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Analysis of Charges Associated with Definitive Non-Surgical Therapy for Early-Stage Lateralized Tonsil Cancer

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Abstract

Objective—The cost of treatment as it affects comparative effectiveness is becoming increasingly more important. Since cost data is not readily available, we aimed to evaluate the charges associated with definitive non-surgical therapy for early-stage lateralized tonsil cancers.

Methods—Patients treated with unilateral radiation therapy (RT) for T1 or T2 tonsil cancer patients between 1995 and 2007 were retrospectively reviewed. Total and radiation-specific charges, from 3 months before to 4 months after radiation, were adjusted for inflation. All facets of treatment were evaluated for significant associations with total billing.

Results—Eighty-four patients were identified. Three-year OS, DSS, and RFS were 97% (95% CI: .88-.99), 98% (95% CI: 0.89–1), and 96% (95% CI: 0.88–0.99), respectively. The median for radiation-specific charges was \$60,412 (range \$16,811–\$84,792). The median for total charges associated with treatment was \$109,917 (range \$36,680–\$231,895). Total billing for treatment was significantly associated with the year of diagnosis ($p=0.008$), intensity-modulated radiation therapy versus wedge pair RT ($p=0.005$), pre-radiation direct laryngoscopy ($p<0.0001$), chemotherapy ($p<0.0001$), gastrostomy tube placement ($p=0.004$), and post-radiation neck dissection ($p=0.005$).

Conclusions—Although cost data for treatment is not readily available, historically, the recovery rate is approximately 30%. The charges associated with definitive non-surgical therapy for early-stage lateralized tonsil cancer have a wide range likely due to treatment-related procedures, the use of chemotherapy, and evolving RT technologies. These benchmark data are important given renewed interest in primary surgery for tonsil cancer. Cost of care, disease

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control, and functional outcomes will be critical for comparisons of effectiveness when selecting treatment modalities.

Keywords

unilateral radiation; head neck cancer; tonsil cancer; treatment charges; treatment billing

Introduction

National health spending is projected to exceed the expected average annual rise in gross domestic product (GDP) during the next decade, comprising an estimated 19.8% of the GDP by 2020.¹ At this current rate of increase, health spending may exceed the GDP in 2050.² As such, healthcare reform has become a national priority. Current efforts have been aimed at improving the quality and efficiency of healthcare through comparative effectiveness research;³ cost containment should result from optimization of healthcare efficiency. However, when treatment options with comparable clinical outcomes exist, cost plays a critical role in decision-making. This is especially important since the care of head and neck cancer patients is presently among the most costly types of cancer care.⁴

Early-stage lateralized tonsil cancer can be treated upfront either with definitive radiation to the primary tumor and ipsilateral neck⁵ or with surgery,⁶ with excellent reported clinical outcomes. Since cost data are not readily available, we evaluated billing charges associated with definitive radiation using ipsilateral techniques in patients with early-stage lateralized tonsil cancer to determine which factors associated with treatment significantly correlate with charges.

Methods

After the research protocol was approved by the appropriate institutional review committee, a retrospective chart review of patients who were treated with definitive radiation to the primary tumor and ipsilateral neck for a lateralized tonsil cancer at the University of Texas MD Anderson Cancer Center (MDACC) between 1995 and 2007 was previously reported.⁵ The decision to irradiate using ipsilateral techniques was determined by consensus at a weekly conference. Patients had tumors that were confined to the tonsillar fossa, with extension, when present, to either the anterior tonsillar pillar or to less than 1cm onto the soft palate. Patients with Tx tumors, in general, had undergone diagnostic tonsillectomies prior to evaluation at MDACC and were included only if the surgical defect, pathologic evaluation, and pre-tonsillectomy imaging suggested a lesion T2 or smaller. No patients with N3 or level IV nodal disease received radiation using ipsilateral techniques. Patients were staged using the 7th edition of the TNM classification of the American Joint Committee on Cancer.

This study utilized this previously-reported cohort to examine billing data. Patients with previous or synchronous cancers were excluded, since concurrent follow-up or treatment could confound billing charges. Furthermore, patients were only included if complete medical records were available on the current electronic medical record system. Billing data for both hospital and physician charges were obtained for each patient covering the time

period between 3 months prior to beginning treatment and 4 months after completing treatment. Charges were adjusted for inflation by conversion to 2010 U.S. dollars using the medical care services component of the Consumer Price Index. In addition to demographic and clinical outcomes data, details of patients' treatment including work-up, actual treatment, treatment-related procedures, hospitalizations and emergency room visits were examined for significant associations with total billing. Four patients who received non-cancer-related treatment for management of comorbidities during this management window were excluded from the billing analyses.

The primary clinical outcomes were overall survival (OS), disease-specific survival (DSS), and recurrence-free survival (RFS). OS was defined as the time from diagnosis of tonsil carcinoma to death. DSS was defined as the time from diagnosis of tonsil carcinoma to death from tonsil carcinoma progression. RFS was defined as the time from diagnosis of tonsil carcinoma to contralateral neck recurrence, distant metastasis, or death, whichever occurred first. Patients were censored at the last follow-up if the event did not occur. Kaplan-Meier curves were produced. The median survival time (in years), and the survival rates at years 2, 3, and 5 years, along with the 95% confidence intervals, were estimated. Univariate and multiple linear regression analyses were performed to examine independent factors for increased cost. All tests were two-sided. P-values less than 0.05 were considered statistically significant. All analyses were conducted using SAS (version 9.1, Cary, NC) and S-plus (version 8.0, TIBCO Software Inc., Palo Alto, CA) statistical software.

Results

We identified 84 patients with a median age of 53 years, of whom 70.2% were male. Table 1 details patient demographics and stage at presentation. Patients underwent direct laryngoscopy (39.3%), tonsillectomy (22.6%), neck dissection (2.4%), and dental work (39.3%) prior to definitive radiation (table 2). Four patients did receive systemic therapy; 3 (3.6%) as neo-adjuvant treatment and 4 (4.8%) concurrent with radiation. Seventy-five percent of patients received IMRT, with the rest of patients receiving wedge radiation. Twelve (14.3%) of patients underwent a neck dissection after radiation. No patients had a tracheotomy performed and 9 (10.7%) patients had a gastrostomy tube placed. Six patients (7.1%) were hospitalized 7 times, with a 1-day median length of stay (mean 2.4 days). Fourteen patients (16.7%) had 16 emergency center visits, 3 of which lead to inpatient hospitalization.

Total billing charges including those patients who received systemic therapy ranged from \$36,680 to \$231,895, with a median of \$109,917 (table 2). Radiation-specific charges ranged from \$16,811 to \$84,792, with a median of \$60,412. On univariate analysis, the year of diagnosis, N stage, and tumor pathology were significantly associated with billing charges (table 3). In addition, pre-radiation dental work or direct laryngoscopy, the receipt of systemic therapy, radiation technique (IMRT or wedge radiation), post-radiation neck dissection, gastrostomy tube placement, and emergency center treatment significantly correlated with billing charges. However, on multivariate analysis, N stage, tumor type, pre-radiation dental work, and emergency center visits were not significantly associated with billing charges; year of diagnosis, pre-radiation direct laryngoscopy, the receipt of systemic

therapy, radiation technique, post-radiation neck dissection, and the placement of a gastrostomy tube remained significant factors.

Three-year OS was 97% (95% confidence interval 0.88–0.99), RFS was 96% (95% confidence interval 0.88–0.99), and DSS was 98% (95% confidence interval 0.89–1) (figure 1).

Discussion

As healthcare spending in the United States continues to rise, it is critical that efforts to control cost and improve the quality of care are increased. The total medical cost of cancer nearly doubled between 1987 and 2007, with a shift away from in-patient care.⁷ A recent study examining the cost burden of oral, oropharyngeal, and salivary gland cancers found it to be higher for these head and neck cancers than most other types of cancer.⁴ The healthcare cost expenditure for post-surgical head and neck cancer patients nearly triples after their index diagnosis.⁸ With the care of head and neck cancer patients already being more expensive than the care of most other cancers,⁴ consideration of cost should increasingly play a role in deciding among treatments of comparative effectiveness.

There are many approaches to evaluating the cost of treatment. Recent studies have used insurance claims data to identify costs,^{4,8,9} focusing either on disease type^{4,9} or treatment type.⁸ While having the advantage of determining actual cost, relying on claims coding to identify patients and treatments is not without fault; 24.5% to 67.1% of patients identified by a diagnosis of cancer had no consequent identifiable treatment.^{4,9,10}

Other studies have examined cost from the hospital side, relying on hospital charges, as in this study. Dedhia et al undertook cost identification of charges surrounding a particular procedure: total laryngectomy.¹⁰ By extrapolating costs based on known departmental cost/charge ratios, they demonstrated that operating room costs comprised 24% of the total cost, whereas room charges accounted for 38% of the total cost.¹⁰ As in the current study, Funk et al approached charges from a disease perspective; they tallied charges from pre-treatment evaluation to one-year post-treatment follow-up for oral cavity cancer, finding that T stage, N stage, TNM stage, uni- versus multi-modality treatment, and patient comorbidities significantly impacted the cost of care.¹¹

We identified 84 patients who received definitive radiation using ipsilateral techniques between 1995 and 2007. We determined that the median charge for early-stage lateralized tonsil cancer is \$109,917 (range \$36,680–\$231,895), with median radiation-specific charges of \$60,412 (range \$16,811–\$84,792) (2010 USD). While reimbursement data are not available, the historic recovery rate is approximately 30%. Surprisingly, however, Lang et al examined insurance claims data for advanced head and neck cancer patients and reported a mean total cost of treatment over a 6-month period as \$56,900 for radiation alone and \$91,564 for chemoradiation (2006 USD).¹² Likewise, Jacobson et al evaluated both commercial insurance and Medicare claims for patients with oral, oropharyngeal, and salivary gland cancer, finding that mean 6-month costs for radiation alone were \$52,168 in the Medicare cohort and \$66,670 for commercial insurance (2009 USD).⁴ More aligned with

our anticipated final costs were the findings of Epstein et al, who used California Medicaid claims for oral and pharyngeal cancers, reporting a median 1-year post-diagnosis cost of \$35,546 (2010 USD).⁹

Factors significantly impacting the total charges of treatment included the year of diagnosis ($p=0.008$), intensity-modulated radiation therapy (IMRT) versus wedge pair RT ($p=0.005$), pre-radiation direct laryngoscopy ($p<0.0001$), chemotherapy ($p<0.0001$), gastrostomy tube placement ($p=0.004$), and post-radiation neck dissection ($p=0.005$) (Table 3). Although adjusted for on multivariate analysis, the year of diagnosis may reflect advances in treatment technology and simply, that the cost of healthcare is increasing faster than the rate of inflation. The impact of chemotherapy on treatment costs has been widely corroborated by other studies;^{4,9,11,12} we repeated our analyses excluding those patients who received chemotherapy and found that the other factors significantly affecting total charges did not change (data not shown). Of interest, on multivariate analysis, treatment-related hospitalizations and emergency room visits did not significantly correlate with increased charges ($p=0.145$ and $p=0.290$, respectively). Others have identified intensive care unit stays as having the greatest impact on cost¹⁰ and none of our patients required an intensive care unit stay.

We report 3-year OS, DSS, and RFS of 97%, 98%, and 96%, respectively. A recent study examining upfront surgery, including resection of the primary tumor and ipsilateral neck dissection, reported a 3-year RFS of 93.5%.⁶ With both upfront surgery and upfront definitive radiation delivering excellent clinical outcomes, cost should factor into management decision-making. Nijdam et al addressed this in the Netherlands, comparing definitive radiation with or without neck dissection to upfront surgery with post-operative radiation.¹³ They concluded that both upfront surgery and upfront radiation conferred excellent clinical outcomes, but surgery with post-operative radiation was more expensive than radiation followed by neck dissection. Although their radiation treatment was significantly different than ours, using both external beam radiation and brachytherapy and, even without a neck dissection, having an average hospital stay of 5.5 days, their analyses included a projection of the cost of treatment using intensity-modulated radiation therapy (IMRT). They concluded that the increased cost of IMRT was negligible when compared to the cost upfront surgery with post-operative radiation.¹³

More recently, Moore et al used reimbursement data to determine the cost of upfront surgery with or without post-operative adjuvant treatment and of concurrent chemoradiation for oropharyngeal cancer.¹⁴ Defining cost as reimbursement during a 3-month window of treatment, they concluded that upfront surgery with adjuvant treatment decided by findings on histopathology was more cost conscious.¹⁴ However, they did not have patients treated with radiation-alone or radiation followed by surgery. In addition, their surgical approaches included both transoral endoscopy with laser microsurgery and transoral robotic surgery; the latter is generally billed as an un-coded charge such that reimbursement may not reflect the cost to the institution, which would absorb potential losses.

There has recently been a renewed interest in upfront surgery for treating oropharyngeal cancers. Current surgical initiatives have included utilizing robotics;^{6,14} the cost of this trend

is just beginning to be explored.¹⁴ In thyroid surgery, the cost of a robotic approach exceeds the cost of endoscopic approach.¹⁵ A systemic review of surgical approaches in urologic surgery concluded that the cost of robotic surgery exceeded that cost of open or laparoscopic approaches because of capital cost, maintenance costs, and the limited life of the instruments.¹⁶ Furthermore, this analysis determined that the decreased lengths of hospital stay and of surgical time associated with urologic robotic surgery did not offset the increased overall cost.¹⁶

Fourteen percent of our cohort underwent a neck dissection after completing radiation, but in 2 recent reports of upfront surgery for oropharyngeal cancers, radiation or chemoradiation was recommended for 76% and 87% of patients.^{6,14} Since previous cost analyses, including our analysis of billing charges, have demonstrated that multimodality therapy significantly increases the cost of treatment,^{4,9,11} we infer that this difference in the percent of patients requiring multimodality treatment would make upfront surgery more costly than definitive radiation. However, further studies are needed to directly compare both the effectiveness and the cost of definitive radiation and upfront surgery for oropharyngeal carcinoma, as well as resulting functional outcomes.

Conclusions

Our patients enjoy excellent survival outcomes: 3-year OS, DSS, and RFS were 97% (95% CI: .88-.99), 98% (95% CI: 0.89–1), and 96% (95% CI: 0.88–0.99), respectively. The charges associated with definitive non-surgical therapy for early-stage lateralized tonsil cancer have a wide range likely due to treatment-related procedures, the use of chemotherapy, and more highly developed RT technologies. Total billing for treatment was significantly associated with the year of diagnosis ($p=0.008$), intensity-modulated radiation therapy versus wedge pair RT ($p=0.005$), pre-radiation direct laryngoscopy ($p<0.0001$), chemotherapy ($p<0.0001$), gastrostomy tube placement ($p=0.004$), and post-radiation neck dissection ($p=0.005$). These benchmark data are important as there is renewed interest in primary surgery for tonsil cancer. Cost of care, disease control, and functional outcomes will be critical for comparisons of effectiveness when selecting treatment modalities.

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Figure 1.

A) Overall, B) recurrence-free, and C) disease-specific survival.

Table 1

Demographics of study sample.

Demographics	n (%)
Male	59 (70.2)
Female	25 (29.8)
Median Age (y)	53
Smoking	
Current	16 (19)
Former *	26 (31)
Never	41 (48.8)
Unknown	1 (1.2)
Pathology	
SCC	78 (92.9)
Undifferentiated carcinoma	6 (7.1)
T Stage	
T1	45 (53.6)
T2	25 (29.8)
Tx	14 (16.7)
N stage	
N0	20 (23.8)
N1	22 (26.2)
N2a	18 (21.4)
N2b	21 (25)
Nx	3 (3.6)

* Patients who quit >1 year prior to diagnosis

y: years

SCC: Squamous cell carcinoma

Table 2

Treatment and Associated Charges.

Treatment	n (%)
Pre-Radiation Procedures	
Direct laryngoscopy	33 (39.3)
Tonsillectomy	19 (22.6)
Neck dissection	2 (2.4)
Dental work	33 (39.3)
Systemic therapy	
Induction	3 (3.6)
Concurrent	4 (4.8)
Radiation type	
IMRT	63 (75)
Wedge radiation	21 (25)
Post-radiation neck dissection	12(14.3)
Inpatient hospitalization	6 (7.1)
Emergency center visit	14 (16.7)
Gastrostomy tube placed	9 (10.7)
Tracheostomy placed	0 (0)
Charges (2010 USD)	Median Range
Radiation-specific	\$60,412 \$16,811–\$84,792
Total charges including systemic tx	\$109,917 \$36,680–\$231,895
Total charges excluding systemic tx	\$106,128 \$36,680–\$162,296

IMRT: Intensity-modulated radiation therapy
Tx: therapy

Table 3

Analysis of Factors Associated with Billing Charges.

	Univariate Analysis	Multivariate Analysis
Demographics	p	p
Year of diagnosis	<0.001	0.008
Age	0.332	
Sex	0.154	
Smoking history	0.918	
T stage	0.998	
N stage	<0.001	0.468
Pathology (SCC vs. Undifferentiated)	0.011	0.103
Pre-radiation procedures		
Direct laryngoscopy	0.001	<0.0001
Tonsillectomy	0.318	
Neck dissection	0.726	
Dental work	0.008	0.227
Systemic therapy	<0.001	<0.001
Radiation technique	<0.001	0.005
Post-radiation neck dissection	0.024	0.005
Gastrostomy tube placement	0.019	0.004
Inpatient hospitalization	0.051	0.145
Emergency center treatment	0.005	0.290

Note: Analyses were repeated excluding those who had received systemic therapy without changes in significant correlates.

SCC: Squamous cell carcinoma
Undifferentiated: Undifferentiated carcinoma