Kulak Burun Bogaz Ihtis Derg 2014;24(6):334-338 doi: 10.5606/kbbihtisas.2014.50024

Original Article* / *Çalışma - Araştırma

The effect of adenoid hypertrophy on tympanometric findings in children without hearing loss

İşitme kaybı olmayan çocuklarda adenoid hipertrofisinin timpanometrik bulgulara etkisi

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Objectives: This study aims to investigate the effects of adenoid hypertrophy on negative middle ear pressure and diagnostic efficiency of tympanogram in the detection of otitis media with effusion in children without parental suspicion of hearing loss.

Patients and Methods: Fifty-six children (26 boys, 30 girls; mean age 5.9±2.2 years; range, 3 to 12 years) who underwent adenoidectomy were analyzed using otoscopy, nasal endoscopy, and tympanometry (before 1 week and 3 months after adenoidectomy).

Results: The median negative middle ear pressure before the adenoidectomy was significantly higher from after adenoidectomy (p=0.045). Type B tympanogram were detected in 13 of the 112 ears preoperatively. About 17.9% (n=20) of the ears with otitis media with effusion were confirmed by myringotomy.

Conclusion: Our study findings suggest that the adenoid hyperthrophy is associated with increased negative pressure in the middle ear. We believe that it is necessary to perform the middle ear examination and tympanometry in children before adenoidectomy and in children without parental suspicion of hearing loss, even.

Keywords: Acoustic stapedius reflex; adenoidectomy; hearing loss; myringotomy; otitis media with effusion; tympanometry.

Amaç: Bu çalışmada adenoid hipertrofisinin orta kulak basıncı üzerine etkisi ve ailesel işitme kaybı şüphesi olmayan çocuklarda, timpanogramın efüzyonlu otitis mediada tanısal etkinliğinin araştırılması amaçlandı.

Hastalar ve Yöntemler: Adenoidektomi ameliyatı yapılan 56 çocuk (26 erkek, 30 kız; ort. yaş 5.9±2.2 yıl; dağılım, 3-12 yıl) otoskopi, nazal endoskopi ve timpanometre kullanılarak analiz edildi (adenoidektomiden 1 hafta önce ve 3 ay sonra).

Bulgular: Adenoidektomi öncesi ortalama negatif orta kulak basıncı adenoidektomi sonrasına göre anlamlı derecede yüksekti (p=0.045). Yüz on iki kulağın 13'ünde ameliyat öncesi tip B timpanogram saptandı. Kulakların %17.9'unda (n=20) efüzyonlu otitis media miringotomi ile doğrulandı.

Sonuç: Çalışma bulgularımız adenoid hipertrofisinin artmış negatif orta kulak basıncı ile ilişkili olduğunu göstermektedir. Çocuklara ve ailede işitme kaybı olmayan çocuklara dahi, adenoidektomi öncesinde orta kulak muayenesi ve timpanometri yapılmasının gerekli olduğu kanısındayız.

Anahtar Sözcükler: Akustik stapes refleks; adenoidektomi; işitme kaybı; miringotomi; efüzyonlu otitis media; timpanometre.

Available online at
www.kbbihtisas.org
doi: 10.5606/kbbihtisas.2014.50024
QR (Quick Response) Code

Received / *Geliş tarihi:* June 03, 2014 Accepted / *Kabul tarihi:* July 21, 2014

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Adenoidectomy is the most frequently performed surgical operation during childhood. Indications of adenoidectomy are mostly mouth breathing, snoring, sleep apnea, hyponasality, sinusitis and otitis media with effusion (OME).[1]

The main function of the eustachian tube is middle ear ventilation to equalize the middle ear pressure with atmospheric pressure.[2] Mechanical obstruction of the Eustachian tube because of adenoid hypertrophy may be an important factor in OME.[3,4] Signs and symptoms of OME are usually occult. Some children with adenoid hypertrophy have OME in spite of having no complaint of hearing loss.[5] Sometimes parents are not aware of their children's symptoms of hearing loss. Untreated OME may result in serious consequences in the form of poor speech and intellectual development and permanent anatomical distortions within the middle ear cavity. Therefore, correct and early diagnosis and appropriate treatment of OME in children is imperative.[6]

In this article, we investigated the effects of adenoid hypertrophy on middle ear pressure and the diagnostic efficiency of tympanometry for detecting OME in children without parental suspicion of hearing loss.

PATIENTS AND METHODS

This prospective study was approved by the hospital research ethics board and written informed consent was obtained from the parents. This study was performed on 56 children (26 boys, 30 girls; mean age 5.93±2.2 years; range 3 to 12 years) diagnosed with adenoid hypertrophy for adenoidectomy between December 2012 and December 2013. Children who had adenoid hypertrophy (≥90% ratio of adenoid tissue to choanal opening on nasal endoscopic examination) and whose parents did not suspect hearing loss were enrolled the study. Children with craniofacial anomalies or systemic diseases, nasal septal deviation, concha hypertrophy, sinusitis, rhinitis and history of previous adenoidectomy were excluded from the study.

Evaluation included history, otolaryngological examination, otoscopic examination, and tympanometric assessment. In the history children's complaints such as nasal obstruction, snoring, mouth breathing or difficulty in breathing during sleep, or apnea, hyponasal speech were questioned. In addition, parents were questioned on suspicion of hearing loss. Endoscopic nasal examinations were done in all patients in addition to examination. Images recorded during endoscopic nasal examination were evaluated and an obstruction ratio of adenoid tissue to choanal opening was calculated using a 0 degree 2.7 or 4 mm rigid nasal endoscope (Storz, Tuttlingen, Germany) for each patient. The ratio of adenoid tissue to choanal opening was noted in percentage (%) by one of the authors.

Tympanometry was performed by an audiologist using an impedance Audiometer Az 26 (Interacoustics A/S, Assens, Denmark). The equipment used a probe tone frequency of 226 Hz and a positive and negative pressure sweep between +200 and -400 daPa. Tympanometry was performed by the same audiologist one week before adenoidectomy. Three consecutive tests were performed to obtain a reliable curve for interpretation. The tympanograms were classified according to modified Jerger's classification as types A, B, or C.[6] Myringotomy was added to patients according to preoperative otomicroscopic OME findings. All operations were performed by one of the authors. Surgeons were blinded to types of tympanogram. Intraoperative myringotomy findings were used as the diagnostic reference standard. Tympanometry was performed by the same audiologist three months after adenoidectomy.

SPSS for Windows version 19.0 (IBM SPSS Armonk, NY, USA) software program was used for calculations and statistical analysis. Chi-square analysis was done for statistical confirmation of the data.

RESULTS

The median value of negative middle ear pressure before adenoidectomy -48 -(29-130) daPa was significantly higher than after adenoidectomy -44 -(32-75) daPa (p=0.045).

There was no significant difference in type of tympanogram before and after adenoidectomy (p=0.560).

Type A tympanograms in 79 of the 112 ears, type B in 13 of the 112 ears, and type C in 20 of the 112 ears were detected preoperatively. About 17.9% (20/112) of the ears with OME were confirmed by myringotomy (Table 1).

Table 1. Myringotomy findings and relationship with type of tympanogram for diagnosis of pediatric otitis media with effusion

Myringotomy	Type A		Type B		Type C	
	n	%	n	%	n	%
Yes	0	0.0	12	60	8	40
No	79	85.9	1	1.1	12	13

n: Number of ears.

About 92% (12/13) of the ears with type B tracing tympanograms were confirmed by myringotomy. Type B tracing tympanograms correctly predicted the myringotomy results, providing a sensitivity of 92.3% and a specificity of 91.9%.

Type C tympanograms were detected in 20 of the 112 ears (13.3%). Tympanic pressure was higher than -200 daPa in seven of the 20 ears with type C tympanograms and less than -200 daPa in 13 of the 20 ears with type C tympanograms. However, two ears in which the tympanic pressure was higher than -200 daPa correctly predicted the presence of OME and six ears in which the tympanic pressure was less than -200 daPa confirmed the absence of OME by myringotomy (p=0.642) (Table 2). Type C tympanograms without acoustic stapedius reflex correctly predicted the myringotomy results in eight of the 10 ears (80%) (p=0.000) (Table 3).

DISCUSSION

Adenoid hypertrophy can partially or completely obstruct the nasal airway. The influence of adenoid hypertrophy on eustachian tubes has been extensively studied.[7] Current studies showed the mean values of middle-ear pressure were significantly higher in patients with adenoid hypertrophy.[8-10] The airflow passing through the relatively narrower lumen will cause a negative pressure which will induce tubal dysfunction in the most severe cases.[5] Alhady and Sharnoubi[8] reported that eustachian tube dysfunction is maximum in patients with obstructing adenoids, less in chronic sinusitis and least in chronic tonsillitis. Kindermann et al.[11] found obstruction of the eustachian tube orifice by adenoid tissue was associated with tympanograms suggestive of abnormal pressure in the middle ear. Our study showed that the median value of negative middle ear pressure before adenoidectomy was significantly higher than after adenoidectomy (p=0.045). Our findings are consistent with these studies.

Otitis media with effusion is described as fluid in the middle ear without signs or symptoms of ear infection. It usually gives symptoms such as hearing loss and perception of ear obstruction. On the other hand, the primary clinical problem for many children with signs and symptoms of OME are occult and easily overlooked. Otoscopy can be a commonly used tool in the diagnosis of OME. It is very difficult to examine the tympanic membrane when the ear canals are narrow.[5] Nevertheless, the tympanic membrane can be congested due to children often crying during the examination.[12] Therefore OME can easily be overlooked by otoscopy, especially in children without hearing loss complaints.[5] If untreated, OME might end up in serious consequences in the form of poor speech and intellectual development and permanent anatomical distortions within the middle ear cavity. Thereby, correct and early diagnosis and appropriate treatment of OME in children is imperative.[6]

Tympanometry provides useful quantitative information about the presence of fluid in the middle ear.[13] Usually, tympanometry is more easily performed than otoscopic examination in children.[12] Middle ear pressures in the range of

Table 2. Myringotomy findings and relationship with tympanic pressure in patients with type C tympanograms

Myringotomy	Tympanic pressure			
	<200 daPa		>200 daPa	
	n	%	n	%
Yes	7/13	53.8	2/7	28.6
No	6/13	46.2	5/7	71.4

n: Number of ears.

Table 3. Myringotomy findings and relationship acoustic stapedius reflexes in patients with type C tympanograms

Myringotomy	Acoustic stapedius reflex			
	Positive		Negative	
	n	%	n	%
Yes	0	0	8	40
No	10	50	2	10

n: Number of ears.

-100 to -400 daPa are common tympanometric findings and often alternate with type B tympanograms indicating middle ear pressures below -400 daPa and the presence of middle ear effusion.[14,15] We found 29.5% (33/112 ears) tympanogram abnormalities (type B and type C tympanogram) in children regarded as having normal hearing by their parents. We suggest that tympanometry should be performed on all patients before adenoidectomy in order to avoid missing a diagnosis of OME.

Kemaloğlu et al.[16] reported that B-type tympanogram positive predictive values were 96%. Ren and Wang[5] found that type B tympanograms correctly predicted myringotomy results, providing a sensitivity of 91.7% and a specificity of 92.2%. In our study, type B tympanograms provided a sensitivity of 92.3% and a specificity of 91.9%. Tympanometry can make a more accurate diagnosis of pediatric OME in adenoid hypertrophy children with or without parental suspicion of hearing impairment. Therefore, tympanometry should be used as a routine examination of the middle ear in children with adenoid hypertrophy.

Tympanometry results mostly correlate with eustachian tube disorders when the static elasticity values are within normal limits in type C tympanograms. The decrease in static flexibility refers to the accumulation in the middle ear fluid. Type C tympanogram especially peak pressure values less than -300 daPa can sometimes be seen in children confirmed with OME.[5,14,17] Type C tympanograms with pressures higher than -200 daPa could exclude OME.[5] In our study, seven (7/13) ears in which the tympanic pressure was less than -200 daPa with type C tympanograms correctly predicted the presence of OME.

Acoustic reflexes change depending on stapes muscle contraction with ipsilateral or contralateral acoustic stimulation in normal ears. In contrast, ipsilateral and contralateral reflexes do not occur in middle ear disease. Therefore, the investigation of acoustic reflexes in the diagnosis of OME, addition to otoscopy and tympanometry, is a useful examination. In our study, patients with type C tympanograms without acoustic stapedius reflexes correctly predicted the myringotomy results. We showed that eight of the 10 ears (80%) having type C tympanograms without acoustic stapedius reflex had OME (p=0.000). We believe that type C tympanograms without acoustic stapedius reflex may play a role in diagnosis of OME.

Adenoid hypertrophy was associated with increased negative pressure in the middle ear. We detected 17.9% OME in children without complaints of hearing loss. Therefore, it is important to perform the middle ear examination and tympanometry in children before surgery even without parental suspicion of hearing loss. If preoperative assessment of OME is not done, without informing the parents it may lead to medical controversy.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

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