REVIEW ARTICLE

Childhood Adenoidectomy and Tonsillectomy (CHAT) Randomized Controlled Trial: Impact on the Management of Obstructive Sleep Apnea in Children

Deepak Shrivastava

Department of Internal Medicine, San Joaquin General Hospital, USA

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Abstract

The results of the first randomized controlled trial popularly known as Childhood adenoidectomy and tonsillectomy (CHAT) in otherwise healthy children of older age (five to nine years) are at best intriguing. These subjects diagnosed with mild to moderate Obstructive sleep apnea (OSA) by polysomnography (PSG) underwent the recommended first line treatment adenotonsillectomy (AT) or watchful waiting. AT provided benefit in terms of quality of life, improvement in symptoms and behavior. There is high quality evidence that AT is beneficial in terms of improvement in PSG parameters. On the contrary, high quality evidence indicates lack of benefit in objective measures of attention and neurocognitive performance compared with watchful waiting. Since its publication, CHAT database has been used for many follow up randomized trials with assessment of cardio-metabolic and demographic variables, respiratory parameters, complication rates, and weight gain.

Introduction

Obstructive sleep apnea (OSA) is a common pediatric sleep disorder, characterized by recurring episodes of upper airway obstruction during sleep. This results in disruption in ventilation and resultant oxygen desaturations and hypoventilation as well as sleep fragmentation. Since most OSA is due to adenotonsillar hypertrophy, the recommended first line treatment is adenotonsillectomy (AT)[1]. The American Academy of Pediatrics considers adenotonsillectomy to be a safe procedure, however cautions regarding potential life threatening complications[2]. Uncontrolled studies indicate the OSA improves in 70-80% children after AT. Although the size of the adenoids and tonsils correlate with upper airway volume, the correlation coefficient remains low at 0.51. There is considerable overlap in adenotonsillar size between asymptomatic children and children with OSA. This suggests likelihood of other factors contributing to the pathogenesis of OSA in children. Given the three fold rise in the prevalence of childhood obesity is likely to increase the simultaneous increase in the prevalence of OSA. In addition, presence of obesity may reduce the efficacy of the AT. The CHAT parallel-randomized single blind, multicenter design protocol included male and female children between ages of 9-12[3]. The study ran from January 2008 through September 2011, with about 400 children evaluated at seven academic sleep centers. The study intended to evaluate attention and executive function as a primary outcome comparing AT and watchful waiting[4]. In the United States only, over 500,000 adenotonsillectomies are performed in the pediatric population each year, mostly for obstructive sleep apnea. This volume is significant for parents and healthcare providers. It has

Address for correspondence:

Deepak Shrivastava, MD, FAASM, RPSGT
Department of Internal Medicine
San Joaquin General Hospital
500 West Hospital Road
French Camp, CA 95231 USA

numerous implications including medical, social, financial, and most of all, personal for those children with OSA[5].

Pediatric obstructive sleep apnea affects somewhere between 2% to 3% of the pediatric population, with African-American and low-income children somewhat more affected than the average. The increased airway resistance associated with narrowing and intermittent pharyngeal collapse leads to snoring and periods of sleep apnea. This often results in intermittent hypoxia, hypercapnia, and sleep disruption[5]. Many adverse health effects can result from this fragmented and insufficient sleep pattern, including systemic hypertension, increased C-reactive protein (CRP), insulin resistance, increased left ventricular mass, and resulting chronic cardiovascular and metabolic disturbances[5]. From a healthcare standpoint this is concerning enough, but when cognitive disturbances such as behavioral problems from sleep deprivation, decreased school performance, and mood impairments, are added to this the effects of pediatric OSA can be quite devastating to a child afflicted with this disorder. In many cases, as the child grows and the airway anatomy matures, OSA can resolve on its own. Because of the health implications, however, current primary treatment for pediatric OSA is surgical adenotonsillectomy (AT).

Surprisingly enough, however, there have not been any large clinically controlled trials to determine if AT is superior to a watch-and-wait approach. In 2013, the CHAT study release provided an important window into the implications of both methods of managing pediatric OSA and showed the superiority of a surgical approach for improvements in secondary outcomes of behavior, cognition, health, and polysomnography[4].

The hypothesis of the CHAT was that in children with OSA without prolonged oxyhemoglobin desaturation, early adenotonsillectomy would result in improved outcomes in several domains as compared to watchful waiting with supportive care, most notably in the neuropsychological realm. The assessment included measuring polysomnographic, cognitive, behavioral, and health outcomes both at baseline and at a time interval of seven months. At the end of this period, the children in both arms of the study were reassessed according to the initial methods (standardized sleep studies, cognitive and behavioral testing, lab results, and survey and behavioral assessments by caregivers and teachers). The chosen pediatric population for this study had the OSA syndrome without prolonged oxyhemoglobin desaturation, and was eligible and suitable candidates for surgery[5].

After completion of the study, the data was mathematically evaluated. While there were several adverse events during the trial, relating to the children assigned either to the watch-and-wait arm or to perioperative complications in the surgery group, these did not significantly affect the results. Upon repeat testing, those children in the surgery arm did not have "significantly greater improvement in attention and executive function, as measured by means of neuropsychological testing, than did children in the watchful-waiting group[5]." However, those who had an adenotonsillectomy had a greater reduction of symptoms and had a greater improvement in behavior, quality of life, and polysomnographic findings[5]. This finding can be interpreted in two ways. First, the major premise of the survey was not borne out by the actual results. The children in both arms did not show a significant difference in the neuropsychological realm, which was the primary hypothesis in the survey. This could be interpreted to mean that AT is not therapeutically necessary but only helpful for symptomatic relief. However, this is not the only conclusion. Among those children who were part of the AT arm, there were improvements in behavioral performance and executive function in activities of daily living, less emotional lability, restlessness, and impulsivity, and reductions in symptoms of OSA with enhanced quality of life[5]. These results can be extrapolated to indicate that AT is a superior management strategy for children with pediatric OSA as these measurements can directly affect the quality of life for these children. It could be theorized that as these children are followed up in the future, positive effects in the neuropsychological realm are possible. Because neurobehavioral effects related to sleepiness resolve quickly, either group could be affected equally as the children in each arm were either treated surgically or simply outgrew the apnea. However, complications from hypoxemia (as might be expected in children in the watch-and-wait group who were not given the benefit of AT) could be insidious and could take longer to manifest in a detrimental fashion[6]. Long-term follow-up would be necessary to confirm these speculations.

The CHAT study certainly contributed in determining the direction of care in management of pediatric OSA. AT does appear to be beneficial in several important ways and could improve the quality of life in children

affected by OSA. Long-term follow-up of those in this study and interim secondary analyses would be desirable to assess exactly where these conclusions ultimately lead.

Utilizing the CHAT database, Quante et al evaluated the effect of early TA on blood pressure, heart rate, lipids, glucose, insulin, and CRP. They further analyzed whether these parameters at baseline and changes at follow up correlated with polysomnographic indices. There is little variation if any noted in standard cardio- metabolic parameters in children with OSA without severe hypoxemia at baseline or after intervention. Of all measures the overnight heart rate turned out to be the most sensitive parameter of pediatric OSA severity[7]. In a recent secondary analysis Baumert et al analyzed respiratory rate, respiratory sinus arrhythmia and heart rate during quiet, non-apenic breathing throughout sleep at baseline and at 7 months polysomnography reported that AT increases baseline respiratory rate during sleep. In addition, they observed that normalization of the apnea-hypopnea index lowers heart rate. The clinical significance of these observations remains uncertain[8]. While AT can be curable for most cases of pediatric OSA, potential complications can be severe. Current guidelines recommend postoperative hospitalization in high-risk children. Using the CHAT study data Konstantinopoulou et al evaluated the polysomnographic parameters as predictors of postoperative complications. CHAT study did not report any significant complications. However, many subjects in CHAT study met published criteria for post-operative hospitalization due to obesity, or polysomnographic severity. Fisher's exact test was applied to examine association between categorical demographic variables and occurrence of complications. The Mann-Whitney test was used to compare polysomnographic parameters between subjects with and without complications. Chi-square tests were used to examine associations with any complication between subjects whose polysomnographic findings were in the most severe quintile for apnea hypopnea index or gas exchange abnormalities compared to the remainder of the group. Interestingly, there were no statistically significant associations between demographic variables, or polysomnographic parameters and the presence of either respiratory or non-respiratory complications. There was no increased rate of complications in children with high AHI[9]. Adequate growth trajectory is considered an important measure of wellness in children. Previous studies have mixed results regarding the accelerated weight gain after AT. Again, using the longitudinal anthropometric data from CHAT study, Katz et al determined if AT for OSA leads to weight gain in children as a primary aim. As a secondary outcomes measure they assessed the influence race, baseline weight, OSA severity and residual OSA on growth after AT. Statistical comparisons were made using unpaired t tests, and Fisher's exact tests. Significant observations were made as AT resulted in greater increases in weight and BMI compared to Watchful waiting cohort. The strength of relationship was high in subjects who had baseline failure to thrive, normal body weight, and overweight. This study suggests need for postoperative monitoring of body weight, nutritional counseling, and engagement in physical activity to prevent recurrence of OSA[10].

1. **Gozal D,** Khreindish L. Disorders of breathing during sleep. In: Chernick V,Boat TF, Wilmott RW, Bush A, eds. Kendig's Disorder of the respiratory tract inchildren. Elsevier Saunders, 2006:1046–70.
2. **Marcus CL,** Brooks LJ, Draper KA, et al; American Academy of Pediatrics. Diagnosis and management of childhood obstructive sleep apnea syndrome.Pediatrics 2012; 130:e714–55.
3. CHAT Protocol V5.0 July 15, 2010
4. **Carole L.** Marcus, Reneé H. Moore, Carol L. Rosen, Bruno Giordani, Susan L. Garetz, H. Gerry Taylor, Ron B. Mitchell, Raouf Amin, Eliot S. Katz, Raanan Arens, Shalini Paruthi, Hiren Muzumdar, David Gozal, Nina Hattiangadi Thomas, Janice Ware, Dean Beebe, Karen Snyder, Lisa Elden, Robert C. Sprecher, Paul Willging, Dwight Jones, John P. Bent, Timothy Hoban, Ronald D. Chervin, Susan S. Ellenberg, and Susan Redline for the Childhood Adenotonsillectomy Trial (CHAT). A Randomized Trial of Adenotonsillectomy for Childhood Sleep Apnea. N Engl J Med 2013; 368:2366-2376
5. **Redline S;** Amin R; Beebe D; Chervin RD; Garetz SL; Giordani B; Marcus CL; Moore RH; Rosen CL; Arens R; Gozal D; Katz ES; Mitchell RB; Muzumdar H; Taylor HG; Thomas N; Ellenberg S. The Childhood Adenotonsillectomy Trial (CHAT): rationale, design, and challenges of a randomized controlled trial evaluating a standard surgical procedure in a pediatric population. SLEEP2011;34(11):1509-1517
6. **De Luca Canto G,** Pacheco-Pereira C, Aydinoz S, et al.Adenotonsillectomy complications: a meta-analysis. Pediatrics2015; 136:702–18.
7. **Quante M,** Wang R, Weng J, Rosen CL, Amin R, Garetz SL, Katz E, Paruthi S, Arens R, Muzumdar H, Marcus CL, Ellenberg S, Redline S; Childhood Adenotonsillectomy Trial (CHAT)..The Effect of Adenotonsillectomy for Childhood Sleep Apnea on Cardiometabolic Measures. Sleep. 2015; 38(9):1395-403.
8. **Mathias Baumert,** Yvonne Pamula, James Martin, Declan Kennedy, Anand Ganesan, Muammar Kabir, Mark Kohler, Sarah A. Immanuel. The effects of adenotonsillectomy for childhood sleep apnoea on cardio respiratory control. ERJ Open Research 2016 2:00003 2016.

9. **Sofia Konstantinopoulou,** Paul Gallagher, Lisa Elden, Susan L. Garetz, Ron B. Mitchell, Susan Redline, Carol L. Rosen, Eliot S. Katz, Ronald D. Chervin, Raouf Amin, Raanan Arens, Shalini Paruthi, and Carole L. Marcus. Complications of adenotonsillectomy for obstructive sleep apnea in school-aged children. Int J Pediatr Otorhinolaryngol. 2015; 79(2):240-5.

10. **Eliot S. Katz,** Renee H. Moore, Carol L. Rosen, Ron B. Mitchell, Raouf Amin, Raanan Arens, Hiren Muzumdar, Ronald D. Chervin, Carole L. Marcus, Shalini Paruthi, Paul Willging, Susan Redline.Growth After Adenotonsillectomy for Obstructive Sleep Apnea: An RCT. Pediatrics 2014; 134:2