Patterns of Hospital Use and Regionalization of Inpatient Pediatric Adenotonsillectomy

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**IMPORTANCE** Pediatric adenotonsillectomy is one of the most frequently performed procedures in the United States. Whereas several studies have focused on tonsillectomy techniques and outcomes, little is known about the overall changes in the distribution of care. Variations in care patterns between academic and nonacademic settings may have important financial and educational effects.

**OBJECTIVE** To determine whether regionalization of inpatient pediatric adenotonsillectomy has occurred over the past decade with respect to hospital teaching status and primary expected payer.

**DESIGN, SETTING, AND PARTICIPANTS** Secondary analysis of all inpatient admissions following pediatric adenotonsillectomy (age <18 years) in the Nationwide Inpatient Sample during the calendar years 2000, 2005, and 2010.

**EXPOSURE** Inpatient pediatric tonsillectomy.

**MAIN OUTCOMES AND MEASURES** The percentage distributions of pediatric adenotonsillectomies with respect to hospital teaching status and primary payer were compared according to calendar year to determine temporal changes. Multivariate analysis was conducted with logistic regression to determine year-to-year changes in the proportion of pediatric adenotonsillectomy admissions, controlling for hospital teaching status and expected source of payment.

**RESULTS** The estimated numbers of inpatient hospital pediatric adenotonsillectomy stays in the United States in 2000, 2005, and 2010 were 12,879 (SE, 1,695), 17,245 (SE, 2,276), and 13,732 (SE, 2,082), respectively. There was a significant increase in the proportion of children admitted to academic hospitals from 60.1% to 69.8% to 78.6%, respectively ($P = .045$). With respect to teaching hospitals, the primary expected payer distribution shifted significantly, with an increase in Medicaid recipients from 38.4% to 38.9% to 50.5%, and a decline in private insurance from 57.7% to 51.5% to 43.9% ($P = .02$).

**CONCLUSIONS AND RELEVANCE** Inpatient pediatric adenotonsillectomies are increasingly being regionalized to academic/teaching hospitals. Concurrently, the proportion of patients using Medicaid as the primary payer has increased for inpatient tonsillectomies in teaching hospitals. Such regionalization has important implications for health care reimbursement and distribution of care.

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Tonsillectomy is one of the most frequently performed surgical procedures in the United States, with more than 500,000 performed annually in children younger than 15 years. The 2 most common indications for pediatric tonsillectomy are sleep-disordered breathing and chronic tonsillitis, with an increasing trend in adenotonsillectomies performed for pediatric obstructive sleep apnea. Despite a significant increase in ambulatory pediatric tonsillectomy and adenoidectomy, there still remains a subset of children for whom inpatient admissions after tonsillectomy are necessary. Previous data from the calendar year 2006 suggest that inpatient pediatric adenotonsillectomy and tonsillectomy represent approximately 2.1% of all tonsillectomies performed.

Much of the practice of general otolaryngology concerns the ear, nose, and throat complaints of children (age <18 years), and almost all pediatric patients receive their care from general otolaryngologists. As a result, there is a complex relationship of pediatric otolaryngologists with their general otolaryngology counterparts. Despite studies demonstrating the societal need of pediatric subspecialists for complex pediatric otolaryngologic disorders, questions still exist regarding the distribution between pediatric subspecialists and general otolaryngologists with respect to more common pediatric disorders such as adenotonsillar disease.

Regionalization toward high-volume centers specializing in the care of children has been demonstrated to be beneficial among other pediatric subspecialties including cardiovascular care, trauma, and neonatal surgery but has yet to be studied in pediatric otolaryngology. Regarding inpatient pediatric tonsillectomies, much of the current literature focuses on surgical techniques and postoperative outcomes. Little is known about the distribution of care for inpatient pediatric tonsillectomies. A better understanding of the distribution and trends of inpatient pediatric tonsillectomies between academic institutions and local or community hospitals could have substantial implications in the provision, costs, and accessibility of care.

In the present study, we sought to delineate recent temporal trends in the distribution of inpatient pediatric tonsillectomies among teaching and nonteaching institutions, as well as insurance aspects that may affect the reimbursement for and access to this care. We also sought to assess the presence of medical comorbidities affecting those treated at teaching hospitals. Improving our understanding of the trends in inpatient pediatric tonsillectomies is likely to have important implications for resident and fellowship training, patient expectations, and future resource allocation for the large cohort of children requiring adenotonsillectomies.

Methods

The data source for this study consisted of the Nationwide Inpatient Sample (NIS) for the calendar years 2000, 2005, and 2010. The NIS is a database developed for the Healthcare Cost and Utilization Project (HCUP) and provides a sample of discharges from all community nonrehabilitation hospitals excluding long-term acute-care hospitals. This study was reviewed and deemed exempt from review by our hospital institutional review board because it uses a publicly available data set with deidentified patient information. For each of these calendar years, all inpatient pediatric tonsillectomy admissions (age <18 years) were extracted on the basis of clinical classification software procedures code 30, “tonsillectomy and/or adenoidectomy.” “Inpatient” tonsillectomies included both 23-hour observation and longer inpatient hospitalizations. The data were then imported into SPSS, version 22.0, statistical software (SPSS Inc) for analysis. For each admission, extracted data included age, sex, International Classification of Diseases, Ninth Revision (ICD-9), codes, hospital teaching status, and primary expected payer for the hospital stay. The primary expected payer field was classified as Medicare, Medicaid, private insurance, or other. Managed care was included under private insurance. The category of “other” also included patients who were self-pay or were not charged for services.

For each of the 3 sampled calendar years, the raw sample size, weighted estimate, and percentage distribution of inpatient pediatric tonsillectomies with respect to hospital teaching status and primary expected payer were determined. Taking into account weighting and stratification variables in the NIS that account for sampling and survey design, we conducted univariate χ² comparisons for these proportions according to calendar year to determine whether changes in the distribution of cases among these differing hospitals’ characteristics occurred over time. The distribution of the primary expected payer according to hospital teaching status over time (2010 vs 2000) was also compared. Next, multivariate analysis was conducted with logistic regression to determine whether year-to-year changes in the proportion of pediatric tonsillectomy admissions to teaching hospitals were significant, adjusting for expected source of payment. Finally, to assess prevalence of medical comorbidities on the basis of hospital teaching status, the volume and relative distribution of patients with bleeding disorders and asthma were calculated, based on concurrent ICD-9 codes. Statistical significance was set at P = .05. Statistics are presented as the weighted estimate and standard error (SE) where appropriate.

Results

The estimated numbers of inpatient hospital pediatric tonsillectomy stays in the United States in 2000, 2005, and 2010 were 12,879 (SE, 1,695), 17,245 (SE, 2,276), and 13,732 (SE, 2,082), respectively. Overall, aggregate mean (SE) patient age across the 3 years was 6.1 (0.1) years. There was a slight predominance of males in the patient population in 2000, 2005, and 2010, with 55.4%, 58.2%, and 57.5%, respectively, although the difference between sexes was not statistically significant (P = .16). With respect to length of stay among the aggregate sample from all 3 sampled years, 3.0% stayed less than 24
A notable decline in private insurance from 57.7% to 51.5% to increase in Medicaid from 38.4% to 38.9% to 50.5%, and a(nonteaching (71.5%) hospitals was statistically significant teaching (23.7%) and private insurance for teaching (57.7%) vs.

In 2000, the difference in proportions of Medicaid as the primary expected payer from 32.6% to 34.9% to 49.3% for teaching vs nonteaching. The observed regionalization of pediatric tonsillectomies to academic/teaching hospitals was significantly higher compared with nonteaching hospitals (P < .001). The proportion of asthmatic patients treated at teaching hospitals was significantly higher compared with nonteaching hospitals (P < .001). The odds ratio of a patient with asthma being treated in a teaching hospital vs a nonteaching hospital was 1.83 (95% CI, 1.37-2.46; P < .001).

Table 1 presents the volume and relative distributions of inpatient pediatric tonsillectomy stays over the 3 sampled calendar years according to hospital status, teaching vs nonteaching. There was a significant increase in the proportion of children admitted to academic hospitals from 60.1% to 69.8% to 78.6%, respectively (P = .045). Additionally, Table 1 presents the volume and relative distributions of inpatient pediatric tonsillectomy stays according to primary expected payer among all hospitals sampled. There was a significant increase in the proportion of children with Medicaid as the primary expected payer from 32.6% to 34.9% to 49.3% for the years 2000, 2005, and 2010, respectively (P < .001). Specifically among teaching hospitals, the primary expected payer distribution shifted significantly (Figure), with an increase in Medicaid from 38.4% to 38.9% to 50.5%, and a notable decline in private insurance from 57.7% to 51.5% to 43.9% (P = .02).

With respect to teaching status and expected source of payment, in 2000, the difference in proportions of Medicaid among inpatient tonsillectomies for teaching (38.4%) vs nonteaching (23.7%) and private insurance for teaching (57.7%) vs nonteaching (71.5%) hospitals was statistically significant (P < .001). In 2010, the difference in proportions of Medicaid among inpatient tonsillectomies for teaching (50.5%) vs nonteaching (43.6%) hospitals and private insurance for teaching (43.9%) vs nonteaching (50.8%) hospitals was not statistically significant (P = .36).

Multivariate logistic regression analysis determined that the increase in proportion of cases at teaching hospitals over the calendar years of the study remained significant, even when adjusting for expected source of payment. The odds ratio for a pediatric inpatient tonsillectomy to be performed as an inpatient procedure for calendar year 2010 vs calendar year 2000 was 3.46 (95% CI, 1.61-7.45; P = .007).

Table 2 presents the volume and relative distribution of patients with bleeding disorders and asthma between teaching and nonteaching hospitals. The proportion of patients with bleeding disorders treated at teaching hospitals was significantly higher compared with nonteaching hospitals (P < .001). The odds ratio of a patient with a bleeding disorder being treated in a teaching hospital vs a nonteaching hospital was 4.00 (95% CI, 1.80-8.89; P < .001). The proportion of asthmatic patients treated at teaching hospitals was significantly higher compared with nonteaching hospitals (P < .001). The odds ratio of a patient with asthma being treated in a teaching hospital vs a nonteaching hospital was 1.83 (95% CI, 1.37-2.46; P < .001).

Discussion

The present study demonstrates the gradual shift of inpatient pediatric tonsillectomies to academic/teaching hospitals from 2000 to 2010. The observed regionalization of pediatric otolaryngology in this study joins a rapidly growing debate regarding the overall regionalization of pediatric surgical subspecialties, particularly with respect to high-risk pediatric patients. From 2000 to 2010, there was an 18.5% increase in children admitted to teaching hospitals following tonsillectomy, with nearly 80% of inpatient pediatric tonsillectomies in 2010 performed at teaching hospitals. Clinical practice guidelines have recommended inpatient admission following adenotonsillectomy for particular subgroups of children to monitor and prevent postoperative complications. These high-risk subgroups include children with severe obstructive sleep apnea, children younger than 3 years with sleep-disordered breathing, and those with high-risk medical comorbidities, including those with bleeding disorders and asthma as explored in the present study. This regionalization of bleeding diathesis to
teaching hospitals exists despite the controversial implications of abnormal preoperative coagulation study results.\textsuperscript{20,22-24} Given a 2.5% posttonsillectomy hemorrhage rate, most clinicians likely approach patients with bleeding disorders and a positive family history of bleeding with caution, suggesting that in practice these children are considered to be at higher risk for surgical intervention.\textsuperscript{10,25,26} Among high-risk children, close medical management in the perioperative period is critical to minimize postoperative medical complications, length of stay, and readmissions.\textsuperscript{27}

Despite substantial discussion regarding the distribution of pediatric patients between pediatric and general otolaryngologists in the community, in practice there may not be such a controversial relationship between the 2 groups.\textsuperscript{9} In fact, a large proportion of children requiring inpatient adenotonsillectomy are likely referred by general otolaryngologists to pediatric subspecialists specifically, although this is likely not quantifiable at this time. In contrast to most community-based general otolaryngologists, pediatric otolaryngologists often practice within academic hospitals that are equipped with the support of pediatric anesthesiologists, nurses, and pediatric postoperative intensive care units that are more familiar with and better prepared to manage the complexities of perioperative care in higher-risk children.

With regard to primary expected payer among teaching hospitals, our study found a significant 12% increase from 38.4% in 2000 to 50.5% in 2010 in the proportion of Medicaid recipients. This increase in Medicaid recipients is largely reflective of the increase in annual Medicaid enrollment of children reported by the Centers for Medicare & Medicaid Services; they reported an increase in enrollment from 20.9 million children (28.8%) in 2000 to 33.0 million children (44.5%) in 2010 (percentages based on US Census population estimates).\textsuperscript{28,29} The overall proportion of Medicaid recipients is likely to continue increasing with the Medicaid expansion of the Affordable Care Act, with an additional 21.3 million people expected to be enrolled by 2022.\textsuperscript{30} Clinically, Medicaid recipients and those of low socioeconomic status have been found to have more postsurgical complications and longer hospital stays.\textsuperscript{31,32} This growing Medicaid patient population may result in a parallel increase in the financial stress endured by academic institutions.

This study has a few limitations that merit mention. First, we use the HCUP-defined categories of teaching vs nonteaching hospital and, in turn, assume that pediatric otolaryngologists are more highly represented than general otolaryngologists among teaching hospitals. Although the distinction in the NIS between teaching and nonteaching hospitals may not truly represent the distinction between pediatric subspecialists and community general otolaryngologists, we believe that it is nonetheless a useful method in measuring the regionalization of adenotonsillectomies toward an academic setting that is likely to have more clinical support for postoperative hospitalization. Furthermore, with the NIS we are unable to extract data in the case of complicated postoperative courses that necessitated transfer from a nonteaching institution to a teaching counterpart. However, we believe that transfers likely represent a small proportion of the sampled cases and may not have a large effect on the overall findings. In addition, the NIS does not allow for a parallel analysis of regionalization of outpatient pediatric tonsillectomy, although this would be a compelling direction for future research.

**Conclusions**

The regionalization of pediatric otolaryngology demonstrated in this study is reflective of an overall trend toward regionalization of pediatric surgical care and a more optimal allocation of pediatric subspecialty resources. To our knowledge, this is the first study of its kind to investigate the regionalization of pediatric otolaryngology. Long-term assessment of the regionalization of pediatric otolaryngology toward academic hospitals, particularly in light of an increasing Medicaid population, needs to be performed before overall societal impact can be further demonstrated.

**REFERENCES**


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