How Accurate Is Parent Rating of Hearing for Children With Otitis Media?

Richard M. Rosenfeld, MD, MPH; Ari J. Goldsmith, MD; Jane R. Madell, PhD

Objective: To determine the accuracy of parent assessment of child hearing.

Design: Prospective study.

Setting: Hospital-based pediatric otolaryngology practice in a metropolitan area.

Patients: One hundred eighty-six children aged 6 months to 12 years (median age, 3.4 years) with chronic otitis media with effusion or recurrent acute otitis media enrolled in a quality-of-life study.

Intervention: Parents rated their child’s hearing over the prior 4 weeks using a 7-point response scale. Otoscopic findings, static admittance, tympanometric width, and audiometric thresholds were recorded concurrently. Fifty children were reassessed to monitor changes in hearing.

Main Outcome Measure: Correlation of parent hearing assessments with baseline hearing status (pure tone average for the better hearing ear) and with changes in hearing status.

Results: The hearing loss questions had good test-retest reliability (R = 0.79) but did not correlate with audiometric results (R = −0.13; P = .09). Only when caregivers reported hearing to be an “extreme problem” were median hearing levels (31 dB) significantly greater than the median response (20 dB). Conversely, static admittance and tympanometric gradient were significant predictors of hearing levels (2-way analysis of variance, P < .01) and explained 44% of the ear-specific variations. Abnormal immittance measures in both ears had an 84% predictive value for hearing loss (20-dB hearing level or poorer), and normal immittance measures in both ears had a 76% predictive value for normal hearing. Caregiver assessments of change in hearing status did not correlate with changes in audiometric results (R = 0.07; P = .65).

Conclusions: Caregiver assessments of child hearing do not accurately predict hearing levels or changes in hearing status. Immittance measures can help identify children at low or high risk for hearing loss, but cannot substitute for audiometry.

PATIENTS AND METHODS

The study was conducted at a hospital-based pediatric otolaryngology practice in Brooklyn, NY, between December 1995 and March 1996. Specific inclusion criteria were (1) age, 6 months to 12 years; (2) chronic otitis media (MEE in 1 or both ears for 3 months or longer) or recurrent otitis media (3 or more acute otitis media episodes in the past 12 months); (3) child accompanied by parent or primary caregiver; and (4) child able to complete age-appropriate audiometry with good reliability. Specific exclusion criteria were (1) tympanic membrane perforation, (2) tympanostomy tube(s) at study entry, (3) middle ear disease other than otitis media (eg, cholesteatoma), (4) known or suspected developmental delay or neurologic disorder, and (4) parent unable to read and understand English.

As part of a quality-of-life study, each child's parent completed a 6-item survey with a question concerning perceived hearing status. Parents were asked to provide a global assessment of how much of a problem their child had over the past 4 weeks with the following symptoms: difficulty hearing, questions must be repeated, frequently says "what," or television is excessively loud. Responses were graded with an ordinal scale consisting of: (1) no problem, (2) hardly a problem at all, (3) somewhat of a problem, (4) moderate problem, (5) quite a bit of a problem, (6) very much of a problem, and (7) extreme problem. Seven-point scales are ideal for survey responses because they possess adequate discriminative and evaluative properties. The child's caregiver completed the survey before and after a specific intervention, with a minimum interval of 4 weeks.

Audiometric testing was performed by a licensed pediatric audiologist in a soundproof booth equipped for evaluation of infants and young children. Two-channel audiometers (Grason Stadler 16, Grason Stadler Inc, Milford, NH) were used for all testing. Air conduction testing was performed using long- or short-pulse alternating microphone techniques (Grason Stadler 33). Single-frequency (226-Hz) tympanometric measurements of static admittance (measured in millimhos [mil]lisiemens) and gradient (measured in decapascals) were recorded for each ear.

Middle ear status was assessed using a validated 4-point clinical profile (Table 1). The profile measures the severity of underlying middle ear disease, and does not rely on qualitative classifications of tympanogram configurations. The profile for a given ear was based on otoscopic findings, static admittance, and tympanometric width (gradient). The otoscopic findings were classified as normal if the tympanic membrane was gray, translucent, without fibrosis, and in a neutral position; all other combinations were classified as abnormal. The static admittance was classified as normal if it measured 0.2 millimho (0.2 millisiemens) or greater, and the gradient was normal if it measured 150 daPa or less. An ear with normal otoscopic findings, normal static admittance, and normal gradient was classified as profile level 1; an ear in which all 3 were abnormal was profile level 4 (89% sensitivity and 78% specificity for MEE). Profile levels 2 and 3 indicate intermediate disease as defined in Table 1.

Data entry was performed using a microcomputer database and verified for 100% accuracy. All statistical analyses were performed using True Epistat software. Spearman rank correlation with an alpha level of .05 was used for all pairwise comparisons. Kruskal-Wallis analysis of variance was used to compare multiple groups, with Neuman-Keuls adjustments for multiple comparisons.

RESULTS

One hundred eighty-six consecutive patients meeting eligibility criteria were enrolled in the study. The median age was 3.4 years (range, 6 months to 12 years), with a 62% male predominance. Chronic otitis media was present in 74% of the patients; recurrent otitis media was present in 46% of the patients; and both were present in 20% of the patients. The patient population was referral based from pediatricians and family practitioners, with 76% of the patients enrolled in managed care plans, including Medicaid (public assistance) managed care.

The median PTA for the better-hearing ear was 20-dB HL (range, 2- to 52-dB HL), with lower and upper quartiles of 15- and 27-dB HL, respectively. Fifty-nine percent of the children had a significant hearing loss (20-dB HL or poorer for the better ear), as defined by the Agency for Health Care Policy and Research. Hearing status did not correlate with the parent’s perception of child hearing (R = -0.13; P = .09). Only when parents reported hearing to be an extreme problem was a trend observed toward poorer pure tone HLs (Table 2). The mean response for the hearing loss question was 2.8 (range, 1-7), with good test-retest reliability for a subset of 60 subjects (R = 0.79; P<.001).

Ear-specific pure tone hearing thresholds were obtained for 83 children (166 ears). The median response was 18-dB HL (range, 2- to 53-dB HL), with lower and upper quartiles of 12- and 28-dB HL, respectively. Ear-specific HLs showed good correlation with middle ear profile level (Table 3), which accounted for 44% of the variance in hearing thresholds. Static admittance and tympanometric gradient were independent predictors of hearing threshold (2-way analysis of variance, P<.01), without significant interaction between the terms. Ears with normal admittance and gradient had a median PTA of 10-dB HL (n = 42), ears with an abnormal admittance or gradient had a median PTA of 13-dB HL (n = 28), and ears with an abnormal admittance and gradient had a median PTA of 25-dB HL (n = 96).

When static admittance and tympanometric gradient were abnormal for both ears (middle ear profile level 4), the sensitivity, specificity, and predictive value for ab-
sensitivity, specificity, and predictive value for normal hearing were 66%, 82%, and 84% (Table 4). When static admittance and tympanometric gradient were normal for both ears (middle ear profile level 1), the sensitivity, specificity, and predictive value for normal hearing were 17%, 96%, and 76% (Table 5). The 4 children with normal immittance test results but abnormal hearing had thresholds of 20-, 20-, 20-, and 23-dB HL. Consequently, normal immittance test results had a 100% predictive value for hearing thresholds that were less than 25-dB HL.

Dynamic hearing and its relation to parent perception were measured for a group of 50 children before and after treatment of their otitis media (37 had tympanostomy tubes). The median change in PTA for the better-hearing ear was 11-dB HL (range, −23- to 35-dB HL), and the median change in parent response to the hearing loss question was 2 units (range, 0-6 units). There was no significant correlation between change in parent perception of hearing and change in audiometric results (R = 0.07; P = .59). HL indicates hearing level; PTA, pure tone average.

Table 2. Parent Ratings of Child Hearing vs Actual Hearing Thresholds

<table>
<thead>
<tr>
<th>Parent Estimate of Child Hearing Loss During the Past 4 wk</th>
<th>Actual PTA Better Ear, dB HL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not present/no problem</td>
<td>61 (33)</td>
</tr>
<tr>
<td>Hardly a problem at all</td>
<td>33 (18)</td>
</tr>
<tr>
<td>Somewhat of a problem</td>
<td>32 (17)</td>
</tr>
<tr>
<td>Moderate problem</td>
<td>26 (14)</td>
</tr>
<tr>
<td>Quite a bit of a problem</td>
<td>13 (7)</td>
</tr>
<tr>
<td>Very much of a problem</td>
<td>15 (8)</td>
</tr>
<tr>
<td>Extreme problem</td>
<td>6 (3)</td>
</tr>
</tbody>
</table>

*Spearman rank correlation, R = −0.13; P = .09. HL indicates hearing level; PTA, pure tone average.

Table 3. Middle Ear Profile Level vs Ear-Specific Hearing Thresholds

<table>
<thead>
<tr>
<th>Middle Ear Profile Level</th>
<th>Ear-Specific PTA, dB HL</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (%)</td>
<td>Median</td>
</tr>
<tr>
<td>Level 4 both ears†</td>
<td>14 (16)</td>
</tr>
<tr>
<td>All others</td>
<td>62 (63)</td>
</tr>
</tbody>
</table>

*Kruskal-Wallis analysis of variance, P < .001; levels 1 and 2 equivalent on multiple comparisons. HL indicates hearing level; PTA, pure tone average.

Table 4. Relationship Between Abnormal Immittance Measures and Abnormal Hearing

<table>
<thead>
<tr>
<th>Middle Ear Profile Level</th>
<th>Abnormal Hearing, No. (%)</th>
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<td>No. (%)</td>
<td>Median</td>
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</tr>
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</tr>
</tbody>
</table>

†Otoscopic findings, static admittance, and tympanometric gradient are abnormal.

Table 5. Relationship Between Normal Immittance Measures and Normal Hearing

<table>
<thead>
<tr>
<th>Middle Ear Profile Level</th>
<th>Normal Hearing, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (%)</td>
<td>Median</td>
</tr>
<tr>
<td>Level 1 both ears†</td>
<td>4 (24)</td>
</tr>
<tr>
<td>All others</td>
<td>106 (63)</td>
</tr>
</tbody>
</table>

*Normal hearing is defined as a pure tone average of less than 20-dB hearing level for the better-hearing ear.
†Otoscopic findings, static admittance, and tympanometric gradient are normal.

Parent perceptions of hearing for children with otitis media are reliable, but inaccurate. Although global hearing estimates are stable and repeatable (good test-retest reliability), they do not correlate with the child’s actual pure tone hearing thresholds. Further, parent assessments of change in their child’s hearing status are unrelated to actual changes in hearing thresholds. Consequently, health care providers cannot rely on parental perception as a screening tool to determine which children with otitis media are at risk for hearing loss.

We agree with the Agency for Health Care Policy and Research hearing evaluation for children with bilateral otitis media with effusion lasting 3 months or longer. Unfortunately, otitis media with effusion is difficult to diagnose and pneumatic otoscopy (as recommended by the Agency for Health Care Policy and Research) is not uniformly practiced. Immittance tests are a partial solution to this problem because they are easy to perform and readily available. Abnormal static admittance and tympanometric gradient (middle ear profile level 4) have a 94% predictive value for otitis media with effusion. For the 87 children in our study with abnormal immittance test results in both ears (Table 4), the prevalence of hearing loss (20-dB HL or poorer for the better ear) was 84%. In contrast, 100% of children with normal admittance findings in both ears had hearing thresholds that were less than 25-dB HL, and 74% had thresholds that were less than 20-dB HL.
Our study used a single question to assess hearing status to simulate current practice patterns. Parents were presented with a list of symptoms or behaviors associated with hearing loss (eg, difficulty hearing, questions must be repeated, frequently says “what,” or television is excessively loud) and were asked to rate how much of a problem they were for their child. Global questions are a valid means of assessing general and disease-specific quality of life,1,16 but have unknown validity for assessing hearing loss. Although our question was a reliable measure of parental perception (test-retest reliability, $R = 0.79$), the perceptions proved to be inaccurate. Such perceptions are an important part of disease-specific quality of life, but are not useful for determining true hearing status.

Several recent studies have shown no relationship between parent perception of hearing and actual HLs for children with otitis media.7,8 Parent perceptions are based on child behavior, and behavior is influenced by many factors other than hearing. A skilled audiologist can use child behavior to assess HLs, but only in a highly structured environment that includes precise instrumentation and a soundproof booth to eliminate distractions. Furthermore, most children with otitis media have only slight hearing impairment (median, 20-dB HL for the better ear in this series), making parent detection even more difficult.

When chronic bilateral otitis media with effusion is associated with more pronounced hearing impairment, parent assessments may be more accurate. As part of a trial of alternative regimens for glue ear, Haggard and Smith9 surveyed parents regarding their child’s hearing. The 7-item scale of reported hearing difficulties included: turning up television volume, not responding, mishearing, turning the wrong way to sound, difficulty hearing face to face, difficulty hearing in a group, and asking for things to be repeated. Significant static and dynamic correlations were observed between audiometric and reported-hearing-difficulty results ($R = 0.46$). Because all children studied had documented hearing loss (better PTA, $\geq 20$-dB HL), it remains unknown whether the reported-hearing-difficulty scale can discriminate among children with and without hearing loss.

Our study highlights the limited utility of asking parents to judge how their child’s hearing is affected by otitis media. Although parent reports of suspected hearing loss must be taken seriously, they do not correlate with pure tone audiologic results. Only when parents reported an extreme problem with child hearing was a trend observed toward poorer audiometric thresholds. Conversely, assurance by parents that their child’s hearing is normal cannot rule out a significant hearing problem. Impedance measures can help identify children at high or low risk for hearing loss, but cannot substitute for assessment by a licensed audiologist. Audiometry remains the “gold standard” for assessing the impact of otitis media on child hearing.

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Corresponding author: Richard M. Rosenfeld, MD, MPH, Department of Otolaryngology, Long Island College Hospital, 339 Hicks St, Brooklyn, NY 11201.

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