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RESEARCH ARTICLE

Correlation Analysis Study between Hearing Loss Occurence and Duration of Type 2 Diabetes Mellitus in Sultan Agung Islamic Hospital Semarang

Citta Arunika Risyudhanti[1*], Agung Sulistyanto[2], Suparmi[3]

[1] Medical Faculty of Sultan Agung Islamic University (UNISSULA) Semarang
[2] Ear, Nose & Throat Departement of Medical Faculty of Sultan Agung Islamic University (UNISSULA) Semarang
[3] Biology Departemen of Medical Faculty of Sultan Agung Islamic University (UNISSULA) Semarang
Citta Arunika Risyudhanti, Jalan Villa Aster 1 Srondol Asri blok P-1 Semarang, Jawa Tengah.
* Email: cittaarunika@yahoo.co.id / 085640404989

ABSTRAK

Pendahuluan: Gangguan pendengaran akibat kerusakan koklea merupakan salah satu komplikasi penyakit diabetes melitus tipe 2 (DM2) yang telah berlangsung lama. **Tujuan:** menganalisis korelasi antara lama menderita DM2 dengan kejadian gangguan pendengaran. **Metode:** Penelitian Observasional Analitik dengan rancangan *Cross Sectional,* dengan menggunakan data rekam medis pasien diabetes mellitus rawat jalan di Poli Penyakit Dalam dan hasil pemeriksaan audiometri nada murni di poli THT Rumah Sakit Islam Sultan Agung Semarang (RISA). Sesuai dengan kriteria inklusi dan eklusi diperoleh data rekam medis sebanyak 31 pasien. Data tersebut terdiri dari, 18 orang menderita DM2 kurang dari 6 tahun dan 13 orang menderita DM2 lebih dari 6 tahun. Kemudian dilakukan pemeriksaan audiometer nada murni. Analisis statistik menggunakan perangkat lunak SPSS 20. Korelasi antara lama menderita DM2 dengan gangguan pendengaran menggunakan uji *Chi Square,* tingkat keeratan hubungan menggunakan uji koefisien kontingensi dengan tingkat kemaknaan < 0.05.
Hasil: Distribusi frekuensi gangguan pendengaran pada telinga yang diperiksa (62 telinga) di RS Islam Sultan Agung Semarang diperoleh sebanyak 27 telinga menderita gangguan pendengaran tipe SNHL (43,5%), 19 telinga menderita gangguan pendengaran tipe CHL (30,6%) dan sebanyak 16 telinga dalam batas normal (25,8%) dengan $p = 0,02$ ($p < 0,05$).
Kesimpulan: Lama menderita diabetes mellitus tipe 2 dengan terjadinya gangguan pendengaran berhubungan lemah.

Kata kunci: Diabetes Mellitus, Sensory Neural Hearing Loss

ABSTRACT

Introduction: *Hearing impairment due to cochlear damage is one complication of Type 2 Diabetes Mellitus (DM2).* ***Objective:*** *This study aims to determine the relationship between duration of DM2 with hearing impairment.*
Method: *The analytic observasional study with the cross sectional design using the medical record of DM2 outpatient in internal clinic of Islamic Sultan Agung Hospital Semarang and also pure tone audiometric examination's record in Otorynolaryngology clinic of Islamic Sultan Agung Hospital Semarang. 31 medical records of DM2 patients were meeting the inclusion and exclusion criteria. The data consist of 18 medical records of patients with less than 6 years duration of DM2, and 13 medical records of patients with more than 6 years duration of DM2. The pure tone audiometry was used to classified the hearing impairment. The data analysis was conducted using SPSS 20.0. The correlation between the duration of DM2 and hearing impairment was analyzed using Chi Square test. The significance relation between the duration of DM type 2 and hearing impairment was analyzed using cooficient contigency, with significance of < 0.05.* ***Result:*** *hearing impairment's distribution frequency on tested ears in Sultan agung Islamic Hospital Semarang were 27 ears having SNHL type (43,5%), 19 ears having CHL (30,6%) and 16 ears were normal (25,8%), p = 0,02 (p < 0,05).*
Conclusion: *There is a weak correlation between the DM 2 duration and the incidence of hearing impairment in Sultan Agung Islamic Hospital Semarang.*

Keywords : *Diabetes Mellitus, Sensory Neural Hearing Loss.*

INTRODUCTION

Hearing loss is one of the problems causing inconvenience. The major challenge facing adults with hearing impairment is verbal communication. The symptoms limit the daily activities especially in workplace, leading to psychological problems. Hearing impairment can be caused by noise exposure, intake of ototoxic drugs, degenerative process, and systemic diseases like Diabetes Mellitus (DM) (Austin *et al.,* 2009). Cochlea dysfunction can cause hearing impairment due to the longer duration of DM2 (Austin *et al.,* 2009).

Utomo (1999) showed a significant correlation between DM2 and hearing loss. Dalton (2003) conducting research on DM2 and hearing loss concluded

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that there was decrease in hearing measured by pure tone audiometry by59% in patient with DM2 dan 44% in patients with DM2 showing a weak correlation. While Bainbridge et al (2008) reported a significance correlation between hearing loss and duration of DM2 using pure tone audiometry. This inconsistency results require further research, especially in Sultan Agung Islamic Hospital of Semarang.

Diabetes Mellitus type 2 (DM2) and hearing loss have a high prevalence in Indonesia. Indonesia ranks fourth in the number of DM2 patients after US, China dan India. Badan Pusat Statistik (BPS) showed that in 2003, 20.1 million people had diabetes with the prevalence of 14.7 % in urban and 7.2 % rural area. WHO estimated diabetes prevalence for 8.4 million and is expected to affect 21 million by 2025. The previous study showed that the prevalence of hearing impairment in patients without diabetes is 15 % and double by two fold in patient with diabetes (NIH, 2008).

Hearing impairment can be caused by physiologic aging process or patologic ear inflammation, drugs or systemic diseases like DM especially the uncontrolled one (Fukushima *et al.,* 2006). Derek (2012), reported that women aged 60-75 with uncontrolled diabetes have a worse diabetes compared to those with controlled diabetes. In male, there is no significant difference between male with controlled and uncontrolled DM. Microvascular disorder due to type 2 DM complication increase by 6-11% within 6 years of observation and is responsible for a progressive morbidity and mortality (Stratton, 2000). Within 6 years stria vaskularis, arteri auditiva interna, and modiolus blood vessels undergo microangiopathy (Stratton, 2000). Increasing microvascular complications during 6 years observation were the etiology of small blood vessels disorders, including hearing impairment on DM2 patients.

The objective of this study is to analyze the correlation between the duration of DM2 and the incidence of hearing impairment in Sultan Agung Islamic Hospital Semarang.

METHOD

This is an observational analytical study with a cross sectional design. This study included 31 medical records of patients from the population of DM 2 patient attending internal medicine clinic of Sultan Agung Semarang Islamic Hospital between September 2013 and October 2013, meeting the inclusion and exclusion criteria. The inclusion criteria were outpatient controlled DM, aged < 55 years. While the exclusion criteria were having chronic tinnitus, under ototoxic medication and a history of trauma of os. Temporale and neoplasma.

The duration of type two diabetes is defined as the period since the diagnosis by the doctor was confirmed by the medical records, classified into 2 categories: less than 6 years and more than 6 years. Hearing impairment is defined as total or partial disabilities in hearing voices on one or both ears, diagnosed using pure tone audiometry, classified into Sensorineural Hearing Loss (SNHL) type and non SNHL type (whether Conductive Hearing Loss/CHL or normal hearing).

The data analysis was conducted using SPSS 20.0. The correlation between the duration of DM type 2 and hearing impairment was analyzed using Chi Square test. The significance relation between the

Table 1. The characteristics of the samples based on gender, age, duration of DM2 and hearing impairment

	number	
	N	**%**
gender		
female	19	61,3%
male	12	38,7%
age		
<40 y	2	6,5%
40-45 y	9	29%
46-50 y	9	29%
51-55 y	11	35.5%
Duration of DM		
≤6 y	18	58.1%
>6 y	13	41.9%
Hearing impairment		
CHL	27 ears	43.5%
SNHL	19 ears	30.6%
Dalam Batas	16 ears	25.8%

Duration of DM2 and hearing impairment data is presented on cross table 2x2.

duration of DM type 2 and hearing impairment was analyzed using cooficient contigency, with significance of < 0.05.

RESULTS

This study include 31 sample of patients with DM2 selected according to the inclusion and exclusion criteria based on the medical records. The sample were subjected to pure tone audiometric directly to find out the types of hearing impairments. Before the assessment, the integrity or tympanical membrane was evaluated first using otoscopy and subjected to serumen cleaning. The characteristic of the sample and the result of the pure tone auditometry evaluation are presented in table 1.

The crosstab shows the correlation between duration of and hearing impairment. Five subjects with type 2 DM had less than 6 years of hearing impairment and 13 subjects with type 2 DM less than 6 years did not have hearing impairment. Among the subjects having DM2 more than 6 years, 9 subjects had hearing impairment and 4 subjects did not have a hearing impairment, presented in table 2.

Chi square test was used to test the correllation between the duration of DM2 and hearing. *Chi Square test* resulted in a significant correlation between the duration of DM and the incidence of hearing impairment p = 0.02 ($p < 0.05$). Coefficient contigency test resulted in r = 0.380. Thus, the correlation between the duration of DM2 and hearing impairment is weak, presented in table 3 and 4.

DISCUSSION

The duration of DM2 has a weak correlation with hearing impairment. The hearing impairment among the patients with type 2 DM more than 6 years has been due to the vascular disorder called microangiopaty that present in the stria vaskularis capillaries, auditorius internus artery, vasa nervosum ganglion spirale and demyelination of nervus auditorius (Sakuta *et al.,* 2007).

Patients with type 2 DM present with glycolysis process - the binding of glucose in amino acid followed by a sequence of biochemistry reaction resulting in the

Table 2. Cross table between duration of DM2 and hearing impairments

Duratin of DM2	Hearing Impairment		Total
	Yes	No	
<6 years	5	13	18
Expected count	8.1	9.9	18.00
>6 years	9	4	13
Expected count	5.9	7.1	13.0
Total	14	17	31
Expected count	14.0	17.0	31.0

Table 3. Chi Square Test

Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.237[a]	1	.022		
Continuity Correction[b]	3.697	1	.055		
Likelihood Ratio	5.366	1	.021		
Fisher's Exact Test				.033	.027
Linear-by-Linear Association	5.068	1	.024		
N of Valid Cases	31				

Table 4. Coefficient Contingency Correlation Test

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	Contingency Coefficient	.380	.022
N of Valid Cases		31	

formation of the irreversible advanced glycation end products (AGEs)- which is irreversible and increase free radical and has an ototoxic effect including denaturation and aggegration (Votey and Peters, 2008). The increase in AGEs production reduces the elasticity of blood vessel (arteriosclerosis) and leads to plasma protein binding to basement membranes (basal lamina) causing vessel thickening and lumen narrowing (Waspadji, 2009). Microangiopathy causes atrophy of the organ of Corti and hair cells loss. Microangiopathy in vasa vasorum nervus VIII and vasa ligamentum spirale causes neuropathy leading to spiral ganglion to atrophy and demyelination of 8th nerve fiber Various disorder presents in autopsy patients with DM2 (Brainbridge *et al.,* 2008). Six years duration of patients having DM2 was chosen for this study because type 2 DM is the cause for the increase in progressive morbidity and mortality due to the microvascular disorder 6-11% during 6 years of observation. Within 6 years, microangiopathy develops especially related to stria vaskularis, arteri auditiva interna and blood vessel in the modiolus (Stratton et al, 2000).

This present study supports the study conducted by Dalton (2003) showing that there is a decrease in the hearing assessed by pure tone audiometry by 59% in patients with DM2 and 44% in patients without DM2 with a weak correlation. In contrast, Bainbridge et al (2008) showed a strong correlation between the decrease in hearing and DM2. The limitation of Bainbrige's study was that it did not exclude the presbiakusis and interfere the result of the analysis, although it include a large number of samples aged 20-69 years. The difference in correlation in this study also lead to the blood sugar that tend to be controlled.

The limitation of the study is that the blood sugar concentration was not under consideration. This present study is limited to the duration of DM. In fact, another factors like blood sugar concentration might also have an impact on the hearing impairment. Therefore, further studies on hearing impairment in patients with DM that include the blood sugar concentration as a variable are needed.

CONCLUSION

There is a weak correlation between the DM 2 duration and the incidence of hearing impairment in Sultan Agung Islamic Hospital Semarang.

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