

Hearing loss and middle ear symptoms in aspirin-exacerbated respiratory disease

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Clinical Implications

- Otologic complications in aspirin-exacerbated respiratory disease are common and are associated with eustachian tube dysfunction and hearing loss. Regular audiologic evaluation and screening should be considered in this at-risk population.

TO THE EDITOR:

Aspirin-exacerbated respiratory disease (AERD) is an acquired, chronic inflammatory disease characterized by chronic rhinosinusitis (CRS) with nasal polyposis (CRSwNP), asthma, and respiratory reactions to inhibitors of cyclooxygenase-1. Otologic complications of this disease are sparsely reported in the literature. Aural polyps have been reported twice,^{1,2} and a chart review identified hearing loss in 6 of 23 patients with AERD.³ Otologic symptoms have been described in association with CRS^{4,5} and CRSwNP,^{6,7} and at least 1 study suggests that endoscopic sinus surgery improves these symptoms.⁸ In the latter study, 86% of patients with CRSwNP reported ear fullness, dizziness, or ear pain before endoscopic sinus surgery. We sought to report the prevalence of otologic symptoms in patients with AERD and determine their association with clinical factors.

We developed a questionnaire to assess the presence and duration of otologic symptoms using single-choice response questions and free-text response fields (see [Figure E1](#) in this article's Online Repository at www.jaci-inpractice.org). Patients enrolled in the Brigham and Women's Hospital AERD patient registry, a longitudinal cohort of patients with a clinically confirmed diagnosis of AERD, were surveyed electronically; participation was voluntary. Corresponding demographic and clinical data were obtained from the Brigham and Women's Hospital AERD patient registry. Statistical significance among associations was tested with logistic regression, chi-square tests, and 2-tailed *t* tests.

Of the 1045 questionnaires distributed, 660 were completed (63.1%). Demographic characteristics and survey results are presented in [Table I](#). Among respondents, 260 reported a physician-confirmed diagnosis of hearing loss (39.3%). Historic congenital or traumatic hearing loss preceding the diagnosis of AERD occurred in 72; they were excluded from further analysis. At the time of survey, patients with hearing loss were older (51.0 ± 1.0 years vs 44.8 ± 0.6 years; $P < .0001$; [Table II](#)) and had a longer duration of nasal polyposis (17.2 ± 0.9 years vs 10.3 ± 0.4 years; $P < .0001$) than did those without hearing loss. Age at nasal polyp onset was equivalent between groups. Odds of hearing loss increased with each additional year of nasal polyposis (odds ratio [OR], 1.06 per year; 95% CI, 1.04-1.08; $P < .0001$).

TABLE I. Demographic characteristics, otologic symptoms, and major risk factors for hearing loss and MESs in a cohort of subjects with AERD

Demographic characteristics	n	% of total	
Total respondents	660	63.1	
Sex, female	481	72.9	
Race			
Asian	9	1.4	
American Indian/Native Alaskan	3	0.5	
Black/African American	14	2.1	
White	610	92.4	
>1 race	17	2.5	
Other	4	0.6	
Age (y)			
Mean	47.1 ± 0.5		
Range	19-69		
Age at diagnosis of asthma (y)	29.5 ± 0.5		
Age at diagnosis of nasal polyps (y)	37.4 ± 3.1		
No. of lifetime polypectomies	2.5 ± 0.1		
Otologic symptoms	n	% of total	
History of hearing loss	260	39.3	
Prior congenital/traumatic hearing loss or loud noise exposure	72		
History of MESs	309	46.8	
Middle ear effusion	198	30.0	
Chronic ear drainage	40	6.1	
Middle ear infection requiring antibiotics in adulthood	274	41.5	
Vertigo	146	22.1	
Tympanostomy tube placement	59	8.9	
Myringotomy	52	7.9	
Tympanostomy tube & myringotomy	40	6.1	
Aural polyps	9	1.4	
Risk factors for hearing loss	OR	95% CI	P value
Female sex	1.25	0.82-1.89	.28
Presence of MESs	3.76	2.59-5.40	<.0001
Middle ear effusion	4.64	3.16-6.80	<.0001
Chronic ear drainage	7.24	3.33-15.76	<.0001
Ear infections in adulthood requiring antibiotics	3.08	2.15-4.41	<.0001
Years of nasal polyposis	1.06	1.04-1.08	<0.0001
Risk factors for MESs	OR	95% CI	P value
Female sex	1.58	1.12-2.25	<.01
Years of nasal polyposis	1.02	0.998-1.04	.071

Ages and polypectomies reported as mean $\pm$ SE.

Middle ear symptoms (MESs), defined as ear infections in adulthood requiring antibiotics, physician-confirmed middle ear effusion, or chronic ear drainage, were reported by 309 respondents (46.8%; [Table I](#)). There was substantial overlap among MESs, with all patients reporting chronic ear drainage also reporting ear infection in adulthood, and all but 4 also reporting

TABLE II. Comparative clinic characteristics of patients with and without hearing loss and MESs

Characteristic	MESs	No MESs	P value	Hearing loss	No hearing loss	P value
Age	48.1 ± 0.7	46.2 ± 0.7	.06	51.0 ± 1.0	44.8 ± 0.6	<.0001
Age at onset of asthma	28.2 ± 0.8	30.6 ± 0.8	<.05	28.6 ± 1.1	28.9 ± 0.7	.74
Age at onset of NP	40.2 ± 0.7	35.0 ± 0.7	.41	33.9 ± 1.0	34.3 ± 0.6	.73
Duration of NP	14.5 ± 0.6	11.17 ± 0.5	<.0001	17.2 ± 0.9	10.3 ± 0.4	<.0001

NP, Nasal polyps.

Ages and duration of NP are reported as mean years ± SE.

middle ear effusion (see Figure E2 in this article's Online Repository at www.jaci-inpractice.org). The presence of MESs was a significant risk factor for hearing loss (OR, 3.75; 95% CI, 2.59-5.40; $P < .0001$) and was associated with female sex (OR, 1.58; 95% CI, 1.12-2.25; $P < .001$). Compared with those without MESs, patients reporting MESs were younger at the time of asthma diagnosis (28.2 ± 0.8 years vs 30.6 ± 0.8 years; $P < .05$; Table II). There was no difference in current age or age of nasal polyp onset between patients with and without MESs.

To understand the severity of hearing loss and evaluate for eustachian tube dysfunction (ETD), all respondents endorsing hearing loss on the initial questionnaire were sent the Hearing Handicap Inventory for Adults (HHIA) and the 7-item Eustachian Tube Dysfunction Questionnaire (ETDQ-7). Demographic characteristics and results are presented in Table E1 in this article's Online Repository at www.jaci-inpractice.org. The mean ETDQ-7 score was 3.2 ± 0.2 , consistent with ETD. The mean HHIA total score was 0.37 ± 0.02 , suggestive of mild-moderate hearing handicap. Total, social, and emotional hearing handicap scores were significantly higher among respondents younger than 40 years. Pearson correlation demonstrated a significant linear association between ETDQ-7 score and total HHIA score (see Figure E3 in this article's Online Repository at www.jaci-inpractice.org).

Our data suggest a significant and underrecognized burden of otologic disease in one of the largest cohorts of patients with AERD. These results demonstrate that duration of nasal polyps and presence of MESs, independent of age, are risk factors for hearing loss in AERD. Moreover, the hearing loss reported by patients with AERD is associated with ETD and carries significant social and emotional handicap. This study highlights a need for regular audiologic screening for hearing loss and early intervention in this at-risk population. Our study is limited by the questionnaire methodology, because it relies primarily on patient reporting of outcomes, introducing the possibility of recall bias in disclosure of otologic symptoms. This study is also limited by the lack of a non-AERD comparison group and may reflect a burden of disease common in CRSwNP. Without audiogram data, our study cannot confirm the type of hearing loss. We hypothesize a mechanism by which the combination of mechanical obstruction from nasal polyps and chronic sinonasal inflammation lead to ETD, resulting in a primarily conductive hearing loss pattern.

Future studies should seek to compare hearing loss among patients across the CRS disease spectrum, to characterize the cause of hearing loss in AERD, and to identify the mechanisms linking hearing loss, MESs, and chronic sinonasal inflammation.

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TABLE E1. ETDQ-7 and HHIA survey results

Demographic characteristics	Value	P value	P value
Total respondents, n (%)	74 (28.4)		
Previous congenital/traumatic hearing loss or loud noise exposure	22		
Total respondents analyzed	52		
Males, n (%)	15 (28.8)		
Females, n (%)	37 (71.1)		
Age (y)			
Mean	53.7 ± 1.9		
Range	22-75		
Age at diagnosis of asthma (y)	31.2 ± 2.5		
Age at diagnosis of nasal polyps (y)	37.1 ± 2.3		
No. of lifetime polypectomies	2.8 ± 0.4		
ETDQ-7 Results			
Mean score	3.66 ± 0.22		
Males	3.29 ± 0.44	P = .28	
Females	3.81 ± 0.25		
Score by age group	ANOVA P value = .0634		
<40 y	4.95 ± 0.58		
40-49 y	3.04 ± 0.32		
50-59 y	4.20 ± 0.64		
60-69 y	3.47 ± 0.36		
>70 y	3.28 ± 0.52		
HHIA Results			
Total mean score	.37 ± .02		
Males	.38 ± .02	P = .37	
Females	.34 ± .05		
Emotional domain mean score	.39 ± .02		
Social domain mean score	.34 ± .02		
HHIA Total score by age group	ANOVA P value = .012	t test P value	
<40 y	0.56 ± 0.06		
40-49 y	0.32 ± 0.03	<.001	
50-59 y	0.38 ± 0.06	.056	
60-69 y	0.34 ± 0.05	<.01	
>70 y	0.34 ± 0.04	<.01	
HHIA Emotional score by age group	ANOVA P value = .016	t test P value	
<40 y	0.59 ± 0.07		
40-49 y	0.33 ± 0.04	<.001	
50-59 y	0.42 ± 0.07	.09	
60-69 y	0.36 ± 0.04	<.01	
>70 y	0.37 ± 0.05	<.01	

(continued)

TABLE E1. (Continued)

Demographic characteristics	Value	P value	P value
HHIA Social score by age group	ANOVA P value = .028	t test P value	
<40 y	0.52 ± 0.08		
40-49 y	0.30 ± 0.04	.007	
50-59 y	0.33 ± 0.05	.04	
60-69 y	0.32 ± 0.04	.02	
>70 y	0.31 ± 0.03	.01	

Mean values ± SE are reported.

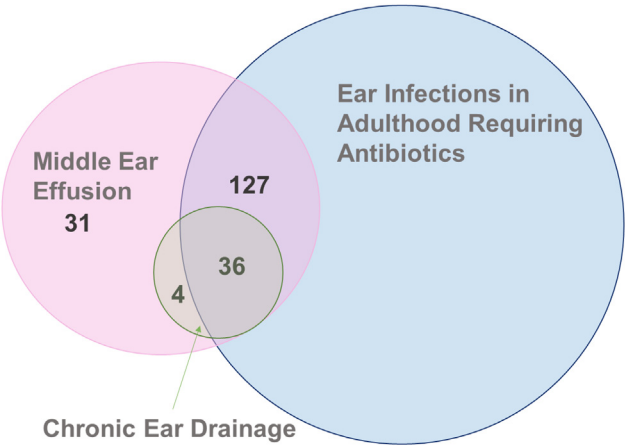


FIGURE E1. Venn diagram demonstrating significant overlap in the MESs reported by survey 1 respondents. All respondents with chronic ear drainage also had either middle ear effusion or both middle ear effusion and ear infections in adulthood requiring antibiotics.

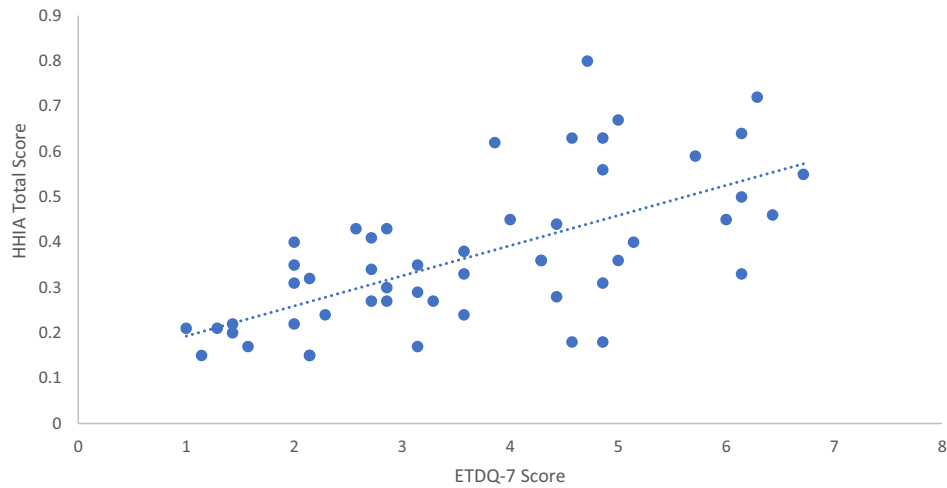


FIGURE E2. ETDQ-7 demonstrates a linear relationship with the HHIA total score among patients with AERD with hearing loss, with Pearson correlation coefficient 0.66 ($P < .0001$).

Have you ever been evaluated for hearing loss? Yes/No
Have you ever been diagnosed with hearing loss? Yes/No
If yes, when? _____
Right ear only? Yes/No
Left ear only? Yes/No
Both? Yes/No
What treatment have you received for your hearing loss? _____
Do you have a family history of hearing loss? Yes/No
Have you experienced vertigo (sensation that the room is spinning)? Yes/No
Do you have a history of loud noise exposure in your profession or from hobbies (manufacturing facility, rock music concerts, etc)? Yes/No
Were you born prematurely (before 37 weeks of gestation)? Yes/No
Have you experienced any prior head trauma? Yes/No
Have you been diagnosed with fluid in your ears as an adult? Yes/No
Have you ever required an incision in your ear drum (myringotomy) to drain fluid as an adult? Yes/No
If yes, when? _____
Right ear only? Yes/No
Left ear only? Yes/No
Both? Yes/No
Have you had ear tubes placed in adulthood? Yes/No
If yes, when? _____
Right ear only? Yes/No
Left ear only? Yes/No
Both? Yes/No
Have you suffered from chronic ear drainage? Yes/No
If yes, when did the chronic ear drainage start? _____
Have any treatments helped your chronic ear drainage condition? _____
What treatments have been tried and were not helpful? _____
Have you received oral antibiotics to treat a middle ear infection in adulthood? Yes/No
If yes, how many times per year on average?
less than 1 per year Yes/No
1-2 per year Yes/No
more than 3 per year Yes/No

Have you been diagnosed with polyps in your ears or on your ear drum? Yes/No
Do you have any other difficulties with your hearing or ears to report? _____

Those subjects reporting a diagnosis of hearing loss were also asked to complete the following:
1) Was your hearing loss confirmed by an audiologist or through audiologic testing? Yes/No
If no, would you be interested in having a full audiologic evaluation at BWH? Yes/No
If yes, do you have records or documentation of your audiologic evaluation? Yes/No
If yes, please upload any pertinent medical records or have them faxed.
2) The 7-item Eustachian Tube Dysfunction Questionnaire (ETDQ-7) as reported by McCoul E.D., Anand V.K., & Christos P.J. Validating the Clinical Assessment of Eustachian Tube Dysfunction: The Eustachian Tube Dysfunction Questionnaire (ETDQ-7). Laryngoscope. 2012 May;122(5):1137-141.
3) The Hearing Handicap Inventory Adults as reported by Newman, C. W., Weinstein, B. E., Jacobson, G. P., & Hug, G. A. The Hearing Handicap Inventory for Adults: psychometric adequacy and audiometric correlates. Ear and Hearing. 1990;11:430-433.

FIGURE E3. Questionnaires used to ascertain presence of hearing loss, MESs, ETD, and impact of hearing loss on quality of life. BWH, Brigham and Women's Hospital.

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