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SHORT COMMUNICATION

# Risk factors for post-operative complications in Chinese children with tonsillectomy and adenoidectomy for obstructive sleep apnea syndrome

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**Abstract**
*Purpose* Tonsillectomy and adenoidectomy (T&A) is commonly performed in children with obstructive apnea syndrome (OSAS). It was our hospital practice to observe all patients post T&A in the pediatric intensive care unit. We aim to describe the post-operative complications after tonsillectomy and adenoidectomy in children with OSAS and to identify risk factors for these complications.
*Method* Medical records of patients from 1 to 16 years old with OSAS and T&A done in this department were retrieved for analysis from April 1999 to July 2006. Information of the individual patients including the demographic data, polysomnography data, and presence of post-operative complications were recorded and analyzed.
*Results* A total of 86 patient records were analyzed (M/F = 69:17). The mean BMI *z* score was 1.13±1.53, and 36% of patients were classified as obese with $z>1.96$. The median apnea–hypopnea index (AHI) before T&A was 9.8 episodes/h. Only six patients had post-operative desaturation. No bleeding complications were reported in our cohort. It was found that patients with desaturation after T&A had significantly higher mean BMI *z* score than children without desaturation ($p=0.014$). There was otherwise no significant difference between the age, sex, AHI score, and the history of allergic rhinitis or asthma between the two groups.
*Conclusion* Our results showed that most children with OSAS underwent T&A without complications. The respiratory complication rate was 7%, and desaturation was the most common post-operative complication. Children with higher BMI *z* score were more likely to have desaturation after T&A ($p=0.014$). Hence, careful monitoring with pulse oximeter after T&A should be offered to those who are obese.

**Keywords** Tonsillectomy · Adenoidectomy · Sleep apnea · Obstructive · Child

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## Introduction

Tonsillectomy and adenoidectomy (T&A) is commonly performed in children with obstructive apnea syndrome (OSAS) [1]. Young children tend to have a higher risk for respiratory morbidity following T&A when compared to the general population [2]. In this hospital, the practice was to admit all patients with OSAS after T&A to pediatric intensive care unit (PICU) for close observation. The aims of this retrospective study were to describe the post-operative complications after T&A in children with OSAS and to identify risk factors for these complications.

## Methods

Medical records of patients from 1 to 16 years old with OSAS and T&A done in this department were retrieved for analysis from April 1999 to July 2006. Only patients who underwent T&A because of OSAS were included in the study. Patients who underwent T&A due to other diseases were excluded from the study. Demographic data including age, sex, body mass index (BMI *z* score) [3], past medical history of allergic rhinitis, and asthma were documented. Polysomnography data were retrieved in every patient, and pre-operative apnea hypopnea index (AHI) was documented. The PICU records

were reviewed for any post-operative complications during the PICU stay including but not restricted to desaturation (defined as oxygen saturation less than 93% and bleeding. During hospitalization, oxygen was not given routinely, and the oximeter alarm was set at $SpO_2$ 93%.

### Overnight polysomnography

All children with suspected OSA were tested with overnight polysomnography. Overnight polysomnography was done according to the American Thoracic Society standards [4] with the Siesta Profusion-2 system (Compumedics; Abbotsford, Australia). The following parameters were recorded during the study: (1) six electroencephalography channels, (2) right and left electrooculogram, (3) submental and tibial electromyogram, (4) electrocardiography, (5) oro-nasal thermistor and/or nasal cannula, (6) oxygen saturation monitoring (Novametrix CO2SMO7100, CT, USA), (7) end-tidal $CO_2$ monitor (Novametrix CO2SMO7100, CT, USA), (7) chest and abdominal wall motion by computer-assisted respiratory inductance plethysmography, (8) snoring microphone, and (9) position sensor. Sleep stages were determined according to Rechtschaffen and Kales criteria [5]. Arousals were defined as recommended by the American Academy of Sleep Medicine [6]. Obstructive apnea was defined as the cessation of airflow despite breathing effort for more than two respiratory cycles. Obstructive hypopnea was defined as the decrease of airflow by >50% but <80% of baseline associated with desaturation of ≥3% or arousal despite breathing effort. The AHI, denoting the number of episodes of obstructive apnea and hypopnea per hour, was calculated. Non-obstructive events, e.g., central apnea, were not analyzed in this study.

### Statistical analysis

The results were analyzed by R 2.8.0 [7]. Student's *t* test was used to compare the mean age, AHI, and BMI *z* score between children with and without post-op complications. Fisher's exact test was used to compare the distribution of gender, obesity, and allergic rhinitis between patients with and without post-operative desaturation. A $p$ value of $<0.05$ was used to determine statistical significance.

## Results

A total of 104 Chinese children underwent T&A between April 1999 and July 2006. Eighteen patients were excluded from the study because T&A was performed due to indications other than OSAS. A total of 86 children (mean age of 8, SD=3.1, age range, 1–16) were included into this study. Sixty-nine patients were male, and 17 were female. The mean BMI *z* score of these 86 children was 1.13±1.53, and 31 of them (36%) were classified as obese by using the *z* score more than 1.96. The median AHI before T&A was 9.8 episodes per hour, and the interquartile range of AHI before T&A was 5.1 to 17.3 episodes per hour.

The prevalence of allergic rhinitis and asthma in the patients were 38.4% ($n$=33) and 9.3% ($n$=8), respectively. Eight patients had other medical problems. One patient had ventricular septal defect, four patients had Down's syndrome, two patients had neuromuscular diseases, and one patient suffered from CHARGE syndrome. None of these eight patients had post-operative desaturation.

In this study, only six patients experienced post-operative desaturation during the PICU admission. After standard nursing care for desaturation like lateral positioning, suction of oropharyngeal secretion, four of these six patients with desaturation required oxygen supplement. CPAP treatment, simulation, or repositioning was not required for any of the patients. No bleeding complications were reported in our subjects. Comparison was made between children with and without desaturation during the PICU admission (Table 1). It was found that patients with desaturation after T&A had significantly higher mean BMI *z* score than children without desaturation ($p$=0.014). There was no significant difference between the age, sex, AHI score, and the history of allergic rhinitis or asthma between the two groups of patients.

**Table 1** Comparison between patients with and without desaturation in the first 24 h post T&A

| | Patients with desaturation ($n$=6) | Patients without desaturation ($n$=80) | $p$ value |
|---|---|---|---|
| Mean age (SD) | 9.2±2.8 | 7.9±3.1 | 0.343 |
| Age range | 5 to 14 | 1 to 16 | |
| Gender (M/F) | 6/0 | 63/17 | 0.594 |
| Mean pre-op BMI *z* score | 1.9±0.6 | 1.1±1.6 | 0.014 |
| Mean pre-op AHI score | 11.6±4.5 | 14.7±16.6 | 0.064 |
| History of allergic rhinitis (%) | 2 (33.3%) | 31 (38.8%) | 0.238 |
| History of asthma (%) | 0 (0%) | 8 (10%) | 0.546 |

## Discussion

T&A is the most commonly performed surgical procedure for children with OSAS [1, 2]. Post-operative respiratory complications were reported to occur in 5% to 25% of children with OSAS who underwent T&A [8, 9]. These complications include desaturation, apnea, atelectasis, lung infiltrate, pulmonary edema, pneumomediastinum, pneumothorax, pleural effusion, and upper airway obstruction [8]. Desaturation was noted to be the most common complication [8]. The risk factors for post-operative desaturation include young age (less than 3 years old), patients with craniofacial abnormalities, asthma, prematurity, hypotonia, morbid obesity, past history of upper airway trauma, and cor pulmonale [8, 9]. Children with more severe OSAS were also at higher risk of developing post-operative complications [8, 10]. The current paper provided, for the first time, the data on post-operative complications in Chinese children who underwent T&A for OSA. In our current study, it was found that most children with OSAS underwent T&A without complications. The complication rate was 7%, and desaturation was the only post-operative complication. None of our patients had post-operative bleeding. The current study showed that T&A was a safe procedure with low complication rate in Hong Kong Chinese children, and the complication was relatively minor provided early intervention was provided. It was previously our practice to monitor all patients in intensive care unit for the first 24 h post-operatively. In fact, resources could be better distributed if only those patients who were deemed to be at higher risk of developing post-operative complications are admitted. On comparing the two groups of patients with and without post-operative desaturation, the only significant finding was that children with higher BMI $z$ score were more likely to have desaturation after T&A ($p=0.014$). Our post hoc calculation found that the sensitivity and specificity for predicting post-operative desaturation by using BMI $z$ score >1.0 were 100% and 33%, respectively. A future prospective cohort study on the diagnostic accuracy of this cutoff point was warranted.

This retrospective study is limited by its small sample size. As a result, the effect of other confounding factors cannot be examined by multivariate analysis. The number of patients with complications might not provide sufficient statistical power to show significant differences in other clinically relevant risk factors such as severe OSAS (AHI >15, $n=23$) or age less than 3 years ($n=1$). Future prospective studies are warranted in this field to identify which children with OSAS are at higher risk for post-operative complications. Another limitation is that the retrospective data collection would miss those complications that occurred after discharge from PICU. Additionally, some PSG parameters such as desaturation index and lowest oxyhemoglobin saturation were not retrieved for analysis, and these parameters might be predictive of post-operative desaturation.

In summary, T&A is a safe procedure in Chinese children, but children with BMI $z$ score >1 are more likely to develop post-operative complications. Other previously reported risk factors like young age and severe OSA should be investigated further in a larger study.

**Conflict of interest** None declared.

## References

1. Constantin E, Kermak A, Nixon GM, Tidmarsh L, Ducharme FM, Brouillette RT (2007) Adenotonsillectomy improves sleep, breathing, and quality of life but not behavior. J Pediatr 150:540–546
2. Sanders JC, King MA, Mitchell RB, Kelly JP (2006) Perioperative complications of adenotonsillectomy in children with obstructive sleep apnea syndrome. Anesth Analg 103:1115–1121
3. Leung SS, Cole TJ, Tse LY, Lau JT (1998) Body mass index reference curves for Chinese children. Ann Hum Biol 25:169–174
4. American Thoracic Society (1996) Standards and indications for cardiopulmonary sleep studies in children. Am J Respir Crit Care Med 153:866–878
5. Rechtschaffen A, Kales A (1968) A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects. US Dept. of Health, Education, and Welfare; National Institutes of Health.
6. No authors listed (1992) EEG arousals: scoring rules and examples: a preliminary report from the Sleep Disorders Atlas Task Force. Sleep 15:173–184
7. R Development Core Team (2011) R: a language and environment for statistical computing. http://www.R-project.org. Accessed 18 February 2011
8. Statham MM, Elluru RG, Buncher R, Kalra M (2006) Adenotonsillectomy for obstructive sleep apnea syndrome in young children. Prevalence of pulmonary complications. Arch Otolaryngol Head Neck Surg 132:476–480
9. Rosen G, Muckle RP, Mahowald MW, Goding GS, Ullevig (1994) Postoperative respiratory compromise in children with obstructive sleep apnea syndrome: can it be anticipated? Pediatrics 93:784–788
10. Rosenfeld RM, Green RP (1990) Tonsillectomy and adenoidectomy, changing trends. Ann Otol Rhino Laryngol 99:187–191