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ORIGINAL ARTICLE

Does Quality of Care Matter? A Study of Adherence to National Comprehensive Cancer Network Guidelines for Patients with Locally Advanced Esophageal Cancer

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Abstract

Introduction The aim of this study was to assess whether adherence to National Comprehensive Cancer Network (NCCN) guidelines leads to differences in survival in patients diagnosed with locally advanced esophageal cancer.

Methods This is a retrospective cohort study of patients with stage II and III esophageal cancer included in the Cancer Registry at the Sidney Kimmel Comprehensive Cancer Center at the Johns Hopkins Hospital from 2008 to 2013. Seven quality indicators were identified using the 2014 NCCN guidelines, and individual and overall quality measure scores were calculated and used to define low and high quality of care groups.

Results One hundred forty-one patients met inclusion criteria, and 88 patients (62.4 %) were identified as receiving high-quality care. Adherence to guidelines ranged from 63.1 to 100.0 %, with an overall compliance of 81.3 %. Risk factors for receiving low quality of care included advanced age, non-white race, lower education level, and unspecified primary site of tumor. A significantly better overall survival was observed in patients who received high-quality care (HR, 0.58; 95 %, 0.37–0.90, $p=0.015$).

Conclusions Delivery of high-quality care is associated with improved survival in these patients. Efforts should be directed at minimizing disparities in treatment in regards to race and educational levels.

Keywords Esophageal cancer · Quality of care · NCCN guidelines · Survival

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Introduction

Esophageal cancer is estimated to affect more than 450,000 individuals worldwide.[1] Projections for 2015 from The National Cancer Institute anticipate 16,980 new cases of esophageal cancer in the USA and 15,590 deaths.[2] Several treatment modalities have been introduced and studied over the years in order to improve outcomes for esophageal cancer, leading to the formulation of therapeutic protocols optimized for every stage of the disease. However, despite advancements in medical and surgical treatment, the prognosis for affected patients remains poor, with a reported 5-year overall survival rate of 16.9 %.[3]

The National Comprehensive Cancer Network Clinical Practice Guidelines in Oncology (NCCN Guidelines) are a set of guidelines detailing the sequential management decisions and interventions that currently apply to the majority of cancers in the USA.[4] These guidelines are generated by multidisciplinary, disease-specific expert panels, and

continuously updated on the basis of the best evidence available at that given time. As a result, the NCCN Guidelines are some of the most widely recognized cancer care guidelines worldwide.[5] While these guidelines are broadly and readily available, the adherence to their recommendations when treating esophageal cancer patients has been poorly studied.

The aim of the present study was to assess if high quality of care (defined as compliance with NCCN Guidelines for esophageal cancer) is being delivered at our institution and to determine whether delivery of high quality of care leads to improved survival. In addition, we sought to identify potentially modifiable factors that might be associated with patients receiving low quality of care.

Materials and Methods

Data Source and Study Population

This is a retrospective cohort study of patients diagnosed and/or treated for locally advanced esophageal cancer (stages II and III) at the Johns Hopkins Hospital (JHH) from 2008 to 2013. Those cancer patients were recorded and then extracted for the purpose of this study from the Cancer Registry at the Sidney Kimmel Comprehensive Cancer Center at the JHH. This database comprises of patients residing in the state of Maryland, other states (most commonly Pennsylvania, Virginia, Florida, and Delaware) as well as a few international sites. Manual review of patients' electronic health records was also performed in order to gather additional information. Patients diagnosed with cervical esophageal cancer or whose stage was unknown were excluded. Stage 0 and Stage I esophageal cancer patients were also excluded from this study since the guidelines for treatment for early stage cancer are not yet fully defined. This study was approved by the Johns Hopkins School of Medicine Institutional Review Board.

Quality Indicators

Seven quality indicators were defined using the 2014 NCCN Clinical Practice Guidelines in Oncology (Esophageal and Esophagogastic Junction Cancers) in conjunction with input from clinical experts.[6] The NCCN guidelines for esophageal cancer stages II-III (locoregional disease) are similar for patients with adenocarcinoma and squamous cell carcinoma (SCC). The quality indicators included (1) histologic confirmation/classification; (2) tumor location; (3) tumor grade; (4) surgery; (5) induction treatment (concurrent chemo and radiation therapy); (6) all three recommended initial staging screenings of positron emission tomography (PET), computerized tomography (CT), and endoscopic ultrasound (EUS); and lastly (7) two restaging scans (PET and CT). If patients did not undergo all three initial staging screenings or both restaging scans, they were considered non-adherent to quality indicators (6) and/or (7). We calculated overall summary measure of quality by placing in the denominator all of the indicators for which a study subject is at risk and in the numerator, all of the indicators for which the subject received recommended care. This resulted in a proportion between zero and one. The median overall score of 0.86 (cumulative score of all individual indicator scores) was used to divide patients into low (patients with overall score less than or equal to 0.86) and high (patients with overall score greater than 0.86) quality of care groups. This method has been used for similar purposes and has been described by Gourin et al..[7]

Demographic, Socioeconomic, Pathologic, and Clinical Factors

Known and potential factors associated with quality of care were investigated. Demographic characteristics included age, gender, race (white, black, or other), marital status (married, single, or other [separated/divorced/widowed]), year and state patients resided at diagnosis (MD, and out of state including two international patients). Socioeconomic status characteristics included insurance type (private, Medicate+supplemental, Medicare only/medical assistance, or none) and 5-year estimates (2009–2013) of median household income and education level (percentage of high school graduate or higher) obtained from the U.S. Department of Commerce United States Census Bureau website using patients' zip codes of residence.[8] Furthermore, the pathologic and clinical factors consisted of histology classification (adenocarcinoma, SCC, or other), clinical stage (II or III), history of family members with cancer, primary site (lower third, middle third, upper third of the esophagus, or not otherwise specified [NOS]/overlapping lesion), tumor grade (moderately, poorly, undifferentiated, not determined, or IV), tobacco and alcohol use (never, previous, current), and history of cardiac and pulmonary diseases. All these factors were compared between the two quality of care groups to identify factors associated with low quality of care.

Overall Survival

Overall survival was defined as time (in months) from diagnosis to death or last follow-up date. The Sidney Kimmel Comprehensive Cancer Center at the JHH frequently confirms patients' vital status using Accurint® for Health Care and EPIC electronic health record system. In addition, they receive monthly updates from their software vendor (ONCOLOG) that uses Social Security death index.

Statistical Analysis

Patients' demographic, socioeconomic, clinical, and pathologic factors were compared between the low and high quality of care groups using Student's *t* test for continuous variables and Pearson's chi-square test for categorical variables. The Fisher exact test was performed when appropriate. The Mann–Whitney test was used for comparison of median values. Risk factors associated with low quality of care among stage II and III esophageal cancer patients were assessed using modified Poisson regression analysis, and risk ratios (RR) were estimated.[9] First, exploratory data analysis was performed using univariate modified Poisson regression. Initially, the multivariable model included all covariates with statistical significance from the univariate analysis and covariates of clinical importance, regardless of statistical significance. The final multivariable model was selected for optimal parsimony by minimizing the Akaike Information Criterion (AIC) and included age, race, median household income, education level, primary site of cancer, and cardiac disease. Potential interactions among variables were explored and none were detected. We did not consider state as a potential factor associated with quality of care. This is because although patients who were not from Maryland may have received some of their care at Johns Hopkins, a non-negligible percentage of the patients received at least part of their care at institutions closer to their home. Overall survival was analyzed using the Kaplan-Meier method. Differences in overall survival between the low and high quality of care groups were estimated using the log-rank test. Statistical significance was indicated by $p<0.05$. All data analyses and management were performed using Stata/MP version 12 (StataCorp LP, College Station, TX, USA).

Results

Study Population

A total of 141 patients diagnosed with stage II or III esophageal cancer between 2009 and 2013 met the study criteria. The median age was 64 years, 78.72 % of patients were male, and 87.23 % were white (Table 1). Almost three quarters of patients were married, and nearly 60 % of them resided in Maryland. The median household income was $61,209, and 41.73 % of patients resided in an area with at least 90 % of high school graduates or higher; 67.38 % of patients were diagnosed with stage III esophageal cancer, and 58.87 % were diagnosed with adenocarcinoma.

Quality Indicators

Overall, 81.2 % of all patients received treatment that adhered to the defined quality indicators (Table 2). All patients

Table 1 Demographic, socioeconomic, pathologic, and clinical characteristics of stages II and III esophageal cancer patients, 2008–2013

Characteristic	Total *N*=141
Age at diagnosis, median (IQR)	64 (59, 73)
Age groups	
<65	71 (50.35 %)
65–79	49 (34.75 %)
≥80	21 (14.89 %)
Male	111 (78.72 %)
Race	
White	123 (87.23 %)
Black	12 (8.51 %)
Other	6 (4.26 %)
Marital status	
Married	101 (73.19 %)
Single	20 (14.49 %)
Other[a]	17 (12.32 %)
Year of diagnosis	
2008–2010	67 (47.52 %)
2011–2013	74 (52.48 %)
State at diagnosis	
Maryland	83 (58.87 %)
Out of state	58 (41.13 %)
Zip code median household income, (IQR)	$61,209 ($50,385, $80,658)
Zip code median household income	
<$60,000	65 (46.76 %)
$60,000–$79,999	39 (28.06 %)
≥$80,000	35 (25.18 %)
Zip code education level[b]	
<85 %	41 (29.50 %)
85–89 %	40 (28.78 %)
≥90 %	58 (41.73 %)
Insurance type	
Private	62 (44.29 %)
Medicare+supplemental	65 (46.43 %)
Medicare/medical assistance	9 (6.38 %)
No insurance	4 (2.86 %)
Clinical stage	
II	46 (32.62 %)
III	95 (67.38 %)
Histology	
Adenocarcinoma	83 (58.87 %)
Squamous cell carcinoma	51 (36.17 %)
Other	7 (4.96 %)
Family members with cancer	
No	77 (54.61 %)
Yes	64 (45.39 %)
Primary site	
Esophagus, lower third	82 (58.16 %)
Esophagus, NOS	26 (18.44 %)
Esophagus, middle third	30 (21.28 %)

Table 1 (continued)

Characteristic	Total N=141
Esophagus, upper third	3 (2.13 %)
Grade	
Moderately differentiated	46 (32.86 %)
Poorly differentiated	50 (35.71 %)
Undifferentiated	1 (0.71 %)
Not determined	43 (30.71 %)
IV	1 (0.71 %)
Tobacco history	
Never	25 (19.84 %)
Previous	78 (61.90 %)
Current	23 (18.25 %)
Alcohol history	
Never	36 (21.58 %)
Previous	25 (21.93 %)
Current	53 (36.49 %)
Cardiac disease	45 (32.37 %)
Pulmonary disease	30 (21.58 %)

Different denominator due to missing observations: marital status, n=138; median household income, n=139; high school graduate or higher, n=139; insurance type, n=140 tobacco history, n=126; alcohol history, n=114; cardiac and pulmonary diseases, n=139

IQR interquartile range, *NOS* not otherwise specified

[a] Separated, divorced, or widow

[b] Percentage of high school graduates or higher in a given zip code

underwent histologic confirmation/classification of disease and had determination of their tumor grade. However, 35.46 % of these patients did not undergo surgical treatment (esophagectomy or gastrectomy) and 36.88 % did not have appropriate restaging administered (PET and CT scans). The overall median quality of care score was 0.86 which was used to dichotomize our groups into low and high quality of care. Based on this criterion, a total of 88 (62.41 %) patients were assigned to the high quality of care group (Table 3). Since the quality scores were not normally distributed, the two groups were not even. Surgical treatment and restaging (both 26.42 %) were the least frequently administrated quality indicators among the low quality of care patients. Moreover, not even half of those patients underwent appropriate initial staging screening (43.40 %).

Overall Survival

The follow-up duration ranged from 4 days to approximately 72 months, with a median of 16.5 months. As of October 2014, a total of 80 (56.74 %) patients from our cohort had died, including 35 (66.04 %) patients who received low quality of care and 45 (51.14 %) who received high quality of care. The median overall survival for all patients after diagnosis was 12.9 months (interquartile range (IQR) 7.6–18.8). Patients who received high quality of care lived approximately 6 more months after diagnosis in comparison to those with low quality of care (median of 15.9 months (IQR 10.7–19) vs. 9.6 months (IQR 6–18.8)). The Kaplan-Meier analysis showed statistically significantly better overall survival in patients who received high quality of care (HR, 0.58; 95 %, 0.37–0.90, p=0.015) (Fig. 1).

Factors Associated with Low Quality of Care

Unadjusted Analysis

Patients who received low quality of care were older (median of 67 vs. 64 years, p=0.075) when compared to those who received high quality of care (Table 4). In particular, patients diagnosed with esophageal cancer at the age 80 or older were more likely to receive low quality of care (9.09 vs. 24.53 %, p=0.043). Black and other race, lower education level, SSC

Table 2 Quality indicators

Quality indicator	Number with indicator/number eligible patients	Mean±SD (median)
Overall	114.6[a]/141	0.81±1.19 (0.86)
Histology	141/141	1.00±0.00 (1)
Location	125/141	0.89±0.32 (1)
Grade	141/141	1.00±0.00 (1)
Surgery[b]	91/141	0.65±0.48 (1)
Induction treatment[c]	116/141	0.82±0.38 (1)
Initial staging (PET and CT and EUS)	99/141	0.70±0.46 (1)
Restaging (PET and CT)	89/141	0.63±0.48 (1)

PET positron emission tomography, *CT* computerized tomography, *EUS* endoscopic ultrasound

[a] Average number of patients who complied with quality indicators

[b] Esophagectomy or gastrectomy

[c] Concurrent chemo and radiation therapy

Table 3 Quality indicators by the level of care

Quality indicator	Low quality of care	High quality of care
Overall	53 (37.59 %)	88 (62.41 %)
Histology	53 (100.00 %)	88 (100.00 %)
Location	40 (75.47 %)	85 (96.59 %)
Grade	53 (100.00 %)	88 (100.00 %)
Surgery[a]	14 (26.42 %)	77 (87.50 %)
Induction treatment[b]	28 (52.83 %)	88 (100.00 %)
Initial staging (PET and CT and EUS)	23 (43.40 %)	76 (86.36 %)
Restaging (PET and CT)	14 (26.42 %)	75 (85.23 %)

PET positron emission tomography, *CT* computerized tomography, *EUS* endoscopic ultrasound

[a] Esophagectomy or gastrectomy

[b] Concurrent chemo and radiation therapy

histologic classification, unspecified primary site of tumor, and history of cardiac disease were also associated with receiving low quality of care. It is interesting to point out that no statistical association was noted between marital status, insurance type, median household income, and the level of quality of care.

Adjusted Analysis

Several factors associated with low quality of care in the unadjusted analysis remained statistically significant in the adjusted analysis (Table 5). Specifically, the risk of receiving low quality of care increased for patients 80 years of age or older (RR 2.18, 95 % CI 1.32–3.58, p=0.002) and decreased for patients with higher education level (<85 % of high school graduates or higher: reference; 85–90 %: RR 0.39, 95 % CI 0.19–0.81, p=0.012; ≥90 %: RR 0.55, 95 % CI 0.32–0.94, p=0.028) while adjusting for other factors. In addition, blacks, other races, and those diagnosed with an unspecified primary site of esophageal cancer had increased risk of receiving low quality of care (RR 1.92, 95 % CI 1.24–2.98, 0.003; RR 2.56, 95 % CI 1.22–5.39, p=0.013; RR 2.20, 95 % CI 1.44–3.36, p<0.001, respectively).

Discussion

The results of our analysis suggest that higher compliance with evidence-based guidelines significantly improves survival in esophageal cancer patients. Moreover, we identified several factors associated with low quality of care, such as age ≥80, lower education level, race different from white, and unspecified primary site of esophageal cancer. While most of these characteristics are not modifiable, understanding their relation with quality of care is realistically the first step towards development of interventions aimed to attenuate their negative influence.

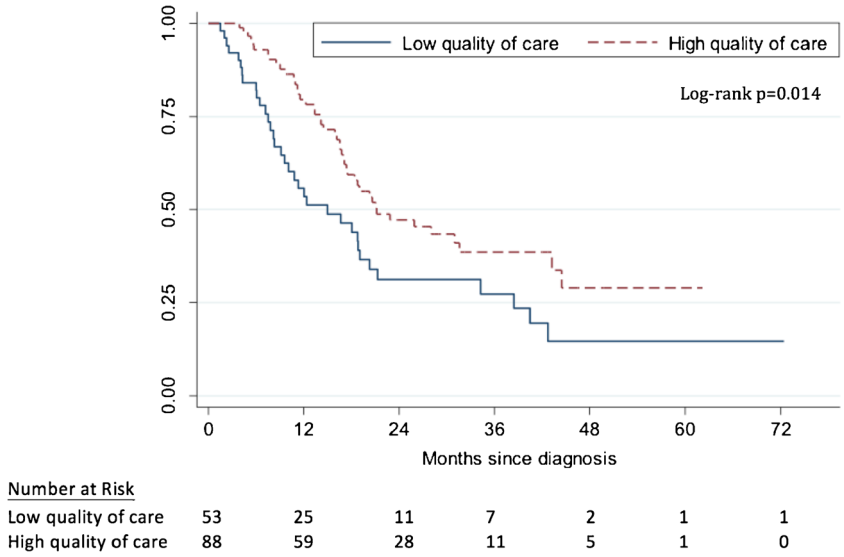

Fig. 1 Kaplan-Meier curves of overall survival rates for stages II and III esophageal cancer patients who received high quality of care versus those who did not

Table 4 Demographic, socioeconomic, pathologic, and clinical characteristics of stages II and III esophageal cancer patients by quality of care, 2008–2013

Characteristic	Low quality of care 53 (37.59 %)	High quality of care 88 (62.41 %)	*p*
Age at diagnosis, median (IQR)	67 (60,79)	64 (58.5,70)	0.075
Age groups			**0.043**
<65	23 (43.40 %)	48 (54.55 %)	
65–79	17 (32.08 %)	32 (36.36 %)	
≥80	13 (24.53 %)	8 (9.09 %)	
Male	40 (75.47 %)	71 (80.68 %)	0.464
Race			**<0.001**
White	38 (71.70 %)	85 (96.59 %)	
Black	11 (20.75 %)	1 (1.14 %)	
Other	4 (7.55 %)	2 (2.27 %)	
Marital status			0.413
Married	34 (66.67 %)	67 (77.01 %)	
Single	9 (17.65 %)	11 (12.64 %)	
Other[a]	8 (15.69 %)	9 (10.34 %)	
Year of diagnosis			0.776
2008–2010	26 (49.06 %)	41 (46.59 %)	
2011–2013	27 (50.94 %)	47 (53.41 %)	
Zip code median household income (IQR)	$61,522.5 ($46,717, $69,825.5)	$60,974 ($51,278, $88,611)	0.104
Zip code median household income			0.187
<$60,000	25 (48.08 %)	40 (45.98 %)	
$60,000–$79,999	18 (34.62 %)	21 (24.14 %)	
≥$80,000	9 (17.31 %)	26 (29.89 %)	
Zip code education level[b]			**0.001**
<85 %	24 (46.15 %)	17 (19.54 %)	
85–89 %	7 (13.46 %)	33 (37.93 %)	
≥90 %	21 (40.38 %)	37 (42.53 %)	
Insurance type			0.847
Private	21 (40.38 %)	41 (46.59 %)	
Medicare+supplemental	26 (50.00 %)	39 (44.32 %)	
Medicare/medical assistance	3 (5.77 %)	6 (6.82 %)	
No insurance	2 (3.85 %)	2 (2.27 %)	
Clinical stage			0.793
II	18 (33.96 %)	28 (31.82 %)	
III	35 (66.04 %)	60 (68.18 %)	
Histology			**0.016**
Adenocarcinoma	24 (45.28 %)	59 (67.05 %)	
Squamous cell carcinoma	27 (50.94 %)	24 (27.27 %)	
Other	2 (3.77 %)	5 (5.68 %)	
Family members with cancer			0.984
No	29 (54.72 %)	48 (54.55 %)	
Yes	24 (45.28 %)	40 (45.45 %)	
Primary site			**<0.001**
Esophagus, lower third	19 (35.85 %)	63 (71.59 %)	
Esophagus, NOS	18 (33.96 %)	8 (9.09 %)	
Esophagus, middle third	14 (26.42 %)	16 (18.18 %)	
Esophagus, upper third	2 (3.77 %)	1 (1.14 %)	
Grade			0.501
Moderately differentiated	15 (28.30 %)	31 (35.23 %)	
Poorly differentiated	18 (33.96 %)	32 (36.36 %)	

Table 4 (continued)

Characteristic	Low quality of care 53 (37.59 %)	High quality of care 88 (62.41 %)	*p*
Undifferentiated	1 (1.89 %)	0	
Not determined	19 (35.85 %)	24 (27.27 %)	
IV	0 (0.00 %)	1 (1.14 %)	
Tobacco history			0.501
Never	7 (16.67 %)	18 (21.43 %)	
Previous	29 (69.05 %)	49 (58.33 %)	
Current	6 (14.29 %)	17 (20.24 %)	
Alcohol history			0.058
Never	9 (24.32 %)	27 (35.06 %)	
Previous	13 (35.14 %)	12 (15.58 %)	
Current	15 (40.54 %)	38 (49.35 %)	
Cardiac disease	23 (45.10 %)	22 (25.00 %)	**0.015**
Pulmonary disease	10 (19.61 %)	20 (22.73 %)	0.667

Different denominator due to missing observations: marital status, $n=138$; median household income, $n=139$; high school graduate or higher, $n=139$; insurance type, $n=140$; tobacco history, $n=126$; alcohol history, $n=114$; cardiac and pulmonary diseases, $n=139$

Bold indicates statistical significance

IQR interquartile range, *NOS* not otherwise specified

[a] Separated, divorced, or widow

[b] Percentage of high school graduates or higher in a given zip code

Table 5 Factors associated with low quality of care among stages II and III esophageal cancer patients, 2008–2013

Characteristic	RR (95 % CI)	*p*
Age groups		
<65	Reference	
60–79	1.05 (0.65–1.70)	0.832
≥80	2.18 (1.32–3.58)	**0.002**
Race		
White	Reference	
Black	1.92 (1.24–2.98)	**0.003**
Other	2.56 (1.22–5.39)	**0.013**
Zip code median household income		
<$60,000	Reference	
$60,000–$80,000	1.58 (1.01–2.49)	**0.046**
≥$80,000	1.04 (0.43–2.53)	0.939
Zip code education level		
<85 %	Reference	
85–89 %	0.39 (0.19–0.81)	**0.012**
≥90 %	0.55 (0.32–0.94)	**0.028**
Primary site		
Esophagus, specified	Reference	
Esophagus, NOS	2.20 (1.44–3.36)	**<0.001**
Cardiac disease	1.41 (0.93–2.13)	0.102

Bold indicates statistical significance

NOS not otherwise specified

The quality indicators we chose are therapeutic milestones that dictate management of cancer for individual patients while ensuring compliance to case-specific guidelines. It is not surprising that location, histology, and grade were the indicators that registered better compliance. Location is often determined at the time of diagnosis, and can be extrapolated either from endoscopic of radiologic evidence of a newly discovered tumor. Histology and grade usually follow shortly after, and are mostly individuated through the same procedure. All of these steps constitute preliminary assessments necessary to plan the optimal therapeutic strategy and can usually be administered safely to all but the most critical patients. Conversely, in order to score a point in the imaging quality indicator, each patient was required to have obtained all three of the imaging tests necessary to ensure staging accuracy. In the clinical practice, this is not always possible for a variety of reasons, especially in the case of endoscopic ultrasound. This might be due to technical difficulties, such as bulky tumors that impede the progression or the probe, or to clinical judgment, as it would be withholding the procedure in critically ill patients incidentally diagnosed with esophageal cancer through imaging performed for other reasons. Similarly, while induction treatment was considered to be high-quality care only if both radiation and chemotherapy were concurrently administered, this regimen is demanding, and patients with severe comorbidities can be deemed unfit for induction, or willingly refuse part of it. These are in part the same reasons that led to a low rate of surgeries in the low-quality group. Esophagectomy is a procedure burdened by significant mortality and morbidity, and several factors, among

which age older than 80, have been reported to be an independent risk factor for increased mortality after this operation.[10] Therefore, it is not surprising that surgical treatment was the least frequently administrated quality indicator. The true causes of missed restaging exams where perhaps the most challenging to individuate. For example, review of patients' data suggested that in several occasions the missing record was due to restaging performed in external facilities, rather than true omission.

Our adjusted analysis showed that the risk of receiving low quality of care increased for patients 80 years of age or older. Since we performed a detailed manual review of patients' records in order to identify specific determinants of lower-quality care, we were able to assess that this finding is attributable to multiple causes. First of all, some patients in this group were diagnosed incidentally with esophageal cancer while they were hospitalized for other life-threatening diseases. As expected, these patients were not medically well enough to be treated according to the standard of care, which ideally relies on multimodality therapy in stage II and III cancers, and is notoriously demanding even in healthy individuals. Additionally, this age group also included the majority of those patients who refused surgery after being diagnosed with esophageal cancer and those who were deemed unfit for surgery during the pre-operative assessment.

The overall survival observed in our population might seem lower to that reported in comparable cohorts.[11] However, this is likely attributable to short follow-up (median of 16.5 months) rather than true survival. Nonetheless, even within this relatively short time span, high quality of care appeared to grant a survival advantage.

The characteristics of our population closely mirror the epidemiology of esophageal cancer in the USA, our average patient being a white, late middle-aged man, affected by distal esophageal adenocarcinoma. Moreover, the vast majority of our patients were former or current smokers. While smoking is mostly known for being a risk factor for SCC, it should not be forgotten that it also represents an important risk factor for esophageal adenocarcinoma, including the junctional subtype.[12,13]

Even though the majority of esophageal cancers in the USA are adenocarcinomas, SCC is still present, and especially well represented in black patients. It is paramount to consider histology when analyzing survival after multimodality treatment for esophageal cancer, since SCC has better response to induction. Indeed, SCC's response to chemo-radiation is so marked that there are data suggesting that it could be a definitive treatment option in these patients, with surgery added in the form of salvage esophagectomy only in case of need.[14,15] While this course is not yet a standardized recommendation, it is reasonable to hypothesize that it might contribute to the observed association of esophageal SCC with lower quality of care. In fact, markedly different responses after induction might have influenced the following therapeutic choices and led, as a consequence, to deviations from the standardized path that ultimately accounted for decreased compliance with NCCN guidelines.

Some of the factors that we found to be associated with low quality of care in esophageal cancer correlate well with findings of other studies on cancer patients. Education level plays an important role in many aspects of the therapeutic journey of cancer patients, starting from attitude towards cancer itself. In this regard, Quaife et al. have reported that lower educational level is strongly associated with negative belief towards cancer prognosis and cancer treatment, which, in turn, might predispose to behaviors likely to affect quality of care, such as higher healthcare avoidance, lower screening uptake, and fear of help-seeking.[16] Similarly, results from the analysis of a large random digit dialing telephone survey in the USA showed that people with lower educational level are more likely to endorse several common misconceptions about cancer treatment.[17]

Lower quality of care among black people affected by esophageal cancer has been observed previously. An analysis of the Surveillance, Epidemiology, and End Results (SEER) registry showed that black patients were more likely to be diagnosed at a more advanced stage and were less likely to undergo surgery; this ultimately resulted in worse survival.[18] More recently, Revels et al. reported that elderly black patients are less likely to undergo surgery after diagnosis of several poor prognosis cancers, including esophageal cancer, regardless of the resection rate of the treating hospital.[19] Reasons for this disparity are still not fully understood, yet it should not be forgotten that surgery remains the mainstay for treatment of esophageal cancer and can drastically modify the natural history of the disease. Therefore, efforts should be made to individuate and remove obstacles towards equal access to the best treatment across races.

Insurance type and lower median household income were not statistically associated with receiving low quality of care. This is somewhat different from what was observed previously by other authors, who reported higher income to be a predictor of lengthened esophageal cancer survival.[20] However, the said study used a considerably lower income threshold than ours and collected data from different geographic regions.

Our study presents several limitations. First of all, we chose to use the 2014 NCCN guidelines to define quality of care indicators across the study period (starting in 2008), even though this tool is subject to continuous updates as new and better evidence towards specific treatments emerges. However, the changes made between annual versions were minor for the purpose of the present study. It is worth mentioning that we carefully selected the time span of the analysis to reflect most of the meaningful changes that the NCCN guidelines underwent after the introduction of the 7th Edition American Joint Committee on Cancer Staging Classification.[21] This publication addressed several issues, starting from a better definition of gastro-esophageal junction cancers, to separation of SCC and adenocarcinoma histologies, and to revision of T, N, and M parameters.[22] Secondarily, some limitations of our study are due to the very nature of the data used; for example, some of the follow-up data were missing, which might

introduce a certain degree of bias. Moreover, the adherence to guidelines witnessed at a high-volume tertiary care center might not be properly extrapolated to that of all hospitals and the general population. Educational level and median household income were obtained using patients' zip codes of residence and therefore might not be accurate for every patient. Finally, we acknowledge that there might have been different reasons leading to noncompliance (patient choice, disease course, complications of treatment, etc.). However, the aim of this study was to identify factors associated with quality of care and the difference in survival based on the level of care received, not to explore the reasons that led to individual therapeutic choices of treatment.

Despite the aforementioned limitations, the scientific question that our analysis aims to answer is, without a doubt, one that tries to shed light on the path leading to delivery of high-quality care. The true effectiveness of guidelines depends on dissemination and compliance, which ultimately determine the impact of guidelines themselves on the targeted disease; studies aimed at measuring these parameters are an essential and irreplaceable step towards quality improvement.[5]

Conclusion

According to our study, delivery of high-quality care is associated with improved survival in esophageal cancer patients. This evidence mandates efforts aimed at minimizing disparities in treatment in regards to race and educational levels.

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