

A CLINICAL STUDY OF SENSORINEURAL HEARING LOSS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

First author

Dr Pravin Tez. S

Assistant Professor

Department of ENT, Head & Neck Surgery
MediCiti Institute of Medical Sciences
Ghanpur, Medchal, Hyderabad - Telangana 501 401

Second Author / Corresponding Author

Dr JainaDivya

Assistant Professor

Department of ENT, Head & Neck Surgery
MediCiti Institute of Medical Sciences
Ghanpur, Medchal, Hyderabad - Telangana 501 401

Third Author

Dr Bomma Vijay Kumar

Assistant professor

Department of ENT
Gandhi Medical College & Hospital
Secunderabad - 500003

Fourth author

Dr M V Subba Rao

Professor

Department of ENT, Head & Neck Surgery
MediCiti Institute of Medical Sciences
Ghanpur, Medchal, Hyderabad - Telangana 501 401

Fifth author

Dr Rama Teja P

Junior Resident

Department of ENT, Head & Neck Surgery
MediCiti Institute of Medical Sciences
Ghanpur, Medchal, Hyderabad - Telangana 501 401

ABSTRACT:

Background: The relationship between sensorineural hearing loss (SNHL) and Diabetes mellitus has been known age ago. The pathophysiology of diabetes related hearing loss is speculative. Hearing loss is usually, bilateral, gradual onset, affecting higher frequencies.

Aim: To find the prevalence of Sensorineural Hearing Loss in Type 2 Diabetes Mellitus patients.

Materials and methods: This is a cross-sectional study, which included 140 diabetics of age group 30 to 50 as cases. All the subjects were subjected to the estimation of FBS, PPBS, HbA1c and pure tone audiometry. Various biochemical and audiological investigations have revealed that there is a strong association with sensorineural hearing loss and Diabetes Mellitus.

Results: The prevalence of sensorineural hearing loss in type II diabetics has been proved to be 66.43%. In the majority of the patients the hearing loss was bilateral progressive and symmetrical affecting higher frequencies of 4 KHz to 8KHz. It was seen that 93 diabetics had sensorineural hearing loss out of which 2 of them had sudden onset hearing loss. Rest of them had progressive hearing loss. The occurrence of hearing loss was matched for age, sex, duration of diabetes, and control of diabetes. It had positive correlation with increased age of the patient and duration of diabetes. There was no significant difference in hearing loss among the two sex groups.

Conclusion: The control of diabetes was measured with glycated hemoglobin which had a correlation with hearing deficit. Patients with poor control (HbA1c greater than 8%) of their glycemic status have increased auditory thresholds.

Keywords: Glycated haemoglobin, Diabetes Mellitus, Sensorineural hearing loss

INTRODUCTION:

Hearing is one of the five special senses, which empowers us and enriches our lives. Hearing enables us to socialize, work, interact, communicate and even relax. It facilitates us to lead our everyday lives without any limitations. Any impairment in hearing may lead to feelings of isolation and even depression. It can cause a significant decrease in our quality of life. Our ability to hear has an impact on almost every aspect of our lives. The sense of hearing, the perception of sound and its biological purpose, is therefore, very essential.

Hearing loss is of two types Sensorineural type and Conductive type. Sensorineural hearing loss (SNHL) is a type of hearing loss, or deafness, in which the root cause lies in the inner ear (cochlea and associated structures), vestibulocochlear nerve (cranial nerve VIII), or central auditory processing centres in the brain. In Conductive hearing loss there is a problem in conduction of sound waves anywhere along, external auditory canal tympanic membrane or the ossicles.

Diabetes mellitus (DM) is a common metabolic disease that causes impairments of the body systems. As diabetes mellitus is very common in general population, the effects caused by it on different organs of the body has utmost significance. One of the known complications of DM is hearing impairment, especially hearing loss and tinnitus, which leads to a decreased quality of life among those affected.¹The relationship between diabetes mellitus and hearing function has been studied for a long time, yet there is no adequate data on this topic. With 422

million diabetics worldwide, WHO rings an alarm that, the prevalence rate would be 5.4% in 2025.²

In developing countries majority of diabetics are in the productive period of their lives, which has a major implication with respect to health care needs. The goal of modern medicine is not just about the treatment of diseases but also their prevention and control, thereby improving the quality of life of individuals and mankind as a whole.³ The results of Pure Tone Audiometry are a good indicator of hearing impairment. It can be used to differentiate between conductive hearing loss, sensorineural hearing loss, and mixed hearing loss.

This study was undertaken to study the prevalence of SNHL in Type 2 Diabetes Mellitus patients and find the correlation of different factors associated with hearing loss in Type 2 Diabetes Mellitus patients. With this study we aim to bring awareness to the clinicians and general public the need for evaluating sensorineural hearing loss in diabetic patients for prevention and early detection of hearing loss. We can give appropriate treatment to the patients and improve their quality of life.

MATERIALS AND METHODS:

Prospective study ENT AND GENERAL MEDICINE OPD, MediCiti Institute of Medical Sciences & Hospital, Ghanpur. 140 patients with Type 2 Diabetic Mellitus attending ENT and General Medicine OPD are included : 18 months (01-01-2020 to 30-06-2021)

Inclusion Criteria: Type 2 Diabetes patients , aged between 30 to 50 years

Exclusion Criteria: Patients with conductive hearing loss, mixed hearing loss, sensorineural hearing loss other than due to Type 2 Diabetes, like head injury, congenital causes etc.

Source of data is from Type 2 Diabetic subjects attending to ENT and General medicine opd, MediCiti Institute of medical sciences. Informed consent will be obtained from all the subjects enrolled in the study after explaining to them in detail about the study in their own language.

- The subjects will be selected on basis of inclusion and exclusion criteria ,then detailed history is taken , later will be subjected to ENT and systemic examination, and audiometric assessment (Pure Tone Audiometry) will be done.
- Fasting and post prandial blood sugar levels will be assessed.
- To assess the diabetic control of the patient in the last 3 months HbA1c is considered.

Pure Tone Audiometry-Procedure:

Audiometric assessment was conducted in sound treated room delivering pure tone stimuli to one ear at a time in frequencies of 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz and 8000Hz at various selected intensities. The reference intensity level is designated "X"dB at each

frequency, is the mean value of minimal audible threshold of pure tones in healthy individuals. Hearing threshold is taken as the least intensity of pure tone that was audible to the subject. The subject is advised to signal on hearing the least sound of any sort till it ceases. The subject is presented with various selected tones for 1 to 3 seconds and for a minimum gap of 1 to 3 seconds between successive presentations.

Air conduction threshold is repeated for 1000Hz to assess the reliability of the procedure. Air conduction thresholds in the right and left ears were marked by 'O' and 'X' respectively. Bone conduction threshold is obtained by using bone vibrator placed on the skin over mastoid process and assessed to a maximum of 4000Hz. It is represented by symbols '[and]' for right and left bone respectively. Masking is employed when the difference in right and left unmasked air conduction threshold is 40dB or more.

The hearing threshold grading is given by **(WHO) (World Health Organisation Grading)**⁴

- 0-25dB –normal hearing
- 26-40 dB –mild hearing loss
- 41-55dB –moderate hearing loss
- 56-70dB –moderately severe hearing loss
- 71-90dB-severe hearing loss
- >90dB- profound hearing loss

Blood investigations:

The patient's blood was assigned for the routine blood investigations as haemoglobin, total count, differential count and platelets to rule out anemia, leukemia and other disorders. Fasting and post prandial blood sugar levels were measured in the central laboratory attached to our hospital. To assess the diabetic control of the patient in the last 3 months HbA1c was done and graded as

- < 7% -good control
- 7-8%- moderate control
- >8%- poor control

Once the investigations were done and extent of disease is established, management was done accordingly.

Data will be entered into MS-Excel (2010), then data will be exported to SPSS and analyzed. Continuous variables will be summarized as mean and standard deviation. Categorical variables will be summarized as proportions. Tests of significance for difference in proportions will be performed by using chi-square test. P value less than or equal to 0.05 were considered statistically significant.

RESULTS:

The occurrence of sensorineural hearing loss in diabetic patients was studied .

Table-1 : Prevalence of Sensorineural Hearing Loss in demographic details

Characters	Number of cases	Prevalence
SNHL	93	66.43%
Normal	47	33.57%
Age (in years)		
31-35	6	4.3
36-40	13	9.3
41-45	42	30.0
46-50	79	56.4
Mean \pm SD	45.41 \pm 4.29	
Range	31-50	
Sex		
Male	54	38.6
Female	86	61.4
Gradual	91	97.8
Duration of DM (in years)		
\leq 5	50	35.71
6-10	48	34.29
> 10	42	30.0
Mean \pm SD	7.11 \pm 4.55	
Range	0-20	

In our study involving 140 type 2 diabetic patients, 93 patients (66.43%) were *found to have sensorineural hearing loss and 47 patients (33.57%) were found normal. The prevalence of diabetes was more among 46-50 age group(56.4%) and least among 31-35 age group (4.3%). As the age group advances , number of diabetes patients increases and majority of patients are in the 41-50 age group. Out of 140 diabetes patients 86 were females and 54 were males. Females constituted 61.4% of total patients and males constituted 38.6%.

In our study of 140 diabetes mellitus patients, 93 patients had SNHL, out of which 91 were of gradual onset, 2 were of sudden onset. 97.8% of patients developed SNHL gradually, where as 2.15% developed SNHL suddenly. 50 patients (35.71%) had diabetes of duration 5 years

or less,48 patients (34.3%) of 6-10 year duration,42 patients(30.0%) of more than 10 year duration.

Table-2: Association of hearing loss of DM patients with their age group

Age group	Left Ear (n=140)		Prevalence (%)	Right Ear (n=140)		Prevalence (%)
	No Hearing Deficit	SNHL		No Hearing Deficit	SNHL	
31-35	5	1	16.67	4	2	33.3
36-40	10	3	23.08	10	3	23.08
41-45	14	28	66.67	15	27	64.29
46-50	18	61	77.22	18	61	77.22
P Value	<0.0001			<0.0001		
Male	16	38	70.37	17	37	65.12
Female	31	55	63.95	30	56	68.52
P Value	0.580			0.851		
Duration of DM (in years)						
≤5	31	19	37.0	30	20	40.0
6-10	11	37	77.08	12	36	75.0
> 10	5	37	88.10	5	37	88.10
P Value	<0.0001			<0.0001		

Association between hearing loss of Diabetes mellitus patients and their age is highly significant as indicated by the P Value. In the left ear,there is a progressive increase in the prevalence of SNHL with the age of the patient.Prevalence of SNHL is lowest among 31-35 age group(16.7) and highest among 46-50 age group(77.2). In the right ear also prevalence of SNHL is highest in 46-50 age group.There is a progressive increase in the prevalence from lower to higher age group with a dip in 36-40 age group. Association of hearing loss of DM patients with Sex of the patient is not significant in both the ears as shown by the P value .The prevalence of SNHL in females was found to be 65.12% and 68.52 in males,showing that SNHL in diabetics has no correlation with the sex of the individual. Association of hearing loss of DM patients with the Duration of DM is highly significant as indicated by the P value.It is observed that as the duration of diabetes increases,the prevalence of SNHL increases. In the left ear 47 subjects with 6-10 yr duration of diabetes 37 developed SNHL(prevalence of 77.08%) and in 42 subjects with more than 10 yr duration 37 developed SNHL(prevalence of 88.10) , which is highly significant. It is clearly seen that as duration of diabetes increases, the predisposition to SNHL also increases. In the right ear also there is an

increase in the prevalence of SNHL with the duration of diabetes mellitus , which is highly significant.

Table-3: Distribution of patients according to their HBA1c status (N = 140)

HBA1c status	Number of cases	Percent
<7	38	27.14
7 to 8	16	11.43
>8	86	61.43
Mean \pm SD	8.76 \pm 2.10	
Range	6.1- 17.3	
FBS(mg/dl)		
\leq 110	30	21.43
111-125	25	25
\geq 126	85	60.71
PPBS(mg/dl)		
\leq 140	9	6.4
141-199	39	27.9
\geq 200	92	65.7
Mean \pm SD	253.9 \pm 89.2	
Range	102-500	

Out of the 140 diabetic patients 38 had HbA1c level less than 7 indicating good glycemic control, 16 had values between 7 and 8 indicating average glycemic control whereas 86 patients had values more than 8 indicating poor glycemic control. Maximum number of patients were in the poorly controlled group(60.71%)and least among the well controlled group(21.43%) indicating the general trend in the community. The highest number of patients were there in the poorly controlled group and the least among well controlled group.

Table -4: Association of hearing loss of DM patients with their HBA1c Levels

HBA1c	Left Ear (n=140)			Right Ear (n=140)		
	No Hearing Deficit	SNHL	Prevalence	No Hearing Deficit	SNHL	Prevalence
<7	25	13	35.9	25	13	34.21
7 to 8	5	11	60.0	6	10	62.50
>8	17	69	80.2	16	70	81.40
P Value	<0.0001			<0.0001		
FBS(mg/dl)						
\leq 110	21	9	30.0	19	11	36.7

111-125	7	18	72.0	10	16	64.0
≥ 126	19	66	77.65	19	66	77.6
P Value	<0.0001			<0.0001		
PPBS Levels						
≤ 140	8	1	11.1	7	2	22.2
141- 199	19	20	51.28	20	19	48.72
≥ 200	20	72	78.26	20	72	78.26
P Value	<0.0001			<0.0001		

The uncontrolled group is found to have more prevalence of SNHL (80.2%,81.4%) than the well controlled group (34.2%,34.29%) and the moderately controlled group was comparatively less affected by SNHL (68.75%,62.50%) in the left and right ear respectively. Fasting blood sugar levels were found to have correlation between the degree of hearing loss as it is depicted in the study, that in subjects with moderately controlled sugar levels have decreased prevalence of sensorineural hearing loss (72%,64%) as compared with uncontrolled (77.6%) and well controlled group (30%,36.7%) in left and right ears respectively indicating even short-term fluctuations of sugar levels can alter the hearing threshold in patients. Differences in the post prandial blood sugar level between the Subjects and SNHL cases were statistically significant in both the ears as seen in the table. The post prandial blood sugar levels were found to have correlation between the degree of hearing loss as it is depicted in the study, that in subjects with moderately controlled sugar levels(51.28%,41.28%) have decreased prevalence of sensorineural hearing loss as compared with uncontrolled(78.26%,78.26%) and well controlled group(11.11%,22.22%) in left and right ears, indicating even short- term fluctuations of sugar levels can alter the hearing threshold in patients .

Table-5 : Distribution of patients according to their degree of hearing loss

	(n=140)	Total (n=140)
PTA(dbHL)	Number	%
<25	47	33.57
26-40	92	65.71
>40	1	0.71
Mean ± SD	29.73 ± 7.23	
Range	11.6-46.7	

In our series of 140 diabetes patients 47 had normal hearing , whereas 93 patients had hearing loss .Out of the 93 patients with hearing deficit 92 had mild hearing loss and 1 had moderate hearing loss. 34.3 % of patients had normal hearing, whereas 65% of patients had mild hearing loss and 0.7% of patients had moderate hearing loss.

DISCUSSION:

It is important to first appreciate that the relationship between hyperglycemia in diabetics and hearing loss remains debated, controversial, unsolved. The effect of diabetes in SNHL has been studied throughout the years in relation to age, sex, onset, duration and glycemic level. The present study was conducted on diabetic subjects selected randomly from our hospital from 1st January 2020 to 30th June 2021 (18 months). 140 type 2 diabetes mellitus patients were selected and they were assessed for having sensorineural hearing loss.

Audiological investigation, PTA was performed by the department audiologist in sound treated room after necessary clinical examination for hearing loss was undertaken. Clinical examination that aided to maintain inclusion criteria were local examination of ear, nose, throat and systemic examination for other co-morbidities and tuning fork test which helped attaining the focused group. PTA test was done with ELKON EDA 3 N3 diagnostic audiometer, telephonics, headphone, Bone vibrator Radio ear B-71. Air conduction test is done at varied frequencies of 125 Hz, 250Hz, 500 Hz, 1 KHz, 2KHz, 4 KHz, 8 KHz. While Bone conduction is done for 250Hz, 500Hz, 1KHz, 2KHz and 4KHz. After assessing and confirming the type and degree of hearing loss by PTA, confirmation and classification of degree of hearing loss was done with the help of WHO grades of hearing impairment.

As per the available literature in recent times, most of them have supported the positive correlation of SNHL with diabetes. In our study involving 140 patients of type 2 diabetics of age 30 to 50 yrs from various backgrounds in social life, the prevalence of sensorineural hearing loss was found to be 66.43% which is of gradual onset and progressive type. The results approximate to those that of Aggarwal (64.86%).⁵ There is wide variation of results regarding the prevalence of SNHL in diabetics due to different inclusion and exclusion criteria, methodology and diagnostic approaches. The results of this study are matching with the results of Kararlapudi et al⁶ and Lerman Garber I et al.⁷ Salvenelli et al⁸, did not find hearing loss in the diabetics included in his study. The results of the present study do not match that of Salvenelli et al.⁸

Review of literature shows that there is no correlation between age of the patient and occurrence of SNHL in diabetes mellitus. This was as stated by Cullen R⁹ In our study both ears prevalence of SNHL is highest in 46-50 age group. There is a progressive increase in the prevalence from lower to higher age group with a dip in 36-40 age group.

Our study shows increased prevalence of SNHL in diabetics in the older age group i.e. between 46 to 50 yrs. Prevalence of SNHL in this age group is 77.2%, clarifying the strong association between advanced age, who found a correlation between the hearing levels and age of the subjects in the diabetic group. They concluded that any hearing loss due to diabetes will be additional to that due to age alone. Thus, aging and diabetes may act synergistically to

elevate the auditory thresholds. These results are contrasting to studies carried out by Cullen.R.⁹

No study till date have compared the hearing thresholds in diabetic males with diabetic females. It was stated by Cullen .R⁹ that male diabetics were deafer than female diabetics. A high and low frequency difference was noted in males, but only high frequency difference was seen in female diabetics. Later it was thought that this difference might be due to better hearing thresholds in females as was seen in female control group. Our study compared hearing loss in male and female diabetics and there was no significant difference in hearing loss among the two-sex groups. Out of 140 diabetes patients 86 were females and 54 were males. Females constituted 61.4 % of total patients and males constituted 38.6%. In males prevalence of hearing loss was 68.52% and in females 65.12% of diabetics.

The hearing loss is usually of gradually progressive type. In our study 91 out of the total 93 SNHL cases had gradual onset which is highly significant. Only 2 patients had sudden onset SNHL which recovered on treatment. Cayonu et al found a significant association between duration of diabetes mellitus and the onset and severity of hearing loss⁵¹. But ShuenFu in 2005 reported a series of 68 Sudden onset SNHL in diabetes.¹⁰

The possible factors that influence the worsening of hearing thresholds in diabetics were evaluated. One of them was duration of diabetes. Zelenka and Virtenimi J state that the hearing threshold increases with increase in duration of diabetes mellitus.¹¹ While Cullen and Kurien .M state that there is no relation between hearing threshold and diabetes mellitus.⁹ The increase in hearing threshold is attributed to microvascular angiopathy occurring in capillaries of striavascularis which make these vessels thicker than normal. These changes can occur in vessels supplying other parts of auditory system as well. Mozaffari et al in a survey of 71 non-elderly diabetic patients also reported mild to moderate hearing loss to be more common than severe hearing loss and that the severity of hearing loss increased with an increase in the duration of diabetes mellitus.¹² Muhammad et al found that a diabetic patient whose duration of diabetes mellitus was 5 years and less had less severity than those whose duration of diabetes was over 5 years.¹³

In our study, it was noted that there was increase in hearing threshold with increase in duration of diabetes mellitus. It was seen that as duration increases more than 6 years the prevalence of hearing deficit increases to a greater extent. As was noted in our study, the prevalence of sensorineural hearing loss increased to 88.10% with duration diabetes mellitus more than 10 years.

Occurrence of sensorineural hearing loss in diabetics depends on the control of the disease. Most of the studies have stated that a better control of diabetes delays or prevents the onset of sensorineural hearing loss in that person. But different studies have used different parameters of diabetic control to analyse the result. The control of blood sugar levels and SNHL has been

the most controversial and to ponder over this the glycated haemoglobin (HbA1C) has been taken in to account. It is estimated that almost 30% of subjects with diabetes are not aware of the disease, and moreover, they already have long-term complications of chronic hyperglycemia at diagnosis. That is why, an International Expert Committee recommended considering the use of glycated hemoglobin (HbA1c) testing in the diagnosis of this deleterious disease. HbA1C was taken in to consideration since it directly gives an idea about the blood sugar control of the patient in the earlier three months. ¹⁴

In our study prevalence of SNHL among poorly controlled patients is 80.23 % where as it is 34.21% among patients in control, which is highly significant. The clinical studies of Lasiet al (2003) ¹⁵ conclusively demonstrate that poorly controlled diabetics have significant hearing loss in all frequencies This could be explained by the cumulative effects of advanced glycation end products and their effects on the inner ear. The present study agrees with the findings of Lasisi et al ¹⁵ and disagrees with M.Mozaffari et al . ¹²

In our series of 140 diabetes patients 47 had normal hearing, whereas 93 patients had hearing loss. Out of the 93 patients with hearing deficit 92 had mild hearing loss and 1 had moderate hearing loss. Mozaffari et al ¹² in a survey of 71 non-elderly diabetic patients also reported mild to moderate hearing loss to be more common than severe hearing loss and that the severity of hearing loss increased with an increase in the duration of diabetes mellitus. Muhammad et al ¹² found that a diabetic patient whose duration of diabetes mellitus was 5 years and less had less severity than those whose duration of diabetes was over 5 years. ¹³

CONCLUSION:

Sensorineural hearing loss is prevalent in 66.43% of type II diabetic patients. Sensorineural hearing loss in diabetes mellitus is gradually progressive involving high frequency thresholds. Hearing threshold increases with advanced age and increased duration of diabetes. There was no sex differentiation. Patients with poor control [HbA1c greater than 8%] of their glycemic status had raised auditory thresholds.

REFERENCES:

1. Maia CA, Campos CA; Diabetes mellitus as etiological factor of hearing loss. *Revista Brasileira de Oto-Rino-Laringologia*. 2005, 71:208–214.
2. K.Park. Preventive and Social Medicine. 25th edition. Banarsidas Bhanot Jabalpur 2019-7-410.
3. Systems Biology Technologies Enable Personalized Traditional Chinese Medicine: A Systematic Review Xijun Wang, Aihua Zhang, Hui Sun, *Periodical : The American Journal of Chinese Medicine* 2012, 06 : 1109-1122.
4. *Bulletin of the WHO* 2014; 92:204-213A.

5. Aggarwal.N.K ,Jha.A .K,S.K.Singh ; Otorhinolaryngological studies in diabetics; Indian journal of otologyand Head &Neck surgery; 1998:vol 50;2;116-20.
6. Kakarlapudi Venkata, Sawyer R, Staecker H. The effect of diabetes on sensorineural hearing loss. *Otology and Neurology* 2003; 24 (3): 382-386.
7. Lerman-Garber ,Daniel Cuevas-Ramos, Samantha Valdés, Lorena Enríquez, Marlette Lobato, MelannieOsornio, et al.Sensorineural hearing loss--a common finding in early-onset type 2 diabetes mellitus. *EndocrPract.* 2012 Jul- Aug;18(4):549-57.
8. SalvenelliF,Miele A, Casale M, Greco F, D"Ascanio L, Firrisi L et al.Hearing thresholds in patients with diabetes. *The internet journal of otorhinolaryngology* 2004; 3(1)
9. Cullen R, Cinnamond N.J. "Hearing loss in diabetes", *Journal of laryngology and otology*, 1993 ; 107 : 179-182.
10. MelihCayonu, Mustapha Capraz, Aydin Acar, AytugAltundag, Murat Salihogu.Hearing Loss Related with Type 2 Diabetes in an Elderly Population. *Int Adv Otolartngology* 2014; 10: 72-5.
11. Virteniemi J , Laakso M, Nuutinen J, Karjalainen S, Vartiainen E. "Hearing thresholds in Insulin dependent diabetes mellitus", *Journal of laryngology and Otology*, 1994 ; 108 : 837-841.
12. Mozaffari M, Tajik A, Ariaei N, Ali-Ehyaii F, Behnam H.Diabetes mellitus and sensorineural hearing loss among non-elderly people. *East Mediterr Health J.* 2010 Sep;16(9):947-52.
13. Muhammad Farooq, AshfaqueAhmedZafar Mehmood, Abdul Waheed. Frequency of Sensorineural Hearing loss (SNHL) in Type 1 and Type 2 Diabetic patients. *Pakistan Journal of Otolaryngology.* 2013;29:87-89.
14. Drzewoski J, DrozdowskaA.Could glycated hemoglobin be used as a diagnostic tool in diabetes mellitus? *Pol Arch Med Wewn.* 2010 Mar;120(3):109-14.
15. Lasisi O A, Nwaorgu O G B, Bella A F. Cochleovestibular complications of diabetes mellitus in Ibedan, Nigeria. *International Congress Series* 1240 (2003); 1325-1328(2003)