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Allergic diseases in children with otitis media with effusion[☆]

Chul Kwon^{a,1}, Ho Yun Lee^{a,1,2}, Myung Gu Kim^b, Sung Hyun Boo^b, Seung Geun Yeo^{a,*}

^a Department of Otolaryngology, School of Medicine, Kyung Hee University, Seoul, Republic of Korea

^b Department of Otolaryngology Head and Neck Surgery, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Republic of Korea

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ABSTRACT

Objectives: Recent studies have shown that allergic diseases may be associated with the pathogenesis of recurrent otitis media with effusion (OME). We aimed to assess the relationship between OME and allergic diseases and other types of disease in children with OME. We also evaluated the between group differences in the characteristics of middle ear effusion.

Materials and methods: We evaluated 370 patients diagnosed with OME between January 2007 and December 2012 and, as a control group, 100 children with no medical history of OME but who had undergone blood tests and MAST-CLA (multiple allergosorbent test – chemiluminescent assay) were selected.

Result: Among the allergic diseases, the incidence of allergic rhinitis alone was significantly higher in children with OME (33.8%) than without OME (16.0%) ($p < 0.05$). The rate of adenoid, but not tonsil, hypertrophy was significantly greater in patients with than without OME also ($p < 0.05$). When we evaluated the characteristics of middle ear effusion (MEE) in patients with OME, we found that 186 had serous, 129 had mucous and 55 had purulent MEE. Of these patients, 75 (40.3%), 36 (27.9%) and 14 (25.5%), respectively, had allergic rhinitis and the rates of allergic rhinitis and asthma were significantly higher in the serous group than in the mucous group ($p < 0.05$).

Conclusion: Allergic rhinitis was significantly more frequent among pediatric patients with than without OME, although the rates of other allergic diseases did not differ in these two groups. The likelihoods of allergic rhinitis and asthma were higher in patients with serous than with mucous MEE.

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1. Introduction

Otitis media with effusion (OME) is the most prevalent ear disease in children and is a common cause of hearing impairment. The prognosis of most patients is good, but 10% of children have recurrent and/or persistent OME. Because recurrent/persistent OME may cause complications, including impaired hearing and language development and behavior disorders, surgical interventions, such as ventilation tube insertion, may be necessary [1,2].

Among the host factors associated with the onset of OME are bacterial infections, Eustachian tube dysfunction, allergic and immunologic factors, genetic factors, breast feeding, gender,

and race. OME may also be associated with environmental factors, including communal living and unhygienic habits, and anatomical and physiologic factors, including cleft palate and Down syndrome, which often accompany Eustachian tube dysfunction [3].

Recent guidelines from otologists, pediatricians, and allergists based on clinical evidence support the role of atopy in the development of OME. The involvement of IgE mediated allergic reactions in the pathogenesis of OME has been suggested by clinical observations of a high prevalence of OME among patients with allergies [4]. The important role of allergy in the genesis and recurrence of OME is also supported by data literature that evidence a statistically significant differences in audiological characteristics among atopic and non atopic subjects suffering from OME. In fact in atopic children it found a predominance of bilateral OME and a higher hearing impairment [5,6]. Indeed, the combination of antibiotics and anti-allergy agents has been shown to be more effective than antibiotics alone in patients with allergy and OME [7] and in patients with Eustachian tube occlusion caused by more severe purulent effusion [8]. Therefore, determining whether patients with persistent or recurrent OME also have allergic disorders is important prior to the commencement of treatment. Among the various types of allergic diseases are allergic

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* Corresponding author at: Department of Otolaryngology, College of Medicine, Kyung Hee University, #1 Hoegi-dong, Dongdaemun-gu, Seoul 130-702, Republic of Korea. Tel.: +82 2 958 8980; fax: +82 2 958 8470.

E-mail addresses: yeo2park@yahoo.co.kr, yeo2park@gmail.com (S.G. Yeo).

¹ Both the authors contributed equally to this work.

² Current address: Department of Otolaryngology, School of Medicine, Eulji University, Daejeon, Republic of Korea.

rhinitis, asthma, allergic conjunctivitis and atopic dermatitis. Most studies have assessed the relationship between allergic rhinitis and otitis media, with fewer studies evaluating the association between OME and other allergic diseases.

We therefore assessed the relationship between OME and allergic diseases and other types of disease in children who had undergone ventilating tube insertion due to a poor response to conservative management of OME for more than 3 months. We also evaluated the between group differences in the characteristics of middle ear effusion.

2. Methods

2.1. Patients

The medical chart of 370 patients, aged 1–14 years (mean 7.5 years), who had been diagnosed with OME at ENT clinics between January 2007 and December 2011 were retrospectively reviewed. As a control group, we selected 100 children aged 3–12 years (mean age, 6.3 years) with no medical history of OME and no history of otitis media on physical examination and audiometry, but who had undergone blood tests and MAST-CLA (multiple allergosorbent test – chemiluminescent assay) due to ankyloglossia, ranula, preauricular fistula or epistaxis during the same period (Table 1).

OME was diagnosed by the presence of an amber-colored tympanic membrane on otoscopic examination and by the presence of B- or C-type tympanograms on impedance audiometry.

The tympanic membranes of all patients were examined by a single otologist with more than 20 years of clinical experience. Patients with chronic OME underwent surgery if they did not show improvement after 2 weeks of antibiotic treatment or if, after a 2–3 month follow up, they showed progressive retraction of the eardrum, hearing loss progression or pure tone threshold under 40 dB.

During the operation, the external auditory canal was cleaned with alcohol, and middle ear effusion was collected aseptically by Juhn Tym Taps (Xomed Products, Jacksonville, FL). Effusion was classified as serous, mucous or purulent. Pale yellow and/or transparent middle ear fluid with low viscosity was classified as serous, with mucous effusions defined as middle ear fluid difficult to remove with a suction tube because of high viscosity. Opalescent yellow to grey colored effusion with low viscosity was classified as purulent.

The use of the samples and the purpose of the study were explained to the parents/guardians of each patient, and written informed consent was obtained. Children suspected of having head

and neck anomalies, systemic disease, or congenital or acquired immunodeficiency were excluded.

All patients were tested using the MAST-CLA, with reactions above class 2 regarded as being positive allergic reactions. Patients' medical charts, including those of patients examined in the departments of pediatrics, otorhinolaryngology, dermatology and ophthalmology, were reviewed to identify those patients with allergic diseases [9,10], and comorbidity rates were compared to the characteristics of middle ear effusion. History or statements by parents without objective evidence or medical documentation were discarded. We also evaluated the rates of non-allergic diseases, including tonsil and adenoid hypertrophy, as well as their sizes on imaging, in the groups of patients with and without OME.

2.2. Statistical analysis

All statistical analyses were performed using SPSS version 12.0 (SPSS Inc., Chicago, IL). Groups were compared using the Fisher's exact test, with a p -value less than 0.05 regarded as statistically significant.

3. Results

Of the 370 patients with OME, 125 (33.8%) had allergic rhinitis (AR), 8 (2.2%) had asthma, 10 (2.7%) had atopic dermatitis (AD), 2 (0.5%) had allergic conjunctivitis (AC) and 27 (7.3%) had chronic rhinosinusitis (CRS). Of the control group of 100 patients without OME, 16 (16.0%) had AR, 8 (8.0%) had asthma, 3 (3.0%) had AD, and 4 (4.0%) had AC and CRS. The two groups differed significantly only in the incidence of AR ($p < 0.05$) (Table 1).

We also found that the rates of tonsil and adenoid hypertrophy above grade 2 were 53.3% and 55.0%, respectively, in patients with OME. The rate of adenoid, but not tonsil, hypertrophy was significantly greater ($p < 0.05$) in patients with than without OME. (Table 1)

Using the MAST-CLA test to determine the distribution of antigens, we found that *Dermatophagoides farinae* was isolated from 91 patients, *D. pterony* from 86 and pollen from 31 (Fig. 1).

When we evaluated the characteristics of middle ear effusion (MEE) in patients with OME, we found that 186 had serous, 129 had mucous and 55 had purulent MEE. Of these patients, 75 (40.3%), 36 (27.9%) and 14 (25.5%), respectively, had allergic rhinitis (Table 2). Comparing these groups, we found that the rates of allergic rhinitis ($p = 0.032$) and asthma ($p = 0.017$) were significantly higher in the serous group than in the mucous group (Fig. 2). However, others did not show significant differences ($p > 0.05$)

Table 1
Demographic characteristics of pediatric patients.

	OME children group	Control group	<i>p</i> value
Numbers	370	100	–
Age (range)	7.5 ± 4.3 (2–14)	5.9 ± 3.7 (3–12)	–
Male:female	235:135	26:24	–
<i>Accompanying conditions</i>			
Allergic rhinitis	125 (33.8%)	16 (16.0%)	0.001
Asthma	8 (2.2%)	8 (8.0%)	0.773
Atopic dermatitis	10 (2.7%)	9(9.0%)	0.861
Allergic conjunctivitis	2 (0.5%)	4(4.0%)	0.216
Chronic rhinosinusitis	27 (7.3%)	4 (4.0%)	0.067
<i>Tonsillar size</i>			
1+	173 (46.8)	45 (45.0)	0.538
2+	115 (31.1)	40 (40.0)	
3+	82 (22.2)	15 (15.0)	
<i>Adenoid size</i>			
1+	106 (28.6)	55 (55.0)	<0.001
2+	198 (53.5)	34 (34.0)	
3+	66 (17.8)	11 (11.0)	

OME: otitis media with effusion.

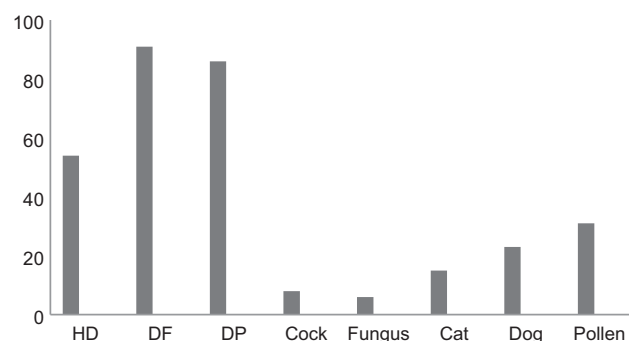


Fig. 1. Distribution of allergens in patients with allergic diseases. HD: house dust, DF: *Dermatophagoides farinae*, DP: *Dermatophagoides pterony*, cock: cockroach.

Table 2

Rates of allergic diseases in patients with serous, mucous, and purulent middle ear effusion.

	Total number of patients	Allergic rhinitis (%)	Asthma (%)	Atopic dermatitis (%)	Allergic conjunctivitis (%)
Serous	186	75 (40.3)	8 (4.3)	6 (3.2)	2 (1.1)
Mucoid	129	36 (27.9)	0 (0.0)	3 (2.3)	0 (0.0)
Purulent	55	14 (25.5)	0 (0.0)	1 (1.8)	0 (0.0)

4. Discussion

OME is caused by the accumulation of fluid in the middle ear cavity without acute symptoms, such as fever or otalgia, and may develop secondary to acute otitis media or other causes without infection. In the first year of life, more than 50% of children will experience OME, and the percentage increases to greater than 60% by age 2 years. Many episodes resolve spontaneously within 3 months, but about 30–40% of children have recurrent OME, and 5–10% of episodes last 1 year or longer [11]. However if effusion in the middle ear cavity persists longer than 3 months, the remission rate remains 20–30%, even after several years.

Allergy was shown to be related to the etiology of OME and should be suspected as a causative factor if antibiotics and conservative treatment are ineffective. In these patients, the combination of antibiotics and anti-allergic agents has shown satisfactory results [7,12,13].

Recently, the middle ear may be considered a component of the united airway consisting of nasopharynx, middle ear and eustachian tube. Basically, nasal allergic inflammation leads to swelling and obstruction of the eustachian tube, which in turn determines a negative pressure in the middle ear and an improper ventilation. In this context, a transient Eustachian tube opening results in aspiration into the middle ear cavity of nasopharyngeal secretions containing bacteria and viruses with the obvious physiopathological consequences [11]. Therefore the development of a mucosal lesion in the middle ear cavity may be followed by disturbance of Eustachian tube function caused by allergic rhinitis. Next, the Eustachian tube becomes blocked. This may increase the synthesis of inflammatory substances and their transmission from local allergic reactions of the nasal cavities and gastric mucosa, enhancing the permeability of the mucosal membranes and the entrance of bacterial secretions from the nasopharynx to the middle ear cavity. Finally, as the surfactant in the Eustachian tubes is diluted by mucosal reactions to allergies, mucociliary clearance may be disturbed [14,15].

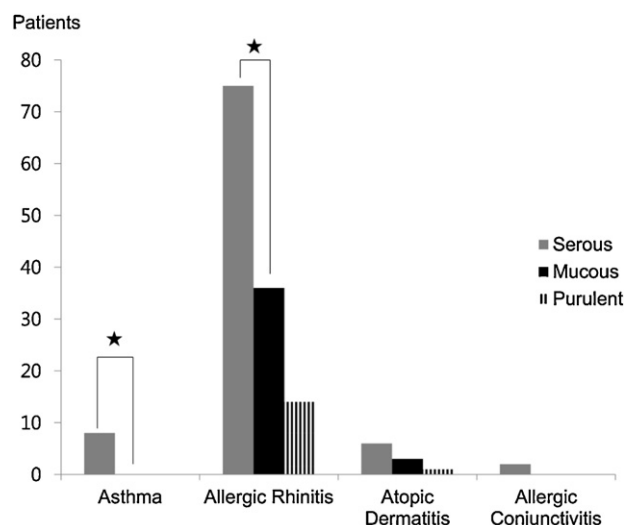


Fig. 2. Distribution of allergic disease according to the characteristics of middle ear effusion. * $p < 0.05$.

The frequency of allergic disease in pediatric OME patients was first reported to be high in 1983 [16]. In a recent review article, OME was considered frequently to be an IgE-mediated, late-phase allergic disease [17]. When we assessed the rates of allergic diseases in patients with and without OME, we found that only allergic rhinitis had a significantly higher rate in patients with than without OME (33.8% vs. 16.0%, $p < 0.05$).

According to literature data these results differ from those of our previous study [18]. We earlier found that neither the presence of OME nor Eustachian tube dysfunction significantly affected AR prevalence, in agreement with earlier data [19]. Similarly, another group has speculated that any role played by allergy may be limited when OME pathogenesis is considered, although nasal symptoms were more common in an OME group [20]. On the other hand, several other studies have reported similar results, with the relationship between allergic rhinitis and OME thought to be due to tube dysfunction secondary to nasal allergic reaction [21]. Furthermore, respiratory allergies were found to be significantly related to the onset of OME, whereas atopic dermatitis and allergic conjunctivitis were not [22]. However, the rate of asthma diagnosis among our patients was lower than that of allergic rhinitis, because only those patients diagnosed by a pediatrician were regarded as having asthma, even if the patients presented with wheezing.

Of our patients with OME, those with asthma and/or allergic rhinitis presented with effusions that were more serous than mucoid in nature, a difference that was significant ($p < 0.05$). However, no other significant between-group difference was found. This may indicate that allergic rhinitis and asthma tend to co-occur less frequently as the viscosity increases. Bacteria are more commonly isolated from purulent than from serous or mucous effusion, suggesting that OME with serous effusion is related to allergy whereas OME with purulent effusion is related to infection rather than allergy.

Tonsil hypertrophy, adenoid hypertrophy and chronic rhinosinusitis (also known as URTI) were also analyzed in patients with and without chronic OME. Similar to previous findings, we found that the rate of tonsil hypertrophy did not differ in these two groups [22], but according to literature data [6] showing that children who had previous URTI and ear infections were significantly more likely to suffer from OME we evidenced that the frequency of adenoid hypertrophy of grade 2+ or greater, usually sign of URTI, was higher in patients with (71.3%) than without (45.0%) OME. Indeed, the rate of the repeat operations was lower in patients who underwent ventilating tube insertion with adenoidectomy than in patients who underwent ventilating tube insertion alone [20]. Moreover, the recurrence of acute otitis media and OME could be prevented by removing the adenoids, the reservoir of pathogenic bacteria [23].

5. Conclusion

We found that the rate of allergic rhinitis was significantly higher among pediatric patients with than without OME, although the rates of other allergic diseases did not differ in these two groups. The likelihoods of allergic rhinitis and asthma were higher in patients with serous than with mucous MEE.

References

- [1] C.W. Cummings, B.H. Haughey, J.R. Thomas, L.A. Harker, P.W. Flint, Cummings Otolaryngology Head & Neck surgery, 4th ed., Mosby Inc., St Louis, MO, 2004, pp. 4445–4450.
- [2] C.D. Bluestone, J.O. Klein, Clinical practice guideline on otitis media with effusion in young children: strengths and weaknesses, *Otolaryngol. Head Neck Surg.* 112 (1995) 507–511.
- [3] P.B. Van Cauwenberge, Relevant and irrelevant predisposing factors in secretory otitis media, *Acta Otolaryngol. Suppl.* 414 (1984) 147–153.
- [4] F. Martines, D. Bentivegna, F. Di Piazza, G. Martinciglio, V. Sciacca, E. Martines, The point prevalence of otitis media with effusion among primary school children in Western children, *Eur. Arch. Otorhinolaryngol.* 267 (2010) 709–714.
- [5] F. Martines, G. Martinciglio, E. Martines, D. Bentivegna, The role of atopy in otitis media with effusion among primary school children: audiological investigation, *Eur. Arch. Otorhinolaryngol.* 267 (2010) 1673–1678.
- [6] F. Martines, D. Bentivegna, E. Maira, V. Sciacca, E. Martines, Risk factors for otitis media with effusion: case–control study in Sicilian schoolchildren, *Int. J. Pediatr. Otorhinolaryngol.* 75 (2011) 754–759.
- [7] D.S. Hurst, Allergy management of refractory otitis media, *Otolaryngol. Head Neck Surg.* 102 (1990) 664–669.
- [8] F. Filiaci, S. Masieri, G. Zambetti, M.P. Orlando, Nasal hypersensitivity in suppurative middle ear effusion, *Allergol. Immunopathol. (Madr.)* 25 (1997) 91–94.
- [9] C. Bachert, P.B. Van Cauwenberge, The Who Aria (allergic rhinitis and its impact on asthma) initiative, *Chem. Immunol. Allergy* 82 (2003) 119–126.
- [10] H.C. Williams, P.G. Burney, R.J. Hay, C.B. Archer, M.J. Shipley, J.J. Hunter, et al., The U.K. working party's diagnostic criteria for atopic dermatitis. I. Derivation of a minimum set of discriminators for atopic dermatitis, *Br. J. Dermatol.* 131 (1994) 383–396.
- [11] F. Martines, D. Bentivegna, Audiological investigation of otitis media in children with atopy, *Curr. Allergy Asthma Rep.* 11 (2011) 513–520.
- [12] W.E. Doyle, T. Takahara, P. Fireman, Role of allergy in the pathogenesis of otitis media with effusion, *Arch. Otolaryngol.* 111 (1985) 502–506.
- [13] G. Mogi, T. Chaen, K. Tomonaga, Influence of nasal allergic reactions on the clearance of middle ear effusion, *Arch. Otolaryngol. Head Neck Surg.* 116 (1990) 331–334.
- [14] K. Tomonaga, Y. Kurono, G. Moge, Role of nasal allergy in otitis media with effusion, a clinical study, *Acta Otolaryngol. Suppl.* 458 (1988) 41–47.
- [15] D.P. Skoner, W.J. Doyle, A.H. Chamovitz, P. Fireman, Eustachian tube obstruction after intranasal challenge with house dust mite, *Arch. Otolaryngol. Head Neck Surg.* 112 (1986) 840–842.
- [16] P. Borge, Atopy and secretory otitis media, immunological studies and responses to topical corticosteroid therapy, *J. Laryngol. Otol.* 97 (1983) 117–129.
- [17] D.S. Hurst, The role of allergy in otitis media with effusion, *Otolaryngol. Clin. North Am.* 44 (2011) 637–654.
- [18] F. Martines, E. Martines, V. Sciacca, D. Bentivegna, Otitis media with effusion with or without atopy: audiological findings on primary school children, *Am. J. Otolaryngol.* 32 (2011) 601–606.
- [19] S.G. Yeo, D.C. Park, Y.G. Eun, C.I. Cha, The role of allergic rhinitis in the development of otitis media with effusion: effect on eustachian tube function, *Am. J. Otolaryngol.* 28 (2007) 148–152.
- [20] M.A. Souter, N.A. Mills, M. Mahadevan, G. Douglas, P.E. Ellwood, M.I. Asher, et al., The prevalence of atopic symptoms in children with otitis media with effusion, *Otolaryngol. Head Neck Surg.* 141 (2009) 104–107.
- [21] C. Caffarelli, E. Savini, S. Giordano, G. Gianlupi, G. Cavagni, Atopy in children with otitis media with effusion, *Clin. Exp. Allergy* 28 (1998) 591–596.
- [22] F.M. chantzi, D.A. Kafetzis, T. Bairamis, C. Avramidou, N. Paleologou, I. Grimani, et al., Ig E sensitization, respiratory allergy symptoms, and heritability independently increase the risk of otitis media with effusion, *Allergy* 61 (2006) 332–336.
- [23] J.L. Paradise, C.D. Bluestone, K.D. Rogers, F.H. Taylor, D.K. Colborn, R.Z. Bachman, et al., Efficacy of adenoidectomy for recurrent otitis media in children previously treated with tympanostomy-tube placement, *JAMA* 263 (1990) 2066–2073.