Effect of Tonsillectomy on Cognition in Preschool Children With Sleep-Disordered Breathing

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Adenotonsillectomy represents 15% of all surgical procedures in children <15 years of age. The primary indication for adenotonsillectomy has shifted over the last 20 years from recurrent throat infections to obstructive sleep-disordered breathing (OSDB) and obstructive sleep apnea (OSA). OSDB includes disorders ranging from primary snoring to OSA and can result in a significant negative impact on quality of life and other health-related consequences. Specifically, OSDB has been associated with a decrease in IQ, attention-deficit/hyperactivity disorder, emotional lability, enuresis, and learning impairment.

Although the exact relationship between OSDB and neurocognitive deficit is unclear, 1 hypothesis is that respiratory disruptions lead to sleep fragmentation and episodic hypoxia, promoting systemic inflammatory changes and vascular changes in specific parts of the brain, resulting in impaired daytime functioning.

Although disruptions sometimes result in excessive daytime somnolence (as in adults), in young children, it is more common to observe hyperactivity, impulsivity, and poor attention span. Some evidence exists that OSDB treatment may result in improvement in these sequelae, however, little evidence on this subject addresses the preschool age group (3-5 years of age).

The Preschool Obstructive Sleep Apnea Tonsillectomy Adenoidectomy (POSTA) randomized controlled trial (RCT), as reported in this month’s issue of Pediatrics by Waters et al, is important for multiple reasons. It is the first study to rigorously evaluate cognitive changes associated with early adenotonsillectomy in preschool children compared with watchful waiting by using pre- and 12-month–postintervention outcome measures that included cognitive and behavioral testing of the children and parent-reported outcomes. Investigators used the Woodcock-Johnson III Brief Intellectual Ability (BIA), a measure of global IQ, as the primary end point. They found that at 12 months postintervention, both adenotonsillectomy and watchful waiting groups had improved cognitive function. Children randomly assigned to adenotonsillectomy did show greater improvement in polysomnography obstructive indices and parent-reported behavior but did not demonstrate a treatment-attributable improvement in cognitive function.

This study provides an important addition to the literature on this subject with implications for counseling and expectations. To date, only 2 comparative studies (ie, treated versus nontreated children with OSDB; Childhood Adenotonsillectomy Trial [CHAT] and the Biggs et al prospective cohort study) have evaluated the impact of adenotonsillectomy for OSA on neurocognitive function. CHAT used the Developmental Neuropsychological

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Assessment (NEPSY) to evaluate attention and the Behavior Rating Inventory of Executive Function to assess behavioral regulation and meta-cognition. Similar to POSTA findings, NEPSY scores improved in both CHAT groups (adenotonsillectomy versus watchful waiting) 7 months postintervention, but group differences were not significant. Global scores on the Behavior Rating Inventory of Executive Function improved among treated children compared with untreated children when evaluated by caregivers. Biggs et al\textsuperscript{17} compared treated children compared with Executive Function improved among Behavior Rating Inventory of and polysomnography parameters. Assessment System for Children), Questionnaire), behavior (Behavior reports of symptoms (Pediatric Sleep whereas it did improve caregiver function as assessed by behavioral and cognitive testing (BIA or NEPSY), Whereas it did improve caregiver improvement in neurocognitive outcomes if children with more severe OSA are included. It is notable that in a follow-up study using CHAT data, Taylor et al\textsuperscript{15} noted small but significant improvements in the adenotonsillectomy group on specific measures of nonverbal reasoning and fine motor skills. Replicating the results of POSTA by using the same primary end point (BIA) in a larger sample size with longer follow-up would further improve confidence in the results.

As the only other RCT assessing the impact of adenotonsillectomy in children with OSA, it is important to compare the POSTA results to the CHAT study. Important differences exist between these studies. CHAT studied children 5 to 9 years of age with OSA syndrome (Apnea-Hypopnea Index score >2 and <30 and/or OAI score >1 per hour and <20 per hour), whereas the POSTA study included children 3 to 5 years old with primary snoring and mild or moderate OSA (OAHI ≤10 hours). Moreover, the POSTA study used a different primary end point (BIA) and had longer follow-up than the CHAT study. Nonetheless, the findings are similar and reinforcing. Adenotonsillectomy did not result in improvement in neurocognitive function as assessed by behavioral and cognitive testing (BIA or NEPSY), whereas it did improve caregiver reports of symptoms (Pediatric Sleep Questionnaire), behavior (Behavior Assessment System for Children), and polysomnography parameters. Both RCTs have limitations. In particular, both studies included children with mild OSA at baseline. The POSTA study excluded children with severe OSA (Apnea-Hypopnea Index >10 events per hour) and included children with primary snoring; thus, the sample had mild OSA at baseline (mean OAHI 1.9 events per hour in both groups). It is possible that adenotonsillectomy might result in clinically important improvement in neurocognitive outcomes if children with more severe OSA are included. It is notable that in a follow-up study using CHAT data, Taylor et al\textsuperscript{15} noted small but significant improvements in the adenotonsillectomy group on specific measures of nonverbal reasoning and fine motor skills. Replicating the results of POSTA by using the same primary end point (BIA) in a larger sample size with longer follow-up would further improve confidence in the results.

To date, a lack of rigorous comparative studies has limited our ability to provide evidence-based counseling regarding the effect of adenotonsillectomy on the neurocognitive functioning of preschool children with snoring and mild sleep apnea. The POSTA study helps fill this gap in knowledge. It showed that adenotonsillectomy is helpful in many domains, including symptoms of obstruction, behavior, and objective polysomnography testing; however, data currently do not support that reversing snoring and mild sleep apnea in the preschool age group has positive effects on global IQ. The impact of adenotonsillectomy on other more specific cognitive measures in preschoolers, or the potential for more long-term developmental sequelae, remains unknown. Care should be taken not to extrapolate these findings to preschoolers who have severe OSA, for whom data on effects of adenotonsillectomy are lacking.

**ABBREVIATIONS**

BIA: Brief Intellectual Ability
CHAT: Childhood Adenotonsillectomy Trial
NEPSY: Developmental Neuropsychological Assessment
OAHI: Obstructive Apnea-Hypopnea Index
OSA: obstructive sleep apnea
OSDB: obstructive sleep-disordered breathing
POSTA: Preschool Obstructive Sleep Apnea
Tonsillectomy
Adenoidectomy
RCT: randomized controlled trial

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