Detection of bacteria in the nasopharyngeal secretion and effusion associated with serous otitis media

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Objective
This study aimed at evaluating the accuracy of nasopharyngeal (NP) specimens in the identification of pathogens in the middle-ear fluid (MEF) in patients with otitis media with effusion.

Materials and methods
This was a prospective, hospital-based study with a cross-sectional design to evaluate the accuracy of NP isolates in identifying MEF pathogens and a case–control design to study NP secretion specimens taken from children undergoing an operation with no otologic indication, the middle-ear swab taken from patients undergoing stapedectomy, and middle-ear secretions taken from patients with secretory otitis media (SOM) of an older age group regarding the tympanogram result, radiograph, and endoscopy.

Results
The numbers and percentages of patients showed significant numbers of bacteria in both the MEF and the NP swap, and showed a statistically significant difference ($P < 0.05$).

Conclusion
Otitis media is the second most common disease of childhood and is responsible for a significant number of visits to the pediatrician. About 10% of the cases with middle-ear effusion after an episode of acute otitis media can persist for more than 3 months. Hearing loss associated with serous otitis media (SOM) can potentially have a detrimental effect on speech and language development.

Keywords:
acute otitis media, middle-ear effusion, nasopharyngeal specimen, otitis media with effusion, serous otitis media

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Introduction

Otitis media is the second most common disease of childhood and is responsible for a significant number of visits to the pediatrician [1].

In 10% of the cases, middle-ear effusion after an episode of acute otitis media (AOM) can persist for more than 3 months. Hearing loss associated with serous otitis media (SOM) can potentially have a detrimental effect on speech and language development [2].

The underlying etiology of acute or serous otitis media

The underlying etiology of acute or serous otitis media determines its treatment. Various host factors and infectious agents have been implicated in the genesis of AOM and SOM. Host factors include anatomical or physiological Eustachian tube dysfunction, retrograde movement of organisms from the nasopharynx, allergy, exposure to environmental irritants, and ciliary dysfunction [2].

Bacterial and viral organisms are recognized as a common cause of otitis media. In a small but significant number of cases, there is failure of resolution despite optimal medical therapy to address presumed host factors and infectious agents. In these cases, routine bacterial and viral cultures can be negative, suggesting the presence of other pathogens [2].

If nasopharyngeal (NP) culture can identify middle-ear fluid (MEF) pathogens accurately, it will be a safer, inexpensive, and less invasive technique than current assessment procedures. It will also allow physicians to make more timely management decisions for chronic otitis media patients [3].

Evidence that otitis media with effusion (OME) is associated with persistent bacterial infection in the absence of culture, combined with its recalcitrance to antibiotic treatment, led to the development of the biofilm hypothesis [4].

Objective

This study aimed at evaluating the accuracy of NP specimens in the identification of pathogens in the MEF in patients with OME.

Materials and methods

This was a prospective, hospital-based study with a cross-sectional design to evaluate the accuracy of NP isolates in identifying MEF pathogens and a case–control design to estimate the prevalence of NP carriage in chronic otitis media patients and controls. The study included 30 patients (children between the ages of 1 and 14 years) diagnosed with OME in a university hospital.

Twenty patients suffering from secretory otitis media (SOM) that was refractory to ordinary medical treatment were enrolled in this study. Patients were selected among those attending the ENT outpatient clinic of Kasr El-Aini Hospital (Children Hospital) Cairo University during the period from June 2012 to January 2013. All patients had a preformed consent to participate in this study. Also, approval from the ethical committee of the ORL Department, Cairo University, was obtained. This study was carried out as a prospective randomized controlled study.

Patient selection criteria

Patients selected were having SOM not previously treated surgically and were refractory to the ordinary medical treatment (including systemic antibiotics, local and systemic decongestants, systemic corticosteroid preparation, and frequent nasal douching), for at least 3 weeks' duration.

A preliminary thorough history of otolaryngologic symptoms, careful clinical examination, otoscopic examination, endoscopic nasal examination, and tympanogram scanning with plain radiographs (nasopharynx soft tissue and lateral view) were used to verify the diagnosis of SOM with or without adenoid.

Endoscopic examination was performed for evidence of adenoid, particularly its grading, and to determine whether Eustachian tube orifice encroachment was present or not. The diagnosis of SOM was established clinically if the duration of symptoms was longer than 3 weeks with failed medical treatment.

A tympanogram was performed for each patient before and after treatment, noting that no or minimal change occurred in its results (type B and C).

Endoscopic nasal examination was performed for each case to detect associated adenoid with its encroachment on the Eustachian tube opening.

A plain radiograph (nasopharynx soft tissue and lateral view) scanning was performed for the diagnosis of associated adenoid.

Exclusion criteria were acute febrile illness, AOM, respiratory tract infection, and antibiotic therapy during the previous 2 weeks. As a control group, NP secretion specimens were taken from children undergoing an operation with no otological indication, whereas a middle-ear swab was taken from patients who underwent stapedectomy and middle-ear secretions were taken of patients with SOM of the older age group.

Collection of middle-ear effusions was accomplished using a tap MEF aspirator/collector. The external auditory canal was first cleaned of cerumen, followed by disinfection with 70% ethyl alcohol for 1 min. A myringotomy was performed, followed by aspiration of the middle-ear effusion. It was then sent for bacterial (aerobes and anaerobes) culture within half an hour after collection. Also, the NP specimen was obtained by direct nasal endoscopy from the Eustachian tube orifice of the diseased ear.

Patients were then divided into two groups randomly, according to the method of treatment used, as follows:

Group A: Twenty patients suffered from OME with or without adenoid.

Group B: Ten control patients underwent stapedectomy and middle-ear secretions of patients with SOM of older age.

Data collection and assessment

Data were collected for tabulation and assessment including demographic data and an assessment sheet.

Demographic data

All patient demographics were reported for further description and analysis including the following:

(1) Age.
(2) Sex.
(3) Special habits.
(4) Duration of the disease.
(5) Methods of previous treatment:
    (a) Use of antibiotics.
    (b) Use of topical corticosteroids.
    (c) Use of systemic corticosteroids.
    (d) Chronic use of topical decongestants.
(6) The medical history for chronic illness, for example, diabetes, TB, drug allergy, and any chronic medications.

Statistical analysis

Descriptive statistical analysis was performed to obtain the means and variance as well as the SD

for all variables. Frequency tables were obtained for nonparametric variables. The Student *t*-test was used to correlate the statistical significance including the one-sample *t*-test, the paired samples *t*-test, and the independent samples *t*-test.

Results

This study included 20 patients with secretory otitis media (SOM) that was refractory to medical treatment. There were 11 male (55%) and nine female (45%) patients. Patients ranged in age from 2 to 11 years with a mean age of 4.5 years. This study also included 10 patients who underwent ear surgery as controls. There were 10 male (50%) and 10 female (50%) patients. Patients ranged in age from 14 to 60 years with a mean age of 40 years.

Group A: This group included 20 patients treated with or without adenoidectomy with myringotomy and grommet tube insertion.

The type of tympanogram

The study showed that 16 patients (80%) had type B, whereas four patients (20%) had type C as per the tympanogram curve results.

Plain radiographic results

The review of radiography in this group showed that 15 patients (75%) had adenoid, two patients (10%) had a picture of allergic reaction, and three patients (15%) were normal.

Endoscopic findings

Fifteen patients (75%) showed the presence of NP hyperplasia (adenoid), whereas five patients (25%) showed no swelling in their nasopharynx.

Middle-ear bacteria culture findings

The bacterial culture results for the MEF showed that *Aspergillus* spp. growth occurred in four patients (20%), *Candida* spp. growth in two patients (10%), low bacterial growth in two patients (10%), negative (No) growth in six patients (30%), and positive growth in six patients (30%).

Nasopharyngeal bacteria culture findings

Bacterial culture results for the NP swab showed negative (No) bacterial growth in 0 patients (0%), whereas positive bacterial growth occurred in 20 patients (100%).

Group B: Ten controlled patients who underwent a different ear surgery were included in this study.

The type of tympanogram

The study showed that seven patients (70%) had type A, whereas three patients (30%) had type B as per the tympanogram curve results.

Plain radiographic results

A review of the radiography in this group showed that one patient (10%) had adenoid, two patients (20%) had a picture of NP mass, and seven patients (70%) were normal.

Endoscopic findings

One patient (10%) showed the presence of NP hyperplasia (adenoid), whereas two patients (20%) showed a NP mass in their nasopharynx. Seven patients (70%) showed no swelling in their nasopharynx.

Middle-ear bacterial culture findings

Bacterial culture results for the MEF showed negative (No) growth in 10 patients (100%) and positive growth in 0 patients (0%).

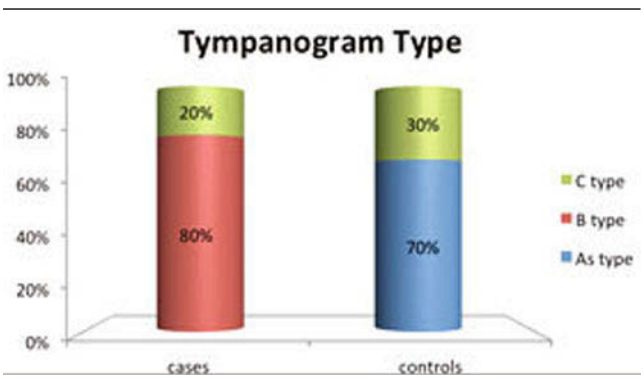
Nasopharyngeal bacterial culture findings

Bacterial culture results for the NP swab showed negative (No) bacterial growth in seven patients (70%), whereas positive bacterial growth occurred in three patients (30%) (Graphs 1–3).

Discussion

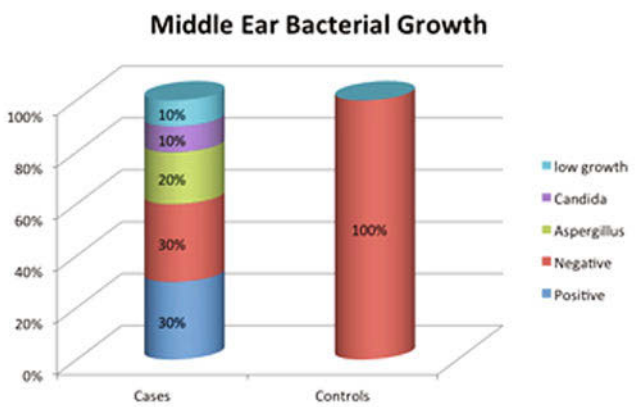
OME is an inflammation of the middle ear in which fluid accumulates behind the eardrum, without any

Graph 1



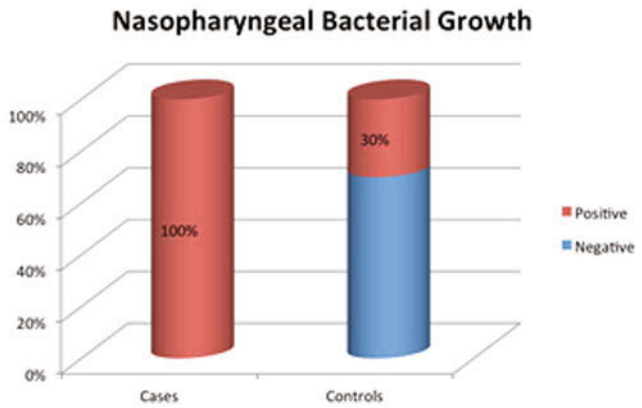
The types of tympanogram in both groups.

Graph 2



The types of middle-ear (ME) bacterial growth in both groups.

Graph 3



The types of nasopharyngeal (NP) bacterial growth in both groups.

signs or symptoms of acute infection, and with an intact tympanic membrane. Secretory otitis media, nonsuppurative otitis media, serous otitis media, and mucoid otitis media are synonymous with OME, but these terms are not as accurate. The frequent opacification and edema of the tympanic membrane may hinder the identification of the type of effusion [5].

OME is often considered as a direct extension of the inflammatory process that occurs during long-lasting or recurrent episodes of AOM, which is confirmed by the fact that almost all cases of OME follow episodes of AOM. The observations mentioned above suggest that OME has an infectious etiology. In contrast, cultures of middle-ear aspirates are positive in only 20–40% of the OME cases. The most frequently detected bacteria are *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*. Recently, PCR techniques were adapted to detect bacterial DNA in middle-ear effusions, and their use increased the frequency of positive results for these bacteria in the examined effusions by nearly 80% [5].

The acquired knowledge about the prevalence of microorganisms responsible for or involved in OME cases may help select the most appropriate antimicrobials and minimize complications that might require surgery [5].

Routine bacterial and viral cultures of the MEF are often negative, suggesting that other infectious agents may be involved. Because of the similarities between the paranasal sinuses and the middle-ear space and the recent recognition of fungi as important pathogens in the inflammation of the paranasal sinuses, the fungi may play role in serous otitis media [6].

On the basis of these observations, this study was designed to evaluate the accuracy of NP specimens in the identification of pathogens in the MEF in patients with OME.

Guided by previous data, this study included 20 patients with secretory otitis media (SOM) that was refractory to medical treatment. There were 11 male (55%) and nine female (45%) patients. Patients ranged in age from 2 to 11 years with a mean age of 4.5 years. This study also included 10 patients who underwent ear surgery as controls. There were 10 male (50%) and 10 female (50%) patients. Patients ranged in age from 14 to 60 years with a mean age of 40 years.

Group A showed that 16 patients (80%) had type B, whereas four patients (20%) had type C as per the tympanogram curves results. However, in group B, seven patients (70%) had type A, whereas three patients (30%) had type B as per the tympanogram curves results.

These results can be explained by the fact that patients in group A had secretory otitis media that was not responding to medical treatment, but in group B, seven patients had otosclerosis and underwent stapedectomy surgery (type A curve), whereas three patients had NP mass for biopsy (type B curve), which may interfere with the Eustachian tube function.

In this study, objective parameters included endoscopic and plain radiographic findings. A review of the radiograph in group A showed that 15 patients (75%) had adenoid, two patients (10%) had a picture of allergic reaction, and three patients (15%) were normal. In group B, one patient (10%) had adenoid, two patients (20%) had a picture of a NP mass, and seven patients (70%) were normal. These were attributed to the endoscopic findings: in group A, 15 patients (75%) showed the presence of NP hyperplasia (adenoid) and five patients (25%) showed no swelling

in their nasopharynx, whereas in control group B, one patient (10%) showed the presence of NP hyperplasia (adenoid) and two patients (20%) showed a NP mass in their nasopharynx. Seven patients (70%) showed no swelling in their nasopharynx.

On comparing the middle-ear bacterial culture growth results, we found that group A showed *Aspergillus* spp. growth in four patients (20%), *Candida* spp. growth in two patients (10%), low bacterial growth in two patients (10%), negative (No) growth in six patients (30%), and positive growth in six patients (30%), whereas group B showed negative (No) growth in 10 patients (100%) and positive growth in 0 patients (0%).

These results can be explained by the presence of fungus on the bacterial culture, which may be attributed to excessive antibiotic intake in these patients, whereas the low growth (10%) can be explained by the presence of a bacterial biofilm. Positive bacterial growth (30%) can be explained by the direct bacterial etiology as a squally from acute suppurative otitis media, whereas no growth (30%) may be due to nonbacterial etiological causes of secretory otitis media (SOM).

These data are nearly comparable to the results of Virolainen and colleagues, who found that bacteria were cultured in 80 (44%) of 180 MEF samples. These results differed from the results of Peled and Yagupsky [7], who found a total of 146 out of 240 (60.8%) samples because they included patients with acute suppurative otitis media in their study.

In the light of the results regarding NP bacterial growth, group A showed negative (No) bacterial growth in 0 patients (0%) and positive bacterial growth in 20 patients (100%), whereas group B showed negative (No) bacterial growth in seven patients (70%) and positive bacterial growth in three patients (30%).

These results can be concluded from the fact that all cases in group A had a compromised upper respiratory mucosal disease that flourished with the NP bacterial flora. This can also be attributed to the three cases in group B with NP masses, but the rest of the stapedectomy cases showed no growth as their mucosa were normal.

In view of the previous discussion, several recommendations for further evaluation of the role of bacterial biofilm in cases with secretory otitis media (SOM) or middle-ear with effusion MEF.

Conclusion

Otitis media is the second most common disease of childhood and is responsible for a significant number of visits to the pediatrician.

In 10% of the cases, middle-ear effusion after an episode of AOM can persist for more than 3 months. Hearing loss associated with serous otitis media (SOM) can potentially have a detrimental effect on speech and language development.

The underlying etiology of acute or serous otitis media determines its treatment, as bacterial and viral cultures of the MEF are often negative, suggesting that other infectious agents, such as fungal agents, may be involved.

The NP culture can identify MEF pathogens accurately. This study aimed at evaluating the accuracy of NP specimens in the identification of pathogens in the MEF in patients with OME.

Acknowledgements

Conflicts of interest

None declared.

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