Immune Responses (CD4 and CD8) to Acute Vibration Stress

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Summary: The aim of the experiments was to observe whether or not there is an immune system reaction to vibration stress. Three vibration frequencies were randomly given to 6 male volunteers. The 63 Hz vibration frequency produced a significant decrease in the ratio of CD4 T-cell to CD8 T-cell. This finding suggests that acute vibration stress suppresses the immune system activity in humans body.

Key words vibration stress, immune response, CD4, CD8

INTRODUCTION

Vibration effects on the human body vary according to the modes of vibration, whole-body vibration and hand-arm vibration. Concerning the immune system reaction to vibration stress, there are a few papers which have shown suppression or augmentation related to the characteristics of the vibration such as vibration frequency, acceleration, and the duration of use [1-3]. In this study, we observed the immune responses to acute vibration stress by measuring CD4 T-cell and CD8 T-cell in serum.

PATIENTS AND METHODS

Six male student volunteers were the experimental subjects. Mean age was 21 years (range 20-21). The subjects were requested to abstain from smoking on the experimental day. The subject were seated in a chair in a soundproof room with a temperature of 22°C. After an initial period or 30 min to adapt the subject to the environment, vibrations with a frequency of 31.5, 63 and 125 Hz were randomly given through the right hand for 3 min. The vibration acceleration was 2.5 m/s² in all experiments. Venous blood

Fig. 1. Comparison of CD4 and CD8 before and after vibration. White and shaded bars show pre- and post-vibration value, respectively. The values shown are mean ± standard errors.

*p<0.1   **p<0.05

Received for publication April 23, 2002
samples for immunological analyses were taken from each subject before and after the experiment. The serum samples separated by a centrifuge were kept in a refrigerator till the immunological analyses of CD4 T-cell and CD8 T-cell. All experiments were performed at 10:00 to 15:00. Analysis of variance was used for statistical analysis.

RESULTS

Figure 1 shows the changes of CD4 T-cell and CD8 T-cell values at each vibration frequency. The values of CD4 decreased significantly from 45.7±3.4 (mean±standard errors)% to 41.4±3.3% at the vibration frequency of 63 Hz (p<0.05). The values of CD8 increased from 29.3±2.9% to 32.1±3.8% at the same frequency (p<0.1). There were no statistically significant changes at the other frequencies. The CD4 values post-vibration showed the largest drop at 63 Hz, at 31.5 Hz the drop was smaller and at 125 Hz there was no change (Fig. 2). By contrast, the CD8 values increased at 125 Hz. At 31.5 Hz and 63 Hz there was a small decrease.

The ratio of CD4 to CD8 decreased at 63 Hz, and 31.5 Hz as shown in Fig. 3 (p<0.1). At 125 Hz, the ratio increased.

DISCUSSION

In the present study, we used vibration frequencies of 31.5 Hz, 63 Hz and 125 Hz with a constant vibration acceleration of 2.5 m/s². The reason for this choice of frequencies was that 125 Hz is the frequency of most occupational vibrating tools such as grinders and chipping hammers. In this study, an immunological suppression was observed at 63 Hz, although the values of CD4 and CD8 were still within the normal range.

The ratio of CD4 to CD8 is regarded as an index of the immune system activity, because the CD4 T-cell is involved in the body production of B cell, while the CD8 T-cell is involved in the suppression immunological reaction [4]. In our results, the ratio of CD4/CD8 was significantly suppressed by vibration stress at 63 Hz. A report states that a long-term
mental stress produces a decrease in CD4/CD8, whereas a short-term stress increases the ratio [1].

The discrepancy of these results may result from the difference of subjects and stress: skilled workers and volunteer students, mental and physiological stress. Treadmill stress produced a decrease in the ratio of CD4 to CD8 [5]. Transient mental stress produced also a decrease in the ratio of CD4 to CD8, and an increase in lymphocyte and neutrophil counts in blood [6]. Patients with vibration disease showed low leucocytes counts and low complement values, as well as hypergammaglobulinemia [1]. An increase in immunoglobulin A by a long-term use of chainsaws has been reported [2]. Another study showed that CD4 and CD8 lymphocytes increased in patients with vibroacoustic disease as compared to controls [3]. The differences may be due to exposure time and individual susceptibility. In conclusion, the immune responses to acute vibration stress may be suppressive generally, but with variations related to vibration frequency and duration of exposure.

REFERENCES