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Travel distance: Impact on stage of presentation and treatment choices in head and neck cancer

Mark J. Ringstrom[a], Jay Christian[b], Matthew L. Bush[a], Jeffrey E. Levy[b], Bin Huang[c], T.J. Gal[a,*]

[a] Department of Otolaryngology-Head and Neck Surgery, University of Kentucky, Lexington, KY, United States of America
[b] Department of Epidemiology, University of Kentucky, Lexington, KY, United States of America
[c] Department of Biostatistics, University of Kentucky, Lexington, KY, United States of America

A B S T R A C T

Objectives: The objective was to examine the impact of travel distance on stage of presentation and treatment choices in head and neck squamous cell carcinoma in the rural setting.
Methods: 6029 cases diagnosed from 2002 to 2011 were obtained from the state cancer registry. Travel time was calculated to the nearest academic medical centers, otolaryngologist, and radiation treatment facilities. Multivariate logistic regression was used to examine the association of travel time with stage of presentation as well as the likelihood of appropriate therapy after adjustment for other demographic variables.
Results: Patients in the highest quartile for travel distance to academic centers were 33% more likely to present with early stage disease ($p = 0.02$), and 42% more likely to receive appropriate surgical therapy for oral cavity cancer. Patients were 70% more likely to receive appropriate surgery if they were farthest from the nearest radiation center ($p = 0.03$). Proximity to otolaryngology care was not significant.
Conclusion: Increased travel distance to academic medical centers is associated with increased likelihood of proper therapy for surgically treated tumors of the head and neck. Impact on these findings on improvements in access to care is discussed.

1. Introduction

Many factors are associated with access to healthcare. These include demographics, insurance status, geography, income and resources for travel, and availability of services. Specialized services, like surgical oncology, advanced reconstructive techniques, and clinical trials, are neither widely nor uniformly distributed. Patient access to these services is often limited by their proximity to them. The distance traveled to healthcare resources and the time it takes to get there can be a significant determinant of both access and utilization.

In 2003, Onega, et al., examined travel times to specialized cancer care in the continental US. It was estimated that roughly 45% of the population had travel times of < 1 h to the nearest NCI cancer center. The median travel time to the nearest NCI cancer center for the US population is 78 min. Approximately 69% were within an hour of the nearest academic medical center, and 92% were within an hour of any specialized cancer care. Travel time increases proportionally with the degree of cancer care specialization needed [1].

A systematic review in 2015 on the burden of travel distance on cancer care suggested that increasing travel requirements were associated with more advanced disease, inappropriate treatment, worse prognosis and quality of life [2]. Advanced diagnosis of breast cancer has been observed to be associated with increased travel distance from the nearest mammography facility [3]. Similarly, increased travel distance from the hospital has been shown to be associated with more advanced stage of presentation of lung and esophageal cancers [4]. However, greater travel distance, suggestive of travel to higher volume centers, has been shown to be associated with improved outcomes and reduced mortality [5–8]. The impact of travel distance in head and neck cancer has received little attention.

The significance of travel distance becomes more pronounced in the rural setting. Lack of public transportation necessitates use of private vehicles to overcome distance barriers. The availability of options for care is much more limited than in the urban setting, where multiple facilities for cancer care are frequently available. It is our hypothesis that the challenges of access to care that can result from the potential barriers of travel may affect not only the stage of presentation of disease, but also the available or chosen options for therapy. The objective of this study was to examine the impact of travel distance on stage of presentation and potential effects on treatment choices. While the

* Corresponding author at: Department of Otolaryngology-Head and Neck Surgery, University of Kentucky Medical Center, 800 Rose St, Rm C236, Lexington, KY 40536, United States of America.
E-mail address: tjgal2@uky.edu (T.J. Gal).

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unique rural nature of Appalachian Kentucky presents an ideal model for this investigation, many parallels can be drawn with much of rural America.

2. Methods

Institutional Review Board (IRB) approval was obtained for this study. De-identified patient data was obtained from the Kentucky Cancer Registry (KCR) for patients with newly diagnosed head and neck cancer in the state of Kentucky between 2002 and 2011. KCR is a population-based cancer registry, and contributing site to the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program.

Demographic data supplied by the KCR included date of birth, gender, race, insurance status, and best known home address at the time of cancer diagnosis. Tumor type was classified by site according to SEER site codes, and stage based on a calculated "Best Stage" derived by the KCR, which is primarily based on the American Joint Committee on Cancer (AJCC) Staging Manual, 7th Edition [9]. Treatment was determined from KCR composite codes of the first course treatment indicating the types and combinations used. This included surgery, radiation, chemotherapy, or other. Primary treatment was classified into one of six categories: surgery only, radiation only, radiation and chemotherapy, surgery and adjuvant (radiation, chemotherapy, both, or other), chemotherapy only, and unknown. Patients were classified based on the initial treatment received. Clinical data supplied by the KCR included date of diagnosis, primary tumor site (SEER site), cancer stage (SEER Summary Stage, and KCR calculated Best Stage), type of treatment received (treatment composite code), and mortality data (both disease specific and all cause).

Home addresses in the registry are denoted by longitude and latitude, with a range of specificity based on the quality of the source data. For example, the coordinates may be based on a patient's exact street address, or simply on their home zip code. If only the zip code is known, the central point of the zip code or county of residence is used.

Names and locations of radiation treatment centers were obtained from listings maintained by the Radiation Health Branch of the Kentucky Cabinet for Health and Family Services [10]. Physical location and date of opening (and in some instances closing) were verified by phone conversation with the individual centers. Otolaryngology providers were identified from a listing of licensed otolaryngologists maintained by the state of Kentucky [11]. Providers listed as active during the study period were identified and contacted by phone to verify physical addresses, years of operation, and the presence of satellite locations. Academic medical centers with fellowship trained head and neck surgeons in Kentucky and immediately adjoining states were also included. Radiation treatment centers and otolaryngologists were included in the analysis only for the portions of the study they were open.

Travel time was calculated using ArcGIS (Esri, Redlands, CA), using Network Analyst extension to calculate one-way travel time in kilometers and minutes between them [12]. Travel times were calculated for the route from each patient's address to the nearest otolaryngologist, the nearest radiation treatment facility, as well as the nearest academic medical center. The University of Kentucky is the only NCI Cancer Center in the state, so only academic medical centers were used. Travel was calculated to the *nearest* facility as a measure of potential access to care, rather than where the patient actually chose to receive care, which would be presumed to be the same, or a greater distance if the patient chose to go elsewhere.

It was presumed that advanced head and neck surgical care was centralized in academic medical centers, while radiation treatment centers were more uniformly distributed statewide. Thus we sought to determine whether there was a difference in the impact of travel distance on tumors primarily treated surgically, tending toward treatment at academic centers, compared to tumors treated non-surgically, specifically with radiation or chemoradiation. NCCN guidelines were used to establish a basis for comparison of surgical and non-surgical disease [13]. Patients with oral cavity tumors treated with surgery ± adjuvant therapy were thus classified as having "ideal" or "preferred" treatment. Patients with oropharynx tumors treated with radiation or chemoradiation were classified as having preferred treatment. The majority of the study period predates the use of surgery, specifically transoral robotic surgery, for the management of advanced oropharyngeal cancer, and was not felt to have a significant impact on this classification. Advanced hypopharyngeal and larynx cancer can preferentially be treated with numerous modalities for a number of reasons. Considering these issues, larynx cancer patients were excluded from the analysis of optimal treatment choices.

The primary objective was to examine travel distance and travel time in relation to stage of presentation and treatment choices. Descriptive statistics were performed examining the characteristics of cancer sites and demographics/clinical factors with Chi-Square tests. Since the travel time and distance were not normally distributed, two-sample Wilcoxon rank-sum (Mann-Whitney) tests were used for differences by stage of diagnosis (early vs. late). To reiterate, optimal treatment for oral cavity cancer, for the purposes of this study, is considered to be surgery ± adjuvant therapy. Optimal or preferred treatment for oropharynx cancer is considered to be radiation ± chemotherapy. Multivariate logistic regression was used to test associations of stage of presentation and other confounders including travel distance/time, classified into quartiles, and treatment, adjusting for demographic factors. Other variables included in the multivariate modeling included age, gender, race, and insurance status, Statistical analysis was performed using Stata 13 (College Station, TX). All statistical tests are two sided with a significance level of 0.05 for statistical significance.

3. Results

6029 patients were identified over the ten-year study period from 2002 to 2011. Demographics are presented in Table 1. The population represented is predominantly white (93%), male (75%), and over the age of 50 (81%). 40% of patients had oral cavity tumors, 39% hypopharynx/larynx cancers, and 21% were tumors of the oropharynx.

Distribution of radiation treatment centers, otolaryngology offices, and academic medical centers are shown in Fig. 1. The population of Kentucky ranged from 4.09 million in 2002 to 4.3 million in 2011. Overall, there were 34 radiation centers statewide with active practices from 2002 to 2011. This corresponds to one radiation center for approximately every 91,000 to 98,000 adults over the study period. Nationally, there is roughly one radiation oncologist for every 53,000 adults [14]. Most, but not all radiation centers outside of the academic institutions were staffed by one radiation oncologist. Thus the number of radiation oncologists per capita in Kentucky could not be calculated. There were 59 otolaryngology offices and 14 academic medical centers. Similarly, many otolaryngologists work out of multiple offices, so the number of offices differs from the number of otolaryngologists. The presumption was that the presence of an office implied access to an otolaryngologist. The state of Kentucky has two academic medical centers, the University of Kentucky and the University of Louisville, with the remaining 12 in the eight states bordering Kentucky.

Average travel time to the nearest academic medical center for all patients averaged well over an hour. Travel time to the nearest radiation treatment center averaged about 25 min, while the nearest otolaryngologist was about 15 min away. Travel times for each site by stage of presentation to the nearest academic center, radiation center, and otolaryngologist are listed in Table 2. Overall, advanced stage disease was associated reduced travel to academic centers when compared to early stage disease. Median differences of 11 min, or 16 km (10 miles) were observed between early and late stage disease. Similar differences were observed for all subsites except oropharyngeal cancer,