reference)			1 (reference)		
African American	0.975	0.813–1.170	0.788	1.029	0.850–1.245	0.79
Hispanic	0.635	0.465–0.868	0.004	0.675	0.488–0.933	0.017
Other/not recorded	0.947	0.733–1.224	0.678	1.134	0.757–2.700	0.539
Histology						
Squamous cell	1 (reference)			1 (reference)		
Adenocarcinoma	1.136	1.028–1.256	0.013	1.100	0.988–1.217	0.082
T stage						
T1b	1 (reference)			–	–	–
T2	1.061	0.671–1.676	0.801	–	–	–
T3	1.340	0.853–2.106	0.204	–	–	–
T4a	1.647	0.879–3.085	0.120	–	–	–
N stage						
N0	1 (reference)			1 (reference)		
N+	1.128	1.042–1.220	0.003	1.175	1.083–1.274	<0.001

Table 3 (*continued*)

Table 3 (*continued*)

Characteristic	Univariate analysis			Multivariable analysis		
	HR	95% CI	P value	HR	95% CI	P value
Pathologic complete response						
Yes	1 (reference)			1 (reference)		
No	1.489	1.329–1.668	<0.001	1.474	1.312–1.656	<0.001
Charlson Deyo score						
0	1 (reference)			1 (reference)		
1	1.170	1.067–1.282	0.001	1.137	1.034–1.250	0.008
2	1.349	1.134–1.604	0.001	1.263	1.070–1.509	0.010
Tumor location						
Cervical/upper	1 (reference)			–	–	–
Thoracic/middle	0.979	0.694–1.381	0.905	–	–	–
Abdominal/lower	0.991	0.713–1.377	0.955	–	–	–
Overlapping/unknown	1.231	0.857–1.769	0.261	–	–	–
Facility type						
Non academic	1 (reference)			1 (reference)		
Academic	0.903	0.838–0.973	0.008	0.917	0.849–0.991	0.028
Insurance						
Private	1 (reference)			1 (reference)		
Medicaid	1.231	1.031–1.469	0.021	1.274	1.066–1.523	0.008
Medicare	1.359	1.255–1.472	<0.001	1.312	1.182–1.457	<0.001
Not insured	1.094	0.844–1.418	0.496	1.075	0.829–1.395	0.584
Income						
<$48,000	1 (reference)			1 (reference)	–	–
$48,000+	0.926	0.868–1.000	0.051	0.933	0.863–1.009	0.081
Year of diagnosis						
2004–2008	1 (reference)			–	–	–
2009–2013	1.050	0.967–1.140	0.242	–	–	–
Dose						
40–41.4 Gy	1 (reference)			1 (reference)	–	–
50–50.4 Gy	1.193	0.985–1.445	0.071	1.200	0.986–1.459	0.069

HR, hazard ratio; CI, confidence interval.

respondents felt that HDs would lead to increased pCR rates, this was not found in our data, which revealed a pCR rate of about 16% in both the LD and HD cohorts.

It is readily acknowledged that both groups were imbalanced prior to propensity matching, given the intuitiveness of delivering more "aggressive" doses to "higher-risk" disease (21), as exemplified by the more advanced T classification and nodal positivity in the HD population. The NCDB also cannot account for tumor volume, which does not necessarily equate to T classification. Nevertheless, these findings are readily explained by the trends toward inferior OS in the HD group (P=0.072) along with the association on Cox multivariate analysis (P=0.069), whereas the propensity matched analysis resulted in no significant trends. Nevertheless, based on the retrospective shortcomings of this study, our results should not necessarily be interpreted as no differences between the HD and LD arms; rather, we posit that there is no evidence supporting routine delivery of HD RT in all cases. On the basis of this study, it may be reasonable to deliver LD RT in squamous cell histology [given that nearly half develop a pCR to LD RT (3)] and/or lower-volume disease. Alternatively, LD RT may also have utility in patients with borderline performance status and/or at risk of adverse or postoperative events (discussed further below). Nevertheless, each patient should be evaluated while taking into account both tumor specific characteristics as well as the patient's underlying comorbidities before a decision on dose is made.

In addition to patients with squamous cell carcinoma, academic centers were also more likely to deliver LD RT, which could relate to greater use of evidence-based medicine in such institutions. However, the independent association between treatment at an academic facility and OS on Cox multivariate analysis has far-reaching implications on patient counseling and management by both oncologists and referring providers. These findings are in concord with data from other neoplasms demonstrating improved outcomes at academic and/or high-volume facilities (22). There are several potential reasons for this, not limited to greater multimodality coordination, streamlined diagnostic processes, technical expertise of a major surgical procedure, ancillary support staff for close clinical monitoring, and potentially the availability of salvage therapies (or clinical trials). Nevertheless, this finding may impact any case of locally advanced EC and could warrant revisions in patterns of patient education.

The findings of statistically insignificant differences in 30-day postoperative mortality, length of hospital stay, and 30-day readmission rates are especially important for surgical providers. However, this study noted slightly worse 90-day mortality in the HD cohort. In the absence of statistically significant 30-day mortality figures, there are many possible explanations for this observation. Because the NCDB does not give causes of death at these time points, it is first unclear whether this mortality figure is specifically related to surgery. However, if these values are ascribed to surgery, it is possible that patients in the HD (having higher T stage and node positive disease) required more extensive surgeries and hence a greater likelihood of complications. This is consistent with a retrospective single-institution report of HD therapy being associated with more acute adverse effects and potentially suboptimal surgical conditions (23). Nevertheless, in light of studies demonstrating that advanced RT techniques may decrease adverse and postoperative events, further work must assess whether a decrease in dose has additive effects as well (24-28).

There are several shortcomings of this investigation. First, issues regarding retrospective selection biases and imbalances between cohorts have been discussed above. Second, the NCDB's coding of RT dose (specific treatment volumes are also not reported) may be incongruous between reporting institutions, because there is likely little standardization between receiving 45 Gy plus a 5.4 Gy boost as compared to 50.4 Gy with no boost. Third, the NCDB does not keep track of several noteworthy variables, such as reasons for a particular treatment, elective nodal coverage, premature cessation of therapy, and salvage treatments. Although receipt of chemotherapy is recorded, specific agents are not mentioned. This is important in light of conflicting single-institutional data claiming higher OS in patients receiving cisplatin/5-fluorouracil (29) versus carboplatin/paclitaxel (30). Although the NCDB has a record of surgical margins, this information is very frequently missing; it also does not record other endpoints such as tolerance of therapy (including specific postoperative complications or toxicities in general), cancer-specific survival, and local/regional control. Lastly, the inclusion of T1-2 N0 patients (similar to the CROSS study) may bias towards no dose-related differences between groups, as patients most likely to benefit from dose-escalated therapy are more advanced cases. Nevertheless, the caveats herein do not obviate the need for further investigation to corroborate these conclusions.

Conclusions

Although the use of LD (40–41.4 Gy) RT as part of neoadjuvant CRT is underutilized, it is increasing in recent years, and is utilized more at academic centers and for squamous cell carcinoma. There were no differences in survival (before or after propensity matching), 30-day readmission/mortality, or length of postoperative hospital stay between LD and HD (50–50.4 Gy) therapy, nor did dose independently predict for survival. Trimodality therapy at academic institutions is independently associated with higher survival.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: As all patient information in the NCDB database is de-identified, this study was exempt from institutional review board evaluation.

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Supplementary

Table S1 The standardized differences of the patient characteristics following propensity score matching

Characteristic	40–41.4 *vs.* 50–50.4 Gy propensity matched
Race	
White	0.07
African American	0.02
Hispanic	0.02
Other	0.09
N Stage N0 *vs*. N+	0.00
Pathologic complete response yes *vs*. no	–0.02
Charlson Deyo score	
0	0.00
1	0.00
2	0.00
Facility	
Non-academic	0.01
Academic	–0.02
Not recorded	0.00
Insurance	
Private	0.00
Medicaid	0.00
Medicare	0.02
Not insured	0.00
Other/not recorded	0.04

Table S2 Patient characteristics for the propensity matched cohorts

Characteristic	40–41.4 Gy; n=257 (%)	50–50.4 Gy; n=257 (%)	P value
Race			0.692
White	233 (90.7)	238 (92.6)	
African American	12 (4.7)	11 (4.3)	
Hispanic	7 (2.7)	6 (2.3)	
Other	5 (1.9)	2 (0.8)	
N Stage N0 *vs*. N+			
N0	113 (44.0)	113 (44.0)	
N+	144 (56.0)	144 (56.0)	
Pathologic complete response yes *vs*. no			
Yes	43 (16.7)	45 (17.5)	
No	214 (83.3)	212 (82.5)	
Charlson Deyo score			1.000
0	194 (75.5)	194 (75.5)	
1	54 (21.0)	54 (21.0)	
2	9 (3.5)	9 (3.5)	
Facility			0.996
Non-academic	108 (42.0)	107 (41.6)	
Academic	147 (57.2)	148 (57.6)	
Not recorded	2 (0.8)	2 (0.8)	
Insurance			0.992
Private	122 (47.5)	122 (47.5)	
Medicaid	16 (6.2)	16 (6.2)	
Medicare	105 (40.9)	103 (40.1)	
Not insured	7 (2.7)	7 (2.7)	
Other/not recorded	7 (2.7)	9 (3.5)	