International Journal of Otorhinolaryngology and Head and Neck Surgery
Acharya S et al. Int J Otorhinolaryngol Head Neck Surg. 2022 Mar;8(3):228-231
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20220473

Original Research Article

Study of incidence of sensorineural hearing loss in allergic rhinitis

Souvagini Acharya[1], Kamalini Bepari[1], Sabyasachi Biswal[1], Sarita Dash[1]*, Priyanka Agrawal[1], Dipali Mohapatra[1], Sujit Naik[1], Aurobinda Das[2]

[1]Department of Otorhinolaryngology, VSSIMSAR, Burla, Sambalpur, Odisha, India
[2]Department of Otorhinolaryngology, BB Medical College and Hospital, Balangir, Odisha, India

Received: 23 January 2022
Revised: 11 February 2022
Accepted: 14 February 2022

***Correspondence:**
Dr. Sarita Dash,
E-mail: dr.saritadash@gmail.com

ABSTRACT

Background: The aim was assessment of sensorineural hearing loss incidence in allergic rhinitis. Anatomical and physiological relation of nose with ear increases the possibility of conductive hearing loss in allergic rhinitis, but association of sensorineural hearing loss is least studied.
Methods: 60 patients with clinically diagnosed allergic rhinitis were compared with age and gender matched controls. All participants were subjected for pure tone audiometry; distortion product otoacoustic emission and tympanometry. Facts and statistics were analysed by chi-square and t- test with significance at $p<0.05$.
Results: Study population had sensorineural hearing loss which was in high frequencies, distortion product otoacoustic emissions revealed low distortion product and mostly "A" type tympanogram when compared with the controls.
Conclusions: We found patients having allergic rhinitis are prone to sensorineural hearing loss.

Keywords: Endolymphatic sac, Inner ear defence, Hair cells, Nasal-associated lymphoid tissue

INTRODUCTION

Allergic rhinitis is characterized by inflammatory changes in nasal mucosa on exposure to aeroallergens.[1] The major symptoms are sneezing, itchy; watery eyes. It is IgE mediated immediate reaction to foreign substances by mucosa of nose. Histamine is the main mediator. In Allergic rhinitis the eustachian tube function is adversely affected and lead to middle ear effusion or otitis media which causes conductive hearing loss.[2] Singh et al suggested a positive correlation between AR and sensorineural hearing loss and found prevalence of hearing loss and outer hair cells abnormality were more in AR patients than normal individuals.[3] The endolymphatic sac has a unique property of processing antigens and producing its own local immune response.[4] Immune system fights against harmful substances like bacteria and viruses but in allergic rhinitis it overreacts to harmless substances and affects hair cells to cause sensorineural hearing loss. Anatomical and physiological relation of nose and ear increases the possibility of conductive hearing loss in allergic rhinitis which has many supported study. Hence, this study was taken with an aim for assessing the association of sensorineural hearing loss in Allergic rhinitis which is least studied. The objective of current study was to evaluate sensorineural hearing loss in cases of allergic rhinitis in comparison to control group and also to find out any associated cochlear involvement.

METHODS

An observational study was done in the Otorhinolaryngology, outpatient department, from June

2020 to January 2021. Convenient sampling method was used and 60 clinically diagnosed allergic rhinitis patients with symptoms more than 4 to 6 weeks in the age group of 10 to 50 years in comparison to age and gender matched controls of equal no. having no history of any cold, allergy for past 4 to 5 months were taken-up. Patients with a history of factors causing hearing loss like use of ototoxic agents, metabolic and systemic diseases, noise exposure, history of neurological factors, tympanic membrane perforation were excluded from the study. All participants were subjected for pure tone audiometry, distortion product otoacoustic emission and tympanometry. Facts and statistics were analysed using Chi-square and paired t- test with significance at $p<0.05$. SPSS software (21.0) was used to analyze the data.

RESULTS

Demography

Frequency distribution of demographic characteristics (Table 1) of patients was studied with respect to incidence of allergic rhinitis. As per result disease is more common in age between 21-30 years followed by 10-20 years and in males.

Pure tone audiometry

Pure tone audiometry (Figure 1-2) was used to test the thresholds of air- and bone-conduction hearing from 250 Hz to 8000 Hz. Hearing loss was considered when at one of the test frequencies the air- or bone-conduction threshold was >25 dB. Sensorineural hearing loss was considered when the air- and bone-conduction threshold curve declined continually without air-bone gap.

Among allergic rhinitis populations sensorineural hearing loss was found in 18 (60%) and of high-frequency decline type. The mean pure-tone average (500, 1000 and 2000 Hz) of individuals with Allergic rhinitis was 19 dB (±4dB) and 21dB(±4dB) in right and left ear respectively. However, the average of 2000, 4000 and 8000 Hz was quite different. The average of these frequencies among individuals with allergic rhinitis (Figure 3) and control group and (Figure 4) represents first evaluation and follow-up evaluation of individuals with allergic Rhinitis. From the figures, it can be noted that thresholds were higher in individuals with allergic rhinitis when compared with control group even after treated for rhinitis as shown in (Figure 4) where threshold did not show any difference. Independent t-test was administered across each frequencies, average of 500, 1000 and 2000 Hz (PTA1) and also average of 4000, 8000 Hz (PTA2) to investigate the effect of Allergic rhinitis on pure tone thresholds. Results (Table 2) revealed significant mean effect ($p<0.001$) across PTA1 (5.7; 6.1) and PTA2 (7.8; 9.4) sequentially in right and left ear. Paired t-test was administered across each frequencies of PTA1 and to investigate the effect of medication on thresholds. Results revealed no statistical significant .

Distortion product otoacoustic emission (DPOAE)

By OtoRead OAE instrument, DPOAE was done for frequencies 1000 - 8000 Hz. and repeated two times in 15 min. For data average DP amplitude and signal to noise ratio (SNR) were considered. Comparison between signal to noise ratio (SNR) of distortion product otoacoustic emission (DPOAE) across 1000-8000 Hz among individuals with allergic rhinitis in the first evaluation, follow-up evaluation and control groups is represented in (Figure 5). Results of DPOAE revealed low-DP amplitude with poorer SNR in both right and left ear across frequencies 4000, 5000, 6000 and 8000 Hz. Independent sample t-test was administered to find the significance of difference across two groups. Results revealed significant mean effect across frequencies was <0.05. Paired t-test was administered to find the significance of difference across pre-medication and post-medication data among individuals with Allergic rhinitis. The post-recording was done 1 month after the initiation of medicines. Results revealed no statistically significant mean difference across frequencies.

Tympanometry

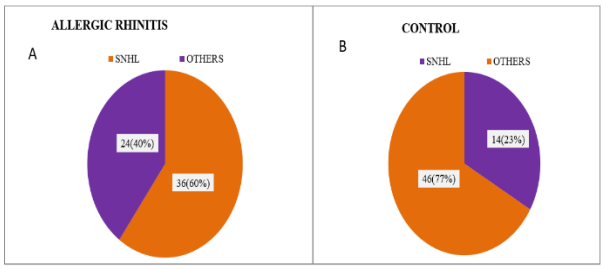
Tympanometry (Figure 6) showed mostly “A” type tympanogram with some B and C type. It indicates middle ear function was nearly normal in most of the study population.

Table 1: Percentage of age and sex distribution in allergic rhinitis patients of study.

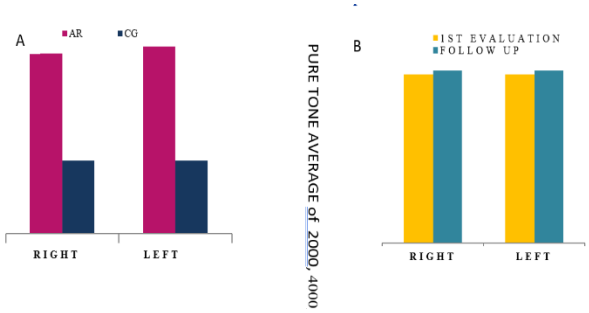
Age (years)	Male, N	%	Female, N	%	Total, N	%
10-20	12	31.58	6	27.27	18	30
21-30	14	36.84	6	27.27	20	33.33
31-40	4	10.52	6	27.27	10	16.67
41-50	8	21.05	4	18.18	12	20
Total	38	100	22	100	60	100

Table 2: PTA1 and PTA2 findings of allergic rhinitis patients.

Ear	PTA1	PTA2	P value
Right	5.7	7.8	<0.001
Left	6.1	9.4	<0.001



Figures 1: Percentage of populations revealed sensorineural and other types of hearing loss in PTA, A) allergic rhinitis, B) control.



Figures 2: Pure tone average of 2000, 4000, 8000 Hz in A) allergic rhinitis and control group, B) 1st evaluation and follow up.

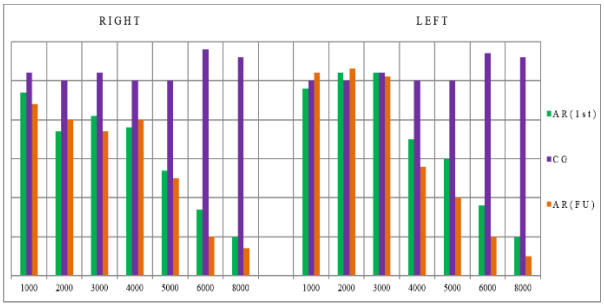


Figure 3: SNR of DPOAE across 1000-8000 Hz among individuals of control groups and allergic rhinitis in first and follow-up evaluation.

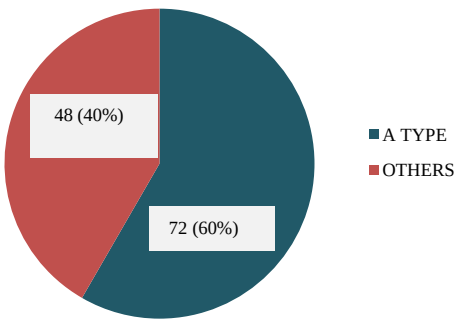


Figure 4: Percentage of study populations revealed A and others (B, C) types tympanogram.

DISCUSSION

Epithelium of human endolymphatic sac has mucin molecules which make it the primary immunological structure of inner ear like MALT in other organs and also co-react with nasal-associated lymphoid tissue (NALT or Waldeyer's ring).[5,6] It has many antigen presenting cells and CD4+T cells and is the main site of antigen-specific immune responses after intranasal immunization. Therefore, allergic rhinitis can lead to sensorineural hearing loss by affecting the connection between the nasal mucosa and inner ears.[7] The endolymphatic sac contains abundant complement factors, lymphocytes and macrophages, cytokines and play important roles in inner ear defence, which may enhances due to TNF-α produced by stimulated macrophages and lymphocytes in response to captured cross-antigens between pathogenic microorganism and body tissues during nasal cavity and paranasal sinus infections.

TNF-α can activate the downstream NF-kB, MAPKs, and START pathways and cause apoptosis and degeneration of hair cells, leading to sensorineural hearing loss.[7] According to Singh et al triggering of antigens in endolymphatic sac by allergens produce local antibody response. Hearing is affected by resultant inflammatory mediators and toxic products which disturb function of hair cells. Histamine may have protective effect on hearing by vasodilatation in cochlear artery and vein.[3] But might cause inflammation directly or indirectly by affecting the cochlea.[8]

Limitations

The limitation of this study was owing to small sample size. A greater sample size could have helped in more extensive analysis.

CONCLUSION

From the present study, pure tone audiometry revealed incidence of SNHL is higher in Allergic Rhinitis populations when compared to control groups & mostly in high frequencies with no significant difference even after administration of medication; with DPOAE showing low/absent-DP amplitude with poorer signal to noise ratio (in high frequencies). So it can be concluded that allergic rhinitis make more susceptible for loss of hearing and allergens affecting the inner ear function, particularly outer hair cells can cause sensorineural hearing loss which does not reverse once occurred. Hence allergic rhinitis should be treated earliest and evaluation of sensorineural hearing loss is a must.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Brown S. Otorhinolaryngology head and neck surgery. 19th ed. England: Royal surgeons publishers: 2017.
2. Kumar S, Singh HP, Kumar S, Verma V, Mishra A. Assessment of otological and audiological status in patients of allergic rhinitis. Int J Otorhinolaryngol Head Neck Surg. 2018;4:956-60.
3. Singh S, Nagarkar AN, Bansal S, Vir D, Gupta AK. Audiological manifestations of allergic rhinitis. J Laryngol Otol. 2011;125:906-10.
4. Sekhon GS, Verma R, Munjal M, Chopra H. Audiological manifestations in patients of upper airway allergy. Int J Otorhinolaryngol Head Neck Surg. 2019;5:1451-6.
5. Lin X. Is sensorineural hearing loss related to chronic rhinosinusitis caused by Outer Hair Cell Injury?. Med Sci Monit. 2019;25:627-36.
6. Low WK, Dip G, Poh S, Rangabashyam M. Inner ear disorders: exploring possible links between the endolymphatic sac, gall bladder and small intestine. Int J Complement Alt Med. 2017;8(6):278.
7. Liu W, Kämpfe NC, Danckwardt LN, Rask AH. Human inner ear immune activity: a super-resolution immunohistochemistry study. Front Neurol. 2019; 10:728.
8. Dwarakanath VM, Shambhu T, Jayanna VJ. Assessment of hearing in individuals with allergic rhinitis. Indian J Otol. 2019;25:117-20.

Cite this article as: Acharya S, Bepari K, Biswal S, Dash S, Agrawal P, Mohapatra D, et al. Study of incidence of sensorineural hearing loss in allergic rhinitis Int J Otorhinolaryngol Head Neck Surg 2022;8:228-31.