Original Article

Association Between Hospital Case Volume and the Use of Bronchoscopy and Esophagoscopy During Head and Neck Cancer Diagnostic Evaluation

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BACKGROUND: There are no clinical guidelines on best practices for the use of bronchoscopy and esophagoscopy in diagnosing head and neck cancer. This retrospective cohort study examined variation in the use of bronchoscopy and esophagoscopy across hospitals in Michigan. **METHODS:** A total of 17,828 patients were identified with head and neck cancer in the 2006 to 2010 Michigan State Ambulatory Surgery Databases. A hierarchical, mixed-effect logistic regression was used to examine whether a hospital's risk-adjusted rate of concurrent bronchoscopy or esophagoscopy was associated with its case volume (< 100, 100-999, or ≥ 1000 cases per hospital) for those undergoing diagnostic laryngoscopy. **RESULTS:** Of 9218 patients undergoing diagnostic laryngoscopy, 1191 (12.9%) received concurrent bronchoscopy and 1675 (18.2%) underwent concurrent esophagoscopy. The median hospital rate of bronchoscopy was 2.7% (range, 0%-61.1%), and low-volume (odds ratio [OR] = 27.1; 95% confidence interval [CI] = 1.9, 390.7) and medium-volume (OR = 28.1; 95% CI = 2.0, 399.0) hospitals were more likely to perform concurrent bronchoscopy compared to high-volume hospitals. The median hospital rate of esophagoscopy was 5.1% (range, 0%-47.1%), and low-volume (OR = 9.8; 95% CI = 1.5, 63.7) and medium-volume (OR = 8.5; 95% CI = 1.3, 55.0) hospitals were significantly more likely to perform concurrent esophagoscopy relative to high-volume hospitals. **CONCLUSIONS:** Patients with head and neck cancer who are undergoing diagnostic laryngoscopy are much more likely to undergo concurrent bronchoscopy and esophagoscopy at low- and medium-volume hospitals than at high-volume hospitals. Whether this represents overuse of concurrent procedures or appropriate care that leads to earlier diagnosis and better outcomes merits further investigation. ***Cancer*** **2014;120:61-7**. *© 2013 American Cancer Society.*

KEYWORDS: otolaryngology, endoscopy, head and neck cancer, diagnostic techniques and procedures, hospital volume, Michigan State Ambulatory Surgery Databases, Michigan.

INTRODUCTION

The National Institutes of Health (NIH) estimated that the costs of cancer in 2008 were $201.5 billion, attributed to both direct medical costs and indirect costs such as lost productivity due to premature death.[1] In the increasingly cost-conscious US health care system, there is concern that variation in cancer-related costs is being driven by expensive diagnostic and therapeutic technologies, differences in reimbursement strategies, and physician-induced demand.[2-5]

Diagnostic practice patterns in head and neck cancer (HNC) are poorly understood. In the only study to date on variation in diagnostic upper aero-digestive tract (UADT) endoscopy, Deleyiannis et al[6] examined a cohort of 1140 patients with HNC from the Surveillance, Epidemiology, and End Results (SEER) Program and Medicare claims databases from 1991 to 1993. The authors found that across 5 SEER sites (Connecticut; Detroit, Michigan; Iowa; San Francisco, California; Seattle, Washington), bronchoscopy usage ranged from 6.9% to 32.7% for local cancer and 12.8% to 50.7% for regional cancer, whereas esophagoscopy usage ranged from 12.9% to 39.8% for local cancer and 22.2% to 59.7% for regional cancer. SEER geographic area was found to be associated with the degree of both esophagoscopy and bronchoscopy use even after controlling for differences in age, sex, race, tumor site and grade, Charlson comorbidity index, and socioeconomic status.

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Current published clinical guidelines from the National Comprehensive Cancer Network (NCCN) are generally ambiguous in regard to optimal UADT endoscopic evaluation. The lack of clear clinical guidelines itself may be due to a paucity of relevant high-quality research. There is currently no evidence that routine comprehensive UADT endoscopy ("panendoscopy"), compared to selective symptom-directed endoscopy, confers a high yield or added survival benefit to patients with HNC.[7] The proliferation of advanced, less invasive diagnostic modalities such as computed tomography (CT) and barium esophagography has complicated the choice of modality to evaluate the tracheobronchial tree and esophagus, if they are performed at all.

In this study, we revisited the problem of variation in diagnostic UADT endoscopy for patients with HNC at the hospital level. We sought to examine how often bronchoscopy and esophagoscopy were used in conjunction with laryngoscopy in the diagnostic evaluation of patients with HNC, and whether this practice varied significantly between hospitals with lower versus higher case volumes.

MATERIALS AND METHODS

We conducted a retrospective cohort analysis of the 2006 to 2010 Healthcare Cost and Utilization Project (HCUP) Michigan State Ambulatory Surgery Databases (SASD), sponsored by the Agency for Healthcare Research and Quality. The Michigan SASD is an all-payer database containing discharge data for 100% of the ambulatory procedures performed at hospital-based ambulatory surgery, rehabilitation, and osteopathic centers.[8,9] We used publicly available, de-identified Michigan SASD data and received an exemption from the University of Michigan Medical School Institutional Review Board.

First, we identified patients with a diagnosis of malignant neoplasms of the head and neck, using *International Classification of Diseases, Ninth Revision with Clinical Modification* (ICD-9-CM) diagnostic codes 140-149 and 161. We initially determined whether HNC patients underwent laryngoscopy using Current Procedural Terminology (CPT) codes 31510, 31512, 31515, 31525, 31526, 31535, 31526, 31535, 31536, 31540, 31541, 31575, 31576, and 31578. All analyses were based on this subgroup of patients with HNC, because the laryngoscopy is the core procedure around which other aspects of diagnostic UADT evaluation are based. We also identified patients who underwent bronchoscopy (CPT 31615, 31622, 31623, 31624, 31625, 31640, and 31461), virtual bronchoscopy (CPT 31626 and 31627), esophagoscopy (CPT 43200, 43202, 43217, 43235, and 43239), and esophageal radiographic studies (CPT 74220, 74230, 74240, 74241, 74245, 74246, 74247, and 74249).

We excluded records missing hospital identifier or ZIP code data (n = 1159), as well as cases done in hospitals that had fewer than 10 patients with a diagnosis of HNC per year of study (n = 141). The primary unit of analysis was defined as hospital case volume, stratified by orders of magnitude into low-, medium-, and high-volume centers (99 or fewer, 100 to 999, and 1000 or more operative HNC patients annually per hospital, respectively). We selected hospital volume for study because this characteristic has been used to show significant disparities in both access and patient outcomes for select major oncologic procedures.[10-12] As a sensitivity analysis, we examined a subset of patients who lived in the same Michigan hospital service areas (HSAs) where they were treated. HSAs are described by the Dartmouth Atlas of Health Care as local health care markets for hospital-based care, defined as a collection of ZIP codes whose residents are hospitalized primarily in hospitals in that area. HSA data were acquired for the patients in our study by merging the SASD databases for each year of study with corresponding Dartmouth Atlas HSA crosswalk data sets.[13] An additional 349 patients were excluded from this subgroup analysis.

We used Stata version 12.1 (StataCorp LP, College Station, Tex) for all analyses. We constructed hierarchical, mixed-effect logistic regression models using maximum likelihood estimation to calculate the odds that a patient with HNC who underwent laryngoscopy also underwent either bronchoscopy or esophagoscopy. We also calculated intraclass correlation coefficients (ICCs), which were used to determine the proportion of variation in bronchoscopy or esophagoscopy rate between hospitals attributable to hospital HNC case volume.[14] We controlled for the potential confounding variables patient age, sex, and urban/rural place of residence as fixed effects. Hospital case volume was included as a random effect. Patients were clustered by hospital and HSA in separate 2-level analyses.

RESULTS

After excluding cases missing hospital identifier or ZIP code data and cases from hospitals performing laryngoscopies on fewer than 10 HNC patients per year, we identified 17,828 HNC cases in 92 hospitals, 9218 (52%) of whom underwent diagnostic laryngoscopy. Patient and hospital characteristics are listed in Table 1. Of those undergoing laryngoscopy, 1191 (12.9%) patients underwent concurrent bronchoscopy and 1675 (18.2%) underwent concurrent esophagoscopy. The median hospital rate of concurrent bronchoscopy was 2.7% (range, 0%-61.1%), and 26 (28.3%) of the 92 hospitals in the study did not perform any concurrent bronchoscopies (Fig. 1). The median hospital rate of concurrent esophagoscopy was 5.1% (range, 0%-47.1%), and 14 (15.2%) hospitals performed no concurrent esophagoscopies (Fig. 2). No hospital reported doing any virtual bronchoscopies, whereas only 30 (0.3%) cases included esophageal radiographic studies.

TABLE 1. Characteristics of Head and Neck Cancer Patients in Michigan Undergoing Outpatient Diagnostic Laryngoscopy in 2006-2010 (n = 9218)

Patient or Hospital Characteristic	Value
Age (mean ± standard deviation)	61.9 ± 11.5 y
Male sex	75.7%
White race	82.3%
Insurance status	
Public/government	55.0%
Private	42.5%
Other	2.5%
Urban residence	77.0%
Median household income	
1st quartile	27.2%
2nd quartile	26.1%
3rd quartile	23.8%
4th quartile	22.9%
Hospital case volume	
Low (<100 cases)	6.9%
Medium (100-999 cases)	38.5%
High (1000+ cases)	54.6%

In unadjusted analyses, concurrent bronchoscopy and esophagoscopy were significantly more common at hospital with low or moderate HNC case volumes than at high-volume hospitals (Table 2). Empty hierarchical regression modeling demonstrated a significant association between bronchoscopy and hospital case volume ($P < .001$). After controlling for age, sex, and area of residence, the regression model remained statistically significant ($P < .001$) with an ICC of 0.511. The model was statistically significant ($P < .001$) and the ICC was 0.506 after controlling for hospital HNC case volume. Thus, approximately 0.9% of overall variation in bronchoscopy rate was due to hospital case volume. Low-volume hospitals had an adjusted odds ratio (OR) of 27.1 (95% confidence interval [CI] = 1.9, 390.7) of performing concurrent bronchoscopy compared to high-volume hospitals, whereas medium-volume hospitals had an adjusted OR of 28.1 (95% CI = 2.0, 399.0).

The association between esophagoscopy and hospital case volume was not statistically significant in the

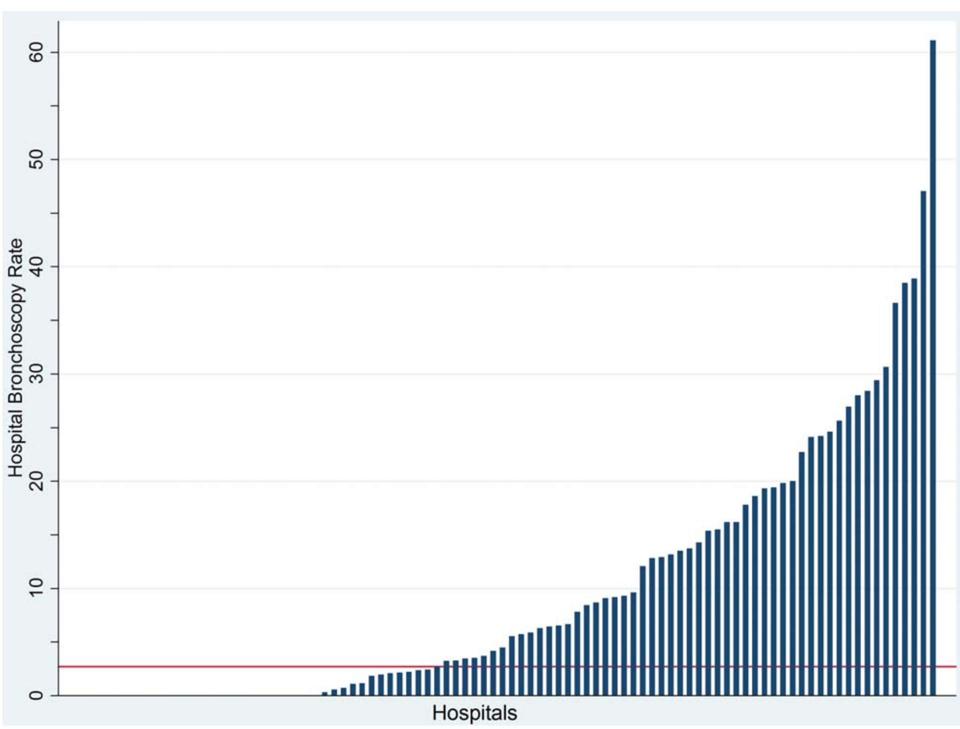

Figure 1. Hospital rates of concurrent bronchoscopy are show, based on all head and neck cancer diagnostic laryngoscopy cases in Michigan performed from 2006 to 2010. The red line represents the median rate of hospital bronchoscopy (2.7%).

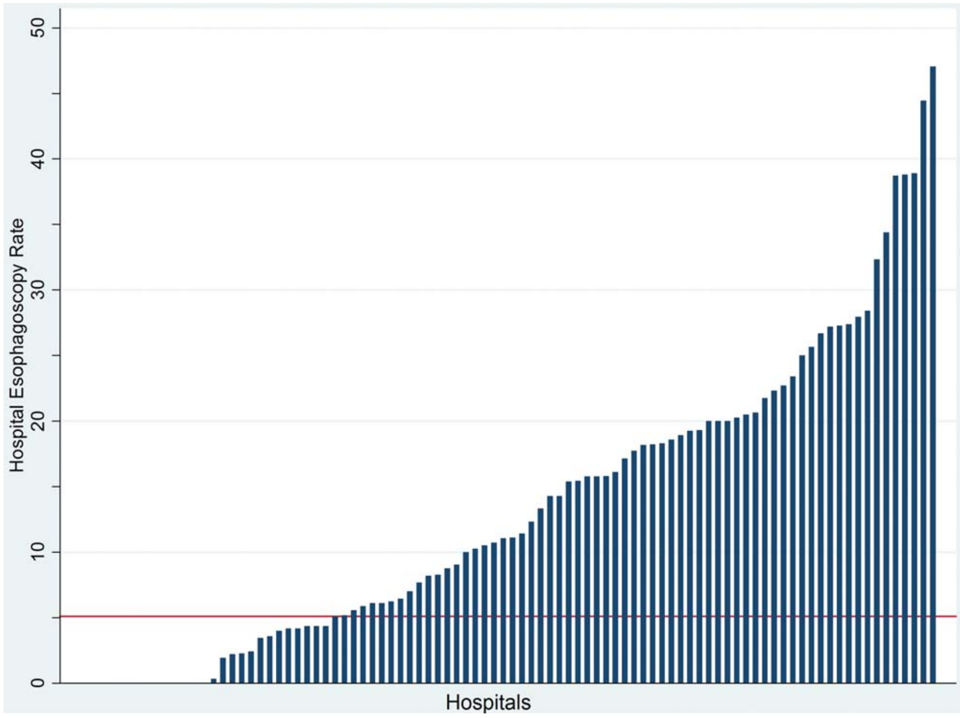

Figure 2. Hospital rates of concurrent esophagoscopy are shown, based on all head and neck cancer diagnostic laryngoscopy cases in Michigan performed from 2006 to 2010. The red line represents the median rate of hospital esophagoscopy (5.1%).

TABLE 2. Percentage of Laryngoscopy Patients Who Also Underwent Concurrent Bronchoscopy or Esophagoscopy

Concurrent Bronchoscopy	Proportion of Cohort	Concurrent Esophagoscopy	Proportion of Cohort
Hospital case volume		Hospital case volume	
Low	30.9%	Low	36.2%
Medium	27.2%	Medium	33.7%
High	0.6%	High	4.9%
Health service area (HSA)		Health service area (HSA)	
1st quintile	9.4%	1st quintile	15.4%
2nd quintile	15.6%	2nd quintile	20.7%
3rd quintile	14.4%	3rd quintile	20.4%
4th quintile	11.2%	4th quintile	16.7%
5th quintile	15.3%	5th quintile	19.5%

empty hierarchical model ($P = .054$). However, after controlling for patient-level characteristics, the model achieved statistical significance ($P = .004$) and an ICC of 0.344. The model remained statistically significant ($P = .002$) with an ICC of 0.335 after including HNC case volume at the hospital level. Thus, approximately 2.7% of overall variation in esophagoscopy rate was attributable to hospital case volume. Compared to high-volume hospitals, low-volume hospitals had an adjusted OR of 9.8 (95% CI = 1.5, 63.7) of performing concurrent esophagoscopy, whereas medium-volume hospitals demonstrated an adjusted OR of 8.5 (95% CI = 1.3, 55.0). Sensitivity analyses using hospital volume tertiles, rather than our a priori high/medium/low categories, revealed similar findings for both bronchoscopy and esophagoscopy.

DISCUSSION

Our study demonstrated large differences in the use of concurrent bronchoscopy and esophagoscopy across Michigan hospitals based on the number of operative HNC patients treated in each institution annually.

Although it is not possible to determine whether this variation represents wasteful or inappropriate care, the finding that high rates of concurrent bronchoscopy and esophagoscopy mainly occur in lower-volume centers is certainly a matter of concern.

The lower rates of bronchoscopy and esophagoscopy in high-volume hospitals may be explained by 3 possibilities. First, tertiary care referral centers tend to be high-volume centers and may consequently treat a large percentage of patients who already underwent extensive workup in other hospitals prior to referral. With sufficiently thorough documentation from outside sources, head and neck oncologists at tertiary care centers may be less inclined to duplicate diagnostic procedures such as esophagoscopy and proceed more quickly to definitive treatment. It was not possible to determine whether any of the patients in the high-volume hospitals in our study had been referred from other centers to verify our hypothesis.

The second possibility is that the variation in bronchoscopy and esophagoscopy reflects ongoing disagreement about the utility of these diagnostic procedures. It is commonly accepted that routine UADT endoscopy will detect asymptomatic tumors in the head and neck, particularly synchronous lesions.[15,16] Clinicians in favor of symptom-directed endoscopy report that this is more efficient and cost-effective than panendoscopy.[17] In contrast, proponents of panendoscopy argue that the associated morbidity rate is low and that in patients with primary HNC, there is a significant possibility of identifying synchronous tumors of the head and neck.[18,19] However, although panendoscopy is still considered the most effective means of detecting second primary tumors in patients with HNC, there is no evidence to suggest that patients with synchronous tumors in the lungs or esophagus have increased survival rates if the tumors are detected by screening rather than close follow-up.[7] Others have suggested increasing roles for nonsurgical means to either supplement or replace endoscopy for diagnosing HNC, including positron emission tomography (PET), CT, or PET/CT imaging.[20,21]

Third, it is possible that low-volume surgeons may simply not be aware of changes in clinical guidelines. Prior research has demonstrated lower adherence to clinical guidelines by community-based clinicians compared with clinicians based at academic or teaching hospitals, whether surgical or medical,[22-25] and community-based surgical centers tend to be lower-volume than their academic counterparts.[22] However, our study was not designed to determine adherence to current clinical guidelines for HNC diagnosis based on practice setting, and further research would need to be undertaken to investigate this phenomenon.

This variation in practice may be influenced in part by a lack of clear clinical guidelines. Specialty-based guidelines published by the American Head and Neck Society in 1995 do not recommend routine bronchoscopy or esophagoscopy for cancers of the nasopharynx, oral cavity, oropharynx, and larynx unless the patient demonstrates a significantly high risk of a synchronous primary tumor (ie, alcohol and tobacco abusers in nasopharyngeal cancer) or if symptoms are present, reserving these modalities for routine use primarily in head and neck metastases of unknown primary and cancers of the hypopharynx. These have since been superseded by the NCCN guidelines, which are ambiguously worded in regards to optimal UADT endoscopic evaluation. Although the 2008 NCCN guidelines specifically recommended both diagnostic bronchoscopy and esophagoscopy for evaluating occult HNC and cancers of the oropharynx and hypopharynx, the language in the 2012 version is less explicit. There is no longer a specific endorsement of bronchoscopy in routine HNC diagnostic workup, whereas esophagoscopy is now specifically suggested only for occult primary evaluation. This study does not consider the question of appropriateness of diagnostic bronchoscopy or esophagoscopy in the context of clinical guideline adherence or the utility of UADT endoscopy in detecting cancers which would have otherwise gone undiagnosed, and further prospective research would be necessary to address these issues.

By defining our primary cohort as patients with HNC who underwent diagnostic laryngoscopy, we intended to capture the broadest possible segment of individuals who would have plausibly undergone concurrent bronchoscopy and/or esophagoscopy. The SASD does not contain information on whether these cases of HNC were new or recurrent, nor did we examine whether patients were diagnosed with more than one HNC because we did not intend to evaluate synchronous or multicentric lesions nor did we plan on stratifying outcomes by tumor subsite. Stratifying patients by subsite would have reduced the effective volume of patients in our study substantially. In addition, this study also was not designed to capture whether patients underwent diagnostic PET or CT imaging modalities, because the SASD data set is surgical and not specifically intended for analysis of radiographic data. We did discover that esophageal radiographic studies were only rarely performed, although it is likely that many of these diagnostic interventions were performed in nonoperative settings. A different database would be necessary to evaluate radiographic diagnostic volume more fully.

This study has several other limitations that must be considered. We omitted patient comorbidity in our study because of the low morbidity associated with UADT endoscopy. Although it is possible that a patient with severe or numerous comorbidities precluding general anesthesia might elect to undergo less invasive diagnostic procedures, it would be unlikely that these comorbidities would justify undergoing only diagnostic laryngoscopy, without other endoscopic procedures, in the operating room. The SASD data sets do not contain tumor staging, long-term survival figures, or other clinical data that would have allowed a more nuanced examination of patient populations served within each category of hospital or an assessment of the appropriateness of these diagnostic procedures. As a result, we were unable to determine the number of esophageal or lung cancer cases that were identified as a result of endoscopy or the number of cases that went undiagnosed due to lack of endoscopy. Finally, SASD does not have cost-to-charge ratio data that would eliminate local differences in price markup and permit a better estimation of the true financial expenses incurred by hospitals performing endoscopy.[26] Administrative or claims data sets such as SASD are also subject to systematic or nonsystematic coding errors and missing data.

CONCLUSIONS

HNC patients undergoing diagnostic laryngoscopy in low- and medium-volume hospitals are significantly more likely to also undergo concurrent bronchoscopy or esophagoscopy compared to their counterparts in high-volume hospitals. Given the persistent controversy over the utility of routine use of these diagnostic procedures, it is not possible to say which practice is better, but the extreme variation found in practice suggests that studies designed to compare the utility of comprehensive versus selective diagnostic UADT endoscopy is needed.

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CONFLICT OF INTEREST DISCLOSURE

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