Section: Otorhinolaryngology

Original Research Article

ASSOCIATION BETWEEN AGE RELATED SENSORINEURAL HEARING LOSS AND AGE-RELATED MACULAR DEGENERATION: ANALYTICAL CASE CONTROL STUDY

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ABSTRACT

Background: Ageing is also best predictor of visual impairment and blindness. Age related hearing loss (presbycusis) is the loss of hearing that gradually occurs in most of us as we older. In the present study we tried to emphasize possible role of melanin in progression of these two disorders in the retinal tissues and inner ear. Early diagnosis and prompt treatment related to delay onset of ARMD and age related SNHL is essential for giving everybody a reasonable chance for living a long and enjoyable final part of life.

Material & Methods: A Hospital based observational analytical case-control study done on 101 patients with symptoms of age-related hearing loss who attended ENT OPD of Sardar Patel Medical College, Bikaner were enrolled as case. Complete ENT examination and otoscopic examination of bilateral ear done. Tunning forks test like Rinne's test, Weber test conducted in bilateral ear of each patient. Every enrolled individual underwent optical coherence tomography (OCT) in bilateral dilated eyes. The quantitative data were presented as mean and standard deviation and were compared by Students t-test.

Results: Our study showed that the mean age of cases was 64.71 ± 12.01 yrs whereas mean age of control was 59.57 ± 10.17 yrs and this difference was found to be statistically significant with p value 0.0001. The both groups were comparable in term of sex, residence and socioeconomic status (p value 0.885, 0.884 & 1.00 respectively) is not significant which signifies that distribution of SNHL does not depend on sex, residential area & socioeconomic status. Smoking is significantly associated with increased risk of occurrence of ARMD with 7.895 folds in cases. The association between severity of hearing loss and ARMD was found to be statistically significant with P value 0.0001*.

Conclusion: We recommend a team approach including ENT specialist and ophthalmologists with mutual consensus is required. Patients with SNHL should be evaluated for ARMD and prompt measures should be taken to delay its arrival and severity.

Keywords: SNHL, ARMD, Ageing, Macula, Degeneration.

INTRODUCTION

Ageing is course of biological reality, starts with conception and ends with death. It is natural process and reflects all the changes taking place over the course of life. Ageing must be considered as an unavoidable end point of the life history of each individual, nevertheless the increasing knowledge on ageing mechanism, allow envisaging different strategies to cope with and delay it.[1] Rapid advances in understanding of mechanism that control cellular proliferation, differentiation and survival are leading to new sight into the regulation of ageing.

Age related hearing loss, medically known as presbycusis is usually bilateral, symmetrical, non-syndromic, genetic, degenerative, more pronounced at higher fequencies (>2kHz) and sensorineural in nature.[2]

Presbycusis is multifactorial in origin. In addition to age related degeneration leading to physiologic and anatomic changes, other contributing factors include genetic factors, hormones, exposure to loud noise or ototoxic agents etc. important role has been attributed by degenerative effect of ageing on cochlea, decreased functioning of stria vascularis (dysfunctioning and decrease amount of melanin basically in basal and apical turn of cochlea), increased oxidative stress, mitochondrial mutations etc.[3]

Ageing is also best predictor of visual impairment and blindness. Most common cause of age related visual impairment in elderly is presbyopia, cataract, age related macular degeneration, primary open angle glaucoma and diabetic retinopathy. ARMD (age related macular degeneration) is chronic and degenerative ocular disorder leading cause of severe vision loss and blindness worldwide. ARMD is main contributor to exponential increase in prevalence of blindness in age >55 yrs. Dry and wet ARMD are two types with deposit of soft, confluent and large drusen on Bruch's membrane in dry type of AMD.[4]

The association between ARMD and age related SNHL may be attributed to common anatomical component such as melanin in these two sensory organs. Melanocytes present in stria vascularis and spiral ligament of cochlea (apex>base) and RPE layer of retina(macula) gradually decrease in function due to increased oxidative stress resulting in free radical formation due to ageing effect. Thus, Age Related SNHL and ARMD are co-related with common factor ageing.[5]

Melanin alteration caused by oxidative stress might account for important concomitant role in visual and hearing impairment. Melanin deficiency might initiate the apoptosis of retinal pigment epithelial cells and cochlear elements i.e. stria vascularis which are abundant in melanin. Thus, both ARMD and age related SNHL occurs simultaneously. Therefore, in this study, we will conduct detailed fundus examination of the patient diagnosed with Age Related SNHL to rule out ARMD and will co-relate severity of ARMD with degree of hearing loss through various investigations.[5] Age Related SNHL is diagnosed clinically, by tuning fork test, by PTA (pure tone audiometry) and tympanometry. ARMD is diagnosed by clinical examination, OCT (optical coherence tomography) and fundoscopy. In the present study we tried to emphasize possible role of melanin in progression of these two disorders in the retinal tissues and inner ear. Early diagnosis and prompt treatment related to delay onset of ARMD and age related SNHL is essential for giving everybody a reasonable chance for living a long and enjoyable final part of life.

MATERIALS AND METHODS

A hospital based observational analytical case-control study done on 100 patients with symptoms of age related hearing loss who attended ENT OPD of Sardar Patel Medical College, Bikaner were enrolled as case. Age and gender matched individuals having normal hearing, visiting ENT OPD of SPMC, Bikaner with other symptoms were enrolled as Control. Informed consent was taken from the cases and controls after explaining the purpose and nature of the study.

Inclusion Criteria for Case

- Age 40 yrs or above
- Age related pure sensorineural hearing loss must be present.
- Willingness to be part of this study.
- Complaint of hearing loss must be chronic and gradual.

Exclusion Criteria for Cases and Controls

- Patient having complaint of active/chronic pus discharge (ASOM/CSOM).
- Patient having any other infectious reason of hearing loss.
- Based on history, patients with congenital, neonatal, infantile, traumatic or sudden hearing loss.
- Patient having conductive /mixed component of hearing loss.
- Patient of age <40 yrs.
- Not willing to be a part of the study.
- Known case of retinopathy and vasculopathy.
- History of traumatic or congenital retinal disorders.
- Any auditory or retinal problems related to toxic medications such as Furosemide or Chloroquine.
- Patients having subnormal mental status.

METHODOLOGY

Cases: 101 individuals having age related sensorineural hearing loss.

Controls: 101 age and gender matched individuals having normal hearing.

A detailed history about the patient's particulars (age, gender, address, etc.), any systemic illness, any otorhinolaryngological disease, medication intake was noted. Complete ENT examination and otoscopic examination of bilateral ear done. Tunning forks test like Rinne's test, Weber test conducted in bilateral ear of each patient. Each patient underwent for Impedence Tympanometry test to rule out middle ear pathologies, if any. Each patient then underwent pure tone audiometry (PTA) test at frequencies of 250, 500, 1000, 2000, 4000 and 8000 Hz.

Audiometric Data

Patients were all evaluated using standardized methods for pure-tone threshold audiometry by certified audiologists. Pure-tone average (PTA) was calculated as an average of the threshold measured at 0.5, 1.0, 2.0, 4.0, 8.0 KHz (speech frequencies).

Ophthalmological evaluation

Each enrolled individual (both case and control) underwent detailed ophthalmological workup. A detailed history regarding any ocular disease, any

toxic medications causing ocular problems, any congenital or neonatal oculopathy were noted. Dilated fundoscopy (with tropicamide and phenylephrine eye drop) was performed in every subject. Every enrolled individual underwent optical coherence tomography (OCT) in bilateral dilated eyes.

Statistical analysis

The Categorical data were presented as numbers (percent) and were compared among groups using the Chi-square test and odd's ratio is also calculated. The quantitative data were presented as mean and standard deviation and were compared by Students t-test. *P* value of less than 0.05 was considered statistically significant.

RESULTS

Our study showed that the mean age of cases was 64.71 ± 12.01 yrs whereas mean age of control was 59.57 ± 10.17 yrs and this difference was found to be statistically significant with p value 0.0001. The both groups were comparable in term of sex, residence and socioeconomic status (p value 0.885, 0.884 & 1.00 respectively) is not significant which signifies that distribution of SNHL does not depend on sex, residential area & socioeconomic status (table 1).

In cases, 19 (38.78%) ARMD patients were smoker whereas 30 (61.22%) were non-smoker, while in control group 2 (13.34%) were smoker whereas 10 (11.63%) were non-smoker. The association between smoking and ARMD was found to be statistically significant with odds ratio 7.895 and 95% confidence interval 1.557 – 40.026 in cases. Smoking is significantly associated with increased risk of occurrence of ARMD with 7.895 folds in cases (table 2).

Maximum 48.51% cases had ARMD whereas in controls only 12 (11.88%) had developed ARMD. The difference of development of ARMD in both groups was found to be statistically highly significant ($p<0.0001$) with odd's ratio 6.989 and 95% confidence interval 3.408-14.330. In our study, odds for ARMD in SNHL patients is 6.989 times higher than in those without SNHL (table 3).

The association between severity of hearing loss and ARMD was found to be statistically significant with P value 0.0001* (figure 1).

In the present study, there is significant association between moderately severe SNHL and drusen type of Dry ARMD (table 4).

Table 1: Demographic profile of cases and control group

		Cases (N=101)	Control (N=101)	P-value
Age (yrs) (Mean±SD)		64.71 ± 12.01	59.57 ± 10.17	0.0001*
Sex	**Male**	63 (62.38%)	61 (60.40%)	0.885
	Female	38 (37.62%)	40 (39.60%)	
Residence	**Rural**	36 (35.64%)	38 (37.62%)	0.884
	urban	65 (64.365)	63 (62.38%)	
SES	**I**	0 (0%)	0 (0%)	1.000
	II	10 (9.90%)	10 (9.90%)	
	III	23 (22.77%)	25 (24.75%)	
	IV	51 (50.50%)	48 (47.52%)	
	V	17 (16.83%)	18 (17.82%)	

Table 2: Association of ARMD with Smoking in cases and control group

ARMD	**Cases**		**Control**	
	Smoker (%)	**Non-Smoker (%)**	**Smoker (%)**	**Non Smoker (%)**
Present	19% (38.78)	30 % (61.22)	2% (13.34)	10 % (11.63)
Absent	18 % (34.62)	34 % (65.38)	13 % (86.66)	76% (88.37)
Total	37 (37)	64 (63)	15 (14.85)	86 (85.16)
P value	0.014*			

Table 3: Distribution of groups according to occurrence of ARMD

ARMD	**Cases**		**Control**	
	No.	**%**	**No.**	**%**
Present	49	48.51	12	11.88
Absent	52	51.49	89	88.12
Total	101	100	101	100
P value	0.0001*			

Table 4: Association between grade of hearing loss with type of ARMD

Grade of hearing loss	**DRY ARMD**		**WET ARMD**		**P-Value**
	Drusens	**GA+ Drusens**	**CNVM only**	**CNVM + MS**	
Mild SNHL	0 (0)	0 (0)	0 (0)	0 (0)	-
Moderate SNHL	10 (29.41)	0 (0)	0 (0)	0 (0)	-
Moderately severe SNHL	13 (38.24)	0 (0)	2 (66.67)	0 (0)	0.002
Severe	11 (32.35)	9 (100)	1 (33.33)	3 (100)	0.237
Total	34 (100)	9 (100)	3 (100)	3 (100)	0.296

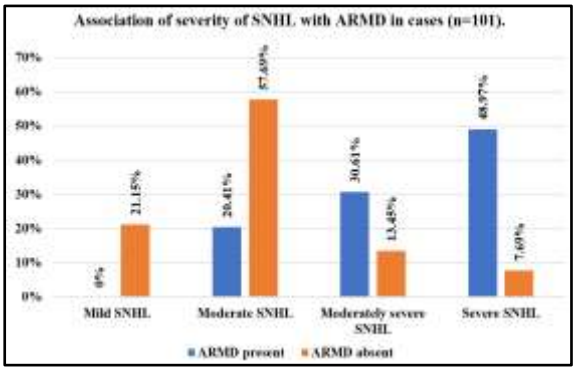

Fig 1: Association of severity of SNHL with ARMD in cases

DISCUSSION

The problems and consequences of age related hearing loss are compounded in the elderly as a result of additional degenerative processes in the central nervous system. This can result in a relative loss in neuronal plasticity, loss of cognitive abilities and other sensory modalities, in particular, sight.[2]

Age related hearing loss (presbycusis) is the loss of hearing that gradually occurs in most of us as we older. Age related hearing loss most often occurs in both ears equally. Similarly, age related macular degeneration is common, chronic progressive degenerative disorder of macula that effects older individual and features loss of central vision as a result of abnormalities in photoreceptor, retinal pigment epithelium, brusch's membrane, choroidal complex etc. Free radical and other reactive oxygen species are considered to be important causative factors in the development of both ARMD and ARHL. Relationship between visual impairment and hearing loss in older patient and combined adverse effect of this impairment on health related quality of life is needed to be studied.

In our study, mean age of cases distribution was 64 +/- 12.01 yrs whereas in control group, mean age was 59.57+- 10.17 and the difference was found to be statistically significant (p value 0.0001) and mean age of case distribution in the cross- sectional study conducted by Joon Mo Kim et al.[6] in Korea in 2019 was 66.02 yrs which is comparable to the present study whereas mean age distribution of control but mean age distribution in controls was 42.18 yrs which is not comparable with our results.

Therefore, distribution of age related sensorineural hearing loss is independent of gender. This result is similar to the retrospective cohort study conducted by Chia-Yi Lee et al.[7] in Taiwan in 2019 where majority of both cases 54.06% and controls 54.22% were male and again data was insignificant.

However, gender distribution is significant in cross-sectional study conducted by Joon Mo Kim et al.[6] in Korea where male prevalence is more (55.6%) in cases but female prevalence is more in control (54.8%) group, published in 2019. In Ronald Klein et al.[8] study as well, after adjusting age, men showed higher prevalence of sensorineural hearing loss than women (59.9% vs 33.2%) with which was statistically significant P value <0.001.

In our study, majority of both cases and control belonged to class IV socioeconomic status and P value is insignificant. Thus, distribution of SNHL is independent of socioeconomic status whereas socioeconomic status was significantly lower in the hearing-impaired group than in normal hearing group ($p<0.05$) in cross- sectional study conducted by Joon Mo Kim et al.[6] in Korea in 2019.

The present study showed that 36.3% of cases were smoker while only 14.85% of controls were smoker and association between SNHL and smoking was found to be significant statistically with P value 0.0001. Similar result was obtained from cross-sectional study conducted by Joon Mo Kim et al.[6] in Korea, published in 2019 and study by Adesh Kumar et al.[9] found 65.7% of smokers were significantly associated with hearing impairment, out of which sensorineural hearing loss was most common type (77.5%) and data was found to be statistically significant with P value <0.05. Therefore, chances of developing ARMD in SNHL patients increase by 7.895 times in smokers to that of non-smoker. According to Marina Istrate et al.[10], chances of occurrence of atrophic ARMD is 1.11 times, exudative ARMD is 1.16 times and sensorineural hearing loss is 1.10 times more in smoker as compared to non- smokers and data is statistically significant with p< 0.001. However, this study does not have any data regarding direct correlation in SNHL patients with smoking, developing ARMD.

Rihong Cong et al.[11] in a meta-analysis concluded that there was statistically significant association of smoking with increased risk of ARMD among cohort studies with relative risk 1.61; 95% CI (1.01-2.57) or case-control studies with relative risk 1.76; 95% CI (1.56-1.99). Similarly, according to Adesh Kumar et al.[9] found 65.7% of smokers were significantly associated with hearing impairment, out of which sensorineural hearing loss was most common type (77.5%) and data was found to be statistically significant with P value <0.05.

Therefore, in our study, odds for ARMD in SNHL patients is significantly higher (6.989 times) than in those without SNHL. According to Joon Mo Kim et al.[6] obtained that weighted prevalence of both early ARMD and late ARMD were significantly higher in hearing impaired groups with 10.6% and 1.6% respectively than in normal hearing group with 2.8% and 0.2% respectively; with P values <0.001 which is comparatively similar to our study.

Similarly, in a population-based cohort study, Chia-Yi Lee et al.[7] done in Taiwan in 2019, found out that incidence rate of ARMD in SNHL patient is significantly higher than those in non-SNHL patients with prominent crude relative risk of 1.411, 95% CI (1.255-1.587). Likewise, Ronald Klein et al.[8] summarized that prevalence of ARMD was 25.4% and of hearing loss was 45.0% in Beaver Dam valley, but both conditions were jointly present in 15.1% of

the population. Hearing loss and ARM were found in 39.5% of the population in >75 yrs of age. These results are also almost similar to our present study.

Various study has been done where ARMD subjects were screened for prevalence of sensorineural hearing impairment. Hassan Ghasemi et al.[12] found that there are significant differences in terms of hearing impairment between ARMD patients and control group (72.8% Vs 54.3% with p value 0.009). Simultaneous visual and hearing impairment in subjects older than 75 yrs was significantly higher in cases than in controls ($p<0.001$). Likewise M K Bozkurt et al.[5] found that the median PTA in the study group was significantly higher (60 dB SNHL) than that of control group (45 dB SNHL) with p value <0.001. Singh et al.[13] in a case series compared audiometric and vestibular changes between 10 cases of different types of ARMD with 10 normal individuals and concluded that 3 (30%) of ARMD patients had hearing impairment. Out of 3, 2 (20%) had mild SNHL and 1 (10%) had mild CHL. All of these results were not exactly comparable to the present study but somehow can be related reversibly. In the present study found that the association between severity of hearing loss and ARMD was found to be statistically significant with P value 0.0001. Therefore, our study shows highly significant association of ARMD with increased severity of hearing loss. This result is similar to the Hassan Ghasemi et al.[12] where they demonstrated hearing loss of 49.92+- 27.34 dB SNHL in cases at 8000 Hz frequency and data was highly significant. Likewise, this result is parallel to study conducted by M K Bozkurt et al.[15] in Turkey concluded that median PTA in ARMD patients were significantly higher (60 dB SNHL) i.e. moderate hearing loss than non-ARMD individuals (45 Db SNHL) i.e. mild hearing loss.

According to Hassan Ghasemi et al.[12] found higher frequencies loss is significantly associated with exudative ARMD than those of non-exudative ARMD and this result is similar to the present study. They demonstrated an increase degree of hearing loss in exudative, CNVM and scar patterns of ARMD with is very alike to this study. Bozkurt et al.[15] also proposed that late ARMD was more likely associated with hearing impairment, however, they didn't weigh different stages of ARMD based on OCT and fundus photography findings. Ronald Klein et al.[8] concluded that the odds for hearing loss were 3.76 times greater in exudative macular degeneration and odds for hearing loss were 3.15 times higher in late ARMD and results were comparable to this study.

CONCLUSION

We concluded that age related macular degeneration is more commonly associated with patients with age related sensorineural hearing loss, smokers being mostly affected with male predominance. Dry type ARMD is more common; drusen being commonest one. Drusen type of dry ARMD is most commonly associated with moderately severe grade of SNHL. Bilateral ARMD presentation is associated with increased severity of hearing loss. Increased degree of hearing impairment is associated with geographical atrophy, CNVM and scar pattern of AR.

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