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Research Article

AUDIOMETRY IN TYPE 2 DIABETIC AND NON-DIABETIC PATIENTS OF THE AGE GROUP 45 TO 65 YEARS: A COMPARATIVE STUDY

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ABSTRACT

Objective: To compare the relationship between Type 2 diabetic patients and hearing loss in patients of age Group 45-65 years.

Methods: The study was conducted on two groups of people: Diabetic and non-diabetic patients (n=25). The results of the pure-tone audiometry were collected from the center and analyzed for statistical differences.

Results: Statistically significant results were obtained. It indicated that diabetic patients had less hearing sensitivity compared to non-diabetic patients.

Conclusion: It was concluded that patients with longer duration of diabetics had less hearing sensitivity.

Keywords: Diabetic, Pure tone audiometry, Frequency.

INTRODUCTION

Diabetes is a common metabolic disorder found worldwide among people not only in older age groups but also more frequently seen among in younger ages too. However, the impact of diabetes may vary from one person to another person. Diabetes mellitus (DM), commonly referred to as diabetes, is a group of metabolic diseases in which there are high blood sugar levels over a prolonged period. It is commonly associated with low insulin production or no response of the cells toward the produced insulin. They affect the normal metabolism and show various signs and symptoms. The classic symptoms of diabetes are weight loss, polyuria (increased urination), polydipsia (increased thirst), and polyphagia (increased hunger) [1]. They also include few other symptoms which denote the onset of diabetes such as fatigue, tiredness, blurred vision, headache, slow healing of wounds and cuts and itchy skin in some cases. DM is mainly of three types [2]:

- Type 1: DM results from the pancreas' failure to produce enough insulin. This form was previously referred to as "insulin-dependent DM"
- Type 2: DM begins with insulin resistance, a condition in which cells fail to respond to insulin properly. This form was previously referred to as "non-insulin-dependent DM"
- Gestational diabetes is the third main form and occurs when pregnant women without a previous history of diabetes develop a high blood sugar level.

Since diabetes is a systemic disease with accompanying pathological problems affecting multiple organ systems, it is necessary to inquire whether the auditory system is affected [3]. The relationship between diabetes and hearing loss was first proposed by Jordoa, in 1857 [4]. After this, many studies were done to investigate the relations between hearing loss and DM [5,6]. Therefore, this study aims to assess the auditory organ function in diabetic patients and to compare them with a normal control group (non-diabetic patients). Although the prevalence of diabetes is associated with more problems, one of its common manifestations includes a decrease in hearing sensitivity. With a longer duration of diabetes, there tends to be a decrease of hearing impairment. In diabetic patients, hearing impairments may be due to presbycusis, ototoxicity, noise exposure, or due to viral infections [7]. This study compares the hearing sensitivities among two groups; one includes diabetic and other includes non-diabetic patients. Even though, there are many tests to determine hearing sensitivity such as Webber test, Rinnie test, pure tone audiometry (PTA), transient evoked otoacoustic emissions, auditory brainstem responses; among which PTA was chosen for this study. It is seen that people with prolonged diabetes have few hearing problems. Hence, the rationale of the study is to analyze the association of diabetes and hearing impairment. Thus, this study evaluates the function of the auditory organ with prolonged Type 2 DM.

METHODS

This study was an observational study conducted in diabetic and non-diabetic patients. Reports were collected from an audiometry center where PTA were done. The sample size consisted of 20 diabetic and 20 non-diabetic patients. All patients were between the age group of 45-65 years and the control group included same aged non-diabetic patients who were asked to go through PTA. All the results were collected from the center and analyzed for any statistical differences.

Inclusion criteria

1. Patients who had type 2 diabetes.
2. Patients who had diabetes for more than 10 years.

Exclusion criteria

1. Patients with evidence of hearing impairment.
2. Patients who had any congenital defects in hearing.
3. Patients who were hypertensive, cardiac problems and thyroid problems were also excluded.

PTA was carried out by diagnostic audiometer with sound delivered through headphones. The procedure was that for different frequencies the hearing thresholds were measured. The frequencies ranged from 250, 500, 1000, 2000, 4000, 6000, and 8000 Hz. The corresponding threshold values were measured for both study and control group.

Statistical analysis

The data were analyzed and independent sample *t*-test was done to compare the mean values between diabetic and non-diabetic persons in terms of frequency and as a whole. The pictorial representations of data are also given below. A significance level was taken as $p<0.05$.

Table 1: Independent samples t-test to compare mean values between diabetic and Non-diabetic persons (all combined)

Frequency	Group	n	Mean±SD	t-value	p-value
Hertz value	Diabetic	140	30.67±3.60	25.875	<0.001
	Non-diabetic	140	19.98±3.31		

SD: Standard deviation

Table 2: Independent samples t-test to compare mean values between diabetic and non-diabetic persons (frequency wise)

Frequency	Group	n	Mean±SD	t-value	p-value
250 Hz	Diabetic	20	25.83±0.72	49.726	<0.001
	Non-diabetic	20	15.27±0.62		
500 Hz	Diabetic	20	27.02±1.00	30.514	<0.001
	Non-diabetic	20	16.84±1.10		
1000 Hz	Diabetic	20	28.63±0.82	34.654	<0.001
	Non-diabetic	20	18.57±1.01		
2000 Hz	Diabetic	20	30.61±0.79	30.771	<0.001
	Non-diabetic	20	19.84±1.35		
4000 Hz	Diabetic	20	32.53±1.07	28.657	<0.001
	Non-diabetic	20	21.46±1.36		
6000 Hz	Diabetic	20	34.39±1.43	29.581	<0.001
	Non-diabetic	20	23.06±0.94		
8000 Hz	Diabetic	20	35.70±0.90	46.969	<0.001
	Non-diabetic	20	24.82±0.52		

SD: Standard deviation

RESULTS

The Table 1 shows that the mean for diabetic patients was 30.67±3.60 and the mean for non diabetic patients were 19.68±3.31.

Table 2 shows the significant p values for each frequency of pure tone audiometry.

The data have statistical significance <0.001. Based on the frequency, the hearing threshold varied for both diabetic and non-diabetic patients. Inter-comparison of PTA values among different groups of diabetic patients as per the duration of diabetic patients found the statistical differences at frequencies of 250, 500, 1000, 2000, 4000, 6000, and 8000 Hz. The mean for hearing thresholds was higher for diabetic patients compared to healthy subjects. Three studies consisted of two datasets; two [8,9] analyzed bilateral and unilateral hearing impairment separately, and one [10] included two independent research studies. All these studies also showed relevant significances (p<0.001).

DISCUSSION

We found a statistically significant harmful effect of DM on hearing and noted this effect varied on the duration of diabetes. Hearing sensitivity at higher frequencies is particularly vulnerable to ototoxic insults such as aging [11,12], hazardous noise exposure, and ototoxic agents. According to this study at higher frequencies hearing thresholds was higher for old aged diabetic patients.

It was also made sure that the patients were not suffering from conductive hearing loss which was exclusion criteria for our study. There was hearing the loss in all most all patients at low, middle, and higher level of frequencies. Similar results were found in Sharma *et al*. and the findings were consistent with the findings of this study [13]. This hearing impairment may be due to the metabolic changes caused by diabetes which can modify the micromechanics of inner ear leading to hearing dysfunction. This was previously confirmed by histopathological studies of the inner ear as follows [14,15].

1. A thickening of the capillary walls of the vascular stria epithelial stratification that forms the endolymphatic edge of cochlear sac, which is important in the production of ionic gradients and of the endocochlear potential;
2. Peri and endolymphatic hemorrhaging;
3. Reduction in the number of fibers of the spiral plate;
4. Degenerative changes in the organ of Corti and reduction in the number of outer hair cells.

CONCLUSION

This study demonstrated a significant relationship between the prevalence of diabetes and hearing impairment in elderly people who had diabetes for more than 10 years. The auditory impairment was influenced by glycemic control. There was association of hearing the loss in diabetics with complications of diabetes such as hypertension, peripheral neuropathy, nephropathy, and cardiac complications in PTA. Since people are not much aware of the hearing impairment due to DM, it is necessary to perform such tests to avoid ear problems. In summary of this study, screening for hearing impairment in patients with DM may provide benefits for prompt intervention or primary prevention, especially in the old age people. Further studies will be conducted on this study for longer durations of diabetics.

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