Application for the Wearable Heart Activity Monitoring System: Analysis of the autonomic function of HRV

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Abstract—The wearable patch-style heart activity monitoring system (HAMS) which was used for recording ECG signal in this study is self-developed. This electrode design helps the non-restricted, non-aware and non-invasive ECG measurement. The modified bipolar electrode is convenient in use because it is designed for easy attachment and detachment with ECG measuring module by snap button. Besides, it minimizes EMI by removing the cables.

In the same subjects who were exposed under stress and non-stress, the questionnaire was given out, the amount of the stress hormone was measured by blood test and the ECG signal was recorded. Through the analysis of ECG signal which is measured with wearable patch-style HAMS, the parameter highly related with mental stress were extracted from frequency and time domain. These parameters were certified as the meaningful factor after correlation analysis on the results from questionnaire and stress hormone test. Also, it is proved that the availability of wearable patch-style heart monitoring system is efficient as health monitoring system in any places and occasion.

I. INTRODUCTION

Recently the death rate has been increasing constantly due to heart disease which comes from the change of dietary life. Therefore, if the heart can be monitored constantly in daily life, the unexpected heart disease will be forecasted not only for the patients who have heart disease but also for the person who take exercise which gives load to the heart itself.

For monitoring of these kinds of heart activities, the non-restricted, non-aware and non-invasive ECG measuring method which can be available in daily life is certainly necessary. The HAMS which was used for recording ECG signal in this study is self-developed.

The merit of the HAMS is that it can easily measure and record the heart activity of the subject in real time at any place and occasion, using 2.4GHz wireless communication.

In the same subjects who were exposed under stress and non-stress, the questionnaire was given out, the amount of the stress hormone was measured by blood test and the ECG signal was recorded.

The amount of stress hormone in blood, result of questionnaire and the parameters from ECG signal were compared in both conditions under the case of stress and non-stress.

Through the analysis of ECG signal which is measured with wearable HAMS, parameters of ECG signal in frequency and time domain highly correlated with mental stress are considered.

II. METHODS

A. Wearable Heart Activity Monitoring System

In this study, modified circular bipolar electrode which consists in 3 electrodes on the 5cm×5cm sized pad was built for easy attachment on the breast without inconvenience due to sticking of many electrodes on the move.

To measure bio signal by using bipolar lead system in one pad, the method for minimizing the distance between electrodes was presented[1]. Minimizing the sticking part by concentrating electrode to only one part, this electrode design helps the non-restricted, non-aware and non-invasive ECG measurement.

The modified bipolar electrode is convenient in use because it is designed for easy attachment and detachment with ECG measuring module by snap button. Besides, it minimizes EMI (Electromagnetic Interference) by removing the cables.

Fig.1 shows structure of patch-style ECG electrode system. Fig.2 and Fig.3 show design of the modified bipolar electrode and the wireless transmitter and receiver of HAMS and...