Original article

Assessment of middle ear effusion and audiological characteristics in young children with adenoid hypertrophy

REN Dong-dong and WANG Wu-qing

**Keywords:** middle ear effusion; adenoidectomy; tympanometry; hearing; auditory steady-state responses; computerized tomography

**Background** Otitis media with effusion is a highly concurrent disease in young children with adenoid hypertrophy. The aim of this study was to assess the middle ear effusion and audiological characteristics in children with adenoid hypertrophy and compare the various assessment methods.

**Methods** Two hundred and seven candidates who were to undergo adenoidectomy were analyzed using otoscopy, tympanometry, air-conduction auditory steady-state responses (AC-ASSR), and computerized tomography (CT) before adenoidectomy.

**Results** About 73.4% (304/414) of ears were confirmed to have middle ear effusion (MEE) by otoscopy; 75.4% (312/414) of ears revealed MEE by CT. CT scan correctly predicted all the myringotomy results, giving 100% accuracy on the diagnosis of MEE. Additionally, CT revealed two children with inner ear malformations. Type B tracing tympanogram provided a sensitivity of 91.7% and a specificity of 92.2%. Type C tympanogram with peak pressure ≤-200 daPa indicated effusion; type C tympanogram having acoustic stapedius reflex could exclude MEE. We excluded the AC-ASSR results of the 4 ears with malformation; 54.2% (223/410) of ears were confirmed of hearing loss. Furthermore, 5.2% (16/310) of the ears with MEE suffered from severe to profound hearing loss. The average threshold level in the 0.25 kHz frequency of children was found to have poorer hearing thresholds than those in the 0.5, 1, 2, and 4 kHz (P < 0.001) frequencies; 29.7% (92/310) of ears with MEE were regarded as normal hearing level. About 55.8% (173/310) of ears with MEE were classified as having slight-mild hearing loss.

**Conclusions** The practitioners should pay much attention to the middle ear condition and be aware of a possible development of severe to profound hearing loss during the course of MEE in young children with adenoid hypertrophy. CT scan is good for the assessment of MEE before ventilation tube insertion.

**A**denoid hypertrophy is a significant cause of childhood morbidity and developmental delay. Nasopharyngeal obstruction due to adenoid hypertrophy leads to hyponasality, mouth breathing, snoring, sleep apnea, slow feeding, sinusitis, otitis media with effusion (OME), and abnormal facial development.

Enlarged adenoid may directly obstruct the pharyngeal ostia of the auditory tube, thus predisposing children to OME. The removal of large adenoids results in better effusion resolution compared to the removing of smaller adenoids, suggesting that mechanical obstruction of the Eustachian tube may be an important factor. However, recurrent or chronic infection in the adenoids without obstructive hypertrophy may also manifest as recurrent acute otitis media, persistent OME, or chronic rhinosinusitis, supporting the widely held theory of adenoids being a reservoir of pathogenic organisms leading to tubal edema and malfunction. The role of adenoids in middle ear disease is complex.

OME is a highly concurrent disease in young children with adenoid hypertrophy. However, young children are not capable of voicing their symptoms of hearing loss or the parents pay less attention of the child's hearing change; some of them with adenoid hypertrophy have OME in spite of no complaint of the hearing loss, which may be neglected if no accurate procedures for the assessment of the middle ear function are done. The etiological relationship between sensorineural hearing loss (SNHL) and OME has been reported as 9% by Mutlu et al.\(^2\) and 20% by Arnold et al.\(^2\) in children. There are numerous researches on the correlation between the OME and adenoid hypertrophy without performing computerized tomography (CT) scan and audiological characteristics prior to surgery.\(^1,8\)

The aim of this study was to analyze the clinical data of 207 candidates aged 2–7 years who were to undergo adenoidectomy and to compare the otoscopy, tympanometry, air-conduction auditory steady-state responses (AC-ASSR), and CT scan in terms of middle ear function assessment and their diagnostic efficacies for detecting OME in children, and thereby to recommend

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the assessments of middle ear functions and audiological characteristics essential in young inpatients with adenoid hypertrophy.

METHODS

Patients
This prospective study was approved by Eye, Ear, Nose and Throat (EENT) Hospital Research Ethics Board and written informed consent was obtained from the subjects. This study was performed on all the 207 cases of positively diagnosed adenoid hypertrophy for adenoidectomy at the EENT Hospital Fudan University, from October 2006 to June 2009; cases with hereditary diseases or other systemic diseases were excluded.

A total of 207 children (414 ears) were evaluated during the study period. Of them, 131 were boys and 76 girls; age range was 2–7 years (mean 5.3 years). One group (A group) consisted of 72 children who only complained of symptoms of upper airway obstruction (UAO); presence of snoring, mouth breathing or difficulty in breathing during sleep, obstructive breathing, or apnea during sleep; the other group (B group) consisted of 135 children who complained of the symptoms of UAO and there was parental suspicion of hearing impairment. The two groups underwent the same clinical examinations and analysis. Children with cranial-facial anomalies, nasal septal deviation, sinusosal infection, and history of previous adenoilecctomy were excluded from the study.

After the ear wax, if any, was carefully removed, the status of the middle ear was examined under the otoscopy, tympanometry, AC-ASSR, and CT scan in order to assess the middle ear function. Intraoperative myringotomy findings were used as the diagnostic reference standard.

Tympanometry
Tympanometer (Zodiac 901, Madsen, GN Otometrics, Denmark) was used for the tympanography. The equipment used a probe tone frequency of 226 Hz and a positive and negative pressure sweep between +200 and –400 daPa. The sweep speed was 600 daPa/s except near the tympanogram peak where it slowed to 200 daPa/s, and the compliance range was 0.1–0.6 ml.

Three consecutive tests were performed to get a reliable curve for interpretation. The tympanometric curve results were classified according to modified Jerger’s classification as types A, B, or C. The types A and C curves were interpreted as no middle ear effusion (MEE), and type B was interpreted as predictive of MEE.9

AC-ASSR
GSI Audera (GSI Company, USA) was tested for ASSR during sleep mode after oral administration of 10% chloralic hydras (0.5 ml/kg). All subjects were tested in a state of total relaxation in a comfortable, quiet, and sound-deprived room. The AC-ASSR was evoked with 0.25, 0.5, 1, 2, and 4 kHz carrier tones modulated in amplitude and frequency with a relative AM/FM phase difference of 0°. The tones were 10% frequency modulated and 100% amplitude modulated between 67 and 95 Hz (250/67, 500/74, 1000/81, 2000/88, and 4000/95 Hz). A single modulated carrier frequency was presented per trial through supra-aural earphones (TDH-39P) calibrated in hearing level (HL). Inter-electrode impedance was minimized using abrasive skin-preparation materials and was typically no more than 5 kΩ. Auditory steady-state response thresholds were established for each test frequency by increasing or decreasing the stimulus presentation level in 10-dB steps. Threshold was defined as the softest level at which a statistically significant response could be obtained.

CT scan
All CT images were obtained using a ten-detector-row helical CT scanner (Siemens, SOMATOM Sensation 10, Germany) with 6.0×0.75-mm collimation and 0.75-mm slice thickness. The scan conditions were 120 kV, 180 mA, 0.75 mm/s, 512×512 matrix, and the field of view (FOV) was 22 cm. The window width was 4000 Hounsfield units (HU) and the window level was 700 HU.

Statistical analysis
Statistical evaluation was performed by using the SPSS 13.0 program (SPSS Inc., USA). Analysis of variance (ANOVA), inter-tool agreement for the detection of OME was assessed by using Mc Nemar’s test, and the audiological characteristics were analyzed by ANOVA and multiple comparisons. A P value less than 0.05 was considered to be statistically significant.

RESULTS

Diagnostic accuracy of otoscopy
About 73.4% (304/414) of the ears with MEE were confirmed by myringotomy, including 94.8% (256/270) of ears in the B group and 33.3% (48/144) of ears in the A group (Table 1).

Otoscopy had a higher sensitivity of 92.3% and 94.8%, respectively, in groups A and B, but a lower specificity of 60.9% and 60.0%, respectively. Otoscopy had a higher positive predictive value (PPV) and accuracy in group B than in group A.

Significant differences in the diagnosis of MEE were found between otoscopy and myringotomy in the B group.

<table>
<thead>
<tr>
<th>Table 1. Diagnostic accuracy of otoscopy in two groups (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myringotomy</td>
</tr>
<tr>
<td>(+)+</td>
</tr>
<tr>
<td>(+)</td>
</tr>
<tr>
<td>(−)+</td>
</tr>
<tr>
<td>(−)</td>
</tr>
</tbody>
</table>

(+)+ indicates otoscopy findings compatible to OME and (+) indicates findings that are not compatible to OME. (+)+ and (−) indicate the presence and absence respectively of the effusion in the middle ear cavity.
Table 2. Efficacy comparison between CT scan and the type of tympanogram for diagnosis of pediatric OME relative to myringotomy (n).

<table>
<thead>
<tr>
<th>Myringotomy</th>
<th>Tympanogram in A group (144 ears)</th>
<th>Tympanogram in B group (270 ears)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type B</td>
<td>Type C</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>5</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>27</td>
</tr>
</tbody>
</table>

Table 3. Diagnostic accuracy of CT scan and tympanometry (n).

<table>
<thead>
<tr>
<th>Myringotomy</th>
<th>Ears</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(+)</td>
</tr>
<tr>
<td></td>
<td>312</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

(+) indicates CT findings compatible to OME and (-) indicates findings that are not compatible to OME. (+) indicates type B and (-) indicates type A or C. (+) and (-) indicate the presence and absence respectively of the effusion in the middle ear cavity.

(P <0.0001). No significant differences in the diagnosis of MEE were found between otoscopy and myringotomy in group A (P=0.120).

Diagnostic accuracy of CT scan
About 75.4% (312/414) of the ears revealed MEE by CT scan and confirmed by myringotomy, including 96.3% (260/270) of ears in group B and 36.1% (52/144) of ears in group A (Table 2). CT scan was successful for 100% (312/312) of the ears. Diagnostic accuracy of CT scan and tympanometry are shown in Table 3.

CT scan correctly predicted all the myringotomy results, giving an accuracy of 100%, a sensitivity of 100%, and a specificity of 100%. Furthermore, CT scan revealed two children with inner ear malformations which included one child with large vestibular aqueduct syndrome and cochlear malformation and the other child with large vestibular aqueduct syndrome in both ears.

No significant differences in the diagnosis of MEE were found between CT scan and myringotomy (P=1.000). Significant differences in the diagnosis of MEE were found between type B tympanometry and myringotomy (P=0.003).

Diagnostic accuracy of type B tympanogram
About 69.1% (286/414) of the ears revealed MEE and were confirmed by myringotomy, including 89.3% (241/270) of ears in group B and 31.3% (45/144) of ears in group A. In 286 of the 294 ears (97.3%), type B tracing tympanogram correctly predicted the myringotomy results, providing a sensitivity of 91.7% and a specificity of 92.2%.

Furthermore, the overall diagnostic accuracy of type B tympanogram for predicting MEE was 100% in group B and gave a sensitivity of 100%, which was higher than the A group whose parents were not suspicious of hearing loss (Table 4).

Significant differences in the diagnosis of MEE were found between type B tympanometry and myringotomy in the two groups (P <0.05).

Diagnostic accuracy of type C tympanogram and acoustic stapedius reflex
Type C tracing tympanogram was detected in 55 of the 414 ears (13.3%); however, 24 ears in which the tympanic pressure was from −320 to −50 daPa correctly predicted the presence of MEE and 31 ears in which the tympanic pressure was from −200 to −70 daPa confirmed the absence of MEE (Table 5). If the tympanic pressure was <−200 daPa in type C tympanogram, with a specificity of 100% and 100% positive predictive value, it indicated that the presence of effusion was in the middle ear cavity. Type C tracing tympanogram having acoustic stapedius reflex could exclude MEE, giving a sensitivity of 100%. No significant differences in the diagnosis of MEE were found between type C tympanometry (tympanic pressure <−200 daPa) and myringotomy (P=0.130).

Audiological characteristics of the young children with adenoid hypertrophy detected by AC-ASSR
All the children (414 ears) underwent AC-ASSR examination; the average threshold reaction of five frequencies (0.25, 0.5, 1, 2, and 4 kHz) with AC-ASSR >30 dBnHL was deemed to hearing loss according to our previous study.10 Because CT scan revealed two children (four ears) with inner ear malformation, the four ears were confirmed to have severe hearing loss (average threshold of AC-ASSR >90 dBnHL). We excluded the ASSR results of the four ears in our statistics analysis. Two hundred and twenty-three ears (54.4%, 223/410) were confirmed of hearing loss, including 33 ears (22.9%, 33/144) in the A group and 190 ears (71.4%, 190/266) in the B group. It was indicated that the children whose parents were suspicious of hearing impairment with the average AC-ASSR threshold level >30 dBnHL were probably diagnosed with OME, giving a high PPV of 99.5% (189/190).

Table 4. Diagnostic accuracy of type B tympanometry in two groups (n).

<table>
<thead>
<tr>
<th>Myringotomy</th>
<th>A group (144 ears)</th>
<th>B group (270 ears)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(+)</td>
<td>(-)</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>84</td>
</tr>
</tbody>
</table>

(+)^ indicates type B tympanogram findings compatible to OME and (-) indicates findings that are not compatible to OME. (+) and (-) indicate the presence and absence respectively of the effusion in the middle ear cavity.

Table 5. Middle ear effusion and the relationship between the tympanic pressure and acoustic stapedius reflex in type C tympanogram (n).

<table>
<thead>
<tr>
<th>Myringotomy</th>
<th>Tympanic pressure</th>
<th>Acoustic stapedius reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(+)</td>
<td>(-)</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>31</td>
</tr>
</tbody>
</table>

(+)^ indicates tympanic pressure <−200 daPa compatible to OME and (-) indicates tympanic pressure ≥−200 daPa not compatible to OME. (+)^ indicates acoustic stapedius reflex can be elicited and (-) indicates acoustic stapedius reflex can be elicited. (+) and (-) indicate the presence and absence respectively of the effusion in the middle ear cavity.
Table 6. Number of ears in the classification of average AC-ASSR hearing threshold levels with the ears of the children with or without middle ear effusion (MEE) (n)

<table>
<thead>
<tr>
<th>Average AC-ASSR threshold level at 250-4000 Hz (dBnHL)</th>
<th>Children with MEE</th>
<th>Children without MEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30 (normal range)</td>
<td>92</td>
<td>95</td>
</tr>
<tr>
<td>31-50 (mild-moderate hearing loss)</td>
<td>173</td>
<td>5</td>
</tr>
<tr>
<td>51-70 (mild-moderate hearing loss)</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>71-90 (moderate-severe hearing loss)</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>91+ (profound hearing loss)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 7. The mean thresholds of two groups AC-ASSR

<table>
<thead>
<tr>
<th>Groups</th>
<th>0.25 kHz</th>
<th>0.5 kHz</th>
<th>1 kHz</th>
<th>2 kHz</th>
<th>4 kHz</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>25±5.16</td>
<td>18±2.7</td>
<td>17±5.6</td>
<td>17±5.6</td>
<td>17±5.5</td>
<td>100</td>
</tr>
<tr>
<td>B</td>
<td>42±15</td>
<td>39±15</td>
<td>38±15</td>
<td>37±14</td>
<td>37±14</td>
<td>310</td>
</tr>
</tbody>
</table>

SD: standard deviation; n: number of thresholds; A: children without MEE; B: children with MEE.

Furthermore, the audiologial characteristics of the adenoid hypertrophy children with or without MEE are displayed in Table 6. About 29.7% (92/310) of the ears with MEE were regarded as normal hearing level; 55.8% (173/310) of ears with MEE were classified as having slight-mild hearing loss; and 5.2% (16/310) of ears with MEE suffered from severe to profound hearing loss.

The average AC-ASSR threshold level in children with and without MEE is shown in Table 7. The average threshold level in the 0.25 kHz frequency of the two groups was found to have poorer hearing thresholds than those in the 0.5, 1, 2, and 4 kHz (P<0.001) frequencies. We identified that there are significant differences in the hearing levels between the children with and without MEE in all the five frequencies (P<0.001).

DISCUSSION

Adenoid hypertrophy can partially or completely obstruct the nasal airway. The airflow passing through the relatively narrower lumen will cause a negative pressure which will induce tubal dysfunction in the most severe cases, and this can only be eliminated by means of adenoidectomy.11,12,13 However, the main clinical problem for some children with symptoms of OME is occult and is easily neglected by the parents, in terms of the poor expression and communication skills of the children. If the ear canals are narrow, it is very difficult to examine the tympanic membrane, then OME can easily be neglected. Wang et al.14 identified 63 cases (77.8%) with OME by CT scan of 81 cases of severe adenoid hypertrophy; the adenoidal size does correlate with otitis media effusion to some degree. This was close to our results (87.9%). Even though some children were regarded as normal hearing by their parents, we found 22.9% (33/144 ears) hearing loss, 31.3% (45/144 ears) tympanogram abnormalities, 36.1% (52/144 ears) CT abnormal in them, indicating that we should pay much attention to check whether there are middle ear abnormalities in children with adenoid hypertrophy.

OME is defined as fluid in the middle ear without signs or symptoms of ear infection. Appropriate treatment in pediatric OME cases is dependent on correct diagnosis. Generally speaking, there exist four problems that may interfere with the examination of pediatric middle ear conditions: (1) poor cooperation of children, (2) cerumen impaction, (3) narrowness of the external ear canal, and (4) atelectasis of the eardrum.

Otoscropy is a frequently used tool in the diagnosis of OME; however, this examination easily causes fear in children thus causing them to cry which in turn will cause tympanic membrane congestion resulting in the possible miscarriage of justice. In our study, 73.4% ears with MEE were diagnosed by otoscopy and then confirmed by myringotomy. Otoscopy had a higher sensitivity but a lower specificity, that is, some children with parental suspicion of hearing loss detected with abnormal tympanic membrane through otoscopy examination probably were diagnosed with MEE. But for the children with normal tympanic membrane were too apt to miss diagnosis of OME.

CT scan could be identified as the gold standard for OME diagnosis, although the accuracy is the same as myringotomy, considering its radiation damage to the young children, it is rarely employed by primary care physicians. In our research, MEE predicted by CT scan were all confirmed in the ear surgery. As noted above, routine operation of myringotomy is impractical in clinical practice. When otoscopic findings, tympanograms of suspected ears, and hearing levels are poorly correlated, CT scan can be helpful to confirm OME. Furthermore, for a minority of children of OME with severe hearing loss may be diagnosed with inner ear malformations; CT scan before surgery can not only detect the MEE but can also evaluate the structure of the inner ear, thus reducing potential medical disputes.

For young children, tympanometry is more easily performed than otoscopic examination,15 therefore, tympanometry should be used as a routine examination in children with adenoidal hypertrophy in the middle ear. Tympanometry provides useful quantitative information about the presence of fluid in the middle ear, mobility of the middle ear system, and ear canal volume. It uses have been recommended in conjunction with more qualitative information (e.g., history, appearance, and mobility of the tympanic membrane) in the evaluation of OME and to a lesser extent in acute otitis media. Tympanogram tracings are classified as type A (normal), type B (flat, clearly abnormal), and type C (indicating a significantly negative pressure in the middle ear, possibly indicative of pathology). According to the Agency for Healthcare Research and Quality guidelines on OME, the positive predictive value of an abnormal (flat, type B) tympanogram is between 49 and 99%.16 Because the ear canals of the young children are highly compliant, B-type tympanogram is not reliable in very young children. Kemaloglu et al.17 and Pan et al.17 reported that B-type tympanogram positive predictive values were 96% and
92.57%, lower than our results (97.3%), because we had selected the study children with adenoid hypertrophy. In our study, type B tracing tympanogram correctly predicted in 97.3% ears, providing a sensitivity of 91.7% and a specificity of 92.2%. The overall diagnostic accuracy of type B tympanogram for predicting MEE was 100% in the group with parental suspicion of hearing loss and giving a sensitivity of 100%, which was higher than the group whose parents were not suspicious of hearing loss. That is, type B tympanogram is the best diagnostic tool for predicting OME in the children with parental suspicion of hearing loss.

Type A or C tympanogram sometimes could be seen in the group of children confirmed with OME, especially peak pressure value is less than −300 daPa.18,19 In our study, when the tympanic pressure was <−200 daPa in type C tympanogram, we could predict the middle ear with effusion and had not misdiagnosed. In addition, type C tracing tympanogram with acoustic stapedius reflex could exclude MEE. But type C tracing tympanogram without acoustic stapedius reflex may have MEE. In this circumstance, other assessment methods were needed to confirm the MEE. We believe that the elicited acoustic stapedius reflex with type C tracing tympanogram plays a valuable role in the diagnosis of OME.

OME may have an important clinical impact on the hearing level and capacity. This disorder can cause a range of hearing changes at various levels, from very mild hearing impairment to distinct hearing loss, reversible or irreversible. Hearing can principally be influenced by two basic mechanisms, sensorineural and mechanical.25 This hearing loss is usually conductive, resulting from tympanic membrane rupture and/or changes in the ossicular chain due to fixation or erosion caused by the chronic inflammatory process. When cholesteatoma or granulation tissue is present in the middle ear cleft, the degree of ossicular destruction is even greater. An issue that has recently gained attention is the additional sensorineural hearing loss due to OME.

Many researches reported that the bone conduction threshold was elevated in children with OME, suggesting that it is not unusual that chronic OME leads to sensorineural hearing loss.20,21 Indeed, we found difficulties in making direct comparisons among published results because there were great variations in the study designs, hearing test methods, criteria in calculating the mean or median audiometric thresholds, and criteria to define hearing loss. Pure tone audiometry (PTA) is the gold standard for the evaluation of hearing level. However, it is not possible to obtain reliable thresholds in all patients. Small children, patients with developmental/neurological delay, patients requiring medical legal auditory evaluation, etc., are the examples of patients in whom it is difficult to test with PTA.22 ASSR to single continuous tones modulated in amplitude has been proposed as an alternative to objective frequency-specific audiometry.23 The ASSR has also rendered accurate estimation of frequency-specific AC thresholds for varying degrees of hearing loss and has the added advantage of objective response detection by statistical tests.24

Because the studied children are of a very young age (≤7 years), they are too young to cooperate for PTA examination. Therefore, we use AC-ASSR to illustrate the hearing level in all the children. Reports have demonstrated significant correlations between ASSR, PTA, and auditory brainstem response (ABR) thresholds across various age groups including adults and children.25-24 Despite good correlations, there are significant differences between studies reporting ranges of ASSR and PTA threshold difference from 4 to 34 dB.24,35 In our previous study of AC-ASSR, we demonstrated the significant correlations between AC-ASSR and PTA thresholds across various hearing impairment groups; the average range of AC-ASSR and PTA threshold difference was 5–10 dB.11 This variability can be explained to a large extent by the following facts: the type of ASSR machine, the operation level, the settings of the testing parameters, and the physiological status of the examined subjects.

Because CT revealed two children (four ears) with inner ear malformation, also confirmed with severe hearing loss, we excluded the ASSR results of the four ears in our hearing level statistics analysis. Two hundred and twenty-three ears (54.4%) were confirmed of hearing loss, including 33 ears (22.9%, 33/144) in the children with parental perception of no hearing impairment and 190 ears (71.4%, 190/266) in the children with parental suspicion of hearing impairment. It was indicated that the children whose parents were suspicious of hearing impairment with the average AC-ASSR threshold level >30 dBnHL were probably diagnosed with OME, giving a high PPV of 99.5%. The average AC-ASSR threshold level in the children without MEE was very similar to that in normal children.11 The average AC-ASSR threshold level in the children with MEE was significantly different from that of the children without MEE (P <0.001). The average threshold levels in the 0.25 kHz frequency of the two groups were found to have poorer hearing thresholds than those in the 0.5, 1, 2, and 4 kHz (P <0.001) frequencies. This leads to elevated ASSR thresholds for 0.25 kHz with a higher degree of variability, which is in agreement with previous reports that have indicated higher amplitude ASSR for higher frequencies compared to 0.25 kHz.24,36,27

The children with parental suspicion of hearing loss, 5.2% (16/310) ears with MEE suffered from severe to profound hearing loss, which may be related to sensorineural hearing loss and will not completely recover even after tube insertion. If the preoperative assessment of the hearing level is not done, without informing the parents and their families of the preoperative hearing status and the expected recovery hearing level, it may lead to unnecessary medical
controversy. Some family members may mistakenly think that the sensorineural hearing loss is caused by medical procedures. Therefore, if the tube insertion can be done at the same time as adenoectomy surgery, it is bound to complete audiological assessments before surgery.

Practitioners should pay much attention to the middle ear condition and be aware of a possible development of severe to profound hearing loss during the course of MEE in adenoid hypertrophy in young children. It is important to perform the middle ear examination and audiological assessments for adenoid hypertrophy before surgery. The otoscopy and tympanometry can make a more accurate diagnosis of pediatric OME in the adenoid hypertrophy children with parental suspicion of hearing impairment. CT scan has the potential to become the diagnostic procedure when otoscopic findings, tympanograms of suspected ears, and hearing loss levels are poorly correlated before the ventilation tube insertion.

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