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Original Research Article

Demographic profile of diabetic subjects with hearing loss in a tertiary health care facility of Punjab

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ABSTRACT

Background: The demographic profile of diabetic patients with hearing loss in the state of Punjab was analyzed. The emphasis was on the age, gender and clinical presentation in this prospective study.
Methods: In this prospective study 30 patients of clinically diagnosed diabetic mellitus were randomly selected from the otology clinics of oto-rhino-laryngology services, Dayanand Medical College and Hospital Ludhiana; in a period of one and a half years 01 March 2021 to 31 August 2022. All patients were taken up audiometric evaluation (pure tone audiometry,) and correlated with the diabetic profile.
Results: Maximum numbers of patients were above the age of 50 years 17 (56.7%) Male patients (21) 70% outnumbered the females (9) 70%. The selection of patients was random and irrespective of gender. Majority of patients were type II diabetic 20 (66.7%). Types I diabetic were only 10 (33.3%). The pure tone average threshold increases with increase in blood glucose, glycosylated haemoglobin (HbA1c). In type II diabetes mean pure tone average was maximum (in right ear 44.67, left ear 45.11) as compared to type I diabetes (in right ear 37.20, p=0.426, left ear 33.20, p=0.149).
Conclusions: Type 1 and type 2 diabetes have been associated with hearing impairment due to hyperglycemia and oxidative stress leading to cochlear microangiopathy and auditory neuropathy. Quality of life improves in diabetic patients with control of glycemic index. Pure tone average shows high hearing threshold in higher frequencies with increase in HbA1c levels (p=0.001).

Keywords: Diabetic mellitus, Hearing impairment, HbIAc, Pure tone audiometry

INTRODUCTION

Diabetes is a chronic health condition that causes considerable morbidity and mortality and affects the quality of life.[1] The organ of corti is the sense organ for hearing and the potential target for hyperglycemic damage that occurs in diabetes mellitus. Hearing loss affects the quality of life and leads to depression, anxiety as well as social isolation.[2] Patients with diabetes mellitus often show symptoms such as dizziness, tinnitus, and hearing impairment. Dalton et al concluded that diabetes mellitus and hearing loss (SNHL) in early studies conducted showed a weak correlation but some later studies showed positive correlations.[3-5] Hearing tests evaluates frequencies of 500, 1000, 2000, 3000, 4000, and 6000 Hz. The average of both ears is used for analysis. The pure tone audiometry

(PTA) of both ears at each frequency is obtained for frequency analysis. According to the American National Standards Institute, hearing loss is classified as slight hearing loss: 16 to 25 dB, mild hearing loss: 26 to 40 dB, moderate hearing loss: 41 to 55 dB, severe hearing loss: 71 to 90 dB, and profound: over 90 dB.[6] Microangiopathy in diabetes mellitus leads to sensori-neural hearing loss in diabetic patients.[7] Due to hyperglycemia deposition of glycoproteins in small blood vessels occurs that impacts the neurological function in diabetes patient.[8,9] Amplitude and intensity of the recorded waves for otoacoustic emission is significantly lower in diabetics than in controls.[10]

Quality of life improves in diabetic patients with the treatment of hearing loss which is the chronic complication of diabetes mellitus.[11]

Cochlea is damaged by the hyperglycemia that occurs in type two diabetes mellitus. Due to damage of outer hair cells in cochlea hearing loss occurs in type 2 diabetes mellitus. The number of undiagnosed cases of undiagnosed diabetes across the globe is approximately 175 million currently. Cochlear hair cell status is assessed by the PTA test battery that is simple, non-invasive and efficient indicator.

Objective of the study

Objective of the study was to study the demographic profile of diabetic subjects with hearing loss.

METHODS

All adult diabetic patients with hearing loss presenting in the ENT and endocrinology clinic of Dayanand Medical College and Hospital Ludhiana, between 01 March 2021 to 31 August 2022 were included in this prospective study.

Inclusion criteria

Adult diabetic patients with hearing impairment were included in the study after informed consent.

Exclusion criteria

Patients with hearing loss secondary to trauma (head injury) with documented temporal bone fracture, presence of any external or middle ear pathology (e.g. stenosis of external auditory canal, otitis media, tympanic membrane perforation, cyst, and otosclerosis), family history of sensory neural hearing loss, noise exposure, patients with ear infections, neoplastic lesions of temporal bone, and patients who not consenting for the study were excluded.

Methodology

Sample size was determined by including all patients visiting the ENT outpatient clinics. Careful selection of subjects was done after applying all the inclusion and exclusion criteria and informed consent was taken. 30 patients who passed the criteria were selected for the study.

Research design

The study was an observational prospective study conducted on adult diabetic patients with hearing loss to detect the site of lesion by means of audiometric evaluation (PTA) and correlated with the diabetic profile.

A detailed history was taken to enquire about complaints of hearing loss which was analyzed prospectively regarding-duration of the disease, blood glucose levels, and serum HbA1c.

Consent

An informed consent was obtained from the patient explaining the need of monitoring in diabetic patients with hearing loss explaining the need to rule out the site of lesion.

Patients were motivated to remain on regular follow up.

History

A detailed history was taken to inquire about diabetic patients with complaints of hearing loss and was analyzed prospectively regarding duration of the disease, blood glucose levels, serum HbA1c, treatment modalities (OHA, insulin) after thorough ENT examination- examination of the ear, and external appearance otoscopic examination.

Otoscopic examination was undertaken with Welch and Allyn hand held clinical otoscope to detect any external ear or tympanic membrane pathology. PTA test was performed to detect site of lesion.

Patients age

The average age of the group was between 31-50 years with minimum age being 19 years and maximum age being 70 years of age group.

Sex

09 females and 21 males were selected for inclusion in the study.

Audiometric testing

Baseline PTA were conducted in all selected subjects.

Test environment

PTA was performed in standard sound treated two room setup, with noise limits within permissible limits according to standard for maximum permissible ambient noise levels.

Measurement of PTA thresholds

PTA was conducted using commercial audiometer ARPHI 2009 and audiometric headphones telephonic TDH39 with tone stimulus ranging from 0.25 to 8 kHz (0.25, 0.5,1, 2, 4 and 8 kHz) and BC thresholds with bone vibrator B-70 with tone stimulus ranging from 0.25 to 4 kHz (0.25, 0.5, 1, 2 and 4 kHz) using the standard modified Hughson Westlake technique. The response was labeled as hearing loss according to WHO classification (1980). Degree of hearing loss-mild hearing loss – 26-40 dBHL, moderate hearing loss – 41-55 dBHL, moderately severe – 56-70 dBHL, severe – 71-90 dBHL, and profound – more than 90 dBHL.

Total hearing loss

The hearing thresholds on audiometry were measured in both ears separately. The findings were expressed as mean of right and left ear.

Standard two room setup for PTA with audiometer

Statistics

All statistical calculations were done using statistical package of social sciences (SPSS) 17 version statistical program for Microsoft windows (SPSS Inc. released 2008. SPSS statistic for windows, version 17.0, Chicago). Ethical approval of the study was taken from the Institutional Ethics Committee.

RESULTS

30 patients who fulfilled the inclusion and exclusion criteria were included in the study. The observations of different parameters of the study have been compiled.

Demographic profile

Maximum number of patients were above the age of 50 years 17 (56.7%) followed by those below 30 years 8 (26.7%). Only 5 (16.7%) were between 31-35 years (Table 1).

Male patients (21) 70% outnumbered the females (9) 70%. The selection of patients was random and irrespective of gender (Table 2).

15 (50%) patients were from rural and 15 (50%) from urban background (Table 3).

Table 1: Age distribution of patients (n=30).

Age group (years)	No. of cases	Percentage
<30	8	26.7
31-50	5	16.7
>50	17	56.7
Total	30	100.0

N=Total number of patients, %=percentage of patients

Table 2: Gender distribution of patients (n=30).

Sex	No. of cases	Percentage
Females	9	30.0
Males	21	70
Total	30	100

N=Total number of patients, %=percentage of patients

Table 3: Topographic distribution of patients (n=30).

Locality	No. of cases	Percentage
Rural	15	50
Urban	15	50
Total	30	100

N=Total number of patients, %=percentage of patients

Diabetic profile

30 (100%) patients were diabetic. Majority of patients were type II diabetic 20 (66.7%). Type I diabetic were only 10 (33.3%) (Table 4).

Table 4: Diabetic status of patients (n=30).

H/o diabetes yes/no	No. of cases	Percentage
Yes	30	100

N=Total number of patients, %=percentage of patients

Audiometric evaluation

It included the following: mean pure tone average, otoacoustic emission, brainstem evoked response audiometry, and mean pure tone average analysis. 30 (100%) patients underwent pure tone average analysis. The pure tone average threshold increases with increase in blood glucose, HbA1c (Table 5).

In type II diabetes mean pure tone average was maximum (in right ear 44.67, left ear 45.11) as compared to type I diabetes (in right ear 37.20, p=0.426, left ear 33.20, p=0.149) (Table 6).

Table 5: Correlation of pure tone average threshold with Hb1Ac and blood glucose (n=30).

Parameters	Pearson correlation, p value, N				
	Weight (kg)	**PTA (R)**	**PTA (L)**	**HbA1c (%)**	**Blood glucose (mg/dl)**
PTA (R)	0.136, 0.489, 28	1.000, 28	0.604, 0.001, 28	0.115, 0.561, 28	0.577, 0.001, 28
PTA (L)	-0.116, 0.557, 28	0.604, 0.001, 28	1.000, 28	-0.153, 0.438, 28	-0.497, 0.007, 28

N=Total number of patients, %=percentage of patients

Table 6: Correlation of pure tone average with type I and type II diabetes (n=30).

Type I		Type II		Z	P value
Mean	SD	Mean	SD		
37.20	18.17	44.67	25.75	-0.809	0.426
33.20	16.23	45.11	22.14	-1.489	0.149

DISCUSSION

Demographic profile

Age

In the present study, majority of patients were in age group above 50 years of age (56.7%) followed by 31-50 years (16.7%) and below 30 years (26.7%). Youngest was 19 years of age and eldest was 70 years of age. In Mia et al study, 53 diabetic patients suffered with hearing loss, majority of patients were above 40 years.[7] Spankovich et al study had 40 young adults aged 18-28 years who were type-1 diabetic.[12]

Gender

In our 30 subject study, male patients 21 (70%) outnumbered the females 9 (30%). Mousavi et al study of 250 diabetic mellitus patients, had 158 (63.2%) females and 92 (36.8%) males.[13]

Kautzky-Willer et al Swedish study had a male predominance, with a male to female ratio up to 1.4 in the age group 10–55 years.[14] In the Ottaviani et al study, 15 of 60 diabetic patients; male patients 35 outnumbered the female patients 25.

Clinical profile

Hearing impairement

In the present study 30 adult patients were diabetic with complaint of hearing loss (100%). 6.7% had family history of sensor neural hearing loss. Majority 28 (93.3%) had no family history of sensor neural hearing loss. In Al-Rubeaan et al study, 157 30-60 years diabetic subjects, aged 30-60 years there were, 77 with hearing loss in both ears 71 (49.0%), 13 had involvement of right ear only (8.3%), 14 of left ear only (8.9%); and 53 (33.8%) had normal hearing.[16] In the 181 ears with sensor neural hearing loss, 90 had mild loss (49.7%), 69 moderate loss (38.2%), 16 severe loss (8.8%) and 6 had profound loss (3.3%). Akinpelu et al study concluded that the incidence of hearing loss ranged between 44% and 69.7% for type 2 diabetics; significantly higher than in controls.[17] The mean PTA thresholds were greater in diabetics than in controls for all frequencies. Hou et al analysis of diabetic patients demonstrated a hearing deficit with elevated hearing thresholds in right ear as well as left ear when compared to healthy controls.[18]

Pure tone audiometric assessment

In our study diabetic patients revealed higher hearing threshold at high frequencies. The mean pure tone average of patients with type I diabetes was in right ear 37.20, left ear 33.20. In type II diabetes was 44.67 in right ear, 45.11 in left ear. As the HbA1c increases mean pure tone average threshold increases (p=0.001). Lasagni et al study in diabetes patients showed significantly higher mean hearing thresholds.[19] Botelho et al study of 40 diabetic patients showed sensor neural hearing loss, affecting frequencies of 6000 and 8000 Hz, which was found only in type 1 DM subjects when compared to the controls.[20]

In our study group, 30 (100%) patients were diabetic. Majority of patients were type II diabetic 20 (66.7%) with type I diabetic percentage of 33.3%. Botelho et al study included 40 adolescents with DM1 and 40 healthy subjects.[21] Eren et al study involved 40 type 2 diabetic patients and 24 healthy volunteer.[22] Samocha-Bonet et al study concluded that both type 1 and type 2 diabetes have been associated with hearing loss.[23]

CONCLUSION

Diabetes is a chronic health condition that causes considerable morbidity and mortality. Both type 1 and type 2 diabetes have been associated with hearing loss secondary to changes in the organ of corti and stria vascularis. Hearing impairment includes the combined contributions of hyperglycemia and oxidative stress to cochlear microangiopathy and auditory neuropathy. Quality of life improves in diabetic patients with control of glycemic index. Pure tone average shows high hearing threshold in higher frequencies with increase in HbA1c levels (p=0.001).

In type 2 diabetic 6 kHz was the frequency which was involved in maximal subjects. Male diabetic had higher incidence of involvement. PTA is a non-invasive screening tool to assess the function of cochlea and vestibulocochlear nerve for early detection and timely management of hearing loss in diabetic patient.

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