



A Population-Based Study of Acute Care Revisits following Tonsillectomy

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Objectives To describe the clinical spectrum and frequency of acute care revisits after tonsillectomy in a population-based sample from a single state in the US.

Study design We used California state discharge databases from 2009 to 2011 to retrospectively identify retrospectively routine tonsillectomy discharges in residents <25 years of age and to establish record linkage to revisits within 30 days at ambulatory surgery, inpatient, and emergency department facilities statewide. Percentages and descriptive statistics were sample-weighted, and revisit rates were adjusted for demographic factors, expected payer, chronic conditions, surgical indication, facility type, and clustering.

Results Records were available for 35 085 index tonsillectomies, most of which were performed at hospital-owned ambulatory and inpatient facilities. There were 4944 associated revisits: 3761 (75.9%) treat-and-release emergency room visits, 816 (17.1%) inpatient admissions, and 367 (7.0%) ambulatory surgery visits. Most revisits (3225 [67.7%]) were unrelated to bleeding; these typically occurred early (mode, day 2) and were commonly associated with diagnosis codes indicating pain, nausea/vomiting, or dehydration. Crude all-cause revisit and readmission rates were 10.5% and 2.1%, respectively. Adjusted all-cause revisit rates (range, 8.6%-24.5%) were lowest in young children, increased in adolescents, and peaked in young adults. Adjusted bleeding-related revisit rates increased abruptly in adolescents and reached 13.9% in males (6.8% in females, $P < .001$) ages 20-24 years.

Conclusions Acute care revisits after tonsillectomy performed at predominately hospital-owned facilities in California are common and strongly age-related. Most revisits are early treat-and-release outpatient encounters, and these are usually associated with potentially preventable problems such as pain, nausea and vomiting, and dehydration. (*J Pediatr* 2015;166:607-12).

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related article, p 613

Although tonsillectomy is a common surgical procedure in the US¹ and its complications are well-characterized,^{2,3} there is little population-based information available about the clinical spectrum and frequency of acute care revisits after the procedure in this country. Posttonsillectomy complications, themselves, have been described in hundreds of published studies, including large surgical case-series,⁴⁻⁹ cohort studies,¹⁰⁻¹⁷ systematic reviews,^{3,18} and meta-analyses.¹⁹ A few prospective, population-based studies have described posttonsillectomy complications, but these studies were conducted outside the US and were restricted to bleeding-related outcomes.^{11-13,15} Generally, studies of posttonsillectomy complications have been confined to select populations (eg, patients at single institutions or groups of hospitals, restricted age groups, or inpatients) or narrowly defined outcomes (eg, revisits to the same institution or revisits associated with secondary bleeding, procedural intervention, or readmission).

Minor bleeding,²⁰⁻²² pain,²³ and postoperative nausea and vomiting^{24,25} are common problems after tonsillectomy, and 2 recent studies of US pediatric cohorts confirm this.^{16,17} Revisits for these problems may reflect quality of care in several domains (including risk communication and care coordination)³ and are also of interest because of uncertainty about optimal pain management³ and recent safety concerns about the use of codeine^{26,27} and dexamethasone^{22,28} in tonsillectomy patients.

Recently, the Healthcare Cost and Utilization Project began releasing state discharge databases with encrypted person-identifiers, and it is now feasible to conduct population-based revisit analyses that include ambulatory encounters.²⁹⁻³¹ We used California discharge databases to establish record linkage between routine tonsillectomies and revisits at hospital inpatient, emergency department, and ambulatory surgery facilities statewide. Our objectives were to: (1) describe posttonsillectomy revisits according to timing, type of facility, and indication; (2) estimate associated 30-day revisit rates; and (3) perform a multivariate analysis to identify perioperative factors associated with these revisits.

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CC Complete-case
MI Multiple imputation

Methods

This study is a retrospective cohort analysis based on patient-level linkage of California discharge records in hospital inpatient, ambulatory surgery, and emergency department databases. The inpatient database includes discharges from all short-term, acute care, nonfederal hospitals. The ambulatory surgery database includes same-day discharges from all hospital-owned and some freestanding (not hospital-owned) outpatient facilities. The emergency department database includes treat-and-release encounters at hospital-owned facilities, excluding visits associated with direct inpatient hospital admission. All 3 databases include information at the facility level (facility identifiers, facility type) and the discharge level (patient demographics, admission source, expected payer, diagnosis and procedure codes, length of stay, total charges, and disposition). Diagnosis and procedure codes are based on the *International Classification of Diseases, Ninth Edition, Clinical Modification* and *Physicians' Current Procedural Terminology*. The University of Wisconsin-Madison Health Sciences Internal Review Board determined that this study was exempt from review.

The study cohort consisted of persons ages 0-24 years for whom a California inpatient or ambulatory surgery record indicated an index tonsillectomy (defined by a procedure code for tonsillectomy with or without adenoidectomy) in 2009-2011. Exclusion criteria included: (1) age (in years) missing from record; (2) patient zip code missing or indicating non-California residence; (3) a diagnosis or procedure code indicating malignancy or chemotherapy³²; (4) nonroutine discharge (transfer to another acute care facility or to home health care, against medical advice, death before discharge, or data missing); (5) discharge in January 2009 or December 2011; and (6) missing encrypted person-identifier.

Occasionally, separate records indicated same-day, same-patient tonsillectomies at both ambulatory and inpatient settings; in such cases, when diagnosis and procedure codes suggested only routine care, we consolidated information into a single (inpatient) record. Surgical indications for index tonsillectomies were classified with indicator variables for infection, apnea or sleep disturbance, and abscess. This classification was adapted from a previously validated scheme based on diagnosis codes³³ with the following modifications: (1) a code for adenotonsillar hypertrophy, by itself, was not considered sufficiently specific to indicate airway obstruction; and (2) abscess was classified separately from other infection-related indications. **Table I** (available at www.jpeds.com) displays diagnosis and procedure codes used in this study.

The primary outcomes for this study were all-cause and bleeding-related revisits and readmissions. A readmission was defined as a hospital inpatient admission within 30 days of discharge from an index tonsillectomy. A revisit was defined as a visit to a hospital emergency department or an ambulatory surgery facility within 30 days or a read-

mission. Principal and secondary diagnosis and procedure codes were used to classify revisits and readmissions by indication. Revisit rates were estimated at the patient level and were defined as the percentage of patients who had at least 1 revisit.

Statistical Analyses

All descriptive statistics were inverse-probability weighted to account for patients with tonsillectomy excluded from the study cohort because an encrypted person-identifier was missing from the index record. Sample weights were derived from a logistic regression model that predicted the likelihood that the encrypted person-identifier was nonmissing based on the following explanatory variables: age group, sex, race, expected payer, facility type, and year. All analyses were performed with SAS software, version 9.3 (SAS Institute, Cary, North Carolina).

Multivariate risk estimates and adjusted rates were based on generalized linear models with a logistic link function and generalized estimating equations to account for facility-level clustering. By design, multivariate risk estimates were stratified by 5-year age group, based on prior evidence that posttonsillectomy bleeding risk is age-related.^{12,13} Estimates were also stratified by sex, based on exploratory analyses that showed statistically significant increases in risk for males in adolescent and young-adult age groups. Additional covariates in multivariate models included race/ethnicity, primary expected payer, number of coded chronic conditions, index procedure (with/without adenoidectomy), surgical facility type, coded surgical indication, and year.

Values for certain demographic data elements (sex, race/ethnicity) in California discharge data were not necessarily missing completely at random because of systematic data perturbation to protect patient confidentiality in selected cases. Under the assumption that these values, nevertheless, were still missing at random, multivariate analyses were conducted on complete-case (CC) data. To test this assumption, a sensitivity analysis was conducted using the Markov Chain Monte Carlo multiple imputation (MI) method. To account for clustering in the study design structure, data were imputed separately for each facility cluster. For facilities with a small number of records (≤ 100), the imputation analysis was combined. The SAS procedure GENMOD was used to estimate model parameters for each imputed dataset, along with corresponding variances and covariances. The results from these multiple datasets were then combined for overall inferences using the SAS procedure MIANALYZE. A simulation study was conducted to validate the results of the imputation analysis.

Results

Index Encounters

A total of 35 085 index tonsillectomies met selection criteria for the study cohort. **Figure 1** (available at www.jpeds.com) shows details of sample selection, and **Table II** (available at

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