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Neck Dissections in the United States from 2000 to 2006: Volume, Indications, and Regionalization

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Abstract

Background—The objectives of this study were to examine trends in neck dissection and regionalization.

Methods—This cross-sectional and longitudinal study used 2000, 2004, and 2006 data from the Nationwide Inpatient Sample. Chi-squared tests compared trends for total neck dissections and specific subsites. To test regionalization, we examined the distribution of procedures across hospital and procedure volume quartiles.

Results—From 2000-2006, the number of neck dissections increased from 18,112 to 22,918. Three-quarters of the total increase were associated with thyroid and parathyroid gland or skin neoplasms. There was an increase in neck dissections for UADT subsites and no decline for the oropharynx and tongue base. Regionalization occurred, as high-volume hospitals and providers performed a greater proportion of neck dissections over time.

Conclusions—Neck dissections increased from 2000-2006. There were no decreases in neck dissections for certain subsites with a greater role for primary chemoradiotherapy. Regionalization has occurred.

Keywords

neck dissection; head and neck cancer; health services research; practice patterns; regionalization

Introduction

Neck dissection is performed for purposes of diagnosis, staging, and/or treatment of multiple types of advanced head and neck cancer. Examination of neck dissection utilization patterns can therefore characterize trends in the surgical management of head and neck cancer, whether comparing specific cancer types or in aggregate.

Treatment of advanced head and neck cancer has traditionally included a combination of surgery (resection of the primary tumor site and neck dissection) and radiation therapy. Over time, treatment recommendations for specific cancer types (depending upon pathologic diagnosis, stage, or subsite) have expanded to include a larger role for primary radiation therapy with or without chemotherapy. For example, treatment recommendations for squamous cell carcinoma of the oropharynx have changed over the past decade, such that concomitant chemoradiotherapy has replaced surgery as the primary treatment modality for advanced lesions over the 2000 – 2006 period.¹⁻³

Regionalization describes the extent to which complex surgeries are directed toward high-volume providers. Studies have shown that there is a strong correlation between procedure volume and patient outcomes, specifically patient mortality, for a variety of complex surgical procedures.⁴⁻⁶ Morton et al. recently showed that surgical volume is an indicator of expertise and is associated with clinical outcomes in neck dissection.⁷ Regionalization may also have implications for the head and neck cancer surgeon workforce. It has been argued that there may be a shortage of head and neck cancer surgeons, based on current trends showing a declining interest in head and neck cancer fellowship training.^{8, 9} To the extent that regionalization occurs already, having fewer but more highly-trained, high-volume surgeons may be sufficient to treat patients with head and neck cancer, whether or not there are changes in the overall volume of procedures. Finally, in an era of health care reform, understanding the trends in neck dissection treatment patterns and regionalization can inform decisions regarding policy initiatives in the area of access and quality.¹⁰⁻¹²

The first objective of this study was to examine the volume and trends in neck dissections performed in the United States from 2000 to 2006, in aggregate and for specific subsites. The second objective was to determine the extent to which regionalization has occurred and the access of certain patient populations to higher-volume hospitals.

Methods

This is a cross-sectional and longitudinal study using data from the Nationwide Inpatient Sample (NIS) for 2000, 2004, and 2006. The NIS is an all-payor national database compiled through the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality. The NIS and related files have been described previously.¹³ The NIS is the largest such database in the United States, and it contains data such as patient demographics, diagnoses, procedures, payment sources, and facility characteristics on all inpatient stays from a 20% stratified sample of hospitals from 37 states. Since the databases do not include all inpatient stays throughout the country, national-level data were calculated indirectly based on weighting algorithms developed by HCUP statisticians specifically for this purpose; rather than a simple count of procedures included in the NIS, sampling overcomes any potential bias related to the larger sampling of hospitals and hospital discharges in the NIS over time.

Neck dissection was defined by the presence of an International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) procedure code of 40.40 (radical neck dissection, not otherwise specified), 40.41 (radical neck dissection, unilateral), and 40.42 (radical neck dissection, bilateral). In addition, the procedure code 40.3 (lymph node excision) was included only if associated with an ICD-9-CM diagnosis code specific to the head and neck.

Primary tumor subsites were identified by ICD-9-CM diagnosis codes specific to the following: nasal cavity and sinuses, nasopharynx, oral cavity (except tongue), oral tongue, oropharynx, hypopharynx, larynx, salivary gland, thyroid and parathyroid glands, and skin.

This enabled an examination of total neck dissection surgical volumes, those related to this entire list of specific subsites, and those related to the upper aerodigestive tract (i.e., not including salivary gland, thyroid and parathyroid glands, and skin). Chi-squared test for trend was used to evaluate potential differences in the trends for specific subsites, compared to trends for either total neck dissections or those specifically associated with the upper aerodigestive tract.

NIS databases contain synthetic hospital identifiers and, from certain states, synthetic provider identifiers. These identifiers permit the determination of hospital and surgeon volume. Based on 2000 data, hospital and surgeon volume quartiles were defined in order to obtain an approximately equal distribution of neck dissections within each quartile. The same cutpoints were used for categorization of the 2004 and 2006 data (although individual hospitals and surgeons could move across quartiles) and examination of regionalization, with a chi-squared test for trend to determine whether the distribution of procedures according to each set of quartiles changed over this period. Use of identical cutpoints across years enables an examination of regionalization, and the same methods have been used previously.¹⁴⁻¹⁷

Because provider identifiers were missing for approximately 40% of the neck dissections, the remainder of the regionalization analysis was performed using only the hospital volume quartiles. The proportion of procedures in each quartile that were performed in hospitals having specific characteristics was examined. These characteristics included hospital location and teaching status (rural, urban non-teaching, or urban teaching) and large bedsize (generally 50+ beds for a rural hospital, 200+ beds for an urban nonteaching hospital, and 400+ beds for an urban teaching hospital); these bedsize cutpoints were contained within the NIS database. The chi-squared test was used to compare the distribution of neck dissection cases across years, and a chi-squared test for trend compared trends for different quartiles over time.

Lastly, patient characteristics that have been previously described as having decreased access to high-volume providers were examined. These characteristics included older adults (age 60 years or older), Black race, and median annual household income (for patient zip code) less than \$45,000.¹⁴ For each patient characteristic, the proportion of neck dissections performed in patients with these characteristics, within each year and quartile-year combination was calculated; no chi-squared or other statistical testing was possible because the denominator used to calculate each proportion (the number of neck dissections performed in each hospital volume quartile) differed for each proportion. Of the neck dissections performed in patients with these characteristics, the proportion performed in hospitals in each volume quartile was determined. Chi-squared testing compared the proportions across years, and a chi-squared test for trend compared trends for quartile over time. A p value of < 0.05 was considered statistically significant for all analyses. All analyses were carried out in SAS, version 9.2 (SAS Institute, Cary, NC) and SUDAAN, version 9.0 (RTI Institute, Research Triangle Park, NC).

Results

The total number of inpatient neck dissections performed as well as those associated with site-specific diagnosis codes is presented in Table 1. From 2000 to 2006, there was an increase in the number of neck dissections in the United States. A substantial portion of this increase was for neck dissections performed for treatment of thyroid and parathyroid or for cutaneous neoplasms (about 75% of the total increase was due to increases in procedures related to these subsites). In contrast, there were decreases (albeit small in absolute terms) in

the number of neck dissections performed for treatment of nasopharyngeal, hypopharyngeal, and laryngeal neoplasms.

There was an overall increase in the volume of neck dissections for upper aerodigestive tract subsites from 2000 to 2006. When compared to this trend, the number of neck dissections for oral tongue primary neoplasms showed an even greater increase over time ($p=0.005$), while those related to the nasopharynx and hypopharynx neoplasms showed statistically significant decreases ($p<0.05$). There was a slight increase in the point estimates for neck dissections for oropharynx neoplasms, but the increase was not statistically different from the trend for all upper aerodigestive tract subsites ($p=0.71$).

Temporal trends in hospital volume and surgeon volume of neck dissections from 2000 to 2006 are presented in Tables 2 and 3. Overall, high-volume hospitals and providers performed a larger proportion of neck dissections over this time period; there was no change in the proportion of surgeons in each volume quartile (chi-square test, $p = 0.18$), suggesting that this was not primarily due to the overall increase in neck dissections over time and a larger proportion of providers' being in the higher volume quartiles. Approximately three-quarters of all procedures occurred in large bedsize hospitals from 2000 to 2006. For hospitals in the highest-volume quartile, 80-95% of cases were performed at large bedsize hospitals, and progressively lower proportions in the lower-volume quartiles were performed in large bedsize hospitals. From 2000 to 2006, a larger proportion of neck dissections performed in large bedsize hospitals were in hospitals in the highest-volume quartile, similar to the overall trend for hospital volume shown in Table 2 (data not shown). For the hospital characteristic of location/teaching status, the proportion of neck dissections performed in urban teaching hospitals increased from 69% in 2000 to 75% in 2004 to 80% in 2006. These trends in hospital volume quartiles (Table 2) were seen in urban teaching hospitals but not in urban non-teaching or rural hospitals (data not shown).

Of all neck dissections, approximately 50% were performed in patients 60 years of age and older from 2000 to 2006, with similar proportions in all hospital volume quartiles (data not shown). Black patients represented 5-7% of all patients undergoing neck dissections over this time period, with a slightly higher share in the highest vs. lowest hospital volume quartiles for 2004 and 2006 (data not shown). A declining proportion of the neck dissection population had median household income (for patient zip code) below \$45,000, from 64% in 2000 to 53% in 2004 to 46% in 2006. There were no systematic differences across hospital volume quartiles within each year (data not shown). Table 4 shows the proportion of neck dissections performed in patients with specific characteristics, including age greater than 60 years, Black race, and annual median income (for patient zip code) less than \$45,000. For all of these characteristics, from 2000 to 2006, a statistically significant, higher proportion of patients underwent neck dissection in higher hospital volume quartiles.

Discussion

The volume of inpatient neck dissections increased over 25% from 2000 to 2006, and much of this increase occurred with treatment of non-upper aerodigestive tract primary neoplasms: salivary gland, thyroid and parathyroid gland, and skin. Thyroid and parathyroid-related neck dissections showed an increase in volume that was even greater than that for neck dissections on the whole. The increases in neck dissections for salivary gland and cutaneous disease were not different from the overall trend. Among the upper aerodigestive tract subsites only, neck dissections performed for oral cavity neoplasms (tongue and non-tongue) accounted for the majority of the increase in volume over this time period.

We hypothesized that there would be a decrease in the number of neck dissections for primary tumor sites for which chemoradiotherapy had assumed a more prominent role as a primary treatment modality. These subsites include squamous cell carcinomas of the oropharynx. Our results, however, suggested a different trend, with an increase in neck dissections over the period 2000 – 2006 for both oropharynx and oral tongue. Because the NIS does not include diagnosed neoplasms (to determine whether there was a change in the proportion of neoplasms for which a neck dissection was performed), we examined the Surveillance Epidemiology and End Results (SEER) published incidence tables that do contain this information.¹⁸ The SEER tables, as opposed to raw data that can be obtained, groups incident diagnosed tumors of the oropharynx and oral tongue subsites within the category of “oral cavity and pharynx” that includes tumors of the tongue, floor of mouth and gum, oropharynx and tonsil, salivary gland, and lip. From 1992 to 2006, there was a statistically significant decrease in the delay-adjusted incidence rate for oral cavity and pharynx tumors (decrease of 1.3 cases per 100,000).¹⁸ Although we cannot comment specifically on oropharynx and oral tongue neoplasms, we acknowledge the limitation of the NIS but have no reason to believe that the increase in the number of neck dissections for these two subsites reflects an increase in the number of newly diagnosed neoplasms. There are several potential reasons for the increase in neck dissections related to these subsites in spite of a larger role for treatment with chemoradiotherapy. Some surgeons perform planned neck dissections following primary chemoradiotherapy, and neck dissections may be recommended as primary treatment for small primary tumors that have nodal involvement.

Our analysis showed that a higher proportion of neck dissections was performed by high-volume providers over time. This regionalization to high-volume providers was also demonstrated for specific subgroups of patients who have been shown to have low access to high-quality or high-volume care, suggesting that they were not being denied access to high-volume providers. High-volume providers and hospitals have been shown to have better outcomes and higher quality for a wide range of surgical procedures,⁴⁻⁷ although there are some limitations to the evidence describing this relationship.¹⁹ In a study by Morton et al., it was found that there was a strong correlation between surgeon procedure volume and both nodal yield and a lower incidence of regional recurrence.⁷

Regionalization can also be used to assess issues of workforce in head and neck cancer surgery. While there may be concerns for declining interest and numbers of head and neck cancer surgeons, trends in neck dissection regionalization indicate that it may be possible for fewer highly-trained surgeons, who each perform a higher volume of procedures, to meet the neck dissection needs in the United States.^{8, 9} The converse would argue that regionalization is the result of a current head and neck cancer surgeon shortage, which occurred due to fewer head and neck surgeons, each performing more neck dissections by necessity.

Another explanation for the extent of regionalization could relate to financial incentives. It is generally considered that the valuation of head and neck cancer procedures, including neck dissection, may not reflect the complexity and time required to perform these procedures; this concern contributed to a recent reweighting (increase) of the relative value units for many head and neck cancer procedures. With a primarily low-income patient population and low relative value unit valuation, patients that require head and neck cancer surgery may be referred to urban, teaching hospitals more frequently, thus contributing to regionalization.

The NIS has the standard limitations of all administrative databases, including its lack of certain clinical information (tumor size, lymph node involvement, and metastases) and the fact that billing information may not accurately reflect the performance of specific procedures. Because neck dissection is a major surgical procedure, we suggest that this procedure is not often overlooked in billing records and, therefore, would be included in this

database. One possible exception may be central neck dissection performed in conjunction with thyroid surgery, where the changes we observed may reflect a change in coding practices rather than practice patterns.

Use of the database requires ICD-9 procedure codes rather than the more-specific Current Procedural Terminology (CPT) codes that describe separately the specific type of neck dissection: radical, modified, or selective. The most important implication is that selective neck dissections that may have been coded with the generic ICD-9 procedure code 40.3 (lymph node excision) without a neck-specific diagnosis code would not have been counted in our analysis. In spite of these limitations, another strength is that the NIS database has been used in many previous studies based on its completeness and the rigor with which it and the weighting algorithms are assembled.

Finally, we do not have detailed information on the incidence of neoplasms of specific subsites and in patient subgroups defined by the specific variables we have examined in this analysis. Ultimately, the strongest conclusions about access to neck dissection care require clinical information and incidence data that are lacking.

Conclusions

The number of neck dissections performed in the U.S. increased from 2000 to 2006, primarily due to an increase in procedures performed for treatment of non-upper aerodigestive tract subsites. There was no decline in neck dissections performed for the oropharynx subsite, for which chemoradiotherapy has assumed more of a primary treatment role. Regionalization has occurred, with a trend towards high-volume hospitals and providers; these trends were also present for patient subgroups that have traditionally had decreased access to high-volume centers.

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Table 1

Neck Dissection Volumes (All Subsites)

Estimated number of neck dissections performed for the years 2000, 2004, and 2006 with 95% confidence intervals. All subsites are included.

	2000 N (95% CI)	2004 N (95% CI)	2006 N (95% CI)	P value for chi-squared test for trend
Total neck dissections	18112 (15037, 21187)	21022 (16784, 25260)	22918 (18218, 27618)	--
Upper Aerodigestive Tract Subsites	6987 (5581, 8393)	8129 (6299, 9959)	8003 (6119, 9887)	0.47
Nasal cavity & sinuses	76 (35, 117)	131 (68, 194)	135 (71, 199)	0.33
Nasopharynx	248 (168, 328)	242 (157, 327)	178 (96, 260)	0.02
Oral cavity-except tongue	2305 (1803, 2807)	2715 (2040, 3390)	2668 (1907, 3429)	0.29
Oral tongue	1233 (948, 1518)	1777 (1331, 2223)	1795 (1309, 2281)	0.17
Oropharynx	2420 (1921, 2919)	2645 (2045, 3245)	2696 (2060, 3332)	0.12
Hypopharynx	289 (198, 380)	293 (197, 389)	222 (144, 300)	0.01
Larynx	811 (556, 1066)	783 (542, 1024)	725 (541, 909)	0.04
Salivary gland	1926 (1604, 2248)	2157 (1712, 2602)	2201 (1778, 2624)	0.20
Thyroid & parathyroid	2822 (2258, 3386)	4268 (3201, 5335)	5282 (3902, 6662)	< 0.001
Skin	3632 (2874, 4390)	3952 (3105, 4799)	4769 (3704, 5834)	0.53

Temporal trends in hospital volume of neck dissections from 2000 to 2006. Quartile volume cutpoints were defined using 2000 data in order to obtain an approximately equal distribution of neck dissections. These same cutpoints (noted in parentheses in the left-hand column) were used to examine the proportion of cases performed within each quartile cutpoint range for years 2004 and 2006.

Table 2
Percent of Cases Performed for Each Hospital Volume Quartile

Hospital volume	2000 (n=6987) % (95% CI)	2004 (n=8129) % (95% CI)	2006 (n=8003) % (95% CI)	P value for chi-squared test for trend
1 st quartile (1-3)	22.4 (17.0, 27.8)	16.5 (12.0, 21.0)	14.4 (10.3, 18.5)	0.008
2 nd quartile (4-10)	27.1 (19.6, 34.6)	18.3 (12.4, 24.2)	15.3 (9.8, 20.8)	
3 rd quartile (11-24)	25.3 (16.0, 34.6)	17.3 (9.8, 24.8)	27.9 (17.6, 38.2)	
4 th quartile (25+)	25.3 (11.8, 38.8)	47.9 (35.5, 60.3)	42.5 (28.6, 56.4)	

Table 3
Percent of Cases Performed for Each Surgeon Volume Quartile

Temporal trends in surgeon volume of neck dissections from 2000 to 2006. Quartile volume cutpoints were defined using 2000 data in order to obtain an approximately equal distribution of neck dissections. These same cutpoints (noted in parentheses in the left-hand column) were used to examine the proportion of cases performed within each quartile range for years 2004 and 2006.

Surgeon volume	2000 (n=4056) % (95% CI)	2004 (n=5425) % (95% CI)	2006 (n=4755) % (95% CI)	P value for chi-squared test for trend
1 st quartile (1)	28.8 (22.0, 35.6)	20.7 (13.4, 28.1)	17.8 (12.6, 23.0)	0.001
2 nd quartile (2-3)	19.4 (14.1, 24.7)	16.4 (11.7, 21.1)	11.4 (7.5, 15.3)	
3 rd quartile (4-10)	26.5 (18.8, 34.2)	27.3 (18.4, 36.2)	31.1 (22.3, 39.9)	
4 th quartile (11+)	25.2 (11.4, 39.0)	35.6 (22.2, 49.0)	39.7 (26.6, 52.8)	

Patient Characteristics

Table 4

Proportion of neck dissections, within each year, performed in each hospital volume quartile for patients with specific characteristics, including age 60 years or older, Black race, and median annual income (for patient zip code) less than \$45,000.

Hospital Volume	2000 (n=3546) % (Age only) (95% CI)	2004 (n=3926) % (Age only) (95% CI)	2006 (n=4073) % (Age only) (95% CI)	P value for chi-squared test for trend P value for chi-squared test
1 st quartile (1-3)	23.1 (17.2, 29.0)	16.6 (11.7, 21.5)	13.3 (9.1, 17.6)	< 0.001
2 nd quartile (4-10)	27.4 (19.5, 35.3)	18.2 (12.0, 24.4)	15.2 (9.3, 21.1)	0.005
3 rd quartile (11-24)	23.3 (14.1, 32.5)	18.2 (10.3, 26.1)	27.4 (16.7, 38.1)	
4 th quartile (25+)	26.2 (12.2, 40.2)	47.0 (34.5, 59.5)	44.1 (29.7, 58.5)	
Hospital Volume	2000 (n=432) % (Black only) (95% CI)	2004 (n=580) % (Black only) (95% CI)	2006 (n=372) % (Black only) (95% CI)	P value for chi-squared test for trend P value for chi-squared test
1 st quartile (1-3)	17.7 (7.4, 28.0)	12.3 (4.8, 19.8)	3.9 (0, 8.5)	< 0.001
2 nd quartile (4-10)	36.6 (18.0, 55.2)	17.5 (5.6, 29.4)	10.0 (1.4, 18.6)	< 0.001
3 rd quartile (11-24)	28.8 (10.6, 47.0)	12.8 (2.6, 23.0)	28.8 (8.9, 48.7)	
4 th quartile (25+)	16.8 (0, 35.2)	57.4 (39.5, 75.3)	57.3 (34.4, 80.2)	
Hospital Volume	2000 (n=4417) % (Low income only) (95% CI)	2004 (n=4178) % (Low income only) (95% CI)	2006 (n=3608) % (Low income only) (95% CI)	P value for chi-squared test for trend P value for chi-squared test
1 st quartile (1-3)	20.8 (15.2, 26.4)	16.6 (11.5, 21.7)	14.5 (9.7, 19.3)	< 0.001
2 nd quartile (4-10)	28.8 (20.3, 37.3)	16.8 (10.4, 23.3)	12.1 (6.8, 17.4)	0.003
3 rd quartile (11-24)	24.4 (14.7, 34.1)	15.9 (8.2, 23.6)	28.6 (17.1, 40.1)	
4 th quartile (25+)	25.9 (11.3, 40.5)	50.6 (37.4, 63.8)	44.8 (29.8, 59.8)	