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POSTISOMETRICAL RELAXATION HEMODYNAMIC EFFECTS IN PATIENTS WITH CERVICOCRANIALGIA AND VESTIBULAR DYSFUNCTION

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ABSTRACT

Aim: To investigate the hemodynamic indexes during the postisometric relaxation in patients with cervicocranial pain and vestibular dysfunction in patients with the cervical spine pathology.

Materials and Methods: The clinical examination included 85 patients of the young age with cervical spine instability. We use randomization into 41 patient with cervicogenic cranialgia and 44 patients with vestibular dysfunctions. Postizometric relaxation (PIR) sessions were included into patients treatment.

Results: Our results revealed increased time-averaged indexes of maximal blood flow velocity through vertebral and basilar arteries in patients with cervicogenic cranialgia. The same indexes were registered to be decreased in patients on the 2nd group. We found that hperreactivity to flexion-extension was determined in patients of both groups, and in patients of the 1st group to left-right rotation. After post-izometric relaxation sessions we registered a decrease in the headache intensity, frequency and duration in patients with cervicogenic cranialgia, and a decrease in dizziness intensity and ringing and tinnitus regression in patients with vestibular dysfunctions.

Conclusions: We found that hemodynamic changes in patients with cervicogenic cranialgia were manifested in the form of hyperperfusion through vertebral artery and basilar artery and a half-increase in reactivity indexes on rotatory tests. The hemodynamic effect of PIR was determined in the form of vertebral blood flow indexes through vertebral artery and basilar artery stabilization, as well as indexes of reactivity to rotatory tests normalization.

KEY WORDS: cervicogenic headache, vestibular dysfunction, postisometric relaxation, cerebral hemodynamics, reactivity index

INTRODUCTION

Prevention of the cerebral organic vascular changes development is the most urgent problem of modern medicine and neurology. It is necessary to determine the main risk factors for the possible cerebrovascular events active prevention at the stage of compensation of intracerebral pathological process. Cervical spine (CS) pathology is the most significant etiopathogenetic factor in these disorders development, and it has a significant prevalence recently, especially in young people [1-3].

A number of pathological mechanisms of vestibular dysfunctions (VD) development can be detected in conditions of cerebral chronic ischemia [4]. Their clinical manifestations in case of vascular dyshemia has direct correlation the degree of brain damage [5, 6]. Vestibular dysfunction is the most common syndrome in cerebral acute and chronic ischemia with predominant vertebral-basilar basin (VBB) lesion [6]. An important aspect of VD occurrence is a change in vegetative-vascular reactivity, which greatly complicates the diagnosis and differential diagnosis of this pathology [6].

Cervicogenic cranialgia (CCA) occurs with CS degenerative-dystrophic pathological changes (dystrophic processes in the discs, CS instability, unvertebral arthrosis, etc.) which leads to compression or irritation of sensitive nerve roots, sympathetic muscles of the neck and occipital region, which might result in the pain initiation [7].

The first three cervical sensory roots form close connections with the trigeminal nerve, forming the trigeminocervical system, and make the CCA pathophysiological background [7]. The pain in CS is caused by the excitation of nociceptors located within the vertebral column, muscles, tendons, roots, and vertebral arteries [8]. The most common place of CCA is the occipital region. Pain irradiation occurs more

often in the temporal, parietal and/or frontal area and homolateral eye socket. The pain is more often has dull of medium intensity, it has an attack-like character, lasts from several hours to several days [9].

The method of transcranial dopplerography (TCD) of the main vessels of the head for a long time was successfully used for the main arteries both extracranial and intracranial parts lesions diagnosis. This method results not only in spatial localization of the pathological process, but allows to obtain detailed information about the cerebral hemodynamic indicators ratio, especially, in patients with headache [10-12]. Methods of differentiated myofascial manual therapy and individual kinesiotherapy within the complex of medical and rehabilitative measures contribute to locomotor apparatus functional activity normalization and suppress degenerative processes [13,14]. The method of post-isometric relaxation (PIR) belongs to the varieties of manual therapy and is actively used in the vertebral pathology complex treatment, in particular, CCA [15]. We suppose promising to use TCD to control the CS pathology manual treatment efficacy.

AIM

The aim of the present work was to investigate the hemodynamic indexes during the post-isometric relaxation in patients with cervicocranial pain and vestibular dysfunction in patients with the cervical spine pathology.

MATERIALS AND METHODS

Our clinical investigation complies with the principles of Helsinki Declaration, the rules of Good Clinical Practice and the legal requirements established for this type of clinical studies. 85 patients (46 women, 39 men) of a young age (18-35 years) with CS degenerative changes and instability were investigated. All patients were randomized into two clinical groups according to dominant syndrome: the 1st group – 41 patients with CCA, the 2nd group – 44 patients with VD. The control group consisted of 25 practically healthy volunteers of the appropriate gender and age.

The intensity of pain syndromes was studied using a standard visual analog scale (VAS).

All patients underwent CS X-ray examination with functional loads. X-rays of the neck were performed on a digital radiographic and fluoroscopic system "OPERA T90x GMM" (Italy). X-rays were performed in standard modes, in direct and lateral projections with functional load (flexion-extension).

Cerebral arteries were examined via triplex mode using "Ultima-PA" ultrasound scanner (RADMIR, Ukraine). The time-averaged maximum blood flow velocity (TAMX) in the anterior (ACA), middle (MCA), posterior (PCA) cerebral arteries, vertebral (VA) and basilar (BA) arteries were studied. The BA reactivity indexes were also determined using the CS functional loads with the determination of reactivity indexes on left-right rotation (RIlr) and flexion-extension (RIfe).

Patients with established CS offered to undergo a course of PIR, consisting of ten sessions. The idea of this technique is short-term (5-10 s) isometric work of minimal intensity and passive stretching of the muscles in the next 5-10 s. These combinations are repeated 3-6 times, as a result of which persistent hypotonia occurs in the muscle and the original soreness disappears. The technique consists of two stages. At the first stage, the spasmed muscle is maximally stretched and fixed in this position. Next, the patient is asked to shorten the muscle, but at the same time the movement is prevented, that is, the muscle is shortened, but at the same time the movement does not occur (post-isometric work of the muscle). At the second stage, the patient relaxes and the muscle is further stretched to the maximum stretch. Then post-isometric contraction is performed again. This is repeated 3-4 times. Sessions were held daily for 10 days. These sessions duration was 25-30 min.

The data obtained were presented as mean (x) and the standard error of the mean (SE). One-way analysis of variance (ANOVA) followed by Neuman-Keuls post-hoc test was used to detect the significant differences between the investigated groups. The nonparametric Kruskal-Wallis test was used to detect the significant differences in case of raw absolute indexes using. $p<0.05$ was considered as statistically significant difference.

RESULTS

The presence of instability in one or more motor segments was determined in all patients. Signs of stair instability (SI) in the vertebral-motor segments (VMS) C_2-C_6 were detected in 17 (41.5%) patients of the 1st group and in 13 (29.5%) patients of the 2nd group. Isolated instability (II) in VMS C_2-C_3 was noted in 9 (21.9%) patients of the 1st group and in 7 (15.9%) patients of the 2nd group; in the VMS C_3-C_4 - in 14 (34.1%) patients of the 1st group and in 12 (27.3%) patients of the 2nd group; in VMS C_4-C_5 - in 2 (4.9%) patients of the 1st group and in 6 (13.6%) patients of the 2nd group; in VMS C_5-C_6 - in 1 (2.4%) patients of the 1st group and in 5 (11.4%) patients of the 2nd group.

33 (80.5%) patients with CCA revealed dull pain of medium or high intensity, in 25 (61.0%) patients pain mainly localized in the cervical-occipital region, in 12 patients (29.3 %) – in parietal-occipital region. More often pain registered monolaterally with an attack-like character (73.2%). Pain occurs more often after staying in an uncomfortable position, i.e., during sleep (34.1%), turning and/or tilting the head (29.3%), in some cases when combing hair, neck movements, may be accompanied by a feeling burning (17.1%), dizziness with nausea (24.4%), sensation of noise and ringing in the ears (17.1%), "flickering of flies" in front of the eyes (12.2%), decreased visual acuity and a feeling of veiling before the eyes (12.2%) as well as double vision (9.8%).

In patients with VD dizziness was non-systemic in 28 cases (63.6%), and in 16 cases (39.4%) it was systemic; caused by physical exertion (27.3%), head movements (34.1%), orthostatic changes (18.2%), fluctuations (usually an increase) in blood pressure (13.6%). Dizziness was also accompanied by noise in the head (38.6%), hearing loss (34.1%), autonomic lability (31.8%), orthostatic hypotension (18.2%).

The hemodynamic parameters in ACA and PCA in patients of both groups did not differ significantly from the control data. Blood flow indexes in MCA were moderately reduced, with an emphasis in patients with VD, which confirms the value of MCA hemodynamics as an indicator of cerebral vascular disorders. Blood circulation velocity in the group with CCA was significantly increased via VA (49.1±5.3 cm/s vs control 34.7±9.1 cm/s; p<0.05) and via BA (49.8±4.2 cm/s vs control 38.9±4.4 cm/s; p<0.05). In the 2nd group patients a moderate decrease in bloodflow indexes was observed in VA (30.6±5.8 cm/s vs control 34.7±9.1 cm/s; p>0.05) and BA (31.4±6.2 cm/s vs control 38.9±4.4 cm/s; p>0.05). These changes could be explained by the presence of a predominantly irritative variant of VBB dyscirculation in patients with CCA and the presence of predominantly compressive disorders in patients with VD (Table 1).

The patients of the 1st group showed significant hyperreactivity to left-right rotation (RIlr - 1.27±0.03 vs the control 1.18 ± 0.03; p<0.05) and flexion-extension (RIfe – 1.26±0.05 vs the control 1.16±0.04; p<0.05). A significant increase in flexion-extension reactivity was noted in patients of the 2nd group (RIlr - 1.29±0.06 vs the control 1.16±0.04; p<0.05). The index of reactivity to left-right rotation tests was slightly increased (RIlr - 1.22±0.05 vs the control 1.18±0.03; p>0.05; Table 2).

It should be concluded that cephalic syndrome occurrence in patients with CS instability is largely due to the pathological reaction of CS vessels to left-right turns of the head, while the VD occurrence is more related to CS flexion and extension.

Due to the fact that manipulative techniques are contraindicated in the case CS instability, the examined patients were offered to undergo a course of PIR. After

Table 1. TAMX indexes (sm/s) in brain arteries in patients with CCA and VD

Groups of patients	MCA	ACA	PCA	VA (V4)	BA
Group 1	57.2±8.4	54.3±7.3	40.8±4.3	49.1±5.3*	49.8±4.2*
Group 2	54.3±9.2	51.6±5.8	36.5±4.7	30.6±5.8	31.4±6.2
Control group	62.6±10.1	52.3±6.7	36.5±5.7	34.7±9.1	38.9±4.4*

*Notes: * – p<0.05 – significant differences in the studied parameters compared to those in the control group*

Table 2. Reactivity indexes on rotary tests in BA in patients with CCA and VD

Groups of patients	RIlr	RIfe
Group 1	1.27±0.03*	1.26±0.05*
Group 2	1.22±0.05	1.29±0.06*
Control group	1.18±0.03	1.16±0.04

*Notes: * – p<0.05 – significant differences in the studied parameters compared to those in the control group*

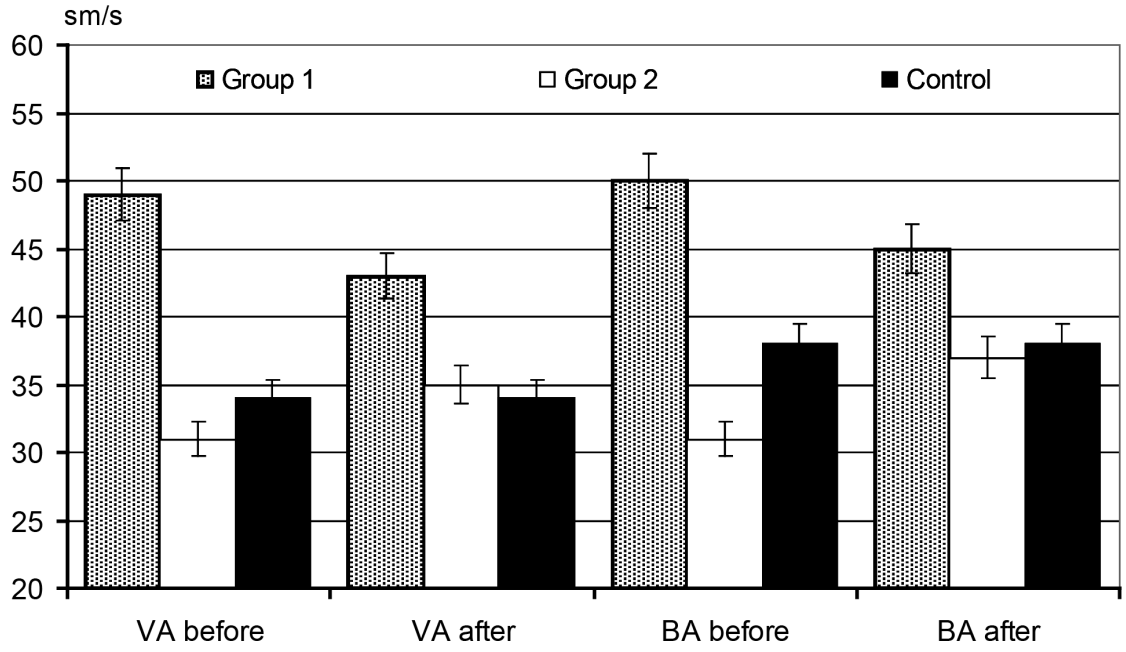

Fig. 1. Dynamic of TAMX indexes in VA and BA in patients with CCA and VD after the PIR administration

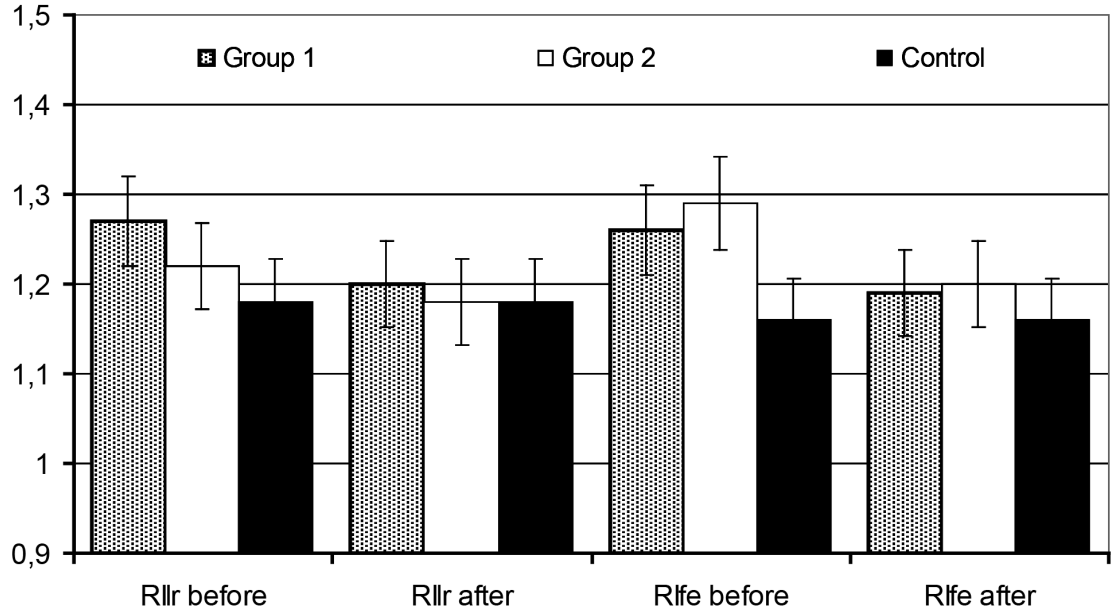

Fig. 2. Dynamic of RIIr and RIfe indexes in BA in patients with CCA and VD after the PIR administration

the post-isometric relaxation course, the patients were prescribed a set of self-relaxation exercises.

34 (82.9%) patients of the 1st group had a decrease of headache intensity according to the VAS scale, in 30 (73.2%) patients we registered a decrease in the frequency and duration of cephalic attacks, in 26 (63.4%) patients - partial regression of accompanying symptoms (dizziness, nausea, decreased visual acuity, etc.).

In the 2nd group we registered a significant decrease in dizziness intensity in 31 (70.5%) patients, regression of ringing and tinnitus in 18 (40.9%) patients, a decrease in autonomic lability symptoms in 14 (31.9 %) of patients. Almost all patients in both clinical groups noted working capacity, memory and quality of night sleep improvement.

The provided PIR session hemodynamic effect was observed in both clinical groups. In the 1st group there was a slight decrease in the initially elevated TAMX in VA (from 49.1±5.3 cm/s to 43.4±6.2 cm/s) and BA (from 49.8±4.2 cm/s to 44.8±5.9 cm/s). More significant positive dynamics was observed in the 2nd group where the hemodynamic indexes increased to the normal ones in VA and BA (Fig. 1).

A similar trend was observed for reactivity indexes on rotary tests. In both clinical groups one could register a decrease in the initially elevated RIIr and RIfe indexes after the PIR sessions. It should be noted that in the 2nd group patients RIIr index stabilized to normal values, other indexes in both groups after treatment were close to control ones (Fig. 2).

DISCUSSION

Therefore, the data obtained demonstrate vascular component importance in CCA and VD in patients with CS pathology pathogenesis. Certain hemodynamic signs characteristic for each clinical group were observed. CCA patients demonstrated patterns of hyperperfusion both in VA and BA together with hyperreactivity on functional tests with left-right rotation. We registered reduced perfusion in VA and BA in patients with VD as well as expressed hyperreactivity to all functional loads with hyperreactivity to flexion and extension tests prevalence. Theses irritative and compressive changes in observed patients confirms the concept concerning the different patterns of hemodynamic existence in persons with CS pathology [16].

The data obtained proved the positive impact of PIR method on the clinical condition of patients with CCA and VD with the CS degeneration and instability. As the result of the provided treatment, there was a decrease in the intensity and frequency of headache attacks in patients with CCA, a decrease in dizziness intensity and regression of ringing and tinnitus in patients with VD together with partial regression of accompanying symptoms in both clinical groups.

The positive impact of PIR on the cerebral hemodynamic resulted in changed blood flow velocity VA and BA indexes stabilization and reactivity indexes to CS rotatory functional loads normalization. Our results confirm the previously described clinical observations regarding the positive effect of cervicogenic headache [17, 18] and VD [19] manual treatment. Our research also confirm existing opinion concerning the PIR positive influence on VA blood circulation in patients with cervicogenic cranialgia [15]. It should be mentioned also that contrary to the above-mentioned authors we firstly investigated the positive impact of manual treatment on indexes of reactivity to rotational loads.

We supposed to be interesting and promising the further targeted research of the PIR method influence on the deep mechanisms of vascular autoregulation in patients with CS instability.

CONCLUSIONS

1. Hemodynamic changes in patients with CCA are manifested in the form of hyperperfusion through vertebral artery and basilar artery and a half-increase in reactivity indexes on rotatory tests.
2. Hypoperfusion through vertebral artery and basilar artery and rotatory tests hyperreactivity with an emphasis on flexion-extension were registered in patients with VD.
3. The PIR method resulted in the intensity and frequency of headache attacks decrease in patients with CCA, and in dizziness intensity decrease and ringing and tinnitus regression in patients with VD.
4. The hemodynamic effect of PIR was determined in the form of vertebral blood flow indexes through vertebral artery and basilar artery stabilization, as well as indexes of reactivity to rotatory tests normalization.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.