DYSFUNCTION OF COCHLEAR AND RETROCOCHLEAR WITH TINNITUS IN NORMAL HEARING

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ABSTRAK

*Tinnitus sering disertai dengan gangguan pendengaran, meskipun dalam beberapa kasus pendengaran normal (< 25 dB), dapat mengarah pada adanya disfungsi cochlear dan retrocochlear. Oleh karena itu, evaluasi lebih lanjut menggunakan OAE dan BERA diperlukan. Tujuan dari penelitian ini adalah untuk menganalisis hubungan antara koklea dan retrocochlear dengan pendengaran normal tinnitus. Sebuah studi cross-sectional pada 14 subyek tinnitus normal pendengaran dilakukan pada pasien THT keluar Dr.Soetomo Surabaya Hospital dengan kelompok kontrol dari 11 subjek normal pendengaran tanpa tinnitus. Analisis statistik yang digunakan meliputi Fischer exact test, Mann-Whitney, uji t independen, uji McNemar dan uji asosiasi Kappa dan Rasio Kemungkinan. Dari penelitian tersebut, TEOAE tidak ada perbedaan yang signifikan dalam hasil TEOAE antara kelompok studi dan kelompok kontrol (p = 0.230). DPOAE ada perbedaan yang signifikan dalam hasil DPOAE antara kelompok studi dan kelompok kontrol (p = 0,046). Dalam evaluasi DPOAE menggunakan frekuensi 1 KHz, p = 0,003, pada 4 kHz p = 0,020, pada 6 kHz p = 0,008 ini menunjukkan perbedaan yang signifikan pada frekuensi 1, 4 dan 6 kHz (p <0,05). Studi BERA karena itu tidak ada perbedaan yang signifikan dalam BERA (p = 0,008). Oleh karena itu, hasil BERA antara kedua kelompok hanya gelombang latency saya berbeda secara signifikan (p = 0,044). Secara statistik, tidak ada TEOAE, DPOAE dan BERA memenuhi koherensi.**(FMI 2013;49:272-276)***

Kata kunci: *tinnitus pendengaran normal, TEOAE, DPOAE dan BERA*

ABSTRACT

*Tinnitus is often accompanied by hearing impairment, although in some cases normal hearing (<25 dB), may mislead the presence of cochlear or retrocochlear dysfunction. Therefore, further evaluation using OAE and BERA are needed. The purpose of this study is to analyze the relation between cochlea and retrocochlear with normal-hearing tinnitus. A cross-sectional study on 14 normal-hearing tinnitus subjects was conducted in out patient otolaryngology Dr.Soetomo Hospital Surabaya with a control group of 11 normal-hearing subjects without tinnitus. Statistic analysis were used including Fischer exact test, Mann-Whitney, independent t test, McNemar test and association test Kappa and Likelihood Ratio. From the study, TEOAE there was no significant difference in TEOAE results between study group and control group (p=0.230). DPOAE there was a significant difference in DPOAE results between study group and control group (p=0.046). In DPOAE evaluation using frequency of 1 KHz, p = 0,003, at 4 kHz the p = 0,020, at 6 kHz the p = 0,008 this shows significant difference at frequency of 1, 4 and 6 kHz (p<0,05). Study of BERA therefore there was no significant difference in BERA (p=0.008). Therefore, the result of BERA between the two groups only latency wave I were significantly different (p=0.044). Statistically, none of TEOAE, DPOAE and BERA fulfilled coherency.**(FMI 2013;49:272-276)***

Keywords: *tinnitus normal hearing, TEOAE, DPOAE and BERA*

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INTRODUCTION

Tinnitus is hearing perception the voice without a sound stimulus (Schleuning et al 2006, Lockwood et al 2002). In everyday life tinnitus cause hearing loss that can degrade the quality of life. Tinnitus is not a disease but a symptom of the disorder, can be either conductive hearing loss when coming from external ear canal and middle ear, a sensory neural disorder caused by irritating or degenerative processes auditory tract from the vibrating hair cells of the cochlea, retro cochlear until center hearing (Bashiruddin & Sosialisman 2006, Chan 2009). Five percent of tinnitus is objective tinnitus caused by a voice from inside the patient's body and can be heard by the examiner. While 95% is generally subjective tinnitus of unknown cause. This type of tinnitus is only heard by patients themselves and most often occured. Research by Mao et al in patients with tinnitus normal hearing is obtained using TEOAE pass as much as 64%, whereas DPOAE pass found as much as 90% (Mao et al 2005). Kehrle et al (2008) got a picture of abnormal in 47% of the results of BERA

tinnitus sufferers who have a normal audiogram. Reported in other literature 31%-40% had abnormal BERA picture.

This is why the patient came for a treatment to an ENT specialist, for it carried out the evaluation hearing function with audiometric. Evaluation of audiogram alone was not enough to describe the disorder/location cause tinnitus early. The relationship between the presence or absence of cochlear disorders and tinnitus retro cochlear with normal hearing until now still unclear (Abiratno 2009, Lockwood et al 2002). Objective evaluation of tinnitus normal hearing, is expected to input in an effort to settle early detection of hearing loss and encourage efforts to further preventive action. This is a concrete step in supporting the program sound hearing 2030. The purpose of this study is to analyze the relationship between cochlear and retro cochlear disorders tinnitus normal hearing. Analyzing the results of TEOAE, DPOAE and BERA in tinnitus normal hearing sufferers compared with controls in people with normal hearing without tinnitus.

MATERIALS AND METHODS

This was our cross sectional-observational study conducted at Outpatient Clinic ENT Dr. Soetomo Hospital Surabaya. The study was done in August and November 2010. This study has been declared worthy of ethics by the ethics committee of health research Dr. Soetomo Hospital. All populations with tinnitus normal hearing and patients without tinnitus normal hearing as a control were included in this study. Inclusion criteria age 20-55 years, hearing threshold ≤ 25 dB, tympanogram type A. Populations with history of head injury, suffered outer and middle ear infection (otitis externa and otitis media), had undergone surgery outer and middle ear (mastoidectomy), once exposed to explosions, each recurrence of tinnitus duration of less than 5 minutes were excluded.

Three kinds of testing tools were used, pure tone Audiometer type AD type 229E, tympanometer Inter acoustic type AT 35, TEOAE and DPOAE Cochlea RS 232 Scan type Biological Systems Corp. and BERA EPA type 25. TEOAE wave obtained by giving non-linear click stimulus average 60Hz and conducted in a soundproof room. Assessment results of TEOAE pass (mean cochlear good) when the wave reproducibility> 70%, which marked the emergence of 'OK', refer (mean cochlear no interference) when the wave reproducibility <70%, which marked the emergence of '?'.

DPOAE examination using the intensity of L1 and L2 = 45dB = 55 dB conducted in a soundproof room, the evaluation at a frequency of 1 KHz, 2 KHz, 3 KHz, 4 KHz and 6 KHz. Assessment of DPOAE as follows pass (good cochlear) if at the end of the 3-4 frequency graph appears piktogram marked with the symbol (*) which indicates the level of emissions above the noise level piktogram symbol (-), refer if the final graph does not appear piktogram symbol (*) above the noise level on the frequency of the first two examinations or when there is no (*) ≥ 3 of all frequencies examined.

BERA examinations used in the examination of the intensity of 80 dB, 12.1 clicks per second stimulus, Rejected 0%, without masking, at a frequency of 2000 Hz, the stimulus click conducted in a room that has low noise. The result of the tinnitus group compared with the control group. Assessment of results of examinations performed on 1 ear tinnitus in each patient, if there were bilateral tinnitus, the assessment only on the most severe tinnitus ear but still have normal hearing, while the control group was assessed in the right ear of each person. The results included in the data sheets and stored by the researcher, at the time of tabulation data will be disguised name of research subjects. Tabulation of data obtained will be processed statistically using Fischer's exact test comparison test, Mann-Whitney, two independent samples t test (independent t test), test and McNemar test and Likelihood Ratio Kappa associations.

RESULTS

In general, the characteristics of both groups there were no significant differences, with p value not smaller than 0.05 (Table 1).

Tabel 1. General characteristics

Characteristics	Tinnitus group	Control group	P Value
Age	39.07 (SD: 11.042)	32.18 (SD: 8.438)	0.010
Male	10 (71.43%)	8 (72.72%)	
Female	4 (28.57%)	3 (27.27%)	1.000

The result of the TEOAE test comparisons between the two groups using Fisher exact test p = 0.230. Means, the results of TEOAE tinnitus and control groups there were no significant differences (p> 0.05). This can be seen in table 2.

Table 2. TEOAE results in Tinnitus group and Control group

TEOAE	*Pass*	*Refer*	Total
Tinnitus group	11 (78.57%)	3 (21.43%)	14 (100%)
Control group	11 (100%)	0 (0%)	11 (100%)
Total	22 (88%)	3 (12%)	25 (100%)

DPOAE examination results between the two groups based on Fisher's exact test p = 0.046. Means, overall DPOAE examination results in tinnitus and control group there were significant differences (p <0.05). This can be seen in Table 3.

Table 3. DPOAE Tinnitus group and Control group Result

DPOAE	Tinnitus group	Control group
Pass	9 (64.29%)	11 (100%)
Refer	5 (35.71%)	0 (0%)
Total	14	11

Based on Fisher's exact test at a frequency of 1 KHz p = 0.003, 4 KHz p = 0.020 and 6 KHz p = 0.008. Means, the results of DPOAE at the frequency 1 KHz, 4 KHz and 6 KHz between tinnitus and control groups there were significant differences (p <0.05). Meanwhile, at a frequency of 2 and 3 KHz there is no significant difference (p>0.05). This can be seen in table 4.

Table 4. DPOAE results in each frequency

Freq. DPOAE	Tinnitus		Control		p
	pass	*Refer*	*pass*	*refer*	
1 Khz	6 (42.85%)	8 (57.14%)	11 (100%)	0 (0%)	0.003*
2 Khz	10 (71.42%)	4 (28.57%)	11 (100%)	0 (0%)	0.105
3 Khz	10 (71.42%)	4 (28.57%)	11 (100%)	0 (0%)	0.105
4 Khz	8 (57.14%)	6 (42.85%)	11 (100%)	0 (0%)	0.020*
6 Khz	7 (50%)	7 (50%)	11 (100%)	0 (0%)	0.008*

In BERA examination results based on independent t-test p = 0.088. Means, the results of BERA tinnitus and control groups there were no significant differences (p> 0.05). The evaluation results of each wave with independent t-test p = 0.044. Meaning, only the first wave latency BERA examination between tinnitus group and control group there were significant differences (p <0.05). Meanwhile, another wave latency there were no significant differences (p> 0.05). This can be seen in table 5.

Table 5. BERA results

BERA Latencies	Tinitus		Control		P
	Means (ms)	SD	means(ms)	SD	
I	1.43	0.13	1.35	0.04	0.044*
III	3.62	0.34	3.42	0.17	0.088
V	5.53	0.33	5.36	0.17	0.119
I – III	2.19	0.33	2.09	0.16	0.332
III – V	1.90	0.13	1.91	0.16	0.819
I – V	4.09	0.31	3.85	0.66	0.219

*=significant (p < 0.05)

From the results obtained there is no statistical test of the three examination are eligible to be called equivalent, shown by the results of comparative McNemar test was not significant (p> 0.05). Test results Kappa significant associations (p <0.05) or Likelihood Ratio of significant (p <0.05).

DISCUSSION

The mean age of patients with tinnitus of this study is similar to the research Kehlre et al (2008) which is 36 years (SD = 7.2). Unlike Savastano (2008) in his study the mean age of patients with tinnitus of 50 years, in this study were an average age of the younger group of tinnitus. Subject of this research on tinnitus group obtained more women than men, ie women as many as 10 people (71.43%) and men 4 women (28.57%). This is different from the literature that men more than women who suffer from tinnitus, although there is no many difference (Schleuning et al 2006, Savastano 2008).

In the TEOAE p = 0.230. Means, in both groups there were no significant differences (p> 0.05). TEOAE test results on tinnitus group of 14 people found the pass as much as 11 ears (78.67%), refer only to 3 ears (21.43%). While the control group all-pass (100%). This is according to research by Mao et al (2005) in tinnitus patients with normal hearing threshold is obtained using a TEOAE pass as much as 64% from 50 ears of tinnitus patients with normal hearing threshold. In contrast to studies conducted by Granjeiro et al (2008), the results obtained using TEOAE in normal hearing threshold tinnitus refer as many as 70.2% compared to patients without tinnitus hearing threshold normal.14 Although the results of TEOAE in this study refer only 21.43% got this show has no deformity OHC cochlea in tinnitus patients with normal hearing threshold but there is no statistically significant difference.

DPOAE examination results tinnitus and control group carried out statistical tests as a whole p = 0.046. Means, DPOAE examination results tinnitus and control group as a whole there were significant differences (p <0.05). DPOAE evaluation results in 14 ears tinnitus group there were 5 ears (35.71%) had results refer, and pass the remaining nine ears (64.29%). While in the control group 11 ears have the pass (100%). Statistical tests at each frequency DPOAE examination of tinnitus and the control group only at the three frequencies there are significant differences (p<0.05). The evaluation results of this study group of tinnitus according to the results of research Granjeiro et al (2008) found significant differences (p = 0.036) between groups of normal hearing threshold and tinnitus control. The study refer to the 68.40% gain tinnitus sufferers, and 31.60%pass.

When compared at each frequency between tinnitus and control groups of this study there were only significant difference in just 3 frequencies of 1 KHz, 4 KHz and 6 KHz. In contrast to research Granjeiro et al (2008) found at all frequencies examined the difference was statistically significant but the differences were greatest

show on the frequency of 3 KHz, 4 KHz and 6 KHz. Although this study found significant differences only at 3 frequencies only, whereas at other frequencies there were no significant differences indicating the location of tinnitus sufferers OHC disruption to normal hearing threshold can occur in the area apical to basal. DPOAE examination using multiple specific frequency is the evaluation of cochlear dysfunction, especially OHC. The existence of the examination results are significantly different in patients with tinnitus and control groups using DPOAE in this study support the opinion in the literature that OHC dysfunction in the cochlea plays an important role as a cause of tinnitus hearing threshold normal (Baguley 2002, Møller 2003, Schleuning et al 2006, Savastano 2008, Ami et al 2007).

BERA examination of statistical test results $p = 0.230$. Means, in both groups there were no significant differences ($p > 0.05$). On 25 ear samples of this study found 52.0% abnormal BERA results consist of 13 abnormal, whereas 44.0% of both groups to normal. This percentage is not much different than previous research by Kehrle et al (2008) who obtain 47% abnormal BERA examination results of 37 people, while research Maurizi et al get 31%-40% of tinnitus normal hearing showed BERA abnormal (Kehrle et al 2008). Statistical test results for each wave in this study tinnitus and control groups on latency wave I got $p = 0.044$. Means, on the wave I latency there were significant differences ($p < 0.05$). While latency wave III and V and IPL I-III, III-V and IV there was no significant difference in both groups.

The existence of wave I latency changes are consistent with studies by Maurizi et al, Lemaire-Beutter, and Ikner as quoted by Kehrle-Hassen et al (2008) who also get a latency prolongation of wave I. While the evaluation of latency wave III, V, IPL I-III, III-V and IV, although there were no significant differences were found during latency lengthened. Prolonged latency can lead to elongation of wave I in the next wave. Waves generated electrophysiological examination BERA I describe the location in the N. VIII which is still situated in the cochlea. This illustrates the existence of peripheral lesions in the auditory system in the form of slowing the process of synapses in the organ of corti or decreased neural conduction in the first auditory neurons (Kehrle et al 2008). BERA examination results of this study was not found significant differences in latency of wave III and V, and IPL I-III, III-V, and IV, described the absence of abnormalities in the area retrokoklea.

The three examination tools cannot be said to equal one another, each tool cannot replace each for examination tinnitus normal hearing threshold. TEOAE and DPOAE examination results both statistically not exactly the same in this study, but refer to the second examination showed abnormalities in the cochlea, especially in the OHC. TEOAE test results there were no significant differences between the two groups, whereas DPOAE there are significant differences in both groups, can be caused by TEOAE is more sensitive at low frequencies, the frequency range 500 Hz to 4 KHz, while, more sensitive to the high frequency DPOAE (Ozimek & Wicher 2006, Gelfand 1997). So tinnitus normal hearing of less cochlear dysfunction can be detected by TEOAE, using DPOAE will appear. In this research, there are 4 people with tinnitus who have the results of TEOAE pass while DPOAE refer. Then it can be concluded that tinnitus normal hearing in this study due to cochlear dysfunction in the basal area/high frequency.

The condition, according to the theory expressed by Jastreboff who said that most cases of tinnitus comes from abnormalities in the cochlea, especially in the high frequency OHC (Granjeiro et al 2008). From this study show that the tinnitus normal hearing evaluation of the cochlea at high frequencies play an important role. The existence of local trauma on the cochlear mechanics, material ototoxic and noise trauma can cause changes in mapping auditory cortex tonotopik the primary. This change is not always associated with hearing loss, but can be accompanied by an increase in spontaneous emission and increased neural synchronization. This situation can become a phenomenon that the suppression of inhibition and excitation of the new activity will ultimately increase the spontaneous emission and synchronization neural (Møller 2003).

TEOAE and BERA results of the examination that there were no significant differences in this study may be caused by both use the same frequency 2 KHz, this is reinforced by examination of the frequency 2 KHz DPAOE there were no significant differences as well. BERA is the ability to work at a frequency of 2 to 4 KHz, for it required further research to evaluate tinnitus patients with normal hearing using BERA. Results DPOAE and wave I BERA equally there is a difference statistically significant, indicating abnormalities in the cochlea. This is consistent with research Riga et al (2007) who get the disorder and BERA DPOAE evaluation results in wave latency I. The existence of tinnitus probably due to changes in the nervous system and OHC efferent interplay. Alleged interference in the efferent nerve fiber itself becomes a direct cause of the emergence of tinnitus, other theories give an abnormal response to OHC efferent innervation that is not directly audible as tinnitus signal. DPOAE and latency wave I BERA still describe the situation in koklea (Riga et al 2007).

CONCLUSION

There are differences in the results of DPOAE between tinnitus patients with normal hearing threshold control. There was no difference in the results of TEOAE and BERA between tinnitus patients with normal hearing threshold control. This shows an indication of abnormality in the cochlea. There was no correlation between the results of TEOAE, DPOAE and BERA. TEOAE, DPOAE and BERA each other cannot replace each other. DPOAE can be considered as an investigation tinnitus normal hearing threshold. It is necessary for further research using the DPOAE amplitude that can display and expand the population.

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