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The correlation between pulse diagnosis and constitution identification in traditional Chinese medicine

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ABSTRACT

Objectives: Our study aimed to correlate pulse wave parameters such as augmentation index (AI) and heart rate variability with traditional Chinese medicine (TCM) constitution for evaluating health status.
Design: Out of 177 subjects, 69 healthy subjects were enrolled in the present study, and others were excluded because of cardiovascular, liver, kidney, or other diseases. Each subject was invited to complete pulse wave examination and the Constitution in Chinese Medicine Questionnaire. Independent Student's *t*-tests, Mann-Whitney tests, and binary logistic regression analysis were used to analyse the correlation between pulse wave parameters and TCM constitution.
Results: Qi-deficient individuals had higher AI ($p = 0.006$) and lower diastolic blood pressure ($p = 0.011$); yang-deficient individuals had lower dP/dt max ($p = 0.030$), systolic blood pressure ($p = 0.020$), and pulse pressure ($p = 0.048$); and damp-heat individuals had higher subendocardial viability index (SEVI) scores ($p = 0.011$). We then categorized the phlegm dampness and yang-deficiency individuals into the cold group and those with damp-heat and yin-deficiency into the heat group. A comparison of the two constitution groups showed higher AI in the cold group ($p = 0.026$). Binary logistic regression analysis demonstrated that only AI was a determinant, as evidenced by the finding that an increase of one unit in AI corresponded to an increase of 5% in the odds ratio for individuals to have a cold constitution ($p = 0.026$).
Conclusions: Individuals with qi-deficient and cold constitutions had higher AI and lower SEVI, potentially reflecting an increase in arterial stiffness. This study can provide a basis for further investigation of the physiological indicators of TCM constitutions in modern medicine.

1. Background

Traditional Chinese medicine (TCM) constitutions manifest individual characteristics regarding health status and risk for disease, which are described in diverse aspects such as body, physiology, psychology, and adaptive capacity.[1] Traditionally, TCM constitutions are evaluated by doctors with four diagnoses, while Wang et al. [1] developed the 60-item Constitution in Chinese Medicine Questionnaire (CCMQ) to investigate TCM constitutions. The CCMQ is based on the consensus among TCM experts, and has been used nationwide with epidemiological studies of 21,948 samples,[2–4] to differentiate the nine constitutions: balance, qi deficiency, yin

Abbreviations: AI, augmentation Index; AP, augmentation pressure; BMI, body mass index; CCMQ, constitution in Chinese medicine questionnaire; DBP, diastolic blood pressure; DPTI, diastolic pressure-time integral; HRV, heart rate variability; PP, pulse pressure; SBP, systolic blood pressure; SEVI, subendocardial viability index; TCM, traditional Chinese medicine; TTI, tension-time index.

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deficiency, yang deficiency, phlegm dampness, damp-heat, blood-stasis, qi stagnation, and special constitution.

However, classification of TCM constitutions has not achieved global consensus. Wendy Wong et al. pointed out that, based on the CCMQ, about 65% of subjects had overlapping constitutions.[2] Kuang et al. proposed that the concepts of eight principles in TCM (yin/yang, exterior/interior, cold/heat, deficiency/repletion) should be applied to TCM constitution classifications to make them simpler and more clear.[5] Wu et al. interviewed 101 hypertension patients constitutionally diagnosed by TCM doctors into yin/yang and deficiency/repletion to modify the classification proposed by Wang.[6]

The CCMQ is solely based on self-evaluation without taking any objective physiological information into account. However, objective information could provide additional support for diagnosis. Pulse diagnosis is a special physical examination in TCM that evaluates the condition of the human body. Nowadays, researchers apply a sphygmomanometer to record and to analyse the pulse wave. According to modern haemodynamics, the heart pumps out the blood and generates the pulse (percussion wave) throughout the body. At the same time, the reflection wave caused by the resistance in the arterial tree adds to the percussion wave, forming the augmentation pressure (AP). The ratio of the original pressure and AP constitutes the augmentation index (AI), which is an index for arterial stiffness and is widely used in several diseases. The reflection wave returns faster and produces a higher AP and AI when arterial stiffness worsens.[7] It has been well known that the heart rate variability (HRV) contains a lot of health information.[8] There was study showing that the autonomic function evaluated by HRV correlated with the yin/yang constitution.[9] Our study correlated pulse wave parameters, such as AI and HRV, with TCM constitutions to evaluate health status.

2. Methods

2.1. Study subjects

We recruited subjects who visited the healthcare centre at Taoyuan Chang Gung Memorial Hospital in Taiwan (August 2012–November 2013). Subjects were excluded if they had cardiovascular disease (hypertension, arrhythmia, ischemic heart disease, heart failure, and peripheral artery disease), abnormal liver function, abnormal renal function, cancer, severe autoimmune disease (such as systemic lupus erythematosus) or acute infection (such as chillness and fever). The study protocol was approved by the Institutional Review Board of Chang Gung Memorial Hospital (102–1771B). Informed consent was obtained from all enrolled subjects. Demographic data and personal medical history were retrieved from the electronic medical record.

2.2. Study protocol

Each subject was invited to complete the CCMQ and a pulse wave examination. The CCMQ was printed in Chinese as a self-administered questionnaire. A TCM doctor or a research staff member gave the subject a brief introduction before he or she began, and the completed CCMQ was reviewed to ensure no items had been left incomplete.

All the pulse wave examinations were performed by a well-trained TCM doctor. After 10 min of rest in a supine position in a quiet and temperature-controlled environment, pulse waves were recorded by using an ANSWatch® wrist sphygmomanometer (Taiwan Scientific Corporation, Taipei, Taiwan). The wrist sphygmomanometer obtained readings for the left radial artery at the radial styloid process site (at the Guan position in TCM). After measuring SBP and DBP, the sphygmomanometer recorded the pulse wave signal with suitable pressure. The blood pressure was also used to calibrate the pulse wave. Then the sphygmomanometer recorded 5 min of pulse rate for HRV. The validity and reproducibility of ANSWatch® have been reported in previous studies.[10,11] The most stable pulse wave signals were analysed by the software automatically.

2.3. Study assessment

2.3.1. CCMQ

CCMQ records were calculated using SPSS Version 19.0 (IBM, Armonk, NY) according to its scoring guidelines. There are 8 items for balance, 8 items for qi deficiency, 8 items for yin deficiency, 7 items for yang deficiency, 8 items for phlegm dampness, 7 items for damp-heat (2 items specific to men and women), 7 items for blood-stasis, 7 items for qi stagnation and 7 items for special constitution. In addition, 5 items are included in both balance and other constitutions (qi deficiency, qi stagnation, blood-stasis, and yang deficiency). A higher score indicates that the subject may be more likely to have the specific constitution.

2.3.2. Eight principles in TCM constitutions

According to TCM theory, we classified the constitutions in CCMQ into cold and heat groups. The cold/heat ratio is the score product of damp-heat and yin deficiency over the score product of yang deficiency and phlegm dampness (the original score of damp-heat, yin deficiency, yang deficiency and phlegm dampness is added by 1 to prevent the product to be 0). Subjects were defined as cold group if the ratio > 1, or heat group if the ratio < 1 (the subject was excluded if the ratio = 1).

2.3.3. Parameters for pulse wave analysis

2.3.3.1. dP/ds max. The maximal rate of pressure rise is the maximal value in the arising slope counted by ANSWatch® Manager Pro software. It indicates the contractility of the left ventricle.[12]

2.3.3.2. SEVI. By computing the pressure-time integral parameters from the ANSWatch® Manager Pro, tension-time index (TTI) in the systolic phase, diastolic pressure-time integral (DPTI) in the diastolic phase, and subendocardial viability index (SEVI, the ratio of DPTI/TTI) were recorded. SEVI represents the ventricular perfusion of the heart.[12]

2.3.3.3. AI. We applied Matlab to define the early systolic pressure and late systolic pressure to calculate AI, according to the derivative method.[7,13] (Fig. 1). Radial AI has a positive correlation with carotid AI and reflects the severity of arterial stiffness.[14]

2.3.4. Parameters for HRV

Frequency-domain analysis was applied in HRV assessments to evaluate autonomic nervous system function. To get the precise very low frequency component (VLF), at least 5 min of pulse rate were needed. However, the physiology of VLF were not clear yet.

2.3.4.1. Variance. Variance of R–R intervals, also equal to the total power in the frequency domain (the sum of LF, HF, and VLF).

2.3.4.2. LF. Low-frequency power in the frequency domain of HRV, representing both vagal and sympathetic activities.

2.3.4.3. HF. High-frequency power in the frequency domain of HRV, representing the vagal activity.

2.3.4.4. LF/HF. The ratio of low frequency power over high frequency power, reflecting sympathovagal balance or the sympathetic modulations.