Study on the Healthy Index Value by the Korotkoff Sound Analysis

− A comparison with the waveform acquired from an arm model −

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ABSTRACT

Blood pressure measurement is employed by many people as the means to know a healthy parameter. Korotkoff sound is used for blood pressure measurement. However, the waveform data of the Korotkoff sound to occur at the time of the measurement are not used for a healthy index value. So we focused on a waveform of Korotkoff sound. We think that a sign to show physical condition and the disease development is appeared in a waveform. We acquired the waveform from not only the human body but also simulation vein this time. We compared the K sound of the human body with the waveform that we acquired from imitation blood vessel.

1. INTRODUCTION

The sound which occurs at blood pressure measurement is called Korotkoff sound (K sound). K sound changes by the physical condition. Various researches about K sound have been done. However, there are few researches which uses K sound as a healthy index value. We analyze the waveform of the K sound of a human body, and the waveform acquired from the simulation vein, and are investigating the method of using as a healthy index value [1-4].

2. THE EXPERIMENT METHOD

2.1 The acquisition method of the K sound from the human body

The setup of the experiment for the K sound analysis is shown in Fig.1. A mercury manometer and a microphone are used for acquisition of K sound. In order to record a waveform on a personal computer, a microphone is set inside cuff. First, cuff is pressurized until the flow of blood stops. Next, a cuff is decompressed until K sound is heard. The point with which decompression is stopped is a point under about 10mmHg from

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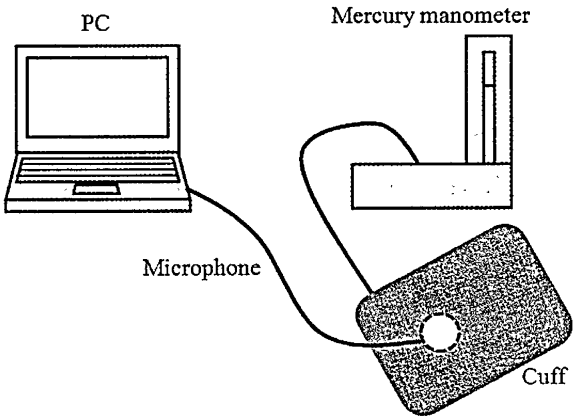

Fig.1 Setup for Korotkoff sound analysis.

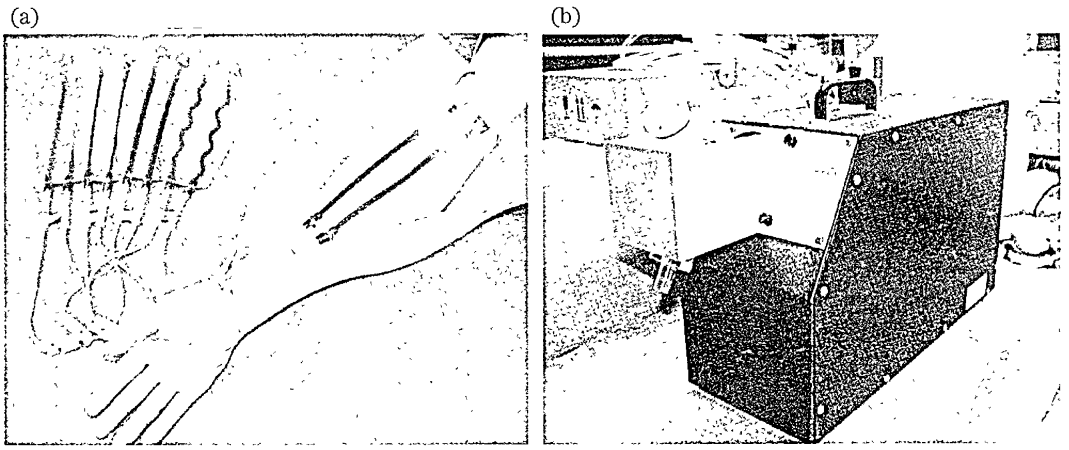

Fig.2 The arm model and pulsation blood flow pump.,
(a)The arm model (Koken Co., Ltd., LM-086, option for advance life support simulator),
(b) Pulsation blood flow pump (Harvard model 1423).

the point where sound was able to begin to be heard. The waveform maintained the state and was recorded by the sampling of 16 bits and 11 kHz.

2.2 The acquisition method of the waveform from simulation vein

The simulation vein and the arm model were used for the experiment. An arm model is a thing used for a paramedic's training. Five kinds of simulation veins from which a type differs can be attached with an arm model (shown in Fig.2(a)). The simulation vein of an arm model is connected to a pulsation blood-flow pump (shown in Fig.2(b). In the inside of an simulation vein, pure water circulates. The method of acquiring a waveform is the same as the method of acquiring K sound from a human body. The example of an experiment setup is shown by Fig.3.

3. EXPERIMENTAL RESULT

3.1 The comparison of a velocity waveform

The sound similar to the beat of the heart

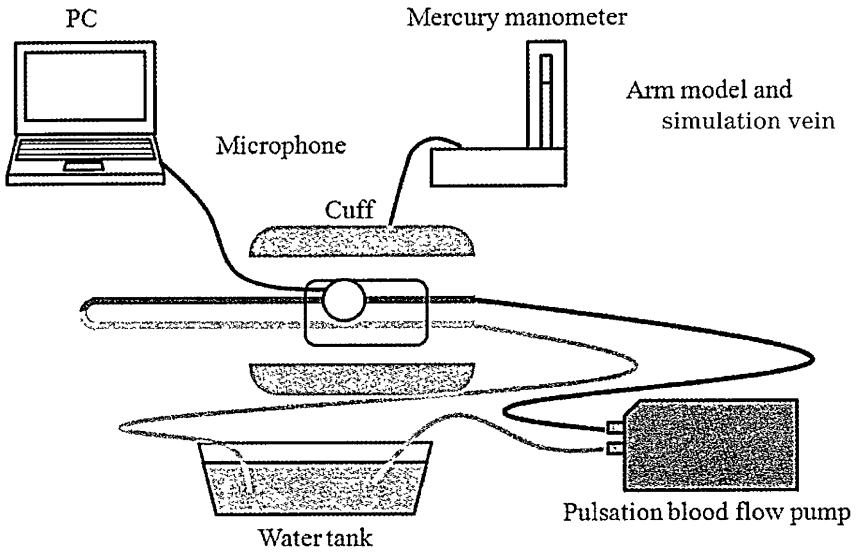

Fig.3 The example of a setup for the wave analysis of an arm model.

was able to be periodically heard from the imitation blood vessel of the arm model. K sound acquired from the human body and the waveform acquired from the arm model are shown by Fig.4. The waveform of K sound of a human body is shown by the black solid line, and the waveform of an arm model is shown by the gray solid line. The example of a waveform of this K sound was acquired from the 20's young man. Another pulse appeared near 0.2 second at the waveform of the arm model.

3.2 The comparison of minus peak frequency

We conducted frequency analysis to the acquired waveform. The example of the analysis result of frequency is shown in Fig.5. This analysis result shows that there is a difference in two waveforms. The sharp minus peak appeared near 2 Hz at both of

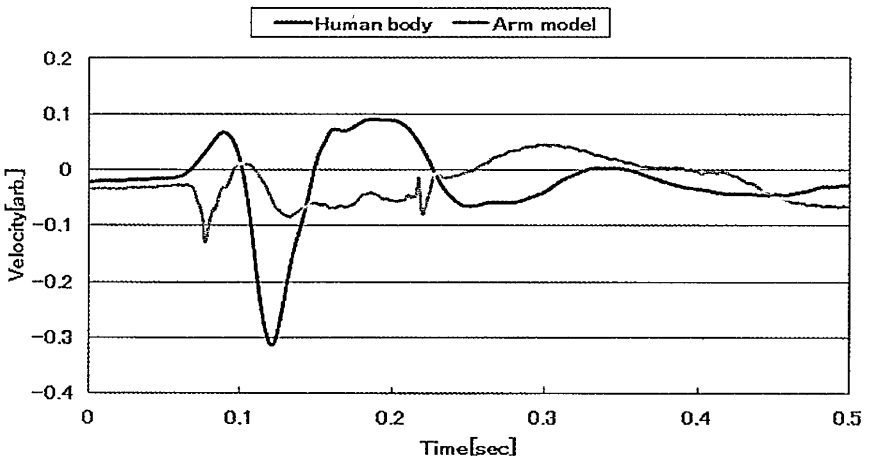

Fig.4 The comparative example of a velocity waveform.

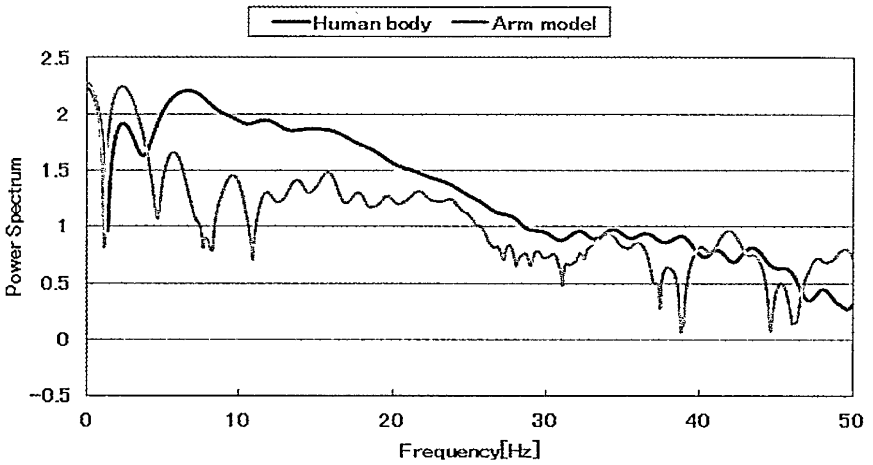

Fig.5 The comparative example of a spectrum.

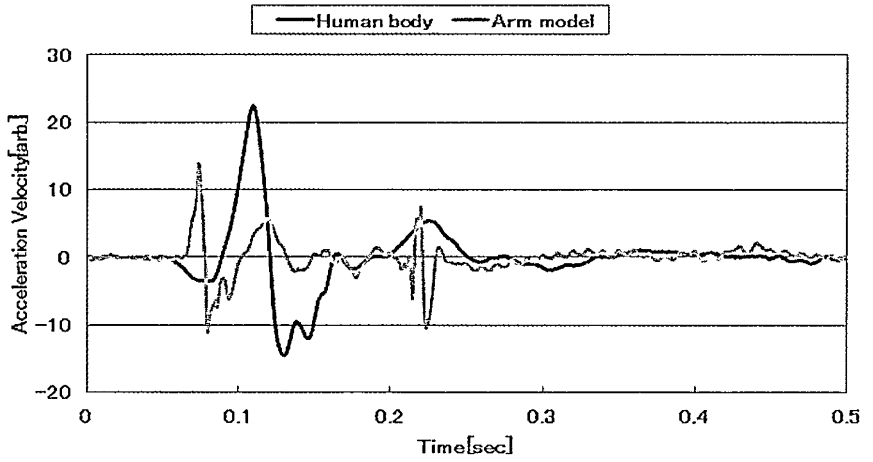

Fig.6 The comparative example of an acceleration waveform.

waveforms. However, some minus peaks appeared after 2 Hz of the waveform of an arm model. It seems that a cause is because the pressure of the pure water sent from a pump and the material of the tube differ from the human body.

3.3 The comparison of an acceleration waveform

An acceleration waveform is obtained by differentiating a velocity waveform. The comparative example of the analyzed acceleration waveform is shown by Fig.6. From the observation of the waveform of an arm model, the waveform near 0.2 second is vibrating. We think that this corresponds to another pulse of a velocity waveform. It seems that a cause is the reflective sound recorded with the microphone.

4. CONCLUSION

A waveform which resembled K sound was acquired also from the simulation vein. If the parameter of a pulsation blood flow pump is adjusted, the state of various human

bodies will be reproduced by the simulation vein. Our future subjects are the experiment which changes the parameter of a pump, and the experiment changed into a different simulation vein. We are going to experiment on various conditions and to acquire a waveform.

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