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Relationship Between Serum Lipid Levels and Sensorineural Hearing Loss

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Abstract: This study was conducted on 60 patients aged between 30-60 years with SNHL attending Otorhinolaryngology outpatient department at Krishna Medical College and Research Center, Karad from 2014-2017. There was no statistical significance for Total Cholesterol and Triglycerides among various degree of SNHL in both males and females. The low-density lipoprotein serum amount was weak in the moderate sensorineural hearing loss and strong in extreme sensorineural hearing loss in both sexes and thus specifically associated with the extent of sensorineural hearing loss degree. The high density lipoprotein serum levels were found to be high in a mild group and low in severe sensorineural hearing loss in both gender and thus negatively correlated with sensorineural hearing loss degree.

INTRODUCTION

Modern lifestyles present new challenges to the usual physiological mechanisms of the human body. Jones and Davis (1999) in their study on the correlation between hyperlipidemia and Sensorineural Hearing Loss (SNHL) found no consistent association between hyperlipidemia and hearing loss. On the other hand Lee *et al*. (1998) their study noted that the hearing level was 5 dB better in women with high ratio of LDL-HDL than in those with a low ratio. The study was designed to demonstrate the requirement for early detection of hyperlipidemia in patients with SNHL who previously were not in physician treatment.

Aim and objectives: To study the relationship between degree of sensorineural hearing loss and serum level of total cholesterol, triglycerides, HDL (High Density Lipoprotein) and LDL (Low Density Lipoprotein) in patients, attending Otorhinolaryngology outpatient Clinic at Krishna Institute Of Medical College Hospital and Research Center, Karad.

Literature review: Zamarro *et al*. (1993) in a cross-sectional study on occupational noise exposure and hypercholesterolemia conducted in a group of 1209 workers exposed to industrial noise found a strong relationship between severe noise induced hearing loss and hypercholesterolemia in all the workers. They support the point of view that the age is an important confounding factor, and in their study there is no relation between noise induced hearing loss and hypercholesterolemia.

Namyslowski *et al*. (2003) in their study to estimate the influence of lipid balance disorders on the small blood vessels of the brain and inner ear in the patients with hypercholesterolemia and hypertriglyceridemia on the base of the audiometric, ABR and TEOAE evaluations. They observed no statistical significant differences

between the mean auditory thresholds in the study and control groups as well as statistical negative correlation between cholesterol serum level and amplitudes of TEOAE. Temporal bone forms a significant portion of base of skull extending from lateral calvaria at the level of external auditory canal to almost the centre of the skull as it articulates with basi-sphenoid. Cranial nerves V to XII course about or through the temporal bone; the middle cranial fossa contents lie on its superior surface and the posterior cranial fossa contents lie on its posterior surface. The internal carotid artery travels through it and internal jugular vein originates within the temporal bone through the jugular foramina.

As the basilar membrane and the spiral ligament reaches the end of hamulus they continue to complete at the apex ultimately ending on the oblique and vertical portion of the interscalar septum. This then creates an oblique channel known as helicotrema formed half by the inner edge of the hamulus of the osseous spiral lamina and half by the end of scala media CSF may mix with the perilymph through two routes; the cochlear aqueduct and the modiolus. The route through the cochlear aqueduct is direct, the route through the modiolus is serpinginous, beginning in the fund us of internal auditory meatus and passing through the spiral tract of foramina in the cochlear area inferior to the horizontal crest. It then goes directly to osseous spiral lamina at the basal turn of cochlea or through the longitudinal modiolar canals to the middle and apical turn following the nerve fibres. From there the route extends along the osseous spiral lamina, to the habenula perforata at the end of the lamina ultimately entering the organ of corti.

The blood supply to the organ of corti and other structures of cochlear duct is provided by vessels within the stria vascular is and also the spiral vessels underlying the basilar membrane and the spiral limbus. The main cochlear artery enters through the modiolus along with the VIII nerve fibers. Arterioles divide at the level of spiral lamina, with one group of vessels proceeding to a position underlying the basilar membrane. The second arteriolar system travels within the periosteal lining across the wall of scala vestibuli to the region of spiral ligament. At this point the arterioles break up to form three capillary networks along the lateral wall of peri-otic labyrinth. The first group of vessels supplies the region of spiral ligament immediately above the insertion of Reissner's membrane. The second group of vessels forms a highly anastomosed capillary bed of stria vascularis. The third set of capillaries supplies the vessels of spiral prominence. It may be noted that neither the organ of corti nor the corti lymphatic space has blood supply.

There are two essential physiological processes in Cochlea namely transmission and transduction. The former accounts for the transfer of acoustic energy from the oval window to the hair cells while the latter is the process by which this sound energy pattern is converted at the organ of Corti into action potentials in the auditory nerve.

Travelling wave theory of Von Bekesy: If vibrations of the basilar membrane are observed, a travelling wave is seen to start at the base of the cochlea and progress toward the helicotrema with increasing amplitude to a region of maximum displacement, the position of which depends upon the frequency.

Helmholtz's resonance place theory: This theory is disproved because basilar membrane cannot act as a resonator.

Rutherford's telephone theory: This theory suggests that pitch perception is based on the rate of firing of individual nerve fibers.

Wever's volley theory: This postulates that high frequencies are perceived by place alone in the basal turn, low frequencies (below 1000) stimulate nerve action potentials at a rate equal to the stimulus frequency while intermediate frequencies are presented in the auditory nerve by asynchronous discharge in groups of neurons whose combined activity represents the frequency of the stimulus.

MATERIALS AND METHODS

Hospital based study was performed with 60 cases of patients aged between 30-60 years with sensorineural hearing loss attending Otorhinolaryngology outpatient department at Krishna Medical College and Research Center, Karad from 7th August, 2014 to 31st January, 2016.

Patients between age group 30-60 years with sensorineural hearing loss who are attending Otorhinolaryngology outpatient department at Krishna Institute of Medical Sciences, Krishna Hospital and MRC, Karad, Maharashtra after excluding certain patients mentioned under exclusion criteria by history, clinical examination and relevant investigations.

RESULTS AND DISCUSSION

About 60 patients aged between 30-60 years with sensorineural hearing loss attending Krishna Medical College and Research Center, Karad from 2014-2016 were studied. Observations recorded in the study are described under the following heading (Table 1).

Age ranged from 30-60 years. Out of 8 cases below 40 years of age, 5 were of mild SNHL and 3 were of

Table 1: Association between age groups and degree of SNHL

Age groups (years)	MiD	Percentage	MD	Percentage	MsD	Percentage	SD	Percentage	Total	Percentage
<40	5	62.50	3	37.50	0	0.00	0	0.00	8	13.33
41-45	4	33.33	6	50.00	2	16.67	0	0.00	12	20.00
46-50	0	0.00	9	69.23	4	30.77	0	0 .00	13	21.67
51-55	1	5.26	8	42.11	7	36.84	3	15.79	19	31.67
56-60	0	0.00	2	25.00	4	50.00	2	25.00	8	13.33
Total	10	16.67	28	46.67	17	28.33	5	8.33	60	100.00

$\chi^2 = 7.5954$, $p = 0.1076$

Table 2: Sex wise distribution of patients

Sex	No. of patients	Patients (%)
Male	35	58.33
Female	25	41.67
Total	60	100.00

moderate SNHL. Among 12 patients in the age group of 41-45 years 4 were of mild SNHL, 6 were of moderate SNHL and 2 were of moderately severe SNHL. Out of 13 cases in the age group 46-50 years 9 were of moderate SNHL and 4 were of moderately severe SNHL. Among 19 cases in the age group 51-55 years 1 was of mild SNHL, 8 were of moderate SNHL, 7 were of moderately severe SNHL and 3 were of severe SNHL. Among 8 cases in the age group 56-60, 2 were of moderate SNHL, 4 were of moderately severe SNHL and 2 were of severe SNHL. On decade wise grouping, we found maximum number of patients between 51-55 years. Out of 60 patients 35 (58.33%) were males and 25 (41.67%) were females. The male to female ratio was 1.4:1 (Table 2).

The results of this study show that there are significant alterations in the lipid profiles among different degree of sensorineural hearing loss. The numbers of male and female patients studied by Suzuki *et al*. (2000) were 607 and 317, respectively and the male: female ratio was 1.91:1. The mean Total Cholesterol values among various groups of SNHL in both males and females in the above studies were not statistically significant. In our present study there was no statistical significance among various degree of SNHL in accordance with the above mentioned studies. In the present study the mean triglyceride levels among various degree of SNHL were not statistically significant in accordance with the above mentioned studies.

Suzuki *et al*. (2000) found mean HDL to be 54.6±14 and 66.5±15 in the male and female patients, respectively. The present study revealed mean HDL in male and female patients to be 39.86±10.93 and 45.60±13.26, respectively. These values were statistically significant (p-0.001).

Expert Panel on Detction Evaluation and Treatment of High Blood Cholesterol in Adults (2006) no hearing association with total cholesterol or triglycerides was documented but HDL was negatively associated with hearing rates in women. Comparing the various lipid parameters with NCEP Adult Treatment Panel III guidelines (Grundy *et al*., 2004; Gates *et al*., 1993) it can be noted that Total Cholesterol and Triglycerides in both sexes are within normal limits among different degrees of hearing loss. The serum levels of LDL is found to be near optimal in mild, moderate and moderately severe hearing loss whereas it is found to be borderline high in case of severe hearing loss groups. In the present study the Total Cholesterol and Triglycerides levels were not found to be statistically significant. Whereas the HDL levels were high and LDL levels were lower in mild SNHL compared to severe SNHL which is similar to the above study.

These findings indicate that a low serum HDL and high LDL are correlated with microcirculatory disruptions of the cochlear vasculature correlated with atherosclerosis and decreased cochlear sensitivity to noise (Sutbas *et al*., 2007).

CONCLUSION

In this study change in various fractions of lipoprotein was studied in different degrees of sensorineural hearing loss. The male: female ratio in this series is approximately 1.4:1. The serum levels of Total Cholesterol and Triglycerides does not influence the severity of sensorineural hearing loss. Serum LDL levels correspond significantly with the extent of sensorineural hearing impairment of both sexes. The serum HDL levels contribute adversely to the extent of sensorineural hearing impairment of both sexes. In the light of the study, a consistent evaluation of the serum rates of LDL, HDL in patients with sensorineural hearing loss is required and appropriate care should be given to avoid further development of sensorineural hearing loss.

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