Outcome of adenotonsillectomy for obstructive sleep apnea in children under 3 years

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OBJECTIVE: **To study the outcome of adenotonsillectomy for obstructive sleep apnea (OSA) in children less than 3 years of age.**

DESIGN AND SETTING: **Prospective study at the University of New Mexico Children's Hospital. Children with OSA underwent pre- and postoperative full-night polysomnography (PSG). Scores were compared using a paired *t* test. A *P*-value <0.05 was considered significant.**

RESULTS: **The study population included 20 children. Fifteen (75 %) were male. The mean age was 2.2 years (range, 1.1 to 3.0). Sixteen (80%) children had medical comorbidities. Over 25% of children had postoperative complications including laryngospasm and marked desaturations. The mean preoperative respiratory distress index (RDI) was 34.1 and the mean postoperative RDI was 12.2 ($P < 0.0001$). After surgery, 7 (35%) children had an RDI < 5. Thirteen (65%) had a postoperative RDI ≥ 5 indicating persistent OSA.**

CONCLUSION AND SIGNIFICANCE: **Children under 3 years show significant improvement in RDI after adenotonsillectomy for OSA, but they may develop complications after surgery. Postoperative PSG is recommended for children under 3 years of age to monitor the severity of persistent OSA. EBM rating: B-2.**
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Obstructive sleep apnea (OSA) has become the most common indication for adenotonsillectomy in the pediatric population.[1,2] Over the last 10 years, there has been increasing awareness that OSA in children may cause developmental delay, failure to thrive, cardiorespiratory complications, and behavioral disorders.[3-6] These problems improve after adenotonsillectomy.[7,8] As a consequence, the percentage of children who undergo adenotonsillectomy for OSA has increased whereas the percentage who undergo this procedure for relief of recurrent tonsillitis has decreased.[1] In a recent study[9] of young children who underwent adenotonsillectomy, 91% had the procedure for OSA and only 9% for recurrent throat infections.

Children under 3 years of age are considered to be at high-risk for the development of complications after adenotonsillectomy.[10] These complications include respiratory compromise caused by edema in the relatively narrow oropharynx of a young child, circulatory collapse as a consequence of blood loss in a child with low blood volume reserves, and high rates of dehydration because of poor oral intake.[5,11,12] In view of these risks, it has been recommended that young children undergoing adenotonsillectomy stay in hospital overnight for observation.[7,10]

Previous reports on adenotonsillectomy in young children have evaluated outcome on the basis of postoperative complications.[2,9,11-15] The emphasis placed on complications reflects the risks of surgery in these children. However, it is also important to establish the degree of improvement in OSA after adenotonsillectomy in young children with the use of full-night polysomnography (PSG),[16] the acknowledged standard for diagnosis of sleep disorders. To date, the high cost of PSG, limited availability of the procedure, and difficulties in obtaining PSG before and after surgery have prohibited this type of study. The present article examines changes in the respiratory distress index (RDI) as measured by PSG [16] after adenotonsillectomy for OSA in children under 3 years of age. The purpose is to evaluate changes in the physiology of sleep after adenotonsillectomy for OSA in the high-risk population of children under 3 years of age.

METHODS

Approval for this study was obtained from the institutional review board of the University of New Mexico School of Medicine, Albuquerque. Children who were shown to have OSA by polysomnography and were under 3 years of age were included in the study. The caregivers of these children were asked to complete an informed consent document before enrolling the child in the study. Exclusion criteria included: (1) children ≥ 36 months of age; (2) children who had a previous adenotonsillectomy; and (3) children with an RDI <5.

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For each child, the following was recorded: age, gender, ethnicity, associated comorbidities, and pre- and postoperative body mass index (BMI). Age- and gender- specific BMI percentiles were calculated, and children were divided into 4 groups according to published guidelines.[17] Group 1 included children who were underweight with a BMI less than or equal to the 5th percentile; group 2 included children who were of normal weight with a BMI greater than the 5th percentile but less than the 85th percentile; group 3 included children who were at risk of being overweight with a BMI greater than or equal to the 85th percentile but less than the 95th percentile; and group 4 included children who were overweight with a BMI greater than or equal to the 95th percentile.

Children underwent a monopolar Bovie adenotonsillectomy and were admitted to hospital after surgery. For each child the following was recorded: complications during extubation or in the recovery room; complications during hospital stay; need for intensive care monitoring; and total length of hospital stay.

The effectiveness of adenotonsillectomy for OSA was evaluated using PSG.[16] A certified sleep medicine physician interpreted the results of all PSGs. The RDI, defined as the average number of apneas and hypopneas per hour of sleep,[18] was used for diagnosis of OSA. Children enrolled in the study also underwent a second PSG within 12 months after surgery and findings were classified as: mild (RDI $\geq 5 < 10$); moderate (RDI $\geq 10 < 20$); or severe (RDI ≥ 20). The minimum oxygen saturation was also recorded.

A power analysis indicated that a sample size of 20 is adequate to detect a difference of 15 in RDI with 80% power and $\alpha = .05$. A change in RDI from 25 to 10 indicates a change from severe to moderate OSA.[10] Therefore, the present study has sufficient power to detect a clinically significant change in the physiological parameters of sleep as measured by RDI. A paired *t* test was used to evaluate the differences in pre- and postoperative RDI. A P value < 0.05 was considered significant.

RESULTS

Twenty-six children were included in the study. Three of these children were lost to follow-up and 3 did not have postoperative PSG. As a consequence, the study population included 20 children of whom 15 (75 %) were male. The mean age of the children at the time of inclusion was 2.2 years (range, 1.1 to 3.0 years). Ten children were Hispanic or Latino, 5 children were non-Hispanic or Latino white, 1 was Native American, and in 4 children the ethnicity was described as "other."

Sixteen (80%) children had associated comorbidities. Six (30%) children had 4 or more comorbidities. These included: gastroesophageal reflux disease (9 children), asthma (8 children), obesity (6 children), Down syndrome (4 children), congenital heart disease (4 children), premature birth (3 children), allergic disease (2 children), cerebral palsy (1 child), and chromosomal abnormality (1 child).

Table 1. Pre- and postoperative PSG results

Preoperative RDI		Postoperative RDI	
Mean	34.1	Mean	12.2
95% CI	22.1 – 46.1	95% CI	5.5 – 18.9
Maximum	110.5	Maximum	55.0
Minimum	5.4	Minimum	0.2

On the basis of preoperative BMI percentiles, 5 children were in group 1 (underweight), 7 were in group 2 (normal weight), 2 were in group 3 (at risk of being overweight), and 6 were in group 4 (overweight). Postoperatively, 2 children were in group 1, 9 were in group 2, 1 was in group 3, and 8 were in group 4. The mean preoperative BMI was 18.2 and the mean postoperative BMI was 18.5. Postoperative BMI values were not significantly different from preoperative values ($P = 0.85$).

The mean hospital stay following surgery was 2.4 days (range, 1.0 to 6.0 days). Six (30%) children stayed in hospital for 4 or more days. Three (15%) children required an overnight stay in the intensive care unit (ICU). The most common reason for prolonged hospitalization was poor oral intake in 6 (30%) children. Two (10%) children had laryngeal spasm after extubation and 1 of these children required reintubation. Five (25%) children required supplemental oxygen because of significant desaturations after surgery.

Mean values for pre- and postoperative RDIs are presented in Table 1 along with minimum and maximum values and 95% confidence intervals. The mean interval between the first and second PSG was 9.3 months (range, 4.3 to 20.6 months). The mean interval between adenotonsillectomy and the second PSG was 7.2 months (range, 4.1 to 20.4 months). The mean preoperative RDI was 34.1 and the mean postoperative RDI was 12.2. The difference in pre-and postoperative RDI values is significant ($P < 0.0001$). Results for children grouped on the basis of RDI values are shown in Table 2. Seven (35%) children had an RDI less than 5 after surgery indicating no evidence of OSA. Thirteen children had an RDI greater than or equal to 5 after surgery indicating persistent OSA. Three children had an RDI greater than or equal to 20 indicating severe persistent OSA. In addition, 12 children had a minimum O_2 saturation below 80% before surgery and 8 children had minimum O_2 saturation below 80% after surgery.