



Complications of adenotonsillectomy for obstructive sleep apnea in school-aged children



Sofia Konstantinopoulou^{a,*}, Paul Gallagher^b, Lisa Elden^c, Susan L. Garetz^d,
Ron B. Mitchell^{e,f}, Susan Redline^g, Carol L. Rosen^h, Eliot S. Katzⁱ, Ronald D. Chervin^{j,k},
Raouf Amin^l, Raanan Arens^m, Shalini Paruthiⁿ, Carole L. Marcus^a

^a Department of Pediatrics, Sleep Center, Children's Hospital of Philadelphia, University of Pennsylvania, Philadelphia, PA, United States

^b Biostatistics Core, The Clinical and Translational Research Center, Children's Hospital of Philadelphia, University of Pennsylvania, Philadelphia, PA, United States

^c Department of Otolaryngology, Children's Hospital of Philadelphia, University of Pennsylvania, Philadelphia, PA, United States

^d Department of Otolaryngology, University of Michigan, Ann Arbor, MI, United States

^e Department of Otolaryngology, UT Southwestern Medical Center, Dallas, TX, United States

^f Department of Pediatrics, UT Southwestern Medical Center, Dallas, TX, United States

^g Department of Medicine, Brigham and Women's Hospital and Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States

^h Department of Pediatrics, Rainbow Babies & Children's Hospital, University Hospitals Case Medical Center, Case Western Reserve University, Cleveland, OH, United States

ⁱ Department of Pediatrics, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States

^j Department of Pediatrics, University of Michigan, Ann Arbor, MI, United States

^k Department of Neurology, University of Michigan, Ann Arbor, MI, United States

^l Department of Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States

^m Department of Pediatrics, Children's Hospital at Montefiore and Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY, United States

ⁿ Department of Pediatrics and Internal Medicine, Cardinal Glennon Children's Medical Center, Saint Louis University, St Louis, MO, United States

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ABSTRACT

Introduction: Adenotonsillectomy is the treatment of choice for most children with obstructive sleep apnea syndrome, but can lead to complications. Current guidelines recommend that high-risk children be hospitalized after adenotonsillectomy, but it is unclear which otherwise-healthy children will develop post-operative complications. We hypothesized that polysomnographic parameters would predict post-operative complications in children who participated in the Childhood AdenoTonsillectomy (CHAT) study. **Methods:** Children in the CHAT study aged 5–9 years with apnea hypopnea index 2–30/h or obstructive apnea index 1–20/h without comorbidities other than obesity/asthma underwent adenotonsillectomy. Associations between demographic variables and surgical complications were examined with Chi square and Fisher's exact tests. Polysomnographic parameters between subjects with/without complications were compared using Mann–Whitney tests.

Results: Of the 221 children (median apnea hypopnea index 4.7/h, range 1.2–27.7/h; 31% obese), 16 (7%) children experienced complications. 3 (1.4%) children had respiratory complications including pulmonary edema, hypoxemia and bronchospasm. Thirteen (5.9%) had non-respiratory complications, including dehydration (4.5%), hemorrhage (2.3%) and fever (0.5%). There were no statistically significant associations between demographic parameters (gender, race, and obesity) or polysomnographic parameters (apnea hypopnea index, % total sleep time with SpO₂ < 92%, SpO₂ nadir, % sleep time with end-tidal CO₂ > 50 Torr) and complications.

Conclusions: This study showed a low risk of post-adenotonsillectomy complications in school-aged healthy children with obstructive apnea although many children met published criteria for admission due to obesity, or polysomnographic severity. In this specific population, none of the polysomnographic or demographic parameters predicted post-operative complications. Further research could identify the patients at greatest risk of post-operative complications.

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* Corresponding author at: Division of Pulmonary Medicine, The Children's Hospital of Philadelphia, 11th Floor Colket Building, Philadelphia, PA 19104, United States. Tel.: +1 215 590 3749; fax: +1 215 590 3500.

E-mail address: Konstantis@chop.edu (S. Konstantinopoulou).

1. Introduction

Obstructive sleep apnea syndrome (OSAS) affects up to 4% of the pediatric population [1]. A wide range of adverse health outcomes has been associated with untreated OSAS, such as cardiopulmonary abnormalities [2,3] and failure to thrive [4,5]. Furthermore, there is growing evidence suggesting links between pediatric OSAS and behavioral problems, mood impairment, excessive daytime sleepiness, impaired school performance and poor quality of life [6,7].

Adenotonsillar hypertrophy is the most commonly recognized anatomic risk factor for pediatric OSAS [8] and therefore adenotonsillectomy (AT) continues to be the primary treatment [9]. AT is the second most common pediatric surgery under general anesthesia in the United States, with approximately 218,000 procedures performed annually in school age children [10]. Minor complications include pain, nausea, vomiting and dehydration [11]. However, more severe complications may occur, including hemorrhage, respiratory decompensation, velopharyngeal incompetence, subglottic stenosis, and rarely death [12]. There are a number of identified risk factors for post-operative complications, including age younger than 3 years, obesity, comorbid airway anomalies, Down syndrome and other genetic syndromes, craniofacial abnormalities and neuromuscular disease [13–18]. However, most of the studies that identified these risk factors were based on retrospective data [9] from heterogeneous populations, have often not included polysomnographic (PSG) documentation of OSAS, and have used different definitions of post-operative complications. The risks of AT in otherwise healthy, school-aged children with OSAS are unclear. In these otherwise healthy children, it has been assumed that OSAS severity primarily based on the apnea hypopnea index (AHI) or oxyhemoglobin saturation nadir is the major risk factor for post-operative complications [19–22].

The gold standard for the diagnosis of OSAS is overnight polysomnography [9] which also helps to quantify the severity of OSAS. However, there is no consensus as to the PSG parameters predictive of post-operative complications and hence, which patients would benefit from elective post-operative admission rather than outpatient surgery. According to the recent guidelines published by the American Academy of Pediatrics (AAP), patients with an apnea hypopnea index (AHI; number of obstructive apneas and hypopneas per hour of sleep) $\geq 24/h$, oxyhemoglobin saturation (S_pO_2) nadir $< 80\%$ or peak $PCO_2 \geq 60$ mmHg should be hospitalized postoperatively [9]. In contrast, the recently published clinical practice guidelines from the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) recommend that children with an AHI $\geq 10/h$ or an S_pO_2 nadir $< 80\%$ be admitted electively [8]. Both guidelines are based on evidence from retrospective studies or studies of heterogeneous populations and, therefore, not surprisingly, differ in their recommendations.

In summary, severe OSAS is considered a risk factor for post-operative risk after AT. This notion has justified the practice of hospitalizing many children for post-operative monitoring rather than conduct the procedure as an outpatient procedure. Many of these children are older with few if any comorbidities. The problem is magnified by the paucity of published data regarding the polysomnographic variables predictive of adverse respiratory and non-respiratory events post AT in relatively older (school-aged) and healthy children with obstructive sleep apnea. We therefore sought to determine whether demographic, anthropometric or PSG measures would identify children with elevated post-operative risk in a homogenous study cohort of school-aged children with PSG-proven OSAS without significant medical comorbidities other than obesity.

2. Methods

2.1. Study design and population

This is an ancillary analysis of postsurgical complications from participants in the early adenotonsillectomy arm of the Childhood Adenotonsillectomy (CHAT) study [6,23]. CHAT was a single-blind, randomized controlled trial at six academic centers designed to evaluate the efficacy of early AT versus Watchful Waiting with Supportive Care (WWSC) in children with OSAS. The hypothesis of the CHAT study was that in children with OSAS without prolonged desaturation, early AT (performed within 4 weeks after randomization), as compared with WWSC would result in improved polysomnographic, cognitive, behavioral, and health outcomes within a 7 month period. The methodology of the CHAT study has been described in detail separately [23] but is also briefly reported below. Informed consent was obtained by the parents/guardians and assent from the child where appropriate, and the study received approval by the Institutional Review Boards of all participating sites. In addition, all serious and unexpected adverse events of the study were tabulated for review by a Data Safety Monitoring Board. All children/caregivers received information on sleep hygiene using standardized educational materials that identified the need for regular sleep routines, age-appropriate sleep duration, and avoidance of caffeine prior to bedtime and were provided information on healthy lifestyle (nutrition, exercise). Children also were provided with saline nasal spray to be used nightly. Children had monthly telephone calls/visits to assess their state of health. Children randomized to WWSC were scheduled for reevaluation for surgery by an otolaryngologist after the 7 month observation period, and received treatment as clinically indicated. The primary outcome was changed in the Attention/Executive Functioning Domain score from the Developmental NEUROPSYCHOLOGICAL Assessment (NEPSY A/E). The summaries of results addressing the primary and secondary key outcomes of this study are published separately [6].

The CHAT cohort included children aged 5–9 years who had OSAS without prolonged oxyhemoglobin desaturation (AHI 2–30/h and $S_pO_2 < 90\%$ for no longer than 2% of total sleep time [TST]) and did not have any other severe health problems. OSAS was defined as an AHI $\geq 2/h$ or an obstructive apnea index $\geq 1/h$. Exclusion criteria included severe obesity with a body mass index z-score ≥ 3 , craniofacial anomalies or any major systemic condition.

Polysomnography was performed and scored at a central Sleep Reading Center according to the American Academy of Sleep Medicine pediatric standards [24]. AT was performed using standard surgical techniques (cold dissection, monopolar electrocautery, coblation or micro-debrider, with variation according to surgeon preference) after viewing a mandatory training video which summarized the surgical protocol and after reviewing the CHAT study manual of procedures. In addition there was ongoing oversight by a surgical quality assurance committee. To ensure uniformity across participating sites, intraoperative photographs were obtained on every 10th consecutive patient at each site and reviewed for adequacy of lymphoid tissue removal by the surgical core director. In most cases, AT was an outpatient procedure (i.e., no overnight hospitalization). If PSG showed an AHI was $> 20/h$, or the S_pO_2 was $< 92\%$ for $> 2\%$ of TST, then the clinical site was alerted so that appropriate post-operative management would be considered. Each center followed their own practices regarding elective post-operative admissions based on criteria such as severity of OSAS on PSG, obesity or surgeon's preference.

For each admission, a member of the research team at each site reviewed their medical records for further information regarding the presence or absence of complications and interventions during

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