HEARING IMPAIRMENT IN DIABETES MELLITUS PATIENTS AT TERTIARY CARE HOSPITAL.

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ABSTRACT

Introduction: Hearing impairment is common issue of old age but certain disease like DM may also affect the vestibulochochlear system**. Objective:** To observe the impairment in the hearing threshold among patients of Diabetes Mellitus (DM). **Methods:** This prospective cross sectional study was conducted during February 2017 to January 2018, in the Department of Ear Nose and Throat (E.N.T) Liaquat University of Medical and Health Sciences (LUMHS) Hyderabad in collaboration with the Diabetic clinic LUMHS Hyderabad on 98subjects; the subjects were collected from the diabetic clinic LUMHS Hyderabad. They were included in the study after screening and ear examination.They all were exposed to pure tone audiometry by Audiometer MAICO 39 (Berlin, Germany). The pure tone conduction was dignified at 7 octave wave frequencies at minimum intensity which was perceived and the graph was plotted on Audiogram.Hearingthresholds among subjects were investigated. **Results:** The data was analysed with Statistical Package for Social Sciences (SPSS) version 20. Significantly higher difference was observed in right ear at250, 2000, 4000, 6000 and 8000 Hz frequencies (p-value=0.003, 0.004, 0.000, 0.000 and 0.000) respectively and in left ear highly significant difference was obtained at4000, 6000 and 8000 Hz frequencies (p-value=0.000, 0.000 and 0.000) respectively among diabetic subjects according to duration of diabetes mellitus. **Conclusion:** The hearing threshold difference was significant mainly at higher frequencies among cases.

Key Words: Diabetes Mellitus, Hearing Threshold, Audiometry.

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INTRODUCTION:

Diabetes mellitus (DM) is a chronic metabolicdisorder categorized by hyperglycaemia caused by deficit of insulin secretion, struggle of insulin to work or both[1,2]. Type-1, Type-2 and gestational diabetes mellitus (GDM) are the major types ofDM.The occurrenceof DM in Pakistan is 6.76%[3].According to International Diabetes Federation (IDF) 2017, 425 million cases of DM were disclosed all around the globe; among them 39 million cases were in the MENA region and Pakistan is one of the states in this region[3]. Listed cases of DM up to 2017 in Pakistan are 7.5million and it will reach up to 16.1 million in next 20years[4].

Type-1 DM is an autoimmune disorder only be controlled by giving exogenous insulin; Type-2 DM is categorised by poor response of the body to endogenous insulin, aggravate to hyperglycaemia; while gestational diabetes mellitus (GDM) is considered by high blood sugar level acknowledged first time in pregnancy and it is caused by the diminished response of the body to endogenous insulin due to discharge of placental hormones[5]. Type-2 DM and GDM can be managed by either exogenous insulin or oral hypoglycaemic medications or both of them[4].There are macrovascular and microvascular complications of DM; Neuropathy is one of the microvascular complications of DM[4]. The Hearing loss(HL) describes as more than 25 dB hearing impairment as pure tone thresholds in the better ear, because of which an individual may not pick up parts of words or all of words in general communication[6]. According to World Health Organization (WHO) 466 million people over the globe have HL represents 5% of the population of all continents over the earth, this number will increase to nearby 900 million up to 2050[6]. The external hearing meatus is the air filled space which conducts environmental sounds through the tympanic membrane vibrations into the middle ear which is composed of incus, malleus and stapes ossicles[7]. Stapedius is the only muscle present in middle ear bound to the stapes bone and in accountof noisy sounds it contracts its length to drop down

transmission of sounds toward the cochlea and put it protect from loud sounds injury. The ossicles of middle ear mechanically transfer sound stimuli into the fluid of cochlea[7]. Cochlear fluid vibrations excite the basilar membrane; it is aflexible and most reactive to low frequency sounds at the cochlear apex while the membrane is rigid and sensitive to high frequency sounds at the base of the cochlea[7, 8]. Jordao in 1857 was the first who described relationship between DM and HL[9]. There are number of offences observed which may destroy hair cells in human cochlea resulting in impaired hearing thresholds[10]. There are different elementsrelated to impaired hearing thresholds including gender and DM in adults[7]. Current epidemiological studies have defined significant hearing thresholds differencein diabeticsand it generally targets high frequency tones[11].

The burden of DM is increasing day by day because of theoccurrence of DM is increasing. This study was designed to observe the difference in hearing thresholds in adult diabetes mellitus in a tertiary care hospital.

METHODS:

This twelve months prospective cross sectionalstudy was conducted in the Department of E.N.T. LUMHS Hyderabad in collaboration with the Diabetic clinic, LUMHS Hyderabad from February 2017 to January 2018. The sample size was n=98;Established cases of DMof both gender age between 20 to 45 years who had given consent to be a part of the study were included in the study. While those who had gestational DM, head injury, ear trauma, smoking, other comorbid like hypertensive, ear pathology and family history of ear diseases, exposure to industrial or occupational noise and Upper respiratory tract infection in the last one month were excluded from the study.

After taking an informed written consent by all participants their ear examinations and pure tone audiometry was conducted according to the guidelines of the British society of audiology[12].A detailed history was taken and thorough physical examination was done; B.P was recorded and blood glucose measured by glucometer.The ears' examination was done by Otologist in which normal landmarks and mobility of tympanic membrane was assessed afterwards hearing test was performed by tuning fork (T.F) 512 Hz i.eRinne's, Weber's and absolute bone conduction.

Audiometry was done in the noise free environment by an Audiometer (MAICO-M 39, Germany); Supra- aural headphones (TDH-39, Germany) were to be placed on both ears of subjects after removing any obstruction that could intervene with placement of the earphone cushions over the external auditory meatus. A better ear was tested first; the responses were given when the tones heard by raising the corresponding hand of the subjects'. The most commonly used procedure for hearing threshold is called a modified Hughson Westlake procedure[13]. This is defined as at first 40 dB intensity stimuli was given at 1000 frequency HZ to make identification about the stimuli. One by one each ear threshold were sensed of the volunteers by 10 down and 5 up method at 1000, 2000, 4000, 6000, 8000, 500 and 250 HZ in respective order.

At audiogram right ear hearing threshold indicated by O and left ear by X symbol. HL was classified according to WHO[12]. About 20-25 minutes were consumed in audiometric examination of each subjects' then they were free to go. All data were recorded on specialized proforma.

The data was analysed with SPSS version 20. Frequency and percentages of categorical variables were calculated and statistical differences were tested by applying Chi-square test; quantitative variables were computed by mean ±standard deviation and statistical differences were tested by applying t-test. p-value<0.05 was considered to be significant.

RESULTS

The mean right ear hearing threshold was observed significantly higher at 1000Hz and 250Hz among cases with age group of 31-40 years as compared to 20-30 years (p-values= 0.044 and 0.018) respectively. While non-significant difference was found in mean right ear hearing threshold at frequencies of 8000Hz, 6000Hz, 4000Hz, 2000Hz and 500Hz among cases between two age groups.

The mean left ear hearing threshold was observed significantly higher at 250HZ among cases with age group of 31-40 years as compared to 20-30 years (p-values= 0.001). While non-significant difference was found in mean left ear hearing threshold at frequencies of 8000Hz, 6000Hz, 4000Hz, 2000Hz, 1000Hz and 500Hz among cases between two age groups (Table-I).

Table I. Mean Right and Left ear hearing thresholds according to age among cases (n=98)

Hearing Threshold	**Age Groups**		**P-Value**
R(RIGHT EAR) L(LEFT EAR)	**20-30 years n= 22**	**31-40 years n=76**	
250HZ	R=20.90±2.02 L=20.00±0.00	R=22.74±2.66 L=22.35±2.89	0.018* 0.001*
500HZ	R=22.00±2.73 L=20.83±2.04	R=22.55±2.73 L=21.95±2.71	0.686 0.267
1000HZ	R=20.00±0.00 L=21.66±2.88	R=20.45±1.45 L=20.67±1.73	0.044* 0.614
2000HZ	R=20.50±1.58 L=20.71±1.88	R=21.31±2.22 L=20.97±2.00	0.179 0.741
4000HZ	R=22.30±3.88 L=21.36±2.33	R=23.26±2.82 L=22.36±3.00	0.412 0.231
6000HZ	R=25.55±5.91 L=25.93±6.38	R=26.62±4.54 L=26.25±5.23	0.482 0.856
8000HZ	R=23.23±4.98 L=23.12±5.43	R=24.29±3.80 L=24.55±3.56	0.420 0.331

Table II. Mean Right and Left ear hearing thresholds according to gender among cases (n=98)			
Hearing threshold R(right ear) L(left ear)	**Gender**		**P-Value**
	Male n=71	**Female n=27**	
250HZ	R=22.64±2.71 L=22.38±2.95	R=22.04±2.51 L=21.00±2.07	0.365 0.054
500HZ	R=22.50±2.76 L=22.05±2.78	R=22.50±2.63 L=21.15±2.19	1.000 0.252
1000HZ	R=20.41±1.40 L=20.60±1.65	R=20.45±1.50 L=21.42±2.43	0.942 0.422
2000HZ	R=21.27±2.20 L=21.09±2.09	R=20.93±2.01 L=20.41±1.44	0.573 0.210
4000HZ	R=23.41±3.12 L=22.14±2.88	R=22.27±2.54 L=22.36±3.05	0.098 0.784
6000HZ	R=26.59±4.96 L=26.19±5.22	R=25.86±4.43 L=26.20±6.00	0.514 0.997
8000HZ	R=24.30±4.13 L=24.35±3.99	R=23.47±3.82 L=24.04±4.06	0.387 0.766

Non-significant difference was observed in mean right and left ear hearing threshold between two gender groups (Table-II). The mean right ear hearing threshold was found significantly higher among cases with duration of DM more than 05 years as compared to cases with duration of DM less than 05 years. A significant difference was noted in mean right ear hearing threshold according to the duration of DM at frequencies of 8000Hz, 6000Hz, 4000Hz, 2000Hz and 250Hz (P-value =0.000, 0.000, 0.000, 0.004 and 0.003) respectively.A significant difference was noted in mean left ear hearing threshold according to the duration of DM at frequencies of 8000Hz, 6000Hz and 4000Hz (P-value =0.000, 0.000 and 0.000) respectively (Table-III).

Table III. Mean Right and Left ear hearing thresholds according to duration of DM (n=98)			
Hearing Threshold	**Duration of DM**		**P-Value**
R(RIGHT EAR) L(LEFT EAR)	**0-5 years n=63**	**6-10 years n=35**	
250HZ	R=21.66±2.38 L=21.37±2.27	R=23.54±2.64 L=22.66±3.14	0.003* 0.077
500HZ	R=22.20±2.53 L=21.57±2.38	R=22.77±2.88 L=21.96±2.83	0.446 0.618
1000HZ	R=20.23±1.09 L=20.26±1.14	R=20.57±1.62 L=21.19±2.18	0.400 0.098
2000HZ	R=20.51±1.53 L=20.53±1.57	R=22.14±2.51 L=21.40±2.29	0.004* 0.121
4000HZ	R=21.96±2.46 L=20.94±1.98	R=25.00±2.88 L=23.70±3.15	0.000* 0.000*
6000HZ	R=24.31±2.37 L=24.13±3.98	R=30.00±5.77 L=29.70±5.76	0.000* 0.000*
8000HZ	R=22.31±2.69 L=22.80±2.88	R=26.91±4.26 L=26.51±4.41	0.000* 0.000*

Frequency of hearing impairment among diabetic subjects (6-10 years and 0-5 years) were 24

Table IV. Hearing Impairment among cases n=98		
Hearing Impairment Frequency in Subjects		
	Diabetics n=63 (0-5years)	**Diabetics n=35 (6-10years)**
Present	09 (09.18%)	24 (24.48%)
Absent	54 (55.10%)	11 (11.22%)

(24.48%) and 09 (09.18%) respectively. Among subjects (6-10 years and 0-5 years) 11 (11.22%) and 54 (55.10%) were having normal hearing respectively (Table-IV).

DISCUSSION:

In the present study significant HL was found in diabetic subjects; overall about 33% Hearing impairment was observed in diabetic patients. HL was slight to moderate; it was observed mainly for high frequency thresholds.

There was no significant difference in HL between different age groups and two genders. A Significant difference was observed in HL at higher frequencies with duration of diabetes mellitus. Daniel et al observed 21.7% hearing impairment in a 46 cases study involving patients of type-2 DM[13]. Saini S. et al observed 30% HL in diabetics with mean age of 31.8 year[14]. Similar findings were made Muhammad Irshadet al[15], Shahid Majeedet al[16] these findings are in agreement with present study.

In the current study a significant difference was observed in diabetic subjects at high frequency thresholds. Similar findings are reported by SainiS et al[14], Meena R et al[17], Jankar et al[18], In-Hwan Oh et al[19] and S.Vijayasudaram et al[20].

ShahidMajeed et al in a 310 cases study observed a significant HI in about 46% of cases[16], Muhammad Irshad et in a 286 cases study observed a significant HI in about 12.2% of cases[15], while Daniel et al observed 21.7% hearing impairment in 46 cases; he had found significantly higher mean hearing thresholds at all frequencies in cases and significant bilateral threshold difference above 2000Hz[13], these findings are comparable with findings observed in the present study.

Kufre Robertet al [21] showed significantly higher mean hearing thresholds at higher frequencies in cases.Mishra et al conducted study in India have got significant difference in mean hearing thresholds in cases through pure tone audiometry from frequencies 2000 to 8000Hz with normal mean hearing thresholds below frequencies 2000Hz[22].

Dr.Naseret al[23] demonstrated significant mean hearing thresholds at higher frequencies likewise in the present study. Zeinolabedini et al found significantly higher mean hearing thresholds at 2000, 4000, and 8000Hz for both ears among cases with mean age of 35 years but within normal hearing ranges[24]; the findings correlate with the present study.

Significantly higher mean hearing thresholds have been observed by In-Hwan Oh et al at 6000Hz in cases among 20-40years of age [19]; the finding likewise in the current study pointing out that difference in hearing thresholds commences at high frequencies in younger then progress at normal frequency of human speech, later on involvement of low frequency hearing thresholds.

Bhatia et al[25] in comparative study observed significantly higher mean hearing thresholdsamong cases at 6000 and 8000 Hz; these finding are in agreement with the present study.

In the present study some differences existed with other studies. These might be due to differences in period of study, inclusion and exclusion criteria and heterogeneity of study subject.It would be easy to know difference in hearing thresholds by screening which otherwise could not be detected.

CONCLUSION

Hearing threshold difference was significantly more common in cases. Mean right and left ear hearing threshold was significantly more common at higher frequencies in cases. Audiometric testing must be suggested in all diabetics to monitordifference in hearing threshold and to avoid further damage.

ETHICS APPROVAL: The ERC gave ethical review approval

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin

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