



Low prevalence of middle ear disease in cystic fibrosis patients

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Abstract

Objective: To assess the prevalence of middle ear alterations in cystic fibrosis (CF) patients.

Methods: In this descriptive study, 120 CF patients aged 5 months to 18 years were assessed by clinical history, otoscopy, and tympanometry. Data on *P. aeruginosa* colonization and parenteral and/or inhaled aminoglycoside use were also collected from medical charts.

Results: Clinical history revealed absence of previous otitis media in 57% of patients. Tympanic membranes were normal in 94% of patients who underwent otoscopic evaluation; chronic otitis media was suggested in about 1% of the cases, otitis media with effusion (OME) in 2%, and Eustachian tube dysfunction in 3%. As for tympanometry, 91% of patients who underwent the exam showed normal results, OME was suggested in 2% of the cases, and Eustachian tube dysfunction in 7%.

Conclusion: There was a low prevalence rate of middle ear alterations in our series of CF patients. The use of aminoglycosides and colonization by *P. aeruginosa* did not influence the prevalence of middle ear alterations. Our results suggest that a detailed clinical history and a routine otoscopy evaluation may confirm or rule out most middle ear alterations in CF patients.

J Pediatr (Rio J). 2011;87(1):80-83: Cystic fibrosis, middle ear, tympanometry, tympanoscopy.

Introduction

Exocrine gland dysfunction in cystic fibrosis (CF) is manifested by abnormalities in the composition and physicochemical properties of secretions. The mucus produced is 30 to 60 times more viscous than normal, which predisposes to a high incidence of sinusitis. The occurrence of recurrent airway infections is an important causal factor for recurrent otitis, because middle ear

mucosa is a direct continuation of the mucosa of the upper respiratory tract.¹

In the 1970s, prevalence rates of middle ear alterations from 10 to 48%² were reported, but studies carried out in the following decade shown rates up to 25%, mostly related to Eustachian tube dysfunction, such as tympanic retraction and otitis media with effusion (OME).^{3,4}

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No conflicts of interest declared concerning the publication of this article.

Financial support: This work was supported by Universidade Federal de Minas Gerais (UFMG), Brazil, and was carried out in the Otorhinolaryngology and Cystic Fibrosis Clinics of the University Hospital. Paulo Camargos is supported by the Brazilian research agencies Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Grant 303827/2009-2) and Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG, Grant PPM-00230-10).

Suggested citation: Martins L, Guimarães RE, Becker HM, Bedran MB, Medeiros M, Camargos P. Low prevalence of middle ear disease in cystic fibrosis patients. *J Pediatr (Rio J)*. 2011;87(1):80-83.

Manuscript submitted Aug 03 2010, accepted for publication Oct 27 2010.

doi:10.2223/JPED.2061

The present study aims to assess the prevalence of middle ear alterations in CF patients using clinical history, otoscopy, and tympanometry.

Patients and methods

One hundred and twenty clinically stable patients with cystic fibrosis (CF) followed in the Cystic Fibrosis Clinic, University Hospital, Universidade Federal de Minas Gerais (UFMG), were enrolled from April to December, 2002. This population represented 85% of all patients aged from 5 months to 18 years followed in our clinic.

Characteristics of the tympanic membrane were evaluated by otoscopy performed with a Welch Allyn 71000® otoscope (Welch Allyn, New York, USA) and were classified as: normal, tympanic retraction, presence of air-liquid level, hyperemia, opacification, and tympanic membrane perforation.

For tympanometry, the Amplaid 770® device (Amplaid, Milan, Italy) was used. Tympanometric curves were classified according to Jerger, as follows: type A, normal (pressure level > -30 daPa), type C, negative pressure (-30 to -400 daPa), and type B, no detectable pressure curve.³

In order to control possible bias associated with description and interpretation of the results of the three different evaluations to which patients had been submitted, an otorhinolaryngologist was assigned to obtain the clinical history and to perform the otoscopy, while another ear, nose and throat specialist was held responsible for carrying out impedance audiometry.

Data on *P. aeruginosa* colonization and parenteral and/or inhaled aminoglycoside use were collected from medical charts.

Variables related to otoscopy and tympanometry were categorized and compared using non-parametric tests. Both study documentation form and informed consent were approved by the Ethics Committee of the UFMG.

Results

Seventy-seven percent of the 120 studied patients were Caucasian or of mixed ethnicity, and there was a slight predominance (56%) of males. Approximately 83% of patients were in the 2-14 years age group (mean age 8.5 + standard deviation 4.3 years). Clinical history revealed that 57% of patients did not have otitis media in the past, 65% did not have otitis in the first year of life, and 71% did not have otitis in the year preceding study admission. The majority (58%) did not have family history of recurrent otitis.

Otoscopy findings showed that 94% of the tympanic membranes were normal, approximately 1% showed alterations suggesting chronic otitis media sequelae

(tympanic perforation), 2% suggesting OME (opacification with or without hyperemia), and 3% suggesting Eustachian tube dysfunction (tympanic retraction). Out of the nine patients with tympanic alterations, 6 were in the 2-6 year and 3 in the 7-14 age group.

Approximately 90% (109) of patients underwent tympanometry, and 91% of them had a normal type A curve. There was a trend towards symmetry in the type of curve in each patient ($p = 0.00$ by Fisher's exact test), that is, the same findings were often present in both ears.

Furthermore, a statistically significant relationship (using the chi-square test for row-by-column analysis) was observed between normal otoscopy and type A tympanometric curve ($p < 0.01$), and between abnormal otoscopy and types B and C tympanometric curves ($p < 0.01$) (Table 1).

Table 1 - Comparison between otoscopy and tympanometry results and types of tympanometric curves of 109 patients

Otoscopy	Tympanometry			Total
	A	B	C	
Right ear ($p < 0.01$)*				
Normal	95	7	0	102
Abnormal	4	1	2	7
Total	99	8	2	109
Left ear ($p < 0.01$)*				
Normal	93	7	1	101
Abnormal	4	0	1	5
Total	97	7	2	106

* Chi-square for row-by-column analysis.

Tympanometry results are presented in Table 2. The test was performed in 109 right ears and 106 left ears because the auditory canal could not be occluded in three patients. As shown, the majority of subjects had normal tympanometric curves (pressure level > -30 daPa).

Medical chart data revealed that 59 (57%) of the 109 patients were colonized by *P. aeruginosa*. Seventy-three (70.8%) did not use parenteral and/or inhaled aminoglycosides, 14 (13.5%) only received one course, 13 (12.6%) from two to five courses, and 3 (3%) received more than six courses. Statistical analysis did not reveal differences in alterations in tympanic membrane between *P. aeruginosa* colonized and non-colonized groups ($p = 0.687$). Moreover, there was no statistically significant difference, in tympanic membranes evaluated by otoscopy, related to the use of aminoglycosides ($p = 0.621$).

Table 2 - Tympanometric curves of 109 patients

Tympanometry	n (%)	95%CI
A curve		
Right ear	99 (90.8)	
Left ear	97 (91.5)	
Total	196 (91.0)	87.4-95.6
B curve		
Right ear	2 (1.8)	
Left ear	2 (1.9)	
Total	4 (2.0)	0.1-3.7
C curve		
Right ear	8 (7.3)	
Left ear	7 (5.8)	
Total	15 (7.0)	3.5-10.3

95%CI = 95% confidence interval.

Discussion

Our literature review identified few studies assessing middle ear disease in CF patients.²⁻⁵ Most of them had a smaller sample size than ours and few have evaluated children younger than 6 years. Furthermore, the descriptive characteristics of our subjects, mainly those related to mixed ethnicity, differ from most North American and European published studies, in which subjects are predominantly Caucasian.

The present study found an absence of previous otitis media in 57% of cases, a value lower than those reported elsewhere (61-70%).²⁻⁵ Reports of previous otitis in studies of pediatric populations without CF varies greatly from 8 to 90% in children up to 2 years old, and Bluestone has found a rate of 60% in a study of 198 pre-schooling children.⁶

To avoid recall bias, we also asked about the occurrence of otitis in the preceding year, and 71% of patients did not report such problem. In accordance with this result, otoscopy was normal in 94% of our patients. Even though earlier studies reported abnormalities of tympanic membrane in up to 48% of study patients,² more recent studies reported a percentage of 7 to 10%,^{3,4} a rate closer to the one found in the present study. This might be explained by the more frequent use of antibiotic therapy in CF patients. About 91% of tympanometries performed in this study had a type A curve (normal), 2% suggested OME (B curve), and 7% Eustachian tube dysfunction (C curve). Similar percentages were found in previous studies carried out in CF patients, such as 6 to 10% of patients with B curve and 14% with C curve.^{2,3} There was a statistically significant relationship between otoscopy findings and the type of tympanometric curve, and also a statistically significant distribution between the right and left ear curves, suggesting a tendency towards symmetry.

Therefore, tympanometry and otoscopy findings showed a low prevalence of middle ear alterations in CF patients. These alterations are mostly suggestive of Eustachian tube dysfunction, and the prevalence of alterations suggesting OME or chronic otitis media in these patients is equal or even lower than the prevalence observed in non-CF patients.⁶ These findings have important clinical implications for the CF team, as they suggest that otoscopy, performed during routine consultations, in addition to clinical history concerning auditory complaints, is sufficient to confirm (or rule out) most cases of middle ear infections in childhood.

We can speculate that the low prevalence findings of middle ear infections in CF patients may be explained by their low calciform cell count in middle ear mucosa, thus decreasing the amount of viscous mucus, as observed by an anatomopathological assessment of the temporal bone.⁷ Another plausible explanation is that there might be different genetic expressions of mucins in middle ear and in bronchial tree mucosa, which could contribute for a lower mucus production in these patients.^{7,8} Moreover, Todd & Martin⁹ have hypothesized that the gene responsible for the proper formation of the Eustachian tube is related to the gene that determines CF, and Choi et al.¹⁰ reported that, in the normal middle ear mucosa, the expression of the cystic fibrosis transmembrane regulator (CFTR) seems to be less prominent than in the nasal mucosa, and a chloride channel induced by ATP might be an alternative to CFTR. Due to these peculiarities, middle ear maintenance without fluid might be less dependent on CFTR and therefore less altered in CF patients. Even another possible explanation is that these patients are already being treated for pulmonary exacerbations, which would act as prophylaxis for middle ear infections. However, data from the present study suggest that the use of antibiotics and the non-colonization by *P. aeruginosa* were not factors related to the lower for the lower incidence of middle ear alterations.

Further studies are needed to determine the causes of the low prevalence of middle ear infections in these patients. These studies should probably include patients with different severity scoring, as well as assessments of upper respiratory tract.

In conclusion, the present study has shown a low prevalence of middle ear alterations in CF patients. The use of aminoglycosides and colonization by *P. aeruginosa* did not influence the prevalence of middle ear alterations. Our results suggest that a detailed clinical history, in addition to routine otoscopy, can confirm or rule out most middle ear alterations in CF patients.

References

1. Lubianca Neto JF, Hemb L, Silva DB. *Systematic literature review of modifiable risk factors for recurrent acute otitis media in childhood.* *J Pediatr* (Rio J). 2006;82:87-96.

2. Bak-Pedersen K, Larsen PK. [Inflammatory middle ear diseases in patients with cystic fibrosis](#). *Acta Otolaryngol Suppl*. 1979;360:138-40.
3. Haddad J, Gonzalez C, Kurland G, Orenstein DM, Casselbrant ML. [Ear disease in children with cystic fibrosis](#). *Arch Otolaryngol Head Neck Surg*. 1994;120:491-3.
4. Jorrisen M, De Boeck K, Feenstra L. [Middle ear disease in cystic fibrosis](#). *Int J Pediatr Otorhinolaryngol*. 1998;43:123-8.
5. De Vincentiis GC, Sitzia E, Bottero S, Giuzio L, Simonetti A, Rossi P. [Otolaryngologic manifestations of pediatric immunodeficiency](#). *Int J Pediatr Otorhinolaryngol*. 2009;73 Suppl 1:S42-8.
6. Bluestone CD. [Studies in otitis media: Children's Hospital of Pittsburgh-University of Pittsburg progress report-2004](#). *Laryngoscope*. 2004;114:1-26.
7. Yildirim N, Sone M, Mutlu C, Schachern PA, Paparella MM, Le CT. [Histopathologic features of the temporal bone in patients with cystic fibrosis](#). *Ann Otolaryngol Head Neck Surg*. 2000;126:75-8.
8. Ubell ML, Khampang P, Kerschner JE. [Mucin gene polymorphisms in otitis media patients](#). *Laryngoscope*. 2010;120:132-8.
9. Todd NM, Martin WS. [Temporal bone pneumatization in cystic fibrosis patients](#). *Laryngoscope*. 1988;98:1046-9.
10. Choi JY, Son EJ, Kim JL, Lee JH, Park HY, Kim SH, et al. [ENaC- and CFTR-dependent ion and fluid transport in human middle ear epithelial cells](#). *Hear Res*. 2006;211:26-32.

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