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RESEARCH ARTICLE

Gender and Measuring-position Differences in the Radial Pulse of Healthy Individuals

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Abstract
In this research, radial pulse differences according to gender and measuring positions in healthy individuals were investigated in an objective manner. A total of 372 healthy volunteers (189 males and 183 females) participated in this study. The radial pulse was measured at six different measuring positions using a multistep tonometry system. The pulse data were compared between males and females and between different measuring positions. Compared to the pulses in females, those in males were deeper and slower, with a longer diastolic proportion and a shorter systolic proportion. Amplitude of the radial pulse increased as it went distal. The pulse was deepest at the *Cheock* position and shallowest at the *Gwan* position. Compared to the right pulse, the radial augmentation index was higher and the main peak angle was larger in case of the left pulse. The results of this research show that the radial pulses in healthy individuals differ significantly according to gender and measuring positions.

1. Introduction

It may be said that pulse diagnosis is the essence of traditional Eastern medicine. In Asia, "going to have the pulse checked" used to mean "going to see a doctor" [1].

The concept of pulse in the West differs from that in the East. In the West, a pulse is considered to be related to the heart, blood circulation, blood vessels, etc. However, in the East, it relates to the entire body. In traditional Eastern medicine, a pulse is considered to contain complete

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information on any part of the body, revealing everything about an individual's health—superficial and deep, organs and bowels, structure and mind, etc. Therefore, intrinsic factors, such as gender, age, and constitution, as well as extrinsic factors, such as disease pathogens, treatment stimuli, and surrounding climate, may affect the pulse. In other words, pulse reflects overall physiological and pathological conditions of a person [2].

The pulse is examined at different positions on the wrist, which are called *Chon, Gwan,* and *Cheock*, bilaterally. Each position corresponds to different internal organs or body parts; hence, the pulse observed at each position is considered to indicate the conditions of the corresponding organs or body parts [1,2].

Some studies have been conducted focusing on pulse differences according to intrinsic factors such as race, gender, measuring positions, etc. [3—8]. For example, King et al [7] examined 148 healthy humans to develop profiles of radial pulse differences according to gender; however, in their study, pulse examination was conducted by one expert in a subjective manner. Besides, Lee et al [8] reported on different pulse waveforms at different measuring positions; however, they examined only one female participant.

As another effort to identify the effects of intrinsic factors on pulse, in this study, we investigated the physiological differences of radial pulse according to gender and measuring positions in an objective manner.

2. Materials and methods

2.1. Participants

A total of 372 healthy volunteers (189 males, age: 22.95 ± 2.68 years, height: 173.79 ± 4.28 cm, weight: 69.23 ± 8.29 kg; and 183 females, age: 20.99 ± 1.85 years, height: 166.08 ± 7.45 cm, weight: 62.16 ± 8.37 kg) who were 20—29 years of age with no underlying diseases and were not prescribed any medicines were included in this study.

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

All participants provided written informed consents. This study was approved by the Institutional Review Board of Oriental Hospital of Daejeon University, Daejeon, Korea (approval no. P2011-09-03).

2.2. Pulse measurement

All participants took 30 minutes of rest sitting on a comfortable chair prior to the pulse measurement. The radial pulse was measured in a sitting position. The participants were asked to remain calm, and were allowed to take water, but restricted from consuming food or other drinks.

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

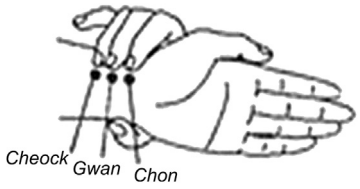

Figure 1 Pulse measuring positions.

Pulse measurement was conducted in a quiet room. The room temperature was kept constant at 24—26°C and humidity was maintained at 40—60%.

2.3. Pulse measuring system and data acquisition

The radial pulse was measured using a multistep tonometry system (Daeyomedi Co. Ltd, Ansan, Korea). This device has an arterial tonometry sensor with an array of five piezoresistive semiconductor transducers. The sensor placed at the pulse-measuring position automatically scans the artery and applies multiple levels of pressure to obtain stable multiple-step pulse waveforms [9] (Figs. 2 and 3).

In this study, pressure was applied at five different levels (50 g, 90 g, 140 g, 190 g, and 240 g), and the pulse waves were recorded for 5 seconds at each level. Data at each level included five pulse waves from five piezoresistive semiconductor transducers. Therefore, 25 pulse waves were obtained from one measuring position [10,11] (Figs. 4 and 5).

2.4. Data analysis

2.4.1. Pulse wave selection

Once the tonometry sensor begins pressing on the skin at the pulse-measuring position, the applied pressure gradually increases, and the pulse height also increases initially to some extent, but decreases later [9] (Fig. 4). In this study, we applied pressure at five different levels. The pulse waveform with the highest *H*1 was the most distinct and considered suitable for observing pulse characteristics; therefore, it was selected as the "representative pulse wave" among the five pulse waves measured at five different pressure levels [11] (Figs. 5 and 6).

The tonometry system automatically scans the artery and places the sensor above the arterial flow. Because the central transducer is placed above the center of arterial flow, we analyzed the representative pulse wave from the

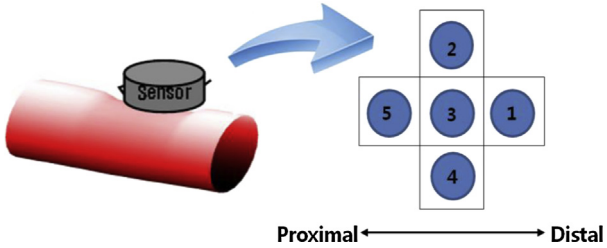

Figure 2 Array sensor.