



Effect of adenotonsillectomy on attention deficit-hyperactivity disorder in children with adenotonsillar hypertrophy: A prospective cohort study



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ABSTRACT

Background: This study was conducted to explore the effect of adenotonsillectomy on the improvement of attention deficit hyperactivity disorder (ADHD) symptoms in children with adenotonsillar hypertrophy. **Methods:** This prospective cohort study was conducted on 59 children aged 6–12 years with adenotonsillar hypertrophy and ADHD who were candidates for adenotonsillectomy at Besat Hospital, Hamadan University of Medical Sciences, in 2014. The status of ADHD was evaluated at baseline and one and three months after surgery using Conners' Rating Scales.

Results: Of 59 children with ADHD (35 boys and 24 girls), 41 improved one month after surgery and 51 after three months. Only 8 children had no improvement. The Conners' score decreased significantly from 71.37 at baseline to 61.31 ($P = 0.001$) and 49.14 ($P = 0.001$) one and three months after surgery, respectively. The score of attention deficit and hyperactivity decreased from 1.76 and 2.10 at baseline to 1.52 and 1.83 after one month ($P = 0.001$) and to 1.24 and 1.52 after three months ($P = 0.001$), respectively. The results were statistically significant for both boys and girls.

Conclusion: This study indicated that adenotonsillectomy can significantly improve ADHD in children with adenotonsillar hypertrophy and help them return to normal life.

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1. Introduction

Attention deficit hyperactivity disorder (ADHD) is one of the most common psychiatric disorders in school children. The disease is characterized by inappropriate hyperactivity and constant attention deficits and impulsive behaviors resulting in decreased educational performance. Hyperactivity and or attention deficit should be more than six months, according to the Fourth Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [1]. The prevalence of ADHD has been reported between 9% and 16% [2].

Adenotonsillar hypertrophy is a common cause for obstructive airway disease in children. It may result in pulmonary hypertension and decreased alveolar ventilation in advanced stages [3]. Sleep apnea syndrome is a common complication in children with adenotonsillar hypertrophy [4,5]. This syndrome is the result of hypoxemia and hypercapnia. It may be associated with considerable cognitive and behavioral complications. There is a relationship

between cognitive disorders and obstructive sleep apnea syndrome (OSAS) [6].

Current evidence has shown that adenotonsillectomy can improve obstructive sleep apnea syndrome in children with adenotonsillar hypertrophy by removing the airway obstruction [7]. Adenotonsillectomy may have a beneficial effect on improvement of the ADHD symptoms in children with adenotonsillar hypertrophy. Adenotonsillectomy may improve attention and behavioral disorders and enhance cognitive functions, especially attention capacity, in children with upper airway obstruction [8–10]. It has been shown that the severity of ADHD symptoms decreases significantly after adenotonsillectomy [11–13]. However, more evidence from different setting is required to ensure that adenotonsillectomy can improve ADHD or at least reduce its severity. The current prospective cohort study was conducted to explore the effect of adenotonsillectomy on ADHD symptoms in children with adenotonsillar hypertrophy.

2. Methods

This prospective cohort study was conducted at Besat Hospital, affiliated with Hamadan University of Medical Sciences, in the west

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Table 1
Comparison of the mean scores of attention deficit hyperactivity disorder (ADHD), based on Conners' score, before and one and three months after adenotonsillectomy.

Variables	Before adenotonsillectomy		1 month after adenotonsillectomy			3 months after adenotonsillectomy		
	Mean	SD	Mean	SD	P value	Mean	SD	P value
Conners' score								
Total (59)	71.37	8.46	61.31	8.64	0.001	49.14	12.86	0.001
Girls (24)	69.04	6.80	59.38	7.11	0.001	45.46	12.30	0.001
Boys (35)	72.97	9.19	62.63	9.42	0.001	51.66	12.79	0.001
Attention deficit								
Total (59)	1.76	0.35	1.52	0.38	0.001	1.24	0.44	0.001
Girls (24)	1.69	0.37	1.45	0.08	0.001	1.10	0.47	0.001
Boys (35)	1.80	0.34	1.57	0.06	0.001	1.34	0.39	0.001
Hyperactivity								
Total (59)	2.10	0.35	1.83	0.34	0.001	1.52	0.38	0.001
Girls (24)	2.01	0.32	1.74	0.30	0.001	1.41	0.32	0.001
Boys (35)	2.17	0.37	1.89	0.36	0.001	1.59	0.41	0.001

of Iran, in 2014, and followed up for three months. Informed consent was received from all parents. The Research Council as well as the Ethics Committee of the university approved the consent procedure.

According to the results of a study conducted by Mitchell and Kelly [14], the proportion of behavior impairment in children with adenotonsillar hypertrophy decreased from 35% before adenotonsillectomy to 9% after that. On the basis of these results, we arrived at a sample size of 59 at 95% significance level and 80% statistical power.

The study population included 59 children aged 6–12 years with sleep apnea or snoring due to adenotonsillar hypertrophy and chronic airway obstruction or with chronic infections, who were candidates for adenotonsillectomy. The patients had ADHD based on Conners' Rating Scales [15]. The patients with co-existing mental retardation or other behavioral or cognitive disorders were excluded from the study. The diagnosis of adenotonsillar hypertrophy was approved by an otolaryngologist according to the patients' history and results of physical exam. We performed adenotonsillectomy for all patients using intracapsular procedures. ADHD was diagnosed and scaled using the Persian version of the short revised form of Conners' Parent Rating Scales [16]. The status of ADHD was evaluated at baseline and one and three months after surgery.

The Conners' Parent Rating Scales is a popular research and clinical tool for obtaining parental reports of childhood behavior problems. This rating scale is used all over the world to assess youth from many cultures. This tool is a set of rating scales that is used to gather information about the behaviors and feelings of children and adolescents. This rating scale provides a reliable, accurate, and relatively brief measure of parental perceptions of children's disruptive behavior [17]. Research has shown that the Conners' scales are reliable and valid, which means that the scores that are produced by the scale can be trusted. The reliability of the Persian version of this scale was 0.73 based on Cronbach's alpha coefficient [18].

The independent t-test was used for comparison of the means before and after surgery. All statistical analyses were performed at a significance level of 0.05 using Stata software, version 11 (StataCorp, College Station, TX, USA).

3. Results

Of 264 children who were candidates for adenotonsillectomy, 67 had ADHD and were eligible. Seven children were excluded from the study because they did not have appropriate cooperation. The analysis was based on data from the remaining 59 patients (35 boys and 24 girls). The mean (SD) age of the patients was 8.66 (1.77) years.

Of 59 children with ADHD, 41 improved for one month after surgery and 51 after three months. Only 8 children had no improvement. The effects of adenotonsillectomy on ADHD, one and

three months after surgery, are given in Table 1. The Conners' score decreased significantly from 71.37 at baseline to 61.31 ($P = 0.001$) and 49.14 ($P = 0.001$) one and three months after surgery, respectively. The score of attention deficit decreased from 1.76 at baseline to 1.52 after one month ($P = 0.001$) and to 1.24 after three months ($P = 0.001$). The score of hyperactivity decreased from 2.10 at baseline to 1.83 after one month ($P = 0.001$) and to 1.52 after three months ($P = 0.001$). The results were statistically significant for both boys and girls.

4. Discussion

Adenotonsillar hypertrophy is associated with upper airway obstruction. It is the most common cause of OSAS [1]. Sleep disturbance related to obstructive airway disease can result in considerable cognitive and behavioral disorders. The relationship between behavioral problems such as aggressiveness and ADHD with OSAS has been shown in several studies [9,11,19]. A meta-analysis conducted by Ueno et al in 2014 reported a statistically significant association between ADHD and sleep disorder due to airway obstruction [20].

In this study, we investigated the effect of adenotonsillectomy on ADHD symptoms in children with adenotonsillar hypertrophy and concluded that ADHD symptoms improved significantly three months after surgery. Our results were consistent with the results of previous studies. Amiri et al [11] assessed the effect of adenotonsillectomy on the ADHD symptoms in 53 children with adenotonsillar hypertrophy and sleep disordered breathing. They reported that adenotonsillectomy improved significantly the ADHD symptoms three and six months after surgery. Aksu et al [8] explored the efficacy of adenotonsillectomy in 41 children aged 6–11 years with upper airway obstruction and adenotonsillar hypertrophy. They indicated that ADHD symptoms decreased remarkably six months after surgery. Horiuchi et al [9] evaluated neurocognitive functions before and after adenotonsillectomy in patients with OSAS. They concluded that cognitive functions, especially attention capacity, and behavioral problems improved substantially.

Marcus et al [21] conducted a prospective, randomized controlled trial and randomly assigned 464 children, aged 5–9 years, with the obstructive sleep apnea syndrome to early adenotonsillectomy or a strategy of watchful waiting. The attention and executive function score did not differ significantly between the two groups at the end of follow-up ($P = 0.16$). In contrast, there were significantly greater improvements in behavioral, quality-of-life, and polysomnographic findings and significantly greater reduction in symptoms in children who underwent adenotonsillectomy compared with the watchful-waiting group. One reason that may explain the inconsistency between the results of this trial and previous studies is the difference in diagnostic tools used for evaluation of attention and executive function. In this trial, neuropsychological testing was used,

which is based on clinical evaluation, whereas in some previous studies as well as our study, the Conners' Parent Rating Scale was employed, which is based on parents' expression.

The pathophysiology of ADHD is unknown, but there are suggestions that an abnormal sleep pattern may be one causal factor. ADHD is a disorder caused by hypovigilance rather than hypervigilance. If hypovigilance really plays a role in pathophysiology of ADHD, it makes sense that children with decreased or poor sleep secondary to adenotonsillar hypertrophy and obstructive sleep apnea syndrome would be much more likely to suffer from symptoms of ADHD. Consequently, if the sleep obstruction was removed, it should follow that the quality of sleep would improve and therefore symptoms of ADHD would diminish [22].

The main limitation of the present study was that all children were candidates for adenotonsillectomy and we were not ethically allowed to assign the patients randomly to the intervention group (to undergo surgery) and control group (not to undergo surgery). Therefore, we could only follow the children during the routine treatment as a prospective cohort and compare their status in terms of ADHD before and after surgery. Another limitation of this study was the small sample size and the short-term follow-up period. We were unable to follow the patients for longer duration because children's parents refused to be followed up for longer time. Despite its limitations, this study was able to efficiently assess and compare the ADHD symptoms before and three months after adenotonsillectomy in boys and girls separately.

5. Conclusion

The results of this study indicated that adenotonsillectomy can significantly reduce postoperative ADHD symptoms in children with adenotonsillar hypertrophy.

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Conflict of interest

The authors declare that they have no conflicts of interest for this research.

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