

Effect of Adenotonsillectomy on ADHD Symptoms of Children with Adenotonsillar Hypertrophy

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Abstract- Adenotonsillar hypertrophy and obstructive sleep disordered breathing can lead to attention deficit/hyperactivity disorder (ADHD). The purpose of this study was to evaluate effect of adenotonsillectomy on improvement of ADHD symptoms in a quasi-experimental (before and after) study. The efficacy of adenotonsillectomy on improvement of ADHD symptoms of 35 children aged 5-12 years with adenotonsillar hypertrophy and ADHD was evaluated six months after surgery. Diagnosis of ADHD was based on the DSM-IV criteria in three subtypes (predominantly inattentive type, predominantly hyperactive-impulsive type and combined type). Seventeen boys (49%) and eighteen girls (51%) with mean (\pm SD) age of 7.4 ± 3.8 years (range: 1-10 years) were evaluated. Frequency of combined type of ADHD decreased significantly six months after adenotonsillectomy (54.3% versus 22.9%, $P=0.003$). ADHD inattention score (2.26 ± 1.93 versus 0.96 ± 0.45 , $P=0.005$), hyperactivity score (4.23 ± 3.57 versus 3.57 ± 8 , $P=0.03$) as well as ADHD combined score (9.66 ± 2.58 versus 7.2 ± 3.67 , $P=0.0001$) improved significantly after surgery. Upper air way obstruction due to adenotonsillar hypertrophy might be an important and treatable cause of ADHD and should be considered in evaluation of affected children. Adenotonsillectomy in these children is associated with improvements in ADHD symptoms.

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Introduction

Approximately 3% of children had obstructive sleep apnea syndrome and chronic adenotonsillar hypertrophy manifesting various degrees of airway obstruction is the most common cause of sleep apnea in children (1). Obstructive sleep disordered breathing (OSDB) can cause hypoxia, hypercapnia, state of arousal, night terror, sleepwalking, enuresis, morning headache, poor appetite, excessive daytime sleepiness, failure to thrive and developmental delay (1,2). If OSDB is not treated, it can lead to neurocognitive dysfunction (memory problems, impairment in concentration, learning disability, language dysfunction, lower sensorimotor integration and reduced intelligence quotient), attention deficit/hyperactivity disorder (ADHD), poor academic achievement, emotional instability, depression and anxiety (1,3-6).

Main cognitive dysfunction in children with OSDB is related to concentration and attention (7). On the other hand, ADHD is the most common behavioral disorder of children. Based on Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (DSM-IV), ADHD is defined by presence of either or both of the following: At least 6 out of 9 symptoms of inattention, at least 6 of 9 hyperactive or impulsive symptoms that persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level (8).

Inattention and hyperactivity was seen in 20-30% of children with OSDB (9,10). Children with ADHD symptoms should be assessed from view of OSDB as treatment of sleep disorders is often associated with improvement in these symptoms and decreased need for stimulants (11).

As the time and degree of ADHD symptoms improving is not clear, the purpose of this study was to evaluate effect of adenotonsillectomy on ADHD

symptoms of children with adenotonsillar hypertrophy six months after surgery in Yazd, a central city of Iran.

Patients and Methods

In a quasi-experimental (before and after) study, all consecutive children for whom adenotonsillectomy was done in ENT operation room of Shahid Sadoughi Hospital between September 2008 and March 2010 in Yazd (Iran), entered the study until the desirable sample size (n=35) was completed. Sample size were calculated based on Z formula with 80% power, SD=30 and d=15 to detect a significant difference between the two groups with a level of $\alpha=0.05$.

Care was taken to include children aged 5-12 years, with normal IQ (≥ 70) based on Wechsler Intelligence Scale for Children (WISC-III) IQ testing (12), with nocturnal snoring, constant oral breathing and airway obstruction due to adenotonsillar hypertrophy based on otolaryngologist evaluation. Inclusion criteria also included having ADHD based on DSM-IV criteria and not receiving any drug for treatment of ADHD. Patients with mental retardation (IQ <70), epilepsy, major psychiatric disorders (pervasive developmental disorder, bipolar disorder, major depression, anxiety disorder and psychosis) and major systemic diseases were excluded. Informed consent was taken from parents of children and the study was approved by the ethics committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

At first, a pediatric neurologist interviewed the parents of children to identify ADHD children based on 18 criteria outlined in the DSM-IV in three domains of inattention, hyperactivity and impulsivity. Each criterion was evaluated by a question and there were four answering alternatives: “never”, “a little”, “very much” or “too much”. Questions which were answered “very much” or “too much” were considered “having of this symptom” and also, gained one score. If a child had at least 6 of 9 symptoms of inattention, it was considered as predominantly inattentive type and if had at least 6 of

9 hyperactivity-impulsivity symptoms, it was considered as predominantly hyperactive-impulsive type and if the child had both of the them (6 of 9 symptoms of inattention and 6 of 9 hyperactivity-impulsivity) it was considered as combined type of ADHD.

Then adenotonsillectomy was done in patients with inclusion criteria and these children were followed up six months after adenotonsillectomy. In fact, patients were considered control group before surgery, and case group six months after adenotonsillectomy.

Sum of scores in dimension of inattention, hyperactivity, impulsivity and all three dimensions, before and six months after surgery were calculated and compared. The data were analyzed using SPSS statistical software. Chi-square test or Fisher’s exact test were used for data analysis of qualitative variables and mean values were compared using paired t-test. Differences were considered significant at *P*-values of less than 0.05.

Results

During this study, adenotonsillectomy was done in 83 children. Among whom 36 patients had different types of ADHD. One patient did not complete follow up period. Finally 35 children including 18 girls (51%) and 17 boys (49%) with mean age (\pm SD) of 7.47 ± 3.8 years (range: 5-12 years) were evaluated. Mean of duration of having ADHD symptoms was 18.1 ± 5.2 months (range: 6-36 months). Comparison of frequency distribution of different types of ADHD before and after surgery is shown in Table 1. This table indicates that the frequency of combined type of ADHD decreased significant after surgery ($P=0.001$).

Comparison of mean scores in dimension of inattention, hyperactivity, impulsivity and combined ADHA, before and after adenotonsillectomy is presented in Table 2. This table indicates that adenotonsillectomy could improve symptoms in dimension of inattention, hyperactivity, impulsivity as well as combined ADHD.

Table 1. Frequency of different types of ADHD in children before and after adenotonsillectomy.

ADHD Type		Before surgery		After surgery		P-value
		Number	%	Number	%	
Predominantly inattentive type	Yes	5	14.3	2	5.7	0.45
	No	30	85.7	33	94.3	
Predominantly hyperactive-impulsive type	Yes	11	31.4	9	25.7	0.24
	No	24	68.6	26	74.3	
Combined type	Yes	19	54.3	8	22.9	0.003
	No	16	45.7	27	77.1	

Table 2. Comparison of mean scores in dimension of inattention, hyperactivity, impulsivity and combination of three dimensions, before and after adenotonsillectomy.

Score in dimension	Before surgery	After surgery	P-value
	Mean \pm SD	Mean \pm SD	
Inattention	2.26 \pm 1.93	0.96 \pm 0.45	0.005
Hyperactivity	4.23 \pm 3.57	3.57 \pm 1.8	0.03
Impulsivity	1.71 \pm 1.4	1.4 \pm 1.03	0.07
Combined score	9.66 \pm 2.85	7.2 \pm 3.67	0.0001

Table 3. Comparison of mean scores in dimension of inattention, hyperactivity, impulsivity and combine of three dimensions, before and after adenotonsillectomy in girls.

Score in dimension	Before surgery	After surgery	P-value
	Mean \pm SD	Mean \pm SD	
Inattention	2.6 \pm 1.6	2.5 \pm 1.39	0.09
Hyperactivity	4.22 \pm 1.73	3.33 \pm 1.94	0.02
Impulsivity	1.83 \pm 1.04	1.56 \pm 1.04	0.29
Combined score	10.1 \pm 1.04	7.39 \pm 3.97	0.001

Table 4. Comparison of mean scores in dimension of inattention, hyperactivity, impulsivity and combine of three dimensions, before and after adenotonsillectomy in boys.

Score in dimension	Time	Before surgery	After surgery	P-value
		Mean \pm SD	Mean \pm SD	
Inattention		2.21 \pm 1.81	1.1 \pm 0.53	0.01
Hyperactivity		4.24 \pm 1.92	3.82 \pm 1.66	0.39
Impulsivity		1.59 \pm 1.1	1.24 \pm 1.03	0.13
Combined score		9.29 \pm 3.12	7.1 \pm 3.44	0.01

Comparison of mean scores in dimension of inattention, hyperactivity, impulsivity and combined ADHD, before and after surgery in girls and in boys are presented in Tables 3 and Table 4. These results indicate that mean scores in dimensions of hyperactivity and combined ADHD in girl and mean scores in dimensions of inattention and combined ADHD in boys were significantly lower after surgery.

Discussion

In this study, the effect of adenotonsillectomy, six months after surgery on improvement of ADHD symptoms of children with adenotonsillar hypertrophy was evaluated. Based on our results, 43.9% of children with adenotonsillar hypertrophy had ADHD. Dillon *et al.* reported that 27.8% of 5-12.9 years old children whom had been scheduled for adenotonsillectomy had ADHD (13). Avior *et al.* also reported that 63% of 19 children of 5-14 years old with obstructive sleep apnea syndrome had inattention and impulsivity based on test of variables of attention (14).

In this study, adenotonsillectomy was effective in improvement of combine ADHD symptoms which is in agreement with other studies (15-17). For example, in a study by Weber *et al.* improvement in attention deficit, hyperactivity and impulsivity was reported six months after surgery in 8-11 years old children (15). In 2007, Huang *et al.*, studied 66 school-age children with mild sleep apnea and ADHD (17). Twenty seven of whom treated with methylphenidate, 25 had adenotonsillectomy, and 14 received no treatment. Improvement in attention span, impulse control, response time and total ADHD score was significantly better in the adenotonsillectomy group (17). In a study by Mitchell and Kelly, improvement in depression, hyperactivity and somatization was observed after adenotonsillectomy (18).

In our study, mean of score in dimensions of inattention and hyperactivity reduced and improved significantly difference after adenotonsillectomy which is in agreement to other studies (17,19,20,21). Avior *et al.* also reported improvement in scores of inattention and impulsivity based on test of variables of attention,

two months after surgery (14). Although, the result of present study showed that adenotonsillectomy has a beneficial effect on ADHD symptoms of children with adenotonsillar hypertrophy, there are limitations to this study such as small sample size, lack of control group and short follow up period. Therefore, it is suggested that further randomized controlled studies should be conducted with larger sample sizes and longer follow up periods to provide definitive evidence for the effect of adenotonsillectomy on ADHD symptoms in the general population.

Based on results of this study, it is suggested that evaluation of upper air way obstruction due to adenotonsillar hypertrophy can be considered in ADHD children as adenotonsillectomy is associated with improvements in behaviour and cognitive function of these children.

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