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The effect of diabetes mellitus in patients with sensory neural hearing loss in Mosul city

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Abstract
Background: As the prevalence rate of diabetes mellitus increasing worldwide, it's complications in various organs of our body assume greater importance, especially hearing impairment which is irreversible and usually cannot be alleviated surgically or by medical intervention.
Objectives: To identify whether the sensory neural hearing loss is associated with Diabetes Mellitus disease among the population comparing to non-Diabetics and determine the correlation between glycosated hemoglobin (HbA1c) levels and the audiometric parameters in diabetic patients.
Patients and methods: A case-control study design was adopted, and conducted in the ENT and Audiology consultation unit in Al-Jumhoori Teaching Hospital in right sector of Mosul city. The period of study and data collection was eight months extended from the 1st of October, 2018 to the 30th June, 2019. Any attendant to the hospital who had Diabetes Mellitus with or without hearing loss aged 15–65 years were referred to ENT unit to be interviewed and included in the study. The interview was done by the researcher and personal consent was taken before the investigations and the questionnaires proceed regarding the existing of DM. Diagnostic Pure tone Audiometry (PTA) and HbA1c investigations were done; 92 allocated as cases and 184 as controls. The paired sampling technique regarding age groups and gender was used in this study. Data was entered into Microsoft excel sheet and analyzed using descriptive statistics such as percentages and proportions, also Odd ratio, p value and 95% confidence intervals were calculated by SPSS with personal laptop.
Results: Distribution of study population according to age and gender reveals that age group (45-54) years more commonly associates with SNHL with male predominance, and the highest percent of cases have mild type and lowest have the profound with left side dominant. The table (1) shows the association of SNHL and risk of diabetes mellitus and portrays very highly significant statistical association with (OR 9.24) at p-value (0.000). Table (2) illustrates that diabetic patient with HBA1c < 7 are protected from SNHL (OR= 0.02, p value 0.000); patients with HBA1c 7-8 have a risk of developing SNHL (OR= 2.29) but statistically insignificant (p value 0.444); while patients with HBA1c >8 have 15.75 times to have SNHL with a very high statistically significant association (p value= 0.002, 95% CI=1.82-136.64).
Conclusions: SNHL is 52.96 times more frequent among diabetic patients than non-diabetics with very high statistical association (p-value 0.000), which necessitate more attention by the clinicians during the management of DM and frequent Checkup for the HBA1c, which seem to be a reflection for the association.

Keywords: diabetes mellitus, sensory neural hearing loss

Introduction

Hearing is a vital sense that required for human development, communication, education, function and occupation, the loss of it will affect the quality of life. Around 360 million human, who represent 5% of the entire world people, experience a hearing loss problem, and this rate increases according to World Health Organization (WHO) due to age, genetic factors, and neurological diseases, causes of vascular origin, metabolic disorders, ototoxic drugs, noise, and diabetes. [1, 5] Sensory neural hearing loss (SNHL) is an emergency disease requiring immediate diagnosis and treatment. It could be occurs among diabetics as a result of harm to the cochlea or beyond, that is, either along the 8th cranial nerve or in the brain. SNHL can cause complete loss of hearing, despite the outer ear and middle ear being normal, although the pathological process is not clearly understood but this association may be related to an increase in capillary lesions in the cochlea, more specifically in the stria vascularis and basilar membrane. Other studies have also reported a reduction in the number of spiral ganglion neurons. These differences could be related to the time-span of diabetes and to co-morbidities that could affect the inner ear [6, 9]. Although several studies have investigated the effects of diabetes on SNHL, the relationship between these two conditions remains unclear. Some studies have suggested that diabetes may be a cause [10, 11], whereas others have failed to find an association [12-18]. The presence of confounding variables and the complexity of the auditory system could be the main obscurity in investigating the association between diabetes and SNHL [19] According to a recent national survey, diabetes became worldwide escalating epidemic particularly type II, it may be a silent disease that may continues for a long time without being detected so it could be presented primarily with complications [20, 21]. For the several last years, type II diabetes was observed only among adults, but, based on recent WHO data, it is also increasingly manifesting in

children [22]. The prevalence rate of DM were; in Saudi Arabia (31.6%), a national census of Bahrain (28.1%), employees surveyed in Kuwait (21.4%), urban dwellers in Jordan (17.1%), health care center users in Qatar (16.7%) and a representative sample of Lebanon (15.8%) [23]. In Iraq, epidemiological transition was noticed along the past twenty years [24], although there are insufficient epidemiological studies and randomized controlled trials (RCTs) related to diabetes which makes it difficult to fully estimate the prevalence of diabetes in Iraq [25], there are around 1.4 million of Iraqis have diabetes and the reported DM prevalence in Iraq ranges from 8.5% (IDF—age-adjusted) to 13.9%. A local study including more than 5400 people in the city of Basrah, Southern Iraq, reported a 19.7% age-adjusted prevalence of diabetes in subjects aged 19 to 94 years [26]. Moreover the optimal self-monitoring tests are not available to most diabetic people and facilities for the prevention and treatment in comparing with other diabetic complication were still limited in Iraq [27]. In the present work, the association between the SNHL and diabetes was study to clarify it among people living in Mosul city.

Patients and methods

In order to achieve the aim of the present study, a case-control study design was adopted, and conducted in the ENT and Audiology consultation unit in Al-Jumhoori Teaching Hospital in right sector of Mosul city. The period of study and data collection was eight months extended from the 1st of October, 2018 to the 30th June, 2019. Any attendant to the hospital who had Diabetes Mellitus with or without hearing loss aged 15–65 years were referred to ENT unit to be interviewed and included in the study. The interview was done by the researcher and personal consent was taken before the investigations and the questionnaires proceed regarding the existing of DM.

First step: all data regarding name, age, sex, occupation, religion and their residence were recorded. Also personal habits regarding smoking, tobacco or alcohol intake were noted. In females menstrual history was taken. In all these patients a detailed history was taken so as to rule out hypertension, cardiovascular, hepatic or renal disease, tuberculosis, malignancy, ototoxic drug intake etc. which might be responsible for secondary diabetes. Furthermore, any possible family history was noted either on paternal or maternal side. Noise exposure had been excluded too.

Second step: The study subjects were primarily tested by Diagnostic Pure tone Audiometry (PTA). The device type was of interacoustics A/S1, Audiometer 5500, Middel fart, Denmark, and manufactured in 28-01-2019. The assessment done by using frequency range from 250-8000 Hz, and the SNHL was categorized using PTA as normal, mild hearing loss and moderate hearing loss.

Third step: 5ml of blood was taken from diabetic patients and send for HbA1c. HbA1c level ranges from (3.5 - 5.5%) of total HbA, with good control defined as values less than (7%) and in poor control more than (8%) [6].

The inclusion criteria include

1. Patients with SNHL with DM
2. Age of the patients 15-65 years old

While the exclusion criteria extended to include

1. Family history of deafness.
2. History of chronic suppurative Otitis media.
3. Meningitis.
4. Head and ear trauma.
5. History of chicken pox, smallpox, malaria, jaundice, typhoid.
6. History of ear surgeries.
7. History of ototoxic drugs, chronic smoking, alcohol, radiotherapy, autoimmune disease and systemic diseases as hypertension, cardiac diseases, renal failure and occupational noise exposure.

The paired sampling technique regarding age groups and gender was used in this study, 92 cases with SNHL collected consecutively and inquired in details about their condition and 184 individuals without SNHL were allocated as controls.

Data was entered into Microsoft excel sheet and analyzed using descriptive statistics such as percentages and proportions, also Odd ratio, p value and 95% confidence intervals were calculated by SPSS with personal laptop.

Results

Study population

Distribution of SNHL according to Age and Gender

Figure (1) shows distribution of study population according to Age and Gender, where gradual increase with age is notice among males with highest level at 45-54 years old interval then decreases, while among the females a fluctuating pattern is notice although the highest level is similar to that of males.

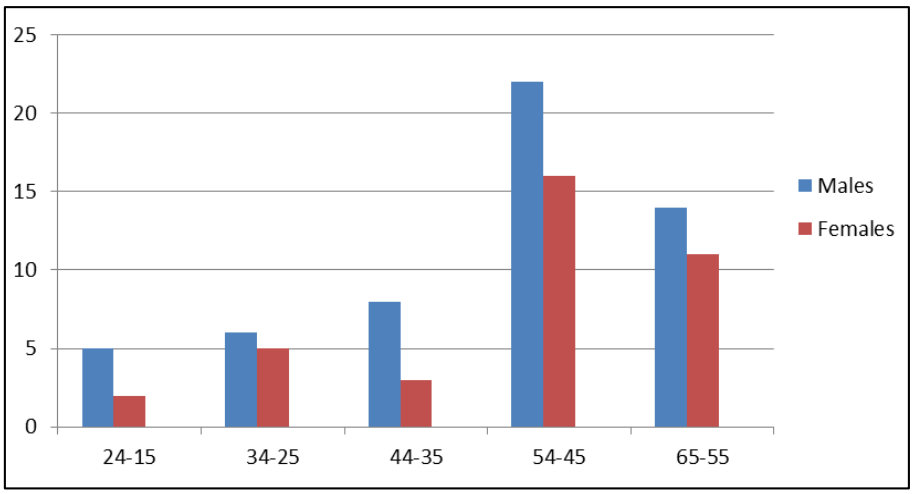

Fig 1: Distribution of SNHL according to Age and Gender

Distribution of SNHL according to severity and side

Figure (2) demonstrates the distribution of study sample according to severity and side of SNHL and reveals that highest percent of cases have mild type and lowest have the profound. Regarding the side, this figure shows that only in mild and profound types the left side SNHL is dominant.

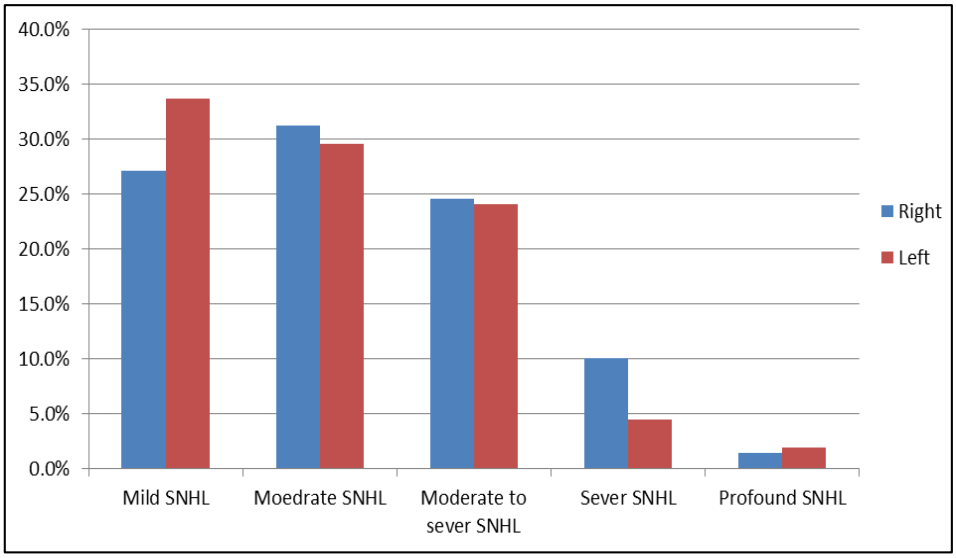

Fig 2: Distribution of SNHL according to severity and side

Analysis of risk factors

The association of SNHL and risk of diabetes mellitus

Table (1) displays the association of SNHL and risk of diabetes mellitus and portrays very highly significant statistical association with (OR 9.24) at p-value (0.000).

Table 1: The association of SNHL and risk of diabetes mellitus

	SNHL		OR	p-value	95% CI
	Present	Absent			
Diabetic	65 (70.7%)	38 (20.7%)	9.24	0.000	5.21-16.41
Non diabetic	27 (29.3%)	146 (79.3%)			

The association of SNHL with levels of HBA1c

Table (2) demonstrates the association of SNHL with levels of HBA1c and illustrates that diabetic patient with HBA1c < 7 are protected from SNHL (OR= 0.02, p value 0.000); patients with HBA1c 7-8 have a risk of developing SNHL (OR= 2.29) but statistically insignificant (p value 0.444); while patients with HBA1c >8 have 15.75 times to have SNHL with a very high statistically significant association (p value= 0.002, 95% CI=1.82-136.64).

Table 2: The association of SNHL with levels of HBA1c

HBA1c	SNHL		OR	p-value	95% CI
	Present	Absent			
< 7	4(6.2%)	6(75.0%)	0.02	0.000	0.0-0.15
7-8	16(24.6%)	1(12.5%)	2.29	0.444	0.26-20.02
>8	45(69.2%)	1(12.5%)	15.75	0.002	1.82-136.64

Discussion

Diabetes has harmful effects on almost the entire body systems including vestibular and cochlear systems; its mechanisms, patho-physiology and characteristics of the cochlear system unfortunately are not completely determined [28, 29]. The relation between diabetes and the sensory hearing impairment was not well investigated and the literatures lack the information [30, 31]. In the present work, this association was studied and case-control study design was the appropriate choice, 92 patients with SNHL and 184 attendants as control were enrolled in.The distribution of study sample according to age group and gender showed the age group (45-54) for both gender have the highest frequency among other groups with the predominant for males as illustrated in figure (1) (males 20%, females 16%), which nearly to the result of study done in Navodaya Medical College Hospital where, the prevalence of SNHL was highest among 46-50 years age group (22.41%) among diabetic patients [32], but showed predominant of females, similar conclusions about the effect of DM on hearing loss according to the age were made by Mozaffari M [33], Virteniemi *et al* [34] and A. Jagdish *et al* [35] this may be not directly related to age rather than the longer duration of DM, As the diabetes accelerate the aging process [36] and the prevalence of DM in the locality is more among males [37]. While in other studies, SNHL found frequently among females as shown in a prospective observational study of incidence of sensory neural hearing loss in DM patients" was carried out in 100 patients with known case of diabetes at least for 3 years, in Department of ENT, Government Medical College, Bhavnagar [38] where 52 (52%) females and 48 (48%) males. The present work's result could be due to that the males were payed less attention to their health. Regarding the distribution of study sample according to severity and side as portrayed in figure (2), the result was that most of the patients had mild degree of SNHL, which correspond to other study were (65.75%) of patients had mild SNHL [38] Table (1) points up that 70.7% of SNHL were diabetics with a very highly significant association (p-value 0.000) and the risk of 9.24 times. The results of this study were matching with the results of Kararlapudi *et al* [39], Wackym *et al* [40] and Lerman Garber

I *et al* [41]. This relation could be explained by the fact that the ear as other parts of the body, the hair cells of the inner ear rely on good circulation to maintain healthy function. The translation of sound into electrical impulses and conduction along the auditory nerve to the brain to be interpreted were affected. Since these sensory hair cells do not regenerate, so once they are damaged or die, hearing is permanently affected. The current work revealed as shown by table (2) a very high significant statistical association of HbA1c >8 with SNHL by 15.75 times than diabetic patients without SNHL and HbA1c <7 appeared to be protective. Similarly a positive relation between HbA1c levels and the severity of hearing loss was observed by Krishnappa and Naseeruddin in 2014 [42]. Patients with poor glycemic control HbA1c levels >8% showed higher levels of hearing loss, while patients with good glycemic control had either normal hearing or mild hearing loss. Likewise, several studies [43, 48] had same results with HbA1c >8, this reflect the bad management and control of diabetic and the excess micro-vascular complication. Other studies found no relation [33, 39]

Limitations

In order to find the un-confounded association between SNHL and DM, several exclusions were considered, and this contributed to the small sample size within the time period of data collection. Moreover the time required from the patients to complete the PTA and blood sample taking for HbA1c, shorten that planned for the interview.

Conclusions

SNHL is 9.24 times more frequent among diabetic patients than non-diabetics with very high statistical association (p-value 0.000), which necessitate more attention by the clinicians during the management of DM and frequent check up for the HBA1c, which seem to be a reflection for the association.

Recommendations

1. Implementations of further studies about this subject to estimate the SNHL prevalence and clarify the duration and severity of diabetes required for SNHL to correlate with in Iraq and Mosul city.
2. It particularly there should be compels the treating physician to recognize the cause and site of hearing impairment and to treat patients by knowing their clinical profile in this part of the country and to rehabilitate them, not only treating the diabetic as disease but also as probable complication, so that every patient should be send to ENT unit to have period checkup.

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