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MORPHOMETRIC CHARACTERISTICS OF CEREBRAL CORTEX GYRUS PRECENTRALIS IN THE MALES-MESOCEPHALIC ACCORDING TO CT - SCAN

ABSTRACT

The **purpose** of research was to determine the width of the precentral gyrus, to determine the thickness of the cerebral cortex and the X-ray density of the precentral gyrus neurons in males-mesocephalic according to CT-scan. The analysis of CT-scan study results of 55 males masacrans, mesocephalics in age from 22 to 35 years without diseases and traumas of central and peripheral nervous system in anamnesis, with predominance of the right hand (right-handed) was done. Morphometric characteristics of the precentral gyrus the cerebral cortex, were determined at three points: above the upper temporal gyrus, at the level of the middle frontal gyrus and above the cingulate gyrus.

It is found that the maximum width of the precentral gyrus is determined above the upper temporal gyrus. Its minimum value was found above the cingulate gyrus. The largest indicator of the thickness of the cerebral cortex of the precentral gyrus is set at the level of the middle frontal gyrus, the lowest value is noted above the upper temporal gyrus. In the left hemisphere, the maximum X-ray density of neurons in the cerebral cortex of the precentral gyrus is set above the cingulate gyrus. In the right hemisphere, the limiting density of neurons was detected above the upper temporal gyrus. The lowest density of neurons in the cerebral cortex of the precentral gyrus was determined by CT-scan in both hemispheres of the brain at the level of the middle frontal gyrus.

Comparative analysis of the parameters of the width of the precentral gyrus, the thickness of the cerebral cortex and the X-ray density of the precentral gyrus neurons showed a statistically unreliable degree of interhemispheric differences with a tendency to reduce all indicators in the right hemisphere in comparison with the left one.

Keywords: precentral gyrus, cerebral cortex, X-ray density, morphometric characteristics, CT-scan, mesocephalic.

Introduction. The structure of the central nervous system is devoted to many works of both domestic and foreign scientists. Scientists have found that the cerebral cortex, which is a layer of gray matter in different departments has a different thickness. The surface of the crust is characterized by a complex relief, which includes numerous furrows and located between them elevations – convolutions [12, 14]. Of particular interest for various specialties doctors are information about the morphology of the precentral gyrus, since it originates the pyramid pathway responsible for arbitrary movements [13].

The possibilities of using such modern methods as CT-scan or magnetic resonance imaging in the diagnosis of various diseases impose new requirements to the level of knowledge about the parameters and structure of specific anatomical formations, taking into account the sex, age and typological characteristics of the subject [1, 5, 7]. In the scientific literature there is information about the anatomical characteristics and cytoarchitectonics of many areas of the cerebral cortex and cerebellum, taking into account the specific period of postnatal human ontogenesis [2, 11. 15]. At the same time, detailed knowledge of the morphometric features of the precentral gyrus revealed by computed tomography is very scarce and has a fragmentary character.

The aim of the study was to determine the width of the precentral gyrus, to determine the thickness of the cerebral cortex and the X-ray density of the precentral gyrus neurons in males-mesocephalic according to CT-scan.

Materials and methods. The work is based on the analysis of the results of X-ray computer tomographic study of 55 men who underwent examination and treatment in the Department of radiology of the state Autonomous health institution of the Perm region «City clinical hospital №4». The age of the subjects ranged from 22 to 35 years inclusive. The research was approved by the ethical Committee of the E.A.Vagner Perm State Medical University (№10 from 22.11.2017). The examinees had no history of diseases and injuries of the Central and peripheral nervous system, noted the predominance of the right hand (right-handed). All of them agreed to X-ray examination, which was carried out only according to the indications. Transverse-longitudinal (cranial) index of the subjects was 76,6±1,22%.

Review craniography was conducted in the standard projections (frontal and lateral) X-ray Chirana MP 15-B (Slovakia). Craniometrical study included the measurement of the longitudinal and transverse dimensions of the skull and the definition of craniata largest cross-longitudinal index. The study sample was made up objects with a skull of average form – mesocrans, mesocephalic, the value of the cranial index of which is varied in the range from 75,0 to 79,9. The longitudinal and transverse dimensions of the skull were measured at the extreme protruding points on the axial section and in 3D reconstruction mode. CT-scanwas performed on 16-slice apparatus Optima CT 520 (General Electric – GE Healthcare, USA). Scanning was performed by a native with a slice thickness of 5 mm, with subsequent postprocessing reconstructions with a slice thickness of 0.65 mm in the mode of Head

and Bone with the use of the sharpen filters. The width of the precentral gyrus, the thickness of the cerebral cortex of the precentral gyrus and the X-ray density of neurons were determined at three points (T): in T1 – above the upper temporal gyrus, in T2 – at the level of the middle frontal gyrus, in T3 – above the cingulate gyrus. Statistical processing of the results was performed using the software system STATISTICA V. 6.0. The results were presented in the form of the arithmetic mean value (M), relative error (m), maximum and minimum values, variation coefficient, median. The significance of differences in mean values was assessed using the student's parametric t-test. The critical level of significance when testing statistical hypotheses was considered to be equal to 0.05, while the confidence interval, $p<0.01$, indicating differences between the relative frequencies of the characteristic values was determined.

Results and discussion. Morphometric characteristics of the cerebral cortex of the precentral gyrus in males-mesocephalic are presented in the Table. Maximum width of precentral gyrus in men mesocephalic is inserted over the superior temporal gyrus (T1). It is 15.72±0.04 mm in the left hemisphere and 15.68±0.04 mm in the right hemisphere of the brain (Table). A minimum width of 11.41±0.03 mm in the left hemisphere and 11.37±0.03 mm in the right hemisphere was found above the cingulate gyrus (T3).

The greatest thickness of the cerebral cortex of the precentral gyrus was established at the level of the middle frontal gyrus (in T2). The smallest thickness of the cortex in both hemisphere was noted above the upper temporal gyrus (T1).

In the left hemisphere, the maximum X-ray density of neurons in the cerebral cortex of the precentral gyrus, equal to 33.45±0.09 HU, was detected above the cingulate gyrus (in T3). In the right hemisphere, the limiting density of neurons reaches 33.32±0.09 HU above the upper temporal gyrus (T1).

The lowest density of neurons in the cerebral cortex of the precentral gyrus was established by X -ray computed tomography in both hemispheres of the brain at the level of the middle frontal gyrus (T2).

When comparing the parameters of the width of the precentral gyrus, the thickness of the cerebral cortex and the X-ray density of the neurons of the precentral gyrus in both hemispheres, no statistically significant differences were found, with a tendency to reduce all indicators in the right hemisphere compared to the left ($p>0.05$).

Conclusion. In the available publications, the researchers noted that the more advanced evolution of the kinesthetic analyzer, located in the precentral gyrus, led mainly to the development of the right hand in humans [10]. In the modern literature there is information about the results of a comprehensive comparative analysis of the organization of cell groups, intercellular space, the area of neurons in the cerebral cortex of the precentral gyrus, performed in fetuses, newborns and infants with intrauterine growth retardation. It was determined that interhemispheric asymmetry is manifested in the cerebral cortex of the precentral gyrus by the predominance of the area of cell groups of the left hemisphere and the thickness of the cortex [8]. In our study, performed in men aged 22 to 35 years, on the basis of X-ray computed tomography, statistically significant interhemispheric differences in the width of the precentral gyrus and the thickness of the cerebral cortex of the precentral gyrus were not revealed. However, there is a tendency for parameters to prevail in the left hemisphere.

In the course of studies of quantitative and qualitative characteristics of neuron-glial-capillary relationships in the upper frontal gyrus of the human cerebral cortex, taking into account gender, age and hemisphere, scientists have found that the density of glial cells increases with age regardless of gender. When calculating the glial-neuronal index, the researchers note that the ratio of glia-neuron in elderly people is one and a half times higher than in young people [9]. In this case, the density of capillaries throughout a person's life decreases. However, in both men and women there were no statistically significant differences in the indices of neurons, glia and capillaries between the right and left hemispheres of the brain [4].

Determination of the X-ray density of neurons in the cerebral cortex of the precentral gyrus, also did not show significant interhemispheric differences, while paying attention to the tendency to the predominance of parameters in the left hemisphere. The obtained results can serve as an equivalent of the age and sex anatomical norms of the brain precentral gyrus in men aged 22 to 35 years with a predominance of the right hand, which will allow using this data in further funda-

Morphometric characteristics of the cerebral cortex of the precentral gyrus in males-mesocephalic according to CT-scan (n=55)

Hemisphere	Point of measurement	M±m	Max	Min	σ	Cv	Me
Width of the precentral gyrus. mm							
Left	T1	15.72±0.04	16.28	15.10	0.33	2.11	15.67
	T2	13.49±0.04	14.09	12.92	0.33	2.47	13.54
	T3	11.41±0.03	11.79	11.01	0.23	2.04	11.45
Right	T1	15.68±0.04	16.29	15.11	0.33	2.11	15.69
	T2	13.46±0.04	14.10	12.90	0.35	2.61	13.42
		11.37±0.03	11.80	11.06	0.21	1.83	11.33
Thickness of the cerebral cortex of the precentral gyrus. mm							
Left	T1	4.43±0.04	5.00	3.92	0.34	7.70	4.41
	T2	4.69±0.04	5.24	4.10	0.34	7.28	4.72
	T3	4.48±0.04	4.94	3.91	0.31	6.87	4.50
Right	T1	4.40±0.04	4.96	3.90	0.32	7.17	4.38
	T2	4.66±0.04	5.22	4.12	0.30	6.54	4.66
		4.43±0.04	4.90	3.92	0.30	6.67	4.40
X-ray density of neurons in the cerebral cortex precentral gyrus. HU							
Left	T1	33.37±0.09	34.55	32.02	0.70	2.11	33.38
	T2	32.86±0.07	33.99	31.81	0.61	1.85	32.72
	T3	33.45±0.09	34.62	32.13	0.76	2.27	33.55
Right	T1	33.32±0.09	34.53	32.02	0.71	2.13	33.23
	T2	32.84±0.08	33.93	31.82	0.64	1.95	32.75
		33.20±0.08	34.58	32.17	0.65	1.95	33.11

mental researches and clinical work.

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