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"FALLING VALUES": ARTIFACTS OR SOURCE OF UNIQUE INFORMATION? Drastically low electrical conductivity of acupuncture points is accompanied by significant deviations of EEG, HRV, immunity, metabolism and GDV parameters

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Abstract

Background.
With this article, we start the project "Functional relationships between the parameters of acupuncture points and the neuro-endocrine-immune network", thereby joining the construction of a bridge between the Western and Eastern paradigms of medicine.
Materials and methods. The object of observation were 10 women (32-76 years) and 10 men (37-67 years) examined twice with a weekly interval. The volunteers were considered practically healthy, but the initial testing revealed deviations from the norm in a number of parameters of the neuro-endocrine-immune (NEI) network as a manifestation of maladaptation. We recorded electrical conductivity in acupuncture points (AP) Pg(ND), TR(X) and MC(AVL) as well as parameters of NEI network, gas discharge visualization (GDV) and metabolism.
Results. The preliminary analysis of the parameters revealed in the female SO drastic deviations from both the reference and the average for the sample, the levels of electrical conductivity of three pairs of AP - that is, the so-called "falling values", which are usually removed from the subsequent analysis as artifacts. However, we found the same drastic or significant deviations of a number of other parameters of GDV, EEG, HRV, adaptation hormones, immunity and metabolism in this patient. Therefore, the registered drastic decrease in electrical conductivity of AP is by no means an artifact, but reflects the peculiarities of the NEI network, GDV and metabolism of the patient's body during the first examination. It is significant that upon re-examination, the deviations of the parameters significantly or completely approached the range of the average for the sample ± SD or the norm ± SD.
Conclusion. The above gives us a reason to initiate a broad discussion of the problem of "falling variables" as carriers of unique information that is ignored and lost.

***Keywords*:** acupuncture points, GDV, EEG, HRV, adaptation hormones, immunity, metabolism, relationships.

INTRODUCTION

Acupuncture, originating in China, can be traced back to more than 2500 years. It is one of the most time-honored treatment methods and an indispensable component of Traditional Chinese Medicine. It is practiced by inserting and twisting acupuncture needles in multiple directions and speeds, aiming to cure diseases under the theory of traditional Chinese medicine. Currently, acupuncture has been accepted to a certain extent throughout the world. According to the traditional medicine strategy of the World Health Organization (WHO) (2014–2023), 183 countries around the world have launched acupuncture projects. However, it is challenging to obtain a widespread understanding of its effect. The unclear mechanism of acupuncture impedes its extensive application [17,19].

Compared with Western medicine, acupuncture is a physical stimulus that restores normal function by adjusting the internal environment and rebuilding physiological homeostasis, instead of directly acting on the pathogen. Besides, acupuncture is both **holistic** and bidirectional [19]. This also makes summarizing the mechanism of acupuncture based on a **single** factor or system impossible.

MATERIAL AND RESEARCH METHODS

The object of observation were 10 women (32-76 years) and 10 men (37-67 years) examined twice with a weekly interval. The volunteers were considered practically healthy (without a clinical diagnosis), but the initial testing revealed deviations from the norm in a number of parameters of the NEI network (details follow) as a manifestation of maladaptation, which actually prompted them to participate in the study with the hope of recovery.

The battery of tests was created in line with concepts NEI network [50] and functional-metabolic continuum [23].

The day before, daily urine was collected, in which was determined the concentration of electrolytes: calcium (by reaction with arsenase III), magnesium (by reaction with colgamite), phosphates (phosphate-molybdate method), chloride (mercury-rhodanidine method), sodium and potassium (flamming photometry) as well as nitric metabolites: creatinine (by Jaffe's color reaction by Popper's method), uric acid (uricase method) and urea (urease method by reaction with phenolhypochlorite). The analysis carried out according to instructions [22] with the use of analyzers "Reflotron" (BRD) and "Pointe-180" (USA) and corresponding sets of reagents.

In the morning in basal condition we recorded electrical conductivity in follow acupuncture points: Pg(ND), TR(X) and MC(AVL) at Right and Left side, which represents the nervous, endocrine and immune systems respectively. Used complex “Medissa”. For each pair, the Laterality Index (LI) was calculated using formula [46]:

LI, % = 200•(Right – Left)/(Right + Left)

Then we registered kirlianogram by the method of GDV using the device “GDV Chamber” (“Biotechprogress”, SPb, RF). The first base parameter of GDV is Area of gas discharge image (GDI) in Right, Frontal and Left projections registered both with and without polyethylene filter. The second base parameter is a coefficient of shape (ratio of square of length of external contour of GDI toward his area), which characterizes the measure of serration/fractality of external contour. The third base parameter of GDI is Entropy, id est measure of chaos. It is considered that GDI, taken off without filter, characterizes the functional changes of organism, and with a filter characterizes organic changes [32,34].

Next we recorded simultaneosly electrocardiogram (ECG) and quantitative electroencephalogram (EEG). ECG recorded during 7 min in II lead to assess the parameters of heart rate variability (HRV) (hardware-software complex "CardioLab+HRV" produced by "KhAI-Medica", Kharkiv, Ukraine). For further analysis the following parameters HRV were selected. Temporal parameters (Time Domain Methods): heart rate (HR), the standart deviation of all NN intervals (SDNN), the square root of the mean of the sum of the squares of differences between adjacent NN intervals (RMSSD), the percent of interval differences of successive NN intervals greater than 50 ms (pNN_{50}), triangular index (TNN). Spectral parameters (Frequency Domain Methods): power spectral density (PSD) bands of HRV: high-frequency (HF, range 0,4÷0,15 Hz), low-frequency (LF, range 0,15÷0,04 Hz), very low-frequency (VLF, range 0,04÷0,015 Hz) and ultralow-frequency (ULF, range 0,015÷0,003 Hz). We calculated classical indexes: LF/HF, LFnu=100%•LF/(LF+HF), Centralization Index (VLF+LF)/HF [5,8,26].

EEG recorded a hardware-software complex “NeuroCom Standard” (KhAI Medica, Kharkiv, Ukraine) monopolar in 16 loci (Fp1, Fp2, F3, F4, F7, F8, C3, C4, T3, T4, P3, P4, T5, T6, O1, O2) by 10-20 international system, with the reference electrodes A and Ref on the earlobes. Two minutes after the eyes had been closed, 25 sec of artifact free EEG data were collected by computer. Among the options considered the average EEG amplitude (μV), average frequency (Hz), frequency deviation (Hz), index (%), coefficient of asymmetry (%), absolute (μV^2/Hz) and relative (%) PSD of basic rhythms: β (35÷13 Hz), α (13÷8 Hz), θ (8÷4 Hz) and δ (4÷0,5 Hz) in all loci, according to the instructions of the device. In addition, calculated coefficient of Asymmetry (As) and Laterality Index (LI) for PSD each Rhythm using formulas:

$$As, \% = 100 \bullet (Max – Min)/Min; \quad LI, \% = \Sigma [200 \bullet (Right – Left)/(Right + Left)]/8.$$

We calculated for HRV and each locus EEG the Entropy (h) of normalized PSD using Popovych’s IL formulas [24,30,48,49] based on classic Shannon’s CE [53] formula:

$$hHRV= -[SPHF \bullet \log_2 SPHF+SPLF \bullet \log_2 SPLF+SPVLF \bullet \log_2 SPVLF+SPULF \bullet \log_2 SPULF]/\log_2 4;$$

$$hEEG = - [PSD\alpha \bullet \log_2 PSD\alpha+PSD\beta \bullet \log_2 PSD\beta+PSD\theta \bullet \log_2 PSD\theta+PSD\delta \bullet \log_2 PSD\delta]/\log_2 4.$$

At last in portion of venous blood we determined levels of main adaptation hormones such as Cortisol, Aldosterone, Testosterone, Triiodothyronine as well as Calcitonin and PTH (by the ELISA with the use of analyzer “RT-2100C” and corresponding sets of reagents from “Алкор Био”, XEMA Co, Ltd and DRG International Inc) as well as the same metabolic parameters.

Immune status evaluated as described in the manual [39]. For phenotyping subpopulations of lymphocytes used the methods of rosette formation with sheep erythrocytes on which adsorbed monoclonal antibodies against receptors CD3, CD4, CD8, CD25, CD22 and CD56 from company "Granum" (Kharkiv) with visualization under light microscope with immersion system. Subpopulation of T cells with receptors high affinity determined by test of “active” rosette formation. The state of humoral immunity judged by the concentration in serum of Immunoglobulins of classes G, A, M (ELISA, analyser “Immunochem”, USA) and circulating immune complexes (by polyethylene glycol precipitation method).

We calculated also the Entropy of Immunocytogram (ICG) and Leukocytogram (LCG) using formulas [24,30,48,49,50]:

$$hICG = - [CD4 \bullet \log_2 CD4 + CD8 \bullet \log_2 CD8 + CD22 \bullet \log_2 CD22 + CD56 \bullet \log_2 CD56]/\log_2 4;$$

$$hLCG = - [L \bullet \log_2 L + M \bullet \log_2 M + E \bullet \log_2 E + SNN \bullet \log_2 SNN + StubN \bullet \log_2 StubN]/\log_2 5.$$

Parameters of phagocytic function of neutrophils estimated as described by Kovbasnyuk MM [38]. The objects of phagocytosis served daily cultures of Staphylococcus aureus (ATCC N 25423 F49) as typical specimen for Gram-positive Bacteria and Escherichia coli (O55 K59) as typical representative of Gram-negative Bacteria. Take into account the following parameters of Phagocytosis: activity (percentage of neutrophils, in which found microbes - Hamburger’s Phagocytic Index PhI), intensity (number of microbes absorbed one phagocytes - Microbial Count MC or Right’s Index) and completeness (percentage of dead microbes - Killing Index KI).

Normal (reference) values of variables are taken from the instructions and/or database of the UkrSR Institute of Medicine of Transport [1,22,30,50].

For statistical analysis used the software package "Statistica 6.4".

RESULTS

The preliminary analysis of the parameters revealed in the female SO (age 32 years, height 163 cm, weight 67 kg) drastic deviations from both the reference and the average for the sample, the levels of electrical conductivity and it symmetry of three pairs of AP (Table 1) - that is, the so-called "falling values", which are usually removed from the subsequent analysis as artifacts. When re-testing after a week, the parameters of AP almost did not differ from the reference, so there were formal reasons to consider the results of the first test as an artifact. By chance, a significant increase in electrical conductivity was found across the sample, but this fact will be the subject of analysis in a subsequent article already prepared for publication.

Table 1. Summary of the analysis of discriminant functions in relation to the parameters of Acupuncture Points

Step 3, N of vars in model: 3; Grouping: 2 grps; Wilks' Λ: 0,3069; approx. $F_{(3,4)}$=27,9; $p<10^{-6}$

	Cases (n) and Means±SE				**Parameters of Wilks' Statistics**				
Variables currently in the model	**Extremal (1)**	***Re-test (1)***	**Others cases (38)**	***Reference (40)***	Wilks' Λ	Partial Λ	F-remove (1,37)	p-level	Tolerancy
MC(AVL) Right, units	42	56	63,9 0,7	*57,5* *0,4*	0,356	0,863	5,9	0,020	0,549
Pg(ND) Left, units	42	54	63,6 0,7	*57,5* *0,4*	0,427	0,719	14,4	0,001	0,107
Pg(ND) Right, units	46	54	64,0 0,9	*57,5* *0,4*	0,400	0,768	11,2	0,002	0,112
Variables currently not in the model	**Extremal (1)**	***Re-test (1)***	**Others cases (38)**	***Reference (40)***	Wilks' Λ	Partial Λ	F to enter	p-level	Tolerancy
MC(AVL) Left, units	45	*56*	64,0 0,6	*57,5* *0,4*	0,303	0,988	0,454	0,505	0,177
TR(X) Right, units	45	*56*	63,9 0,7	*57,5* *0,4*	0,307	0,999	0,035	0,852	0,279
TR(X) Left, units	44	*56*	63,7 0,7	*57,5* *0,4*	0,303	0,987	0,465	0,500	0,283
TR(X) Laterality, %	+2,2	*0,0*	+0,22 0,51	*-0,31* *0,51*					
Pg(ND) Laterality, %	+9,1	*0,0*	+0,43 0,48	*-0,51* *0,39*					
MC(AVL) Laterality, %	-6,9	*0,0*	-0,06 0,53	*-0,17* *0,30*					

Notes. Standard errors are given below the average values. The *Re-test and Reference* columns are not object to discriminant analysis.

Application of the method of discriminant analysis (method forward stepwise) [29] with the calculation of individual values of the discriminant root by raw coefficients and a constant (Table 2) made it possible to visualize the integral state of AP both in the SO patient and in other women and men (Fig. 1).

Table 2. Coefficients and constant for parameters of Acupuncture Points

Coefficients Variables	Standar-dized	Structural	Raw
MC(AVL) Right, units	0,601	0,771	0,145
Pg(ND) Left, units	1,943	0,712	0,440
Pg(ND) Right, units	-1,733	0,489	-0,325
		Constant	-16,10
$r^*=0,833$; Wilk's $\Lambda=0,307$; $\chi^2_{(3)}=44$; $p<10^{-6}$			
Squared Mahalanobis Distance=46,3; $F_{(3,4)}=28$; $p<10^{-6}$			

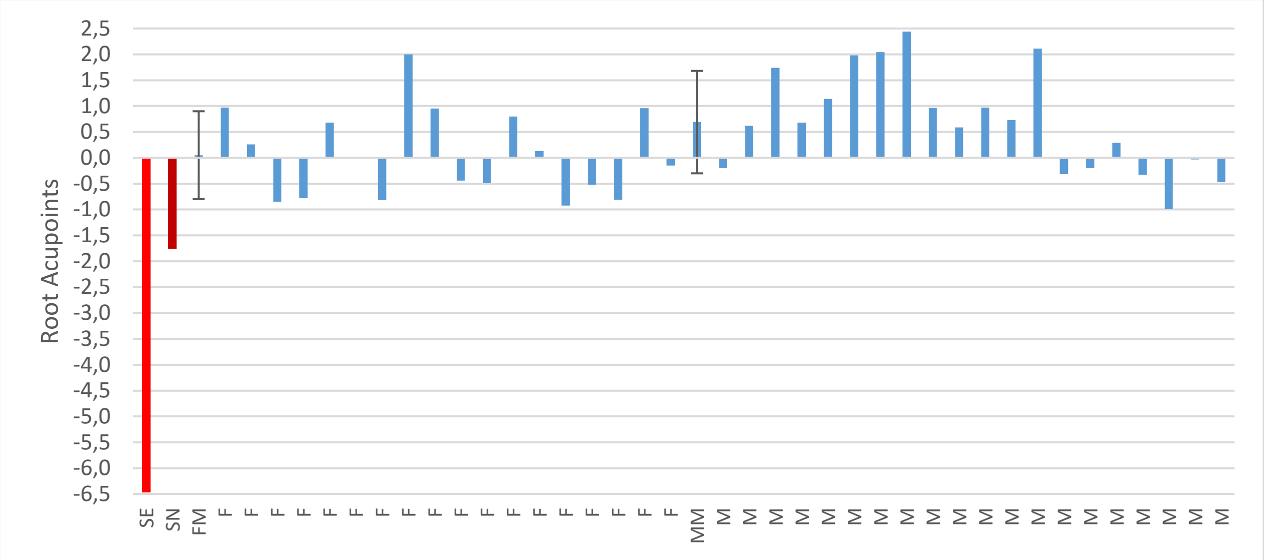

Fig. 1. Individual values of the discriminant root of the acupuncture points of patient S during the first and second testing, as well as the average (M±SD) and individual values of the other women (F) and men (M) of the sample

However, we found the same drastic or significant deviations of a number of other parameters of GDV, EEG, HRV, adaptation hormones, immunity and metabolism in this patient.

In particular, the testosterone level was 3.76 nM/L against the reference level of 2.37±0.24 nM/L and the average of other women in the sample of 2.76±0.23 nM/L. On the other hand, the calcitonin level was 1.53 ng/L against the reference level of 5.05±0.55 ng/L and the mean of the other women in the sample of 5.76±0.68 ng/L. Sex- and age-adjusted testosterone and calcitonin levels were in the normal range (Table 3).

In addition, patient SO had significantly higher than average levels of entropy HRV, vagal tone, PTH, blood eosinophils, serum sodium, chloride, and creatinine as well as phosphaturia, while lower than average levels of VLF band HRV, blood rod shaped neutrophils and circulating immune complex, as well as urine calcium, potassium and magnesium.

Table 3. Summary of the analysis of discriminant functions in relation to the parameters of Gas Discharge Visualization, Neuro-endocrine-immune network and Metabolism

Step 16, N of vars in model: 16; Grouping: 2 grps; Wilks' Λ: 0,218; approx. $F_{(16,2)}=5,4$; $p<10^{-4}$

	Cases (n) and Means±SE				Parameters of Wilks' Statistics				
Variables currently in the model	**Extremal (1)**	***Re-test (1)***	**Others cases (38)**	***Reference (40)***	Wilks' Λ	Partial Λ	F-remove (1,24)	p-level	Tolerancy
Testosterone normalized, Z	1,06	*-0,01*	-0,16 0,20	*0* *0,32*	0,254	0,859	3,945	0,059	0,561
Entropy of HRV bands	0,795	*0,729*	0,680 0,021	*0,807* *0,013*	0,219	0,996	0,087	0,771	0,662
Eosinophils, %	6	*4*	3,97 0,38	*2,75* *1,20*	0,373	0,585	17,03	10^{-4}	0,219
Sodium Serum, mM/L	146,5	*144,4*	143,1 1,4	*145,0* *0,8*	0,274	0,796	6,151	0,021	0,370
Chakra 5 Energy	0,07	*-0,01*	-0,02 0,05	*-0,04* *0,08*	0,245	0,891	2,948	0,099	0,194
Chakra 3 Energy	0,28	*0,01*	-0,09 0,05	*-0,08* *0,07*	0,360	0,606	15,62	0,001	0,145
Chakra 3 Asymmetry (f)	-0,10	*0,04*	-0,01 0,04	*-0,03* *0,03*	0,240	0,906	2,478	0,129	0,593
Calcitonin normalized, Z	-1,46	*-0,65*	-0,47 0,16	*0* *0,32*	0,434	0,502	23,80	10^{-4}	0,386
VLF band HRV, $msec^2$	905	*1245*	1233 156	*1211* *106*	0,221	0,987	0,313	0,581	0,452
Calcium Urine, mM/L	2,10	*2,30*	2,41 0,11	*3,13* *0,11*	0,232	0,941	1,504	0,232	0,469
Potassium Urine, mM/L	28,3	*40,0*	39.9 1,1	*46,4* *2,0*	0,284	0,767	7,301	0,012	0,475
Magnesium Urine, mM/L	1,80	*2,81*	2,55 0,16	*2,93* *0,12*	0,259	0,843	4,463	0,045	0,483
Rod shaped Neutrophils, %	2	*3*	3,11 0,18	*4,25* *0,21*	0,224	0,974	0,633	0,434	0,462
Entropy of GDI Left (f)	3,52	*3,67*	3,77 0,03	*3,68* *0,03*	0,227	0,959	1,028	0,321	0,544
Chakra 6 Energy (f)	-0,28	*-0,16*	-0,08 0,04	*-0,12* *0,05*	0,278	0,785	6,565	0,017	0,241
Circulat Immune Complex, un	29	*39*	37 2	*45* *3*	0,268	0,813	5,517	0,027	0,355
Variables currently not in the model	**Extremal (1)**	***Re-test (1)***	**Others cases (38)**	***Reference (40)***	Wilks' Λ	Partial Λ	F to enter	p-level	Tolerancy
RMSSD HRV, msec	35	*24*	25,1 2,8	*29,0* *2,2*	0,217	0,994	0,150	0,702	0,134
HF band HRV, $msec^2$	715	*351*	364 98	*342* *41*	0,218	1,000	0,002	0,965	0,205
Parathyroid hormone, pM/L	3,30	*2,96*	3,06 0,11	*3,75* *0,14*	0,216	0,972	0,220	0,640	0,410
Phosphaturia, mM/24 h	20,1	*15,3*	15,5 1,5	*25,2* *1,2*	0,216	0,991	0,217	0,646	0,408
Chloride Serum, mM/L	104,6	*103,0*	101,9 1,1	*101,5* *0,5*	0,220	0,990	0,050	0,800	0,550
Creatinine Serum, µM/L	83	*78*	77,2 1,3	*84,0* *2,4*	0,218	0,998	0,046	0,832	0,598

VLF band HRV, %	33,2	*58,3*	54,6 2,9	*54,2* *2,4*	0,230	0,990	0,660	0,429	0,200
Area Frontal of GDI (f), kPixels	26,18	*27,23*	27,38 0,43	*26,89* *0,46*	0,218	0,998	0,040	0,843	0,254
Entropy of GDI Left	3,65	*3,73*	3,77 0,03	*3,75* *0,02*	0,215	0,985	0,355	0,557	0,418

Unlike HF band HRV, which is generally accepted as a marker of vagal tone, the interpretation of VLF band HRV remains a subject of debate. Taylor JA et al. [54] in young healthy subjects observed that β-adrenergic blockade had no significant effect on VLF power; ACE blockade modestly (approximately 21%) increased VLF power in the supine (but not upright tilt) position; atropine, given alone or with atenolol, decreased VLF band by 92%. Authors concluded that although VLF band are influenced by the renin-angiotensin-aldosterone system, they depend primarily on the presence of parasympathetic outflow. However, del Valle-Mandragon L et al. [18] showed that during hemodialysis angiotensin II had a positive correlation with VLF band (r=0.390) and with LF/HF (r=0.359) while a negative correlation with LF (r=-0.262) and HF (r=-0.383) bands. Therefore, the contradictions regarding the nature of VLF connections with vagal and sympathetic tone as well as the renin-angiotensin-aldosterone system remain unresolved. Besides it was shown that low VLF power has been correlated with low levels of testosterone, while cortisol have not [55]. In our group study [31], was also found a direct correlation of **absolute** PSD VLF band with the HF band (r=0.65) and plasma testosterone in men (r=0.32), no correlation with LFnu (r=-0.16) as well as also inversely, but insignificantly, with aldosterone (p=-0.19). However, the **relative** PSD of VLF band correlates negatively with markers of vagal tone (r=-0.44÷-0.54), but positively with the stress index (r=0.27) and AMo (r=0.31), as well as cortisol (r=0.44) in the complete absence of a connection with both aldosterone (r=-0.05) and testosterone (r=-0.03). So, in this specific situation, the **relative** PSD of VLF band acts as a marker of sympathetic tone and cortisol [52]. In other situation, a decrease in **relative** PSD of VLF band was accompanied by a decrease in LF/HF (r=0.34) and testosterone level (r=0.26) in combination with an increase in relative PSD of HF (r=-0.60), i.e. it is a marker of sympathetic tone and testosterone [60].

One gets the impression that in this particular situation the VLF band reflects a sympathetic tone.

The increased Energy level of the **fifth** Chakra of patient SO is perfectly consistent with the increased level of PTH, and the increased Energy level of the **third** Chakra, which is connected to the **Spleen** and innervates its **celiac plexus ganglion**, is most likely related to the levels of eosinophils, rod shaped neutrophils and circulating immune complex. We will postpone the discussion of other GDV parameters to the next set.

The calculation of the individual values of the discriminant root by the coefficients and the constant (Table 4) visualizes, firstly, the drastic deviation of the parameters of GDV, HRV, Hormones, Immunity and Metabolism of patient SO from such other women and men of the sample, and secondly, the complete leveling of the integral condition of patient SO during repeated testing (Fig. 2).

Table 4. Coefficients and constant for parameters of GDV, HRV, Hormones, Immunity and Metabolism

Coefficients Variables	Standar-dized	Structural	Raw
Potassium Urine, M/L	0,793	0,206	0,121
Calcitonin normalized, Z	1,284	0,121	1,338
Rod shaped Neutrophils, %	-0,267	0,116	-0,241
Entropy of GDI Left (f)	0,311	0,106	1,751
Magnesium Urine, mM/L	0,644	0,095	0,690
Chakra 6 Energy (f)	1,068	0,087	4,080
Circulat Immune Complex, un	0,820	0,072	0,061
Calcium Urine, mM/L	-0,401	0,052	-0,583
VLF band HRV, msec^2	0,191	0,041	0,0002
Chakra 3 Asymmetry (f)	-0,449	0,047	-1,896
Chakra 3 Energy	-1,865	-0,137	-5,894
Testosterone normalized, Z	-0,567	-0,117	-0,468
Entropy of HRV bands	-0,083	-0,107	-0,672
Eosinophils, %	-1,558	-0,104	-0,686
Sodium Serum, mM/L	-0,839	-0,045	-0,122
Chakra 5 Energy	0,849	-0,035	2,788
		Constant	3,074
r*=0,884; Wilk's Λ=0,218; $\chi^2_{(16)}$=47; p<10^{-4}			
Squared Mahalanobis Distance=73,5; $F_{(16,2)}$=5,4; p=10^{-4}			

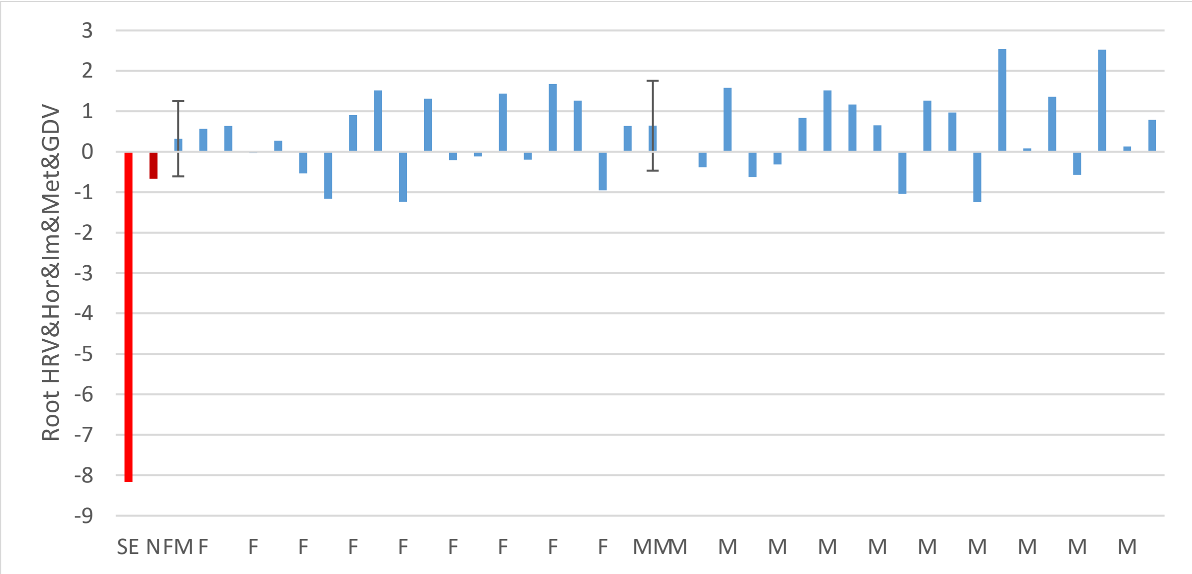

Fig. 2. Individual values of the discriminant root of the GDV and NEI network parameters of patient S during the first and second testing, as well as the average (M±SD) and individual values of the other women (F) and men (M) of the sample

The decreased Energy level of the sixth Chakra, which is connected to the **brain**, apparently related to both increased levels of PSD of delta-rhythm and decreased levels of PSD of beta- and alpha-rhythms EEG (Table 5).

Table 5. Summary of the analysis of discriminant functions in relation to the parameters of EEG

Step 10, N of vars in model: 10; Grouping: 2 grs; Wilks' Λ: 0,100; approx. $F_{(10,3)}$=27,0; $p<10^{-6}$

	Cases (n) and Means±SE				Parameters of Wilks' Statistics				
Variables currently in the model	**Extremal (1)**	***Re-test (1)***	**Others cases (38)**	***Reference (112)***	Wilks' Λ	Partial Λ	F-remove (1,30)	p-level	Tolerancy
PSD Fp1-δ, μV²/Hz	1186	*146*	123 29	*58* *6*	0,471	0,212	111,4	10^{-6}	0,246
PSD F8-δ, μV²/Hz	399	*132*	180 45	*92* *14*	0,213	0,469	33,96	10^{-5}	0,202
PSD O1-δ, %	69,2	*35,6*	29,7 3,3	*23,5* *1,5*	0,105	0,953	1,488	0,232	0,521
PSD Fp2-β, μV²/Hz	81	*63*	53 6	*70* *6*	0,107	0,932	2,184	0,150	0,219
PSD F8-β, %	10,3	*21,5*	21,7 2,3	*29,4* *1,6*	0,130	0,769	9,015	0,005	0,365
PSD O2-β, μV²/Hz	37	*84*	86 10	*90* *5*	0,102	0,984	0,473	0,497	0,246
Amplitude α, μV	9,0	*14,0*	18,0 2,2	*17,4* *1,0*	0,117	0,857	5,026	0,033	0,164
Asymmetry α, %	12	*21*	21,9 2,0	*20,2* *1,1*	0,133	0,751	9,924	0,004	0,617
Asymmetry θ, %	102	*24*	30,8 3,6	*27,8* *1,8*	0,110	0,909	3,002	0,093	0,686
Laterality δ, %	-36	*-8,5*	-3,0 4,6	*2,5* *3,8*	0,110	0,906	3,100	0,088	0,702
Variables currently not in the model	**Extremal (1)**	***Re-test (1)***	**Others cases (38)**	***Reference (112)***	Wilks' Λ	Partial Λ	F to enter	p-level	Tolerancy
PSD Fp1-δ, %	86,0	*34,9*	32,3 3,5	*23,6* *1,5*	0,100	0,999	0,016	0,899	0,121
PSD P3-δ, %	55,5	*31,2*	35,7 3,3	*25,6* *1,7*	0,100	0,999	0,027	0,871	0,393
PSD O2-δ, %	54,0	*29,6*	30,5 3,0	*22,8* *1,6*	0,098	0,978	0,640	0,430	0,357
PSD Fp1-β, μV²/Hz	42	*77*	64 7	*63* *4*	0,099	0,993	0,245	0,624	0,183
PSD F3-β, μV²/Hz	54	*91*	77 7	*79* *5*	0,098	0,978	0,666	0,421	0,330
PSD C3-β, μV²/Hz	65	*108*	106 12	*93,5* *6*	0,099	0,992	0,236	0,631	0,295
PSD P3-β, %	13,3	*17,2*	19,5 1,5	*22,7* *1,1*	0,098	0,984	0,474	0,497	0,509
PSD P4-β, μV²/Hz	54	*87*	91 12	*89* *5*	0,100	0,998	0,064	0,802	0,119
PSD P4-α, μV²/Hz	96	*187*	284 60	*288* *36*	0,100	0,997	0,090	0,766	0,044
PSD P3-α, %	20,7	*34,9*	34,4 3,0	*42,7* *2,0*	0,100	0,999	0,019	0,890	0,240
PSD F7-θ, %	7,0	*10,5*	10,2 0,7	*10,0* *0,4*	0,099	0,986	0,398	0,533	0,841
PSD C3 Entropy	0,759	*0,813*	0,830 0,024	*0,862* *0,009*	0,099	0,992	0,238	0,630	0,620

The calculation of the individual values of the discriminant root by the coefficients and the constant (Table 6) visualizes, firstly, the drastic deviation of the parameters of EEG of patient SO from such other women and men of the sample, and secondly, the complete leveling of the integral condition of patient SO during repeated testing (Fig. 3).

Table 6. Coefficients and constant for parameters of EEG

Coefficients / Variables	Standardized	Structural	Raw
PSD Fp1-δ, μV²/Hz	-1,885	-0,443	-0,011
PSD O1-δ, %	0,317	-0,146	0,016
PSD F8-δ, μV²/Hz	1,710	-0,060	0,006
PSD Fp2-β, μV²/Hz	-0,587	-0,054	-0,016
Asymmetry θ, %	-0,384	-0,243	-0,018
PSD F8-β, %	0,838	0,060	0,060
PSD O2-β, μV²/Hz	0,265	0,059	0,004
Amplitude α, μV	0,985	0,050	0,074
Asymmetry α, %	0,669	0,060	0,055
Laterality δ, %	0,385	0,088	0,014
		Constant	-2,416
r*=0,949; Wilk's Λ=0,100; $\chi^2_{(10)}$=78; p<10^{-6}			
Squared Mahalanobis Distance=185; $F_{(10,3)}$=27; p<10^{-6}			

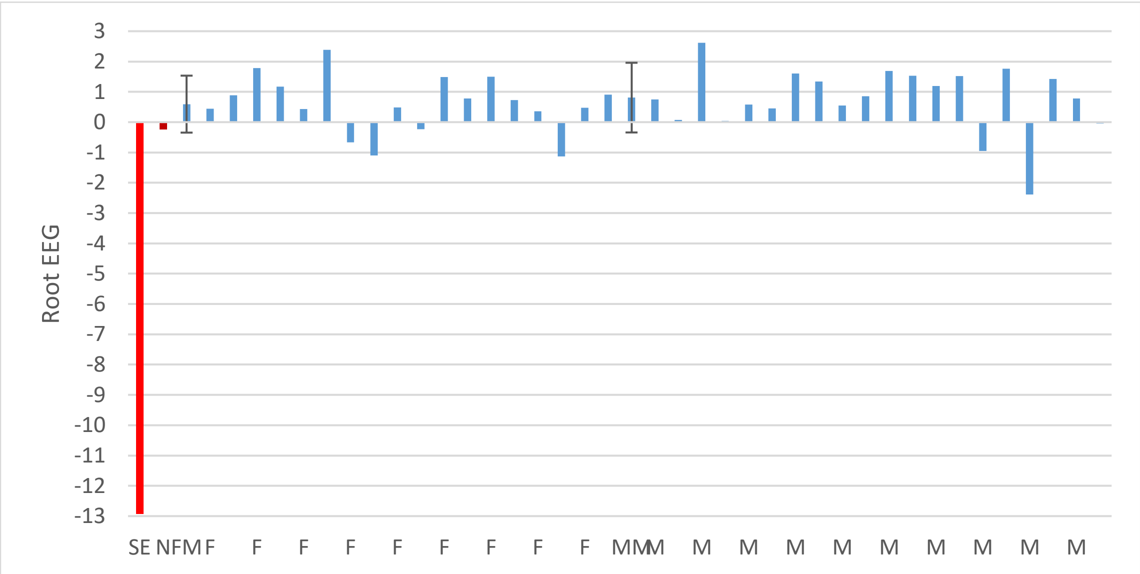

Fig. 3. Individual values of the discriminant root of the EEG parameters of patient S during the first and second testing, as well as the average (M±SD) and individual values of the other women (F) and men (M) of the sample

DISCUSSION

Modern scientific research has shown that the inherent regulatory system of the body is a **neuro-endocrine-immune (NEI) network**, including the nervous, endocrine and immune systems, which is the biological basis for maintaining the homeostasis of the body [9,10]. Under the dominant control of the central nervous system, the body's functions can be coordinated and regulated through the integration of the NEI network. The body can then respond adaptively to the stimulation of the internal and external environment to maintain a steady state. Following this novel concept, the primary research into acupuncture has gone further. At present, several studies have reported that acupuncture can regulate the body's function through adjusting the NEI network.

Ding SS et al. [19] suggested that the regulatory effect of acupuncture may be achieved through the NEI network. Therefore, authors reviewed the relevant studies on acupuncture's effects on the NEI network to find evidence that acupuncture regulates it and reveal the mechanism underlying acupuncture.

The direct feeling during acupuncture is ***de qi* (**in Chinese ***get it***), an internal composite sensation of soreness, numbness, heaviness, distension and aching, and a radiating sensation at and around the acupoints. The sensation of de qi is most closely related to nervous system. Therefore, most of these studies focus on nervous system. Many studies have found that acupuncture can directly or indirectly activate the nervous system, causing changes of functional activities in different levels of the nervous system, and then playing its modulatory role through release of related neurochemicals. The main form of nervous system functional activities is electrical activities. Electrophysiological studies of neural activities show that acupuncture stimulation can cause peripheral afferent nerve fibers to be excited [42]. On one hand, the excitement could be transmitted via spinal cord [28] to brain [25], and after central integration, efferent nerves [56] transfer information to the target organs. On the other hand, the excitement could be transmitted through axon reflex to target organs [6], eventually showing regulatory effect. Thus, acupuncture can cause discharge activities of different parts in nervous system, regulating nerve functions at different levels. In recent years, many studies of acupuncture effect on neural functional activities have introduced advanced noninvasive neuroimaging technologies, including positron emission tomography, single proton emission computerized tomography and functional magnetic resonance imaging. These powerful imaging technologies make it possible to visualize the anatomic and functional effects of acupuncture stimulation in the brain. Studies have shown that acupuncture can cause changes of activities in different functional areas of human or animal brain. It provides evidence that acupuncture can affect neurons functional activities in the brain [7].

Researches carried out in the past years have shown that acupuncture can affect synthesis, release and action of several neurotransmitters (such as serotonin, dopamine, catecholamine, glutamate, acetylcholine, etc.) and neuropeptides (such as oxytocin, neuropeptide Y, cholecystokinin, vasoactive intestinal peptide, substance P, calcitonin-gene-related peptide, pituitary adenylate cyclase activating polypeptide, etc.) in both the central and peripheral nervous systems [20,59]. The changes of neurotransmitters and neuropeptides caused by acupuncture are different due to different diseases or needling parameters. Because of the hypothalamus–pituitary–adrenal (HPA) axis, hypothalamus–pituitary–gonadal (HPG) axis and hypothalamus–pituitary–thyroid (HPT) axis playing an important role in the endocrine activities, recent researches about the effects of acupuncture on the endocrine system more focused on these axes, with related hormones as observation indexes. For example, acupuncture could obviously reduce hormones such as adreno corticotropic hormone (ACTH), corticosterone related to HPA axis in chronic stress-induced rats [21]. Electroacupuncture could regulate the level of uterus estrogen, pituitary follicule-stimulating hormone and luteinizing hormone and hypothalamic gonadotropin releasing hormone in ovariectomized rats, to restore the disorder of hypothalamus–pituitary–ovary axis [16]. Acupuncture could increase the level of thyrotropin releasing hormone, thyroid stimulating hormone and total three typical thyroid original axis in chronic fatigue rats, to restore the inhibition of HPT axis [57]. All these studies suggest that acupuncture can modulate the function of HPA, HPG and HPT axes.

Modern studies have found that after inserting the needle into the acupoint, traumatic inflammation occurs in the acupoint, activating the local immunomodulation at the acupoint [13]. Ding SS et al [19] also showed that acupuncture could initiate mast cells to gather in the acupoint, secreting bioactive substances such as histamine, bradykinin, SP and serotonin. These secretions caused vasodilatation, increased local permeability and local reaction. At the same time, inflammatory cell infiltrated, cytokines (IL-1β, IL-6, IL-8, TNF-α and IL-4) and adhesion molecules (E-selectin and L-selectin) increased in the acupoint. These changes led a local inflammation in acupoints. Numerous researches have shown that acupuncture can regulate the nonspecific immune function [47], including the following aspects: acupuncture can improve the number and function of phagocytes, increase the number and activity of natural killer (NK) cell, promote the synthesis, secretion and biological activities of cytokines and adjust the content of serum complement. Studies have shown that acupuncture has certain regulating effect on both cellular immunity and humoral immunity. The influence of acupuncture on cellular immunity mainly include that it can promote the proliferation of T cells, improve the ratio of $CD4^+/CD8^+$ T cells and modulate the synthesis and secretion of cytokines in the immune response. The effect of acupuncture on humoral immunity mainly includes the following aspects: it can modulate the synthesis and secretion of various kinds of immunoglobulin and promote T-helper lymphocytes secreting cytokines [41,44].

As already mentioned, components of NEI network coordinate with each other, forming the biological basis to maintain the body's homeostasis. When in pathological conditions, the NEI network remodeled, playing a role of self-regulation, to make internal environment tend to stability [9,10]. NEI network has the characteristics of dual directional, divergent and polymerized nature. The dual directional nature refers that the regulation between two system is dual directional, and the regulation can be positive or negative. The divergent nature refers that an environmental change can cause regulatory reaction of multiple systems. The polymerized nature refers that a cell can receive a variety of control signals from different systems. Further researches indicates that nervous system, endocrine system and immune system share common signaling molecules and their affiliated receptors, including some neuropeptides, neurotransmitters, cytokines, hormones, etc. and their receptors [12]. The cells in each system can secrete these signal molecules and at the same time the cells surface have the moleculars' receptors. Hence, the common signaling molecules and their receptors constitute the molecular structural foundation of NEI network. These molecules and receptors are called the common biological language of NEI network [19], being responsible for information communication and transmission between the three systems. Substantial evidence has shown that the skin is a neuroimmunoendocrine organ; the body skin is rich in nervous, endocrine, immune tissues structurally, and closely associated with these three systems in function. And exogenous noxious stimuli to the skin can affect the NEI network through several pathways [51], which provides beneficial evidences for the exogenous noxious stimuli activating the NEI network.

With the development of researches, scholars have found that acupuncture has modulating effect on the nervous, endocrine and immune systems. A researcher proposed a hypothesis, that was "***the bidirectional positive regulatory role of acupuncture was achieved by NEI network***" [58]. Subsequently, several researches about acupuncture effect on NEI network were carried out, with related indicators of the three systems such as neurotransmitters, endocrine hormones, immune cells or cytokines as observed indexes. Ju et al. [27] conducted the related research at the early time. It's about acupuncture analgesia, finding that there was a NEI regulatory loop in the acupuncture analgesia. In addition, human studies have also indicated that acupuncture can modulate the NEI network. Ma ZH et al [43] found that acupuncture can regulate the concentration of plasma IL-2, prostaglandin E2, encephalin and NK cell activity in patients with rheumatoid arthritis. These suggested that acupuncture could modulate the NEI network. Further studies showed that acupuncture could also modulate some common signaling molecules of NEI network. For example, electroacupuncture could promote T-cell immune responses in aging rats, with several common signaling molecules of NEI network involved in, such as serum IL-6, hippocampus IL-6R, hypothalamus β-endorphin and corticotropin-releasing hormone, ACTH and corticosterone of HPA axis [40]. But it remains to be studied that how acupuncture modulate the common signaling molecules.

Ding SS et al [10] summarize that the NEI network as the body's inherent regulatory system, manifests dual directional, divergent and polymerized characteristics during the progress of maintaining the body's homeostasis. These characteristics are very similar to the acupuncture's features of whole regulation, dual directional regulation. This also provides some basis for that acupuncture effect might be achieved through its modulation of NEI network. As a physical stimulation, acupuncture might play its role with the assistance of the body's inherent regulation system, which determines there is a certain limitations of the acupuncture effect. Therefore, if we can clarify regulating role of acupuncture on NEI network, it's beneficial to explain the characteristics of acupuncture effect from the perspective of modern science, and also can provide some basis for illuminating the common link of acupuncture mechanism. These studies show that acupuncture has certain modulatory effect on NEI network. But at present, lots of related studies more focus on a single system, always paying little attention to study the three systems as a whole. And many current researches about acupuncture effects on NEI network choose some indexes of nervous, endocrine and immune system or part of their common signaling molecules as observation object, it remains lacking of overall grasp and systematic research on NEI network. Due to the close interrelation among the three systems, acupuncture modulatory effect on NEI network still need further studies. Therefore, future researches should be conducted from the integrative and associated perspective, to clarify the modulating effect and mechanism of acupuncture on NEI network.

Inspired by the above, we set ourselves the goal: to find out the canonical correlations between the parameters of acupuncture points (electrical conductivity and its asymmetry), on the one hand, and the neuro-endocrine-immune network, on the other.

At the same time, we want to join in building a bridge between Eastern and Western paradigms of medicine. We stand in solidarity with Korotkov KG [32,34] that such a bridge is gas discharge visualization (GDV). Method of GDV, essence of which consists in registration of photoelectronic emission of skin, induced by high-frequency electromagnetic impulses, allows us to represent the same phenomena in different languages, in different systems, to look at the same things from different points of view. GDV method measures the distribution of electron densities in human systems and organs. These electron densities are the main basis of physiological energy, so there is reason to say that the GDV method allows us to measure the body's potential energy reserve and to estimate integrated psycho-somatic state of organism [11,32-36].

According to Ayurvedic medicine, Chakras are power centers, related to the endocrine glands and neural plexus as well as to some organs. Chase CR [14] provides a table according to which the **first** Chakra is associated with **adrenals**, **pelvic nerve plexus**, spine, kidneys, bladder, large intestine; **second** Chakra with **testes/ovaries**, **inferior mesenteric ganglion**, ileum, organs of reproduction; **third** Chakra with **[endocrine] pancreas, celiac plexus ganglion**, liver, gall bladder, stomach, duodenum, pancreas, **spleen**; **fourth** Chakra with **thymus**, celiac plexus, heart, circulation, **vagal nerve**; **fifth** Chakra with **thyroid and parathyroid** glands, **inferior cervical ganglion**, lungs, bronchus, larynx, pharynx, large intestine, **vagal nerve**; **sixth** Chakra with **pituitary and pineal** glands, **superior cervical ganglion**, thalamus, hypothalamus, left and lower **brain**, ears/nose, left eye; **seventh** Chakra with **pineal** gland, right and upper **brain**, right eye.

Korotkov KG [32] put forward the concept that each Chakra is associated with a part of the finger. This approach is embodied in the "GDV Chakras" program, which allows us to quantify the state (Energy and Asymmetry) of ***virtual*** Chakras.

The so-called informational (non-material) parameters require special attention. We assume that the deviations of Entropy of the EEG and HRV will be accepted by readers at least tolerantly, similar to our previous publications regarding the physiological correlates of the Entropy [24,30,49,50]. We also hope for an understanding regarding the Entropy and Area of GDI. Although there is still skepticism about the GDV/PEI method, it has a biophysical basis [45,32-36] and physiological correlates [1-4,11]. Instead, the Energy and Asymmetry of the *virtual* Chakras, we predict, will be criticized by readers, but will be accepted by the adepts of the Eastern medicine paradigm. We are open to discussion.

CONCLUSION

Therefore, the registered in patient SO drastic decrease in electrical conductivity of AP is by no means an artifact, but reflects the peculiarities of the NEI network, GDV and metabolism of the patient's body during the first examination. It is significant that upon re-examination, the deviations of the parameters significantly or completely approached the range of the average for the sample ± SD or the norm ± SD. The above gives us a reason to initiate a broad discussion of the problem of "falling variables" as carriers of unique information that is ignored and lost.

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ACCORDANCE TO ETHICS STANDARDS

Tests in patients are conducted in accordance with positions of Helsinki Declaration 1975, revised and complemented in 2002, and directive of National Committee on ethics of scientific researches. During realization of tests from all parent of participants the informed consent is got and used all measures for providing of anonymity of participants.

For authors any conflict of interests is absent.

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