

Tympanometric values in young Malay adults: preliminary data

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ABSTRACT

Introduction: The present study aimed to obtain preliminary tympanometric data of young Malay adults and to compare the results between genders.

Methods: 96 undergraduate students (49 males and 47 females), aged 19–25 (mean and standard deviation 21.14 +/- 1.31) years, participated in this study. Ooscopic examination, pure tone audiometry, qualitative tympanogram and ipsilateral acoustic reflex were measured to ensure a clear ear canal, normal hearing and normal middle ear function, prior to tympanometric measurement. As a result, a total of 154 ears (80 ears from males and 74 ears from females) were selected for further statistical analyses. The tympanometric parameters measured were peak compensated static acoustic admittance (Peak Y_{tm}), tympanometric width (TW) and equivalent ear canal volume (V_{ea}).

Results: The results showed that the mean Peak Y_{tm} , V_{ea} and TW for males were 0.81 mmhos, 1.48 cubic cm and 113.67 daPa, respectively. The mean Peak Y_{tm} , V_{ea} and TW for females were 0.63 mmhos, 1.12 cubic cm and 98.04 daPa, respectively. Males were found to have significantly higher mean V_{ea} and mean Peak Y_{tm} than females. However no significant gender difference was observed in the mean TW.

Conclusion: The current study suggests that young Malay adults may require gender-specific Peak Y_{tm} and V_{ea} values when implementing a quantitative approach in tympanogram interpretation.

Keywords: hearing loss, middle ear, tympanometry

Singapore Med J 2009;50(11): 1077-1079

INTRODUCTION

Tympanometry is a routine, safe and quick audiological procedure for assessing middle ear (ME) function in

the paediatric and adult populations.⁽¹⁾ Quantitative tympanogram interpretation has significant clinical values in diagnosing the middle ear status.^(2,3) Unlike qualitative tympanometric classification,^(4,5) the quantitative approach provides normative data in the form of absolute units and values. These include peak compensated acoustic admittance (Peak Y_{tm}), tympanometric width (TW) and equivalent ear canal volume (V_{ea}). Peak Y_{tm} is defined as the acoustic admittance value at the lateral surface of the tympanic membrane referenced to the peak pressure of the tympanogram. An abnormally low Peak Y_{tm} suggests the presence of otitis media with effusion.⁽⁶⁾ TW is defined as the width of tympanogram measured in decapascals (daPa) at half of the height from tympanogram peak to tail.⁽⁶⁾ An abnormally-wide TW may indicate the presence of otitis media with effusion.^(7,8) Ivey noted that a narrow TW may indicate stiffness of the ossicular chain.⁽⁹⁾ V_{ea} is defined as the acoustic admittance estimate of the volume between the probe tip and the tympanic membrane, if the tympanic membrane is intact.⁽⁸⁾ A large V_{ea} accompanied by a flat tympanogram may suggest the presence of ear drum perforation or patent grommet tube, as the value includes the ME cavity.⁽¹⁰⁾ The quantitative approach allows the development of tympanometric normative data which can be used as guidelines for ME screening. Normative data for adults' ME status have been documented for reference.^(3,11) Recommended tympanometric normative data was included in the Guideline for Middle Ear Screening by the American Speech-Language-Hearing Association.^(12,13)

The present study used a quantitative approach to obtain tympanometric data in young Malay adults. Tympanometric normative data for young adults have long been developed for diagnostic purposes.^(3,11,14) Except for the study done by Margolis and Heller in 1987,⁽¹¹⁾ the normative data recommended are age and gender specific. For example, Roup et al examined Peak Y_{tm} , TW and V_{ea} values on 102 young non-Hispanic Caucasian males and females. Their study demonstrated that a significant gender difference was observed in each parameter measured. A more recent study on normative tympanometric data on young Southern Chinese adults⁽¹⁵⁾ found a significant ethnic difference from the results obtained by Roup et al,⁽³⁾ but it did not show any significant gender difference. The results of the above studies suggest the importance

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Table I. Tympanometric data.

Patients	Peak Y_{tm} (mmhos)	V_{ea} (cm ³)	TW (daPa)
Total (n = 154 ears)			
Mean \pm standard deviation	0.72 \pm 0.37	1.31 \pm 0.34	106.16 \pm 63.96
90% range	0.32–1.48	0.78–1.90	40.00–230.80
Male (n = 80 ears)			
Mean \pm standard deviation	0.81 \pm 0.42	1.48 \pm 0.31	113.67 \pm 74.41
90% range	0.37–1.73	1.00–2.10	28.41–279.50
Female (n = 74 ears)			
Mean \pm standard deviation	0.63 \pm 0.28	1.12 \pm 0.27	98.04 \pm 49.52
90% range	0.29–1.07	0.68–1.62	43.33–208.75

of developing ethnic- and gender-specific tympanometric data. Therefore, the present study aimed to obtain gender-specific tympanometric data in young Malay adults. The tympanometric parameters measured were Peak Y_{tm} , TW and V_{ea} .

METHODS

96 young Malay adults (49 males, 47 females) with normal hearing participated in the present study. They were undergraduate students of Universiti Kebangsaan Malaysia (UKM) and participated voluntarily following advertisements placed around the campus. Their ages ranged from 19 to 25 years, and the mean ages were 21.16 \pm 1.44 years for males and 21.11 \pm 1.66 years for females. Levene's test confirmed that both groups were homogenous in age (F 2.39; p > 0.05). The inclusion criteria included: no history of hearing loss and ear diseases during the study; clear and normal ear canals with intact tympanic membranes as shown by an otoscopic examination; normal air conduction thresholds (20 dB hearing level [HL]) at octave frequencies from 250 Hz to 8,000 Hz; and normal ME function as indicated by the presence of a single peak tympanogram⁽⁴⁾ and ipsilateral acoustic reflexes screened at 500, 1,000 and 2,000 Hz using a 90 dB HL pure tone.

A total of 114 young Malay adults with a mean age of 21.14 \pm 1.31 years were first screened using otoscopic examination, pure tone air conduction audiometry, ipsilateral acoustic reflexes and tympanometry, to ensure they fulfilled the inclusion criteria. However, only 154 ears (80 ears from males and 74 ears from females) fulfilled the inclusion criteria. All the tests were carried out in a soundproof room at the Audiology Clinic of UKM. Air conduction thresholds were obtained on each subject using a G1 clinical audiometer (Grason-Stadler Instrument, Madison, WI, USA), calibrated according to ANSI S3.6 1996 standards.⁽¹⁶⁾ The instrument was fitted with TDH-50P headphones to deliver pure tone signals. A GSI Tymptstar version 2 Middle Ear Analyzer (Grason-Stadler Instrument, Madison, WI, USA), calibrated in accordance to ANSI S3.39 1987 standards,⁽¹⁷⁾ was used to

screen the subjects' ME status. The same instrument was used to obtain the tympanometric values. The instrument was set at 226 Hz probe tone, pump speed of 600/200 daPa/second, and the direction of the pressure was from +200 to -200 daPa. Parameters included in the tympanometric normative data were Peak Y_{tm} , V_{ea} and TW. The reading for each parameter was automatically calculated and displayed on the instrument. Three readings were obtained for each parameter to ensure data reliability. The mean from each parameter was used for statistical analysis using the Statistical Package for Social Sciences version 12.0 (SPSS Inc, Chicago, IL, USA).

RESULTS

The Peak Y_{tm} , V_{ea} and TW were obtained from 154 ears. The skewness ratio was utilised to observe the data distribution for Peak Y_{tm} , V_{ea} and TW. V_{ea} was found to have a normal distribution (2 SE), while Peak Y_{tm} and TW were not normally distributed. Therefore, an independent t -test was performed to compare the mean V_{ea} between the ears. The Mann-Whitney U test was performed to compare the means of Peak Y_{tm} and TW between the ears. Statistical analyses found no significant difference between the ears for V_{ea} ($t[152] = 0.231$, $p > 0.05$, $\eta < 0.14$, power < 80%), Peak Y_{tm} ($z = -0.50$, $p > 0.05$, $\eta < 0.14$, power < 80%), and TW ($z = -0.34$, $p > 0.05$, $\eta < 0.14$, power < 80%); therefore, the results between the ears were combined for further analysis.

Table I provides the mean, standard deviation and 90th percentile range for the tympanometric data obtained from the male ($n = 80$ ears) and female ($n = 74$ ears) young Malay adults. The independent t -test showed that the mean V_{ea} for males (1.48 \pm 0.31 cm³) was significantly higher than that for females (1.12 \pm 0.27 cm³) ($t[152] = 7.64$, $p < 0.05$, $\eta > 0.14$, power > 80%), and the 90th percentile range was larger in males compared to females. The Mann-Whitney U test revealed that males had a significantly higher mean Peak Y_{tm} (0.81 \pm 0.42 mmhos) compared to females (0.63 \pm 0.28 mmhos) ($z = -2.98$, $p < 0.05$, $\eta < 0.14$, power > 80%), and the 90th percentile range was smaller in females

compared to males. No significant gender difference was found in TW ($z = -1.29$, $p > 0.05$, $\eta < 0.14$, power $< 80\%$), but the 90th percentile range was larger in males.

DISCUSSION

This present preliminary study aimed to obtain the tympanometric values of young Malay adults and to compare the data between the genders. The findings suggest that young Malay adults may require gender-specific Peak Y_{tm} and V_{ea} values because both values were significantly higher in the males than the females. However, this present study found no significant gender difference in TW values in the subjects involved. The existence of a significant gender difference found in the V_{ea} value might be attributed to the body size factor.⁽¹⁾ Although body size was not measured in this present study, young Malay males are generally larger in body size than young Malay females. The difference in body size may contribute to the existence of a significant difference in the ear canal volume between these two groups. This current finding is supported by other research, which suggested that males have larger ear canal volumes than females.^(3,11,14,15)

Body size may also contribute to the size of the ME cavity,⁽¹⁵⁾ which may affect the Peak Y_{tm} value. Research has found that there is a relationship between the size of the ME cavity and ME compliance.⁽¹⁸⁾ A smaller ME cavity is less compliant than a larger one, and therefore it is reflected as a smaller Peak Y_{tm} value. The reduction in the Peak Y_{tm} value in a relatively small ME cavity is related to the small volume of air in the cavity.⁽⁶⁾ A smaller volume of air in the ME cavity increases its stiffness and thus reduces the Peak Y_{tm} value. However, the relationship between body size and the volume of the ME cavity needs further investigation. The tympanometric data for the young Malay male and female groups was statistically compared between the right and left ears. The present study also suggests that Peak Y_{tm} , TW and V_{ea} are symmetrical between the left and right ears, which is consistent with previous study findings.^(3,15)

Our study also found that the mean TW of young Malay adults is relatively higher than that of the Caucasian population, and the difference can be observed in both genders. However, as raw data from the Caucasian population was not available to this present study, the difference between these two ethnic groups was not conclusive. Nonetheless, the risk of having a ME dysfunction may explain the difference observed in the TW between the Malay and Caucasian populations. Certain ethnic groups may have a higher risk of developing ME dysfunction. Studies have found that the TW value in native Hawaiian children was higher than that of nonnative Hawaiian children.⁽¹⁹⁾ The prevalence rate of ME

dysfunction in native Hawaiians was 11%, and the high incidence of ME pathology may indicate higher TW values. The present study may reflect that young Malay adults have a higher risk of developing ME dysfunctions. A previous study on ME disorders in the Malay population showed that the prevalence rate of otitis media in Malay children was 13.8%.⁽²⁰⁾ This could explain the higher TW in young Malay adults compared to the Caucasian population. However, further investigations are required to explain these findings. This preliminary study suggests that gender-specific Peak Y_{tm} and V_{ea} values may be required for quantitative tympanogram interpretation among young Malay adults.

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