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Research article

A STUDY ON HEARING LOSS IN TYPE II DIABETICS

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ABSTRACT

Diabetes-related sensorineural hearing impairment affects people's ability to hear and understand sounds. We carried out this case control study with the purpose of determining the hearing loss in type II diabetes mellitus in relation to the age and gender of the patients and duration of the illness using tuning fork tests and pure tone audiometry. **Aim:** To study the hearing loss in type II diabetics and controls. **Objectives:** 1. To study the hearing loss in relation to different age groups in diabetics and controls. 2. To study the hearing loss in relation to gender in diabetics and controls. 3. To study the hearing loss in relation to duration of diabetes. **Material and Methods:** 200 diabetic patients and 200 age and sex matched controls took part in the study. They were evaluated by Tuning fork tests and Pure Tone Audiometry. **Results:** The hearing of diabetics was significantly impaired than the non-diabetic control group. This hearing impairment was noted in all the frequencies tested. The hearing acuity was not influenced by the duration of diabetes, age or sex of the subjects. **Discussion:** The possible mechanisms underlying the hearing loss in diabetic individuals are microangiopathy, demyelination, hyperglycemia, etc. **Conclusion:** Type 2 diabetes causes significant hearing loss in the patients, but it is not affected by the age and sex of the patient or duration of the illness.

Key words: Audiometry, Diabetes, Sensorineural hearing loss

INTRODUCTION

Diabetes mellitus is a heterogeneous group of metabolic disorders characterized by chronic hyperglycemia that results from defects in insulin secretion, insulin action or both. Diabetes mellitus leads to long term damage, dysfunction and failure of various organs, especially the eyes, kidneys, heart and blood vessels.¹

Diabetes-related sensorineural hearing impairment affects people's ability to hear and understand sounds. Although evidence from as early as the mid-19th century linked diabetes with hearing loss, a degree of controversy has surrounded this association.²

Various tests are available for the clinical assessment of hearing loss. Localization and type

of hearing loss can be known by use of simple tests like the tuning fork tests, while audiometry gives the graphic recording of hearing quantitatively and qualitatively.³⁻⁵

We carried out this case control study with the purpose of determining the hearing loss in type II diabetes mellitus in relation to the age and gender of the patients and duration of the illness using tuning fork tests and pure tone audiometry.

Aim: To study the hearing loss in type II diabetics and controls.

Objectives:

1. To study the hearing loss in relation to different age groups in diabetics and controls.
2. To study the hearing loss in relation to gender in diabetics and controls.
3. To study the hearing loss in relation to duration of diabetes.

MATERIAL AND METHODS

The present study was conducted on patients attending the ENT and Medicine OPD and IPD of civil hospital, Miraj after proper consent. 200 diagnosed diabetic patients (Fasting plasma glucose 126 mg/dl or 2 hour plasma glucose 200 mg/dl during an oral glucose tolerance test) and 200 age and sex matched controls took part in the study. The Ethical Committee of the Govt. Medical College and Hospital, Miraj approved this study.

Inclusion criteria: Case: Diagnosed cases of type 2 diabetes, Age above 40 yrs, both genders.

Table1: Interpretation of tuning fork tests

Test	Normal	Conductive deafness	Sensori-neural deafness
Rinne	AC > BC	BC > AC	AC > BC
Weber	Not lateralized	Lateralized to poorer ear	Lateralized to better ear
ABC	Same as examiner's	Same as examiner's	Reduced

RESULTS

Table 2: mean age of Diabetic and non-diabetic (controls)

	Diabetics	Non-diabetics
Total no.	200	200
Mean age (years)	50.30 ± 5.78	50.25 ± 5.69

Control: non-diabetic healthy controls, Age above 40 yrs, both genders.

Exclusion criteria: Diabetes other than type2, patients with conductive hearing loss, or hearing loss associated with other causes.

Interpretation of tuning fork tests³⁻⁵ Initial screening of hearing loss in the study and control group was done by tuning fork tests.

Then they were subjected to pure tone audiometry

Pure Tone Audiometry³⁻⁵: Instrument:- Elkon EDA-3N3 Giga 3 Audiometer^{5a} was used in the study.

- I. Air conduction tests: The Conventional “5-up-10-down method” was followed. In this procedure the tones are lowered in 10 dB steps and increased in 5 dB steps for each frequency. The exact hearing threshold is obtained when one gets at least 3 out of 5 responses correct.
- II. Bone conduction tests: Technique:- the “5-up-10-down method” is followed for bone conduction study.

Participants were labeled as having sensory-neural hearing impairment if the average of the pure-tone thresholds in either ear exceeded 25 dB HL and the air–bone gap less than 15 dB.⁵

Statistical Analysis: Analysis was done by ‘chi – square’ test using Microsoft Office Excel 2010. A ‘p’ value of < 0.05 was considered statistically significant.

Table 3: Age and sex wise distribution of Diabetics and Non-diabetics

	Diabetics		Non-diabetics	
	Males	Females	Males	Females
Age 41-50 yrs	60	40	60	40
Age 51-60 yrs	60	40	60	40

Table 4: Duration wise distribution of Diabetics

Duration < 5 years	79
Duration > 5 years	121
Total	200

Table 5: Comparison of hearing loss in diabetics and non-diabetic controls (chi square test) (Odd's ratio: 2.398)

Hearing Loss	Diabetics	Non-diabetics	P value
Present	72	38	0.0001*
absent	128	162	
Total	200	200	-

p value: 0.0001 (highly significant)

Table 6: Comparison of hearing loss in relation to different age groups in diabetics and non-diabetic controls (chi square test)

Age	Diabetics	Non-diabetics	P value
41-50 years	29	16	0.852
51-60years	43	22	
Total	72	38	-

Table 7: Comparison of hearing loss in relation to sex in diabetics and controls. (chi square test).

Sex	Diabetics	Non-diabetics	P value
Male	42	24	0.6233*
Female	30	14	
Total	72	38	-

Table 8: Comparison of hearing loss in relation to duration of diabetes in diabetics. (chi square test).

Duration	Hearing loss	No Hearing loss	P value
< 5 yrs	25	54	0.2999
> 5 yrs	47	74	
Total	72	128	-

DISCUSSION

The results of the present study showed that the hearing of diabetics was significantly impaired than the non-diabetic control group. All the frequencies tested demonstrated this hearing

impairment. The hearing acuity was not influenced by the duration of diabetes, age or sex of the subjects.

Thus, statistically highly significant hearing loss has been observed in the diabetic group than in the non-diabetic control group and Odd's ratio of 2.398. This finding coincides with the findings of other workers –Taylor I and Irwin J⁶, Wackym PA⁷, Kurien M et al⁸, Dalton DS et al⁹, Róza ska-Kudelska¹⁰, Kakarlapudi V et al¹¹, Panchu P¹², Bainbridge KE et al¹³.

Diabetes-related hearing loss is a progressive, sensorineural impairment typically affecting audiometric thresholds between 500 and 8,000 Hz.^{7,13}

The pathophysiology underlying diabetes-associated hearing loss may involve the effect of diabetes-related microvascular disease on the cochlea.¹⁴ Few microscopic studies (obtained post-mortem) show sclerosis of the internal auditory artery, thicker vessel walls of the stria vascularis and of the basilar membrane, damage to the outer sheath (demyelination) of the cochlear nerve, and atrophy of the spiral ganglion (linking the cochlear nerve and the brain).^{7,15}

One study among autopsied diabetic patients shows atrophy of the spiral ganglion and demyelination of the eighth cranial nerve indicating a neurological etiology to diabetes-related hearing impairment.¹⁵

Hyperglycemia itself via elevated glucose levels in the cerebrospinal fluid or in the perilymph can lead to cochlear dysfunction in diabetic patients. This is independent of angiopathic or neuropathic lesion.⁸

Study on severe diabetic neuropathy has reported a reduction of Nerve Growth Factor (NGF) in neuropathic diabetics causing limitation of axonal retrograde transport and nervous fibres demyelination.^{16,17}

Thus, the possible mechanisms underlying the hearing loss in diabetic individuals from the above discussion are as follows:

1. Microvascular disease affecting the stria vascularis,
2. Thickening of the basilar membrane,

3. Damage to the outer sheath (demyelination) of the cochlear nerve,
4. Atrophy of the spiral ganglion,
5. The loss of outer hair cells,
6. Neuronal degeneration or diabetic encephalopathy,
7. Hyperglycemia,
8. Hyperactivity of oxygen free-radicals,
9. Reduction of Nerve Growth Factor (NGF),
10. Atherosclerotic narrowing of the internal auditory artery.

The effect of age on auditory thresholds in diabetic subjects was statistically not significant. Kakarlapudi¹¹ Dalton⁹ Róza ska-Kudelska¹⁰, and P. Panchu¹² showed similar findings in their study. Thus, age of the patient is not related to hearing loss in diabetics.

The effect of sex on auditory thresholds in diabetic subjects was statistically not significant. Similar findings were reported by Kathleen E. Bainbridge et al.¹³ Thus, there is no sex difference as far as occurrence of hearing loss in diabetics is concerned.

When hearing loss in diabetics is compared with relation to duration of diabetes, the difference in the two groups was statistically not significant. Thus the duration of diabetes does not alter hearing thresholds. Similar findings were noted by Pallavi Panchu¹², Kurien M et al⁸, Dalton S et al⁹, Taylor IG and Irwin J.⁶

The degree of hyperglycemia and the duration of uncontrolled hyperglycemia are gaining more importance as causative factors than the duration of the disease itself as indicated by the studies of Kakarlapudi¹¹ Frisina et al¹⁸, Hsueh¹⁹, Panchu P¹², Bainbridge et al.¹³ Thus, the age or sex of the subject or the duration of diabetes are not related to hearing loss in diabetics but the duration and degree of uncontrolled hyperglycemia may be related to hearing loss in diabetic patients and it needs further study.

CONCLUSION

The present study shows that type II diabetes causes significant hearing loss in the patients, but it is not affected by the age and sex of the patient or duration of the illness.

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