

Left-right asymmetry of biophoton emission from hemiparesis patients

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Left-right biophoton asymmetry from the palm and the dorsum of hands from 7 Korean hemiparesis patients were studied. There is a strong tendency that the left-hemiparesis patients emit more biophotons from the right than the left hands, while the right-hemiparesis patient emits more from the left hand. Acupuncture treatment reduces dramatically the left-right asymmetry of biophoton emission rates. However there is no systematic difference for the patients in the emission rates from the palm and the dorsum of hands.

Keywords: Biophoton asymmetry, Biophoton emission, Hemiparesis patient

Biophoton measurements have widely attracted researchers' attention because of their coherent nature within living systems¹⁻⁴, inter- and intracellular communication for regulatory function⁵, and many possible applications in areas such as medicine and agriculture⁶⁻⁸. The potential applications in medicine and healthcare are particularly novel and many biophoton emission studies are being done on blood plasma, urine, breath, wrists, hands, finger, arms, and human skin in order to investigate the feasibility of its medical applications⁹⁻²². Among them there is a finding that a multiple sclerosis patient emits more biophotons than ordinary healthy people and further the symmetry of biophoton emission from both side of hands is broken¹³⁻¹⁵ in patient. There are a few earlier reports of left-right asymmetry in biophoton emission from unhealthy people^{12,23}. These reports are particularly relevant for the traditional oriental (Chinese) system of healing and medicine. The system has a viewpoint that diseases are caused by the unbalance of vital forces from left and right side of body, called Yin and Yang respectively. Hemiparesis is thought to be caused by the unbalance of Yin and Yang. If biophoton signals have a relation with these vital forces,

the pulses of biophotons obtained from the left and right wrists of the patients of hemiparesis will be different, and these pulses can be used as indicators for diagnostic purpose in traditional Chinese medicine.

In this paper, the report of our study in 7 cases of hemiparesis patients is presented. The study has been undertaken to explore the tendency of left-right asymmetry in biophoton signals in unhealthy people by simultaneous measurement of biophotons from the left and right sides of hands. We evaluated the tendency of left-right asymmetry in palm and dorsum of hands, photon counting statistics in second order moments²⁴ and the possibility of the use of biophoton measurement as a diagnostic tool.

Materials and Methods

Measurements were done with two Hamamatsu R331-05S photomultiplier tubes inside a dark chamber assembly (Fig. 1) specially fabricated for simultaneous measurement of biophoton emission from the right and left hands of persons. The amplifiers and discriminators converted the output signals from PMTs to 5V pulses and were kept inside a dark room. These pulses were fed to an IBM PC with two synchronized interface cards for counting in the operator compartment.

Every hemiparesis patient waited for at least an hour in a normal room before the start of measurements; the waiting period eliminated the contribution to the signal coming from exposure to sunlight. The

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patient then entered the operator compartment wearing a white gown. The operator informed the patient about the arrangement of experimental system and protocol, checked his/her body temperature, cleaned palm and back of hands with ethanol-soaked cotton. The patient subsequently entered the dark room, where the measuring steps were organized in the following sequences: 10 min of initial adjustment → measurement of the dark count (3 min) → measurement from the palms of both hands (3 min) → measurement from the dorsa of both hands (3 min) → measurement of the dark count (3 min). An assistant in the dark room helped the patients to put the

hemiparesis side of hand in front of the detector in some cases only. The background dark count of both PMTs was about 20 counts/sec (CPS).

All seven hemiparesis patients (6 males, 1 female) were Korean of 41 to 73 years of age. All subjects except one (the subject 4) were right-hemiparesis patients. Gender, age, cause, hemiparesis side and grade of patients are shown in Table 1. Grading was in a scale from 0 to V and was determined according to the 'grading and recording of muscle strength'. The consecutive grades 0-V respectively mean the patient in (0) normal condition, (i) no movement, (ii) trace

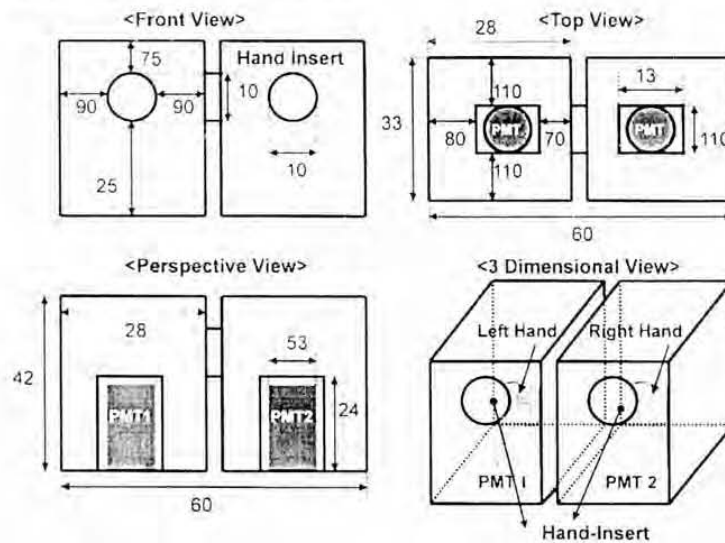


Fig. 1 — The measuring unit for simultaneous detection of biophotons: The dark chamber is made of wood with interior black thin styrene foam and holes to insert hands. Its dimensions are given in mm.

Table 1—Information about the condition of the patients

[The order of subject in the table is according to the date of measurement – the measurements were first made with subject 1 followed by subject 2 and so on. The abbreviation Cb/Gr. stands for cerebral/grade, and Rt./Lt. for right/left side. The grades are represented by "grading and recording of muscle strength". Gr. 0-V corresponds to no movement, trace movement, able to move with gravity eliminated, able to move poorly against gravity but not resistance, able to oppose gravity plus resistance, in normal condition, respectively. Grading was restricted to hands only because the measurement of biophoton emission was restricted to hands only]

Subject	Gender	Age	Cause	Hemiparesis side & grade (Rt/Lt)
1	M	73	Cb-infarction	Gr.IV / Gr.V
2	F	63	Cb-hemorrhage	Gr.III / Gr.V
3	M	50	Cb-hemorrhage	Gr.IV / Gr.V
4	M	41	Cb-hemorrhage	Gr.V / Gr.IV
5	M	46	Cb-infarction	Gr.IV / Gr.V
6	M	59	Cb-infarction	Gr.V / Gr.V
7	M	64	Cb-infarction	Gr.V / Gr.V

movement, (iii) able to move with gravity eliminated, (iv) able to move poorly against gravity but not resistance, (v) able to oppose gravity plus resistance. The subject 2 was in grade III so that she couldn't walk for herself. The subjects 6 and 7 almost recovered from hemiparesis and their grading of left and right side were both in grade V, i.e. normal. A Korean traditional medical doctor, one of the authors, did diagnosis and grading. Six patients were taking anti-hypertension drug to control their blood pressure and one (subject 7) took diabetic drug for the control of blood glucose.

Eleven measurements were done during daytime between 1400-1600 hrs during September-November at room temperature ($21^{\circ} \pm 1^{\circ}\text{C}$) RH ranging (22-56%) due to seasonal variations.

Results

The measured data of biophoton emission from the palm and the dorsum of both hands from seven patients presented in Table 2. The subjects 1-4 were measured twice, before and after the acupuncture treatment, whereas the rest were measured only once. The biophoton emissions of the patients (subjects 1-4) before the acupuncture treatment had a large asymmetry between the left and the right hands. The average difference between the left and the right hands is:

$$\Delta_{L-R}^p = |\bar{n}_L^p - \bar{n}_R^p| = 106.2 \pm 60.5,$$

$$\Delta_{L-R}^d = |\bar{n}_L^d - \bar{n}_R^d| = 111.2 \pm 61.4$$

where Δ_{L-R}^p and Δ_{L-R}^d denote the mean values of the absolute counting difference between the left (\bar{n}_L^p) and right (\bar{n}_R^p) palms, and the left (\bar{n}_L^d) and right

(\bar{n}_R^d) dorsa of hands, respectively in CPS. The values of the asymmetry in healthy subjects are much smaller. The average and standard deviation in the present study were:

$$\Delta_{L-R}^p = 17.3 \pm 15.1,$$

$$\Delta_{L-R}^d = 8.6 \pm 8.4$$

where Δ_{L-R}^p and Δ_{L-R}^d are the average differences between the left and right hands for 20 healthy people measured for three weeks during July²¹.

The left-right asymmetry of biophoton emission was reduced dramatically after the acupuncture treatment (Table 2 subjects marked as 1', 2', 3', 4*, 5*). The average differences were:

$$\Delta_{L-R}^p = 34.5 \pm 53.3,$$

$$\Delta_{L-R}^d = 20.1 \pm 9.8$$

These values are small and comparable to the values of healthy subjects. The grade of muscle movements in two patients (subjects 6, 7) was V, which implies that the patients were almost normal and have recovered from the hemiparesis and hence the left-right asymmetry is almost as small as normal healthy-subject.

The difference between photon counts from the palm and dorsum in left and right hands does not show significant difference with those of healthy people (Fig. 2). The average values of the difference of photon counts in patients were:

$$\Delta_{p-d}^l = 61.0 \pm 48.0, \Delta_{p-d}^r = 72.4 \pm 42.7$$

where Δ_{p-d}^l and Δ_{p-d}^r is the mean value of photon counts of left palm subtracted from counts of left

Table 2—Biophoton counts from the palm and dorsum of both hands of seven Korean hemiparesis patients

[The data are presented in unit of counts per second (CPS) for convenience even though measurements were performed with a gate time of 100 ms. Prime (') and star (*) indicates the fact that the subject took acupuncture treatment at the day in measurement and at the day before the measurement, respectively. Subject 1-6 took anti-hypertensive drug daily and subject 7 took diabetic drug. Rt./Lt. stand for right/left]

Subject	Lt. palmar hand	Rt. palmar hand	Lt. dorsal hand	Rt. dorsal hand
1'	109	103	79	56
1	194	170	136	64
2'	84	64	51	45
2	132	59	98	49
3*	200	219	128	90
3	318	165	257	144
4'	233	398	271	295
4	348	522	236	446
5*	213	214	68	88
6	172	159	98	78
7	177	160	89	81

dorsum of hand, and of counts of right palm subtracted from counts of right dorsum of hand, respectively. These values were only marginally higher than the values obtained with healthy subjects represented by Δ' i.e.

$$\Delta_{p-R}^L = 46.4 \pm 40.6, \Delta_{p-R}^R = 55.4 \pm 38.7$$

Discussion

We studied the asymmetry of biophoton emission rates from left and right hands of seven hemiparesis patients. The left and right differences of biophoton emission rates were very large in untreated patients (1, 2, 3, 4) compared to the 20 healthy subjects both for the palm(a), and the dorsum of hands(b) (Fig. 3).

The subjects 1, 2 and 3 were right-hemiparesis patient; both palm and dorsum of their right hands emitted less number of biophotons than those emitted by their left hands. The subject 4 was left-hemiparesis patient and his left hand emitted less number of biophotons. Admittedly, the statistics are not good enough to make a conclusive statement, but the data clearly indicate the diagnostic potential of biophoton emission.

The above case studies show that biophoton signals reflect faithfully the viewpoint of traditional oriental system of medicine on hemiparesis patients. Effect of oriental medical treatment of patients on their biophoton emissions was observed. The patients were given the acupuncture treatment, which dramatically reduced the biophoton emission asymmetry in patients 1', 2', 3*, 5*. The asymmetry in every case

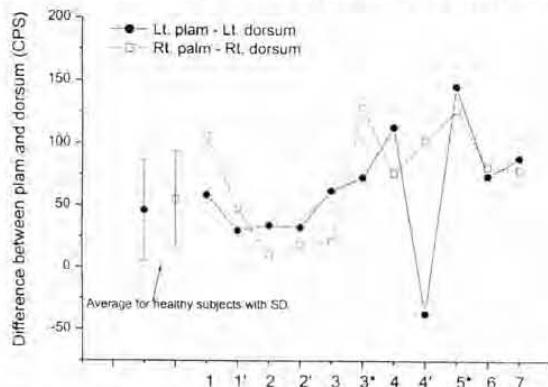


Fig. 2—Difference in the biophoton emission from the palm and the dorsum of hands: The filled circles denote mean values of biophotons from the left palm minus that from the left dorsal side of hands whereas the empty squares denote mean values of right palm minus that of right dorsal side of hands in different patients. The average values for 20 healthy subjects are given in the figure.

was within the normal range after the treatment. It indicates the therapy's effectiveness. In case 4' the reduction in asymmetry as a result of treatment occurred only in the emission from the dorsum and not from the palm. It suggests that the acupuncture prescription should be changed to improve the palm side. These case studies show that the evaluation of effectiveness of treatment is possible by the measurement of biophotons. The patients 6 and 7 almost recovered to normal condition by the usual diagnosis, so that the asymmetry in their biophoton emission was small.

We also examined the δ -value of the patients in order to see whether it reflects a health-condition. The δ -value is defined as:

$$\delta = \frac{\sigma^2 - \langle n \rangle}{\langle n \rangle}$$

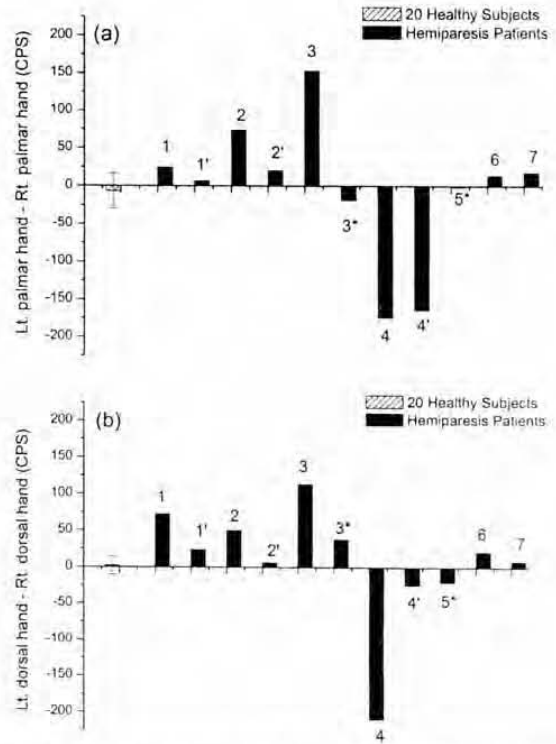


Fig. 3—Difference between biophoton counts from the left and right hands: The quantity of vertical axis is (a) mean value of photon counting from right palm minus the mean of left palm, (b) mean of right dorsum minus the mean of left dorsum. Positive/negative quantity denotes more photons in left/right side. Mean value of biophotons of twenty healthy Korean people with standard deviation is given in the left side in the figure. Each measurement was done simultaneously for both hands for 3 min in a gate time of 100 ms.

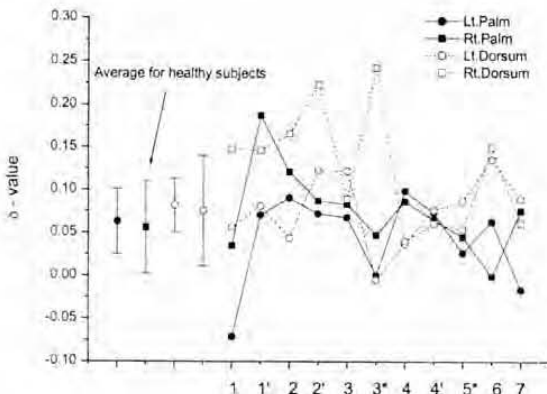


Fig. 4 — δ -values for biophotons from hands: The first 4 data with error bars are average δ -value of biophoton emission from 20 healthy subjects with standard deviation. The solid/dashed lines are for photon emission from palm/dorsum of hands. The circle/square is for biophotons from the left/right hand.

where σ^2 is variance $\langle n \rangle$ is the average of photon emission rate during the measuring time. For healthy people, δ -value showed good agreement with Poisson distribution²². Figure 4 presents δ -value for 11 measurements with patients along with the average for 20 healthy persons. The deviations in some cases were larger than the standard deviation of healthy persons. But on an average there was not much difference among healthy persons. The average values are given by:

$$\bar{\delta}_{Rt.Dorsum} = 0.08 \pm 0.07$$

$$\bar{\delta}'_{Rt.Dorsum} = 0.13 \pm 0.07$$

where $\bar{\delta}_{Rt.Dorsum}$ and $\bar{\delta}'_{Rt.Dorsum}$ is the average δ -value for healthy persons and for the 11 cases of patients. Since the value increased only slightly for the right dorsum of hands of patients, it cannot be used for diagnostic purpose. Perhaps, the analysis of higher moments will be more efficacious. It needs further research¹².

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References

- Popp F A & Yan Y, Delayed luminescence of biological systems in terms of coherent states, *Phys Lett A*, 293 (2002) 93.
- Bajpai R P, Coherent nature of the radiation emitted in delayed luminescence of leaves, *J Theor Biol*, 198 (1999) 287.
- Popp F A, Chang J J, Herzog A, Yan Z & Yan Y, Evidence of non-classical(squeezed) light in biological systems, *Phys Lett A*, 293 (2002) 98.
- Bajpai R P, Kumar S & Sivadasan V A, Biophoton emission in the evolution of a squeezed state of frequency stable damped oscillator, *Appl Mathe Computation*, 93 (1998) 277.
- Popp F A, Gu Q & Li K, Biophoton emission: Experimental background and theoretical approaches, *Mod Phys Lett B*, 8 (1994) 1269.
- Shen X, Mei W & Xu X, Activation of neutrophils by a chemically separated but optically coupled neutrophil population undergoing respiratory burst, *Experientia*, 50 (1994) 963.
- Amano T, Kobayashi M, Devaraj B, Usa M & Inaba H, Ultra-weak biophoton emission imaging of transplanted bladder cancer, *Urol Res*, 23 (1995) 315.
- van Wijk R, Regulation of DNA synthesis in cultured rat hepatoma cells, *Int Rev Cytol*, 85 (1983) 63.
- Yoda B, Goto Y, Sato K, Sacki A & Inaba H, Ultra-weak chemiluminescence of smokers' blood, *Arch Environ Health*, 13 (1995) 23.
- Agatsuma S *et al.*, Hydroxyl radical-induced characteristic chemi-luminescent spectra from plasma of hemodialysis patients, *Clin Chem*, 38 (1992) 48.
- Kobayashi M, Usa M & Inaba H, Highly sensitive detection and spectral analysis of ultra-weak photon emission from living samples of human origin for the measurement of biomedical information, *Trans Soc Instrum Control Eng*, 30 (1994) 385.
- Jung H -H *et al.*, Photon counting statistics analysis of biophotons from hands, *Indian J Exp Biol*, 41 (2002) 446.
- Cohen S & Popp F A, Whole-body counting of biophotons and its relation to biological rhythms, in *Biophotons*, edited by J J Chang, J Fisch & F A Popp (Kluwer Academic Publishers, Dordrecht) 1998, 186.
- Cohen S & Popp F A, Biophoton emission of the human body, *J Photochem Photobiol B Biol*, 40 (1997) 187.
- Cohen S & Popp F A, Low-level luminescence of the human skin, *Skin Res Tech*, 3 (1997) 177.
- Bieske K, Gall D & Fisch J, Measurement of low level emissions: Investigation on human hands, wrists and lower arms, in *Biophotonics and coherent systems*, edited by Belousov *et al.*, Proceeding of the 2nd Alexander Gruwitsch Conference Moscow (Moscow Univ Press) 2000, 397.
- Nakamura K & Hiramatsu M, Some features of ultra-weak photon emission from human hand, *Personal communication*, (2002).
- Yan Z, A study on the pathological illuminating signal point. Investigation of 300 subjects, *J Traditional Med*, 3 (1983) 37.
- Wallace E, Acute alteration of biophoton emission by intention, California Institute of Human Science (1999); C Chevalley & M Vekaria, Biophoton emission by intention (2001), personal communication.
- Choi C *et al.*, Biophoton emission from the hands, *J Kor Phy Soc*, 42 (2002) 275.
- Kim T J *et al.*, Biophoton emission from fingernails and fingerprints of living human subjects, *Acupun Electro Therapeutics Res Int J*, 27 (2002) 85.
- Kim J D, Lim J, Sung B & Soh K -S, Biophoton emission from rat liver, *J Kor Phy Soc*, (2002) submitted.
- Woo W -M, Diagnostic application of biophoton in acupuncture, paper presented to the IIB conference on biophotons, International Institute of Biophysics, Neuss, Germany, 26-28 August, 2002.
- Shen X, Liu F & Li X Y, Experimental study on photocount statistics of the ultra-weak photon emission from some living organisms, *Experientia*, 49 (1993) 291.