: Effect of blood group on susceptibility to noise induced hearing loss

by Niraj Kumar Singh

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PROJECT PROPOSAL FORMAT

Part -A

1.0 Title of the Project : Effect of blood group on susceptibility to noise induced hearing loss.

Area of Research:

a) Speech, Language, Hearing

1.1 Principal Investigators:

Mr. Rajesh Ranjan

Dr. Niraj Kumar Singh

1.2 Principal Co- Investigator

Mr. P.ArivudaiNambi

1.3 Collaborating Institute

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Kasturba Medical College (Manipal University), Attavara,

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1.4 Total Grants Required: Rs 5,68,000 (Five lakhs sixty eight thousands only)

1.5 Duration of the Project: - 1 year

2.0 Project Summary (Max 300 Words)

Earlier studies have investigated the prevalence of NIHL in different blood groups and the found that NIHL is more common in certain blood groups. Muluk & Oguzturk, (2008) reported that NIHL is more prevalent in blood groups A and AB. On contrary Doğru, Tüz, & Uygur, (2003) found that NIHL was prevalent in subjects with O blood group. Overall, results of these studies give a notion that, there could be an association between blood group and NIHL. However, there is no consensus the vulnerability associated with any particular blood group for NIHL. Thus the aim of the current study is to assess the effect of blood group on susceptibility to NIHL. A total of 120participants, with 30 participants in each blood group (A, B, AB, & O) will be recruited for the current study. Participants within the age range of 20-35 years and having hearing thresholds ≤15 dB HL at octave audiometric test frequencies will be included in the study. Susceptibility to NIHL will be evaluated using fine structure distortion product oto-acoustic emissions (FS-DPOAE), aural harmonics test

and brief tone audiometry. Appropriate statistical analyses will be used for comparison between the groups for finding out susceptibility for NIHL.

3.0 Introduction(under the following heads)

3.1 Definition of the Problem

No one needs to lose his or her hearing in order to earn a living. Noise induced hearing loss (NIHL) is one of the most prevalent conditions among the hearing disorders. Pharmacological line of management is less effective in bringing the hearing back to normal level in individual with permanent NIHL. Hence, occupational hearing conservation programs (HCP) focus on prevention of NIHL. For this purpose HCP uses a globalized approach of prescribing ear protective device and shift in occupational placements. However few researches have indicated that NIHL is prevalent in certain blood groups, which creates an impression that there could be association between blood groups and susceptibility to NIHL. Audiological test such as DPOAE, TEOAE, Aural Harmonics test and Brief tone audiometry have the ability to predict the susceptibility of normal hearing adult to NIHL. If the association between blood group and susceptibility to NIHL is known, tailor made hearing conservation program can be developed based on blood groups. Hence current project propose to study the association between susceptibility to NIHL and blood groups.

3.2 Objectives

The aim of the current study is to assess the association between blood group and susceptibility to NIHL. The specific objectives of the study are,

- To quantify the fine structure of DPgrams of individuals with different blood groups.
- To perceptually measure the lowest intensity at which input signal can produce first harmonic using aural harmonics test.
- To measure the threshold differences for 20ms and 200ms duration pure-tones using brief tone audiometry
- To investigate the association between blood groups and outcomes of fine structure DPgram, Aural harmonics test and brief tone audiometry.

3.3 Review of status of research and development in the subject

In 1900, Karl Landsteiner reported a series of tests, which identified the ABO Blood group system (cited in Mouro, Colin, Chérif-Zahar, Cartron, & Le Van Kim, 1993). He classified the blood groups based on the antigens present on red blood cells (RBC). Blood group antigens are the molecules expressed on the surface of human RBC, against which antibodies occur naturally or can be raised. ABO antigens are glycolipids, which are oligosaccharides attached directly to lipids on red cell membrane. It has been shown that particular disorders are more commonly seen in certain blood groups. Numerous studies have dealt with the relative frequency of the ABO blood groups in different disease entities. The individuals with blood group O have a higher risk of peptic ulcers when compared with other blood groups (Edgren et al., 2010). An association has been also found between blood group A and gastric carcinoma (Aird, Bentall, & Roberts, 1953), particularly convincing are associations of duodenal and gastric ulceration with blood group O, and pernicious anemia, and diabetes mellitus with blood group A (Clarke, 1959); (Matsunaga, 1959). It has been reported that human blood group antigens are transiently expressed in developing cochlear hair cells in the fetus (Gil-Loyzaga et al., 1989). So, it may be speculated that blood group and auditory functions are related. Few attempts have been made to investigate the association between blood groups and auditory function.

Studies have been done to investigate the association between maternal blood group and probability of children developing middle ear disorders. Children with maternal blood group of "A" are at risk for developing acute otitis media (Gannon, Jagger, & Haggard, 1994) and secretory otitis media (Mortensen, Lildholdt, Gammelgård, & Christensen, (1983). Apostolopoulos, Labropoulou, Konstantinos, Rhageed, & Ferekidis, (2002) reported that blood group O and possibly AB plays a preventive role, while blood group A and B are risk factors for otitis media. However, Rhesus factor has no relationship with otitis media. Other than middle ear disorders, few efforts were made to assess the association between blood groups and noise induced hearing loss. Muluk & Oguzturk, (2008) studied the effects of blood group on occupational noise induced hearing loss (NIHL) and they reported that NIHL is more prevalent in blood groups A and AB. However on contrary (Doğru, Tüz, & Uygur, 2003) found that NIHL was significantly more frequent among subjects with O blood group. Overall, results of these studies give a notion that, there is an association between blood group and NIHL. However, no clear cut consensus on which blood group is more vulnerable for NIHL.

Susceptibility to NIHL can be evaluated using methods such as Distortion product oto-acoustic emission (DPOAE) (Vázquez, Jimenez, Martin, Luebke, & Lonsbury-Martin, 2004), transient evoked oto-acoustic emissions TEOAE (Plinkert, Hemmert, & Zenner, 1995), aural harmonics and brief tone audiometry (Humes, 1978).

Otoacoustic emissions, TEOAE and DPOAE are sounds that are generated in inner ear and can be recorded in the external ear using a sensitive microphone. They are generated by the active amplification of the outer hair cells, and are considered to reflect the status of the most vulnerable part of the hearing better than regular behavioral thresholds (Hammershøi, Ordoñez, Torrente, & Kochendörfer, 2010). It has been reported in the literature that, individual who has

low amplitude TEOAEs or DPOAEs are more susceptible for noise induced hearing loss (Konopka & Zalewski, & Pietkiewicz, 2001; Lapsley Miller, Marshall, Heller, & Hughes, 2006; Marshall et al., 2009). DPOAE fine structure can be observed in a graph of DPOAE amplitudes as a function of fine increments in frequency. The patterns of fine structure across frequency vary between subjects, but are extremely reproducible over time within each subject (Sally A. Gaskill, 1990)The DPOAEs fine structures have been used to study the functioning of the outer hair cells in both humans and animals (Reuter & Hammershøi, 2006). The disappearance of DPOAE fine structure is more sensitive indicator of auditory dysfunctions than the DP level alone (M Mauermann, Uppenkamp, van Hengel, & Kollmeier, 1999). (Manfred Mauermann, Long, & Kollmeier, 2004) suggested that the fine structure might help for the early identification of auditory dysfunctions.

The aural harmonics is distortion process that occurs with in the inner ear at moderate stimulus intensities. The aural harmonics can be determined directly in animals and indirectly in human through psychoacoustic methods. (Lawrence & Blanchard, 1954) were first to psychophysically evaluate aural harmonics to evaluate susceptibility in human and conclude that the aural harmonic test appeared to be sensitive to susceptibility difference among normal hearing individuals (Humes, 1978).

Brief tone audiometry is another psychophysical procedure which involves the measurement of auditory threshold for pure tone for varying duration. In normal ears as the tonal duration decreases greater intensity is required to maintain audibility. Brief tone audiometry is a temporal integration test where slope of the integration function 10dB/ tenfold change in duration (C B Pedersen & Elberling, 1972). Cochlear impaired ears, including those damaged from excessive noise exposure, tend to exhibit a reduced slop of temporal integration (C. Brahe Pedersen, 2009).

3.4 International and national status

Muluk&Oguzturk, (2008) reported that NIHL is more prevalent in blood groups A and AB. On contrary Doğru, Tüz, & Uygur, (2003) found that NIHL was prevalent in subjects with O blood group. Overall, results of these studies give a notion that, there could be an association between blood group and NIHL. However, there is no consensus regarding the vulnerability associated with any particular blood group for NIHL.

3.5 Importance of the proposed projectin the context of current status

Knowing the Effect of blood group on susceptibility to NIHL would help us in developing new approach of hearing conservation programs. If results of the current study is positive, blood group based hearing conservation program can be implemented in industrial setups.

4.0 Work Plan

4.1 Method

Participants.

Thirty individuals in each blood group (A, B, AB, and O) within the age range of 20-35years will be included in the current study. All 120 participants should have hearing thresholds less than 15 dB HL at octave audiometric test frequencies. All the participants should have 'A' type tympanogram and acoustic reflexes present at 500Hz, 1 kHz and 2 kHz. Participants should be free from any history of otological disease, neurological symptoms and prolonged exposure to high levels of noise.

Materials.

Two channel diagnostic audiometer will be used to estimate the hearing sensitivity of the participants. Fine structure DPOAE will be measure using Mimosa Acoustic's Hear ID DPOAE analyzer. Stimuli for aural harmonics and Brief tone audiometry will we generated using custom written softwere installed on PC. Stimuli will be delivered through creative sound blaster X-fi USB 2 external sound device and sennheiser HD 280 pro headphone.

Procedure.

Fine structure DPgram.

A computer-based Mimosa Acoustic's Hear ID DPOAE analyzer will be used to record DPOAE fine structure. DPOAEs will be recorded between the F2 frequencies of 1000Hz and 8000Hz at the resolution of 40 points per octave. Frequency ratio of F2/F1 will be 1.20 in all occasions (S A Gaskill & Brown, 1990); (Harris, Lonsbury-Martin, Stagner, Coats, & Martin, 1989). Intensities of F1 and F2 will be kept at 65/55 dB SPL. The recording frame will be rejected if it exceeds the 30 dB SPL rejection criterion or if L1 and L2 differed by more than 2 dB from the target values. These test acceptance criteria and test rejection criteria will be selected because they are consistent with the values that are employed in clinical settings (Kim, Sun, Jung, & Leonard, 1997).

DPOAE testing will be recorded with the above parameters in a single sitting. DPOAE fine structure will be analyzed for three parameters in line with suggestions given by Reuter & Hammershøi, (2006). The parameters are (i) ripple spacing (frequency difference between two minima) (ii) ripple density (level difference between a maxima and the mean of two minima of either side of maxima and (iii) ripple prevalence (number of ripples per octave) >3 dB in height per 1 octave in line with suggestions given by (Reuter & Hammershøi, 2006) Only those maxima which were 6dB above the noise floor estimate will be considered for the analysis.

Aural Harmonics.

Aural harmonics test will be performed using GSI-61 audiometer. Aural harmonics will be measured for two probe tone frequencies (PF) that are 1000Hz and 2000Hz. The tones will be generated using custom software and routed through creative sound blaster X-fi USB 2 external sound device. Probe tone will be delivered through sennheiser HD280 pro headphone. For both

probe tones initial presentation will be 70dBSL. Presence of first harmonic will be determined by presenting a test tone with the frequency of 2PF+3 Hz along with the probe tone. Both test tone and probe tone will be presented to the same ear. Perception of beat with the introduction of test tone will indicate the presence of aural harmonic. Perception of beats will be determined by adaptively varying the intensity of test tone. Lowest level at which the probe tones generate harmonics will be estimated by adjusting the intensity of probe tone at fixed step size.

Brief tone Audiometry.

Stimuli will for brief tone audiometry will be generated using custom software, which will be routed through creative sound blaster X-fi USB 2 external sound device and sennheiser HD280 pro headphone.. Threshold will be measured at 1 kHz and 2 kHz test frequencies. Duration of the test frequency will range from 20ms to 220ms with interval of 40ms. Thresholds will be measured for test tones of 2 different frequencies and 6 different durations (6X2=12 conditions). Threshold will be estimated using adaptive transformed up-down procedure with the fixed step size o

Analyses.

DPOAE fine structure will be analyzed for three parameters in line with suggestions given by Reuter & Hammershøi, (2006). The parameters are (i) ripple spacing (frequency difference between two minima) (ii) ripple density (level difference between a maxima and the mean of two minima of either side of maxima and (iii) ripple prevalence (number of ripples per octave >3 dB in height per 1 octave in line with suggestions given by (Reuter & Hammershøi, 2006) Only those maxima which were 6dB above the noise floor estimate will be considered for the analysis. The main effect of blood group on susceptibility will be assessed using one way ANOVA.

6.0 **Implications of the results of the study (Illustrative)** File enclosed

a) Presentation of scientific papers in professional seminars / publication of articles	:	The outcomes will be presented and published in national/international journals & conferences
b) Discussion with professionals	:	-
c) To utilize the results in the development of remediation	:	The outcome will help to identify the blood groups that pose susceptibility for NIHL. This will be helpful in tailor making the hearing conservation programs.

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