

БИОЛОГИЧЕСКИЕ НАУКИ

ASSESSMENT OF VISUAL SENSATIONS COLOR ALTERATIONS IN CHRONIC PAIN PATIENTS DURING EMPATHO-TECHNIQUE SESSIONS

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SUMMARY

The article presents the results of the visual sensation colors parameters investigation in patients with chronic pain of different origin during Empatho-technique sessions. There were studied visual sensations which did and didn't appear in response to pain in trigger points.

The impact of Empatho-technique is aimed at enhancing the antinociceptive system activity and deactivation of the excitation focus in the brain which results in the chronic pain intensity decrease. It was found out that the visual sensations of the long wave color of chromatic spectrum and dark grey colors ("grey" scale) appeared in response to poststimulus pain. The pain absence revealed itself in the middle- and short-wave colors of the chromatic spectrum and light-grey colors. The reduction of chronic pain intensity, change of the visual sensation parameters and their approximation to the parameters of the control group provide grounds to assume that visual sensation color can correlate with the CNS functional state and can serve as a sign of the nociceptive and antinociceptive systems activity.

On top of that, practicing the Empatho-technique application allows not only to eliminate the pain sensations, but also to foster researches of pain and visual modalities interaction mechanisms. In accordance with the received results, we can presume the participation of the color-sensitivity cells in the appearance of visual sensations of different colors.

Key words: Empatho-technique, chronic pain of the psychogenic, somatogenic and neurogenic origin, color opponent systems, antinociceptive system, excitation focus, color of visual sensation.

INTRODUCTION

The patients' complaints regarding chronic pain are most significant in the clinical practice and require special approach in the selection of adequate therapeutic methods. Thus, it is necessary to consider not only the reasons of the chronic pain occurrence, but also its development mechanisms and multi-componency of its structure (Kukushkin et al., 1994; Kukushkin, Reshetnyak, 1997; Kukushkin, Khitrov, 2004; Richardson et al., 2006).

The works on pain under acute and chronic stress are widely known (Waldman, Ignatov, 1976; Kalyuzhny, 1984; Ashkinazi et al., 1992; Psychosomatic disorders in the practice of a therapist: a guide for doctors, 2008). Previously, we studied the influence of the patients' emotional state on the perception of chronic pain (Ishinova, Svyatogor, 2009 a). Tactile and pain sensitivity was investigated in the condition of the psycho-emotional tension (Ishinova, 2007 a; Ishinova et al., 2007 b; 2010 a; Vartanyan et al., 1985).

There were found more expressed fluctuations of the tactile and pain sensitivity thresholds in patients with psychogenic pain in comparison with patients suffering from chronic pain of somatogenic origin. This could be connected with the actualization of the different impact mechanisms on the CNS peripheral part. (Ishinova et al., 2010 a; Ishinova et al., 2014 b; Ishinova, Svyatogor, 2016 a). The results of the brain bioelectrical activity investigation in patients with psychogenic pain have revealed the instability of the

neurodynamic processes with domination of the excitation processes.

This could be viewed as the verification of the central regulation mechanisms influence on the tactile and pain skin sensitivity (Ishinova et al, 2009; Ishinova, Svyatogor, 2009; 2010 b).

It was noticed that the patients suffering from chronic pain regularly visualized pain in different colors. Such consistency required to research the correlation of pain and visual modalities. We did not find information on changing color visual sensations parameters which occurred after pain stimulation in patients with chronic pain in the sources available to us.

There are works on the influence of light stimulus of different colors via visual analyzer on the psychophysiological state of patients (for example, red, orange, yellow colors produce excitation effect, while green, blue and violet colors have a calming [down] effect (Lobzin, Reshetnikov, 1986; Lusher, 1996; Serov, 2002). On the other hand, the psychophysiological state of the patients influences the color choice. It was found out, that color perception of the patients with psychogenic pain differs from the color perception of patients with somatogenic and neurogenic pain (Adashinskaya et al., 2005).

This article presents the results of studies referring to changes of the visual sensations color parameters arising in response to poststimulus pain in the trigger points and/or different body parts in patients with chronic pain of various origin in the process of Empatho-technique application.

The earlier performed investigations (Ishinova, Svyatogor, 2009; Ishinova, Svyatogor, 2010 b; Ishinova, Svyatogor, 2009) revealed that the patients registered visual sensations of the long-wave part of the spectrum (red, orange, yellow), and dark shades of the grey color of the achromatic zone ("grey scale") which emerged in response to poststimulus pain.

While the visual sensations were changing color to the middle-waves (green), short-waves colors (blue, violet) and light grey, the pain sensations were disappearing. The observed phenomena could assumably be connected with the convergence process between pain and visual modalities in the unspecific and associative neurons of the thalamic structures.

Materials and Methods

Participants. The investigation was carried out with 218 patients divided into 4 groups.

Group 1 – 49 patients (42 females and 7 males aged 24 to 46) with somatoform diseases, suffering from chronic pain of psychogenic origin. The tension headache, stomach-ache, pain in spine, cardialgia with vegetative reactions (instability of the blood pressure, dizziness, disturbance of the respiratory rhythm, muscular tension) were the chief complaints. These symptoms occurred usually in combination with stress, had no organic origin and were not verified by medical investigations.

Group 2 – 54 patients (43 males and 11 females aged 48 to 60) with coronary artery disease suffering from anginous pain (chronic pain of somatogenic origin). 46 of them underwent myocardial revascularization and had disability of 2nd-3d degree. Patients complained of heartache, high arterial pressure, state of anxiety, sleep disorder, inclination to rapid fatigability.

Group 3 – 79 patients (54 males and 25 females aged 49 to 71) with phantom pain of 4 months to 17 years duration (chronic pain of neurogenic origin). They underwent amputation surgery of lower limbs. Amputation was caused by severe chronic diseases accompanied by the expressed pain syndrome. All patients had the disability of 1st, 2nd or 3d degree.

Group 4 (reference group) – 36 healthy subjects (22 females and 14 males aged 31 to 56). They had no neurotic and somatogenic complaints at the time of investigation.

The work was conducted in accordance with the Russian national RAC Bioethics Committee Regulations.

Experiment procedure. The "Empatho-technique" method was used for elimination of pain:

- the work on pain or discomfort sensation in various body parts was performed in patients with psychogenic pain (Gr.1) and healthy people (Gr. 4) (Ishinova et al, 2009).

- in patients with coronary heart disease, the work was carried out on trigger points and muscle tightness

zones of the anterior, lateral, posterior surfaces of the left hemithorax (Travelell, Simons, 1989; Ishinova, 2011).

- **in patients who underwent amputation, the work was conducted on trigger points of the low extremity stumps. Their stimulation caused the onset of phantom pain and phantom sensations (Ishinova, 2014 a; Ishinova, Ishinov, 2016).**

Each Empatho-technique session was performed this way: a clinician carried out the search of the painful trigger points or various painful body areas by palpation. After their detection, patients were suggested to close their eyes and to concentrate on the visual sensations which appeared in response to the poststimulus pain. We named the process of appearance and change of visual sensation colors the "color reflection of pain". At the end of every session patients were asked to select the color from Microsoft Word program using an option "other colors – spectrum" which corresponded to the visual sensation colors of pain or to its absence. The digital codes of Red/Green/Blue were registered in the protocol (Ishinova V.A., 2014 a). From 5 to 15 sessions were performed for every patient if necessary.

Before and after every Empatho-technique session, patients assessed the chronic pain intensity using the visual analog scale (VAS). The fluctuations of CP (difference between indices registered before and after the session) were defined as a psychogenic component in the CP structure (Ishinova V.A., 2016 b; Ishinova, 2018).

For evaluation of emotional state at the beginning and at the end of Empatho-technique course there were used:

Eysenck's Questionnaire for eliciting the neuroticism signs (emotional instability). At this, the range 1 to 6 scores corresponded to the low level; 7 to 11 scores – moderate level; 12 to 21 scores – expressed level (Djakonov, 2005);

The Symptom Check List-90-Revised scales were applied for emotional state assessment: ANX (anxiety), DEP (depression), HOS (hostility) (Tarabrina, 2001).

The statistical analyses of investigation results was carried out by means of Statistica v.12.0 program using the parametric and non-parametric methods. The results of level $p < 0,05$ were considered significant.

Results and discussion

In all individuals with CP of strong (Gr. 2 and 3) and very strong CP intensity degree (Gr. 1) there were registered higher ANX, DEP, HOS indices and neuroticism level ($p < 0,001$) in comparison with patients of Gr. 4. In this, lower indices ($p < 0,001$) were found in patients with phantom pain (Gr. 3) versus Gr. 1 and 2 patients (Tabl. 1 and 2).

Neuroticism indices had no intergroup differences and corresponded to high level.

Table 1

**CP intensity of different origin before and after the first and the last Empatho-technique sessions.
The psychogenic component after the first and the last sessions in patients and participants
of control group**

Groups	Sessions		CP		PC M±SE
			M±SE		
Gr.1 (n=49)	First session	Before	7.06±0.34	4.56±0.23	
		After	2.60±0.19		
	Last session	Before	3.20±0.36		
		After	2.50±0.23		
Gr.2 (n=54)	First session	Before	5.35±0.31	2.85±0.23	
		After	2.57±0.26		
	Last session	Before	2.84±0.26		
		After	1.51±0.24		
Gr.3 (n=79)	First session	Before	6.61±0.22	3.83±0.13	
		After	2.79±0.16		
	Last session	Before	2.25±0.18		
		After	1.73±0.13		
Gr.4 (n=36)	First session	Before	1.56±0.09	0.40±0.07	
		After	1.31±0.10		

Notes: M±SE – Mean ± Standard Error of mean; Gr.1 – patients with CP of the psychogenic origin; Gr. 2 – patients with CP of the somatogenic origin; Gr. 3 – patients with CP of the neurogenic origin; Gr. 4 – control group; CP – chronic pain; PC – psychogenic component.

The long-wave colors of chromatic zone and the shades of dark grey colors “grey scale” were revealed during the investigation of the visual sensations corresponding to pain sensations in the trigger points and various body areas. Their change to the middle- and short-wave colors of chromatic zone and light-grey colors of achromatic spectrum (“grey scale”) were accompanied by the absence of pain in the trigger

points and various body areas. Analyses of the digital codes of the color model Red/Green/Blue helped to reveal the shift in correlation of these colors towards (p < 0, 0 1) the Red color in patients with pain in the trigger points and various areas of their body and towards their balance (light grey color) in patients without pain (Tabl. 3).

Table 2

**Indices of the neuroticism and negative emotions intensity in patients with CP of the different origin
before and after Empatho-technique course**

Empatho-technique course	Scales	Groups			
		Gr.1 (n=49) M±SE	Gr.2 (n=54) M±SE	Gr.3 (n=79) M±SE	Gr.4 (n=36) M±SE
Before course	ANX	1.44±0.12	0.91±0.09	0.45±0.04	0.24±0.04
	DEP	1.30±0.11	0.96±0.08	0.66±0.05	0.24±0.03
	HOS	0.96±0.11	0.81±0.10	0.55±0.05	0.25±0.04
	Neuroticism	12.90±1.07	14.36±0.92	12.71±0.41	8.56±0.49
After course	ANX	0.53±0.04	0.38±0.04	0.22±0.03	-
	DEP	0.56±0.06	0.44±0.05	0.34±0.04	-
	HOS	0.42±0.07	0.35±0.05	0.26±0.03	-
	Neuroticism	11.11±1.05	8.93±0.67	8.51±0.32	-

Notes: M±SE – Mean ± Standard Error of mean; Gr.1 – patients with CP of the psychogenic origin; Gr. 2 – patients with CP of the somatogenic origin; Gr. 3 – patients with CP of the neurogenic origin; Gr. 4 – control group; CP – chronic pain; ANX – anxiety; DEP – depression; HOS – hostility.

The discomfort state in various body areas or its absence in healthy participants was accompanied by the occurrence of the dark- and light-grey colors respectively, in contrast to all patients.

After the first Empatho-technique session, the patients of all groups assessed CP as mild. The groups-correlation indices had no significant differences (Tabl. 1). However, the psychogenic component indices in patients of all groups were significantly (p < 0, 0 0 1) higher than those of the healthy participants.

Nevertheless, psychogenic components in patients of Gr. 1 and 3 corresponded to moderate level, in contrast to Gr. 2 patients (“mild level”).

We can suppose that emotional, cognitive and psychosocial factors played an important role in development of not only psychogenic pain, but also of phantom pain in patients who underwent amputation (Gr. 3). However, the patients of Gr. 3 were psychologically ready for the social after-effects of surgical treatment. The appearance of phantom pain

after surgery was the reason of emotional decline, but to a lesser degree than in patients with psychogenic pain. These patients were determined to look for the

somatic reasons of pain and were reluctant to agree with physicians' opinion about psychological nature of their pain.

Table 3

Visual sensations' color in pain sensations and without them in the trigger points and/or various body parts during Empatho-technique sessions in patients with CP of different origin and in participants of the control group

Groups	Sessions	Pain sensations	Parameters of visual sensations color			CVS
			RED M±SE	GREEN M±SE	BLUE M±SE	
Gr.1 (n=49)	First session	Pain presence	205.09±14.79	118.36±22.91	66.09±17.17	
		Pain absence	202.82±12.26	212.54±13.05	202.09±11.54	
	Last session	Pain presence	181.50±22.79	157.80±16.84	97.50±26.69	
		Pain absence	191.50±12.24	202.50±9.05	202.70±9.34	
Gr.2 (n=54)	First session	Pain presence	205.92±17.56	79.17±21.77	85.4±18.35	
		Pain absence	166.58±16.40	191.58±13.56	161.91±19.26	
	Last session	Pain presence	128.63±15.04	136.87±10.64	134.56±10.11	
		Pain absence	182.18±8.88	182.18±8.88	182.18±8.88	
Gr.3 (n=79)	First session	Pain presence	177.15±9.66	115.31±9.39	81.32±9.21	
		Pain absence	169.23±8.43	182.75±6.52	167.96±8.49	
	Last session	Pain presence	154.15±8.21	148.67±6.89	130.44±9.53	
		Pain absence	196.73±6.78	210.38±5.13	200.69±7.05	
Gr.4 (n=36)	First session	Discomfort present	146.88±5,83	154.0±6.95	142.48±6.61	
		Discomfort absence	181.88±7.59	182.20±7.54	182.20±7.54	

Notes: M±SE – Mean ± Standard Error of mean; Gr.1 – patients with CP of the psychogenic origin; Gr. 2 – patients with CP of the somatogenic origin; Gr. 3 – patients with CP of the neurogenic origin; Gr. 4 – control group; CP – chronic pain; CVS – color visual sensations.

The lower indices of psychogenic component in patients with ischemic heart disease could be caused by the dominant influence of the biological trigger (Ishinova V. A., 2016 b).

At the end of the course, before the last Empatho-technique session, all patients assessed the CP intensity as "the state of discomfort", but the indices of CP were ($p<0,05$) higher than those in healthy participants. After the last Empatho-technique session the CP and psychogenic component indices had no substantial differences with those of control group participants and went along with the improvement of their emotional state (Tabl. 1 and 2).

The discomfort state in trigger points and other body areas correlated with the yellow-green colors visual sensations in patients of Gr. 1, the grey-green colors in patients of Gr. 2 and the dark grey color - in patients of Gr. 3 during the last session. The color codes ratio analyses in the color model of Red/Green/Blue showed the increase of the green color in patients of Gr.1, green and blue – in patients of Gr. 2 and of the blue color – in patients of Gr. 3. The balanced ratio of the color codes was registered in all patients in the absence of the discomfort sensation in the trigger points and various body areas at the end of the session. The balanced ratio of the color codes corresponded to visual sensations of the light grey colors as in healthy participants (Tabl. 3).

Conclusion.

The Empatho-technique application contributed to optimization of the psychophysiological patients' state : the CP intensity and psychological component decreased, emotional state ameliorated. This can evidence of the improvement of adaptive body possibilities and CNS functional state as a whole. The obtained data agree with the research results referring to bioelectrical brain activity and the thresholds of the tactile and pains sensitivity with the focused ultrasound application during Empatho-technique sessions (Ishinova V.A. et al, 2007 b; Ishinova V.A., Svyatogor I.A., 2010 b).

The change of the visual sensations color and decrease of the pain intensity in the trigger points and other body areas at the end of the course and their proximity to those of the control group can also witness of the improvement of the psychophysiological patients' state as well as the functional state of their CNS in toto.

Thus, the earlier performed researches involving the electroencephalography, registered the intensification of alfa-activity at the occipital region of head when visual sensations colors of the middle- and short-waves spectrum appeared, which verifies the normalization of corticosubcortical ties in the visual cortex.

The data obtained during approximately 30.000 sessions over the 20 years period of the practice with

patients of the different age groups suffering from CP, allows to suppose that not only the external visual signals, but also the internal signals caused by the pain stimulus, contribute to activation of the color-sensitivity cells. This was reason why we had assume the participation of the color-opponent system (Red-Green, Yellow-Blue, Grey-Black) in the formation of the color visual sensation in response on the poststimulus pain (Shiffman, 2003). Upon this, the poststimulus pain can activate cells-on inducing the visual sensation of long-wave part of the spectrum which were suppressed by the cells-off (green and blue colors).

When patients observed these visual sensation colors they registered the pain absence in the trigger points and various body areas. The balance between visual sensations colors belonged to the light grey colors of the “grey scale”, which implies the significant decrease of CP intensity or its absence.

The obtained results speak of the actuality of Empatho-technique usage within complex therapy as a method for decreasing the CP intensity. This can provide grounds for studying the mechanisms of interaction between visual and pain modalities.

Our hypothesis about participation of color-opponent systems in the formation of the visual sensation color appearing in response to poststimulus pain, requires to be further investigated.

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