THE EFFECT OF GLYCEROL ON STATIC ACOUSTIC IMPEDANCE IN MENIERE'S DISEASE

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T. Sarıoğlu, M.D.* / B. Gürsel, M.D.* / E. Belgin, Ph.D.****

* *Professor, Department of Otorhinolaryngology, Faculty of Medicine, Hacettepe University, Ankara, Turkey.*
** *Professor, Division of Audiology, Department of Otorhinolaryngology, Faculty of Medicine, Hacettepe University, Ankara, Turkey.*
*** *Instructor, Department of Otorhinolaryngology, Faculty of Medicine, Hacettepe University, Ankara, Turkey.*

SUMMARY

The changes in static acoustic impedance (SAI) after the ingestion of glycerol in the patients with Meniere's disease are presented. Two groups of subjects are studied. Group A consisted of 24 patients with Meniere's disease. Group B included 10 normal subjects. Each subject underwent a pre-glycerol audiologic test. After the ingestion of glycerol, final audiologic tests were performed. The pure tone thresholds, speech discrimination scores and also the static acoustic impedance results were recorded. Significant decrease in SAI in Group A patients was observed. Group B subjects failed to show a remarkable change in SAI. The post-glycerol decrease in SAI is an important finding and it is significantly correlated with the improvements in pure tone thresholds and speech discrimination scores in Meniere's disease.

Key Words: Glycerol, Static acoustic impedance, Meniere's disease

INTRODUCTION

Klockhoff and Lindblom (1) first reported the use of glycerol as a diagnostic aid in Meniere's disease. The glycerol dehidration test has been advocated for confirming the diagnosis of Meniere's disease and determining the reversibility of the symptoms by medical therapy (2,3). The test can also be used to predict the success of surgery and diuretic therapy (4,5). The glycerol effect is well known for the improvement in pure tone thresholds and speech discrimination scores for the early reversible Meniere's disease (6,7). Although the alterations in pure tone thresholds and speech discrimination scores have been widely searched, the effects of glycerol for the static acoustic impedance remain obscure. The aim of this study is to determine the changes of the static acoustic impedance, as well as to discuss the correlation of results with the post-glycerol pure tone thresholds and the speech discrimination scores.

In cases of Meniere's disease with fluctuating hearing loss, consistent and significant improvement in hearing sensitivity and speech discrimination scores, after the ingestion of glycerol has been reported (8,9). The improvement in the hearing sensitivity seems to be greatest at the low frequencies that are below 1000 Hz (10). In the more advanced stages of the disease in which the hearing sensitivity usually consisted of a flat audiometric configuration without fluctuation, no significant improvement could be observed (8).

The criteria for a positive test result are an improvement in thresholds, 10 dB or more at two or more frequencies between 250 Hz and 2000 Hz and an improvement of 12 % or more in the speech discrimination scores (3).

The evaluation of middle ear function by the measurement of static acoustic impedance involves a measurement of parameters of a probe signal reflected off the intact tympanic membrane. The flow of acoustic energy introduced into the ear canal by an impedance measuring instrument is affected by mechanical factors encountered at the eardrum. The eardrum characteristics are generally presumed to be related primarily to its attachments. The mobility of the ossicles and the size and state of the air in the middle ear and mastoid space as well as the "resistance of the cochlear fluid" are presumed to be the primary factors that affect the impedance of the middle ear system (11). The normal acoustic impedance ranges between 1000-3000 acoustic ohm (12,13). In Meniere's disease, the elevated endolymphatic pressure is reflected to the foot-plate, resulting in an increase in the static acoustic impedance (11,14).

MATERIAL AND METHODS

Two groups of subjects were studied. Group A included 24 patients with Meniere's disease, 9 of them bilateral cases i.e, 33 ears. Group B consisted of 10 normal subjects i.e, 20 ears. Patients that were admitted with the complaints of hearing loss, vertigo, tinnitus and sensation of fullness in the ear had undergone audiologic and caloric tests. According to history of the patient and the test results, those which were interpreted as Meniere's disease have been included in Group A. Fourteen of 24 patients were females and 10 of them were males. The youngest patient was 20 and the oldest patient was 61 years old. The mean age in Group A was 33.2 years. Group

B consisted of normal subjects without otorhinolaryngologic complaints. No abnormality was recorded in the ear, nose and throat examination and audiologic and caloric tests. The youngest subject in Group B was 19 and the oldest was 41 years old with a mean age of 31.1 years. Each subject underwent a pre-glycerol audiologic test in the morning. Breakfast intake was limited. 1.5 gr per kg of glycerol with an equal amount of physiological saline was ingested perorally. A final postingestional audiologic test was performed 3 hours after the administration of glycerol. The pure tone thresholds and speech discrimination scores as well as the static acoustic impedance values were recorded in both the pre and post-glycerol tests. Audiologic tests were applied at IAC standard sound-proof rooms by using Interacoustics AC-5 clinical audiometers with TDH 39 MX 41/AR earphones. Speech discrimination scores were obtained at the Most Comfortable Loudness (MCL) using phonetically balanced words. Middle ear function was evaluated with Interacoustics AZ-7 Electroacoustic Impedancemeter and AG-3 recorder. The probe tone was 220 Hz. Regarding the 1035 K constant the acustic impedance was calculated by using the formula Z=K/C2-C1.

RESULTS

For Group A, the improvement of the pure tone thresholds was observed mainly for the frequencies below 2000 Hz. The maximum improvement was for 250 Hz (15 dB). The improvements were 11 dB and 9 dB for 500 Hz, and 1000 Hz indicating a decreasing fashion. In Group B, no significant improvement for any frequency was noted (Fig. 1).

Speech discrimination (SD) scores were better in 70% of the ears in Group A, whereas the rate was 10% for Group B. For Group A, the SD average was 82% in the initial test; whereas it has increased to 95% in the post-glycerol period. Changes in SD is shown in Fig.2.

In Group A, the static acoustic impedance (SAI) values were found to be decreased in 24 of 33 ears indicating a rate of 73%. The rate of decreased SAI was 20% for Group B (Fig 3). The average SAI was 4120 acoustic ohm and 3222 acoustic ohm in the pre and post-glycerol tests for Gorup A, considering the whole samples. When taking only the 24 ears with decreasing SAI, they were 4278 and 2894 in the pre and post-glycerol tests. In Group B, the SAI was found to be decreased in only 4 of 20 ears. The pre-glycerol average was 2378 ac. ohm which slightly increased to be 2424 ac. ohm in the post-glycerol period. (Fig. 4).

The rate of positive test results was 64% for Group A. None of the patients in Group B was a glycerol (+) resultant. The criteria for a glycerol (+) sample were, an improvement of 10dB or more in thresholds at two or more frequencies between 250 Hz and 2000 Hz and an improvement of 12 % or more in the SD scores (7). In Group A, 85% of the glycerol (+) resultants were found to have decreased SAI. (Table I).

All of the results were analysed with the khi-square method and a significant difference between the two groups was observed.

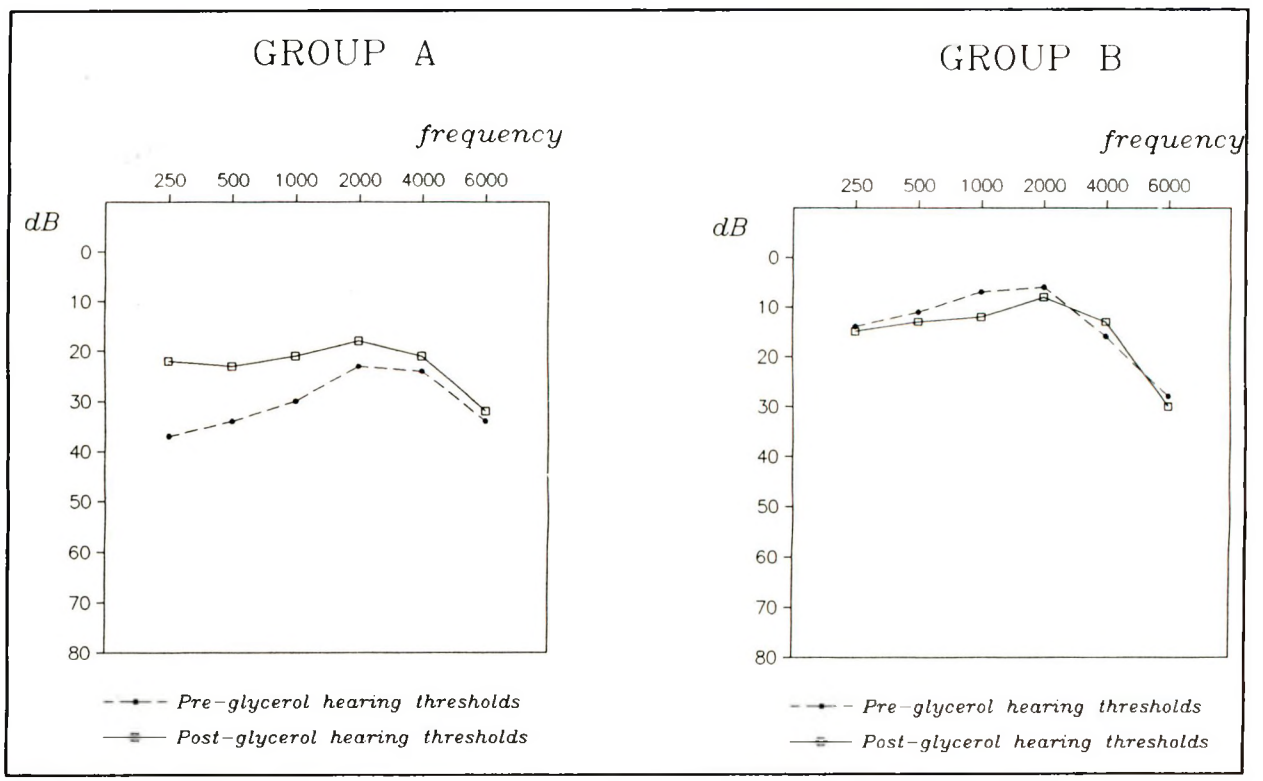

Fig 1. Mean of the hearing thresholds for groups A and B obtained by the pre and post glycerol tests

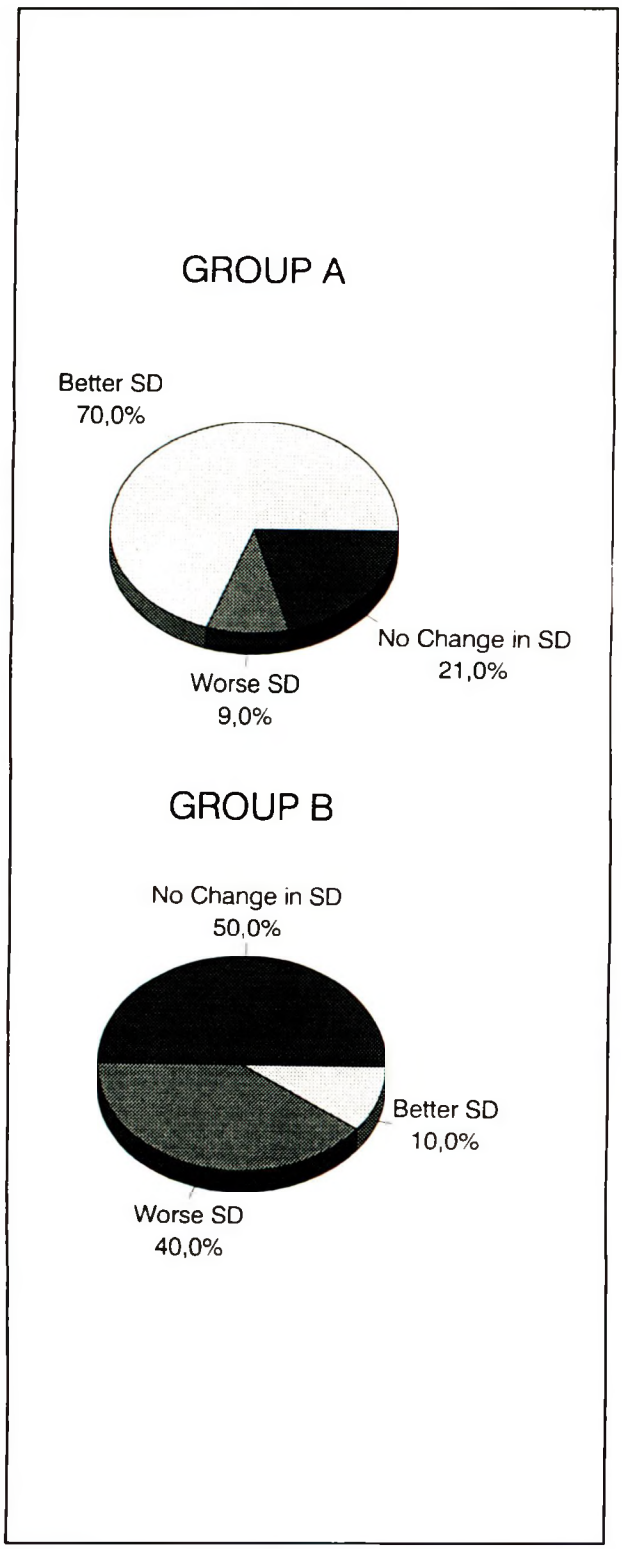

Fig 2. Changes in the speech discrimination (SD) scores in the post-glycerol test for groups A and B

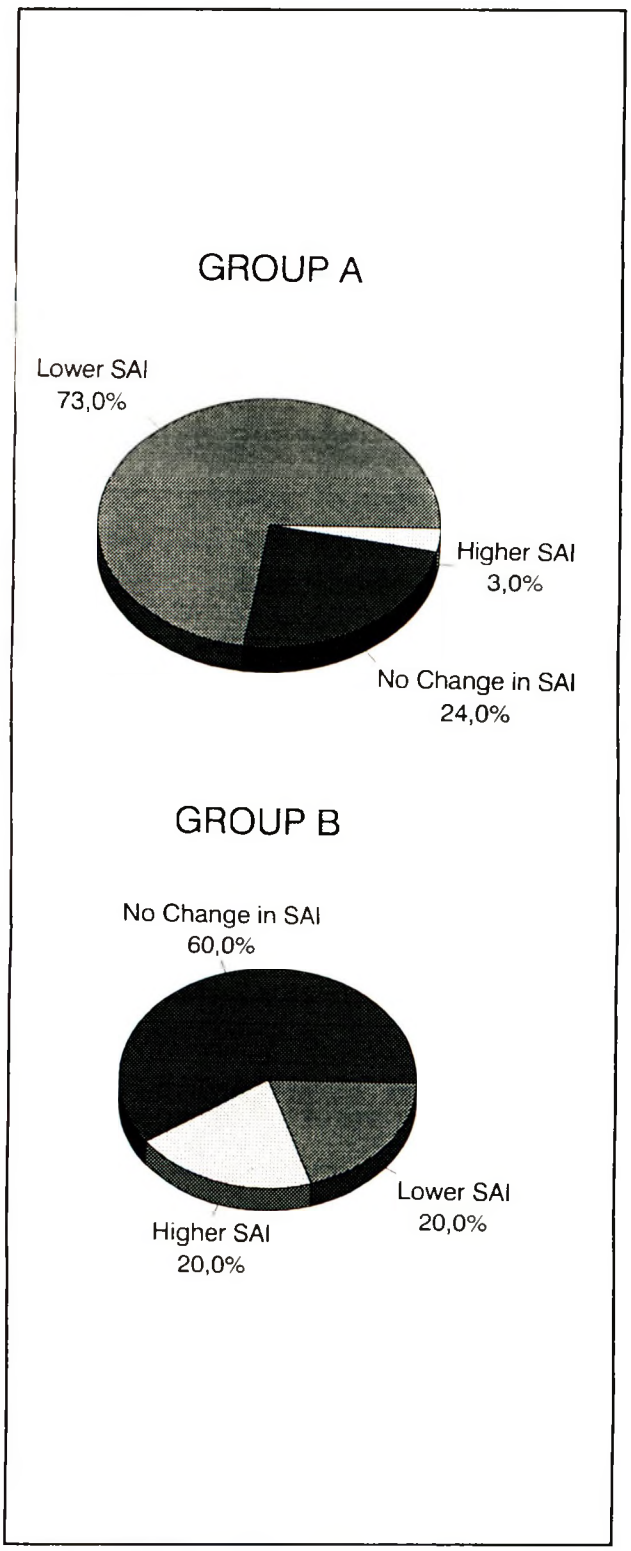

Fig 3. Changes in the static acoustic impedance (SAI) for groups A and B

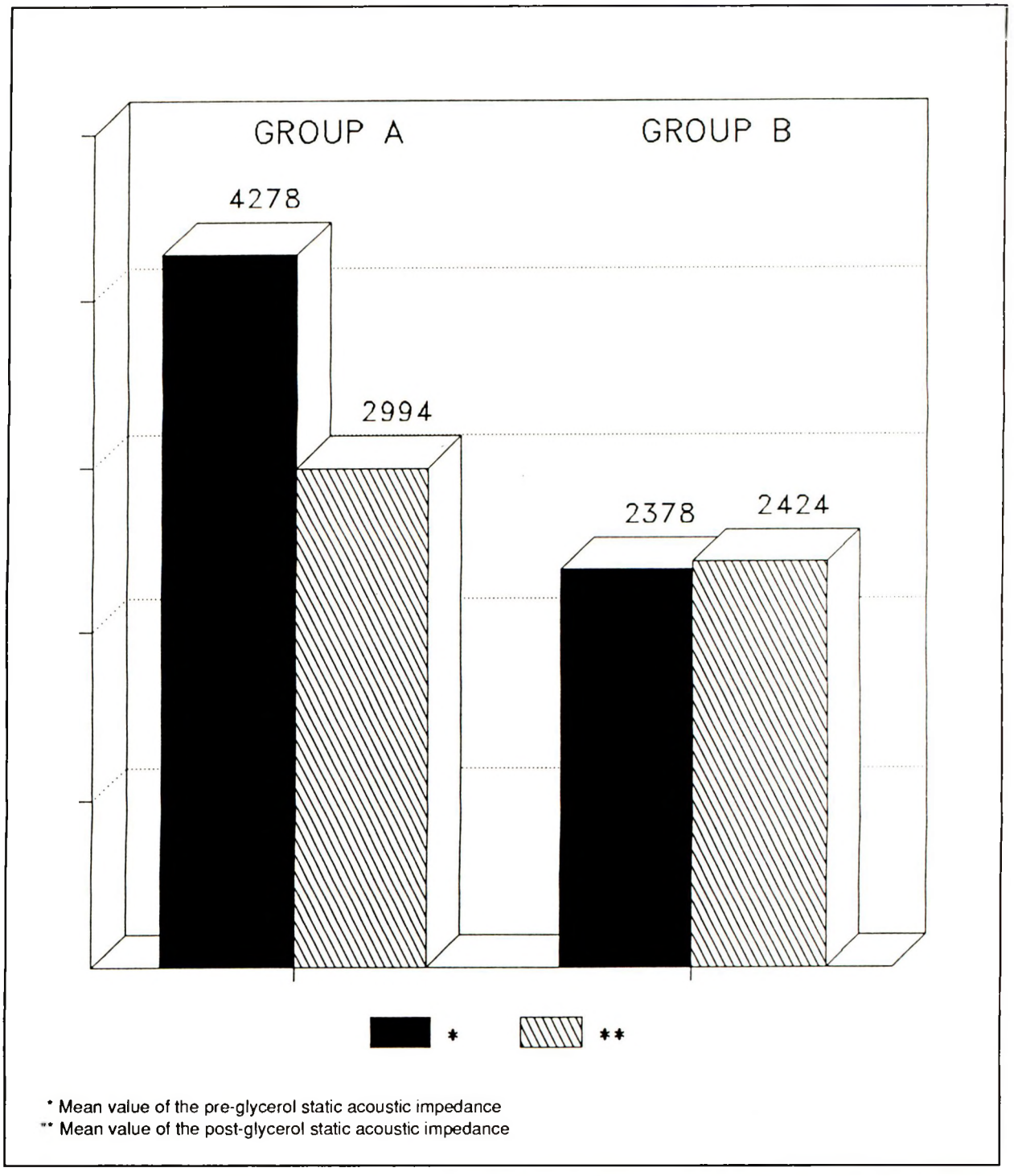

Fig 4. Mean value of the pre and post glycerol static acoustic impedance measurement. (The value obtained for group A includes only the samples that resulted with decrease for the static acoustic impedance in the post glycerol test)

Table I- The distribution of the changes for SAI among Glycerol (+) and Glycerol (-) samples in Group A

	GROUP A	Glycerol (+)	Glycerol (-)
Lower SAI	% 73	% 85	% 50
Higher SAI	% 3	% 5	0
No change for SAI	% 24	% 10	% 50
TOTAL	% 100	% 100	% 100

DISCUSSION

The glycerol dehidration test has been advocated for confirming the diagnosis of Meniere's disease and determining the reversibility of symptoms by medical or surgical therapy (4,5). Following its ingestion, glycerol, acting as a diauretic, draws back the excess fluid in the endolymphatic space. As a result, the endolymphatic pressure decreases to be normal, indicating improved pure tone thresholds and speech discrimination scores (14). The same mechanism can be considered as the cause of the decreased static acoustic impedance. The elevated endolymphatic pressure, reflecting to the foot-plate diminishes after the ingestion of glycerol resulting in a decrase for the static acoustic impedance.

In the patients with Meniere's disease, the post-glycerol static acoustic impedance values were found to be decreased at a rate of 73%. The rate was 85% for the ears showing a positive glycerol test result determined by the previously described criteria.

The mean value of the static acoustic impedance indicated a significant decrease in the first group whereas it was found to be slightly increased in the normal ears. It was found that the decrease was significantly correlated by the improvements either in the pure tone thresholds or the speech discrimination scores, confirming the idea of accepting the same possible mechanism for the last two, as the cause of the decrase in the static acoustic impedance.

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