

Effects of Music on Recovering Process of Immune System

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Abstract: Previous studies suggest that relaxing music alleviates subjective anxiety, depression, and bodily pain. On the other hand, while those effects obtained from psychological studies, mainly using subjective questionnaires, are seemed to be well consistent literally and empirically, the effects of music on the physiological indices, that is assumed to be objective, are still less consistent. In this study, we focused on one of the major immune substance, named immunoglobulin A (IgA), and investigated the modulation of IgA induced by stressful task and following relaxing music. Participant were asked to conduct a simple calculation task and, after that, they were exposed to relaxing music, noise, or silence in the dark room. As a result, we observed an increase of SIgA right after the calculation task and decrease of SIgA after auditory stimuli. Notably, the amount of decrease in the case of relaxing music was significantly greater than other cases. We suggest the possibility of physiological effect of music on the recovering process after a short-term stress, and it is necessary to investigate the effects of music focusing on the aspect of its context dependent nature.

Key words: *Psychoneuroimmunology, Immunoglobulin A, stress, music, Kansei*

1. Introduction

Effects of music on human have been broadly and frequently studied, and various kinds of somatic and mental effects of music were reported. Especially, previous psychological studies, which mainly use subjective questionnaires such as the State-Trait Anxiety Inventory, suggest that the relaxing music alleviates subjective anxiety, depression, and bodily pain. Many attempts have also been made for testing, evaluating and/or inducing physiological effects of music across the field of behavioral science to neuro-physiological science. Most of those studies introduces the autonomic nervous system related indices, such as blood pressure, heart rates, respiratory rate, and so on, and reported some kind of sedative effects of music in the clinical population[1].

On the other hand, recently, with developing of analysis technique of chemical substances within human body, such as enzyme-liked immunosorbent assay (ELISA), several attempts introducing such substances has been made to evaluate some sort of internal effects or modulation induced by music. Those substances were frequently introduced for the studies of mental stress. The mechanism brought forth an internal change against mental stresses is frequently described by the activation of the sympathetic-adrenal medullary system. But there is still huge distance to explicate how mental stresses or relaxing factors bring forth the external (visible) change, like as autonomic nervous system related indices, and the internal change like as endocrine and immune system related indices. In this study, we attempted to evaluate the physiological effects of music and stressful task on human by using one of major immune substance named immunoglobulin A.

2. Method

2.1 Secretory Immunoglobulin A (sIgA)

A glycoprotein called immunoglobulin A (IgA) is one of the most important substance for human immune system, which exists within serum and other various secretory fluids, such as saliva, breast milk, and nasal, gastrointestinal, bronchial, and urogenital secretions[2]. IgA in those secretory fluid (sIgA) are normally in the dimeric form combined with other glycoprotein named J chain and secretory component (SC) which stabilized the sIgA molecular and protect it from degradation in those fluid[2]. SIgA antibodies work nonspecifically and, therefore, play the very important role for our health, for example, for preventing bacteria from forming colonies, neutralizing toxins and enzymes produced by bacteria, inhibiting pathogenic viruses to penetrate into epithelial cell. It is thus though that salivary IgA works as the first line of defense from an influenza or other upper respiratory tract infectious illnesses. Actually, clinical studies suggest the relation between relatively high levels of sIgA and a lower incidence of acute upper respiratory tract illnesses (See review of Jemmott et al. 1998[3]).

On the other hand, in the 70's behavioral-immune studies, which is now called psychoneuroimmunology[4], it was found that salivary IgA changes its level accompanying with various types of psychosocial factors, such as desirable or undesirable daily events, daily hassles, negative or positive mood, academic stress such as an examination or presentation, and a short term stress or relaxation. Tsujita S. et al.(1999) reviewed number of such studies focusing the effects of academic stresses on salivary IgA[5], and found that there are distinguishable two types of stress effect on IgA; 1) increasing sIgA secretion immediately after stress named "immediate stress effect", and 2) decreasing sIgA secretion several days after stress named "delayed stress effect" [2]. Because the delayed stress effects could be easily masked by the immediate stress effect, he concluded that sIgA can be a useful stress maker for a short-term stress. There are also studies focusing the effects of various relaxing factors on sIgA, and those studies reported the increasing of sIgA level. However, because few attempts have been made to investigate the effects of such relaxing factors with/under stressful situation[6], the relationship of such increasing of sIgA level with the immediate stress effect is not clear.

We, then, assessed mental calculation task as a short-term stress and, after that, music as a relaxing factor, to investigate the effects of music on sIgA.

2.2 Our experiment

Subjects (six healthy male student, ages ranged from 25-33 years old) required conducting 30 min. of a mental calculation task and, after that, they were exposed to music or noise, or just left in silence for 7 min. in a dark and soundproof room. The mental calculation task is a series of simple and boring addition calculation task. The music piece we used is characterized as slow tempo, instrumental and not too mach inflection. The noise is so-called sandstorm (noise burst). Saliva samples were taken by cotton before and after the mental calculation task, and after music, noise, or silence. Each subject underwent 3 types of experiment of calculation-music, calculation-noise and calculation-silence. SIgA concentration was measured by enzyme immunoassay (EIA s-IgA test kit, Medical & Biological Laboratories co., ltd.).

3. Results and Discussion

As Fig.1 shows, sIgA concentration was significantly increased after the mental calculation task (error bar

represents standard error of the mean for each condition, mean and SD of “before” is 97.21 and 86.31, that of “after” is 233.77 and 121.77, $p < .001$ by t-test). On the other hand, after the calculation task, sIgA concentration decreased regardless of music, noise or silence condition in most case (15 case out of 18). However, as Fig.2 shows, the amount of sIgA decrease after music was significantly greater than other two conditions (error bar represents standard error of the mean amount of decrease, $p < .05$ by t-test). Moreover, in the music condition, sIgA decreased nearly to the base line only for 7 min. Increase of sIgA by the mental calculation task is quite consistent with other similar experiment and it can be the same effect with “immediate stress effect” described above. However, characteristic modulation of sIgA concentration by music, which is of “after the stressful task” or , in other words, “recovering process”, obtained by our experiment seemed to be unique.

The effects of music on human mind and body have been studied using psychological and physiological indices. However, while those effects obtained from psychological studies, mainly using subjective questionnaires, seems to be well consistent literally and empirically, the effects of music on the physiological indices, that is assumed to be objective, are less consistent[1]. Such studies using sIgA are less consistent either, while the number of study is rather small. However, as described above, few studies assessed the effects of music with/under stressful situation but introduced a music peace just as a single auditory stimulus. Music might make someone much more relax when he/she is under stressful situations, but the same music might irritate someone when he /she does some task and the music breaks his/her concentration. In fact, one study reported that the stress-induced increase of SIgA was prevented when subjects were exposed to relaxing music, while the increase of SIgA was observed when the subject were exposed to the same music without stressful task[1]. Therefore, for investigating the effect of music on the physiological indices, it can be necessary to pay attention to the context, i.e. situations that the subjects were involved, experiences that the subjects have experienced before treatment, and so on.

4. Conclusions

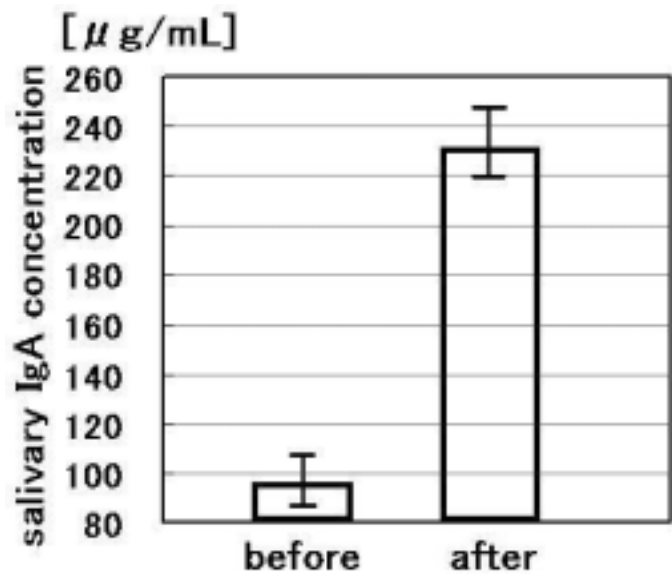


Fig.1. SIgA concentration before and after the mental calculation task.

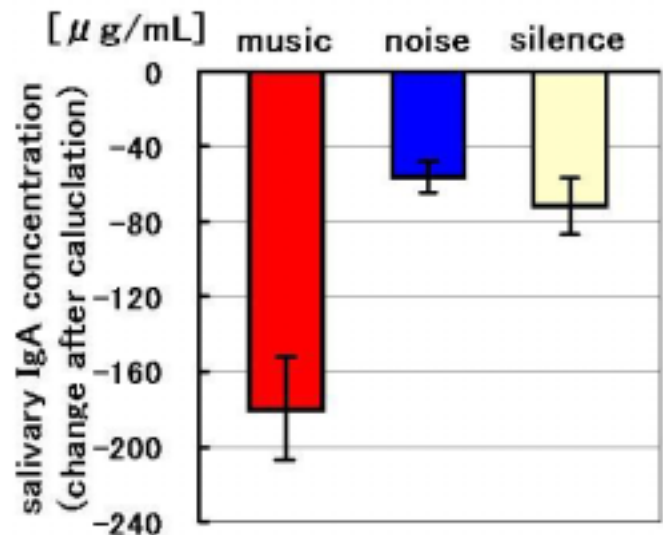


Fig.2. Change of SIgA concentration during 7min of “music”, “noise” and “silence”.

We have to admit there must be uncountable potential mediator, e.g., personality[7], and methodological varieties. But it still could be supposed that our result suggests the possibility of physiological effect of music on the recovering process after a short-term stress, and that is necessary to investigate focusing on the aspect of its context dependent nature.

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