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Original Research Paper

Speech & Hearing

INFLUENCE OF BLOOD GROUP ON EVOKED OTOACOUSTIC EMISSIONS

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ABSTRACT OAE testing is more sensitive in the detection of the early onset of cochlear pathologies before a change in hearing thresholds. In the development of cochlear hair cells in the foetus human blood group antigens were involved. **Aim:** The present study is aimed to investigate the effect of blood group on evoked otoacoustic emissions among young adults in the Indian context. **Method:** A total of 120 normal young adults of age 18 – 30 years were selected and grouped according to the ABO system of blood group, each consists of 30 participants and recorded both DPOAE and TEOAE. **Results:** The DPOAE and TEOAE amplitude showed significant difference across frequencies and ears which do not follow a uniform pattern of significance in all blood groups indicating no effect of blood group in OAE amplitude. **Conclusion:** The present study revealed no effect of blood group over evoked otoacoustic emission, though the results report a significant difference among the majority of the test frequencies which is not uniform indicating any influence, and this opens the possibility of other factors influencing the OAE response.

KEYWORDS : Otoacoustic emissions, Blood group, DPOAE, TEOAE

INTRODUCTION

Otoacoustic emissions (OAEs) are sounds generating from the cochlea which transmit through the middle ear to the ear canal (Kemp, 1978). The presence of OAEs is an indication of healthy cochlear function (Kemp, 2002). In the development of cochlear hair cells in the foetus human blood group antigens were temporarily expressed and correspond to the main events of inner ear differentiation, e.g. hair cell development, synaptogenesis, and ciliogenesis. Blood group antigens are genetically derived (Sircar, 2008) and genetic differences across blood groups influence susceptibility and resistance to certain disorders, in addition to their possible role in Noise-induced hearing loss (Lashley, 2005). Individuals with certain blood groups (blood groups A, B, and AB) have been found to be significantly less prone to NIHL compared to those with blood group O (Dogru, Tüz & Uygur, 2003).

OAE testing is more sensitive in the detection of the early onset of cochlear pathologies before a change in hearing thresholds (Basner, Babisch & Davis, 2014). The assumption is that small amplitude OAEs, compared to large amplitude OAEs, possibly indicates reduced OHC activity in the cochlea (Lonsbury-Martin & Martin, 2007). The response amplitudes of OAEs would be significantly different among female normal-hearing individuals from the four main blood groups and participants of blood group O has lower amplitudes. (Chow et al., 2016). Similar study done by Chen, Chow & McPherson (2017) including young adult male participants of age range 18 – 26 years following the same methodology of Chow et al., (2016) and found that the response amplitudes of OAEs would be significantly different among male normal-hearing individuals from the four main blood groups and participants of blood group O has lower amplitudes.

These haematological and genetic factors underlying the cochlea and hair cells create amplitude changes in the emissions from the cochlea. These reviews enlightened the thought for scrutinizing the effect of blood group on evoked otoacoustic emission among young adults, in the Indian context. This study aims to investigate the effect of blood group on evoked otoacoustic emissions among young adults.

METHOD

A total of 120 normal young adults of age group 18 – 30 years were selected and grouped according to the ABO system of blood group each consists of 30 participants. . Informed consent was taken from all enrolled subjects and the confidentiality and privacy of the participants were maintained. Ethical committee clearance was taken during Institutional Ethics committee meet on 02/08/2018 for the study.

The participants completed a questionnaire in which they provided information regarding their age, blood group, hearing history, major health problems and noisy hobbies. The otoscopic examination was carried out on both ear canals of each participant, using a Welch Allyn Otoscope. The individuals enrolled were screened with immittance audiometry (GSI-Tympstar) for 'A' type tympanogram with reflexes present, and pure tone audiometry (GSI-61) for air conduction and bone conduction threshold of less than or equal to 15 dBHL. The subjects selected accordingly were tested with DPOAE and TEOAE.

Intelligent hearing system (IHS) was used for measurements of TEOAEs and DPOAEs in both ears. The Calibration and testing system meets the FDA QSR Part 820 and ISO13485:2003 standards. A silicon rubber probe tip of appropriate size was fitted in the ear canals of each participant. TEOAE was tested using Smart TEOAE version 5.40.00. Nonlinear click stimulation was used and clicks with amplitudes of 80 dB SPL were repeated 19 times per second to evoke TEOAEs. The test was completed in the tested ear when 1024 responses to the clicks were collected and averaged. The results were recorded from both ears and the responses are noted at one or more of the frequency bands centred on 1000, 1500, 2000, 3000 and 4000 Hz were considered indicative of true TEOAE findings when the signal-to-noise ratio was at least 6 dB.

DPOAE was tested using Smart DPOAE version 5.40.00. DPOAEs at the frequency 2f1-f2 were obtained and stimuli with two primaries were presented with an f2/f1 ratio of 1.22

and with L1 and L2 set at 65 and 55dB SPL, respectively, to obtain robust responses (Prieve & Fitzgerald, 2009). A total of 13 f2 frequencies: 357 Hz, 450 Hz, 562 Hz, 704 Hz, 885 Hz, 1120 Hz, 1409 Hz, 1775 Hz, 2245 Hz, 2822 Hz, 3560 Hz, 4480 Hz and 5649 Hz (fdp- frequency distortion product) were used.

The entire test procedure was administered in a sound-treated room. The ambient noise levels were maintained within the permissible levels according to American National Standards Institute standard S3.1– (1999).

RESULTS

A total of 120 participants equally distributed, 30 each in four blood groups: A, B, AB, O who met the criteria participated in this study.

TEOAE Findings:

Kruskal Wallis test was used to check for differences in TEOAE amplitudes among the four blood groups at frequencies 1000, 1500, 2000, 3000 and 4000 Hz in both right and left ears.

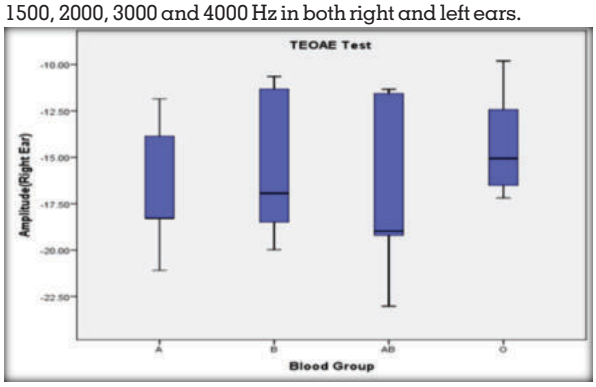

Figure-1 Indicates The Descriptive Statistics Of TEOAE Amplitude Across Different Blood Groups Of The Right Ear.

Figure-1 depicts the range in which the data lies. The box indicates the inter-quartile range and the solid line indicates the median. The whiskers at the top indicate the maximum value of amplitude and the whisker at the bottom indicates the minimum value of amplitude. For blood group-A, the values lie in the range of 9.2 and the median is -18.2880. In blood group-B values range in 9.34 for the median -16.9420. Range of values for blood group-AB is 11.70 with median -18.9270 and for O-group the range lies in 7.38 with median -15.0630.

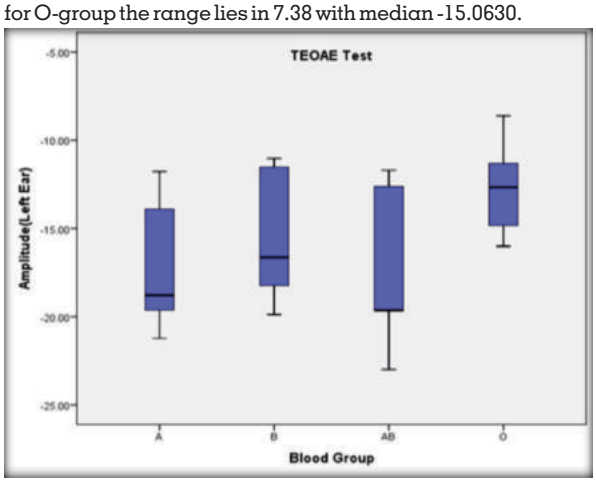

Figure- 2 indicates the descriptive statistics of TEOAE amplitude across different blood groups of the left ear.

Figure-2 depicts the range in which the data lies. For blood group-A, the values lie in the range of 9.46 and the median is -18.7860. In blood group-B values range in 8.85 for the median -16.6380. Range of values for blood group-AB is 11.30 with median -19.636 and for O-group the range lies in 7.40 with median -12.6600.

The p-value shows a significant difference in mean amplitude at 1000 Hz in the left ear, 1500 Hz in both ears, 2000 Hz in both ears, 3000 Hz in both ears & 4000 Hz in both ears. There is not much significant difference in mean value at 1000 Hz recorded from the right ear (P>0.01).

DPOAE Findings:

Kruskal Wallis test was used for analysing the effect of blood group in DPOAE amplitude.

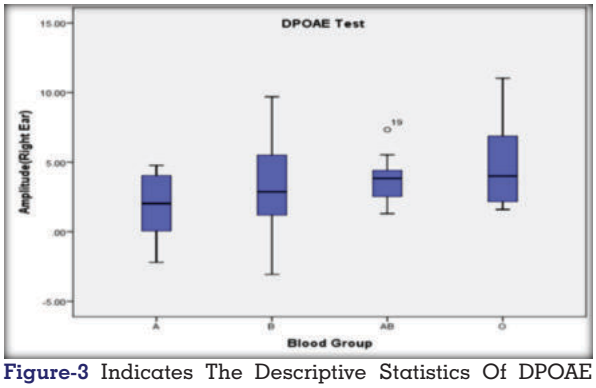

Figure-3 Indicates The Descriptive Statistics Of DPOAE Amplitude Across Different Blood Groups Of The Right Ear.

Figure-3 depicts the range in which the data lie for the DPOAE amplitudes values of the right ear. For blood group-A, the values lie in the range of 6.97 and the median is 2.0330. In blood group-B values range in 12.77 for the median 6.03. Range of values for blood group-AB is 6.03 with median 12.77 and for O-group the range lies in 9.43 with median 4.000. There is an outlier value which is low minimum outside the range which is uncommon in the data.

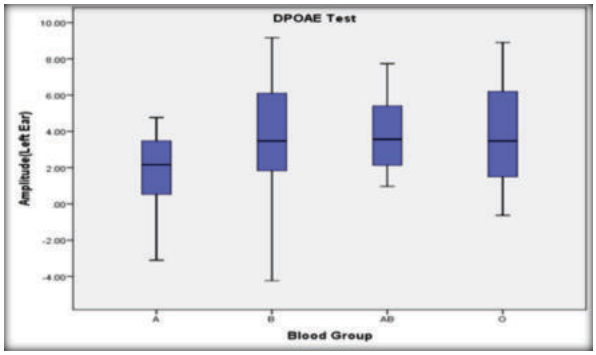

Figure-4 Indicates The Descriptive Statistics Of DPOAE Amplitude Across Different Blood Groups For The Left Ear.

Figure-4 depicts the range in which the data lie for the DPOAE amplitudes values of the left ear. For blood group-A, the values lie in the range of 7.87 and the median is 20. In blood group-B values range in 13.40 for the median 3.4670. Range of values for blood group-AB is 6.77 with median 3.5670 and for 0 group the range lies in 9.53 with median 3.4670.

There is no significant difference in the amplitude at frequencies 450 Hz in the left ear, 562 Hz in both ears, 704 Hz in the left ear, 3560 Hz in the right ear and 4480 Hz in both; p-value > 0.01.

Since the results showed a significant difference among the majority of the frequencies a post hoc analysis with Man-Whitney test was done to compare among the blood group and the results are as follows:

Comparison Of TEOAE Amplitude Across Blood Groups:

Table- 1 Indicates The Post-hoc Analysis Of TEOAE Across

Blood Groups For Both Ears.

Frequency	Ear	A-B	A-AB	A-O	B-AB	B-O	AB-O
1000 Hz	Right	.352	.399	.037	.352	.160	.010
	Left	.403	.539	.000	.110	.001	.000
1500 Hz	Right	.004	.001	.121	.935	.267	.359
	Left	.004	.003	.012	.620	.690	.894
2000 Hz	Right	.107	.067	.271	.014	.728	.038
	Left	.010	.442	.000	.000	.003	.000
3000 Hz	Right	.035	.030	.002	.000	.174	.000
	Left	.028	.086	.000	.000	.037	.000
4000 Hz	Right	.941	.701	.000	.492	.000	.000
	Left	.853	.745	.000	.959	.000	.000

Table-1 shows there is a significant difference in comparison between A- group and B- group for 3 mid frequencies. Similarly, in comparison of A- group and AB- group, there is a significant difference at 2 frequencies. While comparing B-group to AB-group there is a significant difference across 2 frequencies in right and left ear. Comparison of AB-group to O-group shows a significant difference in 4 frequencies. The blood group comparison of B-group to O-group showed a significant difference in 4 frequencies. Comparing A- group to O -group showed a significant difference at 5 frequencies.

Comparison Of DPOAE Amplitude Across Blood Groups:

Table- 2 Indicates The Post-hoc Analysis Of DPOAE Across Blood Groups For Both Ears.

Frequency	Ear	A-B	A-AB	A-O	B-AB	B-O	AB-O
357 Hz	Right	.118	.002	.135	.000	.001	.073
	Left	.152	.003	.620	.000	.168	.000
450 Hz	Right	.195	.099	.177	.018	.018	.923
	Left	.689	.538	.161	.619	.056	.093
562 Hz	Right	.853	.829	.028	.935	.045	.032
	Left	.057	.449	.390	.107	.486	.841
704 Hz	Right	.578	.635	.002	.561	.001	.000
	Left	.096	.587	.048	.250	.711	.008
885 Hz	Right	.005	.007	.000	.114	.238	.000
	Left	.002	.006	.002	.045	.667	.125
1120 Hz	Right	.001	.329	.001	.002	.900	.001
	Left	.012	.088	.015	.038	.431	.069
1409 Hz	Right	.000	.028	.000	.000	.935	.004
	Left	.000	.003	.001	.047	.935	.070
1775 Hz	Right	.005	.121	.006	.172	.784	.163
	Left	.045	.373	.022	.100	.900	.081
2245 Hz	Right	.001	.038	.002	.154	.929	.194
	Left	.019	.026	.011	.397	.711	.285
2822 Hz	Right	.000	.000	.003	.677	.859	.859
	Left	.001	.000	.086	.504	.303	.275
3560 Hz	Right	.189	.556	.166	.291	.784	.292
	Left	.010	.072	.256	.116	.014	.012
4480 Hz	Right	.017	.095	.267	.177	.416	.837
	Left	.335	.711	.750	.444	.790	.624
5649 Hz	Right	.399	.005	.123	.017	.064	.450
	Left	.307	.005	.071	.008	.041	.548

Table-2 shows a significant difference in comparison between A- group and B- group for 6 mid frequencies. Similarly, in comparison of A- group and AB- group there is a significant difference at 6 frequencies, B-group to AB-group there is a significant difference across 5 frequencies, AB-group to O-group shows significant difference in 4 frequencies, B-group to O-group showed a significant difference only in 3 frequencies, A- group to O -group showed significant difference at 7 frequencies.

The results revealed a significant difference in amplitude values of evoked otoacoustic emissions (DPOAE & TEOAE) among different frequencies across blood groups, but the results were not found to be uniform /consistent across frequencies and ears indicating no particular influence of blood group in TEOAE and DPOAE amplitude in the current study.

DISCUSSION

The recent studies have indicated that there are differences in otoacoustic emission responses in young adults. Many reviews (Chen et al., 2016; Chow et al., 2017; Prabhu et al., 2018) suggested that blood group-O have reduced amplitude in otoacoustic emissions among young adults due to the genetical predisposition of antigens in blood group causing a reduction in the number of hair cells.

The results of the present study showed no effect of blood group in evoked otoacoustic emissions among young adults. The DPOAE amplitude showed significant difference across frequencies and ears which do not follow a uniform pattern of significance in all blood groups, also the significant difference found in TEOAE amplitude were inconsistent for frequencies and ears across blood groups. This result agrees with result of the study done by Sequi-Canet et.al in 2019 that showed a similar finding in which no correlation was obtained between the ABO blood group or Rh and TEOAE pass rates in healthy newborns.

This current study is not reporting any influence of blood group and evoked otoacoustic emission. Since the majority of previous studies have reported the effect of blood group on evoked otoacoustic emissions in which there is a reduction in OAE amplitude for O-group compared to other groups. The following factors have to be studied in detail: 1) previous studies (Chen et al., 2016; Chow et al., 2017; Prabhu et al., 2018) have selected the methodology by either female or male subjects. In the current study subjects were randomly selected with majority of female participants, 2) in the current study the effect of different phases of the menstrual cycle were not taken into consideration. Adriztina et al., 2015 and Souza et al., 2017 have reported the effect of the menstrual cycle on hearing sensitivity, 3) smaller sample size was used in the present study. Differences stemming from previous studies must be further researched and confirmed. It is thus necessary to study other factors that can influence the blood group on evoked otoacoustic emissions. However, this study cannot conclude that there is not a difference in OAE response amplitudes across blood groups this opens the possibility of other factors influencing the OAE response.

CONCLUSION

The present study revealed no effect of blood group over evoked otoacoustic emission, though the results report a significant difference among the majority of the test frequencies which is not uniform indicating any influence.

The previous majority studies on the effect of blood group on otoacoustic emissions have reported the influence of blood group on evoked otoacoustic emissions in which there is a reduction in OAE amplitude for O- group compared to other groups. The current study did not find any effect. The authors stress on following factors that must be studied in detail: such as smaller sample size, subjects were randomly selected (gender was not taken into consideration as the current study has a greater number of female subjects than males), and the effect of the menstrual cycle of the subjects was not considered. So, the current study illustrates the necessity of detailed research regarding the effect of blood group on evoked OAE's and its multiple variables.

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