Hearing changes in children and adolescents with type 1 diabetes mellitus

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INTRODUCTION

- Diabetes mellitus (DM) is a metabolic disease that produces complications of vascular and neurologic malfunction.
- Patients with DM have hearing loss greater than those without.
  - Hearing loss in diabetics (J Laryngol Otol 1993).
  - Early identification of hearing impairment in patients with type 1 diabetes mellitus (Otol Neurotol 2001).
  - Characterization of hearing loss in aged type II diabetics (Hear Res 2006).
- Severity of DM or serum glucose level may be related to hearing loss.
- Suggested pathogenesis for DM-associated sensorineural hearing loss:
  - Cochlear microangiopathy
  - Hyperglycemia of the cerebrospinal fluid or perilymph
  - Auditory neuropathy
  - Diabetic encephalopathy.
- Lack of pediatric studies examining hearing changes of patients with T1DM.

OBJECTIVES

- To investigate hearing changes in children and adolescents with T1DM.
- To examine if hearing changes is associated with glycemic control.

SUBJECTS AND METHOD

- Children and adolescents (n=53) of age 5-18 years with T1DM.
  - No chronic complication
  - Disease duration ≥ 6 months
  - Well-controlled: HbA1c < 9%; poorly-controlled: ≥ 9%
- Sex, age-matched normal healthy controls (n=33).

-Pure tone audiometry-

- Pure tone air conduction thresholds were obtained for pulsed tones.
- Stimuli were presented by audiometer through insert earphones.
- Frequencies tested were from 125 to 8000 Hz..

RESULTS

Table 1. General characteristics of T1DM and control groups

	T1DM (n=53)	Control (n=33)	*p*-value
Age (years)	14.5 ± 4.1	14.3 ± 3.2	0.821
Sex (M : F)	23 : 30	14: 19	0.929
HbA1c (%)	9.1 ± 2.4		
Disease duration (years)	4.0 ± 2.9		
C-peptide (ng/mL)	0.39 ± 0.54		

Table 2. Comparison of pure tone threshold between T1DM and normal control groups

Pure tone threshold (dB)	T1DM (n=53)	Control (n=33)	*p*-value
Right Ear (Hz)			
125	16.0 ± 6.7	14.5 ± 6.0	0.299
250	12.9 ± 7.7	12.0 ± 5.7	0.540
500	11.6 ± 5.9	10.6 ± 5.1	0.428
1000	9.2 ± 5.4	10.8 ± 5.0	0.174
2000	7.5 ± 5.2	8.0 ± 6.4	0.646
4000	8.2 ± 7.3	7.7 ± 6.7	0.762
6000	17.6 ± 7.9	10.0 ± 6.5	<0.001
8000	8.6 ± 7.8	9.5 ± 5.6	0.511
Left Ear (Hz)			
125	14.4± 6.0	12.3 ± 5.9	0.106
250	12.5± 6.6	10.9 ± 5.9	0.274
500	10.61 ± 5.9	8.8 ± 5.7	0.171
1000	8.3 ± 4.8	7.9 ± 6.4	0.727
2000	7.6 ± 5.3	6.3 ± 5.2	0.244
4000	7.9 ± 9.6	5.5 ± 4.9	0.174
6000	14.8 ± 7.4	8.6 ± 6.5	<0.001
8000	9.3 ± 7.5	7.3 ± 6.1	0.189

Table 3. General characteristics of well-controlled (HbA1c < 9%) and poorly-controlled (HbA1c ≥ 9%) groups

	Well-controlled (n=28)	Poorly-controlled (n=25)	*p*-value
Age (years)	13.7 ± 4.3	15.5 ± 3.7	0.102
Sex (M : F)	14 : 14	9 : 16	0.305
HbA1c (%)	7.2 ± 1.0	11.1 ± 1.6	<0.001
Disease duration (years)	3.2 ± 2.6	4.9 ± 3.0	0.034
C-peptide (ng/mL)	0.46 ± 0.56	0.30 ± 0.52	0.306

Table 4. Comparison of pure tone threshold between well-controlled and poorly-controlled control groups

Pure tone threshold (dB)	Well-controlled (n=28)	Poorly-controlled (n=25)	*p*-value
Right Ear (Hz)			
125	15.2 ± 4.4	17.0 ± 8.5	0.344
250	11.3 ± 5.9	14.8 ± 9.1	0.103
500	10.5 ± 5.0	12.8 ± 6.8	0.169
1000	8.6 ± 4.5	9.8 ± 6.4	0.417
2000	5.7 ± 4.2	9.4 ± 5.5	0.008
4000	5.9 ± 6.1	10.8 ± 7.9	0.014
6000	15.4 ± 6.9	20.2 ± 8.2	0.024
8000	7.1 ± 7.0	10.2 ± 8.5	0.157
Left Ear (Hz)			
125	13.2 ± 6.0	15.8 ± 5.9	0.119
250	11.1 ± 6.1	14.0 ± 6.8	0.105
500	9.5 ± 5.5	11.8 ± 6.1	0.149
1000	7.5 ± 4.4	9.2 ± 5.1	0.201
2000	7.3 ± 4.8	8.0 ± 6.0	0.648
4000	7.7 ± 10.8	8.2 ± 8.1	0.845
6000	12.1 ± 6.4	17.8 ± 7.4	0.004
8000	7.9 ± 7.5	11.0 ± 7.4	0.131

Table 5. Correlations between HbA1c and pure tone threshold

Pure tone threshold (dB)	r	*p*-value
Right Ear (Hz)		
125	0.108	0.440
250	0.263	0.057
500	0.250	0.071
1000	0.272	0.049
2000	0.341	0.012
4000	0.295	0.032
6000	0.360	0.008
8000	0.177	0.205
Left Ear (Hz)		
125	0.335	0.014
250	0.290	0.035
500	0.273	0.048
1000	0.207	0.136
2000	0.093	0.507
4000	0.084	0.551
6000	0.393	0.004
8000	0.260	0.060

CONCLUSIONS

- T1DM is associated with an increased risk of hearing loss in children and adolescents.
- Hearing changes seems to be related to blood glucose control states.
- Hearing evaluation and interventions are required in the management of T1DM in children and adolescents.

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