

# Complications and Determinants of Length of Stay for Inpatient Pediatric Otolaryngologic Procedures

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**Objective:** To identify clinical factors associated with morbidity, mortality, and length of stay (LOS) for inpatient pediatric otolaryngologic procedures.

**Study Design:** Retrospective cohort study.

**Methods:** Records of patients undergoing pediatric otolaryngologic procedures were extracted from the National Hospital Data Survey for the calendar years 1995 through 1999. These records were examined to determine demographics, morbidity, mortality, type of procedure (as defined by anatomic subsite), and LOS. The effects of morbidity and type of procedure on LOS were identified.

**Results:** A total of 4861 children underwent inpatient otolaryngologic procedures. The overall morbidity rate was 4.6%. The most common morbidity was pneumonia, occurring in 171 patients (3.5%). The presence of any morbidity was associated with a significantly in-

creased LOS (18.4 days vs 4.6 days;  $P < .001$ ). The occurrence of pneumonia was associated with an increase in LOS to 19.7 days vs 4.7 days in patients without pneumonia ( $P < .001$ ). Procedures involving the larynx, trachea, or esophagus carried the longest LOS (12.3 days;  $P < .001$ ) among all procedural categories. The overall mortality rate was distinctly low at 0.4%. However, the occurrence of morbidity was associated with an increased risk of death, with an odds ratio of 8.0 ( $P = .001$ ). Mortality was highest (13 of 18 deaths) after procedures on the larynx, trachea, or esophagus.

**Conclusions:** Medical complications in children undergoing inpatient otolaryngologic procedures are associated with significantly increased LOS. Despite procedural complexity, overall mortality is remarkably low. Efforts to decrease medical morbidity in this population may result in decreased LOS and improved clinical outcomes.

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**P**EDIATRIC otolaryngologic procedures are increasingly being performed in an ambulatory setting. Improvements in safety for these procedures, combined with increased pressure to reduce the cost of health care, has led to fewer postoperative hospital stays. Although most pediatric otolaryngologic procedures are currently performed on an outpatient basis,<sup>1</sup> a substantial number require inpatient postoperative management. The inpatient pediatric otolaryngologic population includes children undergoing more complex procedures, often including airway or wound management. It also may include children with medical comorbidities, necessitating postoperative admission, with increased susceptibility to perioperative complications.

Most previous studies evaluating perioperative complication rate and postoperative hospitalization have focused on

specific procedures at a single institution. Several previous reports have examined the safety of outpatient adenotonsillectomy in the general and high-risk pediatric populations.<sup>2-5</sup> Others have sought to identify preventive strategies for perioperative morbidity of airway surgery<sup>6</sup> or to reduce the time interval for first tracheotomy change in an effort to curtail hospital stays for pediatric otolaryngologic procedures.<sup>7</sup> To identify multiple morbidities, their incidence, and association with various procedure types, a large database of pediatric otolaryngologic procedures was examined. This allowed for inclusion of a population from multiple centers, in an effort to eliminate institutional and procedural biases.

The National Hospital Discharge Survey (NHDS) is an annual survey conducted by the National Center for Health Care Statistics, a public agency that tracks health care utilization on a yearly basis

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**Table 1. Length of Stay, Morbidity, and Mortality Rates by Procedure Type**

Procedure Type (No. of Procedures)	Mean (SD) Length of Stay, d	Morbidity Rate, %	Mortality Rate, %*
Otologic (708)	3.03 (4.81)	2.12	0.0
Rhinologic (294)	5.11 (6.37)	5.44	1.00
Oral cavity/oropharynx (2193)	2.45 (4.09)	1.55	0.05
Larynx/trachea/ esophagus (1221)	12.29 (28.58)	12.29	1.06
Open head and neck (445)	3.36 (5.32)	2.47	0.22

\*Overall mortality rate, 0.37.

across the United States. From the combined group of US hospitals, representative institutions are randomly selected to provide data for the NHDS. A sample of discharge records from this national sample of nonfederal hospitals from the 50 states and the District of Columbia is reviewed, and data are collected both manually and electronically by trained staff members. The sample contains representative proportions of inpatient hospital admissions spanning all services, diagnoses, hospital sizes, and geographic locations. Ambulatory surgical patients are excluded. Only hospitals with an average length of stay (LOS) of 30 days or less are included. General hospitals and free-standing children's hospitals are included in the NHDS database. This dataset has been previously examined to determine factors influencing disease incidence, rates of surgery, and annual trends. It has also been used to examine morbidity and mortality in medical and surgical populations.<sup>8-12</sup>

## METHODS

The NHDS databases from each of the years 1995 through 1999 were combined into a composite database, consisting of 1 290 835 hospital admissions. A list of otolaryngologic surgical procedure codes was catalogued in accordance with the American Board of Otolaryngology surgical case log for graduating residents. Procedures from all subcategories of otolaryngologic procedures were included for children 16 years and younger. The subcategories were divided on the basis of anatomic subsite and included (1) otology, (2) rhinology, (3) oral cavity and oropharynx, (4) larynx, trachea, and esophagus, and (5) head and neck open procedures.

The data were evaluated by means of the SPSS statistical package (SPSS Inc, Chicago, Ill). From the *International Classification of Diseases, Ninth Revision, Clinical Modification*, diagnosis codes, categorical variables that reflected one or more of the following medical complications were designed: pulmonary embolism, acute myocardial infarction, acute cerebrovascular accident, pneumonia, and acute renal failure. The term *complication* herein refers to one of these medical morbidities occurring during a postoperative hospital admission. The *morbidity rate* refers to the rate of occurrence of 1 or more of these complications in the population.

Descriptive statistics for the patient population were computed. In addition, data for LOS, incidence of morbidities during hospital admission, discharge status, and mortality were examined for the entire database of pediatric otolaryngologic surgical procedures. The procedures were subclassified by anatomic subsite, in accordance with the anatomic subdivisions of the American Board of Otolaryngology operative log. The incidence of acute

**Table 2. Distribution of Mortality According to Procedure**

Procedure	Total No. Performed	No. of Deaths
Other permanent tracheotomy	60	5
Temporary tracheotomy	110	3
Tracheal repair	16	2
Closed bronchial biopsy	83	2
Anterior nasal packing for epistaxis	11	1
Turbineotomy (not elsewhere classified)	5	1
Ethmoidectomy	74	1
Tonsillectomy and adenoidectomy	795	1
Other tracheal operations	6	1
Excision of deep cervical node	11	1
<b>Total</b>	<b>1171</b>	<b>18</b>

mortalities was determined overall and by anatomic subsite. The Pearson  $\chi^2$  statistic was used to assess association between morbidities and mortality. Where appropriate, odds ratios for mortality were calculated. Univariate analysis of variance was used to determine the influence of type of procedure, procedure subsite, and morbidities on LOS.

## RESULTS

A total of 1 290 835 patients were hospitalized from 1995 through 1999, according to the NHDS database. The database, extracted for inpatient pediatric otolaryngologic surgery, identified 4861 patients, representing 0.37% of all inpatient admissions. Of the 4861 inpatient procedures, 708 were otologic, 294 were rhinologic, 2193 involved the oral cavity or oropharynx, 1221 involved the larynx, trachea, or esophagus, and 445 were open head and neck procedures. The mean age of the population was 5.49 years (SD, 4.98 years), and the mean LOS was 5.25 days (SD, 15.43; range, 1.0-478.0 days). The male-to-female ratio was 1.24:1. A total of 226 patients sustained a perioperative morbidity, resulting in a morbidity rate of 4.60%. Age was not a factor influencing the likelihood of morbidity or mortality. The mean age of patients with no morbidity was 5.49 years (SD, 4.96 years), and the mean age of those incurring any morbidity was 5.50 years (SD, 5.43 years;  $P = .98$ ). The mean age of patients who survived was 5.50 years (SD, 4.98 years), and the mean age of patients who died was 5.39 years (SD, 5.07 years;  $P = .93$ ). Sex also did not influence morbidity ( $P = .26$ ) or mortality ( $P = .99$ ).

The presence of any morbidity was associated with a significantly increased LOS (18.4 days vs 4.6 days with no morbidity;  $P < .001$ ). A total of 18 patients died (mortality rate, 0.40%). The occurrence of any morbidity was associated with an increased risk of death, with an odds ratio of 8.0 ( $P = .001$ ,  $\chi^2$ ).

The LOS and complication rate varied among procedures, with procedures on the larynx, trachea, and esophagus having statistically significantly higher LOS than any of the other procedures (12.3 days;  $P < .001$ ) (**Table 1**) as well as a higher rate of death (13 of 18 total deaths) (**Table 2**). The most common complication overall was pneumonia, occurring in 171 patients (3.5%). The presence of pneumonia was associated with an increase

in LOS to 19.7 days vs 4.7 days in patients without pneumonia ( $P < .001$ ). Other complications such as diabetes, arrhythmias, congestive heart failure, hypertension, and cerebrovascular accident were less common, each occurring in less than 0.5% of cases.

#### COMMENT

With the advent of minimally invasive surgical techniques, improved anesthetic management, and pressures to reduce health care costs, most pediatric otolaryngologic surgery is performed in the outpatient setting. D'Errico et al<sup>13</sup> reviewed incidence of prolonged recovery room LOS and unplanned outpatient hospital admissions after outpatient pediatric surgery. Prolonged LOS and unplanned hospitalizations were due to respiratory complications in 16% of cases. The authors found that these admissions were associated with higher American Society of Anesthesiology physical status and underlying chronic respiratory disease.<sup>13</sup>

A substantial number of inpatient pediatric otolaryngologic surgical procedures are performed annually. This population may be at higher risk for perioperative complications, secondary to chronic baseline disease and/or complexity of the surgical procedure. The highest morbidity rate was found in patients undergoing procedures of the larynx, trachea, and esophagus. This was most likely owing to the increased risk of bronchopulmonary complications from these procedures and/or baseline bronchopulmonary disease. Even without complications, these patients had the longest LOS of all procedural groups. Pneumonia was the most commonly seen morbidity. As such, efforts to protect against pneumonia may offer an effective way to reduce LOS in the pediatric otolaryngologic patient population.

Adenotonsillectomy remains the most common inpatient surgery in patients younger than 15 years.<sup>10</sup> Several studies have previously examined high-risk groups for complications after adenotonsillectomy.<sup>5,14,15</sup> High-risk groups include children younger than 3 years and those with a history of cerebral palsy, congenital heart disease, prematurity,<sup>13</sup> severe obstructive sleep apnea,<sup>15</sup> or chromosomal abnormalities.<sup>16</sup> Even in this patient population, which is naturally selected for more complicated or problematic cases, adenotonsillectomy is a safe procedure, with only 1 death occurring among 795 cases.

Others have investigated minimizing postoperative complications after airway reconstruction by prevention of perioperative infections and aggressive treatment for gastroesophageal reflux.<sup>6</sup> With a view toward shorter hospital stays, Deutsch<sup>7</sup> reviewed the safety of early first tracheotomy tube changes in children, allowing for reduced postoperative hospital stays without risk to the patient. Other subspecialties such as pediatric cardiothoracic surgery have evaluated safety of abbreviated postoperative hospital stays after elective congenital cardiac surgery.<sup>17</sup> More such studies are required among the inpatient pediatric otolaryngologic population.

In 1993, Derkay<sup>10</sup> reviewed NHDS data for inpatient pediatric otolaryngologic surgery during a 10-year

period (1977-1987). Since that time, NHDS data for inpatient pediatric otolaryngologic procedures have not been reviewed, nor has there been focus on LOS and postoperative complications. Our review of 4861 children undergoing inpatient pediatric otolaryngologic surgery during a 4-year period showed an overall complication rate of 4.6% and mortality rate of 0.4%.

The pediatric morbidity rate was found to be similar to the morbidity rate of adults undergoing inpatient head and neck surgery (5.65%); however, the adult patient group incurred a mortality rate of 2.98%. The higher mortality was attributed to increased patient age and significant medical morbidity, such as acute myocardial infarction, pneumonia, and cerebrovascular accident.<sup>11</sup>

Our data indicate that patients undergoing surgery on the larynx, trachea, and esophagus incurred the highest morbidity and length of stay. This was likely due to the complexity of the procedures and the baseline medical condition of the patients. The most common complication was pneumonia, which was associated with significantly increased LOS. This information may allow for greater vigilance for perioperative respiratory complications in this patient population, with more focus on aggressive pulmonary management in an effort to prevent postoperative pneumonia and reduce postoperative hospital stay. Families should be specifically counseled regarding the potential for respiratory complications after pediatric upper aerodigestive tract surgery.

There were several limitations to this study, by virtue of the database chosen for analysis. First, only patients whose primary procedure was an otolaryngologic procedure were included in the database. The analyzed population therefore would exclude patients undergoing multiple procedures such as cardiac or gastrointestinal tract surgery before their otolaryngologic procedures. It would also exclude infants in the neonatal or pediatric intensive care units who undergo interventions by multiple pediatric subspecialists. This restriction of the database is required to ensure that the outcomes examined are more likely to reflect results from the otolaryngologic procedure rather than contemporaneous nonotolaryngologic procedures. Therefore, the data should be interpreted as the mortality and morbidity occurring when these primary otolaryngologic procedures are being performed. A second limitation is that both morbidity and mortality incurred were reviewed for hospital stay alone, and not for postoperative complications incurred after discharge to home. Thus, unscheduled postoperative physicians' office visits, emergency department visits, or hospital readmissions were not included in the database. Overall, the NHDS database provides a large patient population, drawn from several hospitals and regions of the United States. In return for this limited bias and large sample size, data collection limitations as detailed above were encountered. Recognizing these limitations, we believe that the data presented afford important information for patient counseling and performance comparison data for the pediatric otolaryngologic inpatient population.

## CONCLUSIONS

Length of stay after pediatric inpatient otolaryngologic procedures is strongly influenced by the type of procedure, with surgery of the larynx, trachea, or esophagus incurring the longest LOS. Postoperative morbidity, most commonly pneumonia, was also associated with a significantly prolonged LOS. Identification of patients at risk for postoperative morbidity, with specific attention to those undergoing laryngotracheal or esophageal surgery, may afford a reduction in postoperative complications and reduced LOS in patients undergoing inpatient pediatric otolaryngologic procedures.

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