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A Study on Reducing Stress through Deep Breathing

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Abstract

Stress is the source of all kinds of diseases and causes various physical and psychological diseases. Stress reduces immunity, affects autonomic nerves, and affects various organs and blood vessels. In order for humans to maintain a healthy life, relief of stress is essential. Deep breathing is known to be one of the best ways to relieve stress. Deep breathing helps to relieve the stress by activating the nervous system activity by facilitating the oxygen supply.

In this paper, we tried to investigate the effect of deep breathing on stress by using the SDNN value showing the correlation between stress and heartbeat. Heart rate measurement test seven out of eight subjects showed an increase in SDNN during deep breathing. Seven subjects with elevated SDNN values had six stress conditions prior to deep breathing, five of whom were deep breathing. These results show that deep breathing helps to reduce stress.

Keywords: Stress, Deep breathing, Autonomic nerve, Heartbeat, SDNN

INTRODUCTION

Stress is the source of all kinds of diseases. Stress causes tension and pain, consumes a lot of energy, and causes mental and physical illnesses. Stress is the most common cause of health damage in our society. When we analyze cancer, cerebrovascular disease, and cardiovascular disease, which are the three major causes of death in our country, about 70% are caused by stress. Stress is a disease caused by abnormality of autonomic nerve. Autonomic nerve is connected to the central nervous system and peripheral nervous system and affects various organs and blood vessels. It is divided into sympathetic nerve and parasympathetic nerve, and works constantly to maintain the steady state of the body. When a person is stressed, it affects the central nervous system and the endocrine system, and it lowers the immunity. It also affects the autonomic nervous control, thereby lowering the activities of the sympathetic nerves and parasympathetic nerves. This decrease in the activity of sympathetic and parasympathetic nerves causes changes in cardiac movements [1][2][3][4][5][6][10][12][13][14][15][16].

We try to reduce it in a number of ways if we are stressed or severely nervous. One of the best ways to reduce stress is deep breathing. Deep breathing is known to maintain balance of emotions, reduce uneasy psychology, excrete toxins in the body, reduce body pain, make the heart healthy, and help digestion of digestive organs. Studies have shown that deep breathing is a good way to facilitate oxygen supply to the mitochondria involved in cell respiration as one of the organelles. Deep breathing can change the heart movement by activating the nervous system activity by facilitating the oxygen supply to the body. Modern people are always stressed in complex social relations and infinite competition. It is very important for modern people to reduce their stress as long as they can live healthy and disease free. Deep breathing is a very effective method that can be used by everyone to reduce stress [3][4][11][17][18][19][20][21][22].

In this paper, we investigated the effect of deep breathing on stress by using the correlation between stress and heartbeat. In Chapter 2, we explain the principle of heart rate measurement and the relationship between heart rate and stress. In Chapter 3, we describe the experiment and the experimental results of how the stress index changes by measuring heart rate when deep breathing is performed. Finally, Chapter 4 concludes.

RELATIONSHIP BETWEEN HEART RATE AND STRESS

This widened flame burns a large amount of oxygen and removes oxygen from the burning material. In addition, sound causes the vibration of the air layer to interfere with the bonding of oxygen to the surface of the fire. Third, due to the resonance of the flame molecules due to the sound, high fuel evaporation occurs, which spreads the heat energy over a

large space, thus lowering the overall temperature of the flame. In other words, sound fire extinguisher is a fire extinguisher that is applied to all three principles of fire extinguishing, 'elimination of burning substance', 'oxygen block', and 'temperature lowering'. The heart beat is due to the contraction of two atriums and two ventricles, and Electrocardiography (ECG Signal) in Figure 1 represents the potential of heart beat activity. The heart repeats the PQNST procedure as shown in Fig. 1, and the number of occurrences of N, which coincides with the first heart sound, for one minute is called the heart rate [4][5][6][21][22][23][24][25].

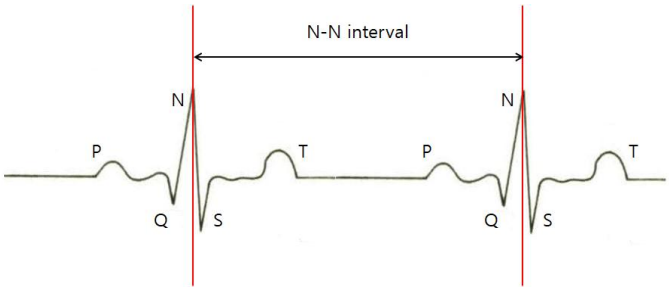

Figure 1. Electrocardiographye (ECG Signal)

The heart rate measurement method is very diverse and can vary slightly depending on the measurement method and measurement location. In recent years, heart rate measurement has become very convenient as the spread of heart rate measuring devices or smart devices becomes more active. In this paper, the heart rate was measured using a simple Pulse Oximeter capable of recording the heart rate during the measurement time. The Pulse Oximeter and the recording method measuring the heart rate are shown in Fig 2.

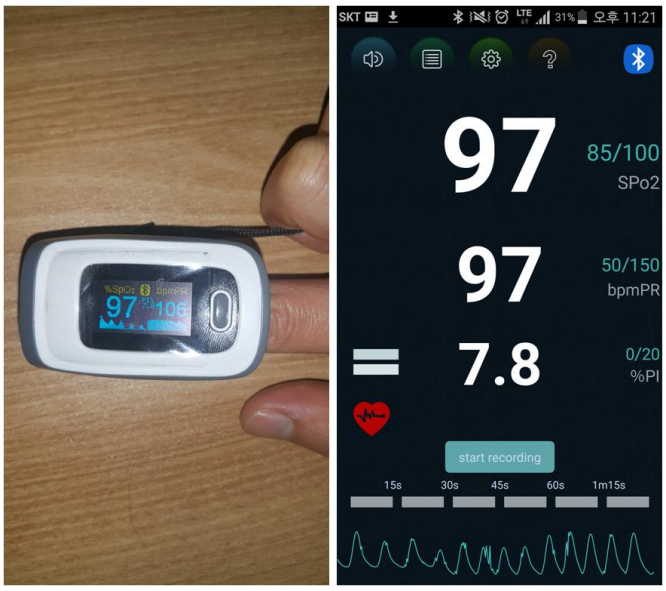

Figure 2. Pulse Oximeter & Heart Rate measurement / recording

We can estimate the mechanism of autonomic nerve regulation from minute changes between heartbeat. Heart beats are sensitive to a variety of factors, including oxygen levels, blood pressure, and body temperature, but those who are sick or under stress are less likely to experience heart beat changes. In 1996, "Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology" presented guidelines on the methods and standards for the analysis of heart rate variability (HRV). In addition, most of the medical devices associated with heart beat follow this standard. Heart Rate Variability (HRV) refers to the change in heart beat cycle over time, indicating the activity and balance of autonomic nerve. HRV can be used to analyze HR Tachograph, HR Distribution, HR Histogram, SDNN, etc. SDNN (Standard Deviation N-N Interval) is used as a stress index. SDNN can be obtained by standard deviation of the N-N interval of the ECG signal in Fig 1. The lower the SDNN, the higher the stress. The relationship between SDNN and stress is shown in Table 1 [5-6].

Table 1. Correlation between SDNN and stress

Ages	Mean SDNN	SDNN reference
10s	55	50↑ : High normal, ANS's regulating function and stress coping ability is good 35 ~ 50 : Low ~ Mid normal, ANS's regulating function and coping ability is normal 20~35 : Low, there's risk of developing stress induced disease, weakened ANS function 20↓ : Very Low, there's high risk of having chronic stress induced disease related to ANS dysfunction
20s	47	
30s	41	
40s	37	
50s	32	40↑ : High normal 20~30 : Low~Mid normal 15~20 : Low 15↓ : Very low
60s	27	

The N-N interval can be calculated from the heart rate, and the method for calculating the SDNN is shown in Equation (1).

$$\text{SDNN } (\sigma) = \sqrt{\sum_{k=1}^{n} (x_k - \mu)^2} \quad (1)$$

x_k = K' s N-N Interval

μ = N-N Interval' s Mean

EXPERIMENTS AND RESULTS

As a result of this experiment, most fire extinguishers and blowers showed the same fire extinguishing result in the candle experiment. However, when the inside of the PVC pipe is 85 ~ 95% of the newspapers, the fire extinguisher burns off the candle better than the same wind speed blower, It is confirmed that the light of the light is not turned on well.

Heart rate measurement experiment was conducted to examine the effect of deep breathing on stress. Eight healthy men and women aged 20 ~ 40 were included. Eight adult men and women measured heart rate in normal breathing state and heart rate in deep breathing state. Participants measured the heart rate while not talking and not moving while measuring the heart rate. The procedure for comparing SDNN changes using measured heart rate data is shown in Figure 3.

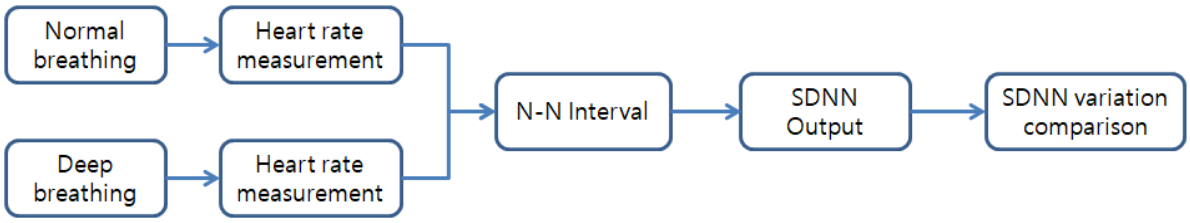

Figure 3. SDNN comparison procedure

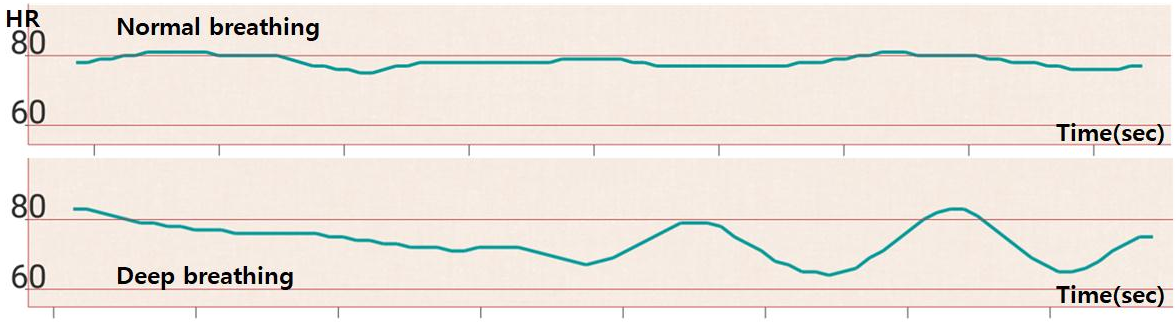

Figure 4. Comparing Heart Rate Variation with breathing

Figure 4 is a graph showing how the heart rate for normal breathing and the heart rate during deep breathing change for subject "A". Figure 4 shows that the heart rate does not change very much in general, but deep breathing changes the heart rate significantly.

Table 2 shows the experimental results of eight men and women participating in the heart rate measurement experiment. The N-N interval was calculated from the heart rate change data of eight subjects who were confirmed by the result of Fig. 4, and the SDNN was calculated by this.

Table 2. Results of Heart Rate measurement

Subject	General breathing			Deep breathing		
	Average heart rate	Average N-N Interval	SDNN (σ)	Average heart rate	Average N-N Interval	SDNN (σ)
A	78.35	766.08	15.22	73.67	818.27	56.05
B	75.27	797.52	18.19	75.18	800.2	40.69
C	67.65	887.43	21.54	67.79	888.3	51.83
D	103.84	578.47	19.28	99.87	601.77	24.02
E	76.77	783.13	35.17	64.7	929.66	44.05
F	71.44	840.93	30.55	66.56	902.9	35.42
G	117.09	512.63	10.41	114.38	524.61	4.97
H	65.31	919.05	16.82	64.78	930.32	59.34

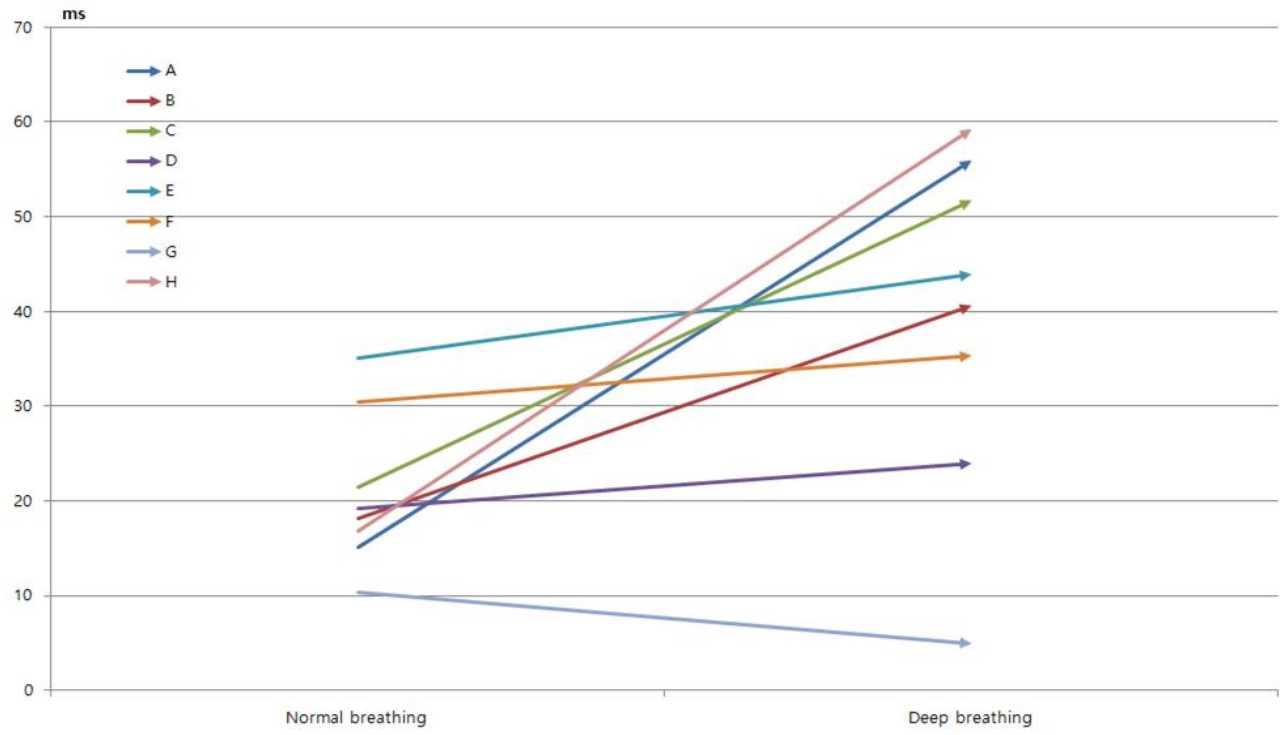

Figure 4. SDNN change with deep breathing

Figure 5 is a graph showing SDNN changes according to the deep breathing of the subjects based on the results of Table 2. In Figure 5, the SDNN values of subject "G" were lowered at deep breathing, while the remaining 7 subjects showed a higher SDNN level when deep breathing than at normal breathing. In particular, six of the subjects with SDNN elevations were in the range of 10 to 35 SDNN under stress during normal breathing, but five of them were in the normal range of SDNN 35 or more after deep breathing. In addition, SDNN levels were also elevated in deep breathing subjects who were in steady range during normal breathing.

CONCLUSION

Stress is one of the most fundamental causes of diseases in our bodies. Stress lowers the immune system of the human body and lowers the ability of autonomic nerve to regulate and slows the activity of various organs. In addition to various physical illnesses, stress also causes mental suffering such as dissatisfaction, nervousness, anxiety, anger, frustration, and depression. Modern people are inevitably under stress in a complex and infinitely competitive society. Stress must be reduced to be able to live without disease. One of the best known ways to reduce stress is deep breathing. Deep breathing, also known as hyperpnoea, is known to be a beneficial way to supply deficient oxygen to the body. The autonomic nerves, which are less able to control due to stress, affect the heart and change the heartbeat. Deep breathing changes the heart beat by activating the autonomic nerve, which is disturbed by stress. Through these correlations, we have shown through experiments how effective deep breathing is in reduce stress. Experimental Results in Chapter 3, SDNN was elevated during deep breathing in seven of 8 subjects in normal breathing and deep breathing. In addition, 5 subjects were changed to steady range through deep breathing in stress condition, and SDNN was also elevated after deep breathing in subjects in steady condition in normal breathing. From these results, it was concluded that deep breathing effectively reduced the stress by facilitating oxygen supply to the body. The results of this study show that the health condition of each participant and the error of the experimental environment may exist, but a large number of results indicate that deep breathing helped to reduce the stress. This is a meaningful result that it is objectively confirmed that deep breathing actually helps reduce stress by measuring the SDNN value for what is known to be vague deep breathing that helps reduce the stress. Stress is a cause of the disease that must be overcome in modern man. Effective stress relief is needed to live a healthy 100-year old age. We hope that this study will help the public health welfare by confirming the effect of stress reducing method.

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