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Differences between the effects of water Naftussya from fields of Truskavets' and Pomyarky on the parameters of the EEG, HRV, immunity and metabolism

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Abstract

Background. In previous studies involving subjects of both sexes with dysfunction of the neuroendocrine-immune complex, we found that the weekly use of Naftussya as Truskavets' and Pomyarky deposits generally has the same effect on its parameters.The **purpose** of this study is to identify the differences between the effects of water of these deposits. **Material and research methods.** Observations were conducted with the participation of 22 volunteers with a clinical diagnosis chronic pyelonephritis with dysfunction of the neuroendocrine-immune complex and metabolism. At first, they collected a daily urine, which determined the content of electrolytes and nitrogen metabolites, and then in the morning they started taking samples of capillary and venous blood for biochemical, hormonal and immune assays, as well as registering the HRV and EEG. After the initial survey, 10 volunteers spent 7 days drinking water Naftussya from the Pomyarky (NP) deposit, while the remaining 12 from Truskavets deposit (NT) (250 ml three times a day), after which the above tests repeated. **Results.** The use of NP does not affect the symmetrical theta-and delta-rhythms, as well as causes the right asymmetry of the alpha-rhythm, whereas NT causes the left-hand asymmetry of all three rhythms. Increased asymmetry of alpha-rhythm and amplitude of delta-rhythm under the influence of NP decreases to normal, whereas NT causes even more deviation of these parameters from the norm. The use of NP reduces both the normal spectral power (SP) of VLF band of HRV and the increased SP of LF band without affecting the normal SP of HF band. Instead, NT increases the SP of LF and HF bands without affecting the VLF band. The described differences in neurotropic effects are accompanied by a more pronounced increase in blood levels of active T-lymphocytes and T-killers and more pronounced stimulation of NP

intensity of phagocytosis by neutrophils of Staph. aureus and E. coli, as well as the activity and completeness of phagocytosis the latter's. This leads to a somewhat more pronounced reduction of bacteriuria. **Conclusion.** The revealed differences, apparently, are due to differences in the composition of organic substances and autochthonous microflora.

Keyw ords. Bioactive water Naftussya, Truskavets' and Pomyarky deposits, EEG, HRV, immunity, metabolism.

INTRODUCTION

The Ukraine possesses a number of deposits of bioactive water Naftussya, which are concentrated on the territory of the Ukrainian Carpathians (Truskavets', Skhidnytsya, Shklo, Mrazhnytsya, Opaka, Mizun', Selyatyn, Synyovydne et al) and Podillya (Sataniv, Husyatyn, Makiv et al) [9,13]. In 2015, a well of water Naftusya was restored in the tract of the Pomyarky of the city Truskavets. The reason for including water in the "Naftussya" type is the similarity of physico-chemical indicators, qualitative and quantitative composition of oleaginous organic substances and specific microflora [9,13,18]. It is known that physiologically active factors of bioactive water Naftussya are its organic olefins (paraffins, monoolefins, dienes, monocycloolefins, alkylbenzenes, aethers of aromatic acids, alkylphenols, carboxylic acids, alkylnaphthalenes, polyaromatic hydrocarbons, gross content of 10-20 mg/L) and autochthonous microorganisms (hydrocarbon oxidizing, 60-500 cells/mL, thionic, 10-40 cells/mL, sulfate-reducing, 3-7 cells/mL) [1,3,6,7,10,18].

According to the concept of the Truskavetsian Scientific School of Balneology, organic substances and specific microflora have a modulating effect on the neuroendocrine-immune complex, which in turn reduces or eliminates inflammation and dysfunction of the digestive, urination, endocrine et al systems [2,8,16].

In previous studies involving 20 subjects of both sexes with dysfunction of the neuroendocrine-immune complex, we found that the weekly use of Naftussya as Truskavets' and Pomyarky deposits generally has the same effect on its parameters. In particular, it normalizes the initially elevated: Baevsky's activity of regulatory systems index, markers of both sympathetic and vagal tone, as well as the level of testosterone in women, while initially normal levels of testosterone in men fall into the lower normal zone. The decrease within the zone of the norm was also found in relation to triiodothyronine and other markers of the autonomic nervous system. On the other hand, a slight increase in the norm level of aldosterone, as well as the tendency to increase reactive anxiety (within the low) and postocclusive reactivity of systolic blood pressure was revealed [11,12,15-17].

Among the indicators of quantitative electroencephalography, the normalized increase in the initially decreased of the spectral power density (SPD) of α-rhythm in T6, P4 and F7 loci, increase within the norm of the modal frequency of β-rhythm and further increase of SPD θ-rhythm in T5 locus was found. On the other hand, reduction of the initially normal SPD β-rhythm in the locus O2 and further decrease in the locus P4 was found. In addition, there was a left-sided lateralization of the initially symmetric α-rhythm [12,16].

Regarding the immune status, a significant increase in the norm of reduced parameters of phagocytosis by blood neutrophils was found as gram-positive and gram-negative bacteria. At the same time, the lowered level of circulating immune complexes and elevated levels of immunoglobulins M and A are normalized, and the increased level of natural killers continues to grow. In general, the immunotropic effect is physiologically favorable [14,16].

Among the indicators of metabolism, an increase was found within the normal level of plasma chloride and sodium and the normalization of the lower level of bicarbonate and a decrease in the normal levels of potassium and phosphate levels. Excretion with urine of chloride and sodium increases, while uric acid decreases, its concentration and concentration of phosphates also decreases. The elevated index of lithogenicity of urine is normalized. Reduced levels of triacylglycerides are rising, while the level of cholesterol in the low density lipoprotein is lowered to normal [4,5,16].

No significant differences were found between the effects of BAWN from both deposits. However, the preliminary analysis revealed a number of excellent effects on the parameters of the neuroendocrine-immune complex and metabolism, which became the subject of this study.

MATERIAL AND METHODS OF THE STUDY

Clinical and physiological observations were conducted with the participation of 22 volunteers of both sexes aged 33-76 years with a clinical diagnosis chronic pyelonephritis with dysfunction of the neuroendocrine-immune complex and metabolism. At first, they collected a daily urine, which determined the content of electrolytes and nitrogen metabolites as well as bacteriuria, and then in the morning they started taking samples of capillary and venous blood for biochemical, hormonal and immune assays, scrubbing the buccal epithelium to determine the electrokinetic index and registering the variability of the heart rate to evaluate the autonomous regulation as well as basal electroencephalogram. After the initial survey, 10 volunteers spent 7 days drinking water Naftussya from the Pomyarky (NP) deposit, while the remaining 12 from Truskavets deposit (NT) (250 ml three times a day), after which the above tests repeated.

The content of blood and daily urine of creatinine, uric acid, chloride, sodium, potassium, calcium, magnesium and phosphates is determined by unified methods. Used analyzers “Pointe-180” (“Scientific”, USA) and “Reflotron” (“Boehringer Mannheim”, BRD).

The content of cortisol, triiodothyronine, testosterone and calcitonin was determined by solid-phase immunoassay analysis using analyzers „Tecan” and “RT-2100C” and reagent kits (“Алкор Био”, Chema Co., Ltd and DRG International Inc.).

Indicators of phagocytosis are estimated by absorption and digestion by neutrophils of peripheral blood of museum cultures of Staphylococcus aureus and Escherichia coli. The phenotypes of lymphocytes are determined by the method of rosette formation with erythrocytes of sheep on which adsorbed monoclonal antibodies against receptors CD3, CD4, CD8, CD22 and CD16 ("Granum", Kharkiv) with visualization under a light microscope with an immersion system. The subpopulation of T-lymphocytes with high affinity receptors is identified by the method of active rosette formation with erythrocytes of sheep. The concentration of M, G and A immunoglobulins was determined by the immunoassay method (analyzer "Immunochem", USA).

The electroencephalogram was registered with the software and hardware complex „NeuroCom” (“ХАІ-Медика”, Kharkiv). Heart rate variability was registered with the software and hardware complex „CardioLab” (“ХАІ-Медика”, Kharkiv).

Electrophoretic mobility of buccal epithelium as a marker of biological age was determined by the device "Biotest" (Kharkiv University).

Digital material is processed by methods of variational and discriminant analysis using the software package "Statistica-5.5".

RESULTS AND DISCUSSION

Purposeful screening has revealed a number of parameters that NP is more beneficial than NT. 14 of them reflect **nerve regulation**, 6 **immunity**, 3 **metabolism**, as well as **bacteriuria** and **biological age**. Based on the results of discriminant analysis, 19 of them were included into the model (Tables 1 and 2).

Table 1. Discriminant Function Analysis Summary
Step 19, N of vars in model: 19; Grouping: 2 grps
Wilks' Lambda=0,00027; approx. $F_{(19)}$=395; p=0,0025

Variables which change currently in the model	Norm level (30)	Basal level (22)	Change after BAWN from		Wilks' Λ	Partial Λ	F remove	p-level	Tolerancy
			Pomyarky (10)	Truskavets' (12)					
δ-rhythm Ampl, μV	13,3±0,6	21,5±2,2	-7,6±2,3	+6,8±4,0	,024	,011	180	,006	,000
θ-rhythm Lateral, %	-5±3	-13±7	+18±10	-26±13	,007	,040	48	,020	,002
LF HRV SP, sec²	616±59	1079±264	-692±293	+282±236	,017	,016	125	,008	,001
Micr Count E. coli	54,7±1,1	65,9±1,6	+3,4±2,7	+1,7±3,2	,000	,549	2	,328	,129
T-active Lympho, %	30,0±0,9	29,8±1,0	+2,1±1,0	+1,7±1,0	,073	,004	543	,002	,001
Micr Count St. aur.	61,6±1,0	60,5±1,1	+5,6±1,8	+3,5±2,2	,048	,006	359	,003	,001
θ-rhythm Freque, Hz	6,5±0,1	6,1±0,3	+0,2±0,4	-0,7±0,5	,001	,207	8	,110	,037
θ-rhythm Ampl, μV	7,2±0,2	9,5±0,7	-1,0±0,9	+1,0±1,3	,004	,065	29	,033	,005
VLF HRV SP, sec²	1375±145	1427±251	-729±316	-115±319	,007	,038	50	,019	,003
Mg Excret, mM/day	4,1±0,2	3,6±0,4	-0,3±0,6	+0,8±0,5	,038	,007	282	,004	,001
T-cytolytic Lymp, %	23,5±0,6	23,4±0,7	+2,4±1,0	+0,9±1,0	,004	,066	28	,034	,010
Creatinine Pl, μM/L	79,5±2,6	79,0±1,7	-3,3±3,1	-0,6±3,2	,021	,013	157	,006	,002
α-rhythm Asym, %	17±1	22±3	-7±6	+6±5	,044	,006	326	,003	,001
α-rhythm Lateral, %	-2±2	-8±8	+1±11	-23±15	,004	,071	26	,036	,006
δ-rhythm Lateral, %	+1±4	-6±7	+27±13	-19±12	,010	,026	75	,013	,002
β-rhythm Index, %	87,9±1,9	94,3±1,5	0,0±0,9	-1,6±1,4	,005	,059	32	,030	,005
θ-rhythm Asymm, %	19±1,4	36±6	-23±11	+3±9	,001	,196	8	,103	,014
Killing Ind E. coli, %	62,0±1,1	41,5±3,1	+5,2±3,1	-0,7±5,4	,001	,192	8	,101	,040
Biological Age, ys	50,8±2,8	48,4±2,2	-1,3±0,3	-1,2±0,5	,001	,405	3	,229	,046
Variables which change currently not in the model	Norm level (30)	Basal level (22)	Change after BAWN from		Wilks' Λ	Partial Λ	F to enter	p-level	Tolerancy
			Pomyarky (10)	Truskavets' (12)					
δ-rhythm Index, %	50±5	64±9	-20±11	+19±11	,000	,665	,50	,607	,088
δ-rhythm Asymm, %	33±3	43±6	-7±11	-19±10	,000	,781	,28	,690	,066
HF HRV SP, sec²	336±83	416±121	-136±108	+305±291	,000	,935	,07	,835	,076
Phag Ind E. coli, %	98,3±0,9	99,4±0,1	+0,5±0,2	-0,6±0,6	,000	,629	,59	,583	,020
Bacteriuria, lg CC	0	1,64±0,17	-0,91±0,22	-0,62±0,42	,000	,966	,04	,881	,051
K Excretio, mM/day	65±3	53±5	+3±10	+28±13	,000	,990	,01	,937	,066

Table 2. Summary of Stepwise Analysis and Coefficients for Canonical Variables

Variables which change currently in the model	F to en-ter	p-le-vel	Λ	F-va-lue	p-le-vel	Coefficients		
						Standar-dized	Struc-tural	Raw
δ-rhythm Laterality, %	6,3	,054	,010	30,	$<10^{-3}$	24,15	,0094	,603
θ-rhythm Laterality, %	8,9	,008	,477	10,	$<10^{-3}$	20,26	,0092	,511
α-rhythm Laterality, %	4,6	,070	,028	17,	$<10^{-3}$	12,70	,0047	,295
θ-rhythm Frequency, Hz	3,0	,109	,106	14,	$<10^{-4}$	-4,64	,0045	-3,084
β-rhythm Index, %	7,8	,049	,004	66,	$<10^{-3}$	13,82	,0032	3,482
T-cytolytic Lympocytes, %	2,0	,187	,054	13,	$<10^{-3}$	-9,48	,0038	-2,813
Killing Index vs E. coli, %	4,8	,116	,001	122,	,001	4,48	,0032	,291
Microbial Count St. aureus	4,5	,052	,130	13,	$<10^{-4}$	32,06	,0026	4,686
Microbial Count E. coli	3,2	,093	,213	12,	$<10^{-4}$	-1,87	,0015	-,186
T-active Lymphocytes, %	3,6	,079	,172	12,	$<10^{-4}$	41,51	,0011	12,04
δ-rhythm Amplitude, μV	8,6	,008	,699	9,	,008	-55,14	-,0107	-5,016
LF HRV SP, sec^2	6,0	,025	,358	11,	$<10^{-3}$	-29,44	-,0090	-,035
θ-rhythm Asymmetry, %	8,2	,103	,000	395,	,003	7,45	-,0067	,233
α-rhythm Asymmetry, %	1,2	,308	,047	12,	$<10^{-3}$	30,70	-,0060	1,697
VLF HRV SP, sec^2	1,6	,234	,079	13,	$=10^{-4}$	17,58	-,0048	,018
θ-rhythm Amplitude, μV	2,0	,182	,091	13,	$<10^{-4}$	13,97	-,0045	3,679
Mg Excretion, mM/day	2,0	,188	,066	13,	$<10^{-3}$	29,30	-,0044	14,66
Creatinine Plasma, μM/L	1,2	,310	,024	17,	,001	-24,02	-,0021	-2,335
Biological Age, ys	6,9	,018	,255	12,	$<10^{-4}$	-3,59	-,0006	-2,298
r*=0,9999; Wilks' Λ=0,0003; $\chi^2_{(19)}$=86; $p<10^{-6}$. Mahalanobis Distance=15131; F=394; p=0,0025							**Constant**	-42,12

As you can see, the use of NP does not affect norm frequency of theta-rhythm as well as the symmetrical theta-and delta-rhythms, as well as causes the right asymmetry of the alpha-rhythm, whereas NT causes the left-hand asymmetry of all three rhythms and reduces frequency of theta-rhythm. Increased asymmetry of alpha-rhythm and amplitude of delta-rhythm under the influence of NP decreases to normal, whereas NT causes even more deviation of these parameters from the norm. The use of NP reduces both the normal spectral power (SP) of VLF band of HRV and the increased SP of LF band without affecting the normal SP of HF band. Instead, NT increases the SP of LF and HF bands without affecting the VLF band.

The described differences in neurotropic effects are accompanied by a more pronounced increase in blood levels of active T-lymphocytes and T-killers and more pronounced stimulation of NP intensity of phagocytosis by neutrophils of Staph. aureus and E. coli, as well as the activity and completeness of phagocytosis the latter's. This leads to a somewhat more pronounced reduction of bacteriuria.

Regarding the parameters of metabolism the use of NP does not affect urinary excretion of magnesium and potassium while NT increases its, leading to loss of its body. On the other hand, NT reduces plasma creatinine levels, while NT is ineffective. Finally NP has a somewhat tangible “rejuvenation” effect.

After calculating the individual values of canonical root using raw coefficients for changes in variables and constant given in Table 2, the position of each person were visualized in information space of the root (Fig. 1).

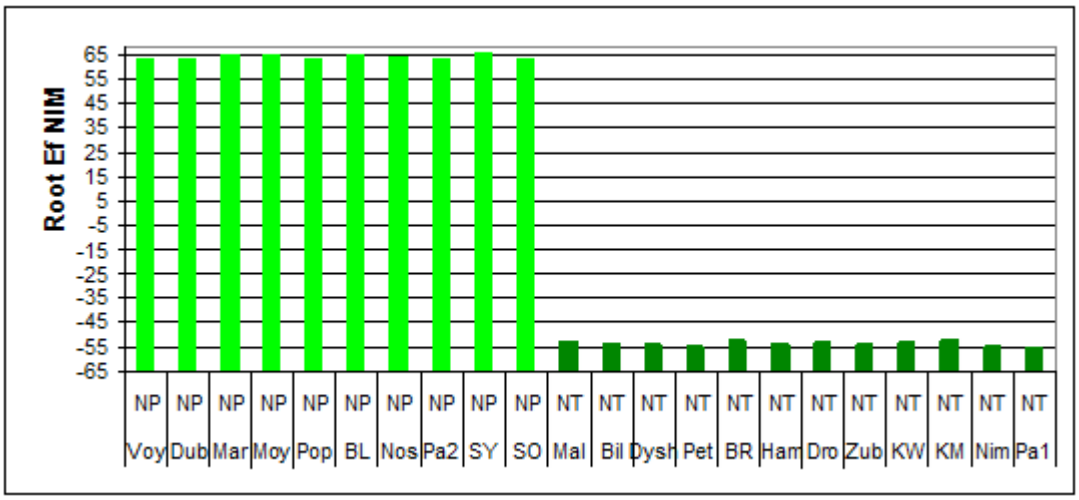

Fig. 1. Individual sizes of discriminatory canonical roots of changes in parameters of persons who use water Naftussya from Pomyarky (NP) and Truskavets' (NT) layers

The revealed differences, apparently, are due to differences in the composition of organic substances and autochthonous microflora.

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