Original Article

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Protective Effect of Oral N-acetyl Cysteine in Noise-induced Hearing Loss in Factory Workers

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Abstract

Introduction: Noise-induced hearing loss (NIHL) is an important etiological factor for deafness. Occupational exposure to loud sounds has been brought under control through various new factory and labor laws and use of protective devices during work. Still, the incidence of hearing loss in factory workers is on rise.

Purpose: The purpose of this study was to evaluate the protective effects of oral N-acetyl cysteine (NAC) in NIHL in factory workers.

Materials and Methods: In this study, 60 workers of local factory working with heavy machinery and ambient noise 85-90 dB were selected. All workers were healthy males between the age of 25-35 years with no pre-existing ear pathology.

Results: Temporary threshold shift mainly in the three frequencies 2, 3, and 4 kHz. Hearing threshold was normal at 8 kHz which indicated that it's not age related. Temporary threshold shift was similar in both right and left ears. Maximum threshold shift was observed at 4 kHz.

Conclusion: NAC use decreased the temporary threshold shifts in workers exposed to loud sounds.

Key words: Hearing loss, N-acetyl cysteine, Oxidative damage

INTRODUCTION

In modern times, noise-induced hearing loss (NIHL) has been seen in two settings. First, the occupational exposure as in factory workers or traffic police officers, and second, the recreational exposure as in young population listening to loud music through headphones or people going to nightclubs.[1] Research has shown that noise-induced cochlear damage is a result of oxidative stress in the inner ear. Approximately 5% of the population worldwide suffers from industrial, military, or recreational NIHL at a great economic cost and detriment to the quality of life of the affected individuals.[2] A variety of antioxidants and other chemicals have been used to reduce this oxidative damage and limit the hearing loss. Previous animal studies showed protective effects of antioxidant medicines against NIHL.[3] It is unclear whether antioxidants would protect humans from NIHL. This study evaluates the protective effects of N-acetyl cysteine (NAC) in NIHL.

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MATERIALS AND METHODS

In this study, 60 workers of local factory working with heavy machinery and ambient noise 85-90 dB were selected. All workers were healthy males between the age of 25-35 years with no pre-existing ear pathology.

The workers were divided into two groups randomly:
Group A: Received a placebo
Group B: Received NAC 1200 mg/day for 15 days.

Both groups were subjected to a base pure-tone audiometry at the beginning of the 8 h shift duties and the again at the end of the duty and there hence after 15 days and 1-month interval.

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The pure-tone audiometry results pre- and post-exposure were compared between the two groups.

Statistical Significance

Paired *t*-test was used to analyze the results for statistical significance.[4]

RESULTS

The pre-shift average hearing threshold in either of the groups was as follows (Table 1).

Serial audiograms were done:
1. Post-shift duty
2. 15th day
3. 1 month.

In all patients in both the groups, post-noise exposure audiograms showed (Figure 1):
1. Temporary threshold shift mainly in the three frequencies 2 kHz, 3 kHz, and 4 kHz
2. Hearing threshold was normal at 8 kHz which indicated that it is not age related
3. Temporary threshold shift was similar in both right and left ears
4. Maximum threshold shift was observed at 4 kHz.

Table 2 shows average hearing threshold at 4 kHz immediately after 8 h factory shift.

Table 3 shows the results of paired *t*-test was used to analyze the results for statistical significance.

Confidence Interval

The mean of Group A (Control)−Group B (NAC)=7.67.

95% confidence interval of this difference: From 6.22 to 9.12.

Intermediate Values Used in Calculations

t=10.8216
df=29
Standard error of difference=0.708.

P Value and Statistical Significance

The 2-tailed $P < 0.0001$ by conventional criteria, this difference in threshold shift between the two groups is statistically significant.

DISCUSSION

Development of NIHL can be divided into two distinct phases:[5]

Table 1: Pre-shift baseline pure tone average thresholds

Group	2000 Hz	3000 Hz	4000 Hz
A	−5 to 0 db	0 to 5 db	0 to 5 db
B	−5 to 0 db	0 to 5 db	0 to 5 db

Table 2: Average hearing threshold at 4 kHz immediately after 8 h factory shift were as follows

Number	Auditory threshold at 4 kHz post duty	
	Group A (control) (dB)	Group B (NAC) (dB)
1	40	30
2	40	30
3	35	25
4	40	30
5	35	30
6	30	25
7	40	35
8	40	35
9	40	30
10	35	30
11	35	30
12	35	30
13	40	30
14	40	20
15	30	25
16	40	35
17	40	35
18	40	35
19	40	35
20	35	30
21	35	30
22	40	35
23	40	30
24	40	30
25	30	25
26	40	35
27	40	25
28	40	30
29	35	30
30	40	25

NAC: N-acetyl cysteine

Table 3: Paired *t*-test was used to analyze the results for statistical significance

Group	Group A (control)	Group B (NAC)
Sample size	30	30
Mean auditory threshold at 4 kHz	37.67	30.00
SD	3.41	3.94
SEM	0.62	0.72

SD: Standard deviation, SEM: Standard error mean, NAC: N-acetyl cysteine

The first phase: Temporary threshold shift which is some degree of hearing loss see after exposure to loud noise which is completely withdrawn after a period of the rest. Standard threshold shift is described as an average change in hearing from the baseline of 15 dB or more at any frequency 500 through 6 kHz. Recovery time in temporary

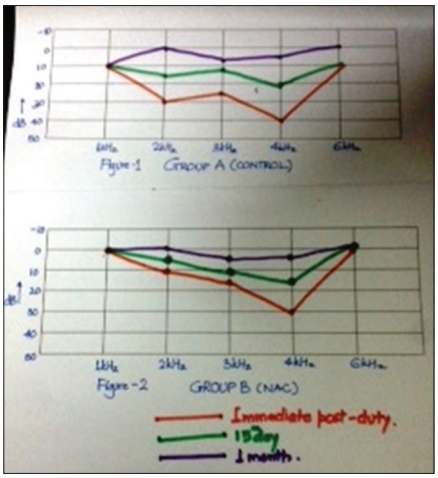

Figure 1: Temporary threshold shifts (TTS) at 2 kHz, 3 kHz & 4 kHz in control group & NAC group

threshold shift ranges from 48 h to few days depending on the intensity of sound and period of exposure.

Second phase: Permanent threshold shift: Frequent exposure to noise capable of inducing temporary threshold shift after a prolonged period produces permanent threshold shift which does not revert to a normal threshold. The cellular mechanism in the noise-induced cochlear damage involves generation of reactive oxygen species. Thus, the use of agents such as NAC has shown to produce statistically significant reduction temporary threshold shift.

Less the temporary threshold shift produced, lesser are the chances of temporary threshold shift becoming into permanent threshold shift.

CONCLUSION

Use of NAC in factory workers exposed to loud sound (>85-90 dB) has shown a significant decrease in temporary threshold shifts which has an overall protective effect in the long run.

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