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Montelukast combined with intranasal mometasone furoate versus intranasal mometasone furoate; a comparative study in treatment of adenoid hypertrophy

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ABSTRACT

Objectives: To evaluate the role of combined therapy using montelukast and intranasal mometasone furoate compared to intranasal mometasone furoate alone in treatment of adenoid hypertrophy regarding efficacy and recurrence rate.

Methods: The study included 100 children with adenoid hypertrophy, they were randomly assigned to two groups. Group I (50 patients) received combined therapy using montelukast and mometasone furoate nasal spray. Group II (50 patients) received only mometasone furoate nasal spray. Patients were treated for 3 months and observed for 3 months after stoppage of treatment. Patients were evaluated using symptoms scores, Adenoid/Nasopharyngeal ratio and endoscopic grading of adenoid hypertrophy.

Results: After 3 months of treatment, group I showed significant better scores of main symptoms than group II; ($P = 0.001$), ($P = 0.019$) and ($P = 0.008$) for rhinorrhea, mouth breathing and snoring respectively. The mean A/N ratio was 52.8 ± 11.3 in group I better than 62.88 ± 12.10 in group II ($P < 0.001$). Regarding the adenoid hypertrophy grading, significant reduction in size was found in group I in 34 (68%) patients better than in group II in 18 (36%) patients ($P = 0.001$). After further 3 months of follow up, the mean A/N ratio was 58.46 ± 10.05 in group I better than 66.36 ± 10.46 in group II ($P < 0.001$). Recurrence occurred in 8 (23.5%) cases out of 34 improved cases in group I better than 10 (55.5%) cases out of 18 cases in group II ($P = 0.02$).

Conclusion: Combining oral montelukast with intranasal mometasone in treatment of adenoid hypertrophy provided better improvements and less recurrence in comparison with single therapy using intranasal mometasone alone.

1. Introduction

Adenoid hypertrophy is one of the most frequent pathologic conditions occurring in pediatrics. It causes many different clinical manifestations depending on the adenoid size [1]. The most common manifestations of pathologic and physiologic adenoid changes are chronic or recurrent infections [2]. Adenoid hypertrophy when obstruct the nasal airway in children may cause severe symptoms and complications, such as enuresis, cognitive and physical developmental retardation, and cardio-respiratory disorders [3].

The most used methods for the diagnosis of adenoid hypertrophy are lateral radiographs and nasal endoscopy [4]. Adenoidectomy is a common procedure in children that may cause complications such as early or late bleeding (4%–5%), adenoid tissue recurrence (10%– 20%), and postoperative respiratory problems (27%) [5]. In addition, anesthesia risks are also among the factors that should be considered [6]. Therefore, the conservative treatments to manage adenoid hypertrophy are under investigation and researches [7].

Intranasal corticosteroids significantly affect the production and/or activity of a variety of pro-inflammatory mediators locally in the nasal mucosa besides the decrease in vascular permeability and edema. This profound anti-inflammatory effect may reduce the immunological activation shown in hypertrophied adenoid tissue [8]. Mometasone is a potent 17-heterocyclic corticosteroid when administered intranasally, it has a higher binding to corticosteroid receptors, poor systematic concentration (0.1%), and extensive first pass metabolism. With the usual doses used intranasal, it does not suppress the hypothalamo-pituitary axis [9].

Leukotrienes are key inflammatory mediators in the respiratory system. These mediators usually involved in the pathogenesis of

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childhood diseases such as asthma. They are also systemically and locally involved in the process of inflammation in adenoid hypertrophy [5]. Cysteinyl leukotriene receptor-1 mediates the inflammatory pathway, in pediatric patients with obstructive sleep apnea, this receptor has been found in high rates in the postoperative adenotonsillar tissues [10]. Montelukast is an oral cysteinyl leukotriene receptor antagonist used in prevention of asthma and allergic rhinitis. It has also been studied for the treatment of adenoid hypertrophy in some clinical trials depending on the recent discovery of increased expression of cysteinyl leukotriene receptors in adenotonsillar tissues of children with sleep apnea [11].

The aim of this work is to evaluate the role of combined therapy using montelukast and intranasal mometasone furoate in comparison with intranasal mometasone furoate alone in the treatment of adenoid hypertrophy regarding efficacy and recurrence rate.

2. Materials and methods

2.1. Patients

This prospective randomized study was carried out at Benha faculty of medicine, Benha, Egypt; during the period from July 2019 to June 2020. The study protocol was approved by the local ethical committee of Faculty of Medicine, Benha University, Egypt. Written informed consent had been signed by children parents to participate. This study was submitted on 100 participants selected from outpatient clinics of Benha university hospital.

The study included children with age range between 3 and 10 years old and presented with adenoid hypertrophy symptoms; mouth breathing, habitual snoring and/or persistent rhinorrhea, and diagnosed with adenoid hypertrophy by lateral neck radiographic examination with Adenoid/Nasopharynx ratio (A/N ratio) > 50%. We included patients showing adenoid hypertrophy grade 3 or 4 on flexible fibro-optic endoscopic examination.

Patients with history of systemic diseases, pervious adenoidectomy or adenotonsillectomy or patients with hypersensitivity to momentasone furate and/or montelukast were excluded from the study. We excluded patients diagnosed with severe obstructive sleep apnea, adenoid hypertrophy complicated with otitis media or patients with acute upper respiratory tract infection. Also, we excluded patients diagnosed with craniofacial anomalies, adenoid hypertrophy grade 1 or 2 endoscopically or (A/N ratio) < 50% radiologically. The study did not include the child if there was a history of current use of any corticosteroids and/or montelukast or pervious use within 4 weeks preceding the initial assessment.

2.2. Initial assessment and evaluation

All patients in this study underwent a thorough clinical assessment including; complete history taking, full general and otorhinolaryngological examination. History was recorded according to the data obtained from parents with special concerns to snoring, rhinorrhea and mouth breathing; which were evaluated using visual analog scale (VAS) scores from 0 to 10. Flexible fibro-optic endoscopic examination of the nose and nasopharynx was performed, and the grade of adenoid hypertrophy was recorded according the classification of Cassano et al. [12], their classification was of four grades; grade I with (0%–25%) obstruction, grade II; (25%–50%), grade III; (50%–75%) and grade IV; (75%–100%) with total choanal obstruction.

Lateral neck radiographs with extended neck and open mouth were performed for assessment of airway patency. Adenoidal/nasopharyngeal ratio (A/N ratio) had been measured according to the method described by Fujioka et al. [13], in that method; (A) represents the distance from the point of maximal convexity of the adenoid shadow to a line along the anterior margin of the basiocciput. (N) represents the distance between the posterior border of the hard palate and the anteroinferior edge of the sphenobasioccipital synchondrosis.

2.3. Lines of treatment

Then, we had randomly assigned patients to two groups, 50 patients in each group. In group I; patients received combined therapy for 3 months using mometasone furoate intranasal spray (2 puff, total 100 μg in each nostril, once daily) combined with oral montelukast once daily either (4 mg in patients < 6 years) or (5 mg in patients > 6 years). While in group II; patients received only mometasone furoate intranasal spray with the same dose, frequency and duration.

2.4. Follow up

All patients had been examined and evaluated after 3 months of treatment and then after further another 3 months of stoppage of treatment to detect the recurrence rate.

The evaluation included assessment of the symptoms with the same scale used initially from 0 to 10. All patients had been submitted for clinical examination using flexible fibro-optic endoscopic examination of the nasopharynx and radiological examination used in the initial assessment.

2.5. Statistical analysis

Obtained data were statistically analyzed using SPSS version 16 software (SPSS Inc., Chicago, IL, USA). Chi square test was used to analyze categorical data. Student's “t” test was used to analyze quantitative data. Matched three continuous variables were tested by Friedman's test. P-value ≤0.05 was considered the accepted level of significance in this work.

3. Results

A total of 100 patients diagnosed with adenoid hypertrophy were enrolled in this study and divided randomly into two groups. Group I included 50 patients received combined therapy using mometasone furoate intranasal spray combined with oral montelukast, while group II included 50 patients received only mometasone furoate intranasal spray.

Group I consisted of 50 patients; 24 males and 26 females aged 3-10 years (mean age 6.7 ± 2.3 years). While group II consisted of 50 patients; 26 males and 24 females aged 3–10 years (mean age 6.9 ± 2.4 years). Regarding age and sex, both groups were matched with non-significant difference.

As shown in Table 1, there was no statistically significant

Table 1
Comparison of baseline scores of main symptoms between studied groups.

Main symptoms	Group I		Group II		*t*-test	P-value
	Mean ± SD	Range	Mean ± SD	Range		
Rhinorrhea	8.46 ± 0.73	7–10	8.60 ± 0.88	7–10	0.8658	0.3887
Mouth breathing	7.48 ± 0.70	6–9	7.60 ± 0.88	6–9	0.7546	0.4523
Snoring	7.49 ± 0.71	6–9	7.60 ± 0.88	6–9	0.6879	0.4931

Table 2
Comparison of the scores of main symptoms between studied groups after 3 months of treatment.

Main symptoms	Group I		Group II		*t*-test	P-value
	Mean ± SD	Range	Mean ± SD	Range		
Rhinorrhea	5.46 ± 2.19	2–10	6.98 ± 2.39	4–10	3.3156	0.0013
Mouth breathing	4.88 ± 2.24	3–9	5.98 ± 2.39	3–9	2.3746	0.0195
Snoring	4.45 ± 2.15	2–9	5.68 ± 2.39	2–9	2.7055	0.008

differences between both groups as regards the base line scores of main symptoms; rhinorrhea, mouth breathing and snoring, P-values were (0.388, 0.452 and 0.493) respectively.

There was no statistically significant difference between both groups regarding the base line A/N ratio (P = 0.186). The mean A/N ratio were (67.48 ± 6.02) and (69.34 ± 7.85) for group I and II respectively. As regards adenoid hypertrophy grading by endoscopic examination, there was no statistically significant difference between both groups at the initial assessment. In group I there were 45 (90%) and 5 (10%) patients with grade 3 and grade 4 hypertrophy respectively. In group II there were 39 (78%) and 11 (22%) patients with grade 3 and grade 4 hypertrophy respectively (P = 0.101).

After 3 months of treatment, by comparing scores of main symptoms; rhinorrhea, mouth breathing and snoring. There were better improvements in group I with statistically significant differences between both groups, P-values were (0.001, 0.019 and 0.008) for rhinorrhea, mouth breathing and snoring respectively (Table 2).

After 3 months of treatment, by comparing both groups as regards A/N ratio, there was better improvement in group I; A/N ratio ranged between 33 and 80 with mean A/N ratio (52.8 ± 11.3). While in group II; A/N ratio ranged between 50 and 85 with mean A/N ratio (62.88 ± 12.10). There was a statistically significant difference (P < 0.001). After the 3 months of treatment, as regards adenoid hypertrophy grading by endoscopic examination, there was a statistically significant difference between both groups with better results in group I than in group II (P = 0.005) (Fig. 1).

After further 3 months of observation after stoppage of treatment, by comparing scores of main symptoms between both groups, group I showed better scores than group II. There were statistically significant differences between both groups, P-values were (P < 0.001) for all symptoms (Table 3).

After the 3 months of observation after stoppage of treatment, by comparing both groups as regards A/N ratio, there were better results in group I; A/N ratio ranged between 33 and 80 with mean A/N ratio (58.46 ± 10.05). While in group II; A/N ratio ranged between 50 and 85 with mean A/N ratio (66.36 ± 10.46). There was a statistically significant difference (P < 0.001).

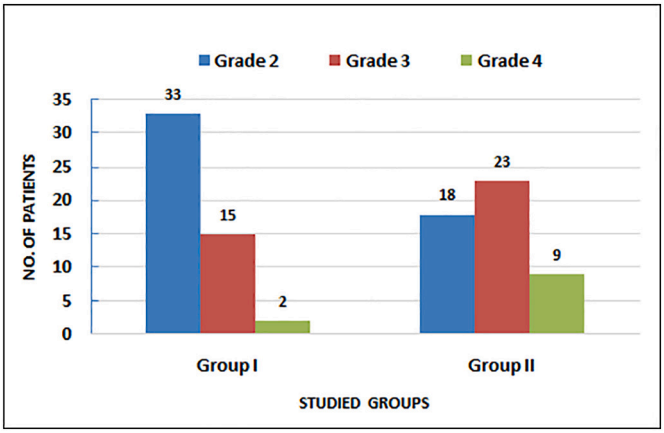

Fig. 1. Comparison of endoscopic grading of adenoid hypertrophy between studied groups after 3 months of treatment.

After the 3 months of observation after stoppage of treatment, as regards adenoid hypertrophy grading by endoscopic examination, there was a statistically significant difference between both groups with better results in group I than in group II (P < 0.001) (Fig. 2).

We compared the change of A/N ratio in each group over the period of the study; at base line, after 3 months of treatment and after further 3 months of observation. As shown in Table 4, over the period of study, there was a statistically significant differences in both groups (P < 0.001).

To assess the improvement and recurrence over the period of the study in each group, we compared the change of adenoid grade by endoscopic examination in each group over the period of the study; at base line, after 3 months of treatment and after further 3 months of observation (Table 5).

In group I; out of 45 cases with grade 3, 31 (68.8%) cases reduced in size to grade 2. And, out of 5 cases with grade 4, 2 (40%) cases reduced in size to grade 2 and 1 (20%) case reduced in size to grade 3 with total 8 (23.5%) recurrent cases in this group. In group II; out of 39 cases with grade 3, 16 (41.0%) cases reduced in size to grade 2. And, out of 11 cases with grade 4, only 2 (18.1%) cases reduced in size to grade 2 with total 10 (55.5%) recurrent cases in this group. These results showed superiority in group I with a significant improvement after treatment (P = 0.001) and a significant more recurrence in group II than in group I after stoppage of treatment (P = 0.02).

4. Discussion

Adenoidectomy is the definitive worldwide used method for treatment of adenoid hypertrophy, adenoid tissue may grow after infections or chronic allergic reactions, and this surgery has some complications like; hemorrhage, infections and palate dysfunction besides the risks of general anesthesia [14]. The risk of these complications and the incidence of recurrence of adenoid tissue aroused the need for more conservative lines of treatment using anti-inflammatory and anti-allergy medications.

Mometasone furoate nasal spray has lower bioavailability, extensive first pass metabolism and a relatively higher binding affinity for the glucocorticoid receptor than the other intranasal corticosteroids [15].

In literature there are many papers studied the effect of nasal steroid, particularly intranasal mometasone for treatment of adenoid hypertrophy. Some authors [1,16–18] found some beneficial effect of mometasone nasal spray on some outcomes of nasal obstruction caused by adenoidal hypertrophy.

Chohan et al. [19] concluded in there systematic review and meta-analysis that mometasone achieved improvements in outcomes of total nasal symptoms and quality of life and recommended more randomized controlled trials of different doses and duration of administration of mometasone to evaluate its clear efficacy and safety in children with adenoid hypertrophy.

In contrary to mometasone, there are few papers about montelukast use in adenoid hypertrophy. Shokouhi et al. [5] studied the effect of montelukast on size and symptoms of adenoid hypertrophy and concluded that montelukast as an anti-inflammatory agent gave promising results in reduction of adenoid size and improving the related clinical symptoms.

Table 3
Comparison of the scores of main symptoms between studied groups after further 3 months of observation after stoppage of treatment.

Main symptoms	Group I		Group II		*t*-test	P-value
	Mean ± SD	Range	Mean ± SD	Range		
Rhinorrhea	6.26 ± 2.33	2–10	7.84 ± 1.89	4–10	3.7239	0.0003
Mouth breathing	5.40 ± 2.25	2–9	6.96 ± 1.84	3–9	3.7952	0.0003
Snoring	5.27 ± 2.30	2–9	6.74 ± 1.96	3–9	3.4398	0.0009

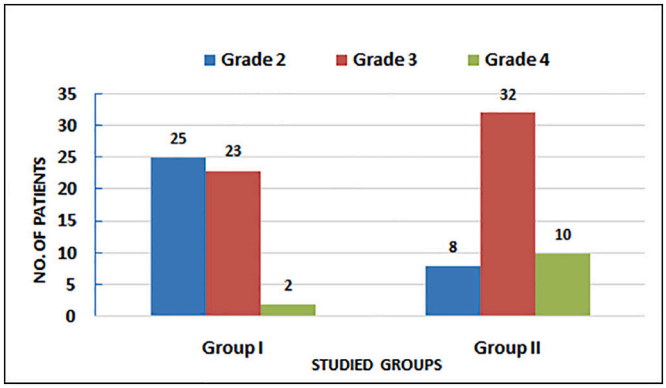

Fig. 2. Comparison of endoscopic grading of adenoid hypertrophy between studied groups after the 3 months of observation after stoppage of treatment.

Table 4
Change of A/N ratio over the period of the study in the studied groups.

A/N ratio	Group I		Group II	
	Mean ± SD	Range	Mean ± SD	Range
Base line	67.48 ± 6.02	51–83	69.34 ± 7.85	52–85
After 3 months	52.8 ± 11.3	33–80	62.88 ± 12.10	50–85
After further 3 months	58.46 ± 10.05	33–80	66.36 ± 10.46	50–85
Friedman test	54.8		18.4	
P-value	< 0.001		< 0.001	

Tuhanıoğlu et al. [14] made a randomized prospective clinical trial to evaluate the effects of montelukast, mometasone furoate and combined therapy on adenoid size, but they did not assess the recurrence rate after stoppage of treatment, they recommended larger studies for dosage and duration of use.

In our study we compared the role of combined therapy using montelukast and mometasone furoate nasal spray in treatment of adenoid hypertrophy, in comparison with mometasone furoate nasal spray alone discussing the efficacy and the recurrence rate after stoppage of treatment. The studied groups were matched in age and sex. We assessed patients in our study using both subjective and objective measures. Patients assigned to groups randomly with no significant differences at the initial assessment as regards main symptoms scores, A/N ratio and adenoid hypertrophy grades.

In our study, we included 50 patients in each group, the age of patients ranged from 3 to 10 years with a mean age of (6.7 ± 2.3) years in group I and (6.9 ± 2.4) years in group II with no significant differences, this matches with Tuhanıoğlu et al. [14], who included 30 patients in each studied groups, with age ranged from 4 to 10 years, the mean age in the group treated with momentasone was 6.83 ± 2.05 years, and in the group treated with combined therapy, it was 7.37 ± 1.85 years.

In our study, after 3 months of treatment, based on the subjective assessment, we compared the scores of main symptoms; rhinorrhea, mouth breathing and snoring between both groups. There were better scores in group I (combined therapy) with statistically significant differences.

Based on the objective assessment, we compared the adenoid hypertrophy grading by endoscopic examination and compared the change in A/N ratio. In our study, by comparing the adenoid hypertrophy grading by endoscopic examination after 3 months of treatment, in group I; out of 45 cases with grade 3, 31 (68.8%) cases reduced in size to grade 2. And, out of 5 cases with grade 4, 2 (40%) cases reduced in size to grade 2 and 1 (20%) case reduced in size to grade 3. In group II; out of 39 cases with grade 3, 16 (41.0%) cases reduced in size to grade 2. And, out of 11 cases with grade 4, only 2 (18.1%) cases reduced in size to grade 2. Our results show superiority in group I (combined therapy) than group II regarding improvement in grading of adenoid hypertrophy (P = 0.001).

Table 5
Change of adenoid grade by endoscopic examination over the period of the study in the studied groups.

Groups	Initial endoscopic grading	After 3 months			Further 3 months of observation		
		Grade 2	Grade 3	Grade 4	Grade 2	Grade 3	Grade 4
Group I	Grade 3 45 (90%) cases	31[a] (68.8%)	14 (31.1%)	0 (0%)	23 (51.1%)	22 (48.8%)	0 (0%)
	Grade 4 5 (10%) cases	2[a] (40%)	1[a] (20%)	2 (40%)	2 (40%)	1 (20%)	2 (40%)
	Total 50 (100%) cases	33 (66%) Total improved[a] 34 (68%) cases	15 (30%)	2 (4%)	25 (50%) Recurrent 8 (23.5%) cases	23 (46%)	2 (4%)
Group II	Grade 3 39 (78%) cases	16[a] (41.0%)	23 (58.9%)	0 (0%)	7 (17.9%)	32 (82.0%)	0 (0%)
	Grade 4 11 (22%) cases	2[a] (18.1%)	0 (0%)	9 (81.8)	1 (9.0%)	0 (0%)	10 (90.9%)
	Total 50 (100%) cases	18 (36%) Total improved[a] 18 (36%) cases	23 (46%)	9 (18%)	8 (16%) Recurrent 10 (55.5%) cases	32 (64%)	10 (20%)

[a] Improvement means reduction in size from higher grade to lower grade.

In our study, we compared the change of A/N ratio in each group over the period of the study. In group I; the mean of A/N ratio was (67.48 ± 6.02) initially and improved after 3 months treatment by combined therapy to (52.8 ± 11.3). In group II; the mean of A/N ratio was (69.34 ± 7.85) initially and improved after 3 months treatment by mometasone alone to (62.88 ± 12.10). Our results show better improvement in group I (combined therapy) regarding A/N ratio with a statistically significant difference ($P < 0.001$).

Our results as regards the change of A/N ratio in group II after treatment with intranasal mometasone matches with Bhargava and Chakravarti [18], in that study, the initial mean of adenoid size was (86 ± 11.62) and improved after 6 months treatment by mometasone alone to (71.67 ± 12.34), they assigned 30 children to 6 months treatment as they were diagnosed with otitis media with effusion and adenoid hypertrophy.

Our results partially matches with results of Tuhanıoğlu et al. [14], they found that both montelukast and mometasone furoate therapies were similarly successful in the treatment of adenoid hypertrophy and the combination therapy is effective at reducing adenoid size, but the difference is that the combination therapy could not establish superiority over steroid alone. In that study the mean of A/N ratio was (82.33 ± 11.12) initially in the group of combined therapy then improved after 3 months treatment to (64.8 ± 13.59) and was (77.43 ± 14.2) initially in the group treated with mometasone alone then improved after 3 months treatment to (60.4 ± 12.83).

To our knowledge, no previous studies discussing the extended effect of the conservative treatment in adenoid hypertrophy using either, intranasal mometasone, oral montelukast or both. In our study, we followed the patients for further 3 months after stoppage of treatment to assess the recurrence of symptoms or adenoid hypertrophy recurrence.

After follow up for further 3 months after stoppage of treatment, subjectively we compared the scores of main symptoms and there were better scores in group I (combined therapy) with statistically significant differences. Objectively, after the same follow up period after stoppage of treatment, by comparing both groups as regards A/N ratio, there were statistically better results in group I (mean A/N ratio 58.46 ± 10.05) than in group II (mean A/N ratio 66.36 ± 10.46) ($P < 0.001$).

To assess the recurrence in each group after the same follow up period after stoppage of treatment, we compared the adenoid grade by endoscopic examination in each group over the period of the study; after 3 months of treatment and after further 3 months of observation. We found that; in group I, only 8 (23.5%) recurrent cases out of 34 cases previously reduced in size with treatment. But in group II, 10 (55.5%) recurrent cases out of 18 cases previously reduced in size with treatment. As regards the recurrence of adenoid hypertrophy after stoppage of treatment, it is significantly lower in group I (with combined therapy) ($P = 0.02$).

5. Conclusion

The results of our comparative study suggest that using oral montelukast and intranasal mometasone furoate as a combined therapy offer benefits over the single therapy using intranasal mometasone furoate alone in treatment of adenoid hypertrophy. Combined therapy provided better subjective and objective improvements after 3 months treatment and less recurrence after stoppage of treatment for further 3 months in comparison with single therapy using intranasal mometasone furoate alone.

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Ethics and consent

The study protocol was approved by the local ethical committee of Faculty of Medicine, Benha University, Egypt. All parents of children included in the study gave their written informed consent to participate.

Declaration of competing interest

The authors declare no conflict of interest.

References

[1] Berlucchi M, Salsi D, Valetti L, Parrinello G, Nicolai P. The role of mometasone furoate aqueous nasal spray in the treatment of adenoidal hypertrophy in the pediatric age group: preliminary results of a prospective, randomized study. Pediatrics 2007 Jun;119(6):e1392–7. https://doi.org/10.1542/peds.2006-1769. [Epub 2007 May 28. PMID: 17533178].

[2] Dixit Y, Tripathi PS. Community level evaluation of adenoid hypertrophy on the basis of symptom scoring and its X-ray correlation. J Fam Med Prim Care 2016 Oct-Dec;5(4):789–91. https://doi.org/10.4103/2249-4863.201156. [PMID: 28348992; PMCID: PMC5353815].

[3] Cengel S, Akyol MU. The role of topical nasal steroids in the treatment of children with otitis media with effusion and/or adenoid hypertrophy. Int J Pediatr Otorhinolaryngol 2006 Apr;70(4):639–45. https://doi.org/10.1016/j.ijporl.2005.08.013. [Epub 2005 Sep 16. PMID: 16169093].

[4] Saedi B, Sadeghi M, Mojtahed M, Mahboubi H. Diagnostic efficacy of different methods in the assessment of adenoid hypertrophy. Am J Otolaryngol 2011 Mar-Apr;32(2):147–51. https://doi.org/10.1016/j.amjoto.2009.11.003. [Epub 2010 Apr 13. PMID: 20392530].

[5] Shokouhi F, Meymaneh Jahromi A, Majidi MR, Salehi M. Montelukast in adenoid hypertrophy: its effect on size and symptoms. Iran J Otorhinolaryngol 2015 Nov;27(83):443–8. [PMID: 26788489; PMCID: PMC4706629].

[6] Shirley WP, Wooley AL, Wiatrak BJ. Pharyngitis and adenotonsillar disease. Cummings otolaryngology: headand neck surgery. 5th ed.Philadelphia, PA, USA: Elsevier; 2010. p. 2782–803.

[7] Chadha NK, Zhang L, Mendoza-Sassi RA, César JA. Using nasal steroids to treat nasal obstruction caused by adenoid hypertrophy: does it work? Otolaryngol Head Neck Surg 2009 Feb;140(2):139–47. https://doi.org/10.1016/j.otohns.2008.11.008. [19201278].

[8] Mygind N, Nielsen LP, Hoffmann HJ, Shukla A, Blumberga G, Dahl R, et al. Mode of action of intranasal corticosteroids. J Allergy Clin Immunol 2001 Jul;108(1 Suppl):S16–25. https://doi.org/10.1067/mai.2001.115561. [PMID: 11449202].

[9] Derendorf H, Meltzer EO. Molecular and clinical pharmacology of intranasal corticosteroids: clinical and therapeutic implications. Allergy 2008 Oct;63(10):1292–300. https://doi.org/10.1111/j.1398-9995.2008.01750.x. [PMID: 18782107].

[10] Dayyat E, Serpero LD, Kheirandish-Gozal L, Goldman JL, Snow A, Bhattacharjee R, et al. Leukotriene pathways and in vitro adenotonsillar cell proliferation in children with obstructive sleep apnea. Chest 2009 May;135(5):1142–9. https://doi.org/10.1378/chest.08-2102. [Epub 2008 Dec 31. PMID: 19118273; PMCID: PMC2716539].

[11] Goldbart AD, Goldman JL, Veling MC, Gozal D. Leukotriene modifier therapy for mild sleep-disordered breathing in children. Am J Respir Crit Care Med 2005 Aug 1;172(3):364–70. https://doi.org/10.1164/rccm.200408-1064OC. [Epub 2005 May 5. PMID: 15879419; PMCID: PMC2718474].

[12] Cassano P, Gelardi M, Cassano M, Fiorella ML, Fiorella R. Adenoid tissue rhinopharyngeal obstruction grading based on fiberendoscopic findings: a novel approach to therapeutic management. Int J Pediatr Otorhinolaryngol 2003 Dec;67(12):1303–9. https://doi.org/10.1016/j.ijporl.2003.07.018. [PMID: 14643473].

[13] Fujioka M, Young LW, Girdany BR. Radiographic evaluation of adenoidal size in children: adenoidal-nasopharyngeal ratio. AJR Am J Roentgenol 1979 Sep;133(3):401–4. https://doi.org/10.2214/ajr.133.3.401. [PMID: 111497].

[14] Tuhanıoğlu 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 Dec 19;47(6):1736–43. https://doi.org/10.3906/sag-1701-179. [PMID: 29306232].

[15] Zitt M, Kosoglou T, Hubbell J. Mometasone furoate nasal spray: a review of safety and systemic effects. Drug Saf 2007;30(4):317–26. https://doi.org/10.2165/00002018-200730040-00004. [PMID: 17408308].

[16] Bhargava R, Chakravarti A. Role of mometasone furoate aqueous nasal spray for management of adenoidal hypertrophy in children. J Laryngol Otol 2014 Dec;128(12):1060–6. https://doi.org/10.1017/S0022215114002503. [Epub 2014 Nov 18. PMID: 25404102].

[17] Rezende RM, Silveira F, Barbosa AP, Menezes UP, Ferriani VP, Rezende PH, et al. Objective reduction in adenoid tissue after mometasone furoate treatment. Int J Pediatr Otorhinolaryngol 2012 Jun;76(6):829–31. https://doi.org/10.1016/j.ijporl.2012.02.052. [Epub 2012 Mar 16. PMID: 22425063].

[18] Bhargava R, Chakravarti A. A double-blind randomized placebo-controlled trial of topical intranasal mometasone furoate nasal spray in children of adenoidal hypertrophy with otitis media with effusion. Am J Otolaryngol 2014 Nov-Dec;35(6):766–70. https://doi.org/10.1016/j.amjoto.2014.06.006. [Epub 2014 Jun 20. PMID: 25151658].

[19] Chohan A, Lal A, Chohan K, Chakravarti A, Gomber S. Systematic review and meta-analysis of randomized controlled trials on the role of mometasone in adenoid hypertrophy in children. Int J Pediatr Otorhinolaryngol 2015 Oct;79(10):1599–608. https://doi.org/10.1016/j.ijporl.2015.07.009. [Epub 2015 Jul 13. PMID: 26235732].