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Sensorineural Hearing Loss and Type 2 Diabetes Mellitus

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Abstract:

Background:

Diabetes mellitus is one of the most common metabolic disorders which develops from complete or partial insulin deficiency, resulting in elevated blood glucose levels associated with long-term vascular and neurological complications. The link between Sensory neural hearing loss and diabetes mellitus is highly controversial. Sensory neural hearing loss occurs due to damage to the inner ear or the auditory nerve pathways, often resulting in difficulty hearing soft sounds and understanding speech, particularly in noisy environments. Type 2 diabetes, on the other hand, is a metabolic disorder characterized by high blood sugar levels and insulin resistance. Type 2 Diabetes Mellitus has an increased risk of Microvascular Damage, leading to SNHL,Neuropathy, Inflammation, Oxidative Stress, atherosclerosis, and other shared risk factors like aging, obesity, and Cardiovascular issues. Some studies have suggested that vitamin D also has a role in maintaining the health of the auditory system. Our study, therefore, aims to assess HbA1c and Vitamin D in patients of SNHL with type 2 Diabetes to observe and report any significant deviations in the same as compared to healthy controls.

Material and method

Patients aged 30 to 45 years with sensorineural hearing loss with Type 2 Diabetes Mellitus attending the ENT outpatient department in SGT Hospital, Budhera, Gurugram, India, were studied. A total of 22 cases and 22 control from the general population were enrolled in the study. Estimation of Glycated hemoglobin (HbA1C) was assayed by an enzymatic method in auto analyzer Trace using commercially available kits, and Vitamin D was performed by Competitive ELISA kit. (Elabscience, USA).

Results:

Our study showed that patients with high HbA1c levels had an increased incidence of SNHL compared to the controls($p<0.001$). Similarly, Vitamin D was significantly decreased in the patients with SNHL compared to the control subjects($p<0.001$).

Conclusion:

Our study clearly showed that SNHL was more frequently found in the Diabetes population when compared with the control association. It was also found that vitamin D was decreased in SNHL patients with Type 2 Diabetes. HbA1c is usually used to estimate long-term blood glucose control and is basically used as an diabetic management indicator. Increased HbA1c Levels are usually related to poorer blood sugar control, which will

lead to the risk of complications related to Diabetes, such as vascular damage, Neuropathy, and Inflammation. All these factors can lead to damage to blood vessels and nerves of the inner ear, reducing blood flow to the delicate structures of the inner ear and nerves responsible for hearing. Similarly, in our study, it was found out that with Increasing HbA1c levels, SHNL was also worsening. Therefore, we suggest early screening of Diabetes mellitus. additionally, managing Diabetes effectively through lifestyle changes as well as medication can help reduce the risk of Diabetes related complications, including those that can affect hearing.

Keywords: *Sensory Neural Hearing Loss, Type 2 Diabetes Mellitus, Vitamin D.*

Introduction

Sensorineural hearing loss (SNHL) is a type of hearing impairment thatusually results from damage to the inner ear or the auditory nerve pathwaysthat connect the inner ear to the brain. This type of hearing loss is typically permanent, and therefore, it can result in complications like perceiving sound and understanding speech; on the other hand, Type 2 Diabetes is a metabolic disorder that develops from complete or partial insulin deficiency resulting in elevated blood glucose levels associated with long term vascular and neurological complications. There is a possible connection between Type 2 diabetes and Sensorineural hearing loss (SNHL), and a potentially high prevalence of complications such as Diabetes mellitus if reported, will therefore lead to assure the physicians of the importance of Early screening for these complications in all Type 2 diabetics patients, for appropriate implementation of early treatment without delay so thatwhich leads to a decreased quality of life among those affected[1,2].

Material and method

Patients aged 30 to 45 years with sensorineural hearing loss attending the ENT outpatient department in SGT Hospital, Budhera, Gurugram, India, were studied. During the study period of one year, from January 2022 to December 2022, a total of 58 patients were included.

Study Design: - Hospital-based observational study

Patients visiting ENT OPD suffering from Type 2 Diabetes mellitus undergo ENT clinical examination with pure tone audiometry. Hearing loss is accessed (sensorineural or conductive hearing loss). Patients visiting ENT OPD undergo clinical ENT examination to rule out patients with perforations.Approximately 5 ml of venous blood will be drawn from all participants in the research following 12-14 hours of overnight fasting, adhering to stringent aseptic measures. The blood will be divided into an EDTA vial and a plain vial. The EDTA blood will be utilized for the assessment of HbA1C (Glycated hemoglobin) using an enzymatic method, while vitamin D levels will be determined through the ELISA method. The data obtained was entered into the spreadsheet and the statistical analysis was performed by using Statistical Package for the Social Sciences (SPSS) version 27.0. Continuous variables were summarized in the form of means and standard deviations. Bar diagrams presented graphical data. Student's independent t-test was applied for comparative study of HbA1c and Vitamin D between SNHL patients with Type 2 Diabetes and the healthy controls. The p-value ($p< 0.05$) was considered statistically significant for all the parameters

Exclusion Criteria

• Hearing loss before onset of Diabetes.

• Sudden onset of hearing loss.

• History of ear discharge.

• Family history of hearing loss.

• Patients with history of head trauma, radiotherapy, oto-toxic drug intake, hypertension, thyroid disorders, noise exposure.

Study design An observational study.

Statistical analysis

Result of various biochemical parameters were calculated by using statistical Package for Social Science version 27. Mean±S.D were calculated for all the parameters analyzed, compared by Student's t-test, and correlated by Pearson's correlation coefficient. The P-value considered significant were as follows: P<0.001-highly significant, P<0.05- Significant.

Results

The findings from our research indicate that individuals with sensorineural hearing loss (SNHL) and Type 2 Diabetes exhibited markedly elevated HbA1c levels and deficient Vitamin D levels in contrast to a healthy control group. The cohort consisted of Type 2 Diabetes patients with SNHL (n=22) and a matched group of healthy controls (n=22), all falling within the age range of 30-45 years. The average HbA1c level in SNHL patients was (8.91±2.01), markedly higher than the healthy control group (4.76±0.54). Additionally, a direct association was identified, indicating that as HbA1c levels increased, the severity of SNHL also worsened

Fig:1- Comparison of Vitamin D level in SNHL patients with Type 2 Diabetes Patients and Healthy Control

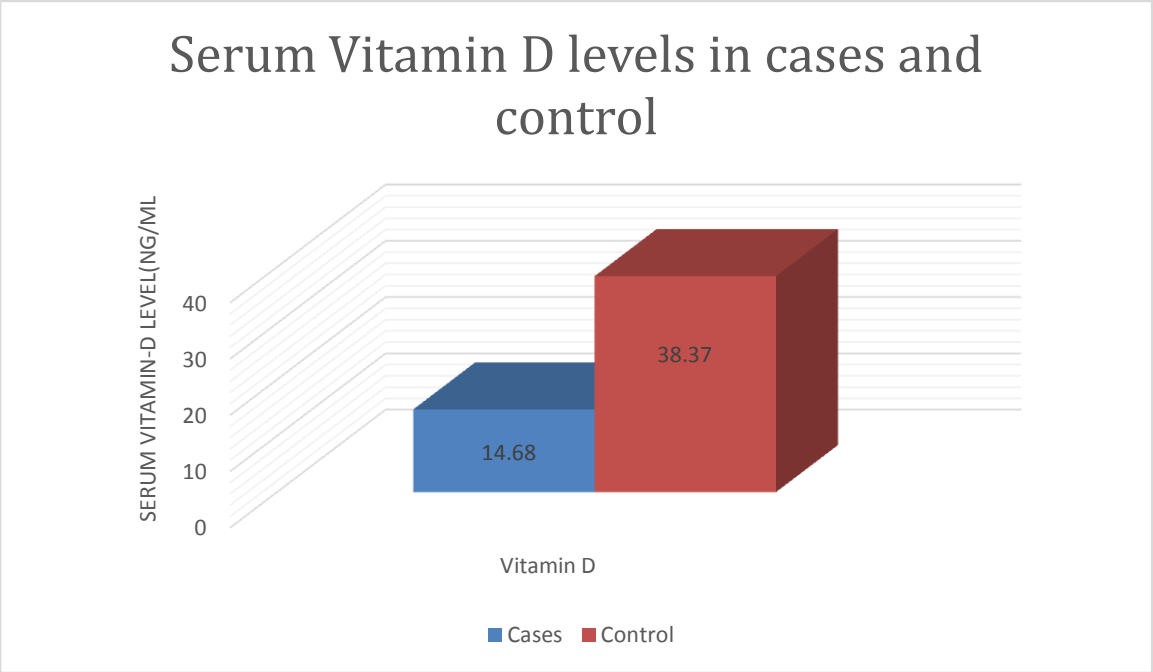

Table:-1 Comparison of HbA1c and Vitamin D level in SNHL patients with Type 2 Diabetes Patients and Healthy Control

Parameters	Cases(Mean±SD)	Control(Mean±SD)	t-value	p-value
VIT D	14.68± 4.66	42.45± 10.37	-11.45	<0.01
HBA1C	8.91± 2.01	4.76± 0.54	9.325	<0.01

Table:-2 Deafness with respect to HbA1c

HbA1c	Number of Cases	SNHL
6.5-7.5	7	Slight(16-25dB)

7.5-8.5	4	Mild(25-40db)
8.5-10	6	Moderate(40-65 db)
>10	5	Severe(65-90db)
Total	22	

In 22 Type 2 Diabetic Patients Deafness with respect to HbA1c was taken it was found that 5 Patients with HbA1c >10had severe SNHL, 6 patients with HbA1c value 8.5-10 had moderate SNHL, 4 patients with HbA1c value between 7.5-8.5 had mild SNHL and 7 patients with HbA1c value 6.5-7.5 had slight SNHL.

In our study of 22 individuals, both Pearson and Spearman correlation analyses between HbA1c and SNHL revealed very strong positive correlations (Pearson: r = 0.944, Spearman: r = 0.967). Both analyses showed highly significant p-values ($p < 0.001$), indicating robust statistical significance. This suggests that as HbA1c levels increase, there is a notable and significant tendency for the severity of sensorineural hearing loss to also increase, and vice versa. The significance level is expressly indicated as "** Correlation is significant at the 0.01 level (2-tailed)," providing compelling evidence against the null hypothesis at the 0.01 significance level.

HbA1c is commonly employed to gauge extended blood glucose control and serves as a key indicator in the management of diabetes. Elevated HbA1c levels are generally associated with suboptimal blood sugar control, heightening the susceptibility to complications linked to diabetes, including vascular damage, neuropathy, and inflammation. These factors collectively have the potential to harm the blood vessels and nerves within the inner ear, diminishing blood flow to the delicate structures and nerves responsible for hearing. In parallel, our investigation observed a correlation between escalating HbA1c levels and the deterioration of sensorineural hearing loss (SHNL)

Discussion

Diabetes mellitus is a widespread metabolic disorder affecting individuals of all ages, frequently associated with hearing loss. The hearing impairment linked to diabetes typically shows bilateral symmetry, a gradual onset, and a progressive nature. The relationship between diabetes mellitus and sensorineural hearing loss is complex, leading to varying perspectives in studies. While some studies highlight a strong association, others argue there is no clear link between diabetes mellitus and sensorineural hearing loss. Two significant factors contributing to hearing difficulties in diabetic patients include diabetic angiopathy and diabetic neuropathy[3].

Our study showed severely high HbA1c and Vitamin D levels were low in SNHL patients with Type 2 Diabetes compared to Healthy Control.It was also found that with Increasing HbA1c levels, SHNL was also deteriorating. The correlation analysis using Spearman's rho between HbA1c (glycated hemoglobin) and SNHL (sensorineural hearing loss) reveals a very strong positive correlation (0.967) in a sample of 22 individuals. The p-values are extremely low ($p < 0.001$), indicating that this correlation is highly significant. This suggests that as HbA1c levels increase, there is a robust tendency for the severity of sensorineural hearing loss to also increase, and vice versa.

In our study, a higher prevalence of hearing loss was observed in individuals with diabetes compared to those without diabetes. This aligns with findings reported by Kakarlapudi V et al[4]. SNHL is a type of hearing loss occurring mainly due to complications with the inner ear or the neural pathway that explicitly transmits sound signals to the brain. Furthermore, Vitamin D, a fat-soluble vitamin that plays a crucial role in maintaining bone health, boosts the immune system, and regulates various physiological processes, was also low in SNHL patients compared with healthy controls ($p<0.01$).

Our study revealed significantly elevated HbA1c levels and lower Vitamin D levels in individuals with sensorineural hearing loss (SNHL) and Type 2 Diabetes compared to a healthy control group. Additionally, we observed a correlation between increasing HbA1c levels and the worsening of SNHL. Comparable results were observed in the investigation conducted by HarnerSG [5] involving 200 patients. Similarly, Tiwari A et al [6], in their study, identified a higher prevalence of sensorineural hearing loss in individuals with diabetes compared to

non-diabetics.In our study, a positive correlation was observed between HbA1c levels and sensorineural hearing loss. This corresponds with the findings reported in the study conducted by Chavadaki JA et al [(7)].Dalton DS et al. in their research demonstrated a higher occurrence of hearing loss in patients with diabetes compared to those without diabetics [(8)]. Tay HL et al. similarly concluded that diabetic patients exhibited poorer hearing thresholds than non-diabetics [(9)]. Wackym PA, in their study, also concluded that individuals with diabetes mellitus experienced significantly more hearing loss than those without diabetes [(10)]. Sensorineural hearing loss primarily stems from complications within the inner ear or the neural pathway responsible for transmitting sound signals to the brain.

Furthermore, the levels of Vitamin D, a crucial fat-soluble vitamin known for its role in maintaining bone health, boosting the immune system, and regulating various physiological processes, were also found to be lower in SNHL patients compared to the healthy control group**.**

The current study highlights an increased vulnerability to vitamin D deficiency or insufficiency in individuals with Type 2 diabetes who also suffer from sensorineural hearing loss (SNHL). Scientific evidence suggests the existence of vitamin D receptors in various parts of the inner ear, including the cochlea responsible for transmitting sound to the brain. Vitamin D plays a crucial role in maintaining inner ear health, possessing anti-inflammatory properties essential for immune system regulation. Associations between inflammation, immune system irregularities, and hearing problems have been noted. An unnoticed causal relationship seems to exist between vitamin D deficiency and cochlear deafness. Impaired vitamin D activity, representing a form of metabolic impairment, may contribute significantly to the development of otosclerosis and presbycusis[(11)], potentially hastening hearing loss in diabetic patients [(12,13)]. The comprehensive impact of vitamin D and metabolic syndromes on hearing loss remains not entirely understood.

Conclusion

The results of the present study suggest that abnormal levels of vitamin D may be associated with a higher risk of hearing loss. It is important to monitor the hearing threshold in patients with diabetes. Also, it seems rational to perform a regular evaluation of vitamin D level and keep it within the normal range to decrease the risk of hearing loss in diabetic patients. Further studies are needed to generalize the results.

Our study clearly showed that Diabetes Patients with high HbA1clevels have more chances of developing SNHL have when compared with the controls. It was also found that as the level of HbA1c rises SHNL will also worse. It was also found out that vitamin D was decreased in SNHL patients with Type 2 Diabetes and abnormal levels of vitamin D may be associated with a higher risk of hearing loss. HbA1c is usually used to estimate long-term blood glucose control and is basically used as a diabetic management indicator. Increased HbA1c Levels are usually related to poorer blood sugar control, which will lead to the risk of complications related to Diabetes, such as vascular damage, Neuropathy, and Inflammation. All these factors can lead to damage to blood vessels and nerves of the inner ear, reducing blood flow to the delicate structures of the inner ear andnerves responsible for hearing. Similarly, in our study, it was found out that with Increasing HbA1c levels, SHNL was also worsening. Therefore, we suggest early screening of Diabetes mellitus. additionally, managing Diabetes effectively through lifestyle changes as well as medication can help reduce the risk of Diabetes related complications, including those that can affect hearing.

References

[1] Kakarlapudi V, Sawyer R, Staecker H. The effects of diabetes on sensorineural hearing loss. Otol Neurol. 2003;24:382-6.

[2] Frisina ST, Mapes F, Kim S, Frisina DR, Frisina RD. Characterization of hearing loss in aged Type 2 diabetics. Hear Res. 2006;211:103-13.

[3] Maia CA, Campos CA. Diabetes mellitus as etiological factor of hearing loss. Rev Bras Otorrinolaringol. 2005;71:208-14.

[4] Kakarlapudi V, Robert S, Hinrich S. The effect of diabetes on sensorineural hearing loss. Otology &Neurotology. 2003;24(3): 382-86.

[5] Harner SG. Hearing in adult onset diabetes mellitus. Otolaryngology-HNS 1981;89 (2):322-327.

[6] Tiwari A, Mudhol RS. Prevalence of sensorineural hearing loss among type 2 diabetes mellitus patients attending KLES. Indian J Health Sci Biomed Res. 2018;11:165-9

[7] Chavadaki JA et al. Diabetes Mellitus and the incidence of hearing loss : a cohort study. Int J Epidemol. 2017;46(2):717-26.

[8] Dalton DS, Karen JC, Ronald KB, Barbara EKK, Terry LW. Association of NIDDM and hearing loss. Diabetes Care. 1998;21(9):1540-44.

[9] Tay HL, Nay R, Ohri R, Frootko NJ. Clinical Otolaryngology & Allied Sciences. 1995;20(2):130-34.

[10] Wackym PA, Jr FHL. Diabetes mellitus and hearing loss: clinical and histopathologic relationships. American Journal of Otology. 1986;7(3):176-82.

[11] Brookes GB. Vitamin D deficiency—a new cause of cochlear deafness. The Journal of Laryngology & Otology 1983;5:405-420.

[12] Norman AW, Frankel J, Heldt AM, Grodsky GM. Vitamin D deficiency inhibits pancreatic secretion of insulin. Science 1980;4458:823-825.

[13] Kang SH, Jung DJ, Cho KH, et al. Association Between HbA1c Level and Hearing Impairment in a Nondiabetic Adult Population. Metabolic Syndrome and Related Disorders 2016;2:129-134.