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Impairments to Body Image in Meningioma of the Parietal-Occipital Area

V. B. Nikishina,[1] V. A. Lazarenko,[1] E. A. Petrash,[1] and A. I. Akhmetzyanova[2]

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Objectives. To study impairments to body image in patients with typical meningioma of the parietal-occipital area before and after surgical treatment. **Materials and methods.** A total of 23 patients with diagnosis of "typical meningioma of the parietal-occipital area" were studied. A set of neuropsychological tests was used, along with the "Image-I" dissociation method and the "Silhouette" method. **Results and conclusions.** Derangements to body image were found in patients with meningioma of the parietal-occipital area, these being apparent as disorders of left-right orientation and impairment to the positioning of body parts in space and relative to each other, along with mismatch between objective weight and height values and subjective views of the individuals' own bodies. After surgery, orientation in the body improved significantly, with clear differentiation of the positions of body parts relative to each other, an appropriate relationship between the positions of the two hands, and error-free right-left orientation. Own-body perceptions became more appropriate in relation to the number of body parts and their sizes, though people's views on their own body types generally remained inappropriate.

Keywords: typical meningioma of the parietal-occipital area, body image, body scheme, attitudes to body image.

In modern clinical-psychological categories, the level of differentiation of concepts of corporeality are quite diverse: body image [1–3], body scheme [4, 5], the physical I image [6], body awareness [7], and image of the physical I [8–10] have all been described.

There is a need to discriminate the concepts of "body scheme" and "body image." Body image is a mobile, mainly visual representation, changing depending on circumstances, of one's own body formed in consciousness on the basis of a one's subjective attitudes to one's own objective features [11]. The term body scheme refers to the internal representation constructed by the brain using the functions of the parietal-temporal-occipital areas of the cerebral cortex, a model of the body reflecting its structural organization and carrying out such functions as determining the body's boundaries, forming knowledge of the body as a single whole, perceiving the positions, lengths, and sequences of its components and also their ranges of movement and degrees of freedom [12]. Body scheme is based on the overall set of ordered information relating to the dynamic organization of the subject's body [13]. Body scheme refers to the unconscious internal representation, the overall set of information on the structural organization of the body, its dynamic characteristics, and the current and changing positions of its parts, including the horizontal plane (right-left orientation) [12]. This representation is regulated by the processes maintaining and forming posture and organizing movements. The functional purpose of the body scheme as a system transforming signals from extero-, intero-, and proprioceptors is linked with systematization a person's view of him- or herself.

Studies of the phenomenon of the body scheme, mainly its psychological aspects, have been pursued intensely in the last decade, as evidenced by bibliometric analysis using the scientific online library e-Library.ru [14]. The number of scientific publications has increased by a mean factor of 1.5 per year. A similar trend has been noted in studies of the

[1] Kursk State Medical University, Kursk, Russia; e-mail: petrash@mail.ru.
[2] Kazan Federal University, Kazan, Russia.

image phenomenon: the number of scientific publications has increased by a factor of 8.5.

Models of the body scheme are among the most important conditions for appropriate self-awareness in humans, and their correction is a significant rehabilitation resource. Stressing the importance of body scheme in the rehabilitation process of patients with typical meningioma of the parietal-occipital area, we note that at the morphofunctional and neuropsychological levels, formation of the body scheme occurs in the tertiary zones of the cerebral cortex (the parietal-temporal areas) and subcortical structures supporting interhemisphere interactions, as well as the corpus callosum. The inferior parietal lobe, at the level of neurophysiological manifestations, supports the function of attention to visual targets, the mechanisms of speech perception, and spatial relationships; impaired functioning produces acoustic aphasia and visuospatial agnosia. The supramarginal gyrus supports the feeling of a body scheme, right-left orientation, and recognition of own body parts; functional impairments lead to autotopagnosia. The intraparietal (interparietal) sulcus supports the feeling of the spatial positions of the body parts in space relative to each other; impairments produce autotopagnosia (loss of the sensation of one's own body). The angular gyrus, at the level of neurophysiological manifestations, supports the feeling of right-left relationships, the writing function (spatial orientation of letters when writing in left-right coordinates); impairments produce loss of the sensation of spatial perception of the surrounding world and the position of one's own body and the interactions between its parts.

Brain tumors in the parietal-occipital area lead to derangements of body scheme. In classical neurology, impairments to body scheme, apparent as autotopagnosia, anosognosia, and pseudomelia (right-hemisphere symptoms), are regarded as part of the description of symptoms from lesions to the parietal lobes. The most common (35.5%) brain tumors, with relatively favorable prognoses, are meningiomas, 94% of which are typical.

In typical meningiomas of the parietal-occipital area, impairments to body scheme can be apparent as acoustic aphasia and visuospatial agnosia due to lesions to the inferior parietal lobe. Lesions to the supramarginal gyrus and the area around the intraparietal sulcus are accompanied by agnosia of the body scheme, or autotopagnosia, which is apparent as the inability to recognize where the right side and left side are (right-left agnosia), and inability to recognize one's own fingers (finger agnosia). These impairments most commonly arise in contralateral lesions (on the side opposite the hemisphere with the lesion focus) [15]. Damage to the cortex of the angular gyrus causes greater loss of the feeling of spatial perception of the world, the position of one's own body, and the interactions between its parts. Damage to the connections between the parietal lobes at the level of the corpus callosum also produces impairments to body scheme. Its specific manifestations in patients with typical meningioma of the parietal-occipital area are determined by the size and location of the neoplasm.

The aim of the present work was to study impairments to body scheme in patients with meningioma of the parietal-occipital area before and after surgical treatment.

Materials and Methods. A total of 23 subjects took part in the study – 16 women and seven men aged 32–41 (mean 36.7 ± 1.96) years.

Inclusion criteria were the presence of typical meningioma (ICD-O code 9530/0 in the right hemisphere with grade 1 malignancy (G–I): these were benign, slow-growing formations not infiltrating local tissues, with favorable prognosis and low recurrence frequencies. The gender distribution of the patients corresponded to the distribution typical for meningioma (70% women, 30% men).

The study was performed at the Department of Neurosurgery, Kursk Regional Clinical Hospital. All patients give informed consent [16, 17].

The study was run in three stages. The first stage consisted of tomographic brain investigations to determine the size and structure of the neoplasm. At the second stage, qualitative and quantitative analysis of parameters of body scheme were assessed before surgical treatment. The third stage involved qualitative and quantitative analysis of body scheme parameters six months after surgical treatment (removal of meningioma).

The method for studying body scheme included neurophysiological tests: right-left orientation, demonstration of own body parts and face, test for spatial orientation (Head's test), reproduction of hand position in relation to the face, reproduction of the relative positions of the hands, transfer of posture from one hand to the other [15], and the authors' modification of the Self-portrait method to study image-I dissociation.

Clinical psychological parameters of the analysis of body scheme in patients with typical meningioma of the parietal-occipital area include right-left orientation in the body, orientation of the positions of body parts in relation to the body, orientation of the positions of body parts relative to the face, objectivization of body scheme parameters, appropriateness/inappropriateness of perceptions of own corporeality, and appropriateness/inappropriateness of perceptions of the sizes of own body parts.

Studies of right-left orientation in the body were performed using a special neuropsychological test: the patient was told to indicate his or her left hand; to indicate the psychologist's right leg; to indicate the right hand of the psychologist sitting with the arms crossed. Orientation of body part positions relative to the body was studied using Head's test (the patient was told to reproduce the position of one hand (right for right, left for left, without mirroring) – frontal, horizontal, or sagittal); a test for reproduction of the relative positions of the two hands (the patient had to repeat the hand positions demonstrated by the psychologist sitting opposite); the "Indicate body and face parts" test (the patient is

TABLE 1. Results of Neuropsychological Tests in Patients with Meningioma.

Test	Performance accuracy			Differential performance		
	mean, $M \pm m$	min	max	mean, $M \pm m$	min	max
Right-left orientation	3.2 ± 0.11	3	4	3.4 ± 0.12	3	4
Head test	3.1 ± 0.08	3	4	3.2 ± 0.14	3	4
Reproduction of relative hand positions	3.3 ± 0.19	3	4	3.2 ± 0.11	3	4
Reproduction of hand positions relative to face	3.2 ± 0.14	3	4	3.3 ± 0.21	3	4
indication of parts of own body and face	3.1 ± 0.08	3	4	3.4 ± 0.29	3	4
Transfer of posture from one hand to the other	3.4 ± 0.16	3	4	3.2 ± 0.13	3	4

asked to indicate different parts of his or her own body); the test for transfer of position from one hand to the other (the psychologist places the patient's hand in some position or other and tells the patient to reproduce this gesture with the other hand, with the eyes closed). Orientation of the positions of body parts relative to the face was studied using a test for reproduction of the positions of the hands relative to the face: the patient had to reproduce six postures of one hand in particular positions relative to the face demonstrated by the psychologist sitting opposite. Body scheme parameters were objectivized in terms of weight (kg), height (cm), diameter of right index finger (mm), length of foot (cm); instruments were used to make measurements of diagnostic parameters (height, weight). The appropriateness/inappropriateness of views of own corporeality was assessed using the Silhouette method, in which patients are presented with three silhouette images of am adult human (normo-, hyper-, and asthenic constitutions), and the patient had to select the one most closely corresponding to their own morphology; a method for studying image-I dissociation was also used in which the patient had to draw a self-portrait on a piece of paper and then a shadow of the image on the same sheet. The appropriateness/inappropriateness of views on the sizes of body parts was assessed by analysis of images of the diameter of the index finger of the right hand and the length of the foot: the subject had to draw on a sheet of paper a circle with the diameter of the right index finger and a line with the length of the foot.

Objectivization of body scheme in this study was in terms of the parameters of actual weight and height (kg and cm respectively) and right index finger diameter (mm) and foot size (cm). Actual weight and height values allowed the patients to be divided into three groups: normal-, hyper-, and asthenic. The ratio of weight to height was expressed as the body mass index (BMI) – weight (kg) divided by height (m) squared. The normal range for men is 19–25 kg/m^2 and the normal range for women is 19–24 kg/m^2.

Performance of neuropsychological tests was assessed in terms of performance accuracy and differentiation of movements. Points scores were determined for each parameter on the following scale [18]: 0 points (no errors or "nonspecific" errors for one test or another, as also seen in healthy subjects, for example, orthographic errors in writing, etc.); 1 point (mild impairments; a number of small errors corrected by the subject with little input from the experimenter, lower limit of normal); 2 points (moderate impairment to higher mental functions; subject able to perform tasks after several attempts, hints, and leading questions); 3 points (profound disorders to higher mental functions; unable to perform task even after repeated detailed explanations by the experimenter).

Qualitative and quantitative processing of the resulting data were performed using descriptive (mean, spread, minimum and maximum values, distribution by proportions) and comparative (Fisher's φ angular transformation, nonparametric χ^2 test to assess the significance of differences in linked groups) statistics.

Results and Discussion. Body scheme in patients with typical meningioma of the parietal-occipital area was characterized by significant impairments to the accuracy with which functional tests were performed (accuracy of following instructions and repeating movement acts following visual or tactile images) and the level of differentiation of performance (the clearness with which each component of the movement act was performed in the neuropsychological test), as indicated by the results from assessments of the performance of the neuropsychological tests used (see Table 1).

Results on both accuracy and differentiation of movements pointed to significant impairments to body scheme in patients with typical meningioma of the parietal-occipital area, which was apparent as impairment to right-left orientation (incorrectly indicating the right and left limbs of both the psychologist and their own); mirror repetition of the spatial positions of the hands; errors in the relative positions of the hands and in reproducing the positions of the hands relative to the patient's own face. Errors were not corrected by patients, even after hints from the psychologist and when told they had made them.

Studies of objective measures of body scheme and concepts of corporeality yielded the following results: on the basis of objective measures, the normosthenic body type was noted in 39% of cases, the asthenic in 31%, and the hypersthenic in 30%; in terms of subjective measures, the normosthenic body type was present in 61% and the asthenic in 39%; the hypersthenic body type was not reported.

The subjective views of patients with meningioma of the parietal-occipital area and normosthenia in terms of objective weight and height parameters were asthenic in 100% of cases. All patients with meningioma of the parietal-occipital area with the asthenic body type at evaluated themselves at the subjective level as normosthenics. Among patients who in terms of objective weight and height measurements were hypersthenic, 22% rated their body type as normosthenic and 9% as asthenic. Patients with meningioma of the parietal-occipital area also showed mismatch between objective measurement of right index finger diameter and foot length and subjective evaluations (in all cases, subjective images were larger than real images).

Investigations of measures of image-I dissociation identified a high level of dissociation (the mean difference between the heights of the main and supplementary images was $\Delta d_1 = -24.18$; the angle between the main and supplementary images was 12.6°).

These results from studies of body scheme in patients with meningioma of the parietal-occipital area point to mismatch between objective measures – real weight and height values and body parts (right index finger diameter, foot length) and subjective representations, which were also confirmed by high levels of image-I dissociation.

Thus, impairment to body scheme in patients with meningioma of the parietal-occipital area include disorders of right-left orientation and the positions of body parts in space and relative to each other, along with mismatch between objective weight and height measures and subjective representations of their own bodies.

The third stage of the study addressed the task of conducting a qualitative-quantitative analysis of body image parameters in patients with typical meningioma of the parietal-occipital area six months after surgical treatment. A total of 21 patients were studied who had taken part in the pre-operative investigation.

Repeat investigation of patients using the Friedman χ^2 test and Fisher's φ angular transformation demonstrated statistically significant differences ($p < 0.05$) in all diagnostic parameters except perception of overall body scheme.

The levels of significance of differences in body image parameters in patients with typical meningioma of the parietal-occipital area before and after surgical treatment (Friedman χ^2 test, Fisher's φ angular transformation, $p < 0.05$) were as follows: test for right-left orientation, 0.028; Head's test 0.031; test for reproduction of relative positions of the two hands 0.019; test for reproduction of hand positions relative to the face 0.016, normosthenia 0.007, asthenia 0.018, hypersthenia 0.024.

Thus, surgery was followed by significant improvements in orientation in the patient's own body (quasispatial orientation), which was apparent as clear determination of the positions of body parts relative to each other and appropriate relationships between the positions of the two hands, and error-free right-left orientation. Concepts of own body became appropriate in terms of the number of body parts and their sizes (patients imaging themselves correctly indicated the number of body parts according to their real sizes). Inappropriateness persisted in relation to views on the proportions of their own bodies, which was apparent in terms of the body type identified. The phenomenon of asomatognosis was found in patients with meningioma of the parietal-occipital area, which was seen as the feeling of deformity (distortion) of their own body, which produced a change in the subjective assessment of own weight and the sizes of different body parts.

The authors have no conflicts of interests.

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