

The prevalence of atopic disorders in children with chronic otitis media with effusion

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We studied 209 children, referred to a multi-disciplinary 'Glue ear/Allergy' clinic at our hospital with a history of chronic or recurrent otitis media with effusion (OME), in order to determine the prevalence of atopic disease in this population. Referrals were made either from within the hospital by Ear, Nose and Throat (ENT) Surgeons and Audiological Physicians (internal), or by General Practitioners (external). Assessment of atopic status was based on medical history, physical examination, nasal smears and skin-prick testing (SPT) in all children; and on blood eosinophil counts and total immunoglobulin E (IgE) levels in a randomly selected subset. The main outcome measures were number of children with rhinitis, asthma, eczema, positive SPT, raised IgE level (>100 IU/l), and nasal and blood eosinophilia. We found allergic rhinitis in 89%, asthma in 36%, and eczema in 24%. SPTs were positive to one or more of eight common inhalant aeroallergens in 57% of children. Blood tests in the selected subset revealed eosinophilia in 40% and a raised serum IgE in 28%. The worldwide prevalence of allergic rhinitis in children has been estimated to be 20%. The 89% prevalence found in this study is very high and there are a number of reasons which suggest that there may be a causal relationship. Whole-population studies will be required to confirm these findings, which could have important therapeutic implications for OME.

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Otitis media with effusion (OME), commonly known as 'glue ear', is an inflammation of the middle ear with collection of fluid and an intact tympanic membrane (1). It is labeled 'chronic' when the fluid persists for longer than 3 months or when episodes recur on six or more occasions over a 12-month period (2). It is the most frequent cause of hearing loss in childhood (3) and the commonest reason for surgery (4).

The etiology of OME is probably multifactorial (5). Middle ear fluid when cultured displays infection with viruses (6,7) and bacteria (6,8) in 16–19% and 28–43% of children, respectively. The role of allergy in OME has been disputed for a number of years, and the prevalence of atopy varies from 23 to 80% (9) in published reports. Chronic or recurrent OME is commoner in children with allergic rhinitis (10); and otitis-prone children were found to be twice as likely to be allergic as a control group (11). A

recent report (12) (published after the completion of this study) suggests an increase in symptoms associated with atopy in OME children compared with a control group ($p < 0.001$), although skin-prick testing (SPT) results were not significantly different. The presence of rhinitis and of atopic eczema were significantly associated with OME.

In September 1990, the General Paediatric, Paediatric Audiology, and Paediatric Rhinology Departments of the Royal National Throat, Nose and Ear Hospital established a joint clinic for the management of children with chronic OME. Preliminary observations on children seen in the 'Glue Ear/Allergy' clinic suggested that a high proportion were atopic.

This study was carried out to assess the prevalence of atopic disorders in children with chronic OME. The results are presented of 209 children studied, and the possible causative link between allergy and OME is discussed.

Subjects and methods

Subjects

Throughout a 2-year duration, all children referred to the Glue Ear Clinic were assessed and all 3–8-year-olds with a history of chronic (>3 months) or recurrent OME were recruited into the study. The children had been referred either directly from General Practitioners (the external group) or were secondary referrals from the Audiology and Ear Nose and Throat Departments of the Hospital (the internal group) (Fig. 1). Children with predisposing conditions, such as Down's syndrome, cleft palate, or cystic fibrosis, were excluded from the study (n=5).

Questionnaire

The patient's parent/guardian completed a questionnaire. This questionnaire included requests for details of the following: an account of presenting aural symptom; secondary complaints; symptoms caused by allergies; exposure to environmental risk factors; previous medical history, surgery and medication for the presenting complaint; and family history of asthma, eczema or hayfever.

Examination

This included an ear, nose and throat, chest and skin examination. Height and weight measurements were recorded for all the children.

Peak expiratory flow rate (PEFR)

A Paediatric Wright's peak flow meter was used to measure the PEFR, and the best of three attempts, following detailed instruction and encouragement, was taken as the definitive measure.

Our guide was a nomogram (13), which compared PEFR with respect to height. Testing was repeated after exercise in those children with a history of exertional cough or wheeze and/or 10 min after 100 mg of salbutamol was administered via a spacer. This was used in the determination of the diagnosis of asthma (vide infra).

Skin sensitivity tests

Eight common inhalant aeroallergens – house dust, house dust mite, *cladasporium*, *aspergillus*, grass pollen, tree pollen, feathers, and cat – were used for this test (Allergopharma Products, Joachim-Ganzer KG, Reinbeck). The results were compared with a histamine-positive control, and reactions 3 mm greater

than the normal saline-negative control were taken as positive. Skin tests were carried out at a subsequent visit when there was a history of anti-histamine ingestion in the previous week.

Nasal smear

A sample of nasal mucus was collected (for estimation of eosinophil count) by light brushing of the nasal inferior turbinate with a cotton bud. The specimen was transferred to a glass slide, fixed immediately, and then stained with Giemsa's solution. Cells were counted under $\times 250$ magnification and an eosinophil count of >10% was considered as a positive result.

Blood test

Analyses of blood eosinophil counts and immunoglobulin E (IgE) levels were performed in a randomly selected sub-section of the study group.

Pure tone audiometry (PTA) and impedance audiometry

Hearing thresholds were determined using a Peter's AC30 audiometer, and averaged over 500 Hz, 1 kHz, and 2 kHz. Middle ear compliance and pressures were estimated using a GSI screening tympanometer.

Diagnostic criteria

1 Allergic rhinitis. A history of rhinorrhoea and nasal obstruction led to the diagnosis of rhinitis. It was classified as allergic if the child had, in addition, at least two of the following features: excessive sneezing, nasal itch, allergic crease/salute, pale and/or swollen turbinates; or one of these features plus a positive SPT or nasal eosinophilia.

2 Asthma. The diagnosis of asthma was made from a history of an intermittent or chronic cough, precipitated by exercise or laughter, with or without wheezing, together with dyspnoea on exertion and a reduced PEFR (on initial testing or following exertion) with reversibility on inhalation of salbutamol and/or after several weeks of therapy on sodium cromoglycate or inhaled corticosteroids.

3 Eczema. Recurrent dry scaly and itchy skin lesions involving flexural sites among others, with or without a history of weeping, led to the diagnosis of eczema.

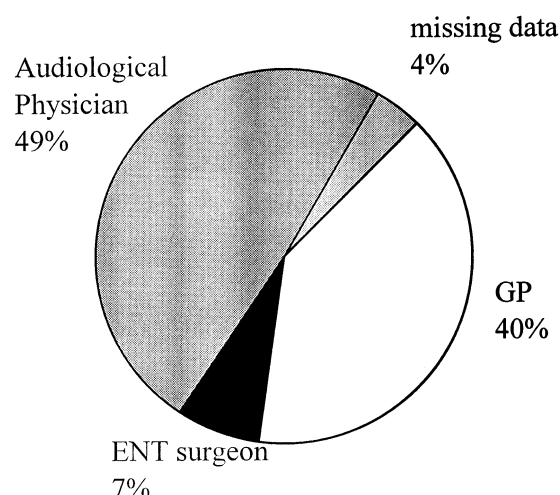


Fig. 1. Referral pattern. ENT, ear nose and throat.

Results

Patient population

Two-hundred and nine children were entered in the study. Mean age at presentation was 5.37 years ($SD \pm 1.63$ years). The male to female ratio was 1.3:1, but the difference was not statistically significant. One hundred and eighty-seven children (89.5%) had already been treated medically for chronic OME. Seventy-five children (36%) had already had surgical intervention. Forty per cent of children showed nasal eosinophilia of $>10\%$, and 40 children had elevated blood eosinophil counts.

Allergic rhinitis, asthma, and eczema (Fig. 2)

Symptoms of rhinitis were present in 94% of children; symptoms together with signs on examination suggestive of allergy were seen in the majority of children (89%). Of these, 58%

were internal and 42% external referrals. Seventy-six patients (36%) had a history suggestive of asthma with clinical signs in half (18.3%) on the day of examination. Eczema was reported in 24% of children, with 9.4% showing signs of active disease.

A family history of atopy was obtained in 174 children (83%). Maternal allergies were commonest (50%), followed by paternal (32%), and siblings (31%). Statistical comparison of internal and external referrals on the basis of allergic symptoms and signs was not significant (chi-square test, $p = 0.317$).

Tests for allergy

SPTs were positive in 119 (57%) patients. In these patients, house dust mite (55%) and house dust (54%) were the commonest allergens implicated, followed by feathers (45%), cat (40%), and grass pollen (35%). Forty-one per cent of children had a nasal eosinophilia. Ninety-nine randomly selected children had blood tests, and 40 had elevated blood eosinophil counts ($>0.4 \times 10^9/l$). Eighty-two of these 99 patients had sufficient blood taken for IgE level estimation and levels >100 IU/l were found in 23 (28%); 20 (87%) of these had positive SPTs.

Ear examination

Otoscopic findings in 418 ears (209 patients) are reported. Middle ear effusion was found in 218 (52.2%) ears, acute infection in 3%, a grommet in 3%, and normal tympanic membranes in 12.9% ears. We could not visualize the tympanic membrane of 17 patients (4.1%), owing either to a lack of co-operation or because of the presence of wax. Effects of recurrent middle ear

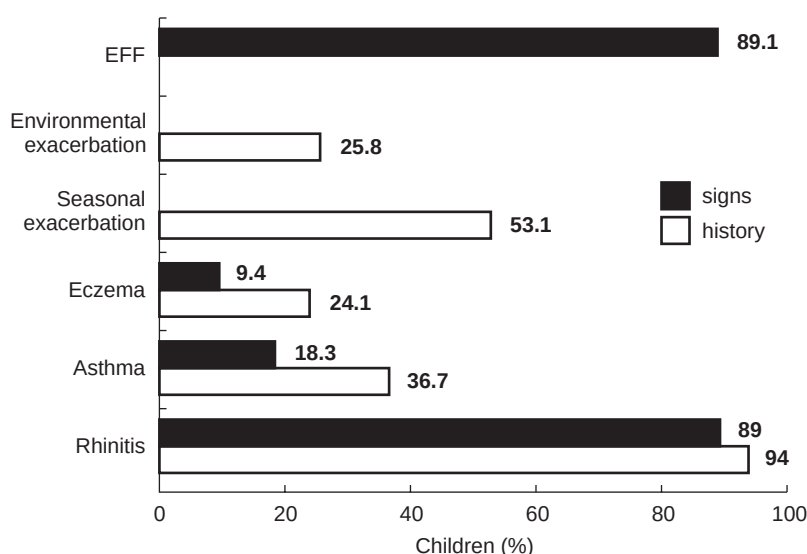


Fig. 2. Comparison of major complaints of allergy and physical findings; percentage of children exhibiting exacerbations with seasonal and environmental allergen exposure. EFF, external facial features of rhinitis.

disease were as follows: perforation (1%), tympanosclerosis (4.3%), and retraction and atelectasis (19.5%).

PTA and impedance audiometry findings

Flat tympanogram (type B), indicating middle ear effusion, was recorded in 106 children (50.7%). Of these, 76 children (71.7%) had bilateral flat traces, and 30 (28.3%) had a unilateral flat trace. Unilateral negative middle ear pressure (≥ -200), suggestive of an effusion, was seen in another 30 children (14.4%). Hearing assessment was performed in 188 children. Of these, 60 children (32%) had a bilateral hearing loss of ≥ 20 decibels, and 43 (23%) had a similar unilateral hearing deficit with the other ear being normal.

Discussion

A high prevalence of atopic disease was found in our study group of 209 children, 3–8 years of age, with chronic OME. The prevalence of atopic disease in our study group was considerably higher than that reported for the general population, which varied in 6–7-year-olds from 0.8 to 14.9% in the recent international study of asthma and allergies in childhood (14). The prevalence of rhinitis was not significantly different between the internal group and the external group, suggesting that the high proportion of atopics was not simply the result of reference bias: 187 (89.5%) of these children had had previous medical treatment and 75 (36%) surgical intervention for chronic OME. Referral to this clinic indicated a failure of long-term resolution. These children form a highly selected group and therefore the results cannot be extrapolated to the normal glue ear population. The results, however, do raise the intriguing possibility that the development of chronic OME and atopy are closely linked, an association which warrants further investigation.

The probable mechanism by which allergic rhinitis affects the middle ear is via eustachian tube dysfunction. The eustachian tube is normally closed, but opens on yawning and swallowing, thus equalizing middle ear pressure to that of the surroundings. If opening is reduced, the air from the middle ear space is absorbed and a negative middle ear pressure results. This could occur in allergic rhinitis owing to swelling of the eustachian tube lining, which is similar and in continuity with that of the nose and nasopharynx.

Allergic rhinitis sufferers develop a significant negative middle ear pressure following nasal allergen challenge (15) and, during the hay-fever season, as allergen levels peak, there is a proportional increase in the number of subjects with negative pressure (16). These subjects, however, do not develop a middle ear effusion. Therefore, negative middle ear pressure in itself does not cause OME. However, in patients with uncontrolled perennial allergic rhinitis, ongoing inflammation will chronically affect the tube (17). This reduces opening, and the resulting compromised mucociliary function (18,19) could delay clearance of an acute infective middle ear effusion contributing to the chronicity of OME (5).

Allergic rhinitis may also predispose to upper respiratory tract infections. The expression of intracellular adhesion molecule-1 (ICAM-1) in the nasal mucosa is increased in allergies and, recently, ICAM-1 has been shown to be a receptor for rhinoviruses, which cause 30% of childhood upper respiratory tract infections (20). Secondary bacterial infection is common following viral colds, and in the presence of negative middle ear pressure and nasopharyngeal colonization with infective organisms, eustachian tube opening may lead to a siphoning effect into the middle ear, precipitating an acute otitis media and a subsequent effusion (21). Rhinitis in childhood is very common and is thought to be frequently infective, with the average child having six to eight viral upper respiratory tract infections per year. In young children (under 3 years of age), infective rhinitis is thought to be the commonest predisposing cause of OME. However, in the age group of patients in our study (3–8 years), allergic rhinitis is a frequent confounding diagnosis, as is adenoidal hypertrophy. However, the additional symptoms of nasal itch and rubbing, nasal eosinophilia, and association with conjunctivitis, asthma and eczema, suggest that, at least in children attending our clinic, allergic rhinitis is the commonest form. SPT alone is unreliable in the diagnosis of childhood allergic rhinitis as local nasal sensitization occurs (22). Our study, and that of Caffarelli et al. (23) did not find significantly elevated SPT positivity. Therefore, in children attending glue ear clinics, allergic rhinitis needs to be actively sought by a full medical history, physical examination, and allergy tests (including nasal smears), together with a search for asthma and atopic eczema. The importance of making the diagnosis is that the possibility exists that by treating the allergic rhinitis the chronic OME will resolve.

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