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RESEARCH ARTICLE

The Effect of Short-term Bed-rest on Radial Pulse in Healthy Subjects

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Abstract
The objective of this study is to investigate the effects of short-term bed rest on the radial pulse in healthy subjects. Twenty-one healthy volunteers participated in this study. Their radial pulse was measured at different measuring positions using a multi-step tonometry system. The participants took 30 minutes of bed rest and their radial pulse was measured before and after the bed rest. The effects of bed rest on the radial pulse were analyzed. The pulse area, the amplitudes of h4 and h5, the pulse period, and the diastolic pulse proportion increased with short-term bed rest, whereas the proportions of systolic and hightension pulse and the fundamental frequency of the pulse wave decreased with short-term bed rest. All the changes were in the same direction in both male and female participants at all measuring positions; however, some parameters changed more in women than in men, and some changed more at the distal position than at the proximal position. In shortly, Short-term bed rest induces significant changes in the radial pulse of healthy subjects. The results of this study could be used as a control reference for clinical acupuncture studies with participants lying on a bed for acupuncture treatment.

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1. Introduction

According to traditional Eastern medical theories, the pulse provides complete information, not only about the cardiovascular system, but also with regard to the entire body, revealing the physiological and pathological disorders of the individual [1]. In this view, the intrinsic and extrinsic factors that affect the body also affect the pulse. For example, on the basis of Eastern medical pulse diagnosis, pregnancy induces specific physiological changes in the radial pulse. Liao et al reported the differences in the radial pulse spectrum between healthy pregnant women and women who were not pregnant, indicating that pregnancy affects the radial pulse and also validating the traditional pulse diagnosis [2]. Other studies have reported the effects of food intake on the pulse [3,4] and a growing number of investigations have described the effects of acupuncture or herbal treatments on the pulse [5–10].

We believe that pulse analysis could be a possible quantitative and objective methodology for use in evaluating the effects of traditional medical treatments as well as in the diagnosis of diseases. We believe that pulse analysis can be used to interpret the disease condition of a patient before treatment and also to evaluate the efficacy of a treatment after it has finished.

Pulse diagnosis has the advantages that it is noninvasive and easy to access, offering real-time results. We therefore suggest that it could be used to monitor the pathophysiological changes that occur in the human body before and after acupuncture treatment.

Although acupuncture is performed in various postures, the supine posture is most often used in acupuncture clinics [11]. The duration of acupuncture treatment also varies, but 20 minutes of needle retention is most often suggested [12]. Considering the extra time required for needle insertion, withdrawal, and manipulation, we have assumed that 30 minutes of lying on a bed is the most common format in acupuncture clinics. We therefore investigated the effects of 30 minutes of bed rest on the radial pulse as a control reference for clinical acupuncture studies using pulse analysis with participants receiving acupuncture treatment while lying on a bed.

2. Methods

2.1. Subjects

Twenty-one healthy volunteers (11 men, mean ± standard deviation (SD) age 22.00 ± 2.39 years, height 174.64 ± 2.48 cm, weight 71.64 ± 7.86 kg; 10 women, age 21.90 ± 1.52 years, height 168.60 ± 7.13 cm, weight 65.60 ± 8.08 kg) in the age range 20–29 years with no underlying disease and not taking any prescribed medicines were included in this study.

The criteria for exclusion were as follows: arrhythmia, systolic blood pressure >150 mmHg, diastolic blood pressure <60 mmHg, wounds or scars in the region of pulse measurement, body mass index <18 kg/m^2 or >32 kg/m^2, pregnancy, or menstruation.

All subjects provided written informed consent. This study was approved by the institutional review board of Daejeon University Hospital (Approval No. P2011-09-03).

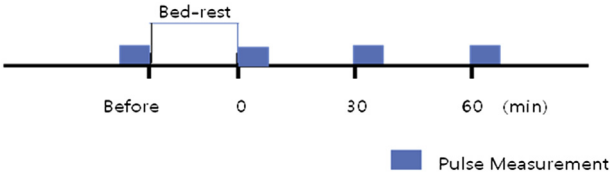

Figure 1 Time-line for experimental procedure.

2.2. Experimental procedure

Fig. 1 shows the time-line of the experimental procedure. The pulse measurement procedure was conducted in a quiet room. All participants took 30 minutes of rest sitting on a comfortable chair before the pulse measurement. The radial pulse was measured in a sitting position. After the first measurement of the radial pulse, the participants lay on a bed next to the pulse-measuring system. After 30 minutes of bed rest the radial pulse was measured again in the same manner as the first measurement, taking three measurements at 30-minute intervals. The participants were asked to remain calm throughout the experiment. Participants were allowed water, but were restricted from consuming food or other drinks. The experimental room was kept at a stable temperature (24–26 °C) and humidity (40–60%).

2.3. Pulse measurement

The radial pulse was measured at three different positions (bilateral *Chon*, *Gwan*, and *Cheock*) on the wrist (Fig. 2). The region opposite the styloid process of the radius is *Gwan*, distal to *Gwan* is *Chon*, and proximal to *Gwan* is *Cheock* [1].

For reliable data acquisition and experimental reproducibility, the position of *Gwan* was marked on the skin in the first measurement. The next measurements were conducted based on this mark, thus guaranteeing that the pulse was measured at the same position in every measurement [13,14].

The pulse was measured using the DMP-3000 system (Daeyomedi Co. Ltd, Ansan, Korea). This device has an arterial tonometry sensor with an array of five piezoresistive semiconductor transducers. After the sensor is placed on the pulse-measuring position, it scans the artery automatically and applies multiple levels of pressure to obtain stable multi-step pulse waveforms [15] (Fig. 3).

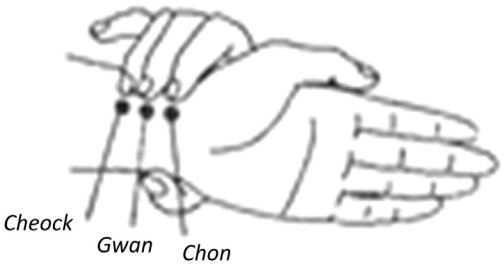

Figure 2 Pulse measuring positions.