Original article

DOI: https://doi.org/10.36330/kmj.v19i1.101076

Vol. 19, No. 1, 2023

Submitted at: 22 January 23 Accepted at: 14 May 23

Sensorineural Hearing Loss in Diabetes Mellitus

Anmar Abdullah Jassim ⁽¹⁾, Ghassan Mohammad Ahmed ⁽²⁾, Ahmed Saadallah Ahmed ⁽³⁾, Samet Elias Al-Moula ⁽⁴⁾

⁽¹⁻³⁾Department of Otolaryngology- Al- jumhory Teaching Hospital, Mosul, Iraq.
⁽⁴⁾Department of Medicine, Faculty of Medicine, Kufa University, Najaf, Iraq.
Corresponding Author Email: <u>samete.almoula@uokufa.edu.iq</u>

ABSTRACT

Background: Sensorineural hearing loss are common neurological deficit, and diabetes mellitus is a common cause for these problems. Hearing impairment affects the quality of life of diabetic patients. Many researchers found hearing impairment in diabetic patients because diabetes mellitus can cause sensorineural hearing loss (SNHL) because of neuropathy and microvascular complications of diabetes mellitus.

Aim of the study: The study aims to sensorineural hearing loss in diabetic patients compared with non-diabetic control.

Patients and methods: A prospective case control study is performed during the period between Jan 2018 and May 2019. This case series study included 100 known cases of diabetes mellitus, their ages were between 20-60 years, treated at Al-wafaa center, which is specialized center for treatment and follow up of diabetic patients, and Al-Jumhory Teaching Hospital in Mosul. The control group included 100 individuals who did not have any diabetes mellitus or any of the exclusion criteria mentioned in the study.

Results: It has been found that sensorineural hearing loss (SNHL) was more common in diabetic patients group than controls group, 21% versus 8%. The prevalence of (SNHL) was more in male 31.7% than female diabetic patients 13.5%. Hearing threshold in diabetic patients was higher than that in control group. The hearing loss in diabetic patients is slowly progressive and directly related to the duration of diabetes.

Conclusions: Sensorineural hearing loss has been found to be more common in diabetic patients than in control group, and the hearing loss in diabetic patients is slowly progressive. The hearing threshold in diabetic patients had a direct correlation with the duration of disease.

Keywords: Diabetes Mellitus, Pure Tone Audiometer, Sensorineural Hearing Loss.

INTRUDUCTION

Hearing problems are common neurological deficit, and diabetes mellitus is a common cause for these problems. The organ of Corti which is essential for hearing is at the risk of damage by high blood sugar⁽¹⁾. Hearing impairment affects the quality of life of

diabetic patients, many researchers found hearing impairment in diabetic patients⁽²⁾. Diabetes mellitus can cause sensorineural hearing loss (SNHL) because of neuropathy and microvascular complications of diabetes mellitus. The presence of comorbidities in diabetic patients such as hypertension and atherosclerotic vascular diseases, also can affect hearing $^{(3)}$. Some histopathological studies revealed a neurological and vascular damage in the inner ear of diabetic patients⁽⁴⁾. It is well known now that increased oxidative stress has an important role in the development of long term complications of diabetes mellitus⁽⁵⁾. Diabetes-related hearing impairment is of gradual onset but progressive and bilateral sensorineural deficit, which affect higher more than lower frequencies⁽²⁾. The present study aim to study the relation of sensorineural hearing with diabetic mellitus in comparison to non-diabetic control.

PATIENTS AND METHODS

The study has been performed during the period between 1st of January 2018 and 1st of May 2019 at Al-wafaa Center, which is specialized in the treatment and follow up of diabetic patients, and Al-Jumhory Teaching Hospital in Mosul.

The Study Design

It is a prospective case-control study.

Subjects

This study included 100 known cases of diabetes mellitus, who have history of the disease for at least one year; their ages were between 20-60 years. The diabetic patients included 90 patients (90%) with type 2 diabetes mellitus (NIDDM) and 10 patients (10%) with type 1 (IDDM).

Controls

The control group consisted of 100 individuals who did not have any diabetes mellitus or any of the exclusion criteria mentioned below; their ages were between 20-60 years.

Exclusion criteria

- Diabetic patients who have history of the disease for less than one year.

- Diabetic patients who have family history of deafness.

- Patients with history of acoustic trauma, or noise exposure.

- Patients with history of ear surgery, trauma, and perforated eardrum.

- Patients with autoimmune diseases.

- Patients have history of using ototoxic drugs.

Data collection:

For data collection a questionnaire was designed to record the subject's information.

Instruments

Pure tone audiometer, auroscope, Tuning fork 512 Hz were used and pure tone audiometry was done for diabetic patients and control group by the same examiner and under the same condition, at a frequency of 500, 1000, 2000 and 4000 (Hz). Everyone in both groups has bone hearing level more than (25) dB at one or more of the frequencies tested (500, 1000, 2000 and 4000 Hz) was considered as suffering from (SNHL).

Statistical analysis and data management

The Statistical Package for Social Sciences (SPSS, version 18) was used for data entry and analysis while a Chi (χ^2) square test of association was used to compare proportions of different factors among sample groups. P value of ≤ 0.05 was regarded as statistically significant.

RESULTS

Out of 100 diabetic patients, whose average age was (46.57) years, (41%) were male and (59%) were female, while out of the control group which consists of 100 individuals, whose average age was (42.59) years, (65%) were male and (35%) were female as shown in Table (1). In the diabetic group, hearing loss was found in 21% (21 patient;13 male and 8 female); it was more common in male (31.7%) than female patient (13.5%). In the control group the incidence of hearing loss was 8%, 8 subject; 6 male (9.2%) and 2 female (5.7%), as shown in Table (2). The incidence of hearing loss was more in diabetic patients than control group, p-value is < 0.01 which is statistically significant. The hearing loss in diabetic patients is slowly progressive, and hearing threshold showed a direct correlation with the duration of diabetes, see Figures (3).

Table (1): The distributions of gender and residency of diabetic patient and controls.

	No.	Male	Female	Urban	Rural
Controls	100	65	35	77	23
Patients	100	41	59	87	13

Table (2): The distributions of sensorineural hearing loss in diabetic patients and control group.

	Male	Female	Total	p-value
DM	13	8	21	
Control	6	2	8	< 0.01



Figure (1): Average bone conduction thresholds in decibel (dB) for control and diabetic patients



Figure (2-A): Average bone conduction thresholds in decibel (dB) for diabetic patient in 4 age groups.



Figure (2-B): Average bone conduction thresholds in decibel (dB) for controls in 4 age groups



Figure (2): Average bone conduction thresholds in decibel (dB) for diabetic patients in relation to duration of diabetes.

DISCUSSION

The present study found higher prevalence of sensory neural hearing loss (SNHL) in the diabetic group than in control group, 21% and 8%, respectively. This agrees with many studies done by Raveendra⁽²⁾, Bainbridge⁽³⁾, Bener⁽⁴⁾, Kakarlupudi⁽⁶⁾, Taziki⁽⁷⁾, Diniz and Guida⁽⁸⁾, Tylor⁽⁹⁾, Kurien⁽¹⁰⁾, and Kashyap⁽¹¹⁾, but disagrees with Sieger *et al.*⁽¹²⁾, who did not report a significant differences in hearing loss in diabetic and non-diabetic patients. This wide range of results can be explained on the basis of the studies done by different person, on different countries, on different age group, on different patients, and examined by different audiologist. It has also been found here that the diabetic patients who have (SNHL) were in the (500, 1000, 2000, 4000 Hz). The difference in hearing thresholds at different frequencies in (dB) between diabetic patients and nondiabetes controls was higher in older people, age group (51-60 years) in low, mid, and high frequencies. However, in the younger people in age group (20-30 years) the difference in hearing thresholds was also apparent in all frequencies but specially in low and mid frequencies. These results indicate that the high frequencies were more affected in older age group and these can be explained on the basis of the effects of diabetes and age related hearing loss (presbycusis) and other risk factors. These results are in agreement with Raveendra⁽²⁾, Bainbridge et al⁽³⁾, Naini et al.⁽¹³⁾, Ren et al⁽¹⁴⁾, Celik et al.⁽¹⁵⁾, and Grassi⁽¹⁶⁾. The present study has also revealed that the (SNHL) in diabetic patients was more common in male, (13) patients (31.7%), than in female, (8) patients (13.5%). These results are in line with Bener et al.⁽⁴⁾, and Cullen and Cinnamond⁽¹⁷⁾; this may be explained by the occupational noise exposure in male much more than female $^{(4, 17)}$. In this point, the current results disagrees with Taylor and Irwin⁽⁴⁾ who reported a significantly higher SNHL in female than male diabetic patients. Many studies did not report any difference between male and

female patients⁽¹⁸⁾. The present study has also found that the increase in hearing thresholds was directly related with the duration of diabetes; this observation indicates the progressive nature of the complication of diabetes. These results are in agreement with Kakarlupudi⁽⁶⁾, and Celik et al.⁽¹⁵⁾. Yet, Kurien, et al. did not find a relationship between hearing loss and age of the patients or duration of diabetes, but they reported that hearing loss in diabetic patients is directly related to the degree of blood sugar control and it was more common and more severe in poorly controlled diabetic patients⁽¹⁰⁾. In the present study, the number of patients, who were hypertensive within the diabetic group was (48) patients (48%), and 11(22.9%) of them have SNHL; in control group, 14 person (14%) were hypertensive, (3) of them have (SNHL), recording (21.4%). Out of these results, hypertension might be considered as a risk factor for developing (SNHL) in both groups; this may be due to the effects of hypertension and anti-hypertensive drugs. Duck et al. ⁽¹⁹⁾, reported that high blood pressure in diabetic patients increase the risk of high-frequency SNHL. Diabetic patients with retinopathy also developed more hearing loss because of the similarity of the microvascular blood supply of the ear and the eye ^(19, 20). It has also been found here that (21.1%) of patients with (NIDDM) have (SNHL), and (20%) of patients with (IDDM) have (SNHL). This means that both groups have nearly a similar risk of hearing loss. Raveendra *et al*⁽²⁾ observed that age-matched patients with diabetes treated with oral hypoglycemic agents had more hearing loss than those treated with insulin. Wackym and Linthicum⁽¹³⁾ reported that diabetic patients treated by oral hypoglycemic drugs had fewer hearing problems than those treated by dietary restriction alone. These studies suggested that the aggressive treatment of diabetes reduces the risk of hearing loss ⁽²¹⁾.

Limitations

The conventional audiological test (Pure tone audiometer) done for assessment of hearing threshold and hearing loss is a subjective test and not very sensitive to detect the early phase of hearing loss. Similar types of these limitations were also mentioned by Bainbridge ⁽³⁾, Bener ⁽⁴⁾, Clícia Adriana ⁽²²⁾, and Grazyna Lisowska⁽²³⁾.

CONCLUSIONS

1. Hearing loss is more common in diabetic patients group than in control group, 21% versus 8%

2. The prevalence of SNHL is more in male (31.7%) than female diabetic patient (13.5%).

3. Increased hearing thresholds in diabetic patients is directly related to the duration of the disease.

4. Hearing thresholds were higher in all tested frequencies among patients with diabetes compared to control participants, in the elder age group, the loss was in low, mid, and high frequencies, while, in the younger age group, it was in low and mid frequencies.

RECOMMENDATIONS

- 1- Screening all patients with diabetes for hearing loss, and performing an audiological test initially on all diabetic patients as baseline hearing thresholds.
- 2- Searching for the proper method to alleviate hearing impairment in diabetic patients and the proper method to manage this complication.

References:

- Dyanand A, Dheebika J, Prathula S, and Palaninathan S. A Study on Prevalence of Hearing Loss as Complicatuon of Diabetes. European Journal of Health and Medical Sciences 2020; 2 (4): 405-10.
- Raveendra P, Puneeth S, Tejaswini J. Clinical Assessment of Sensorineural loss Among Diabetes Mellitus Patients. Bengal Journal of Otolaryngology and

Head Neck Surgery 2020: 28 (2); 113-19.

- Bainbridge K. Hearing impairment an under-recognized complication of diabetes. Diabetes Voice. (2009); 54: 13-16.
- Bener A, Salahaldin AH, Darwish MS, Al-Hamaq A. Loida G Biomedical Res. (2018); 19: 187-193.
- Robertson RP. Chronic oxidative stress as a central mechanism for glucose toxicity in pancreatic islet beta cells in diabetes. J Biol Chem. (2004); 279: 351-354.
- Kakarlapudi V, Sawyer R, Staecker H. The effect of diabetes on sensorineural hearing loss. Otol and Neurotol. (2013); 24:382-386.
- Taziki Mohammad H, And Mansourian Azad R. The Comparison of Hearing Loss Among Diabetic And Non-Diabetic Patients. 2011; 5(1): 88-90.
- Diniz TH and Guida HL. Hearing loss in patients with diabetes mellitus Braz Otorhinolarygol. 2009; 4: 573-8.
- Taylor IG, Irwin J. Some audiological aspects of diabetes mellitus. J Laryngol Otol. 1978; 92: 99–113.
- Kurien M, Thomas K, Bhanu TS. Hearing threshold in patients with diabetes mellitus. J Laryngol Otol. 1989; 103: 164-168.
- 11. A S Kashyap Cardiothoracic Centre, Goliban Maidan, Pune 411040, India Skashyap department of Medicine, Armed forces medical College, Pune 411040 India Submitted 1 June 1999.
- Sieger A, White NH, Skinner MW. Auditory function in children with Diabetes Mellitus. Ann. Othol Rhinol Laryngol. 1983; 92; 237-41.
- Naini SA, Fathololoomi1 RM, Naini SA. Effect of diabetes mellitus on the hearing ability of diabetic patients. Tanaffos. (2003); 2:51-58.

- Ren J, Zhao P, Chen L, Xu A, Brown SN, Xiao X, Hearing loss in middleaged subjects with type 2 diabetes mellitus. Arch Med Res. 2009; 40:18-23.
- Celik O, Yalcin S, Celebi H. Hearing loss in insulin dependent diabetes mellitus. Auris nasus larynx. 1999; 23:127-132.
- 16. Grassi T. Diabetes and deafness. Ann Intern Med. 2008; 149:1-10.
- Cullen JR , Cinnamond MJ .Hearing loss in diabetics. J Laryngol Otol. 1993; 107:179–82.
- 18. Dobie RA (1998). Noise-Induced Hearing Loss. In, Head and Neck Surgery-Otolaryngology, Second Edition, Byron J. Bailey, ed. Lippincott-Raven Publishers. www.utmb.edu /otoref/Grnds/Hear-Loss-Noise.../Hear-Loss-Noise.doc.
- Duck SW, Prazma J, Bennett PS, et al. Interaction between hypertension and diabetes mellitus in the pathogenesis of sensorineural hearing loss. Laryngoscope 1997; 107: 1596–604.

- 20. Jorgensen MB. The inner ear in diabetes mellitus. Arch Otolaryngol 1961; 74: 373–81.
- 21. Wackym PA, Linthicum FH Jr. Diabetes mellitus and hearing loss: clinical and histopathological relationships. Am J Otol 1986; 7:176– 82.
- 22. Clícia Adriana S. Maia1, Carlos Alberto H. de Campos. Diabetes mellitus as etiological factor of hearing loss. Rev Bras Otorhinolaryngology. 2005; 71(2): 208-14.
- 23. Graz'yna Lisowska, Grzegorz Namysłowski, Krzysztof Morawski, and Krzysztof Strojek. Early Identification of Hearing Impairment in patient with type 1 Diabetes Mellitus. Otology& Neurotology. 2001; 22:316– 320.
- 24. American Speech-Language-Hearing Association (2005) Guidelines for manual pure-tone threshold audiometry. www.asha.org/docs/html/GL2005-00014.html.