

The Study of Pulse Condition of Traditional Chinese Medicine in Information Age

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Abstract

Using the study of pulse condition in Traditional Chinese Medicine (TCM) as a case example, this paper discusses the characteristics of pulse information obtained by Chinese medicine practitioners, how to correctly understand the relationship between the human body and Chinese medicine in the information age, how to deal with pulse data, and how to study TCM pulse condition. Furthermore, we point out that the application of modern big data processing technology to the pulse of Chinese medicine offers new opportunities.

Keywords:

Traditional Chinese Medicine; Delivery of Health Care; Pulse condition

Introduction

In the information age, with the development of science and technology, our understanding of the human body is being gradually deepened. The observation of the human body has extended from human vision to the microscopic world of cells, proteins and genes. Medical equipment is being constantly developed, from the optical microscope to the computerized electron microscope, from the stethoscope to X-ray, CT, MRI and beyond. Surgical treatment has been expanded from operations by surgeons to remotely operated robots. Similarly, with the advent of the information age, Chinese medicine treatment and diagnostic technology is also being constantly developed, evolving from the traditional acupuncture using silver needle to electro-acupuncture, intermediate frequency treatment and laser acupuncture; from the observation of the tongue by naked eye to the acquisition and quantitative analysis on tongue images; from the fuzzy sense of pulse-taking by fingers to pulse condition acquisition and quantitative analysis; from handwritten medical records to electronic medical records.

Currently, some of the studies of traditional Chinese pulse diagnosis return to the anatomy of the cardiovascular system, such as using Wrist-type self-help sphygmomanometer device to evaluate the function of cardiovascular system. We cannot say that these results are not related to the clinical pulse image of Chinese medicine, but the relevance is not believed to be of a great degree. Pulse images within traditional Chinese medicine (TCM) should be associated with the 28 clinical pulse patterns of TCM. The fingertip's feeling during clinic pulse-taking should be analyzed and the pulse condition information should be acquired and quantified using some kinds of sensors. Following this acquisition and quantification, the fuzzy boundary between these objective data and clinical pulse measurements can be determined by big data analysis. In addition to the dynamic feeling of pulse-taking, many properties can constitute a feeling sensation such as thickness, float, length, frequency, rhythm, hard and soft, etc. In clinic, different pulse patterns can appear in one pulse image. Even for the TCM doctor with many years of experience, it is

difficult to accurately differentiate pulse patterns. Therefore, for the analysis of pulse condition by using big data, ambiguity is a big challenge.

In a word, TCM diagnosis and analysis technology is developing rapidly in the information age. However, compared to other diagnosis and treatment technologies, the development of TCM diagnosis and treatment technology is much slower. New diagnostic techniques based on TCM are not easily used in clinical practice, for example the electropulsograph and tongue image. The reason is related to the characteristics of clinical information obtained by Chinese medicine practitioners, their methods of clinical information processing and their means of treating diseases. Furthermore, one can argue that this generalization is related to the information characteristics of Chinese culture and the theory of TCM. The relationship between the human body and Chinese medicine needs to be correctly understood in the information age. Studying the pulse image as an example, this paper discusses the characteristics of pulse information obtained by Chinese medicine practitioners, how to deal with pulse data, and how to study pulse diagnosis in TCM [1].

The human body needs to be correctly recognized in information age

As we know, the human body is extremely complex. The system can use sensitive sensory organs at any time and any place to receive all kinds of information from the outside world such as visual observation, smelling, listening, and palpation. In order to maintain equilibrium, the human body ingests a variety of substances and energy through the digestive and respiratory systems, and eliminates waste by exhaling carbon dioxide, feces, urine, and sweat. In order to adapt to the changing natural and social environment, it needs to store energy, accumulate experience, learn knowledge, and update information constantly in the struggle for survival.

As can be seen from modern science, the internal environment of the human body is extremely complex. The body system is composed of a number of interrelated and mutually cooperative subsystems such as the digestive system, respiratory system, cardiovascular circulatory system, and nervous system. These systems are composed of a variety of cells and intercellular substances, which are invisible to the naked eye. From in-depth study, the human body is a huge, open, adaptive, self-organizing, complex information system. It becomes more and more complex when one examines how micro-systems communicate, transfer information, and maintain the normal activities of the human body. As a complex system, the human body is not easy to investigate.

This system is observed to have the properties of automatic regulation and self-recovery, with a complete set of defenses, such as adaptation, immunity, compensation, self-organization. In the future, if the human body incurs disease, doctors should be able to mobilize the body's own disease prevention and treatment system to the target, and it will be a big step forward in medicine [1].

TCM needs to be correctly recognized in the information age

The human body is an extremely complex information system. For human beings, the "human system" is still a "black box." In response to such a "black box", modern medicine attempts to gradually open the "black box" through our knowledge of nerves, body fluids, organs, tissues, cells, proteins, and genes. Although TCM does not clearly understand the internal structure of the human body, the collection of data still remains the basis of four diagnostic techniques: "observe, smell, ask, pulse-feeling and palpation". The data collected by these techniques reflect the disease state of the body. Using this information, treatments such as TCM tinctures and acupuncture can be performed to mobilize the body's defenses against diseases. This applies a black box control theory to the management of diseases. This method is the most practical method to solve complex problems. For thousands of years, the Chinese people have been using this principle to analyze and treat with human disease, and have created a wealth of information and methods to treat the complex system of the human body. This method of TCM which mobilizes the immune system to treat disease, is the direction of the development of modern medicine for diseases such as cancer. Therefore, the abundant clinical history of TCM is worthy of our exploration and promotion [2].

The Significance of Pulse Information of Traditional Chinese Medicine

Pulse information is a very important component of clinical information for TCM. Traditional pulse information is collected by the fingertips touching the radial artery resting against bone. This segment of the radial artery is located above the radial bone, and the tissue covering it is not thick, so it is easy to detect. Placement of the radial head also supports easy measurement of pulse. The position of the radial artery is between the aorta and the arterioles. Cardiac output produces a reflected wave of blood due to the narrowing in front of the vascular wall. These reflected waves and forward pulse waves are superimposed on the radial artery to form a pulse wave, carrying a wealth of information on the dynamic characteristics of the cardiovascular system including heart, internal organs, the end of blood vessels, etc. The circulatory system coordinates body tissue energy metabolism, oxygen and nutrients, and helps remove metabolic waste. Generally, modeling disease information from the circulatory system is very important, as it provides a basis for life. Therefore, the pulse diagnosis in TCM is a meaningful and important means of diagnosis of disease.

Chinese medicine is shrouded in mystery. However, as early as 1979, Professor Zhaorong Liu at Fudan University used numerical simulation to uncover the mystery behind slippery pulse. They simulated the slippery pulse of pregnant women by increasing the flow from the abdominal cavity; the results of the study are consistent with the clinical practice of traditional Chinese medicine [3].

Perplexity in the study of TCM pulse condition

TCM pulse condition is a visualized expression which is related to the radial pulse and the state of the patient. It can be obtained by the clinical doctor using the sensation of touch. It is an important basis for clinical differentiation of TCM syndromes. Generally speaking, it can be classified according to the descriptive adjectives of Float, Sink, Slow, Fast, Thick, Thin, Strong, Weak, Fluent, Astringent and Rhythm.[4]

In the Jin Dynasty (266-420 BCE), Shuhe Wang subdivided the pulse into twenty-four kinds in the book "*Maijing*". In the Ming Dynasty (1368-1644 BCE), Shenzhen Li described pulse with up to twenty-seven kinds in the book "*BinHu*

sphygmology". This knowledge about the pulse is in the form of natural language to provide a vivid expression for pulse diagnosis in TCM. For example, in the description of the pulse image of TCM, slippery pulse (Hua Mai) which is fluent should refer to the smooth, such as beads moving on the disk. Floating pulse (Fu Mai) refers to that which beats easily, heavily presses down and is diminished but not empty. In the understanding of diseases, floating pulse is mainly for surface symptoms; however slippery pulse is mainly for phlegm and food stagnation. Slippery pulse is also common phenomenon when women have no disease and pregnancy.

Clinically, TCM determines the pulse properties according to the comprehensive sensations from the doctors' fingertips, and combines the pulse information with patients' overall characteristics rather than understanding the pulse according to the position of modern radial artery in the cardiovascular system. For example, Yin and Yang, surface and inside, cold and heat, the actual situation of the internal organs and so on. That is, the pulse of traditional Chinese medicine is fuzzy and subjective data, and the rules of TCM treatments are abstract. These problems have caused a lot of confusion in Chinese medicine research [5].

How to Study TCM Pulse in Information age

Reviewing the history of study of the TCM concept of pulse, this study involves a lot of cross disciplinarity. In order to explore the mechanism of pulse generation, it is not only necessary to have knowledge of cardiovascular pathophysiology, but also knowledge of biomechanics, cardiovascular dynamics and blood rheology. In order to objectively reflect the information of doctors' fingers, not only reliable and sensitive sensors are needed, but further analysis is also needed as to the mechanical characteristics of the finger and the characteristics of the sensory cells of the finger surface when the doctor of traditional Chinese medicine is taking a pulse. Pulse information refers to a feeling of the doctor's finger surface, and is a doctor's subjective qualitative data. In addition, the study of pulse condition based on the application of pulse instrument in a previous study in China, has lead to doctors merely using the obtained information to analyze the cause of the disease instead of extending such information to the dynamic characteristics of the whole human body. Clinically, traditional Chinese medicine uses the information of pulse to judge overall dynamic trends of the human body such as Yin and Yang, inside and outside, cold and heat, asthenia and sthenia and so on. In that case doctors can use the theory of Chinese medicine to treat patients with syndrome differentiation. All of the above adds great difficulty to research into TCM pulse.

In the era of big data, Google Flu Trends project has been developed to predict flu using search words from people on the Internet who were seeking to investigate their health problems. Google collects people's "cough", "fever", "pain" and other subjective data determine the direction of the spread of influenza with big data analysis. This shows that the subjective data are useful as long as the correct use of big data association rules. However, there is no intersection among the "cough", "fever", "pain" and other subjective data concepts mentioned above, which results in an independent variable for big data processing.

Chinese clinical medicine, however, is based on the fuzzy sense of doctors' fingers to obtain the pulse information, and the concept of pulse is a comprehensive qualitative conception, of which the most common is composite pulse. Composite pulse is assembled by a variety of pulse characteristics. From the same pulse condition, doctors' subjective judgments result in multiple diagnoses. There therefore are intersections between the pulse data, which result in data traps for big data processing. Therefore, in order to

avoid these data traps, the pulse data must be preprocessed. First of all, it is necessary to set up a pulse acquisition and analysis instrument that simulates the pulse diagnosis of TCM and acquires the pulse condition with floating, sinking, thick, thin, strong, weak, slippery, astringent, frequency and rhythm information [3]. At present, the three-inch-foot pulse instrument developed by Shanghai University of Traditional Chinese Medicine has been developed in line with these requirements. Then, we can combine the objective data recorded by the clinical pulse condition with the characteristics of the TCM pulse condition to establish a qualitative classification database meets the requirements for the method of big data processing. There are thousands of Chinese medicine hospitals in China, in which many hospitals have adopted the "electronic medical record system" to record clinical data. If these hospitals can be equipped with pulse acquisition and analysis devices, the amount of data could be amazing. Therefore, modern large-scale data processing technology has brought new opportunities to researching pulse condition within TCM [6].

Conclusions

In information age, with the high degree of scientific and technological development, the research on the human body has extended from the human visual sense to the microscopic range such as cell, protein, gene and etc. In clinical treatment, CT, MRI, ultrasound and other equipment have been applied to detect the internal state of the human body. Also people have used a fully automated instrument to detect blood and urine and obtain patients' information. However, traditional Chinese medicine seems to have not yet entered the information age. TCM still uses sensory organs to subjectively collect clinical data and apply experience and traditional Chinese medicine theory to deal with data.

This paper analyzes the causes of this confusion and believes that the pulse data which perceived by TCM fingers are consisted of a variety of physical quantities. The obtained information by doctors' sensory organs is subjective and the boundary is fuzzy.

The clinical TCM pulse condition is composed of largely a composite pulse and doctors have different subjective judgments. There are intersections between the classification of Chinese pulse conditions, these intersections create barriers to the use of big data methods. To solve these problems, the authors suggest collecting the objective data about floating, sinking, fast, thick, thin, strong, weak, smooth, astringent, frequency, and rhythm by a pulse analysis system used for simulating the clinical Chinese medicine pulse diagnosis. Further studies on the function of Chinese medicine pulse condition within TCM analysis of diseases should be subjected to big data analysis to advance the theory of pulse condition. There are new breakthroughs in the field of Chinese pulse condition in the near future.

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