Audiovestibular Changes in Diabetes Mellitus

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Abstract

Audiovestibular functions in 50 cases of diabetes mellitus have been evaluated to find out the type of hearing loss. Diabetes mellitus causes a significant bilateral symmetrical hearing loss at higher frequencies and with the progress of disease and added complications the hearing further deteriorates. On control of diabetes hearing changes are found to be irreversible. However vestibular functions remain uninvolved in cases of diabetes mellitus. A direct correlation was found between hearing loss and increasing blood sugar level.

Diabetes mellitus has been described for some 3500 years, but neurological disorders associated with the disease were recorded in 1798 by John Rollo. The relationship between diabetes mellitus and audiovestibular organs are known for more than 100 years. Jordao (1857) was the first to report a case of incipient diabetic coma in a 41 years old man exhibiting impairment of vision, hearing, smell and taste. Marchal de Calvi (1864) also observed neurologic disorders in diabetes mellitus and sensorineural deafness has caused much controversy with reference to the site of lesion and degree of hearing loss. The literature exhibits many contradictions concerning the correlation between hearing impairment and diabetic manifestations.

Material and Method

The present study has been under taken to de-

termine the audiovestibular profile in cases of diabetes mellitus. In this study 25 age and sex matched healthy subjects as control (group -I) have been evaluated along with 25 diagnosed cases of diabetes mellitus Group (II) and 25 cases of diabetes mellitus with complications like peripheral neuropathy, non healing ulcer, hemiparesis, recurrent fungal infection etc. Group (III), with a view to assessing audiovestibular profile of the cases. Patients with a history or finding indicative of any otological pathology have been excluded from the study. To exclude cases of presbycusis the study has been done in fairly young diabetics. All the patients included in the study were subjected to a thorough systemic and ENT examinations. The criteria for diagnosis of diabetes mellitus was based on history, clinical examination and biochemical investigations. Audiological evaluation was done by pure tone audiometry (Arphi audiometer Model 700 MK-

IV type) SISI & tone decay test. Evaluation of vestibular functions was done by differential caloric test (Fitzgerald and Hall Pike - 1942). The control and diabetic groups consist of 13 male and 12 females, with age range from 20-50 years.

Observations

The present study consists of 3 groups of cases, group-I (Control), Group-II (diabetes mellitus) and Group-III (diabetes mellitus with complications). In each group there were 13 males and 12 females with age ranging from 20-50 years. In Group-III cases a variety of one or more diabetic complication were seen. The predominant being retinopathy (48%), neuropathy (44%), and nephropathy (44%). None of the patients gave any history of vestibular involvement. However 4 patients volunteered history of hearing loss. On pure tone audiometry hearing loss was found in 24 cases (48%) Table I.

Table - I

Age wise distribution of Patients

Age range	No. of Cases	Hearing loss	No. of cases with hearing loss
21-30 Yrs	13	7	53.8%
30-40 Yrs	18	6	33.3%
41-50 Yrs	19	11	57.8%

Hearing loss was found to be bilateral symmetrical and sensorineural in type. The number of cases with hearing loss was more in 41-50 years age group (57.8%). The hearing loss was mild in 16 cases (66.6%) moderate in 5 cases (20.8%) and severe in 3 cases (12.5%) on speech frequencies.

All the cases had abnormal tone decay suggestive of retrocochlear lesions Table II.

Table - II

Correlation of Tone Decay of different Groups

Frequencies	Hz	Gr. I	Gr. II	Gr. III
1000	Mean	3.000	22.200	22.200
	S.D.	± 1.936	± 7.916	± 7.716
		$P < 0.05$		$P \geq 0.05$
2000	Mean	3.000	25.200	24.000
	S.D.	± 1.936	± 7.427	± 6.614
		$P < 0.05$		$P \geq 0.05$
4000	Mean	2.667	26.600	25.800
	S.D.	± 1.484	± 6.570	± 6.622
		$P < 0.05$		$P \geq 0.05$

The hearing loss was found to be more in the diabetic with higher blood sugar level Table III.

With control of diabetes there was no improvement in hearing loss. Hearing threshold at different frequencies for air conduction and bone conduction both ears, there was a constant hearing loss upto 4000 Hz followed by a sudden fall in hearing threshold Fig.-I. In Group III

Table - III

Correlation of Blood Sugar Level and Hearing Loss

Fasting Blood Sugar level mgm%	No. of Cases	Normal Hearing	Impaired Hearing	Type of Hearing loss (HL)
100 mg% (normal)	25	25(100%)	—	—
100-150	10	6(60%)	4(40%)	Sensorineural (SN)
151-200	15	8(53.3%)	7(46.6%)	S.N.HL
201-250	10	4(40%)	6(60%)	S.N.HL
> 250	15	7 (46.7%)	8 (53.3%)	S.N.HL

cases one or more complications were seen in all the cases. The number of cases with hearing loss was found to be more in Group III. Out of 24 diabetic cases showing hearing loss 6 cases were in Group II, 18 cases (75%) of diabetics were in Group III. On correlation of age and sex with hearing loss no difference between audiovestibular functions has been found in any age group or between the sexes.

In the present study statistically no difference in audiovestibular functions was found neither in any age group nor between the sexes. The audiological profile of control group was essentially within normal limits and the mean hearing threshold in diabetics on statistical analysis showed a significant statistical difference ($P < 0.05$).

Table - IV
Comparative Value of Hearing Thresholds of Group II, III

Frequencies Hz	Mean		S.D.		P
	Gr. II	Gr.III	Gr. II	Gr. III	
250	8.100	11.200	9.085	8.426	<0.05
500	10.200	13.700	8.142	6.911	<0.05
1000	12.100	15.800	7.633	7.379	<0.05
2000	16.900	19.100	9.577	8.249	<0.05
4000	22.900	24.900	10.599	9.819	<0.05
8000	39.060	46.460	18.485	17.843	<0.05

When hearing threshold of Group II and III were compared (Table-IV), it was found that there was a statistical difference ($P < 0.05$) of hearing threshold at all the frequencies. From Table-V it is clear that in the diabetic patients there is a bilateral symmetrical high tone sensorineu-

ral deafness and it is more significant when the hearing threshold of diabetic patients was compared to normal. It involves all the frequencies. The comparative values of short increment sensitivity index of three groups is shown in Table V.

Table - V
Comparative Values of SISI Scores of three Groups

Frequencies Hz		Gr.I	Gr.II	Gr.III
1000	Mean	3.500	18.400	18.200
	S.D.	± 2.803	± 5.858	+4.361
	S.E.	0.724	1.172	0.872
2000	Mean	3.833	17.800	15.200
	S.D.	± 2.650	± 7.264	+3.139
	S.E.	0.684	1.453	0.628
4000	Mean	3.167	17.800	15.200
	S.D.	± 2.582	± 7.264	+2.492
	S.E.	0.670	1.453	0.498

Table-V shows that there is a statistical difference ($P < 0.05$) in SISI score of Group I and III but there was no statistical difference ($P < 0.05$) when Group II and III were compared. On comparison of tone decay test in Group II and Group III it is inferred that the type of deafness is of retrocochlear type.

The comparative values of tone decay at 1000, 2000 and 4000 Hz for Group I and II, Group II and III are shown in Table II. It is found that there is a statistical difference ($P < 0.05$) when Group II and Group III are compared.

A positive correlation has been found between hearing threshold and blood sugar level. With the increasing blood sugar level there is a constant increase of deafness. But the vestibular system remains unaffected. These findings of noninvolvement of vestibular system have also been observed by Jorgensen & Buch (1961).

Discussion

The audiological profile of diabetic cases has been found to be controversial over the years. The type and range of hearing loss has differed widely, in numerous studies.

The present study has revealed no differences in audiovestibular profile in different age group not between sexes of the diabetic patients. These observations are contrary to Shaia and Sheehy (1976) Taylor and Urwin (1978) who observed more hearing loss in females than males. Camisca (1950) and Dietzel (1964)

found more deafness in males. Axelsson and Fagerberg (1962) found no difference between the sexes.

All the cases showed sensorineural deafness, retrocochlear type which is bilaterally symmetrical and more at higher frequencies. Axelsson and Fagerberg (1968) have also observed retrocochlear type of deafness. Fedele et al (1983) and Panda et al (1987) have described involvement of somatic, autonomic and central nervous system on brain stem evoked response studies in diabetes mellitus. Jorgenson et al (1961) have stressed upon the theory of cochlear type of deafness due to angiopathy in diabetes mellitus.

Triana et al (1991) also described loss of sensory hair cells in cochlea in diabetics resulting in cochlear hearing loss. The cochlear or retrocochlear deafness in cases of diabetes mellitus cases may be explained on the hypothesis of microangiopathy or neuropathy which is a well known phenomenon in cases of diabetes mellitus. Whertherin (1929) and Benesi and Somer (1929) suggested that the deafness is caused by combination of cochlear and retrocochlear type of lesions.

The hearing loss was found to be irreversible, with control of diabetes. No evidence of vestibular dysfunction was found in diabetics. Probably vestibular structures are resistant to ischaemia as suggested by Sander et al (1982).

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