Physiological Changes Associated with Neiyang Qigong

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Qigong is a method adopted by many people for their health maintenance and therapy at present. But up to this day, there is still no detailed conclusion as to the physiological state of Qigong or how to define it. This study tries to explore and provide a definition for Qigong state. The subject applied Neiyang Gong to enter Qigong state. We used a multifunctional physiological recorder to record the difference of various physiological parameters before and after entering Qigong state. The results showed that when the subject entered Qigong, the alpha brain wave at the left forehead of the cerebrum was concentrated. Temperature of the left palm rose extensively. There were large fluctuations in the electromyogram (EMG) base line of the left hand dorsum. Finger pulse amplitude (FPA) pulse appeared very frequent and the amplitude increased. Skin conductance level (SCL), increased evidently. These physiological parameter variations showed that the subject is under a certain emotional state. Also, exploration of the three characteristics of Qigong showed that Qigong should be a kind of emotional state: we can see that there were several kinds of reactionary methods in the behavioral reactions of Qigong, some people can enter Qigong state in an instant, and after having learnt certain methods and having entered Qigong state, it becomes easier to enter Qigong emotional state continuingly. By understanding the mechanical system of Qigong, we are able to develop a Qigong method that is more effective to physical health maintenance.

Key words —— Qigong, emotion, electroencephalogram, electromyorgram, skin conductance level, relaxation

INTRODUCTION

Qigong relaxation exercise is one of the traditional healthcare self-management techniques for preventing and curing disease, protecting and strengthening health and improving human potentiality.[1)] It is estimated that about 1 billion people practice Qigong in the world.[2)] Currently, there are thousands of forms of qigong including Qi-training, Meditation, Tai Chi, Yoga, Transcendental Meditation (TM) *et al*.[3–5)] However, the basics of the breathing techniques are easy to learn and only vary slightly according to the different forms of Qigong.

Lim *et al*.[6)] have outlined a way to the practice of Qigong. In brief, it is a rhythmic respiration with a slow inhaling and exhaling of air through a control of the mind, diaphragm, nasal passage, tongue, mouth and lung in certain body postures so that Qi flows in a certain direction controlled by the mind. There are three basic principles in the practice of Qigong: breathing methods, adjustment of posture (sitting, lying, standing and walking) and control of the will. Yu[7)] also reported that there are two focal concerns to the practice of Qigong: perseverance and concentration. It is recommended that the techniques are practiced daily, and during any practice sessions, it is important to focus one's attention intensely on the Qi itself and the flow of Qi. After a period of time, Qi can be felt or detected as a form of warmth or heat and can be directed to any part of one's body. But why after practicing is a person able to enter Qigong state, and what is Qigong state? While up to this day there is still no detailed conclusion as to the physiological state of Qigong, this study will try to define the Qigong state.

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MATERIALS AND METHODS

Subjects —— The study was performed on fifty-six healthy volunteers, including 20 males and 36 females aged between 18 and 24 years old. Normally, our volunteers practice Neiyang Gong. Neiyang Gong is a kind of Qigong method that enables a person to enter Qigong state easily.[8] In other words, it is a breathing method using stomach breathing, with eyes closed, keeping one's concentration at the hypogastrium, then counting silently while breathing from 1 to 10, and repeat the whole process again. On the day of the test, the volunteers were not allowed to have any alcoholic or caffeinated beverages. Every subject was restricted from food intake at least one hour before the experiment, and routinely requested to take one hour's rest before the test. All examinations were carried out in a quiet, draught-free laboratory, controlled for temperature (24°C ± 1°C), in the morning at about the same time of day. Each subject was first asked to sit down, then subject started practicing Neiyang Gong until he or she felt that his or her whole body was at the Qigong state. The subject could feel heat rising from the hypogastrium and there was propagated sensation along meridians (PSM), feeling tingling heat or that tingling heat feeling was circulating all over the body. PSM is an obvious characteristic of meridian research. PSM can be produced by needle puncturing,[9] Qigong[10] or patting on the skin surface.[11] The phenomenon of PSM is the feeling of liquid, heat or numbness flowing in a certain path on the skin.

Physiological Recordings —— Physiological recordings were made using Chart 3.3.5 on a computer linked to a multi-channel digital data recorder (PowerLab/8S ML780, AD Instruments Inc., Milford, MA, U.S.A.).[12,13] The following parameters were measured: electroencephalogram (EEG), finger pulse amplitude (FPA), electrocardiograph (ECG) integrated through a cardio-tachometer to achieve a mean heart rate (HR, beats per minute), skin conductance level (SCL), electromyogram (EMG) from the dorsum of right hand, and skin temperature from the dorsum of right hand. Skin temperature was measured with a type-T thermocouple thermometer (BAT-10, Physitemp Inc., New Jersey, U.S.A.) that could detect differences in temperature with a resolution and accuracy of 0.05°C. In each experiment, probes were placed in the dorsum of the right hand. FPA was measured by using a piezoelectric element to convert force applied to the active surface of the transducer into an electrical signal. The transducer (The Maclab Transducer 1010) was connected directly to the british naval connector (BNC) input of the PowerLab. In order for it to produce a signal, a change in force must be applied to the active surface of the transducer. Expansion and contraction of the second finger circumference due to changes in blood pressure could be detected by the transducer. SCL was measured by two Med Associate 10-mm Ag/AgCl cup electrodes connected to the fingertips of the first and third fingers of the right hand. The 10-mm diameter of the electrode represented electrode paste (ECI Electro-Gel) contact. An electrode placed on the left leg process was used as an earth reference. EMG was measured from the dorsum of right hand using two miniature Gereonics Ag/AgCl electrodes placed on the right palm and dorsum of right palm. EMG was collected for each scoring period of the baseline. EEG in the right frontal lobe of cerebrum site signal was amplified using Grass P511 amplifiers (half-amplitude set at 0.3 Hz and 10 kHz), and digitized (usually at 100 Hz). The raw EEG signal was displayed on one EEG channel. Power spectra for the raw EEG signal were generated by the PowerLab software. The output of EMG, SCL and ECG was 12-bit A/D converted and recorded with a 4/86 computing systems technology (CST) computer at a sampling rate of 50 Hz.

Statistical Analysis —— In all physiological parameter statistics, the data after the subject had closed his or her eyes and 2 min before entering Qigong state serves as the control group and the data 2 min after entering Qigong state as the experimental value. Statistical comparison is conducted from average value of the control values and experimental values of each subject. Data are presented as the average ± S.D. and were analyzed by using analyses of Student's *t*-test.

RESULTS

We applied Neiyang Gong to practice Qigong. Once the subject went into the Qigong state, Fig. 1 & Table 1 showed that the temperature of dorsum of right palm rose extensively at the same time when the alpha brain wave in right frontal lobe of cerebrum site concentrated (Fig. 2 & Table 1). The measurements of the power spectrum of subjects showed a significant increase in mean relative power of alpha wave during the qigong state as compared to the control stage. Therefore, we could now confirm that the subject was in the Qigong state. The skin

temperature increased slowly when subject began to practice Neiyang Gong and increased quickly when subject entered Qigong state. This phenomenon was displayed in every subject. The slow increase of skin temperature seemed to be a must for entering Qigong state. In other physiological parameter tests, the baseline of the EMG of the hand was very stable at first, but once the subject went into Qigong state, there was big fluctuation at the baseline. The amplitude of Qigong state was significantly increased 7.1 ± 2.8 mV than of the control (2.2 ± 0.9 mV).This kind of phenomenon was very obvious and was accompanied by tingling heat feeling (Fig. 3 & Table 1). The change of FPA could be seen in the subject who was in Qigong State. Pulse appeared very frequent and the amplitude increased (Fig. 4 & Table 1). There was an obvious change in SCL. Once the subject entered Qigong state, SCL increased (Fig. 5 & Table 1). With regards to HR, this research showed that once the subject entered Qigong state, there was no distinctive difference (Fig. 6 & Table 1).

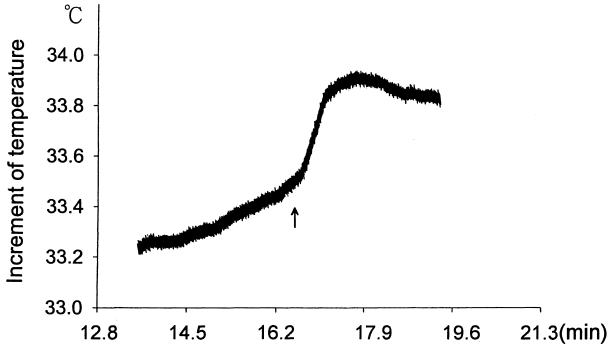


Fig. 1. Effects of Qigong State on the Change of Dorsum of Skin Temperature at Right Palmd

When the subjects entered the qigong state (indicated by arrow), the skin temperature of palm was increased. A representative curve of fifty-one experiments is shown.

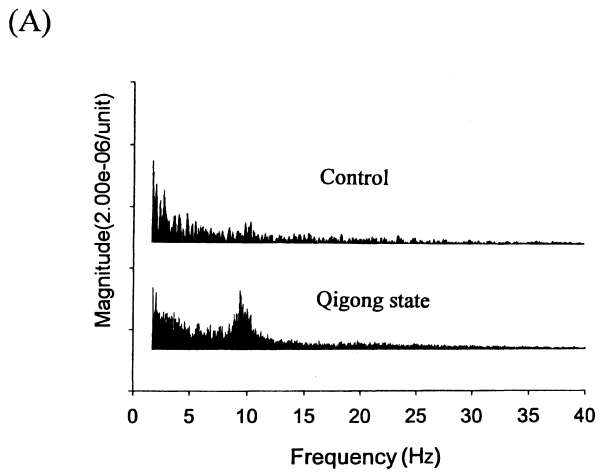
DISCUSSION

The EEG alpha activity occurs predominantly in the anterior half, forehead and occurred silently in the posterior half of the brain during Qigong state.[14–18] Our result shows that once the subject enters Qigong state, aside from the appearance of EEG pattern and temperature rise which are often seen in Qigong,[19] there is also an obvious change in EMG, SCL, and FPA. And these physiological parameter variations show that the subject is in a certain emotional state, because when there is ordinary emotion coming about, there will also be similar physiological parameter variations.[20–23] If the person is anxious, there are changes in EMG and SCL.[24] If the person is happy, there are also changes in EMG and FPA.[25] Therefore, we think that Qigong is a kind of emotional state. Aside from the evidence of physiological parameter variation, we can also see the behavioral reaction method of Qigong in the physical behavioral expression, just like the same emotion with different methods of reaction.[26–28] When someone is very happy, his physiological reaction is laughing. Some people open their mouth, some laugh loudly, some smile with lips close, and some will laugh until the whole body rocks beyond control. For example, when someone is sad, his physiological reaction is to cry. Some people have tears falling down, while some will cry with wide-open mouths. There is a big difference amongst people, they react differently to the same happy event. Even on the same person, sometimes he/she reacts differently at different time. The same situation can also happen

Table 1. The Physiological Parameter for Control and Qigong State

Physiological Parameters	Control	Qigong State
Electroencephalogram	17.9 ± 5.3%	31.7 ± 14.5%[a)]
Skin temperature	33.23 ± 0.17°C	33.92 ± 0.29°C[a)]
Electromyogram	7.9 ± 5.3	126.7 ± 31.5[a)]
Skin conductance level	13.5 ± 5.2 μS	31.2 ± 11.7 μS[a)]
Finger pulse amplitude	31.4 ± 7.5 pulse/min	64.5 ± 14.8 pulse/min[a)]
Heart rate	73.8 ± 8.1 beat/min	70.6 ± 11.2 beat/min

Electroencephalogram data are calculated from the mean relative power of alpha wave. Electromyogram data are presented with integral from base line per min. Heart rate are presented in beats per min. Skin conductance level are calculated from the baseline score. Finger pulse amplitude are calculated from the pulse number per min that amplitude is over 500 bpm. The data are presented as mean ± S.D. (n = 30–56). Student's t-test was used for the comparison between control and qigong state. p-Value of < 0.05 was regarded as significant.



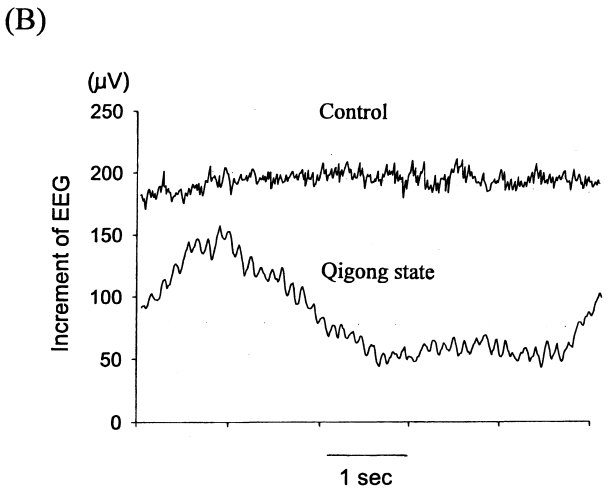


Fig. 2. Changes of Mean Relative Power of Alpha Waves during Qigong State at Right Frontal Lobe of Cerebrum Site

Typical spectra of control stage and qigong state (A). The raw EEG signal were displayed on the (B) (the qigong state being achieved,as indicated by arrow). A representative curve of forty-nine experiments is shown.

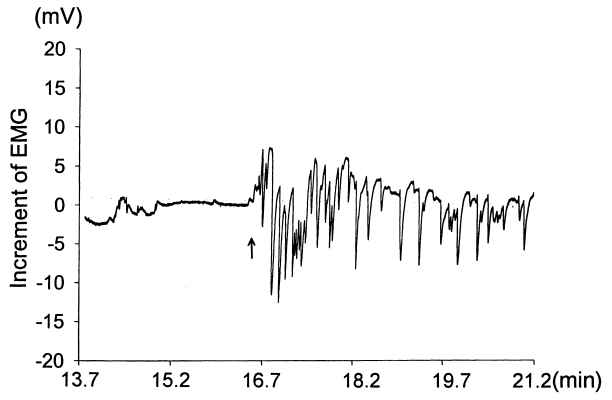


Fig. 3. The Pattern of the EMG at Dorsum of Right Hand for Each Stage during Control (before Qigong State) and Qigong State (Indicated by Arrow)

A representative curve of forty-one separate experiments is shown.

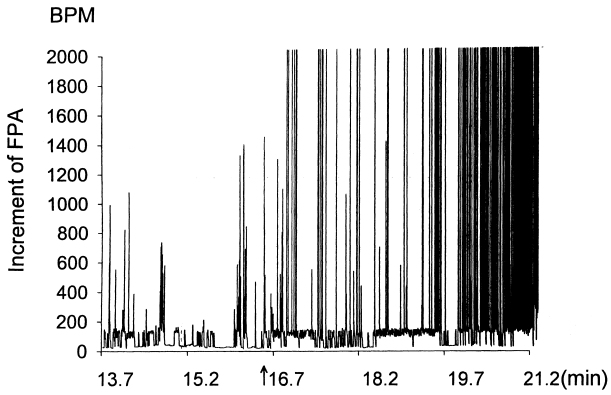


Fig. 4. Effects of Qigong State on the Change of FPA

When the subjects entered the qigong state (indicated by arrow), the finger pulse amplitude and frequency were increased. A representative curve of forty-five experiments is shown.

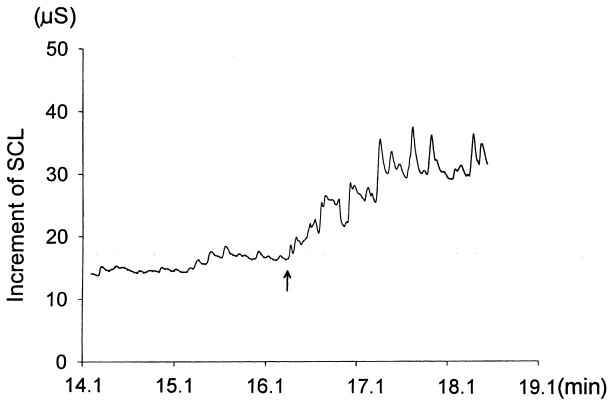


Fig. 5. The Change of the SCL Pattern for Each Stage during Control (before Qigong State) and Qigong State (Indicated by Arrow)

A representative curve of thirty-three experiments is shown.

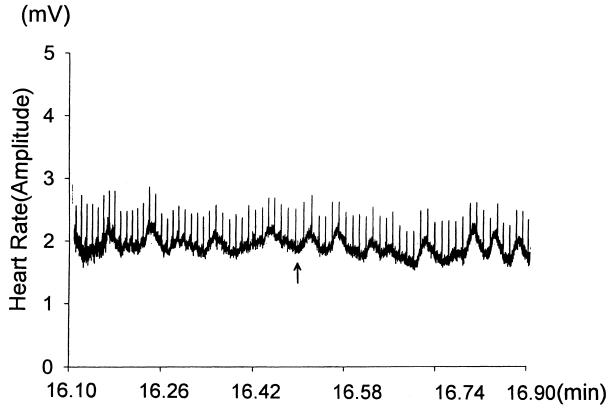


Fig. 6. Effects of Qigong State on the Heart Rate

Arrow indicated the subjects entered the qigong state. A representative curve of thirty-three experiments is shown.

while at the Qigong state, and also because different person at different times may have diversified expressions, thus the physiological reactions of Qigong will greatly differ.[29] Some rocked back and forth, left and right, some would swing both hands, some felt heat all over the body, some stiffened, some relaxed all over. This kind of reactions differs greatly, depending on how deep the Qigong emotion of a person is. Those who often practice Qigong have greater chance of getting into a deeper Qigong emotion and setting off a fierce physiological reaction of Qigong. It is the same as in sad emotion, where reaction greatly differs according to the depth of emotion. As in the sad reaction of hearing someone close died, some will sit blankly, and some will cry. Sad emotion also comes about due to loosing one's job or money. But if a person keeps on encountering sad events, cumulative sad events will cause that person to have an extreme sad reaction, even to the extent of amentia (losing one's mind). As to Qigong emotion, one can get into Qigong state through different methods such as sitting still with a peaceful mind, meditation, paying attention to breathing, concentrating on the hypogastrium, or shadow boxing,[3–5] but it might possibly ignite the same heat or different physiological reaction of Qigong emotion, similar to the fact that different reasons for sad emotions might possibly induce the same tears or other different reactions. Therefore Qigong is a characteristic of emotional state. There are hundreds of ways of starting Qigong, using different training methods, they follow the same principle in using all kinds of methods to help a person enter emotional state of Qigong.[5] It is like getting into a laughing state through some method such as listening to some jokes, recalling a funny incident, or been tickled, and *etc*. Hundreds of incidents and matters can cause people to be in a laughing state.[28]

Qigong is the most obvious characteristic of emotional state. Some people can get into the Qigong state instantly. Under normal emotional state a so-called high level master or a person who is naturally easy to enter Qigong emotional state may enter Qigong state in a flash of thought or in a few minutes, and display the physiological reaction of Qigong. Let's say crying, some people under normal emotion can be ordered to cry and get into the tearful emotion within seconds, some people take several minutes or longer, and some can't even get into a tearful emotion. But training can shorten the time required for letting tears fall. It is the same in entering Qigong emotional state, the time of entering Qigong emotional state can be shortened through training or by grasping the skill.[28]

Qigong is another characteristic of emotional state. After an ordinary person had learned a certain method and entered Qigong emotional state, that person was able to enter Qigong emotional state easily for almost a week or continuously. But if that person stopped practicing Qigong for several months, it would be more difficult to enter Qigong emotional state again within a short period of time. It is the same in sad emotion caused by hearing someone close died. The sad emotion easily resurfaces for almost a week, but after several months you hardly feel the same intense sadness anymore.[28]

If Qigong is a kind of emotional state, then it should be like the emotions of human beings such as happiness, anger, sadness, and joy, which can easily be induced and highly expressed through hypnosis.[22] Based on this inference, we induced the subject to enter Qigong emotional state through hypnosis. As expected, 87.9% ($n = 71$) of the subjects without Qigong experience were able to enter Qigong emotional state within 30 min. This result shall be discussed in details in the next thesis.

Xie[30] claims that the practice of Qigong will lead to amelioration of hypertension; cure of cancer and other chronic diseases such as gastric ulcer, duodenal ulcer, coronary diseases; potentiation of the immune system; and that it also has a bactericidal effect. Physiological studies have been conducted on Qigong practitioners and the results showed that regular practice of Qigong will lead to a decrease in respiratory rate, oxygen consumption and metabolic rate; a reduction in the level of dopamine B-hydroxylase; and, an increase in skin temperature.[6,31–33] Tang *et al*.[33] reported that the excretion of urinary adrenaline increased following the practice of Qigong. It was also reported that Qigong caused an enhancement of brainsem anditory evoked response with a concomitant depression of cortical responses.[10] The physiological response to Qigong as reported by practitioners in China was very similar to that of the relaxation response as described by Herbert Benson, a leading U.S. academic in behavioral medicine.[32] Qigong is a king of emotional state. The reason why it is able to reveal physiological and physical condition should be like happiness, sadness, or anger which were able to set off adrenaline in the body,[34] but this has not been proven yet in Qigong and still needs further study.

After knowing that Qigong is a kind of emotional state, we can design a safer and more effective training method because there are hundreds of training methods and if a person is not cautious enough, he or she can easily go to extremes, and become insane.[35] As in a sad emotion, if the emotion is too strong or not released, it will cause depression or insanity.[36] By understanding the mechanical system set off by Qigong, we are now able to provide another better channel for human physical health.

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