Journal of Otolaryngology: Research

SCIENTIFIC LITERATURE

Special Issue Article "Tonsillectomy"

Research Article

Effect of Adenoid Size and Duration on Pulmonary Functions in Children

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ARTICLE INFO

Received Date: December 24, 2018
Accepted Date: January 07, 2019
Published Date: January 11, 2019

KEYWORDS

Adenoid
Adenoidectomy
Pulmonary function
Upper airway
Children

Citation for this article: Mohammad Waheed El-Anwar, Alaa Khazback, Atef Hussein, Walid Elgendy, Ahmed Mohamed Said and Sanaa Mahmoud Abdel Salam. Effect of Adenoid Size and Duration on Pulmonary Functions in Children. Journal of Otolaryngology: Research. 2019; 2(1):123

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ABSTRACT

Objectives: To find out the relation between pulmonary functions and grade of adenoid hypertrophy and duration of symptoms in children.

Methods: Sixty patients scheduled for adenoidectomy were included. After history taking and clinical examination, lateral neck radiography was performed and adenoid hypertrophy was graded into 4 grades. Spirometric tests were performed to measure vital capacity (VC), forced vital capacity (FVC), forced expiratory volume during the first second of expiration (FEV1), and ratio of FEV1 to FVC (FEV1/FVC).

Results: No statistically significant differences in FEV and FEV/ FVC between smaller adenoid (infective type) and large adenoid (obstructive type) were detected. However, patients with symptoms for more than 2 years showed statistically significant worse FEV and FEV/ FVC than those with symptoms for less than 2 years duration ($p < 0.0001$).

Conclusion: long term upper airway obstruction by adenoid could significantly result in significant negative sequels on pulmonary functions thus early adenoidectomy in children have large adenoid size is important to protect the lower respiratory tract from sequential negative effect.

INTRODUCTION

Adenoid hypertrophy is considered as one of the most common causes of upper airway obstruction in children [1]. It could be performed alone or accompanied with tonsillectomy, adenoidectomy is considered as the most commonly performed otorhinolaryngological surgeries in children [1]. The size of the adenoid was found to be highly correlated to the total patient's symptom scores with high effect on the severity of the nasal obstruction [2].

Increased upper airway resistance that can be caused by adenoid may result in obstructive sleep apnea, intermittent airway obstruction, chronic alveolar hypoventilation and it can lead to severe cardiopulmonary complications like cor-pulmonale as well [3-7].

Although the cardiopulmonary effects of adenoid hypertrophy were investigated in some studies, [1,2,8,9], there is a little and undetailed knowledge about the effect of the size of the adenoid and the duration on the pulmonary functions. In this work, we

tried to find out the relation between pulmonary functions and the adenoid hypertrophy grades and duration in children.

PATIENTS AND METHODS

This study included children (< 16 years) scheduled for adenoidectomy in the period from January 2015 to January 2018. The study was approved by the institutional review board (IRB) at Zagazig University Hospitals and informed written consent was obtained from the parents of the enrolled children. All patients were subjected to full history taking, clinical examination, laboratory testing and radiological examination including plain X-ray nasopharynx. Exclusion criteria included the presence of other causes of upper airway obstruction such as craniovertebral anomalies, septal deviation, thoracic skeleton deformities, hypertrophic tonsil (grade 2, 3) [10,11], body mass index > 35 [12], respiratory tract or heart disease, subglottic or any other secondary airway stenosis resulting from previous surgeries. Children with cleft palate and young children that could not do pulmonary function tests were also excluded from the study. Lateral neck radiography was performed and we calculated the airway / nasopharyngeal (A/N) ratio by Fujioka formula [13].

Spirometric tests were performed one day before adenoidectomy. The patient nostril was pinched by the doctor's hand or by using an anterior rhinoscopy clenching both nostril then the probe of the spirometer was applied into the mouth of the patient and the patient was asked to close his mouth tightly around the probe. The patient was instructed to take 2 regular breaths followed by a deep breath.

The following parameters were recorded: vital capacity (VC), forced vital capacity (FVC), forced expiratory volume during the first second of expiration (FEV1), and ratio of FEV1 to FVC (FEV1/FVC).

STATISTICAL METHODS

All analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 15 packed programs. A difference was considered significant at $p < 0.05$. The results of the study were statistically analyzed using t test (Table 2, 3).

RESULTS

The study included 60 patients; 23 (38%) males and 37 (629%) females. Their ages ranged from 5 year to 15 years (mean; 8.78571 ± 3.2129). Weight of patients ranged between 15 to 65 kilogram (mean; 34.± 13.19). Length ranged between 105 to 150 cm (mean; 119.4.± 15.38672) (Table 1).

Mean of FEV in smaller adenoid (grade 1 + 2) was 1.54 ± 0.75 while mean FEV for large adenoid (grade 3+ 4) was 1.85 ± 0.54 with non-significant difference (t= 1.0638, p = 0.3032). While mean of FEV/ FVC in smaller adenoid (grade 1 + 2) was 99.56 ± 11.3 and for large adenoid (grade 3+ 4) was 98.767 ± 2.49 with also non-significant difference (t= 0.2423, p= 0.812). So no statistically significant differences in FEV and FEV/ FVC between smaller adenoid (infective type) and large adenoid (obstructive type) were detected (Table 2).

On reviewing the results at the scope of disease duration, patients who gave history of symptoms for more than 2 years showed statistically significant worse FEV and FEV/ FVC than patients who gave history of symptoms for less than 2 years duration ($p < 0.0001$) (Table 3). Taking into consideration that patient with symptoms history > 2 years and those with symptoms history < 2 years were matched for age (t= 0.1938, P = 0.8502), weight (t = 1.7258, P = 0.1025), and length (t = 2.7518, P = 0.0127) (Table 1).

Table 1: Age, sex, weight and length in different grades.

	Patients with symptoms history < 2 years	Patients with symptoms history> 2 years	T test	P value
Age Range Mean ± SD	5-15 9.5 ± 4.49	8-15 9.08 ± 3.3	0.1938	0.8502 (non signifiant)
Wight Range Mean ± SD	15- 58 32.5 ± 12.9	30- 60 Kg 38.375 ± 10.3	1.0361	0.3139 (non significant)
Length Range Mean ± SD	100- 150 121.5± 15.19	115- 150 123.57± 12.488	0.3078	0.7618 (non significant)

Table 2: Pulmonary functions tests among different radiological adenoid grade.

Pulmonary function tests		results; Mean ± SD	Statistical difference between grades
FEV	(grade 1 + 2; 13 cases)	1.54 ± 0.75	T test= 1.0638 P= 0.3032 (NS)
	(grade 3 + 4; 7 cases)	1.85 ± 0.54	
FEV/F	(grade 1 + 2; 13 cases)	99.56 ± 11.3	T test= 0.2423 P= 0.812 (NS)
	(grade 3 + 4; 7 cases)	98.767 ± 2.49	

*NS= non signifiant

Table 3: forced expiratory volume (FEV) among disease duration less than and more than 2 years.

	Preoperative FEV	Range	Mean	SD	T value	P value
Preoperative FEV	Disease duration < 2 years	0.67 to 1.39	2.106	0.55	5.4086	< 0.0001 (statistically highly significant)
	Disease duration > 2 years	1.58 to 3.27	1.058	0.2		

DISCUSSION

Adenotonsillar hypertrophy is the most common cause of upper airway obstruction and obstructive sleep symptoms in pediatric population. A significant correlation was reported between the adenoid size and the total symptom scores especially nasal obstruction [8]. Adenoid enlargement may lead to abnormalities in respiratory flows, even without clinical and radiological manifestations [8]. The diminution of air flow during expiration or inspiration is a significant diagnostic feature of airway obstruction [8]. Obstruction is considered the commonest adenoidectomy indication [5].

Kavukcu et al., advised the usage of spirometric results as part of the criteria of the indication of adenoidectomy [14]. They observed obstructive pulmonary disorder of transient character in 60% of the examined group and the parameters indicating the airway obstruction disappeared after surgery.

Pulmonary function assessment in pediatrics with no abnormalities except adenoid hypertrophy was evaluated by Maurizi et al and they found that 52% of patients presented the features of lower airway obstruction [15]. They concluded that 65.7% of clinically normal children with hypertrophy of the adenoid revealed disturbance in the pulmonary functions [15]. Also higher Mean pulmonary arterial pressure values of children with diagnosis of upper airway obstruction resulting from hypertrophied tonsils and adenoids have been reported by Yilmas et al., [9]. However, the detail of pulmonary functions changes in children with different adenoid grades have not been investigated in details yet, Also there is no study showing the relationship between the duration of the symptoms secondary to adenoid enlargement with the degree of affection on the pulmonary functions. Guney in his study recorded a significant recovery in respiratory functional tests and blood gas levels were achieved after adenotonsilectomy for patients with adenotonsillar hypertrophy [16].

A reduction of airflow in the respiratory tract is defined as obturation. This phenomenon leads to diminution of the maximum flow values and air volumes in the unit of time during the forced expiration in relation to the vital capacity. From the pathophysiological point of view, obturation is known as a decrease of Tiffaneau index (FEV1%/VC). It should be mentioned that FEV1%/FVC is the most sensitive indicator of obturation. In our study, FEV1%/FVC did not significantly differ in small (grade1 and 2) and large adenoid (grade 3 and 4). Thus size of the adenoid was not the main factor affect pulmonary functions. But we found that duration of obstruction was a significant factor affecting the pulmonary functions. Thus, early interference in cases of adenoid hypertrophy is important to reduce duration of obstruction and so its effect on lower respiratory tract. Results of the Spirometry in children with adenoid hypertrophy could be useful for convincing reluctant parents to take the decision for early surgical intervention and prevent these patients from progressing to either cardiac or

pulmonary complications, also it could be added as an indicator for adenoidectomy.

Sometimes it is not easy to get accurate measurements by spirometry because it is difficult to do these tests in children [17]. Therefore, it is advised that this assessment should be done many times and compared with each other to get more accurate results. In our study abnormalities of the pulmonary functions disappeared after adenotonsillectomy, hence its relationship with adenotonsillar hypertrophy was established. The duration of airway obstruction associated with recurrent lower respiratory tract infections is an important factor in genesis of cardiopulmonary syndrome [17]. As a non-invasive tool, spirometry might be added to the indications criteria for adenoidectomy and in the way to avoid the cardio-pulmonary complications

In general, in current study, no significant differences were detected in pulmonary functions tests between large adenoid and small adenoid. On the other hands, it is objectively clear from the results of our study that increased duration of upper airway obstruction for more than 2 years could significantly result in significant negative sequels on pulmonary functions focusing on the importance of early adenoidectomy in children have large adenoid size (grade 3 and 4 on X-ray).

Nasal respiration is considered the most effective mechanism for introducing oxygen into the lungs and body for overall health. Oxygen concentration is law in the blood in the mouth breather than those who have optimal nasal respiration; it was proved that low oxygen concentration in the blood may lead to high blood pressure and heart failures [18-21].

The effect of relief of the upper airway obstruction by adenoidectomy on pulmonary artery pressure was studied and minimal decline (about 4 mmHg) [14] and about 6 mmHg in older study [17]. We agree with Rogha et al., [22] that spirometric examination in children with adenotonsillar hypertrophy is valuable to assess the their pulmonary status.. But the effect of adenoidectomy on the pulmonary functions changes with large adenoid need to be studied taking into consideration the duration of obstruction.

Spirometric tests in children with adenoid hypertrophy may be used to convince surgery-reluctant parents to early intervention and complications avoidance, and could be added to indication for adenoidectomy. As a non-invasive tool, spirometry might be added to the indications criteria for adenoidectomy and in the way to avoid the cardio-pulmonary complications.

CONCLUSION

Long-term upper airway obstruction with large adenoid could be responsible for decline of their pulmonary functions. As a non-invasive tool, spirometry might be added to the indications criteria for adenoidectomy as an attempt to avoid the cardio-pulmonary complications.

REFERENCES

1. Niedzielska G, Kotowski M, Niedzielski A. (2008). Assessment of pulmonary function and nasal flow in children with adenoid hypertrophy. International Journal of Pediatric Otorhinolaryngology. 72: 333-335.
2. Yadav SPS, Dodeja OP, Gupta KB, Chanda R. (2003). Pulmonary function tests in children with adenotonsillar hypertrophy. International Journal of Pediatric Otorhinolaryngology. 67: 121-125.
3. Costantini F, Salamanca F, Amaina T, Zibor F. (2008). Videoendoscopic adenoidectomy with microdebrider. ACTA otorhinolaryngologica italica l. 28: 26-29.
4. Cannon CR, Replogle WH, Schenk MP. (1999). Endoscopic-assisted adenoidectomy. Otolaryngol Head Neck Surg. 121: 740-744.
5. Havas T, Lowinger D. (2002). Obstructive adenoid tissue: an indication for powered shaver adenoidectomy. Arch Otolaryngol Head Neck Surg. 128: 789-791.
6. Owens D, Jaramillo M, Saunders M. (2005). Suction diathermy adenoid ablation. J Laryngol Otol. 119: 34-35.
7. Shin JJ, Hartnick CJ. (2003). Pediatric endoscopic transnasal adenoid ablation. Ann Otol Rhinol Laryngol. 112: 511-514.
8. Yilmaz MD, Kahveci OK, Okur E, Yucedag. (2011). The effect of the adenoid of hypertrophy rate on upper airway obstruction symptoms. KBB-Forum. 10: 74-79.
9. Yilmaz MD, Onrat E, Altuntas A, Kaya D, Kahveci OK, et al. (2005). The effects of tonsillectomy and adenoidectomy on pulmonary arterial pressure in children. Am J Otolaryngol. 26: 18-21.

10. El-Ahl MAS, El-Anwar MW. (2016). Expansion pharyngoplasty by new simple suspension sutures without tonsillectomy. Otolaryngology–Head and Neck Surgery. 155: 1065-1068.
11. Adzereil B, Wong EH, Saraiza A, Raman R, Amin J. (2017). The effectiveness of combined tonsillectomy and anterior palatoplasty in the treatment of snoring and obstructive sleep apnea (OSA). Eur Arch Otorhinolaryngol. 274: 2005-2011.
12. El-Anwar MW, Amer HS, Askar SM, Elsobki A, Awad A. (2018). Could nasal surgery affect multilevel surgery results for obstructive sleep apnea? J Craniofac Surg. 29: 1897-1899.
13. Fujioka M, Young LW, Girdany BR. (1979). Radiographic evaluation of adenoidal size in children: adenoidal-/nasopharyngeal ratio, Am. J. Roentgenol. 133: 401-410.
14. Kavukcu S, Coskun S, Cevik N, Kuscu B, Akkoclu A. (1993). The importance of pulmonary function tests in adenotonsillectomy indications, Indian J. Pediatr. 60: 249-255.
15. Maurizi N, Paludetti G, Todisco T, Dottorini M, Grassi V. (1990). Pulmonary function studies in adenoid hypertropy, Int. J. Pediatr. Otorhinolaryngol. 2: 243-250.
16. Gueny E. (1974). To investigate the effects of tonsil and adenoid hyperplasia on cardiopulmonary system in children. Specialist Thesis, Hcettepe university ear nose booaz was native, Ankara.
17. Di Martino E, Mlynski G, Mlynski B. (1998). Effect of adenoid hyperplasia on nasal airflow, Laryngorhinootologie. 77: 272-274.
18. Tanigawa T, Tachibana N, Yamagishi K, Muraki I, Kudo M, et al. (2004). Relationship between sleep-disordered breathing and blood pressure levels in community- based samples of Japanese men. Hypertens Res. 27: 479-484.
19. Andreas S, von zur Muhlen F, Stevens J, Kreuzer H. (1998). Nocturnal oxygen and hypercapnic ventilator response in patients with congestive heart failure. Respir Med. 92: 426-431.
20. Agostoni P, Bussotti M, Cattadori G, Margutti E, Contini M, et al. (2006). Gas diffusion and alveolar-capillary unit in chronic heart failure. Eur Heart J. 27: 2538-2543.
21. Naughton MT, Lorenzi-Filho G. (2009). Sleep in heart failure. Prog Cardiovasc Dis. 51: 339-349.
22. Rogha M, Amini J, Raisi M. (2016). Pulmonary Function after Adenotonsillectomy. Iran J Otorhinolaryngol. 28: 383-388.