Audiological profile in diabetic patients

(السجل السمعي لمرضى السكري)

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الخلاصة

الهدف : لتقييم تاثيرالسكري على السمع الحسي العصبي

المنهجية : هذه الدراسة هي دراسة مقطعية من خلالها أجرينا تقييم سمعي ل 60 من مرضى السكري من كلا نوعي السكري (نوع1 ونوع2) للفترة من حزيران 2012 إلى كانون الثاني 2013شملت مراجعي عيادة السكري والعيادة الخارجية للأذن والأنف والحنجرة في مدينة الامياميين الكاظميين (ع) وقد تم مقارنتهم بأقرانهم من الأشخاص الغير مصابين بالسكري الذين يماثلونهم في الأعمار والأجناس. خضع كل المرضى بالسكري لفحص شامل وأخذ تاريخ مرضي دقيق وكذلك فحص الأشخاص الغير مصابين بالسكري لاستبعاد أولائك الذين لديهم أسباب أخرى لفقدان السمع مثل (تأريخ عائلي لفقدان السمع المبكر أو تعرض لضجيج شديد أو أدوية معروفة بسميتها للجهاز السمعي وكذلك لاكتشاف أي عا ـض أو علامة لمرض آخر في الأذن).تم اجراء تخطيط سمعي لكل مرضى السكري والأشخاص الغير مصابين بالسكري وكذلك أخذت عينة من دم كلاهما لقياس نسبة السكر التراكمي في الدم (HbA1c).

النتائج : هذه الدراسة بينت بأن هناك زيادة مهمة في انتشار فقدان السمع الحسي العصبي بين مرضى السكري عند مقارنتهم مع أقرانهم الغير مصابين بالسكري (P value يساوي اقل من 0.00004 أي انه ذو أهمية) وان فقدان السمع غالبا كان للترددات العالية حيث ان ال (P value كان 0.0794 عند التردد 500Hz أي انه ليس ذو أهمية) وكان (عند التردد 4000Hz اقل من 0.0001 أي انه ذو أهمية).كذلك فان الدراسة بينت بان فقدان السمع يتناسب طرديا مع مدة تواجدالمرض وانه أكثر في المرضى الغير مسيطرين على نسبة السكر في الدم بصورة جيدة وذلك عن طريق قياس نسبة $HbA1_c$. كذلك أوضحت هذه الدراسة بأنه لا يوجد تأثير مهم لنوع داء السكري(نوع1 او نوع2) على فقدان السمع الحسي العصبي.

الاستنتاجات : فقدان السمع الحسي العصبي في الترددات العليا هو احد مضاعفات داء السكري.

التوصيات : الفحوصات الدورية المنتظمة للعتبة السمعية (pure tone audiometry) هي جزء من متطلبات متابعة مرضى السكري.

Abstract

Background: The auditory system is a potential target of the damaging effect of diabetes mellitus.

Objective: To assess the clinical impact of diabetes mellitus on hearing.

Patients and Methods: This is a case control study in which we assess the hearing of 60 diabetic patients of both types (type 1 and type 2 diabetes) regarding (age, gender, type, duration and control) of diabetes mellitus and compare it with 60 normal (age and gender match) control group. Thorough history and full ENT examination done for both diabetic patients and control group to exclude those with other causes of sensorineural hearing loss. Pure tone audiometry were done for all patients and normal control group and (5cc) of blood were taken from diabetic patients for assessment of HbA1c level.

Results: This study shows that there is significant increase (p value <0.00004) of prevalence sensorineural hearing loss among diabetic patient compared with normal (age and gender match) control group. The sensorineural hearing loss was mostly for high frequency (P value at 4000Hz was <0.0001 which is significant), and the loss is proportionate with the duration of diabetes and is more in uncontrolled diabetes than controlled group(according to their HbA1c level) and the P value was 0.0082 (significant). There is no significant effect of type of diabetes mellitus on hearing loss (P value was 0.4526 which is not significant).

Conclusion: High frequency sensorineural hearing impairment is one of the complications of diabetes mellitus.

Recommendation: regular hearing assessment being a part of follow up program of diabetic patients.

Key word: Sensorineural hearing loss, Diabetes Mellitus, HbA1c.

INTRODUCTION

Diabetes mellitus (DM) is a genetically inherited disease in which glucose serum levels are abnormally high due to relative or absolute insulin deficiency. Chronic manifestations of DM are secondary to micro and macrovascular disease, neuropathies (including peripheral, autonomic radiculopathy and mononeuropathy) as well as immunodeficiency secondary to impaired leukocyte/phagocyte function.[1] Prevalence of DM is increasing worldwide, and its complications are the cause of considerable morbidity and mortality and negatively affect the quality of life in individual with diabetes hence it is important that chronic complications are recognized early and promptly managed. [2]

The relationship between DM and hearing loss was first reported by Jorddao in1857. Edgard first noted high frequency sensorineural hearing loss in diabetic patient in 1915.[3] Diabetes mellitus (DM) is a disease that is caused by inadequate insulin, due to either resistance of end organs due to obesity reducing the insulin receptors or insulin responsive cells (type 2), or reduced levels of insulin due to autoimmune response to beta cells of the pancreas triggered by infection (type 1).[4] Type 1 DM typically present in patients under ages of twenty-five year (0.2-0.5% of the population), with no predilection for men or women. The Prevalence of type 2DM is (2-4%), and usually occurs in patients older than (40) years and there is a slight predilection for women.[5] HA1c test measure the non enzymatic reaction of glucose with circulating proteins and therefore reflect longer-term blood glucose levels, and can be separated from unaltered HbA by electrophoretic and other methods. HbA_1 includes the stable HbA_{1c} fraction, which is most closely related to average blood glucose levels over the preceding (6-8) week's .Normal Non-diabetic HbA_{1c} level ranges from (3.5 - 5.5%) of total HbA, with good control defined as values less than (7%) and in poor control more than (8%).[6]

PATIENTS AND METHODS

Sixty patients who were aknown cases of DM, (40) patients of them are type1 (insulin dependent DM) and (20) are type2 (non insulin dependent DM). Those patients were selected randomly from the visiting patients to the diabetic clinic at Al-imamain Al-kadimian medical city, and they compared with (60) normal person control group (ages and gender match) whom they were otologically and medically normal. The age of both patients and control groups were ranged from (10-50) years, mean (34.7) year and the standard deviation was (±11.45). The study carried out from July (2012) to January (2013). We excluded all patients with any of the following criteria (Age more than 50 years to minimize the aging effects i.e presbyacusis, patients with family history of early onset hearing loss, patients with middle ear pathology i.e chronic otitis media, otosclerosic patients, Patients with history of exposure to noise, those with history of tooking ototoxic drugs, patients with history of head injury, patients who underwent ear surgery and those with metabolic or neurological diseases).

Assessment: The subjects in both groups (diabetic and control group) underwent full:

- General and ENT examination.
- Audiological assessment: These were done for both patients and control groups.
- Tuning fork tests: this is done by using 512Hz tuning fork for Rinne and Weber test.
- Pure tone audiometry(PTA); this is done in a sound proof room for all patients and control groups using Atmo screen 20k pure tone audiometer. Both air conduction and bone conduction were assessed using frequency range from 250-8000 Hz.

Investigation: 5ml of blood was aspirated from diabetic patients and send for HbA_{1c}

categorization:

- According to the involvement by diabetes mellitus we had 2 groups: diabetic patients group and control group.
- According to the type of DM there were 2 groups: type 1 DM and type 2 DM.
- According to the age: both patients and control groups were categorized into 4 groups according to their ages ;(10-20) years, (21-30) years, (31-40) years and (41-50) years.
- According to the duration of diabetes mellitus: diabetic patients were categorized into 3 groups according to the duration ;(1-10) years, (11-20) years and more than 20 years.
- According to the control of diabetes: diabetic patients were categorized into 2 groups according to the control of their blood sugar determined by measurement of HbA_{1c} percent; good control(values less than 7%) and poor control(values more than 8%) .

Statistical analysis

The chi-squre (X^2) test was used to evaluate the association between categorical variables to determine whether association was significant. The P value was calculated for the results as follows:

- Significant when the P value is <0.05.
- Not significant when the P value is >0.05.

RESULTS

The results of hearing loss were considered relative to (6) parameters:
The age, types of DM, the gender, Diabetics Vs control, Duration of DM, Control of DM.

The age:

Table 1. The age distribution of both diabetic and control group.

Age of patients and control group/ year	Total No. of patients	Patients with normal hearing	Patients with hearing loss	No. of control persons with hearing loss	P values
10-20	9	8	1	0	0.30
21-30	11	7	4	0	0.027
31-40	15	4	11	1	0.0002
41-50	25	4	21	2	<0.0000001

Table 1. The age distribution of both diabetic and control group who had sensorineural hearing loss and p values according to their age groups. In our study the effect of DM on hearing loss according to the age showed significant effect on all age groups except in (10-20) year age group and it appears more significant loss in patients with age group (41-50) years(P value <0.0000001) .

Type of DM:

Table 2. Distribution of sensorineural hearing loss according to the type of DM.

Type of DM	Total No. of patients	Percentag%	No. of patients with hearing loss	Percentage %
Type1	40	66.7	26	65
Type2	20	33.3	11	55

Table 2. Out of 60 diabetic patients, 40(66.7%) patients are type1 and 20(33.3%) patients are type2 .Twenty six (65%) patients of type1DM and 11(55%)patients of type 2 DM had sensorineural deafness. The P value is 0.4526 which is > 0.05 i.e not significant.

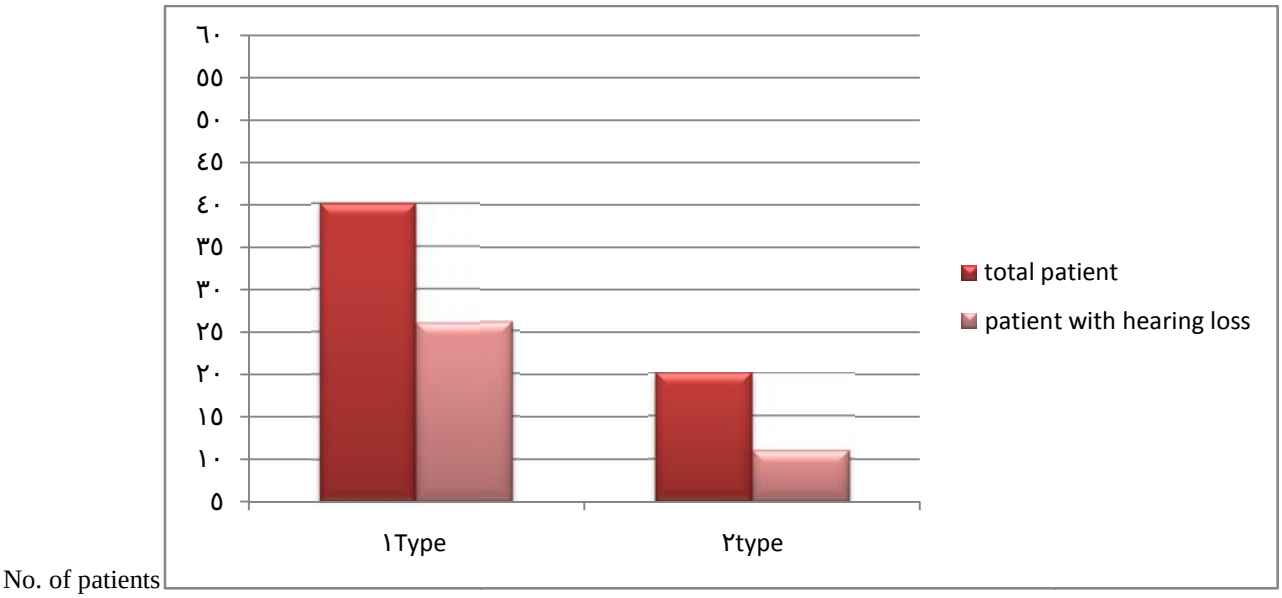

Figure1. Distribution of patients with sensorineural hearing loss according to type of DM.

THE GENDER:

Table 3. Gender distribution.

Total No.	Female	Male
60	35	25
%	58.3	41.7

Table 3. Female to male ratio was 1.4:1(35 female and 25 male).

THE DURATION:

Table 4. Distribution of diabetic patients according to the duration.

Duration of DM/years	No. of patients	% of patients with hearing loss
1-10	28	39.3
11-20	23	73.9
More than 20	9	100

Table 4. Out of the total (60) patients, (28) patients had diabetes for (10) years, (23) patients for (20) years and (9) patients had diabetes for more than (20) years. There is clear relationship between duration and hearing impairment and mostly in those patients who had diabetes mellitus for more than (20) years.

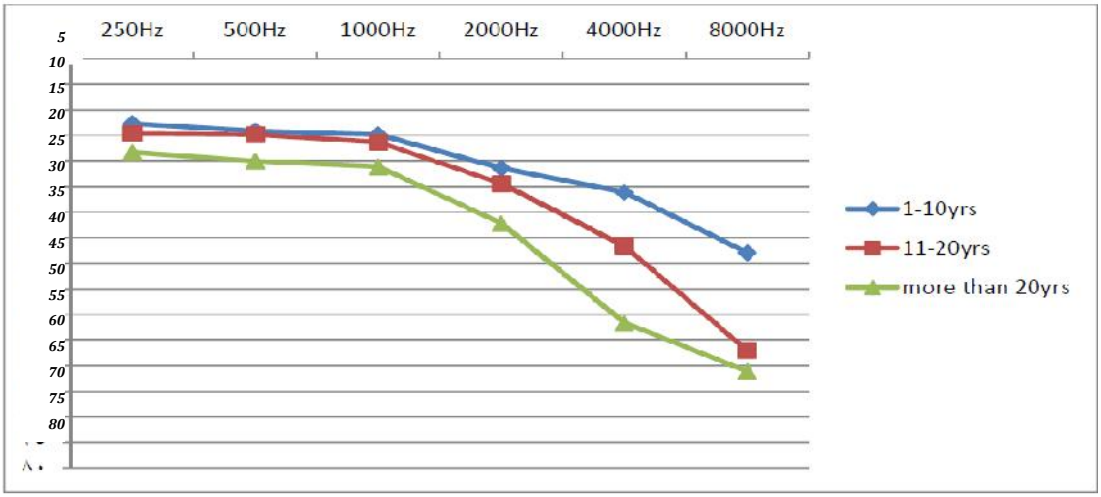

Figure 2.Mean hearing threshold according to the duration of DM.

Diabetics Vs control:

Table 5. No. and (%) of patients with hearing loss in both diabetic and control groups.

	Total No.	No. of patients with hearing loss	%
Diabetic group	60	37	61.1
Control group	60	3	5
P value		<0.00004	

Table 5. Out of 60 diabetic patients, 37 (61.1%) patients had sensorineural hearing loss, while in the (60) non-diabetic person only (3) had sensorineural hearing loss and the (P value was<0.00004 i.e significant).

Hearing threshold:

Table 6. Mean air conduction thresholds for both diabetic and control groups with P value for low frequency (500Hz) was (0.0794 i.e not significant) and for high frequency (4000Hz) was (<0.0001 i.e significant).

Groups	Air conduction hearing threshold in dB					
	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
Diabetics group	15.2	16.3	17.5	26	38	52
Control group	9	9.6	12.4	12.8	13	15
P value		0.0794			<0.0001	

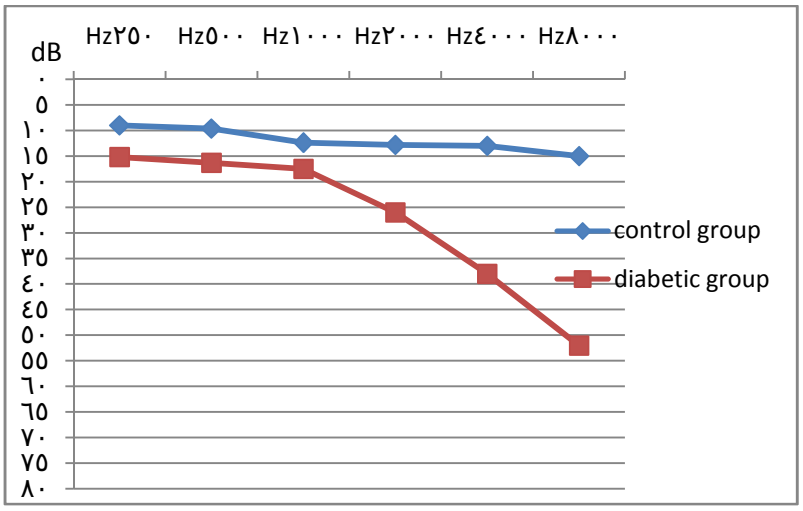

Figure 3. Mean air conduction thresholds of diabetic and control groups.

Control of DM

Table 7. Distribution of diabetic patients according to the control of diabetes and number of patients with hearing loss.

Group according to control(HbA_{1c})	Total No.	with hearing loss	%	without hearing loss	%
Good control (HbA_{1c} less than 7%)	17	6	35.2	11	64.7
Poor control (HbA_{1c} more than 8%)	43	31	72.1	12	27.9

Table7. By measurement of HbA1c percent (as indicator of diabetic control) we categorized diabetic patient into 2 groups.Statistical analysis shows significant relationship between hearing loss and control of blood sugar (P value 0.0082 which is <0.05).

Table 8. The mean hearing threshold was calculated over all frequencies for both good and poor control groups.

Group according to control	Mean air conduction thresholds in dB					
	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
Good control	13.5	14.1	15	20	24.1	35.3
Poor control	16.9	18.5	20	32	51.9	68.7

Table 8.The mean hearing threshold was calculated over all frequencies for both groups (good and poor controlled diabetes mellitus) showing more loss in poorly controlled diabetic group and more for high frequencies**.**

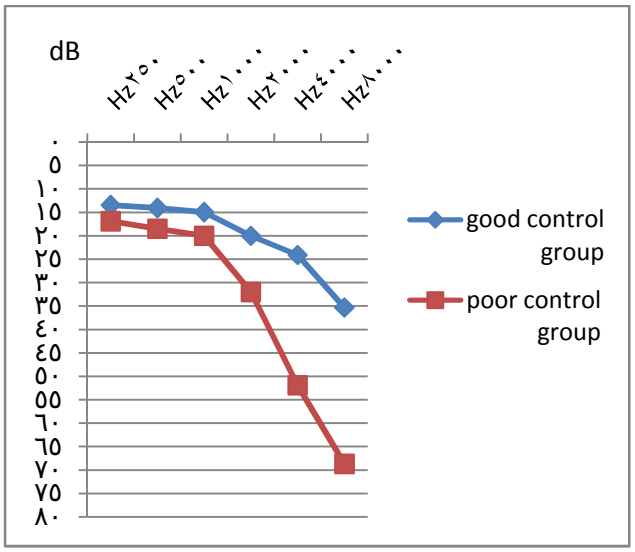

Figure 4. Mean hearing thresholds in good and poor control group as shown in table 8.

DISCUSSION

From the above results we noted that diabetic patient's population has poorer hearing than normal population as shown in tables (5, 6) and figure2.

Out of (60) diabetic patients their age ranging from (10-50) years and of both types of DM there were 37(61.1%) patients had sensorineural hearing loss while only 3(5%) out of(60) normal control group had sensorineural hearing loss (P value was <0.00004 i.e. strongly significant) .This also shown by Vaughan et al in their study and they found that(62%) incidence of high frequency hearing loss.[7] A. Jagdish et al also compared the hearing of(58) diabetic patients, their age ranging from(5-55) years, with (58) normal subject and stated that the diabetic patients aged between (15-50) years showed a significant high frequency hearing loss as compared to normal control group.[8]

The female to male ratio in our study was 1.4:1 which may reflect the ratio of patients visiting the diabetic clinic and ENT out patient in our hospital, this ratio differs than that in A. Jagdish et al study where female to male ratio was 1:1.9[8]. This finding is also corresponding to that in Thiago Hernandes Diniz et al study. [9] It seems that this ratio is not important because there was no evidence on the previous literature of sex predilection in the effect of diabetes on hearing.

Most of our diabetic patients were type1 (40 out of 6o patients was type1 and 20 was type2). A. Jagdish et al study found that type 2DM is more common (45patients out of 58 was type 2 and 13 was type1). [8] Pemmaiah K.D et al investigate only type 2 diabetic patients in their study [10].In our study we think that type1 diabetic patients are more represented diabetic population because it usually start earlier (younger age) so there will be more time for the pathophysiological effect on auditory system which reflect clinically as snsorineural hearing impairment.

The current study also show that there is no significant difference in prevalence of sensorineural hearing loss among patients of both types of DM (P value 0.4526 i.e not significant) as shown in table 2 and figure 1. A. Jagdish et al noticed that the prevelance of sensorineural hearing loss in type 2 DM (82%) more than in type 1(46%).[8]

The current study show that the diabetic related hearing loss is sensorineural and mostly at higher frequencies, as shown in figure 2 and table 6(P value was 0.0794 at 500Hz frequency which is not significant while it was <0.0001 at 4000Hz which is strongly significant). A. Jagdish et al study [8], Pemmaiah K.D et al [10] studies shows similar results.

In our study the effect of DM on hearing loss according to the age showed significant effect on all age groups except in (10-20) year age group.The P value was 0.3 in this age group, it was 0.027 in (21-30) year age group, 0.0002 in (31-40) year age group and 0.0000001in (41-50) year age group and this is clear in table1. Similar conclusion made by A. Jagdish et al,[8] Helzner EP et al,[11] and Mozaffari M[12] in their studies.

Regarding the effect of duration of DM on hearing in our study we found that there were clear relationship between duration and hearing impairment as shown in table 4 and figure2. This also shown by Mozaffari M et al [12], Fukushima H et al [13], Sakuta H et al [14] and Helzner EP et al [15]. The duration of DM of our patients in this study looks longer than that found in other studies, and this is because most of our patients are type1 who had longer duration of diabetes and most of them are in the age group (41-50) year.

Tables(7, 8) and figure(3, 4) shows the effect of control of diabetes mellitus on hearing threshold. Out of (60) patients, (43) patients are poorly controlled DM and only31 (72.1%) patients of them had hearing loss. Only 6(35.2%) patients from the (17) with good control DM patients had hearing loss. Statistical analysis shows significant relation between hearing loss and control of blood sugar (P value 0.0082 which is <0.05). This also noted by A. Jagdish et al[8], Mozaffari M et al [12]and Bamamie AH et al [16] . A. Jagdish et al[8] Bamamie AH et al[16] and Mitchell P et al[17] in their studies stated that there is evidence that good control of blood glucose will decrease the angiopathic effect of DM which means decrease the damaging effects on sensorineural end organs.

In our study we took the HbA_{1c} as indicator of diabetic control which reflect diabetic control better than fasting blood sugar (FBS). A. Jagdish et al [8] use (fasting blood sugar) as an indicator for diabetic control in his study. The HbA_{1C} also used as indicator for diabetic control by Pemmaiah K.D [10], who's stated that HbA1c and hearing loss in higher frequency showed statistically significant correlation.

CONCLUSION

It was clear that there is significant harmful effect of diabetes mellitus on auditory function similar to its effect on visual function, as those diabetic patients in general has poorer hearing threshold than normal non diabetic populations.

The effects of diabetes mellitus on auditory function are clearly proportionate to the duration of diabetes mellitus.

There is evidence that poorly controlled diabetes were significantly more prone to diabetics' related hearing loss, as both types of diabetes mellitus has equal effect on hearing threshold.

RECOMENDATION

For the above causes it is recommended that:

1. Regular hearing assessment being a part of follow up program of diabetic patients.
2. Education of patients about the effect of diabetes mellitus on hearing and highliting the importance of strict control of blood glucose.

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