CHANGE OF ELECTRICAL PROPERTIES IN THE SKIN OF THE BIG TOE DURING ACUTE ASTHMA

Naohiro Nagayama, M.D., Hiroshi Motoyama, Ph.D.

ABSTRACT

Background: Meridian function during acute asthma has not been studied.

Materials and Methods: Electrical properties at 14 Well points (most peripheral acupoints) of patients with acute asthma were studied bilaterally before and after treatment in 22 moderate and 5 severe acute episodes. Square wave pulses (3V×256μsec) were sequentially applied via each active electrode (4 mm square) on Well points and the indifferent electrode (2 cm×3 cm) on the extensor surface of each forearm about 5 cm above the wrist through an external electric resistance of 100 Ω. The electrical current flowing as a result is characterized by 3 parameters: BP [Before Polarization] current, AP [After Polarization] current, and IQ [Integrated Qoulomb]. Mean and right-to-left difference values of these 3 parameters were calculated for the 14 Well points. These parameters in groups of patients with acute moderate or acute severe asthma were compared with non-asthmatic controls.

Results: No significant changes of mean BP, AP or IQ values related to acute asthma were seen at any Well point. On the other hand, the right-to-left IQ difference at the LV (Liver) Well point (IQ(L-R)LV) before treatment was significantly greater than after treatment in both acute moderate and acute severe asthma. This difference at the LV Well point (⊿IQ(L-R)LV) before and after treatment was greater in acute severe than in acute moderate asthma. The right-to-left BP difference at the LV Well point (BP(L-R)LV) before treatment was also significantly lower after treatment in acute severe asthma.

Conclusions: A meridian reaction occurs during acute asthma in the LV but not in Lung (LU) meridian. Severity of acute asthma associates with increased prominence of the LV meridian reaction.

KEYWORDS: asthma, acute, meridian, acupuncture, liver, electricity, subtle energy

BACKGROUND

Complementary and alternative medicine (CAM) is widely supported by the public in many countries.[1] It is used mainly by patients with chronic disease and healthy persons. In the United States, CAM is more popular among patients with allergy, asthma and immunology disorders than among patients with other common chronic medical problems.[2] However, despite its popularity, any actual efficacy of CAM has not been evident.[3] For example, acupuncture, one of the most popular forms of CAM, is sometimes used for patients with asthma. Unfortunately, meta-analysis of the data concerning asthma did not show any evidence of an effect of acupuncture in reducing asthma.[4,5] As the controlled clinical trials reviewed for meta-analysis have not been well-performed, this result may indicate that a full-scale randomized clinical trial is needed.[4,5] However, judging from results of meta-analysis performed thus far, if acupuncture has some effect on patients with acute asthma, its efficacy will be limited and less than that of β-stimulant bronchodilator inhalation.[6,7]

Even so, acupuncture, as is likely to be the case with other forms of CAM, will continue to be used in future. One reason for the popularity of CAM is that it is comfortable for patients. When tired or diseased, in some instances, people are observed to press on acupoints on the body surface unconsciously, even when they have no knowledge of acupuncture medicine. This provides subjective relief, the reason for which must be explained scientifically, even if acupuncture has not been proven effective for treatment of diseases. Therefore, it is necessary and important to investigate basic mechanisms of action of CAM, especially acupuncture, independently of efficacy.

When an organ is diseased, not only the organ itself but also the body as a whole is affected. Many systems in the human body, such as the neurological, hormonal and immune systems act in a coordinated manner to return the organism to a state of health. There may be some other systems which also function in this manner, but are not yet well understood, such as the meridian system, which is said to be intimately related to the connective tissue network widely distributed in the body.[8,9] The meridian system is an assumed network of tracts exploited in Eastern medicine, especially in acupuncture, where Ki energy, the nature of which has never been clarified, flows.

It is difficult to investigate Ki energy or the meridian system. However, it is not difficult to study electrical properties beneath the skin where meridian tracts supposedly run. Representative meridians each have so-called Well points (most distal acupoints) at fingers and toes bilaterally. If meridian tracts do exist and some changes occur in some of them during a disease, the electrical properties beneath the Well points may be altered. To test this hypothesis, we studied the electrical properties of Well points by applying square wave pulses between different electrodes placed on certain Well points and indifferent electrodes placed on extensor surfaces of the forearm in patients with acute asthma.

MATERIALS AND METHODS

PATIENTS

Patients with bronchial asthma attending the outpatient asthma clinic in NHO Tokyo Hospital were included in the study. Twenty-one patients (Male/Female=12/9, age (Mean(SE)) 55.8(2.4), range (30~76) yr, IgE 606(113), (25~1,700) U/ml, Eosinophil count 778(101), (0~1,728) /μl) experienced 27 acute episodes (twice each in 6 patients) between October 1996 and September 1999. The electrical properties at Well points were measured during each episode. Bronchial asthma was diagnosed clinically. All patients had had episodic cough, wheezing, dyspnea, and normal chest radiographic results, and bronchial reversibility had been confirmed spirometrically in 16 patients by either >12% increase of FEV1 (Forced Expiratory Volume in 1 min.) after inhalation of bronchodilator or >15% change of FEV1 in daily life. In the remaining 5 patients, no reversibility test had been performed. Acute asthma was defined by acute coughing, wheezing and dyspnea. All patients visited our hospital seeking relief from these symptoms in acute asthma. All had inhaled β-stimulant bronchodilators at home, without obtaining relief from their acute asthma episode. Patients with acute asthma were divided into two groups, namely, those with moderate or severe asthma. Acute asthma in which patients could hardly walk were defined as severe, with the ability to walk 50 m (distance between the consultation room and the laboratory in the hospital) classified as moderate. Controls consisted of 33 non-asthmatic healthy subjects (M/F=3/30, age 37.2(2.1), (22~60) yr).

PRINCIPLES OF THE MEASURING SYSTEM

Near the root of finger- and toe-nails (some 3 mm distant from the corner of the root) are the Well (Jing in Chinese and Sei in Japanese) points. In Fig. 1(A), 14 Well points of 14 meridians (12 regular and 2 (Stomach Branch [SB] and Diaphragm [DI]) extra meridians) are illustrated.[10] The Well points and meridians are bilaterally symmetrical. Prior to measurement, two indifferent electrodes (Ag/AgCl; 2 cm×3 cm) were attached to the extensor surface of each forearm about 5 cm above the wrists, and plate electrodes (Ag/AgCl; 4 mm square) coated with non-polarizing electrode paste were attached to the right and left Well points of each meridian (28 points in all). Square wave pulses (3V×256 μsec) were then applied sequentially to each active Well point electrode and the indifferent electrode pair through an external electric resistance of 100 Ω. An electrical current then flows in response in the circuit (Fig. 1(B)). The peak current which flows immediately after the application of the external potential to the skin is referred to as the BP (Before Polarization) current. This current is thought to penetrate through all the cells and intercellular spaces with electrical capacity, including those layers possessing dielectric membranes such as the basal cells of the epidermis. After the BP current, an exponentially decreasing current follows

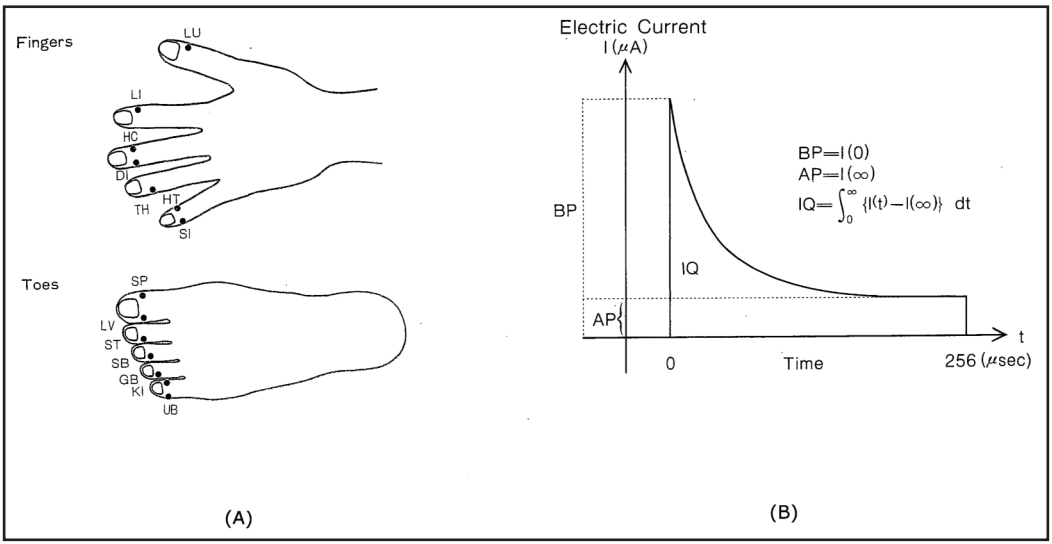


Figure 1. Well points of 14 meridians (A) and response current, and definition of parameters (B).

Upper extremities: LU; Lung, LI; Large Intestine, HC; Heart Constrictor, DI; Diaphragm, TH; Triple Heater, HT; Heart, SI : Small Intestine

Lower extremities: SP; Spleen, LV; Liver, ST; Stomach, SB; Stomach Branch, GB; Gall Bladder, KI; Kidney, UB; Urinary Bladder

BP; Before Polarization, AP; After Polarization, IQ; Integrated Qoulomb

which reflects the polarization process (charging of capacitive elements) in the tissue. The steady-state current which flows after completion of all polarization is termed the AP (After Polarization) current. This is normally reached within about 200 μsec. The total electric charge which is mobilized during the polarization process is designated the IQ (Integrated Qoulomb, or total electrical charge). This is thought to reflect the electrical capacity of the epidermis just beneath the plate electrodes at the Well points.[11,12] The above-mentioned electrical stimulus is so weak that patients do not sense anything during these measurements (that is, the nervous system cannot respond).

The above-mentioned measuring instrument is called an AMI (Apparatus for measuring the functioning of the Meridians and their corresponding Internal organs) and is commercially available. Details of this instrument are described elsewhere.[11,13]

Measurement of Electrical Properties at Well Points

In asthmatic patients, the first measurements were performed during acute asthma. Thereafter, treatment by infusion of corticosteroids and aminophylline was initiated. Measurements were carried out in the sitting position. Clinical recovery from acute episodes was diagnosed by subjective improvement of dyspnea and improvement

of respiration on auscultation. The 2nd electrical recordings were then acquired after clinical recovery. In most cases, it took a few hours to recover from acute asthma, although in a few cases the patient had to be admitted to hospital and took several days to recover. Patients with acute moderate asthma were able to walk from the consultation room to the laboratory to undergo measurements of electrical properties, but those with acute severe asthma were transferred in a wheelchair and underwent measurements of electrical properties in the wheelchair.

The amounts of corticosteroids and aminophylline used in acute moderate and severe asthma were averaged for each group. In those cases where it took a few days to recover, the amounts of these drugs given on the 1st day were used to calculate mean values. In the control group, the 2nd measurements were done on one or a few days after the 1st measurements.

Data presentation and analysis

Data on the 3 parameters BP, IQ and AP measured at 28 Well points were obtained. From these bilateral data, mean values of right and left sides ((left+right)/2) and right-to-left (left - right) differences of each Well point were calculated in each patient. These values at each Well point were then averaged for the 3 (control, acute moderate and severe asthma) groups. Thus 3×2×14 = 84 sets of data were obtained in each group. We sought parameters which were related to acute asthma. Written informed consent was obtained from all patients, and the study was approved by the Ethics Committee of NHO Tokyo Hospital.

Statistical Analysis

Student's paired t-test (one tailed) was used to compare variables. P-values <0.05 were taken as significant

RESULTS

Patients with acute moderate asthma (N=22) were treated with corticosteroid (equivalent to hydrocortisone, Mean(SE)) 416(90) (range, 80~1825) mg and aminophylline 174(13) (80~250) mg intravenously), while in cases of acute severe asthma (N=5) these doses were 680(194) (300~1375) mg 250(39) (125~375) mg, respectively (not significant, p>0.05). Time intervals between the 2 measurements of the electrical properties at Well points in the acute moderate and acute severe asthma groups were 2.6(2.0) (1.0~6.8) and 36.1(27.3) (1.4~143) hrs, respectively. These values for non-asthmatic healthy controls were 41.5(4.7) (22~98) hrs. None of the patients with acute moderate asthma was admitted to hospital, but 2 of the 5 severe cases had to be admitted. One had recovered the next day and the other after several days.

No significant changes of mean IQ and BP values relating to acute asthma were seen at any Well point (Tables 1 and 2). On the other hand, the right-to-left IQ difference at the LV (Liver) Well point (IQ(L-R)LV) before treatment was significantly greater than after treatment in both acute moderate and severe asthma (Table 3). This difference at the LV Well point (⊿IQ(L-R)LV) was greater in severe than moderate asthma (Fig. 2). The right-to-left IQ value differ-

Table 1. Mean IQ values of 14 Well points during and after acute asthma

	Control			Acute Moderate Asthma			Acute Severe Asthma		
N	33			22			5		
	1st meas.	2nd meas.	p	before tr.	after tr.	p	before tr.	after tr.	p
LU	1803(68)	1786(139)	ns	1673(112)	1661(123)	ns	1727(188)	1770(271)	ns
LI	1443(53)	1344(53)	ns	1532(111)	1562(111)	ns	1621(249)	1880(358)	ns
HC	1491(63)	1464(90)	ns	1546(113)	1567(111)	ns	1598(137)	1792(217)	ns
DI	1627(78)	1482(71)	<0.01	1590(125)	1595(123)	ns	1776(340)	1729(301)	ns
TH	1548(66)	1450(73)	ns	1552(101)	1565(109)	ns	1616(121)	1594(245)	ns
HT	603(75)	1470(66)	ns	1603(114)	1550(106)	ns	1875(271)	1919(392)	ns
SI	1504(64)	1448(71)	ns	1498(96)	1478(102)	ns	1630(150)	1587(207)	ns
SP	1739(63)	1763(68)	ns	1871(119)	1921(116)	ns	1790(220)	1733(207)	ns
LV	1822(74)	1822(84)	ns	1973(137)	2000(132)	ns	1854(298)	2000(273)	ns
ST	1660(64)	1664(75)	ns	1800(133)	1762(117)	ns	1608(214)	1651(245)	ns
SB	2117(95)	2117(111)	ns	2742(196)	2641(161)	ns	2634(292)	2696(373)	ns
GB	1713(55)	1755(111)	ns	1842(105)	1916(110)	ns	1936(163)	1908(254)	ns
KI	1778(58)	1885(64)	ns	1869(105)	1858(114)	ns	1660(150)	1709(212)	ns
UB	1526(56)	1525(64)	ns	1665(90)	1680(95)	ns	1648(157)	1653(191)	ns

No significant change of mean IQ values related to acute asthma was seen at any Well point.
Unit of IQ: 10pF
tr.: treatment meas.: measurement
Before tr and after tr refers to during and after acute asthma, respectively.

Table 2. Mean BP values of 14 Well points during and after acute asthma

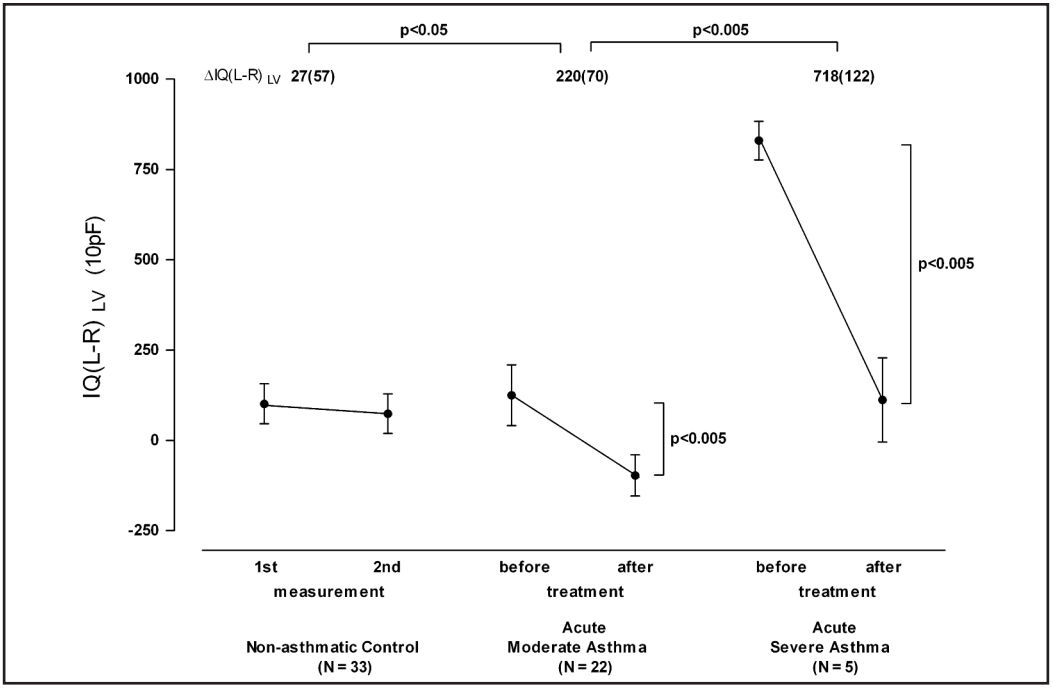
	Control			Acute Moderate Asthma			Acute Severe Asthma		
N	33			22			5		
	1st meas.	2nd meas.	p	before tr.	after tr.	p	before tr.	after tr.	p
LU	1756(33)	1654(36)	ns	1907(64)	1898(69)	ns	1640(134)	1778(101)	ns
LI	1264(33)	1197(35)	ns	1445(68)	1480(64)	ns	1309(189)	1416(144)	ns
HC	1263(32)	1222(37)	ns	1441(60)	1456(60)	ns	1273(84)	1398(82)	ns
DI	1389(29)	1326(34)	ns	1578(56)	1577(53)	ns	1371(125)	1424(85)	ns
TH	1328(25)	1289(28)	ns	1522(52)	1526(58)	ns	1377(98)	1392(94)	ns
HT	1432(30)	1360(33)	ns	1654(60)	1621(61)	ns	1395(85)	1512(100)	ns
SI	1337(28)	1311(27)	ns	1496(58)	1476(57)	ns	1313(93)	1385(87)	ns
SP	1521(46)	1567(46)	ns	1692(74)	1741(69)	ns	1533(110)	1616(137)	ns
LV	1614(45)	1625(51)	ns	1773(82)	1786(73)	ns	1493(172)	1748(81)	ns
ST	1386(40)	1386(42)	ns	1586(65)	1550(59)	ns	1299(137)	1408(123)	ns
SB	1453(38)	1380(41)	ns	1585(66)	1569(62)	ns	1366(96)	1524(133)	ns
GB	1487(36)	1519(45)	ns	1602(69)	1610(58)	ns	1519(74)	1636(121)	ns
KI	1538(40)	1601(47)	ns	1606(66)	1600(69)	ns	1398(164)	1481(153)	ns
UB	1411(36)	1435(43)	ns	1481(57)	1463(56)	ns	1361(94)	1504(149)	ns

No significant change of mean BP values related to acute asthma was seen at any Well point.
unit of BP: μΛ

Table 3. Right to left IQ differences of 14 meridians during and after acute asthma

	Control			Acute Moderate Asthma			Acute Severe Asthma		
N		33			22			5	
	1st meas.	2nd meas.	p	before tr.	after tr.	p	before tr.	after tr.	p
LU	17(52)	-219(256)	ns	-19(56)	64(46)	ns	134(51)	-162(159)	
LI	24(39)	37(37)	ns	-78(40)	33(39)	ns	167(174)	284(363)	
HC	178(49)	21(152)	ns	77(51)	62(54)	ns	161(144)	173(100)	ns
DI	38(57)	-30(42)	ns	-122(59)	-81(55)	ns	17(258)	55(178)	ns
TH	-102(40)	-66(45)	ns	-160(68)	-21(63)	ns	-66(164)	-168(125)	ns
HT	-41(78)	-63(52)	ns	-111(74)	-136(50)	ns	41(124)	93(134)	ns
SI	-38(39)	8(50)	ns	-165(64)	-138(70)	ns	-194(142)	-125(145)	ns
PS	86(55)	87(49)	ns	123(68)	68(72)	ns	-45(131)	-1(130)	ns
LV	102(53)	63(54)	ns	124(84)	-96(56)	<0.005	830(53)	112(116)	<0.005
ST	13(40)	0(47)	ns	-22(44)	-46(54)	ns	174(185)	195(189)	ns
SB	0(53)	-73(46)	ns	-138(68)	-66(73)	ns	-21(83)	12(72)	ns
GB	-3(51)	-62(48)	ns	110(82)	-52(70)	ns	174(136)	166(114)	ns
KI	-138(56)	-67(48)	ns	-84(77)	-102(80)	ns	107(66)	102(66)	ns
UB	29(37)	120(54)	ns	-93(73)	-56(57)	ns	-95(198)	79(158)	ns

*Figure 2. Right-to-left differences of IQ values at Liver (LV) Well points (IQ(L-R)LV) and the differences between 1st (before treatment) and 2nd (after treatment) measurements (**Δ**IQ(L-R)LV). Closed circles and bars represent M±SE. **Δ**IQ(L-R)LV is expressed as M±SE. Numerals in the figure show M(SE) of **Δ**IQ(L-R)LV.*



ence seen at the LV Well point before treatment was due to both a decrease of IQ values at the right LV Well point and an increase of IQ values at the left LV Well point during acute asthma (Fig. 3). The right-to-left BP difference at the LV Well point (BP(L-R)LV) before treatment was also significantly greater than after treatment in acute severe asthma (Table 4, Fig. 4). Mean AP values and right-to-left AP differences did not change at the Well points of any meridians (data not shown).

DISCUSSION

It is shown here that asymmetry of IQ values at LV Well points appears in both acute moderate and severe asthma, and asymmetry of BP values in acute severe asthma. IQ values represent electrical capacitance just beneath Well points and are determined by the electrical properties of the tissues there. BP values, reflecting electrical resistance between the Well points and the indifferent electrodes, are determined mostly by electrical properties along the meridians.[11,12] Therefore, the results presented here show that the electrical properties at LV Well points were altered asymmetrically by acute asthma, and then propagated along the LV meridian proximally, in relation to the degree of severity of the acute asthma.

Figure 3. IQ values at right and left Liver (LV) Well points at 1st (before treatment) and 2nd (after treatment) measurements.
IQ(L)LV and IQ(R)LV are expressed as M+SE and M-SE, respectively.

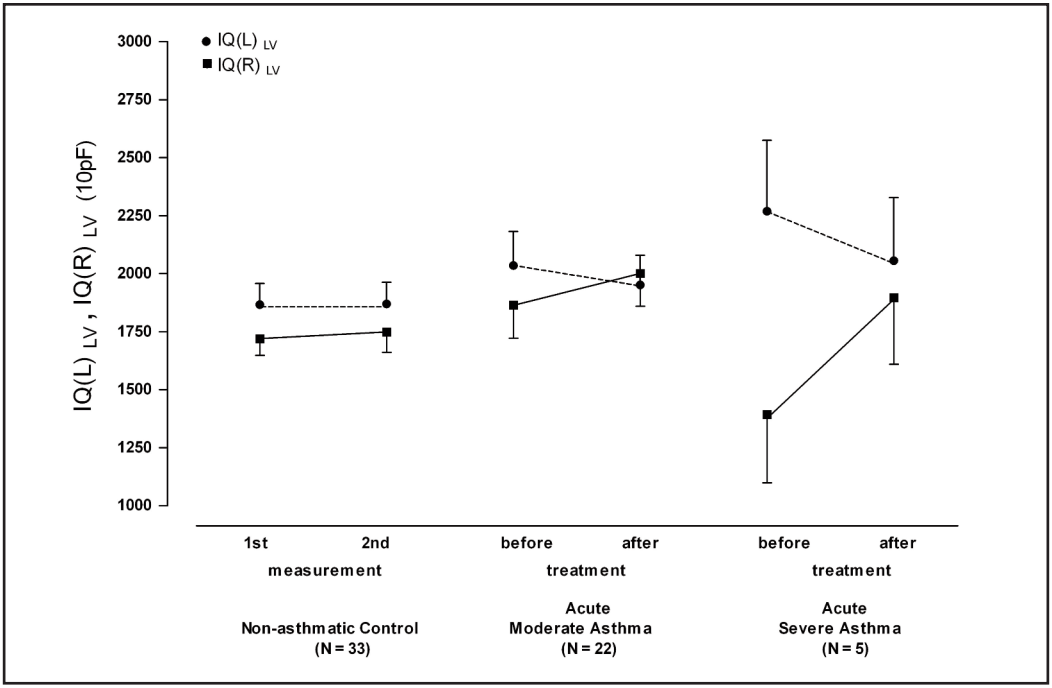
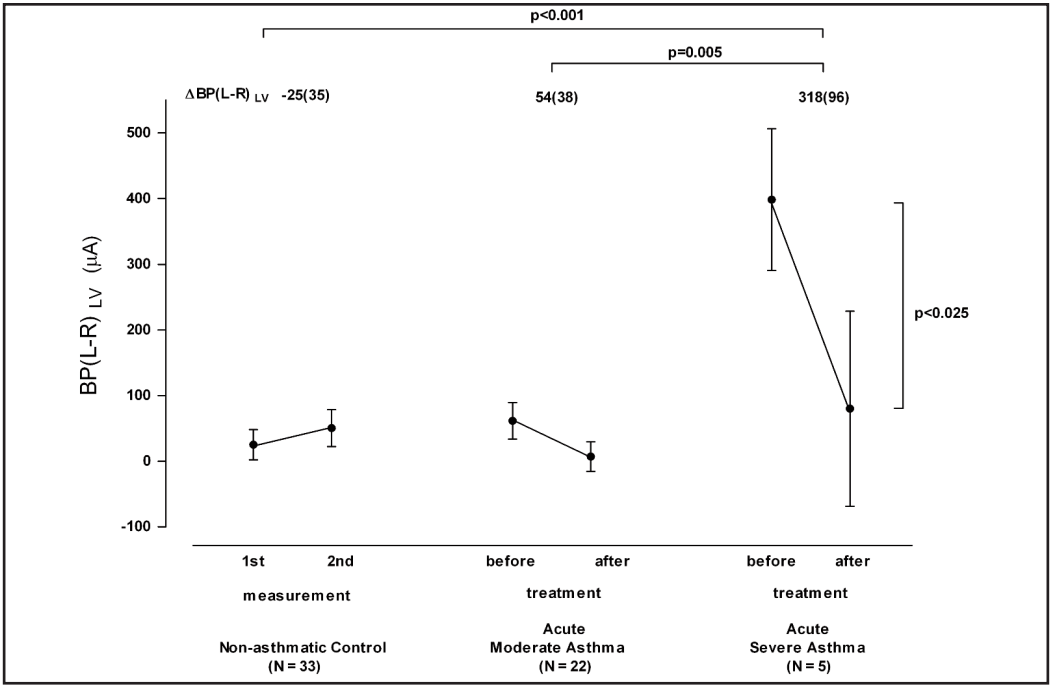


Table 4. Right to left BP differences of 14 meridians during and after acute asthma

	Control			Acute Moderate Asthma			Acute Severe Asthma		
N		33			22			5	
	1st meas.	2nd meas.	p	before tr.	after tr.	p	before tr.	after tr.	p
LU	-48(26)	-62(24)	ns	-34(27)	36(32)	ns	-36(132)	4(91)	ns
LI	-22(29)	8(26)	ns	-20(31)	5(26)	ns	-65(95)	-60(37)	ns
HC	153(29)	116(26)	ns	152(40)	121(33)	ns	76(120)	112(32)	ns
DI	0(23)	11(28)	ns	-52(23)	-31(24)	ns	-153(76)	-36(72)	ns
TH	-45(23)	3(16)	ns	-28(34)	0(22)	ns	-3(61)	-11(36)	ns
HT	-88(13)	-52(24)	ns	-12(27)	-34(24)	ns	-112(75)	-36(36)	ns
SI	-39(23)	2(34)	ns	-39(36)	-43(34)	ns	-48(94)	-25(38)	ns
SP	28(23)	52(20)	ns	49(27)	49(21)	ns	-11(25)	48(66)	ns
LV	24(22)	46(27)	ns	61(27)	7(22)	ns	398(108)	80(148)	<0.025
ST	-5(21)	-12(17)	ns	-14(34)	-9(31)	ns	51(123)	65(130)	ns
SB	-31(23)	-12(27)	ns	-14(28)	2(35)	ns	-5(72)	-36(53)	ns
GB	-7(19)	-13(20)	ns	37(24)	-33(23)	ns	46(53)	51(31)	ns
KI	-64(20)	-46(28)	ns	-33(28)	-30(25)	ns	60(90)	41(24)	ns
UB	-17(28)	57(28)	ns	-5(37)	30(32)	ns	-99(82)	88(55)	ns

Figure 4. Right-to-left differences of BP values at Liver (LV) Well points (BP(L-R)LV) and the differences between 1st (before treatment) and 2nd (after treatment) measurements (ΔBP(L-R)LV). Closed circles and bars represent M±SE. ΔBP(L-R)LV is expressed as M±SE. Numerals in the figure also show M(SE) of ΔBP(L-R)LV. Numerals in the figure show M(SE) of ΔIQ(L-R)LV.



IQ values at Lung (LU) Well points are decreased by the employment of flexible fiberoptic bronchoscopic procedures, such as transbronchial lung biopsy (TBLB) and bronchial brushing, curetting and washing.[12] Not only IQ values at LU Well points but also those at 6 other Well points in the upper limbs are decreased by the procedure of broncho-alveolar lavage (BAL), while BP values are decreased only at LU Well points by BAL.[12] In patients with mild drug-induced hepatitis caused by anti-tuberculosis drugs IQ values at liver Well points were decreased simultaneously with elevation of serum level of hepatic enzymes, and recovered simultaneously with decrease of serum level of hepatic enzymes.[14] In a patient with acute severe viral hepatitis, IQ values were increased at the right LV Well point and subsequently, a week later, at the left LV Well point during recovery.[15] These findings illustrate the intimate relationships between an organ and the corresponding meridian. Therefore, in the context of the meridian reactions described above, our results may indicate that some disturbances occur in the liver during acute asthma. What kind of disturbances in the liver may these be? Firstly, the serum level of several enzymes is not uncommonly increased in acute asthma. High levels of serum aspartate transaminase (AST), lactate dehydrogenase (LDH), and creatinine kinase (CK) are well known. Although the origin of AST and LDH is not sufficiently understood, it is believed that liver dysfunction contributes to these phenomena to some degree.[16, 17] However, it has not been shown that serum levels of these enzymes are correlated with severity of acute asthma. Secondly, metabolism in the liver may be altered during acute asthma. For example, it was shown that the concentration of high density lipoprotein cholesterol increased and that the concentration of total cholesterol decreased during acute asthma episodes in children.[18] Another explanation is that the metabolic rate in the liver decreases during acute asthma.

It is perhaps surprising that no parameters at the LU Well points showed any statistically significant changes during acute asthma. This may indicate that in acute asthma, the lung meridian reaction is not prominent. In this context it is interesting to note that claims that acupuncture is effective in the treatment of asthma are not based on the results of well-performed clinical trials, and that it may not in fact be effective.[4,19] In acute asthma the effect of acupuncture is, if present at all, usually less than that achieved with a beta agonist.[6] Although our measurement system does not encompass all of the meridian reactions, a lack of response at LU Well points observed here may parallel the low efficacy of acupuncture in acute asthma.

Our findings indicated that the more severe the acute asthma was, the larger the asymmetry of IQ values at the LV Well points. In a case with acute severe asthma, subsiding only over several days, there was an accompanying simultaneous gradual improvement of asymmetry in the IQ value at LV Well points. This may suggest that measurements of IQ values at LV Well points, derived from the ideas of Eastern medicine, may be an indicator of severity during acute asthma.

• • •

ACKNOWLEDGEMENTS:
The authors thank Dr. H. Ariga for his contribution to drawing the figures.

CORRESPONDENCE: Naohiro Nagayama, M.D.
Division of Respiratory Medicine,
National Hospital Organization Tokyo Hospital,
Takeoka 3-1-1, Kiyose City, Tokyo, 204-8585, Japan
Telephone: 042-491-2111
Fax: 042-494-2168
E-mail address: nagayama-in@tokyo-hosp.jp

REFERENCES & NOTES

1. Schäfer T. Epidemiology of complementary alternative medicine for asthma and allergy in Europe and Germany. *Ann Allergy Asthma Immunol* **93** (2004) pp. 5-10.
2. Bielory L. Complementary medicine for the allergist. *Allergy Asthma Proc* **22** (2001) pp. 33-37.
3. Passalacqua G, Bousquet PJ, Carlsen K-H, Kemp J, Lockey RF, et al. ARIA update: I -Systematic review of complementary and alternative medicine for rhinitis and asthma. *J Allergy Clin Immunol* **117** (2006) pp. 1054-62.
4. Kleijnen J, Riet G ter, Knipschild P. Acupuncture and asthma: a review of controlled trials. *Thorax* **46** (1991) pp. 799-802.
5. Martin J, Donaldson ANA, Villarroel R, Palmar MKB, Ernst E, Higginson IJ. Efficacy of acupuncture in asthma: systematic review and meta-analysis of published data from 11 randomised controlled trials. *Eur Respir J* **20** (2002) pp. 846-852.
6. Yu DYC, Lee SP. Effect of acupuncture on bronchial asthma. Clin Sci Mol Med 1976; 51: 503-9.
7. Chu KA, Wu YC, Ting YM, Wang HC, Lu JY, Acupuncture therapy results in immediate bronchodilating effect in asthma patients. J Chi Med Assoc 2007; 70: 265-8.
8. Ho M-W, Knight DP. The acupuncture system and the liquid crystalline collagen fibers of the connective tissues. Am J Chin Med 1998; 26: 251-263.
9. Langevin HM, Yandow JA. Relationship of acupuncture points and meridians to connective tissue planes. The Anatomical Record(New Anat.) 2002; 269: 257-265.
10. Xinnong, C. ed. Chinese acupuncture and moxibustion. Foreign Languages Press, Beijing, 1987, pp. 55-58.
11. Motoyama, H. Measurement of Ki energy. Diagnosis & treatments. Treatment principles of oriental medicine from an electrophysiological viewpoint. Human Science Press, Tokyo, Japan, 1997.
12. Nagayama N, Motoyama H: Electrical properties of skin along meridians in the extremities before and after flexible fiberoptic bronchoscopy. Subtle Energy & Energy Medicine 2006; 17: 35-48.
13. Tiller WA: What do electrodermal diagnostic acupuncture instruments really measure. Am J Acup 1987; 15:15-23.
14. Nagayama N, Motoyama H: Electrical properties in the extremities along meridians in patients with unilateral pulmonary tuberculosis. Subtle Energy & Energy Medicine 2007; 18: 9-19.
15. Motoyama, H. Comparison of diagnostic methods in Western and Eastern medicine. Human Science Press, Tokyo, 1999, p94-95.
16. Usher DJ, Shephrd, Deegan T: Serum lactate dehydrogenase isoenzyme activities in patients with asthma. Trorax 1974; 29: 685-689.
17. Karetzky MS: Blood studies in untreated patients with acute asthma. Am Rev Respir Dis 1975; 112: 607-613.
18. Shenoi A, Kumar L, Sarihyan S, Gangully NK: High density lipoprotein cholesterol and total cholesterol in children with asthma and allergic rhinitis. Acta Paediatr 1992; 81: 150-152.
19. Lane DJ. Alternative and complementary medicine for asthma [editorial]. Thorax 1991; 46: 787-97.