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Impact Of Alcohol On Auditory Threshold – A Cross Sectional Study.

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ABSTRACT

In general, approximately 2 billion of the world's population consumes alcohol and 76.3 million people have alcoholic disorders. Alcohol affects almost all organs of the body and causes cirrhosis, peripheral neuropathy, hypertension, myocardial infarction and also hearing loss. The aim of the study is to analyze the hearing loss in alcoholic men and non-alcoholic men by using Pure tone audiometry and smart DPOAE. A total of 134 subjects (25 to 55 years) were included in the study, of which 67 alcoholic men were in the study group and 67 healthy non- alcoholics were controls. The study subjects were selected by an AUDIT questionnaire. Alcoholic men who were diabetic, hypertensive, smoker and subjects using ototoxic drugs were excluded from the study. Audiometric thresholds were recorded by using pure tone audiometer and smart DPOAE. 44 out of 67 alcoholics and only 5 non-alcoholics were affected with sensorineural hearing loss ($p<0.0001$). There is a significant increase in auditory thresholds in alcoholics ($p<0.0001$). The results suggest that alcoholics were affected by high frequency (above 4 KHz) sensorineural hearing loss. The hearing loss is directly related to the duration, amount, type, occupation and age of alcoholics

Keywords: Sensorineural hearing loss, Auditory thresholds, Puretone audiometry, Distortion product otoacoustic emission.

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INTRODUCTION

Alcohol is one of the worldwide medical and social problems. Worldwide, about 2 billion people are consuming alcoholic beverages and 76.3 million people have alcoholic disorders. Around 2.3 million people die because of alcohol related disorders. The deaths due to alcohol constitute around 3.7% of all deaths [1]. About 20 to 30% of adult male and 5% of adult females are consuming alcohol in India. About 28% of traffic injuries are due to alcohol, according to a study conducted recently in Bengaluru [1]. Due to alcoholism there are around 6 % of alcoholic deaths and 7.4% of DALYs (Disability Adjusted Life Years) in men, and 1.1% of alcoholic deaths and 1.4% of DALYs in women. Worldwide, alcohol is responsible for 20% of motor vehicle accidental deaths (Global Health Risks by WHO) [2].

One of the studies in the U.S. shows that, by the eighth grade 46% of adolescents tried the consumption of alcohol and 77% of the adolescents had begun to drink by high school, pertaining to the easy availability of alcohol at ease [1]. In Tamilnadu also, there is an increase in alcohol related disorders, especially the deaths due to drunken driving [1]. Consumption of alcohol is associated with physical, psychological and social problems. The metabolic effects are mainly due to the production of free radicals from the alcohol metabolism affecting directly and indirectly almost all organs [3]. It also causes impairment in cognitive functions. According to the World Health Organization, more than 360 million people have moderate hearing impairment to profound deafness [4]. It is very important to detect the Sensorineural hearing loss (SNHL) in an early stage, so that we can take appropriate measures and arrest its progression. Some studies have even demonstrated the reversibility of hearing loss following early detection and intervention [5].

Alcohol consumption causes tolerance to the sound. Several investigators have reported that acute and chronic alcohol intake in larger doses, causes alterations in the auditory brainstem potentials and auditory middle latency responses. Some studies also showed that there is a temporary reduction in the otoacoustic emission amplitudes at high frequencies, when alcohol is consumed at toxic levels. The studies of Curgan SG, et al [6] and Lohle E, et al [7] proved that alcohol causes deficiency of vitamin B12 and vitamin A and therefore causes sensorineural hearing loss. Sandra Beatriz et al [8] study showed that alcohol abuse in the long term causes damage to the outer hair cells, who also reported that the moderate level of alcohol consumption prevents the disturbances in the cochlear blood flow in addition to having the cardio protective effect like antithrombotic activity [6]. The basic and gold standard procedure to evaluate the auditory threshold measurement is pure tone audiometry. In India, there are very few studies regarding the hearing impairment associated with alcohol intake. The purpose of this study was to evaluate the relation between alcohol use and hearing loss in men.

Aims and Objectives

- To compare the hearing ability among alcoholics and normal individuals by using Pure tone audiometry and Distortion product otoacoustic emission test (DPOAE).
- To identify the sensorineural hearing loss among the alcoholics.
- To evaluate the correlation between the duration of alcoholism and hearing impairment

MATERIALS AND METHODS

This is a cross sectional study conducted in the Department of Physiology, Coimbatore Medical College, Coimbatore along with the Department of Otorhinolaryngology and Department of Psychiatry, Coimbatore Medical College Hospital, Coimbatore. The study was conducted from August 2013 to June 2014. Before the start of the study, the approval was obtained from the ethical committee of the Coimbatore Medical College Hospital. A total of 134 subjects (males) in the age group of 25 to 55 years were included in the study and divided into control and study groups, comprising 67 in each group. The 67 apparently healthy males who have never consumed alcohol were included in the control group (college students, office staff, businessmen and coolies). The study subjects who were alcoholics of more than 2 years of duration were selected from the outpatient department of Psychiatry, Coimbatore medical college, Coimbatore who were coming for deaddiction therapy. They were selected by using AUDIT Questionnaire [9]. Patients who were above 60 years of age were excluded. The subjects who had diabetes mellitus, hypertension, ear infections, any congenital anomalies of ear and those on treatment with ototoxic drugs were excluded. The workers with the history of occupational exposure to noise were excluded from the study. Written informed consent was obtained from all participants. Otoscopic examination of the ear was

done with the otoscopy by the Otorhinolaryngologist. It included the examination for the presence of any infections of the ear like otitis media, otorrhoea, ear wax, any foreign body, any abnormality in the external auditory meatus, bleeding and injury or abnormality of the tympanic membrane.

Tuning fork tests (Rinne's and Weber's test) were done to all participants. In both the cases and controls, the Puretone audiometry was done in the soundproof room at the department of Physiology, Coimbatore medical college, Coimbatore. According to the recommendations of the American Speech language and Hearing Association, the calibration of the MAICO MA 52 clinical digital audiometer was checked and the audiometric testing was conducted and DPOAE recordings were done in the Department of Otorhinolaryngology, Coimbatore Medical College Hospital, Coimbatore uses Grason Staddler (GS I) device (smart DPOAE) with Intelligent hearing system software. The audiometric findings and DPOAE recordings were collected and recorded in a Master Chart.

The Data analysis was done using the Epidemiological Information Package (EPI 2010) produced by Centre for Disease Control, Atlanta. Using this software frequencies, range, percentages, standard deviations, means, 'p' values and chi square were calculated. Unpaired 't' test was used to analyze the significance of differences between quantitative variables. For qualitative variables, Yate's and Fisher's chi square tests were used. A 'p' value less than 0.05 is taken to denote a significant relationship between the variables.

RESULTS

The present study was conducted in the Department of Physiology, Otorhinolaryngology, and the Department of Psychiatry, Coimbatore Medical College Hospital, Coimbatore. A total of 67 healthy males and 67 alcoholic males were included in the study. Group A - 67 cases of alcoholic males. Group B - 67 controls, age matched males. The hearing loss for both groups were assessed by pure tone audiometer and DPOAEs. It was found that alcohol causes sensorineural hearing loss at a high frequency of more than 3000Hz. With pure tone audiometry there is a significant ($P<0.001$) hearing loss among the alcoholics (65.7%) when compared with the Non-alcoholics (7.5%) (Table 1). The DPOAE recordings also showed that there is a significant ($P<0.001$) hearing loss among the alcoholics (62.7%) when compared with the Non-alcoholics (7.5%) (Table 2). Also there is a significant ($P<0.001$) hearing loss among the alcoholics with regards to the duration of alcohol intake (Table 3). The hearing threshold of the alcoholics had increased and caused bilaterally equal minimal to mild hearing loss. The right ear was slightly more affected in the alcoholics when compared with the left ear (Table 4). Table 5 shows the intake of alcohol causes minimal to mild hearing loss when compared to the non- alcoholics.

DISCUSSION

This study shows that there is a significant association ('p' value <0.0001) of alcohol intake with hearing impairment. According to the pure tone audiometry findings, 65.7% of alcoholics were with hearing impairment, when compared with the controls who had only 7.5% affection. By using DPOAE, it was found that 62.7% of alcoholics were affected by hearing loss, while only 7.5% of non-alcoholics were affected. The higher frequencies were more affected when compared with the lower frequencies. Sandra Beatriz et al [6], Kavitha Ashok Kumar et al [10], Tahwinder Upile et al [11], Marcieli Belle et al [12], Perez et al [13] have observed the auditory effects of alcohol and suggested that there is a strong relationship between alcohol and hearing loss.

Kavitha Ashok Kumar et al found that absence of emissions in 76.6% of alcoholics in their DPOAE test [10] suggesting that alcohol causes damage to the outer hair cells of the cochlea and also proved that the sensorineural hearing loss was seen in high frequencies like 4000Hz to 8000Hz. Due to the high frequency loss, which was above the normal speech frequency, the alcoholics never complained of hearing loss, because they didn't realize the hearing impairment. J.H.Hwang et al demonstrated that DPOAE amplitudes in higher frequencies were decreased after moderate alcohol consumption (1.2 g/Kg) [14]. The audiological assessment done by Sandra Beatriz et al [8] using Puretone audiometry proved that higher frequencies above 3000Hz were more affected in alcoholics and also found the absence of TEOAE recordings more in alcoholic subjects when compared to the controls. The study by Roshan K Varma also confirms the elevation of auditory thresholds in the alcoholic subjects [15]. In contrast, Tahwinder Upile et al suggested that the lower frequencies like 1000Hz were also affected by alcohol which was the frequency to discriminate vowels [11].

The present study indicates that the duration of consumption of alcohol also influences hearing loss. Whenever the duration of intake of alcohol increases, hearing impairment also increases ('p' value <0.0001 Significant). Among the study group, 22.2% of cases with less than 5 years duration had hearing loss, but all the 7 cases (100%) who had more than 20 years of alcohol intake were affected. These findings are similar to that of Sandra Beatriz et al [8], Marcieli Belle et al [12], Golabek et al [16] and Wheeler et al [17] who observed more incidences of hearing impairment and high frequency hearing loss in subjects who consumed alcohol for longer periods [8,12]. In contrast, Kavitha Ashok Kumar et al [10] and Rossi et al [18] found that there was no relationship between duration of alcohol and severity of hearing loss. The hearing loss reported may be due to the long term exposure to alcohol resulting in an ototoxicity affecting cochlear function harming specially the external hair cells.

Alcohol not only affects the central nervous system, but also the functions of outer hair cells. The possibilities of outer hair cell damage caused in alcoholism are as follows,

- Alcohol and its metabolites cause disturbances in the endocochlear environment and abnormal outer hair cell motility [14].
- Alcohol enhances the inhibitory transmission via GABA A type receptors and suppresses the excitatory transmission via N-Methyl D-aspartate receptors [3,14].
- Alcohol affects the middle ear muscles and thereby affects the acoustic reflex thresholds [10,14].

Prestin is a transmembrane protein that mechanically contracts and elongates leading to electromotility of outer hair cells (OHC). The toxic effects of alcohol occur in the basal turns of the cochlea [8]. The absence of otoacoustic emissions indicated that the damage occurred in outer hair cells in the organ of Corti. Alcohol acts centrally by involving the temporal and binaural summation of auditory signals and also peripherally by acting on outer hair cells [11]. The acute changes in hearing loss were completely reversible, whereas chronic alcoholic changes were irreversible [11,14]. Long-term exposure to alcohol abuse causes ototoxicity, which affects cochlear function, particularly by damaging the outer hair cells [7]. DPOAE measurements were more sensitive than conventional audiometry for detecting the minor and early changes in the outer hair cells [14]. This study confirms that the consumption of alcohol leads to sensorineural hearing loss for higher frequency sound.

Table 1: Hearing Loss as per Pure Tone Audiometry in Cases and Controls

Group	Hearing Loss			
	Present		Absent	
	Numbers	%	Numbers	%
Group A	44	65.7	23	34.3
Group B	5	7.5	62	92.5
'p'	<0.0001 Significant			

Table 2: Hearing Loss as per DPOAE recordings in Casesand Controls

Group	Hearing Loss as per DPOAE			
	Present		Absent	
	Numbers	%	Numbers	%
Group A	42	62.7	25	37.3
Group B	5	7.5	62	92.5
'p'	<0.0001 Significant			

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Table 3: Effect of duration of alcoholism on hearing

Duration of Alcoholism	Number of Subjects	Hearing Loss			
		Present		Absent	
		Mean	SD	Mean	SD
Up to 5 yrs	9	2	22.2	7	77.8
6 – 10 yrs	12	6	50	6	50
11 – 15 yrs	21	12	57.1	9	42.9
16 – 20 yrs	18	17	94.4	1	5.6
>20 yrs	7	7	100	-	-
Duration (years)					
Mean		15.98		9.09	
SD		5.84		4.22	
'p'		**<0.0001 Significant**			

Table 4: Hearing Threshold in Alcoholics and Non-Alcoholics

Group	Hearing Threshold (Hz)			
	Right ear		Left ear	
	Mean	SD	Mean	SD
Group A (Alcoholics)	18.32	5.73	18.03	5.5
Group B (Non- Alcoholics)	11.63	2.54	12.25	2.39
'p'	**<0.0001 Significant**		**<0.0001 significant**	

Table 5: Hearing loss among Alcoholics and Non-Alcoholics

Hearing Loss	Group A	Group B
Normal hearing	23	62
Minimal hearing loss	39	5
Mild hearing loss	5	0
Moderate hearing loss	0	0
Moderately severe loss	0	0
Severe hearing loss	0	0
Profound deafness	0	0

CONCLUSION

Alcohol is one of the leading causes of death in human beings. It affects all systems of the body, including the special senses like hearing. Alcohol affects hearing not only via the central nervous system, but also by influencing the function of outer hair cells. The study also suggested that alcohol affects the central auditory system by inhibiting the excitatory transmission via N-Methyl D-aspartate receptors. Alcohol affects the peripheral auditory system by altering the prestin, a motor protein in the outer hair cells and reduces the cochlear amplification and electro motility of the outer hair cells.

Hearing loss can interfere with the quality of life, restricting the ability to interact with others. This leads to stress and misunderstandings in communications. The study confirms the positive correlation between alcoholism and hearing loss. As per the saying "Prevention is better than cure", early detection of hearing impairment among the alcoholics is essential, as appropriate management can improve their quality of life. The outcome of this study will raise the awareness among the alcoholics regarding the hearing loss and prevent the further progression of hearing impairment.

Henceforth, for prevention of hearing loss in alcoholics, the first step is the abstinence of alcohol by giving prompt health education regarding the risks through outpatient counseling [19]. This study suggests that PTA and DPOAE tests are the basic and gold standard tests to detect hearing loss in the early

stage, so as to start the treatment earlier and cure the damage of the auditory pathway, as in later periods, this hearing loss will become incurable.

Limitation

In the present study sensorineural hearing impairment is detected by using pure tone audiometry and DPOAEs which are basic screening methods. The early signs of hearing loss could be detected by high frequency audiometry which is more sensitive and accurate than conventional audiometry. Pure tone and speech audiometry or Brainstem evoked response audiometry may help to further demonstrate the actual hearing pathways (central and/or peripheral) affected by alcohol. A longitudinal study with a large sample size involving the women, younger men, and other racial groups will be of great value to demonstrate the relation between alcohol intake and hearing impairment.

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