EFFECT OF DRUGS USED IN MDR-TB ON SPEECH PERCEPTION IN NOISE

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Abstract

Background: Tuberculosis (TB) is a chronic, progressive mycobacterium infection, often with a period of latency following initial infection. The first line and second line of TB treatment show some of the side effects on the individual. Past studies had shown that second line MDR-TB treatment causes an effect in the auditory domain, but there is a shortage of studies related to drugs used in MDR-TB on speech perception in noise.

Objectives: The study aimed to assess the speech perception in noise in individuals with and without tuberculosis.

Material and method: A total of 80 participants in the age rane of 20 to 40 years were included in the study. Further, these participants were categorized into two groups. The first group having individuals without tuberculosis while the second group included individuals with tuberculosis. All the participants were initially undergone for basic audiological evaluation followed by Quick Sin test in Kannada.

Results and discussion: The results showed that there was a significant difference between the groups on speech perception in noise test.

Conclusion: It can be concluded from the current study that individuals with tuberculosis showed poorer performance compared to individuals without tuberculosis on speech perception in noise test.

Keywords:MDR-TB, speech perception in noise, RNTCP

Introduction

Tuberculosis (TB) is a chronic, progressive mycobacterium infection, often with a period of latency following initial infection[1]. There are two types of tuberculosis, i.e. Pulmonary and Extra-pulmonary. According to global tuberculosis report 2020 by the World Health Organization (WHO), an estimated 10.0 million were affected with tuberculosis globally in the year 2019. There exist no specific population and it is reported to be affecting all the age groups. In 2019, 56% of males and 32% of females were affected by tuberculosis[2]. India is having the more incidence of tuberculosis than any other country, accounting to one-fifth (21%) of the global incidence[3]. The National TB Programme (NTP) has been started in 1962 and was Revised (RNTP) in 1992[4].
Treatment of MDR TB has various injectable drugs, and they are associated with a risk of oto-vestibular toxicity[5].

Need of study

The first line and second line of TB treatment show some of the side effects on the indivi

The first line of antituberculosis drugs usually causes peripheral neuropathy[6], while the second line causes hearing loss[7]. The past studies have shown that high-frequency hearing loss individuals majorly faces difficulty for the perception of speech in the presence of background noise. Further, most of the studies have been done on Presbycusis[8,9],noise-induced hearing loss[10]and ototoxicity [11,12] where high-frequency hearing loss is more prominent with a reduction in speech perception score in the presence of background noise. Most of the studies were done on second-line drug treatment that adverse the effect on hearing sensitivity.

There is a lack of studies on speech perception in noise in individuals having tuberculosis. Therefore, the findings of this study will help to understand whether an individual with tuberculosis exhibits similar or different speech in noise scores as compared to individuals without tuberculosis.

Objectives of the study

a. To assess the speech perception in noise among individuals without tuberculosis.
b. To assess the effect of MDR-TB on speech perception in noise among individuals with tuberculosis.

Materials and Method

Participants

A cross-sectional descriptive research design was used in the study[13]. The participants were selected based on

convenient sampling and were equally divided into two groups. The group I (individuals without tuberculosis) and group II (Individuals with tuberculosis) in the age range of 20 to 40 years with 40 participants respectively in both the groups. Further, all individuals in the group II taking second-line treatment of MDR-TB for pulmonary as well as extra-pulmonary TB with greater than 6 months of duration were considered for the study. All the Participants had hearing sensitivity within normal limits (≤ 15 dBHL) at all octave frequencies from 250 Hz to 8000 Hz [ANSI S3.1 (1991)]. All the participants had normal functioning of the middle ear as indicated by bilateral 'A' type of tympanogram with the presence of acoustic reflex (ipsilateral and contralateral) at 500 Hz and 1000 Hz. Participants with speech recognition threshold and speech identification scores proportional to hearing thresholds were selected. Participants with a history of otologic, neurologic problems, hypertension, diabetes, cardiovascular disorders and reported illness on the day of testing were excluded from the study. The research was approved from the Institutional Ethical Committee.

Test environment

Pure tone audiometry was performed in an acoustically treated room with noise levels as per ANSI S 3.1 (1999) standards. All other experiments were done in a quiet room with good illumination, ventilation, and minimum distraction.

Stimulus and procedure

Written informed consent was taken from all the participants for willingly participating in the investigation. Speech perception in noise test was measured at different SNR, starting from +8 dB to -10 dB in 3 dB steps in each successive sentence. The stimuli were presented binaurally through the calibrated headset (Sennheiser) and presented at 70 dB SPL level. The output of the headphones was calibrated using Larsen and Davis, Sound Level Meter (SLM) type 824 with 1" pressure mic Type 2575, with Larsen and Davis Artificial Ear Type No AE

Drugs dosage

All the participants diagnosed with tuberculosis (pulmonary as well as extra-pulmonary) were undergone for initial 6 months of treatment plan given by the Revised National Tuberculosis Treatment Program. MDR-TB occurs when a Mycobacterium tuberculosis strain is resistant to isoniazid and rifampin, two of the most powerful first-line drugs. All the participants from Group II had undergone second-line drug treatment. The drug included were Kanamycin/Amikacin/Capreomycin and were injected daily for 3 months. In-addition, one dose of short regimen drugs combination like Moxifloxacin, Isoniazid, Ethionamide, Pyridoxine, Ethambutol and Pyrazinamide were injected for 9 to 12 months based on weight category.

Routine audiological evaluations

The case history was taken from the participants to rule out any otological, neurological and any other medical history as mentioned in the exclusion criteria. Otoscopy was done to examine the status of the external ear canal and tympanic membrane.

Further, pure tone audiometry was done to assess the air conduction thresholds at all octave frequencies from 250 Hz to 8000 Hz and bone conduction thresholds from 250 Hz to 4000 Hz. Thresholds were established using a modified version of Hughson Westlake procedure[14] Speech recognition threshold with Kannada paired words and speech identification scores with Kannada PB words[15] in quiet was obtained for both the ears.

The conventional 226 Hz probe tone tympanometry was used to measure the static admittance, equivalent ear canal volume, and tympanometric peak pressure.Further, ipsilateral and contralateral acoustic reflex threshold at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz was measured for all the participants.

Quick speech perception in noise

A list of seven sentences (List 2) with five keywords in each was taken from the sentence list of Kannada quick speech perception in noise[16]. The sentences were mixed with eight talker babble noise at different SNR starting from +8 dB to -10 dB in 3 dB steps in each successive sentence. The task of the participant was to repeat the sentences. A score of 1 was given for every correctly identified keyword. The SNR required to identify 50% of the keywords was calculated using the Spearman-Karber equation[17], which is given below:

SNR-50=I + ½ (d) - (d) (# correct)/(w)

Where;

i = the initial presentation level dB (S/B).

d = the attenuation step size (decrement).

w = the number of keywords per decrement.

Correct = total number of correct keywords.

Statistical analyses

Statistical analyses were carried out using statistical software for the social sciences (SPSS) version 21. The normality of the collected data was tested using the Shapiro-Wilk testand descriptive statistics were carried out to obtain mean and standard deviation. Independent sample 'T' test was done to study the significant difference in quick speech perception in noise between the group

Results

The current study investigated the effect of drugs used in MDR-TB on speech perception in noise. Table 1 shows the total number of the participants and the mean age of Group I (without tuberculosis) and Group II (with tuberculosis). The data were subjected to a normality test, and the Shapiro Wilk test revealed that the speech perception in noise test fulfilled the assumptions of normality (p<0.05). Hence, for the analysis of data Independent sample 't' test was used.

Table 1: Total number of participants in each group

Group	**Total number of participants**	**Mean age (in Yrs)**
Group I (Individuals without tuberculosis)	40	28
Group II (Individuals with tuberculosis)	40	29

The signal to noise ratio (SNR) required to identify 50% of the keywords was calculated using the Spearman-Karber equation[17]. The mean and SD of SNR-50 in both groups are depicted in Table 2. It can be noted that the mean SNR-50 scores are better for Group I (Individuals without tuberculosis) compared to Group II (Individual with Tuberculosis). Independent sample T-test was done to assess the statistical significance of the SNR-50 between the groups. There was a significant difference in the scores for the individuals without TB (M= -7.585 SD=.7563) and individuals with TB (M= -2.750 SD= .9961) Conditions; t(78) = -24.449, p= .000.

Table 2: Mean and Standard Deviation (SD) in both the groups

Group	**Mean**	**SD**
Group I (Individuals without tuberculosis)	28.48	1.261
Group II (Individuals with tuberculosis)	20.63	.868

Discussion

The study aimed to assess the effect of drugs used in MDR-TB on speech perception in noise. The results of the study are discussed below:

The results of the current study showed that SNR-50 was better in individuals without tuberculosis as compared with individuals with tuberculosis.

A study done by Faust *et al.* reported higher frequencies are involved before lower frequencies and may be used as a monitoring procedure for the detection of ototoxicity and has communication deficits in patients having aminoglycoside therapy[18]. Whereas, Brummet*et al.* documented speech comprehension can also be affected with hearing loss in the 4000 Hz range and may adversely affect communication, especially in situations like environments with background noise.[19] Harris & Wu Wj. reported have noted aminoglycosides initially cause irreversible high-frequency hearing loss by destroying outer hair cells while sparing inner hair cells. This destruction gradually progresses into inner hair cells of the cochlea, and by the time this damaging effect becomes evident on a conventional pure-tone audiogram.[20,21] Similarly, Selimoglu*et al.* suggested Aminoglycoside appear to generate free radicals within the inner ear with subsequent permanent damage to sensory cells and neurons, resulting in permanent hearing loss [22]. A recent study done by Zadeh*et al.* reported that extended high-frequency (EHF) hearing, beyond the currently tested range of

clinical audiometry, contributes to speech perception in noise. Sound energy above 8 kHz thus contributes to speech perception in noise. The data suggest that EHF hearing is a long-sought missing link between audiometry and speech perception and maybe a sensitive predictor ofhigh-frequency hearing loss much earlier in life when preventive measures can be effectively deployed[23]. Based on various above studies we hypothesize that, as all of the study reported adverse effects of MDR-TB drugs on auditory system and routine audiometry only tests hearing threshold upto 8kHz, therefore, beyond this frequency hearing threshold information miss out which is important for speech perception in noise. This effect would have reflected poorer Speech perception scores among individuals with tuberculosis with normal audiometric configuration.

Summary and Conclusion

MDR-TB occurs when a Mycobacterium tuberculosis strain is resistant to isoniazid and rifampin, two of the most powerful first-line drugs. In MDR TB, healthcare providers use a combination of second-line drugs, and that might induce many side effects. The present study was conducted to assess the speech perception scores among individuals with MDR-TB and without TB. The results of the current study suggest better speech perception in noise performance among individuals without TB as compared to individuals with TB. To conclude, MDR-TB drugs likely to affect the auditory system performance on the task such as speech perception in the presence of background noise before radiometrically evident hearing loss at higher frequencies. Monitoring audiological evaluations after the baseline evaluations have been recommended with speech perception in noise test among MDR-TB individuals. For audiological monitoring of ototoxicity other approaches such as high frequency audiometry and otoacoustic emissions were also included in the test battery approach.

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Conflicts of interest: There are no conflicts of interest.

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