Sensorineural hearing loss in patients with systemic arterial hypertension and diabetes mellitus: a prospective study

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Abstract:

Introduction: Diabetes mellitus and systemic arterial hypertension are related to life style, gender, age and are associated with hearing loss. **Objective:** To evaluate hearing loss in patients with diabetes mellitus and systemic arterial hypertension. **Materials and Methods:** A prospective observational study done for one year. The study was conducted on 60 subjects diagnosed with diabetes mellitus, 60 subjects diagnosed with systemic arterial hypertension and 60 subjects with both systemic arterial hypertension and diabetes mellitus and 60 normal subjects without systemic arterial hypertension and diabetes mellitus. Pure tone audiometry was done on all subjects. **Results:** Out of 180 cases with systemic arterial hypertension or diabetes mellitusor both in the present study 166 were in the age group of 40- 60 and only 14 cases were between ages 20-40. Patients with systemic arterial hypertension were at a higher risk of developing sensorineural hearing loss with an incidence of 90% when compared to controls (0%). **Conclusion:** It was concluded that there is a relationship between diabetes mellitus and systemic arterial hypertension with hearing loss and the hearing loss of sensorineural type prevailed.

Key Words: 1.Sensorineural hearing loss, 2.Hypertension, 3.Diabetes mellitus, 4.Pure tone audiometry

Introduction:

Hearing is the ability to sense vibrations and changes in the surrounding medium's pressure overtime via ear.[1]Hearing loss is a common public health problem that affects work productivity, functional status, social interactions, personal safety and well-being, and quality of life.[2]In Sensorineural hearing loss (SNHL) the root cause lies in the inner ear or sensory organ or cranial nerve VIII or neural part. Systemic disorders, especially systemic arterial hypertension, diabetes mellitus, and dyslipidemias, are directly or indirectly associated with sensorineural hearing loss. The prevalence of Diabetes Mellitus (DM) and systemic arterial hypertension (SAH) are increasing worldwide and it is more pronounced in India. This hypertension and diabetes cause SNHL by affecting the blood supply of the cochlea as the main pathway. One of the audiological implications in individuals with diabetes mellitus is believed to be angiopathy, which can interfere with the supply of nutrients and oxygen to the cochlea. In addition to cochlear changes, DM can also cause secondary degeneration of the eighth cranial nerve (VII), causing neural hearing loss.[3,4] Hypertension is one of the most common vascular disorders, which can facilitate structural changes of the heart and blood vessels. High pressure in the vascular system can result in hemorrhages in the inner ear, which, like other parts of the body, receives a blood supply derived from the anterior inferior cerebellar artery, which divides and supports other

branches of the ear, which can culminate in sudden or progressive hearing loss.[3, 5] Hearing loss (HL) may cause psychosocial effects, like low self-esteem, isolation, depression and irritability, which can interfere with the quality of life of the individual. This study was done to evaluate the hearing loss in patients with diabetes mellitus and systemic arterial hypertension.

Materials and methods:

This is a prospective observational study done for one year from January 2022 to December 2022. The study was conducted on 60 subjects diagnosed with diabetes mellitus, 60 subjects diagnosed with systemic arterial hypertension and 60 subjects with both systemic arterial hypertension and diabetes mellitus and 60 normal subjects without systemic arterial hypertension and diabetes mellitus in the age group of 20-60 years both males and females. The study was conducted in the department of ENT and Head and Neck surgery the Government Medical Anantnag in accordance with the principles of Helsinki Declaration 1975. Informed Consent was taken and complete history about the duration of diabetes mellitus, systemic arterial hypertension and hearing loss was taken. Pure tone audiometry and complete ear, nose and throat, general and systemic examination was performed on all the subjects. Blood pressure ≥140/90 and HbA1c >7 were considered as uncontrolled.

Results:

The sample size was 240 of which 60 cases were diabetic, 60 cases were hypertensive, 60 cases were both diabetic and hypertensive, and 60 cases were without any diabetes and hypertension.

Table 1: Demographic characteristics of patients

Sex	Number of cases	Percentage
Male	96	40
Female	144	60
Age group(years)		
20-40	60	25
40-60	180	75
Duration of hypertension		
<5 years	40	66.6
>5 years	20	33.3
Duration of diabetes		
<5 years	45	75
>5 years	15	25
Spot BP		
<140/90(under control)	35	58.3
≥140/90(uncontrolled)	25	41.6
HBA1C values		
≤7	15	25
>7	45	75

Out of 180 cases with systemic arterial hypertension or diabetes mellitus or both in the present study 166 were in the age group of 40- 60 and only 14 cases were between ages 20-40.

All the patients were on medical treatment for Hypertension and diabetes mellitus from the time of diagnosis.

Table 2: PTA values with SNHL in hypertensive and diabetic cases

PTA values with SNHL in Hypertensive cases	Number of cases	Percentage
Normal hearing(<20dB)	6	10
Mild hearing loss(21-40dB)	54	90
PTA values with SNHL in diabetic cases		
Normal hearing(<20dB)	14	23.3
Mild hearing loss(21-40dB)	46	76.6
PTA values with SNHL in both diabetic and hypertensive cases		
Normal hearing(<20dB)	20	33.3
Mild hearing loss(21-40dB)	30	50
Moderate hearing loss(41-70dB)	10	16.6

Table 3: Effect of Blood Pressure and Diabetes in causing SNHL

Blood pressure in causing SNHL	Normal Hearing	Mild SNHL	Total
BP<140/90	4(11%)	30(85.7%)	34
BP≥140/90	2(8%)	24(96%)	26
Duration of hypertension on SNHL			
<5 years	6(15%)	34(85%)	40
>5 years	0	20(100%)	20
Duration of diabetes on SNHL			
<5 years	14(31%)	31(68.8%)	45
>5 years	0	15(100%)	15
Diabetes on SNHL depending on HBA1C			
HBA1C≤7	10(66.6%)	8(53.3%)	18
HBA1C>7	4(8.8%)	38(84.4%)	42

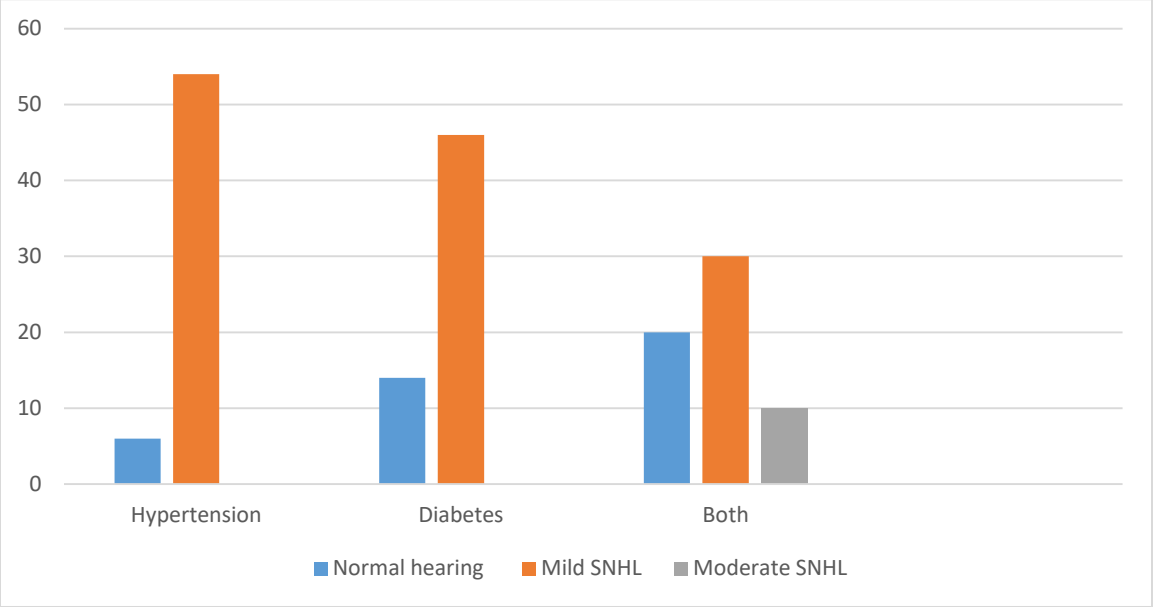

Figure 1: Comparison between Diabetes, Hypertension and both as a cause of SNHL.

All the hypertensive and diabetic cases had only mild SNHL. Moderate SNHL was seen in patients with both hypertension and diabetes.

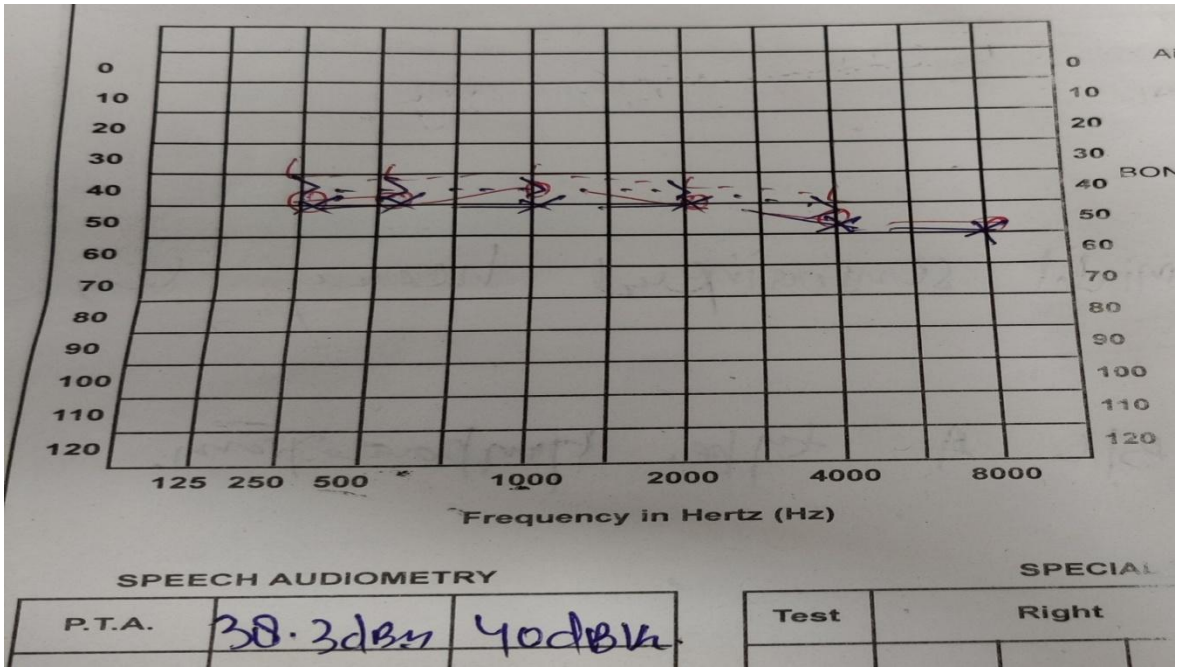

Figure 2: Audiogram of a patient with systemic arterial hypertension and diabetes mellitus complaining of hearing impairment in both ears for 2 years.

Discussion:

Sensorineural hearing loss results from lesions of the cochlea, VIIIth nerve or central auditory pathway.. It has multifactorial causation, is currently a public health concern. Several studies have been conducted in developed and developing countries regarding diabetes and hypertension as causative factors. Out of 180 cases with systemic arterial hypertension or diabetes mellitus or both in the present study 166 were in the age group of 40- 60 and only 14 cases were between ages 20-40. This may be due to as age increases, the comorbidities increase causing SNHL which is adding on to the SNHL caused due to age factor. In their study, Axelsson et al. had already described a worsening in the hearing loss with ageing without, however, finding an association with diabetes control and duration.[6] Brohem et al. studied hypertensive patients complaining of hearing loss usually associated with their more advanced age.[7] Systemic arterial hypertension and advanced age were established as separate risk factors for sensorineural hearing loss by Marchiori et al.[8] Sensorineural hearing loss is linked to microcirculatory insufficiency caused by vascular occlusion caused by emboli, haemorrhage, or vasospasm, and these occur as a result of a syndrome of hyperviscosity or microangiopathy caused by diabetes mellitus or systemic arterial hypertension, and the latter could cause the sensorineural hearing loss via histopathological mechanisms.[9,10]

Hypertensive individuals were significantly more likely to develop hearing loss, when compared to non-hypertensive individuals[11], possibly due to the fact that hypertension can cause microcirculatory insufficiency that can lead to a greater or lesser deterioration of the peripheral auditory system, which may cause sudden or progressive hearing loss.

In the present study patients with hypertension (90%) were at higher risk of developing SNHL when compared to controls (0%). Marchiori et al., conducted a study in 2006, involving 154 cases and 154 controls, aged 45 to 64 years found that there is a significant association between high blood pressure and hearing loss.[12]

In our study duration of hypertension had a slight influence on developing SNHL as only 85% of cases within 5-year duration had SNHL but 100% of cases with a duration of hypertension more than 5 years had SNHL. Agarwal. et.al in his book head Neck Surgery also showed a strong relationship between the duration of hypertension and the development of SNHL.[13] The longer duration of hypertension is postulated to increase the risk of ischemic damage to the cochlea due to vascular changes. The present study showed no significant difference in the effect of controlled (85.7%) and uncontrolled (96%) hypertension on the occurrence of SNHL. The present study evaluated the effect of diabetes mellitus on the SNHL in comparison to controls which showed a 76.6% chance of having SNHL in diabetic cases. Friedman et al. observed an incidence of 55% hearing loss in patients with diabetes. Which is similar to our study.[14]Kakarlapudi et. alnoted that patients with diabetes were more commonly known to have hearing loss (13.1%) when comparing to the control group who were non-healthy subjects without diabetes.[15]

In our study, there is a slightly higher chance of developing SNHL in patients with >5year (100%) diabetes than in cases with <5 years (68.8%) diabetes. A study by Celik et al. noted that as diabetes duration raised to more than 15 years, the hearing loss incidence also increased.[16] Our study showed a higher chance of developing SNHL in diabetic cases with HBA1C >7(84.4%) than with HBA1C < 7. Thus showing increased chances of SNHL in uncontrolled diabetes mellitus. HbA1c level and hearing loss correlation indicate that good glycemic control can modify the progression of hearing loss in type 2 Diabetes Mellitus (T2DM) patients. Hearing loss associated with diabetes is a progressive, bilateral, and sensorineural disorder with a gradual onset and generally points to a higher frequency. Sensorineural hearing loss is caused by chronic and persistent hyperglycemia. When hyperglycemia status is controlled in diabetic patients, the severity of hearing loss will be minimal. Hearing loss should be assessed earlier in T2DM patients to prevent the severity of hearing loss which can also occur due to age.[17]

In the present study, majority of the cases had only mild SNHL. A study conducted by Rajendran et al showed a result similar to our study, The patients with diabetes revealed a high-frequency loss which was bilateral and severity was from mild to moderate of sensorineural type and it was significant (73.3%) as compared to controls of similar age. Whereas Weng et al noted that in 67 patients with diabetes who were examined, 44.8% of them had profound hearing loss.[18]

The present study also showed that there is an increased chance of acquiring a moderate degree of SNHL in patients with both diabetes and hypertension than with individual comorbidities. There is no consensus and details on the real factors that contribute to the risk of hearing loss in subjects with DM and SAH, requiring further research. It is suggested to develop studies that evaluate high frequencies (>8000 Hz) and study otoacoustic emissions (OAE), as well as the brainstem auditory evoked potential (BAEP) of these patients, since it is believed that DM and SAH can cause cochlear as well as central changes.

Conclusion:

Our present study confirms that there is a possible association between systemic arterial hypertension and diabetes mellitus with sensorineural hearing loss with majority of the patients developing mild degree SNHL. Patients with hypertension and diabetes have a greater increase in hearing threshold as compared to those without these comorbidities. Such association between hearing loss and arterial hypertension, diabetes mellitus has been an important object of research in recent decades.

We emphasise the importance of preventive measures that may reduce the mechanisms that trigger hearing apparatus degeneration caused by systemic arterial hypertension and diabetes mellitus, as well as the need for further research into the regulation of these comorbidities' effects on hearing.

Conflict of interest: There are no conflicts

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