ORIGINAL REPORT

Changes in Growth Pattern after Adenotonsillectomy in Children under 12 Years Old

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Received: 3 Aug. 2009 ; Received in revised form: 27 Oct. 2009; Accepted: 3 Jan. 2010

Abstract- The aim of the present study was to determine the effects of adenotonsillectomy on height, weight and body mass index (BMI) in children under 12 years old, with or without airway obstruction and evaluation of the risk of overweight in them. In this case-control study, 120 children with the age of 2-12 years old were studied; 60 children as case group who underwent adenotonsillectomy and 60 healthy children as control group. After collecting the data related to appetite status and sleep breathing disorder of the case group, height, weight and BMI have been measured for all children in two stages; preoperatively and 6 months later. Also in the case group, BMI percentiles, pre and postoperatively have been calculated. Patients with Low appetite in the initiation and at the end of the study in the case group were 80% and 8.3% respectively (P=0.01). Mean of height, weight and BMI variation after 6 months were significantly different between case and control groups (P<0.05). BMI percentiles in the case group preoperatively were: 20% underweight, 67% healthy weight, 10% at risk of over weight, 3% over weight. Postoperatively, after 6 months BMI percentiles in order of above frequency were: 10%, 57%, 22% and 11% (P=0.02). Analysis of the results showed that adenotonsillectomy can lead to increase of height, weight, BMI and appetite not only in the children with low weight due to airway obstruction but also in the normal weight and over weight children. Therefore risk of overweight should be mentioned as a probable undesirable outcome of adenotonsillectomy.

Acta Medica Iranica 2010; 48(5): 316-319.

Key words: Tonsillectomy; growth; body mass index; body weight; body height

Introduction

Adenotonsillar hypertrophy (ATH) is the most common cause of chronic upper airway obstruction in children (1). Obstructive sleep-disordered breathing (OSDB) in children has been associated with a variety of co-morbidities, including hypertension, enuresis, poor scholastic performance, hyperactivity, and attention-deficit/hyperactivity disorder, and these conditions are also ameliorated with successful treatment of OSDB via adenotonsillectomy (A&T) (2). Not only failure to thrive is more commonly recognized but also complications, namely insufficient weight and height gain have been well documented in these children and "catch-up" growth after A&T has been demonstrated (1). Although many different reasons such as poor appetite and difficulties in swallowing, resulting in lower total caloric intake, nocturnal hypoxemia, nocturnal respiratory acidosis and increased energy expenditure during sleep have been implicated, exact etiology of the growth retardation is unknown (1,2). Abnormal nocturnal growth hormone (GH) secretion and impaired GH action have also been suggested (1,3,4). Previous studies have revealed that all of these factors can be improved after A&T (5,3,2).

After A&T, normal-weight and overweight children with or without OSDB may gain weight rapidly (2,6,7). Thus, although A&T has a beneficial effect on OSDB symptoms and improves the other comorbidities listed above, the procedure may also lead to weight gain, even in children who are already overweight, and it can cause recurrent or persistent OSDB, as well as contribute to insulin resistance, hypertension, and other chronic diseases (2).

On the other hand, we should consider that obesity is now becoming a global epidemic, and is no longer present only in well- developed countries of the world (8).

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The aim of this study was to evaluate the influence of A&T on growth (height and weight gain), body mass index (BMI) and the risk of overweight in children with or without OSDB and compare these with healthy control children in Hamedan, Iran, where this study was new.

Patients and Methods

In this case-control study, 120 children with the age of 2-12 years old were studied in Hamadan, located in the west of Iran, since April 2006 to April 2007. This study included 60 children as case study who was candidate for adenotonsillectomy and 60 healthy children as control group. It must be mentioned that at the beginning of the study 180 children were considered but 60 patients did not refer for follow-up so they were excluded from the study. After collecting the data related to appetite status and sleep breathing disorder of the case group from their parents; height and weight has been measured for all children, by one trained personnel, in two stage, preoperatively and 6 months after A&T for the case group and the same period for the control group. Weight was measured to the nearest 0.5 kg using balance beam scale while height was measured to the nearest 1.0 mm with a wall-mounted stadiometer. Body mass index (BMI; kg/m^2) was used as an index of relative weight. BMI for case and control group was calculated initially and 6 months later. BMI percentile for case group was calculated in two similar periods. BMI percentile has been mentioned as below:

-Less than the 5^{th} percentile= Underweight

-5^{th} percentile to less than the 85^{th} percentile= Healthy weight

-85^{th} to less than the 95^{th} percentile= At risk of overweight

-Equal to or greater than the 95^{th} percentile= Overweight

Appetite is a psychological desire to eat and it is noted in 3 statuses at check list: 1) low 2) moderate 3) very good, which marked by the children's parents preoperatively and 6 months later.

Sleep breathing disorder characterized by abnormalities of respiratory pattern (pauses in breathing) during sleep and the need to arouse to resume ventilation and it is evaluated subjectively as YES or NO in the questionnaire which marked by the patient's parents.

The data were analyzed by SPSS software and Wilcoxon test and t-test has been used for statistical analysis.

Table 1. Appetite status in case group preoprative and 6 months after operation

Appetite status	At the beginning	6 months later
	No of patients (%)	
Low	48 (80%)	5 (8.3%)
Moderate	11 (18.3%)	34 (56.7%)
Very good	1 (1.7%)	21 (35%)
Total	60 (100%)	60 (100%)

P value=0.01

Results

The study population consisted of 120 children. 60 children as case study, 2-12 years old (mean age=6.91±2.31 years), 26 boys and 34 girls; and 60 healthy children as control group. There were no significant differences in sex and age between two groups. Appetite status before and after surgery in the case group are presented in table 1. Patients with low appetite in the initiation and at the end of the study were 80% and 8.3% respectively that had meaningful statistical difference by Wilcoxon test (P=0.01).

Indications of adenotonsillectomy in this study were chronic tonsillitis, that was unresponsive to medical therapy, in 30 patients (50%); sleep breathing disorder in 18 patients (30%); recurrent tonsillitis, more than 6 episodes per year or three episodes per year for ≥2 years, in 8 patients (13,3%); and recurrent febrile convulsion in 4 patients (6.7%). Sleep breathing disorder improved completely in all of the patients after surgery (P<0.05).

Anthropometric measurements including height, weight & BMI were evaluated in two periods, preoperatively and 6 months later, in the both groups (Table 2), and mean of height, weight and BMI variation after 6 months were significantly different between case and control groups(P<0.05).

Table 2. Mean variation of height, weight & BMI at the beginning of the study & after 6 months in case group & control group

Variation factors	Case group (Mean± SD)	Control group (Mean± SD)
Height(cm)	1.62 ± 4.32	0.91 ± 3.05
Weight(kg)	2.46 ± 3.63	0.91 ± 1.82
BMI (kg/m^2)	1.41 ± 1.11	0.30 ± 0.63

P value=0.000

Table 3. BMI Percentile in the case group preoperation & 6 months post operation

	Underweight	Normal Weight	at risk of overweight	overweight
	No. of patients (%)			
Preoperation	12 (20%)	40 (67%)	6 (10%)	2 (3%)
Postoperation	6 (10%)	34 (57%)	13 (22%)	7 (11%)

P value =0.02

BMI percentiles in the case group preoperatively were 20% underweight, 67% healthy weight, 10% at risk of over weight, 3% over weight. Postoperatively, after 6 months, BMI percentiles in order of above frequency were: 10%, 57%, 22% and 11% that had meaningful statistical difference by Wilcoxon test (*P*=0.02) (Table 3).

Discussion

ATH is associated with interruption of growth in childhood (1,3,5). In this study a great increment of height was detected in surgically treated children during the 6-month period postoperatively, when compared to the control group. Ersoy *et a*l. (1) in their study showed that heights of the prepubertal children with ATH were shorter than those of their healthy peers at the preoperative period although statistically insignificant. Nevertheless, their heights reached those of their peers at the end of 1 year postoperatively. Stradling *et al*. (5) have reported a significant increment in height standard deviation score (SDS) of patients when compared to that of their healthy peers at postoperative sixth month. However, Bar *et al*. (3) have reported a non-significant increase in height SDS 18 months after the operation and Williams III et al. (9) have also stated a non-significant increase in the height percentile at the postoperative period.

In previous studies, it has been shown that the children's weight increased after A&T operations (3,5,9,10). Similarly, in this study, significant weight gain was detected after six months postoperatively. At the preoperative period, weights of our patients were approximately equivalent to those of their healthy control group; however, at the end of the sixth months after the operation, increase in weight was greater in surgically treated children. Marcus et al. (10) reported the evaluation of caloric intake, sleeping energy expenditure and anthropometric measurements in 14 pre-pubertal children with obstructive sleep apnea syndrome before and after A&T. They found that average sleeping energy expenditure decreased and mean weight SDS increased postoperatively without any change in caloric intake. Nevertheless, in our study only 30% of the patients had sleep breathing disorder and weight increased significantly in the case group compared with the control group, so it should be consider, another causes except decreasing energy expenditure may be affect the weight increment.

BMI is a method widely used to define the relationship between weight and height (11). In this study, we observed a significant increase in BMI at the end of the 6 months following surgery in comparison of the control group. Nieminen *et al*. (12) also reported that BMI increased significantly in children that had been operated. Increase in BMI can be attributed to an increased amount of fat rather than an increase in fat-free mass.

In this study, BMI percentiles in the case group pre and postoperatively were calculated. According to the results, 20% of the patients with ATH were under weight preoperatively which reduced to10% postoperatively. On the other hand, only 3% of the patients were overweight preoperatively but postoperatively it increased to 11%. So the majority of the case group were in healthy weight preoperatively, and there were significant increment of the overweight children.

Nuyens MR et al. (13) showed that the obstructive symptoms, especially snoring and respiratory apneas disappeared or were significantly reduced in 90% of the cases after adenotonsillectomy. In this study sleep breathing disorder improved completely in all of the patients with that problem after surgery.

This study showed that, the patients with low appetite before and after A&T were 80% and 8.3% respectively and suggests that this operation can increase appetite and it can be one of the factors inducing acceleration of growth rate.

In several studies (1,3,12,14) improved growth, especially weight gain, after ATH resolved was accompanied by a significant increase in the circulating IGF-1 and IGFBP-3 concentrations but we did not measure IGF in the present study. In conclusion, analysis of the results of this study, showed that adenotonsillectomy can lead to increase of height, weight, BMI and appetite not only in the children with low weight due to airway obstruction but also in the normal and over weight children. Therefore risk of overweight should be mentioned as a probable undesirable outcome of adenotonsillectomy.

Acknowledgments

The authors would like to thank Mr. Khosro Mani & Dr. Mansour Nazary for statistical analysis; Dr. Alireza Poormohammadjani and Mrs. Moosivand for their help in this research.

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