

ORIGINAL ARTICLE

Medicine Science 2021;10(1):36-9

Effect of montelukast treatment on adenoid hypertrophy and sleep quality in pediatric patientsIsil Cakmak Karaer¹, Ayla Cimen²¹Malatya Traning and Research Hospital, Clinic ENT, Malatya, Turkey²Malatya Traning and Research Hospital, Clinic of Radiology, Malatya, Turkey

Received 05 October 2020; Accepted 11 October 2020

Available online 13.10.2020 with doi: 10.5455/medscience.2020.10.207

Copyright©Author(s) - Available online at www.medicinescience.org

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

**Abstract**

Adenoid vegetation is part of lymphoid tissue located in the upper respiratory tract. When adenoid tissue becomes hypertrophied, it may cause narrowing of the respiratory tract and complications. Generally, treatment of adenoid hypertrophy is surgical; however, currently reducing the size of adenoid hypertrophy with the leukotriene receptor blocker of montelukast is evaluated among treatment choices apart from surgery. The aim of the study was to assess whether montelukast treatment is an alternative to surgical treatment or not. The study included a total of 50 pediatric patients. Adenoid tissue size was evaluated endoscopically and radiographically. Patients were divided into two groups based on closure of the nasopharynx by adenoid tissue. Group 1 comprised adenoid hypertrophy cases with the choana blocked by less than 50%, with Group 2 comprising children with adenoid hypertrophy and more than 50% closure of the choana. All patients began 5 mg montelukast treatment for 12 weeks. Patients had the pediatric sleep questionnaire applied before and after treatment. Tests and radiographic results were compared. In both groups, it was identified that montelukast treatment had no effect on adenoid tissue size ($p=0.286$, 0.304 , respectively). Contrary to this, patients in Group 1 were identified to have statistically significant improvement in sleep quality with montelukast treatment ($p=0.006$). In Group 2 patients, there was no such improvement in sleep quality identified ($p=0.91$). Montelukast treatment increased sleep quality in children with less than 50% obstruction of the choana.

Keywords: Adenoid hypertrophy, children, montelukast, sleep quality**Introduction**

Adenoid hypertrophy refers to the lymphoid tissue belonging to the Waldeyer ring located in the nasopharynx being larger than normal [1]. Adenoid hypertrophy is generally a clinical situation encountered in the childhood period. It may cause many different problems like difficulty with nasal respiration, reduced sleep quality, obstructive sleep apnea (OSAS), recurrent otologic and upper respiratory tract complaints, maxillofacial anomalies, hyperactivity, learning difficulties, growth and development regression or cardiac problems [2]. Generally, families attend the clinic with complaints of disrupted sleep quality initially [3, 4]. Adenoidectomy is most common surgical procedure performed in pediatric otolaryngological practice. Risk of anesthesia, pain, an altered voice and adenoid regrowth is common risk of adenoidectomy. Bleeding, dental trauma and minor injuries to the lips can occur following adenoidectomy [5].

The effect of leukotrienes, with very important place in inflammation in the respiratory system, may reduce with leukotriene receptor blockers. Montelukast is a leukotriene receptor blocker used orally for asthma and allergic rhinitis treatment that is effective, reliable and has few side effects [6,7]. Studies in recent times have identified leukotriene receptor 1 and 2 in lymphoid tissue and there are publications in the literature stating that montelukast treatment may be an alternative to surgical treatment for adenoid hypertrophy [8-10].

Our aim in this study was to research the effect of montelukast treatment on adenoid tissue size and whether it is an alternative to adenoidectomy in pediatric patients with adenoid hypertrophy diagnosis.

Material and Methods

The study included a total of 50 pediatric patients. The study was performed on patients attending the ENT clinic in Malatya Education Research Hospital with snoring complaints. Permission was granted by Malatya ethics committee. The study included 25 female and 25 male patients with adenoid hypertrophy diagnosis on lateral neck radiography aged from 4 to 11 years. Those with systemic diseases,

*Corresponding Author: Isil Cakmak Karaer, Malatya Traning and Research Hospital, Clinic ENT, Malatya, Turkey
E-mail: drisil_cakmak@yahoo.com

using systemic medication or nasal topical corticosteroid treatment, with nutritional and medication allergies, with history of allergic rhinitis, with tonsillar hypertrophy, with obesity, any acute or chronic respiratory tract infection or asthma diagnosis, with maxillofacial deformities or neurological diseases were excluded from the study. All patients were examined by the same otolaryngologist (I.K.). Firstly, endoscopic nasal examination was performed, and patients were classified according to adenoid tissue size [11].

Patients were divided into two groups as

Group 1: 25 patients with adenoid hypertrophy obstructing less than 50% of the choana on lateral radiography

Group 2: 25 patients with adenoid hypertrophy obstructing more than 50% of the choana on lateral radiography

All radiological images were evaluated by the same radiology expert (A.C.) blinded to the patient names and film dates. Adenoid tissue size was evaluated with lateral neck radiography. Using the method described by Fujioka et al., the adenoid/nasopharyngeal ratio (A/N-R) was identified. Adenoid depth was determined by drawing a perpendicular line from a line drawn along the straight part of the anterior margin of basiocciput to a point of maximal convexity of adenoid. Nasopharyngeal depth was determined by drawing a line from the anterior inferior edge of sphenobasioccipital synchondrosis to the posterior superior margin of the hard palate. A/N-R was then determined by dividing adenoidal depth with nasopharyngeal depth. [12].

After all patients were diagnosed, the pediatric sleep questionnaire (PSQ) was applied. The PSQ is a test that can be applied to children aged from 2 to 18 years. The PSQ is a 22-item questionnaire showing sleep-related breathing disorders used in clinical trials to evaluate sleep-related breathing disorders.. It questions the frequency of snoring during sleep in children, presence of apnea, respiratory difficulties during sleep, daytime sleepiness, attention deficit and hyperactivity presence [13]. Responses are “yes” = 1, “no” = 0, and “don't know” = missing. The mean response on nonmissing items is the score, which can vary from 0 to 1. Pediatric sleep-related breathing disorder was defined as a positive mean PSQ score ≥ 0.33 .

Patients with complete examination began 5 mg/day montelukast. After 12 weeks of regular treatment, patients again had the PSQ test applied and lateral neck radiography taken. Outcomes before and after treatment were compared. No drug side effects were seen during treatment.

Statistical analysis

All analyses were conducted using SPSS 15.0 (SPSS® for Windows 15.0, Chicago, USA). Normal distribution of parameters was identified by using the Kolmogorov-Smirnov test. Parameters with normal distribution are given as mean $\pm$ SD and parameters with abnormal distribution are given as median (IQR). The Wilcoxon signed rank test was used to compare parameters before and after treatment. A two-tailed $p < 0.05$ was considered statistically significant.

Results

The mean age of patients in Group 1 was 7.2 ± 1.9 years, while

the age of patients in Group 2 was 6.7 ± 2.2 years. There was no statistically significant difference between the two groups in terms of age. The mean body mass index (BMI) for patients in Group 1 was 17.1 ± 0.7 , while the BMI of patients in Group 2 was 17.8 ± 0.4 . There was no statistically significant difference between the two groups in terms of BMI.

The mean A/N-R was 0.47 (0.42-0.49) in Group 1 before treatment, while after treatment the mean A/N-R was 0.46 (0.42-0.56). There was no statistically significant difference identified between the A/N-R ratio before and after treatment ($p = 0.286$). The PSQ total value in Group 1 was 0.33 (0.23-0.50) before treatment, while after treatment the total value was 0.29 (0.10-0.42). In Group 1, it was identified that sleep quality statistically significantly increased after treatment ($p = 0.006$) (Table 1).

Table 1. Clinical characteristics and radiological results of patients with less than 50% adenoid hypertrophy (Group 1)

	Pretreatment n=25	Posttreatment n=25	p
Age (y)	7.2 $\pm$ 1.9		NS
BMI (kg/m ²)	17.1 $\pm$ 0.7		NS
Female/Male	15/10		
A/N-R	0.47 (0.42-0.49)	0.46(0.42-0.56)	0.286
PSQ-T	0.33 (0.23-0.50)	0.29(0.10-0.42)	0.006*

BMI: Body mass index, NS: not significant, A/N-R: adenoid/nasopharyngeal ratio, PSQ-T: Pediatric Sleep Questionnaire Test - Total value

The mean A/N-R was 0.73 (0.61-0.82) in Group 2 before treatment, while the mean A/N-R was 0.73 (0.61-0.80) after treatment. There was no statistically significant difference identified between the adenoid sizes before and after treatment ($p = 0.304$). The PSQ total value in Group 2 was 0.37 (0.30-0.46) before treatment, while the PSQ total value was 0.37 (0.33-0.50) after treatment. In Group 2, there was no statistically significant difference identified in terms of sleep quality before and after treatment ($p = 0.91$) (Table 2).

Table 2. Clinical characteristics and radiological results of patients with more than 50% adenoid hypertrophy (Group 2)

	Pretreatment n=25	Posttreatment n=25	p
Age (y)	6.7 $\pm$ 2.2		NS
BMI (kg/m ²)	17.8 $\pm$ 0.4		NS
Female/Male	12/13		
A/N-R	0.73 (0.61-0.82)		0.304
PSQ-T	0.73 (0.61.5-0.80)		0.91

BMI: Body mass index, NS: not significant, A/N-R: adenoid/nasopharyngeal ratio, PSQ-T: Pediatric Sleep Questionnaire Test - Total value.

Discussion

The results of this study show that in the group with adenoid tissue size less than 50%, montelukast treatment did not cause a statistically significant change in adenoid tissue size, but the patients in this group were identified to have a statistically significant improvement in sleep quality after montelukast treatment. In the group with adenoid tissue size of more than 50%, montelukast treatment was not identified to cause statistically significant changes in adenoid tissue size and sleep quality.

A study by Goldbart et al. divided 46 non-severe OSAS (obstructive apnea/hypopnea index [AHI] <10) children into two groups. While 23 children were administered placebo, 23 children were given montelukast treatment for 12 weeks. Different to our study, children receiving montelukast treatment were observed to have adenoidal/nasopharyngeal ratio fall from 0.81 ± 0.04 to 0.57 ± 0.04 compared to those not receiving treatment. Additionally, the sleep apnea test scores of children were found to fall significantly compared to the controls receiving placebo. However, no variations were identified in the placebo group [9]. Shokouhi et al. in a study of 60 pediatric patients with adenoid hypertrophy identified 76% reduction in adenoid size in the group receiving 12 weeks montelukast treatment and 3% reduction in adenoid size in the group receiving placebo. The group receiving montelukast treatment were not identified to have a statistically significant improvement in sleep quality. The authors showed montelukast treatment was an alternative to surgery [10].

Another study divided 120 patients into 4 groups. The 1st group only received corticosteroids, the 2nd group received only montelukast, the 3rd group received corticosteroid+montelukast treatment and the 4th group received placebo. Patients with 3 months of montelukast treatment had adenoidal/nasopharyngeal measurements compared before and after treatment. After montelukast treatment they identified a 22.51% reduction in adenoid size. However, a topic noted in this study was that the reduction in adenoid tissue size in the placebo group was 12.46%. Additionally, it was reported that corticosteroid+montelukast treatment was more effective than montelukast treatment alone [14].

Another study administered montelukast treatment for 16 weeks to 26 patients with moderate OSAS ($1 < \text{AHI} < 5$) diagnosis. In this study, adenoid tissue size regressed from 0.76 ± 0.03 to 0.56 ± 0.03 with montelukast treatment. Further, they observed improvements in peak end-tidal carbon dioxide levels in patients after montelukast treatment. However, they did not observe any significant change in sleep quality scores of patients after montelukast treatment. The authors of this study emphasized that the combined use of leukotriene 1 and 2 receptor blockers will be more effective than the use of montelukast alone [15].

In our study, only montelukast was used as leukotriene blocker and patients were given the standard dose of 5 mg/day. Another study of 52 pediatric patients with $\text{AHI} < 10$ investigated the effects of leukotriene receptor blockers on cell culture, proliferation assay, immunohistochemistry and cytokine assays using adenotonsillectomy material from patients. In conclusion, montelukast was the most effective leukotriene receptor blocker; however, the antiproliferative effect on lymphoid tissue increased in dose-linked manner and the efficacy was determined to increase

further when used in combination with other leukotriene receptor blockers [16].

The results of our study can be said to show montelukast treatment alone does not affect adenoid tissue size at standard doses. However, in pediatric patients with low adenoid tissue size, montelukast treatment has a positive effect on sleep quality. This situation may be explained by lymphoid tissue previously shown in pediatric patients with OSAS complaints being different to lymphoid tissue growing linked to chronic infection, but more due to the leukotriene receptor ratio [8]. The reduction in inflammation in adenoid tissue may have increased the patients' sleep quality.

Although there are similar studies [17-19] this study is show that montelukast therapy on improving sleep quality in small adenoid size and prevent postoperative complications. In clinical practice, these study results show that if patients have adenoid tissue obstructing less than 50% of the choana, montelukast treatment may be an alternative to surgical treatment for OSAS due to adenoid hypertrophy. Contrary to this, in children with adenoid hypertrophy obstructing more than 50% of the choana, montelukast treatment for 12 weeks at standard dose does not appear to be an alternative to surgical treatment. However, there is a need for more advanced research administering montelukast treatment for longer durations. and at higher doses to more patients. Additionally the number of patients in the study can be more .

Acknowledgements

The authors declare that there are no conflicts of interest. There is no financial support or funding in this study. I.C.K designed and performed experiments, analyzed data and wrote the paper; I.C.K. collected and analyzed data. All authors contributed equally to this work. I.C. reviewed data from all sites and provided interpretive analysis; A.C. provided the Supplementary Digital Content and analyzed data. All authors discussed the results and implications and commented on the manuscript at all stages. This paper was not presented at any meeting formerly. This paper checked by native English speaker prior to submission

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

The financial support no have.

Ethical approval

This study was approved by the Institutional Ethics Committee and conducted in compliance with the ethical principles according to the Declaration of Helsinki. number of Ethics protocol number 2020/20.

References

1. Mnatsakanian A, Sharma S. Anatomy , Head and Neck, Adenoids. Treasure Island (FL). SourceStatPearls, StatPearls Publishing; 2019.
2. Scadding G. Non-surgical treatment of adenoidal hypertrophy: the role of treating IgE-mediated inflammation. *Pediatr Allergy Immunol.* 2010;21:1095–106.
3. Major MP, Flores-Mir C, Major PW. Assessment of lateral cephalometric diagnosis of adenoid hypertrophy and posterior upper airway obstruction: a systematic review. *Am J Orthod Dentofac Orthop.* 2006;130:700–8.
4. Caylakli F, Hizal E, Yilmaz I ,et al. Correlation between adenoid-nasopharynx ratio and endoscopic examination of adenoid hypertrophy: a blind, prospective clinical study. *Int J Pediatr Otorhinolaryngol.* 2009;73:1532–5.
5. Benjamin JM, Gunjan G. Adenoidectomy. Treasure Island (FL). StatPearls Publishing; 2020.6. National Heart, Lung, and Blood Institute. National asthma education and prevention program; expert panel report 3: guidelines for the diagnosis and management of asthma. 2007.

6. Berlucchi M, Salsi D, Valetti L, et al. The role of montelukast in the treatment of adenoidal hypertrophy in the pediatric age group: preliminary results of a prospective, randomized study. *Pediatrics* 2007;119:1392–7.
7. Goldbart AD, Goldman GL, Li RC, Brittan KR, et al. Differential expression of cysteinyl leukotriene receptors 1 and 2 in tonsils of children with obstructive sleep apnea and recurrent infection. *Chest*. 2004;126:13–8.
8. Goldbart AD, Greenberg-Dotan S, Tal A. Montelukast for children with obstructive sleep apnea: a double-blind, placebo controlled study. *Pediatrics* 2012;130:575-80.
9. Shokouhi F, Jahromi AM, Majidi MR, et al. Montelukast in adenoid hypertrophy: its effect on size and symptoms. *Iranian Journal of Otorhinolaryngology*. 2015;27:443-8.
10. Cassano P, Gelardi M, Cassano M, et al. Adenoid tissue rhinopharyngeal obstruction grading based on fiberendoscopic findings: a novel approach to therapeutic management. *Int J Pediatr Otorhinolaryngol*. 2003;67:1303-9.
11. Fujioka M, Young LW, Girdany BR. Radiographic evaluation of adenoidal size in children: adenoidal-nasopharyngeal ratio. *AJR Am J Roentgenol*. 1979;133:401–4.
12. Yuksel H, Sogut A, Yılmaz O, et al. Reliability and validity of the Turkish version of the pediatric sleep questionnaire: a tool for prediction of sleep related breathing disorder. *Tüberküloz ve Toraks Dergisi*. 2011;59:236-41.
13. Tuhanoğlu B, Erkan SO. Evaluation of the effects of montelukast, mometasone furoate, and combined therapy on adenoid size: a randomized, prospective, clinical trial with objective data. *Turk J Med Sci*. 2017;47:1736-43.
14. Goldbart AD, Goldman JL, Veling MC, et al. Leukotriene Modifier Therapy for Mild Sleep-disordered Breathing in Children. *Am J Respir Crit Care Med*. 2005; 172:64-370.
15. Dayyat E, Serpero LD, Kheirandish-Gozal L, et al. Leukotriene Pathways and In Vitro Adenotonsillar Cell Proliferation in Children With Obstructive Sleep Apnea *Chest*. 2009;135:1142-9.
16. Kumar J. Clinical Outcomes of Montelukast Sodium in Children with Adenoid Hypertrophy. *Biomed J Sci & Tech Res* 27-2020. BJSTR. MS.ID.004438.
17. Kheirandish-Gozal L, Bandla H. P. R, Gozal D. Montelukast for Children with Obstructive Sleep Apnea: Results of a Double-Blind, Randomized, Placebo-Controlled Trial. *Ann Am Thorac Soc*. 2016;13:1736–41.
18. Kar M, Altıntoprak N, Muluk BN, et al. Antileukotrienes in adenotonsillar hypertrophy: a review of the literature. *European Archives of Oto-Rhino-Laryngology*. 2016;273:4111–7.