Aerobic and Anaerobic Bacteriology of Concurrent Chronic Otitis Media With Effusion and Chronic Sinusitis in Children

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Objective: To correlate the aerobic and anaerobic microbiologic findings of concurrent chronic otitis media with effusion and chronic maxillary sinusitis.

Methods: Cultures were obtained from 32 children with concurrent chronic otitis media with effusion and maxillary sinusitis who underwent tympanostomy tube placement.

Results: A total of 42 isolates, 24 aerobic and 18 anaerobic, were recovered from 30 patients; 27 were isolated from both sites, 4 from the ear only, and 11 from the sinus only. The most common isolates were *Haemophilus influenzae* (9 isolates), *Streptococcus pneumoniae* (n = 7), *Prevotella* species (n = 8), and *Peptostreptococcus* species (n = 6). Microbiological concordance between the ear and sinus was found in 22 (69%) of culture-positive patients.

Conclusion: The concordance in recovery of organisms in more than two thirds of the patients illustrates the common bacterial etiology between chronic otitis media with effusion and chronic sinusitis in children.


A CLEAR association is known to exist between the occurrence of otitis media and sinusitis. The literature cites 43% to 47% of children with otitis media with effusion (OME) to have concurrent maxillary sinusitis and that OME was the presenting symptom of chronic sinusitis in 23% of patients. In studies of refractory OME, paranasal sinusitis was documented in 49% of adolescents and in 78% of children, and abnormal radiographs were found in 28% of children with OME.

Even though numerous studies documented the association between OME and sinusitis, no bacteriological studies attempted to correlate the concurrent microbial findings at both sites. This study reports the aerobic and anaerobic microbiologic findings of 32 chronic OME (COME) aspirates and their corresponding chronic maxillary sinus aspirates.

RESULTS

Fifty middle ear aspirates were obtained from the 32 patients. Bilateral aspiration of ears was done in 18 patients. Forty-two sinus aspirates were done in the 32 patients. In 22 patients only 1 maxillary sinus was aspirated and in 10 both maxillary sinuses were aspirated. If an organism was recovered from both ears or sinuses, it was only counted as one isolate.

No bacterial growth in both middle ear effusion and sinus aspirates was observed in 2 patients (Table). In total, 42 isolates, 24 aerobic and 18 anaerobic, were recovered. Twenty-seven isolates were cultured from both middle ear effusion and sinus aspirates, 4 from middle ear effusion only, and 11 from sinus aspirates only (Table). A total of 31 isolates, 18 aerobic and 13 anaerobic, were recovered from middle ear effusions, and a total of 38 isolates, 22 aerobic and 16 anaerobic, were found in sinus aspirates.

Aerobic bacteria only were recovered from middle ear effusion or sinus aspirates of 14 (47%) of 30 culture-positive patients, an anaerobic isolate only in 5 (17%), and mixed aerobic-anaerobic phlegm in 11 (37%). The most common aerobic isolates were *Haemophilus influenzae* (9 isolates), *Streptococcus pneumoniae* (n = 7), and *Staphylococcus aureus* (n = 5); the most frequent anaerobic isolates were *Prevotella* species (n = 8), *Peptostreptococcus* species (n = 6), and *Fusobacterium nucleatum* (n = 3).
PATIENTS AND METHODS

Thirty-two consecutively treated children who had a combination of chronic maxillary sinusitis and bilaterial or unilaterial COME were included in the study. Nineteen were boys, and patients’ ages ranged from 4 to 11 years (median age, 6.3 years), and none had a known underlying immunoological disorder, midfacial anomalies, cholesteatoma, or chronic medical conditions.

The diagnostic criteria applied for chronic sinusitis were the presence of purulent rhinosinusitis for at least 3 months’ duration and radiological abnormalities of the maxillary sinus in the form of total opacity or mucosal swelling. Otoscopy and tympanometry were used as diagnostic parameters for COME that also lasted at least 3 months. All tympanic membranes were evaluated microscopically and with use of the pneumatic otoscope. All patients had received at least 1 course of antimicrobial therapy within the past 3 months; however, none received antimicrobials 2 weeks prior to sample collection.

All children underwent installation of tympanostomy tubes, under general anesthesia as previously described. This was accompanied by aspiration of the involved maxillary sinus(es) through inferior mental antrostomy. Disinfection of the ear canal and nasal mucosa was done as previously described. Microbial isolates were recorded only one time if they were isolated from 2 ear or 2 sinus aspirates in the same patient.

The middle ear effusion was aspirated through sterile polyethylene tubing attached to a disposable middle ear fluid collector. Following aspiration of middle ear effusion or sinus fluid, the excess air was evacuated from the collecting cup by filling the cup with pre-reduced thioglycolate broth. It was sealed and delivered to the microbiology laboratory, where the specimens were plated on media supportive for aerobic and anaerobic bacteria, within 5 to 10 minutes of collection.

Sheep blood (5%), chocolate, and MacConkey agar plates were inoculated for the isolation of aerobic and anaerobic organisms. The plates were incubated at 35°C and examined at 24 and 48 hours. For the isolation of anaerobic bacteria, the specimens were plated to a pre-reduced vitamin K1–enriched Brucella blood agar, an anaerobic blood agar plate containing kanamycin and vancomycin, and an anaerobic blood plate containing phenethyl alcohol, and placed into an enriched thioglycolate broth. All media were incubated in anaerobic jars and examined at 48 and 96 hours. The thioglycolate broth was incubated for 14 days. Identification of aerobic and anaerobic bacteria was accomplished by methods described previously. β-Lactamase production was determined by using the chromogenic cephalosporin 87/312 methodology.

Concordance in the microbiologic findings between the middle ear effusion and sinus aspirate isolates was found in recovery of 27 isolates (16 aerobic and 11 anaerobic) (Table), recovered from 22 patients (69%).

### Isolates From 32 Middle Ear Effusion (MEE) and Sinus Aspirates (SA)*

<table>
<thead>
<tr>
<th></th>
<th>Total No. of Isolates</th>
<th>Present Only in MEE</th>
<th>Present Only in SA</th>
<th>Present in Both MEE and SA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic bacteria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>9 (4)</td>
<td>3 (1)</td>
<td>6 (3)</td>
<td></td>
</tr>
<tr>
<td>Moraxella catarrhalis</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>5 (5)</td>
<td>2 (2)</td>
<td>3 (3)</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>24 (9)</td>
<td>2</td>
<td>6 (3)</td>
<td>16 (6)</td>
</tr>
<tr>
<td><strong>Anaerobic bacteria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peptostreptococcus species</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Prevotella melaninigenica</td>
<td>5 (2)</td>
<td>1 (1)</td>
<td>3 (1)</td>
<td></td>
</tr>
<tr>
<td>Prevotella intermedium</td>
<td>3 (1)</td>
<td>1</td>
<td>2 (1)</td>
<td></td>
</tr>
<tr>
<td>Fusobacterium nucleatum</td>
<td>3 (1)</td>
<td>1</td>
<td>1 (1)</td>
<td></td>
</tr>
<tr>
<td>Propionibacterium acnes</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>18 (4)</td>
<td>2</td>
<td>5 (1)</td>
<td>11 (3)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>42 (13)</td>
<td>4</td>
<td>11 (4)</td>
<td>27 (9)</td>
</tr>
<tr>
<td><strong>No growth</strong></td>
<td>. . .</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

*Number in parentheses indicates number of β-lactamase–producing bacteria.

The greatest correlation was found in cases of S pneumoniae (5 of 7 isolates), H influenzae (6 of 9), Peptostreptococcus species (5 of 6), and Prevotella species (5 of 8).

Thirteen β-lactamase–producing bacteria were recovered from 10 (33%) patients. These were all isolates of S aureus, 4 (44%) of 9 of H influenzae, 3 (38%) of 8 of Prevotella species, and 1 (33%) of 3 of F nucleatum.

This study illustrates for the first time the concordance in the microbiologic findings between middle ear effusion and sinus aspirates in 69% of children with COME and chronic sinusitis. The organisms isolated from the involved ears and sinuses were similar to those previously isolated from patients with COME or chronic sinusitis. However, their simultaneous isolation supports a common bacterial etiology for the infectious process at both sites. This finding also explains why the observation that when antimicrobial therapy is initiated, coverage against these pathogens may lead to resolution of the infection at both sites. Mills et al noted improvement of middle ear disease when the sinus infection was successfully treated. Otten and Grote found that antimicrobial therapy with amoxicillin had a small but significant effect on recovery from OME. These findings also highlight the importance of obtaining cultures from at least one of the involved sites—ear or sinus—so that proper antimicrobial therapy could be chosen. However, since concordance was only demonstrated in two thirds of the patients, it may be necessary to collect cultures from both sites.

The recovery of β-lactamase–producing bacteria in one third of the patients highlights the importance of administering antimicrobials effective against these organisms. These preliminary findings signify the need for prospective studies that will evaluate the efficacy of
surgical and medical therapies including the effect of antimicrobials for otitis media associated with sinusitis in children.

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REFERENCES