Title	Adaptation in acclimatable state (exercise and low-oxygen environment)
Sub Title	
Author	浅野, 均一(Asano, Kinichi) 辰沼, 広吉(Tatsunuma, Hirokichi) 森下, 孝(Morishita, Takashi) 木村, 正一(Kimura, Shoichi)
Publisher	慶應義塾大学体育研究所
Publication year	1968
Jtitle	体育研究所紀要 (Bulletin of the institute of physical education, Keio university). Vol.8, No.1 (1968. 12) ,p.105- 108
JaLC DOI	
Abstract	
Notes	Abstract
Genre	
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=AN00135710-00080001-0105

Adaptation in Acclimatable State

(Exercise and Low-Oxygen Environment)

*By Kinichi Asano**

*Hirokichi Tatsunuma***

*Takashi Morishita****

*Syoichi Kimura****

Introduction

When the facts that the training effect in various sports is memorized relatively long, and that repeated experience in the low-oxygen environments is easy to restore for acclimation are discussed, what is called memory of training must be evidenced.

In case where living bodies are loaded with an exercise accompanied by oxygen consumption, or subjected to the reduction of partial oxygen pressure, there is found no marked difference in the function of adaptation between the living bodies acclimatized to such a load and those not acclimatized, as long as they are in the static state. However, they differ in the attitude of reaction when they are subjected to a certain stimulation. As a method to know this difference, we have searched for the meaning of rises and falls of T-wave traced in the electrocardiogram, and deduced the correlation between such phenomena and the central nerve. Furthermore, the study has been extended to know the difference between acclimated and non-acclimated living bodies in the burden of the central nerve through the application of light-stimulation to them and computation of values for evoked potential induced in various reaction attitudes.

Method

The electrocardiogram was obtained through Nehb conduction. In the laboratory,

* Director and Professor of the Institute of Physical Education, Keio University.

** Professor of the Institute of Physical Education, Keio University.

*** Full-time Lecturer of the Institute of Physical Education, Keio University.

existing electrocardiograph or DC amplifier was used to amplify the T-waves, which were counted by means of a computer. In the outdoor experiment, magnetic tape was used for recording, and the recorded values were later developed and counted. As to evoked potential, it was obtained from occipital area and ear-lobe, amplified by DC amplifier, and computed 30 times by computation device.

In the case of field experiment, it was recorded in separate magnetic tape, and computed through the computation device. Light-stimulation was applied every second.

Results

As an exercise stimulation, a bicycle load (20 km/min.) was applied. Fifteen persons were selected to be subjected to the experiment, including students in general, athletics and volley-ball players, from whom induced potential and electrocardiogram T-wave were measured through light-stimulation befor exercise, immediately after the commencement of the exercise and immediately after the commencement of goal.

As far as the evoked potential (secondary wave) is concerned, the sports group showed lower amount of variation immediately after the commencement of exercise and immediately after the commencement of goal, than in the static state, when compared with the student-in-general group.

This also applies to the variation in T-wave in the electrocardiogram. Field athletes and volley-ball players that have experienced, training, show a smaller variation than the student in general.

The electrocardiogram T-wave usually declines under the low-oxygen environments. Furthermore, personal difference in the reduction of T-wave immediately after the commencement of exercise and time required for such reduction was noted in the exercise load test. This change, however, is smaller with the acclimatized group than with non-acclimatized group.

Also, mice were repeatedly subjected to low-oxygen state for acclimation, and applied with light-stimulation, whereby evoked potential were obtained. This experiment shows that the acclimatized group is more stable than non-acclimatized group.

Discussion and Conclusions

The electrocardiogram obtained when an exercise load stimulation was applied to living bodies showed such T-wave that starts to decline immediately after the commencement of exercise, and rises in about 3 minutes.

From average values obtained, it was noted that the variation with the sprinter was marked immediately after the commencement of exercise, while that with distance runner was not remarkable. As to the time required for T-wave to reach the minimum value, it was shorter with some sprinters than with some distance runners.

No correlation was observed among minimum T-wave value, time for T-wave to reach the minimum value, normal pulse frequency, H. S. T. score, QTc variation, etc.

It was noted, though slightly, that the breath hold exercise in the static state prolonged the T-wave variation in the order of long-distance runner, short-distance runner and field athletic.

A marked correlation, however, was obtained between the cardiopulmonary quotient and minimum T-wave value. Persons with smaller cardiopulmonary quotient develope many variations due to exercise stimulation, depending on internal environments, which may be interpreted as one of the reactions of the vagus nerve from the fact that the T-wave reached its minimum value 20 seconds or so after the commencement of exercise. Also, with such persons, rise in right ventricle pressure and pulmonary trunk pressure is higher than others.

We have loaded the same testing groups continuously with training, to find that T-wave immediately after the commencement of exercise shows a tendency to increase in value from the 20th day. This is noted as one of the variations in the living body that has been acclimatized to the training.

The electrocardiogram T-wave under the reduced oxygen environments declines, and makes smaller change with acclimatized living body than with non-acclimatized living body.

Also, field athletics and volley-ball players that have experienced training show a smaller variation in T-wave than the students in general. From these facts, it is noted that T-wave in the electrocardiogram starts to reduce simultaneously with the commencement of exercise and that minimum T-wave value and the time for T-wave to reach its minimum value have different characteristics between the acclimatized and non-acclimatized living bodies. This justifies the need to think of the central control relative to the adjustment of living body's internal environments.

In other words, besides the questions as to whether T-wave shows a positive potential wave, or it represents any mechanical change in the cardiac ventricle, the said phenomena must have something to do with the effects of the cerebral cortex. One effect may be a stimulation acting in a fixed form upon the bulbar center of the vagus nerve, and the other may be a stimulation (atropin) acting mainly on the terminal device of the heart.

Under the low-oxygen environments, kalium in blood plasma decreases in concentration, which should essentially result in St decline and flat T-wave. And that should make a difference between acclimatized and non-acclimatized bodies. Experimentally, these variations take place due to stimulation by hypothalamus, mid-brain reticularis and cerebral callosum. Therefore, an experiment was carried out for the difference in induced reaction to light-stimulation under the same conditions. As a result, the field athletic and volley-ball player groups showed a small variation, both immediately after the commencement of exercise and commencement of goal. An experiment using mice under low-oxygen environments shows that the acclimatized group is more stable than the non-acclimated.

Generally, the variation of evoked potential in the visual area is closely related to the trend of hippocampus electroencephalogram. Although the electroencephalogram from cortex seems to show the trend of uniform chain waves, it is actually influenced by the fluctuation of the activation system, which reflects on the variation of the evoked potential. Furthermore, in case the evoked potential varies due to "habituation" acquired, the activation effect of the electroencephalogram is reduced, which should explain the fact that the control of the brain-stem reticular formation existing in the central brain may be what the "habituation" originates. Also, the rapid functional decline that takes place under the low-oxygen environments, due to reduced oxygen and glucose concentrations in blood, may be attributed to the disturbed permeability and flux of kalium.