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MEASUREMENT OF BIOPHOTON EMISSION WITH A SINGLE PHOTON COUNTING SYSTEM.

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In Traditional Chinese Medicine, the healing effects of acupuncture and Qigong are often explained as enhancement of the level and flow of vital energy referred to as Qi. Western biomedical research on these two types of intervention has been hampered by the lack of a strict scientific definition of Qi. One approach around this dilemma is to study changes in bioenergy markers that are responsive to Qigong and acupuncture and are measurable with modern instrumentation. In this study, we assembled a system that can quantify visible light emitted by the human body (referred to as biophotons or biophoton emission) with sensitivity at the level of a single photon. This system, designed for quantifying biophotons emitted from the palm of the hand, consists of a photomultiplier tube sensitive to light of ~300-600 nm (Integrated Counting Head, Model H59020-01 from Hamamatsu Corp., powered by Linear Power Supply, Model LPS-304/CE, from AMREL), connected to a timer/counter/analyzer (Model PM6680B/016, from Fluke), which sends the information to a standard desk-top computer for analysis with the TimeView software. The photomultiplier tube, mounted on a stable frame to guide the placement of the hand, is located inside a light-proof chamber. In Part I of this study, we determined that a number of parameters must be precisely controlled in order to produce reliable data. First, while the background noise (dark count) of the photomultiplier tube is sufficiently low and constant for this type of application (about 10 counts per second), it goes up rapidly when the temperature of the tube rises above 25^{o} C. Thus cooling of the tube with a coil containing circulating water of a set temperature is essential to its proper operation. Second, the photon count decreases steadily with distance of the hand from the photomultiplier tube. Third, biophoton emission is highest at the center of the palm (i.e., around the PC8 acupoint), and decreases towards the fingertips. Fourth, exposure of the hand to direct sunlight for even a few minutes can increase biophoton emission by 100 times or more for a couple of hours. Normal indoor lighting has little or no effect on biophoton emission unless a subject's hand is within a couple of feet from a fluorescent light. Fifth, body temperature is another important factor affecting biophoton emission. In a study involving 10 control subjects, heating the hand to increase its temperature by 3^{o} C increased biophoton emission by about 15% while cooling the hand by 14^{o} C resulted in a similar level of change in the opposite direction. As a result of Part I of this study, we can achieve a low variability of around 2-5% in our biophoton measurements when we carefully control all of the factors described above. In Part II of this study, we used our single photon counting system to examine the effect of exercises on biophoton emission. First, 7 subjects were instructed to ride a stationary bicycle with hand and foot pedals (Airdyne by Schwinn) at a comfortable speed for 15 minutes. Afterwards, 6 of the subjects showed an average increase in biophoton emission of 45% while one showed no change. Second, 12 subjects were instructed to practice the "silk reeling" movement of Chen style Tai Chi for 15 minutes. Afterwards 11 of the subjects showed an average increase in biophoton emission of about 15% while one subject showed little or no change. Whether Tai Chi exercise really produces less of an effect than cycling needs to be further investigated with a larger sample of subjects. The conclusion of this preliminary study is that with careful control of the factors described here, the single photon counting system can produce useful data on bioenergy in the form of visible light. (Supported by a grant from the

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