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Polysomnography results versus clinical factors to predict post-operative respiratory complications following pediatric adenotonsillectomy☆,☆☆

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ABSTRACT

Objective: Systematically review the published literature comparing the presence of clinical features (age, BMI, co-morbidities, etc.) versus polysomnogram (PSG) results in the prediction of major post-operative respiratory complications following pediatric adenotonsillectomy (T/A) for the treatment of Obstructive Sleep Apnea Syndrome (OSAS).

Methods: A systematic review of the PUBMED and EMBASE databases was performed to identify studies containing both clinical and PSG data predicting major post-operative respiratory complications following T/A. Inclusion criteria included English language and extractable data. Major respiratory complications were defined as events that required significant intervention (intubation, CPAP,etc.) and/or altered patient disposition. Random effect modeling was performed and study quality was assessed using the Newcastle-Ottawa Scale.

Results: Twenty-two studies met the inclusion criteria with a median sample size of 157 (range 26 −1735) and published between 1992 and 2015. The most common study design was a case series. Most studies included multiple patients at high risk for respiratory complications (Syndromic, obese, etc.). The summary estimate of the major respiratory complication rate following T/A was only 5.8% (95% CI = 4.2 −7.4%, $p < 0.001$, $I^2 = 99\%$). For studies with extractable data, 102 of 112 patients (91.1%) with a post-operative respiratory complication had a clearly identifiable clinical risk factor, the remainder (8.9%) had only moderate or severe OSAS on PSG and no other predictor.

Conclusion: The major respiratory complication rate following pediatric T/A for OSAS is low even amongst series of high risk patients. The majority of the published literature report that readily identified clinical factors predict the large majority of post-operative respiratory complications following T/A.

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1. Introduction

There are several accepted and well documented clinical factors which when present place a child at a higher risk for post-operative respiratory complications following adenontonsillectomy (T/A). These include obesity, failure to thrive, young age (less than 3 years old), prematurity, craniofacial abnormalities, neuromuscular disorders, recent respiratory infections, reactive airway disease, and cardiac abnormalities [1]. When any of these factors are present, the astute clinician will be wary of the increased risk of post-operative complications and will strongly consider enhanced post-operative care to identify and manage potential respiratory complications should they arise.

Children without any these clinical predictors, but with moderate or severe obstructive sleep apnea syndrome (OSAS) diagnosed by overnight polysomnography (PSG) may be also be at potentially higher risk for postoperative respiratory complications following T/A [1,2]. This has prompted the idea that patients undergoing T/A for symptoms concerning for OSAS might undergo a

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pre-operative PSG for the specific reason to identify and quantify OSAS in order to estimate the risk for post-operative respiratory complications and so that appropriate post-operative care can be planned [3]. However, it is unclear if the yield of this approach justifies the increased use of an expensive, limited resource such as pediatric PSG. It is currently not well known how many patients who have post-operative respiratory complications after T/A would have the identification of moderate or severe OSAS on PSG as the sole predictive factor of a complication versus familiar, readily available clinical factors.

There are many appropriate reasons that a PSG may be obtained before pediatric T/A. These include verification of the diagnosis in uncertain clinical circumstances or in patients who have increased operative risk such as with bleeding dyscrasias, a history of anesthetic complications, sickle cell disease, neuromuscular disorders, etc. The utility of using pre-operative PSG for the primary purpose of assessing post-operative risk in patients without any clinical predictors of post-operative complications remains undefined. The aim of this study is to critically analyze the currently available literature to assess the yield of readily available typical clinical predictors such as age, BMI, and medical history versus the data from pre-operative PSG in the prediction of significant post-operative respiratory complications following T/A to help elucidate the optimal use of pediatric PSG in this regard.

2. Methods

This study includes only previously published data and therefore is exempt from Institutional Board review at Walter Reed National Military Medical Center. This study was prepared according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (www.prisma-statement.org) checklist. With the assistance of a full time research librarian, the PUBMED and EMBASE databases were systematically searched from earliest available date through June 2016 for studies available in the English language which reported on respiratory complications following a tonsillectomy or T/A in pediatric patients (<18 years old). The search was performed cross-referencing the key search phrases tonsillectomy, adenotonsillectomy AND pediatric, complications, outcomes, perioperative, post-operative, respiratory, airway, polysomnography, polysomnogram, sleep, perioperative, sleep apnea.

The inclusion and exclusion criteria specified presentation of major respiratory complications following T/A, available overnight PSG data, and available clinical factor data. As not all papers reviewed in this review had strict definitions of a PSG, any patient that had an overnight polysomnography with recorded apnea-hypopnea indices were included. If the study included both participants who had undergone polysomnography and those who had undergone either another form of testing for obstructive sleep apnea (ie-overnight pulse-oximetry), or who had undergone no further testing, only those in the former category were included and analyzed for the purpose of this study. The Apnea Hypopnea Index (AHI) was chosen as the only PSG parameter to be analyzed. Other measurements such as pulse oximeter desaturations and increased carbon dioxide measurements may also hold predictive value but were too inconsistently reported in the literature to be systematically reviewed.

Major respiratory complications were defined as events that required significant medical intervention for the patient by a physician or nursing staff, including re-intubation, continuous positive airway pressure (CPAP) therapy, Bilevel Positive Airway Pressure Therapy (BiPAP), insertion of a nasopharyngeal or oropharyngeal airway, bag mask ventilation, an un-planned admission, elevation of care to the ICU, pulmonary edema, or death. Post-operative desaturations, supplemental oxygen requirements, or need for repositioning, were not included as major respiratory complications.

Study quality was assessed using the Ottawa-Newcastle Quality Assessment Scale for Case-Control Studies [4]. This scale assesses each study on three dimensions: Selection of cases and controls (4 possible “stars”), comparability of cases and controls (2 “stars”), and exposure of the cases and controls (4 “stars”). The overall “star” quality score ranges from zero to ten possible “stars”.

Statistical analysis was performed with the assistance of computer software (STATA 8.3, College Station, Texas). Random effects modeling (weight proportional to sample size) was utilized to estimate the post-operative respiratory complication rate following T/A. Yield in predicting post-operative respiratory complications was calculated from crude pooled data. Quality scores were compared using the Kuskal-Wallis non-parametric statistical test. A p-value of less than 0.05 was considered significant.

3. Results

A total of 901 abstracts were reviewed for relevance to our stated clinical question and twenty-two studies met the inclusion criteria [5–26]. (Fig. 1) These twenty-two studies had a median sample size of 157 (mean = 292, range 26–1735) and with publication dates ranging from years 1992–2015 (Tables 1–3). Ten studies had a sample size of over 100 (45%). The grand mean age of the patients included in this study was 4.7 years old, with a standard deviation of 1.8 years, with the minimum mean age of 1.3 years, and maximum mean age of 8.3 years old. Three studies [11,14,22] (13.6%) were designed as a case control studies and the remaining 19 studies were case series of pediatric patients undergoing T/A who were followed short-term to record for possible post-operative complications. There were 3 studies [6,22,24] (13.6%) that prospectively collected their data while the remaining 19 were retrospectively designed. Of the studies included, fourteen (64%) were deemed to be broadly inclusive in their patient population selection, defined as studies which included patients no matter how young, those with syndromic or comorbid conditions, as well as those who were considered to be extremely over- or underweight for age, etc. Thirteen studies (59%) included advanced statistics such as regression for analysis of their data. Using the Newcastle-Ottawa Quality Assessment Scale, the mean number of stars in the overall quality score was 3.59 and the median was 3.5 with a minimum of one star and a maximum of 5 stars (Tables 1–3).

Nineteen studies reported at least one major respiratory complication following T/A, with an average rate of 12.1 major respiratory complications and a range of 0–55 complications. There were no reported deaths for this patient population. Using random effects modeling the summary estimate of the major respiratory complication rate following T/A was 5.8% (95% CI = 4.2–7.4%, $p < 0.001$, $I^2 = 99\%$) (Fig. 2). This is surprisingly low given most of the studies included a very high-risk population. Thirteen studies [5–17] (59%) (Table 1) concluded that readily identified clinical factors were all that were necessary to predict respiratory complications following T/A, seven studies [18–24] (32%) (Table 2) concluded that both clinical factors and PSG results were helpful in predicting complications, and only two studies [25,26] (9%) (Table 3) definitively concluded that PSG results were necessary beyond clinical factors to accurately predict post-operative respiratory complications. There was no significant difference in Newcastle-Ottawa quality score between these three subgroups. ($p = 0.0893$, Kruskal Wallis Test).

Crude pooled analysis was performed using studies that provided individual subject data. Twelve (54%) studies [6,8,9,11,12,14–16,19–21,25] provided extractable crude data for this pooled individual analysis. One-hundred and twelve pooled