



Review

A Chinese literature overview on ultra-weak photon emission as promising technology for studying system-based diagnostics



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ABSTRACT

To present the possibilities pertaining to linking ultra-weak photon emission (UPE) with Chinese medicine-based diagnostics principles, we conducted a review of Chinese literature regarding UPE with respect to a systems view of diagnostics. Data were summarized from human clinical studies and animal models published from 1979 through 1998. The research fields can be categorized as follows: (1) human physiological states measured using UPE; (2) characteristics of human UPE in relation to various pathological states; and (3) the relationship between diagnosis (e.g., Chinese syndromes) and the dynamics of UPE in animal models. We conclude that UPE has clear potential in terms of understanding the systems view on health and disease as described using Chinese medicine-based diagnostics, particularly from a biochemistry-based regulatory perspective. Linking UPE with metabolomics can further bridge biochemistry-based Western diagnostics with the phenomenology-based Chinese diagnostics, thus opening new avenues for studying systems diagnostics in the early stage of disease, for prevention-based strategies, as well as for systems-based intervention in chronic disease.

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1. Introduction

The use of ultra-weak photon emission (UPE) in living organisms was first described by Gurwitsch in 1923.¹ At that time, the technical capabilities for measuring radiation using physical devices was rather limited. This technology became more feasible when sensitive photomultipliers were developed in the 1960s in the former Soviet Union. The early data were published primarily in Russian journals,^{2,3} with only a fraction of the reports translated into English.⁴ Since the 1970s, UPE has been used by research teams in Germany,⁵ Australia,⁶ Poland,⁷ Japan,⁸ the United States,⁹ and China.¹⁰ UPE has been used successfully in a wide variety of organisms, including bacteria, yeast, plants, animals, and humans, as well as in cells and cellular homogenates derived from living organisms.^{5–11}

UPE occurs spontaneously in living organisms, without the need for external intervention.¹² The emission range of UPE is approximately $10\text{--}10^3$ photons/s/cm². The spectral range of the photons emitted from living systems is 300–750 nm¹³; the photons emitted from human tissue ranges from 420 to 570 nm.¹⁴ The source of UPE is closely related to the electronic transport and the generation of reactive oxygen species (ROS) during oxidative metabolic processes, with UPE originating from the transition from either the singlet excited state (such as singlet oxygen ¹O₂) or the triplet excited level of carbonyl species (³R=O*) to the singlet ground state.^{15,16} Biological ROS—including the reactions of superoxide radical (O₂^{•-}), hydrogen peroxide (H₂O₂), and hydroxyl radical (HO*)—are produced dynamically during chemical metabolic redox reactions, including lipid peroxidation and protein/nucleic acid generation; moreover, during these metabolic processes, electrons can become excited, and energy is emitted in the form of photons.¹⁷ Similar to the ROS theory described above, photons can also be released during the metabolism of radical nitrogen species (RNS). ROS causes the oxidation of biomolecules such as nucleic acids, proteins, and lipids, which play essential roles in many cellular processes, including cell signaling, apoptosis, and pro/anti-inflammatory regulation.^{18,19} Therefore, UPE can be measured in order to detect the physiological state of the human body and to measure dynamic changes in health.^{12,13,20}

In humans, UPE is usually measured using a photomultiplier tube (PMT) or a charge-coupled device (CCD). Emitted photons can be measured directly through the skin in a light-tight, dark environment.^{21,22} The use of UPE as a diagnostic tool for health-related issues in humans has been reviewed recently.²³ The intensity of UPE emitted from the human body can be influenced by several physiological states, including age,²⁴ gender,²⁵ biological rhythms,^{22,26–29} and conscious activities,^{30–32} thus leading to the discovery of putative diagnostic properties of photon emission. For example, hypothyroidism can be diagnosed by measuring the emission of photons from the index finger of human subjects.³³ Furthermore, differences in the intensity of photon emissions have been measured between patients with multiple sclerosis and healthy subjects.^{34,35} Moreover, patients with hemiparesis have asymmetrical UPE intensity between the left and right hands, suggesting that measuring photon emission symmetry could be used as a novel diagnostic parameter in addition to measuring UPE intensity.^{36,37} Based on the aforementioned experimental observations, UPE has been proposed as a non-invasive indicator of the integrated states and dynamic changes in human health.^{12,20,38}

In the newly emerging systems-based view of health, biology can be considered a hierarchy of various levels of organization, ranging from low levels (e.g., biochemistry and molecules) to the cellular and organ levels, all the way up to the integrated systems level.³⁸ In Western medicine, “omics” technologies are often utilized to study genes, proteins, and metabolites at relatively low organizational levels.³⁹ Recent work suggests that the dynamic

distribution of UPE emissions from the human body can reflect both the health status at a large-scale organization level and the dynamics of the system.^{13,20} Similar to UPE, Chinese medicine integrates physiological and pathological information at a higher level of organization—i.e., the phenotype level—in order to obtain a holistic description of the body’s state. Two important types of descriptions are frequently used: constitution differentiation and syndrome differentiation.^{39–41} However, Chinese medicine-based diagnostics is a descriptive, phenomenological approach based on many clinical observations, and the insights regarding molecular and mechanistic biology have been explored only recently.⁴² Given that UPE may provide important insight into health at a high level of organization, measuring UPE parameters may provide novel scientific insights into Chinese medicine-based diagnostics and may help guide Western medicine towards a systems-based view of life, both from a diagnostic perspective and from an intervention perspective. Therefore, it is important to explore the history of this relationship between UPE and Chinese medicine-based diagnostics.

Applications in which UPE has been used to understand and measure systemic organization can be found in Chinese literature; these publications have generally focused on the relationship between UPE and Chinese medicine-based concepts in both human and animal studies. In this review, we summarize these studies published in Chinese scientific journals from 1979 through 1998. In studies published between 1979 and 1998, Chinese medicine-based concepts were used to establish UPE experimental designs. After the turn of the century, there was a shift in UPE research interests in China from healthcare to the agricultural area.^{43,44} As a result, no more Chinese literature was found regarding UPE and Chinese medicine-based concepts after 1998. Because much of the clinical data was published in Chinese, UPE research is relatively unknown among scientists in non-Chinese-speaking countries. By reviewing this literature, we hope to educate scientists in terms of the possibilities regarding linking UPE with Chinese medicine-based diagnostics principles. Furthermore, because Western UPE researchers rarely study Chinese medicine-based diagnostics from a systemic regulatory perspective, this review will also provide a basis for further research in this specific area.

2. Temporal variations in UPE intensity among healthy human subjects

According to the Chinese medicine theory, one’s health depends on a dynamic balance between one’s physiological state and the surrounding environment. The human body can adapt in response to many environmental factors (e.g., changes in the seasons) and internal environmental changes (e.g., emotional variations). These patterns of change that result from changes in the internal and external environments are essential for obtaining a diagnosis in Chinese medicine. Therefore, Chinese physicians are taught to make a comprehensive diagnosis that includes an evaluation of how the body responds to the surrounding environment at various ages, as well as the effect of seasonal fluctuations.^{45–47}

In China, UPE measurements have been used to study temporal changes in human physiological states since the 1980s. Zheng⁴⁸ investigated the effect of gender and age on UPE measured from the fingertips of seven groups of healthy subjects; these results are summarized in Fig. 1. In general, the intensity of UPE was higher among males than among females, and UPE intensity tended to increase with age. This association between age and UPE was later confirmed by Sauermann.²⁴ In a separate study, Yan⁴⁹ examined the relationship between age and UPE by measuring the specific acupuncture point LI1 (also known as the Shangyang acupuncture point); Yan found higher UPE intensity among young subjects (17–49 years of age) compared with both older subjects (50–72

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