

YETKİN YAŞLI İNSANLARDA KƏLLƏNİN PARAMETRLƏRİNİN VƏ BEYNİN YAN MƏDƏCİKLƏRİNİN FƏRDİ XÜSUSİYYƏTLƏRİ, ONLARIN VENOZ-LİKVOR ƏLAQƏLƏRİNİN TİPLƏRİNƏ GÖRƏ FƏRQLƏRİ

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Xülasə. Məqalədə başın uzunluq və eninin, kəllənin hündürlüyünün və beynin yan mədəciklərinin metrik diapazonlarının fərdi xüsusiyyətlərini, həmçinin beynin venoz sistemi ilə beyin-onurğa beyni mayesinin qarşılıqlı əlaqələrini təhlil etmək üçün aparılmış kranio-metrik tədqiqat işi haqqında məlumat verilmişdir.

Tədqiqat göstərmişdir ki, dolixosefal kəllə formasına malik olan kişi və qadınlarda başın, kəllə boşluğunun və yan mədəciklərinin boylama ölçüləri üstünlük təşkil edir. Sağ və sol mədəciklərin kraniotopografik münasibətləri də müvafiq şəkildə formalaşır. Likvor sistemi obyektlərinin köndələn istiqamətli kranio-metrik ölçülərinin nisbətində də müəyyən uyğunluqlar aşkar edilmişdir. Aydın olmuşdur ki, cinsiyyətdən asılı olmayaraq, başın, kəllə boşluğunun və yan mədəciklərin eninin ölçüləri dolixo-, mezo- və braxiosefal formaların ardıcılığı üzrə artır. Bu ölçülərin öyrənilməsinin yan mədəciklərin punksiyasının icra edilməsi üçün əhəmiyyəti vardır.

Kəllə əsasında beynin sərt qişasının və baş beyninin likvor-mədəcik şöbələrinin qarşılıqlı münasibətləri baxımından iki hüdudi tip ayrılaraq edilmişdir: birinci – dənəli (səpələnmiş) tip və ikinci – magistral tip. Bundan əlavə, bu qarşılıqlı əlaqələrdə çox sayda aralıq formalar mövcuddur və yuxarı oxşəkili cəmlə köndələn cəmlərin venoz axacaqları qruplarının toplanmalarında da fərqlilik aşkar edilmişdir.

Açar sözlər: kranio-metrik metod, stereotopografiya, baş beyninin sərt qişası, venoz cəmlər, baş beyni mədəcikləri, kəllənin formaları

Ключевые слова: краниотопографический метод, стереотопография, твердая оболочка головного мозга, венозные пазухи, желудочки головного мозга, форма черепа

Key words: craniotopographical method, stereotopography, dura mater, venous sinuses, ventricles of the brain, shape of the skull

INDIVIDUAL PARAMETER DIFFERENCES SKULL AND LATERAL VENTRICLES WITH THE TYPES OF VENOUS-LIQUOR RELATIONSHIP IN PEOPLE OF MATURE AGE

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The results of a study aimed at determining the range of metric individual differences in the length, width, height parameters of the head (skull) and lateral ventricles in adults, as well as to carry out the craniometric analysis of the relationships between the venous and cerebrospinal fluid systems of the brain in adults of both sexes.

The material of research was dura mater with its sinuses, ventricles of the brain and vault of the skull. We used a complex of macro – and microanatomy techniques.

It has been shown that the longitudinal parameters of the head, cranial cavity and lateral ventricles usually prevail in male and female representatives with a dolichocephalic head shape (long-headed people). Respectively, certain craniotopographic relationships with the right and left lateral ventricles are formed. Craniometric correlations between the transverse dimensions of the studied objects of the cerebrospinal fluid

system have been established. It has been found out that regardless of gender, there is a characteristic trend of gradual increase in the width of the head, skull cavity, and lateral ventricles from dolicho to meso- and brachycephals. The obtained craniometric data are important for purposeful and rational puncture of the lateral ventricles, which allow us to determine and take into account the distance of their location in relation to the bones of the skull vault.

Two extreme types of relationships have been identified between venous-sinus formations of the dura mater of the cranial vault and cerebrospinal fluid-ventricular parts of the brain. The first is the loose type (scattered type), the second is the trunk type. In addition, there are a lot of intermediate forms of these relationships, differing in length and concentration of separate groups of venous tributaries along the superior sagittal and transverse sinuses.

Introduction. The study of morphometric features of cranial structures, individual variability by age, sex and craniotypes is of great importance for obtaining a morphometric standard of their anatomical norms [1, 2]. One of the most complex structures of the brain from the theoretical and practical sides is the cerebrospinal fluid system in the context of individual differences in parameters from the point of view of dependence on the extreme type of structure of an individual [3, 4].

The role of the lateral ventricles cannot be overestimated, because they are in great demand from the functional point of view – regulation of intracranial pressure and outflow of cerebrospinal fluid, reservoir function, etc., which is of great significance for the functioning of the human body [3].

The cerebrospinal fluid system, the lateral ventricles in particular, represent a substrate for scientific research in the fields of neuromorphology and neurosurgery in the focus of modern research methods, such as magnetic resonance imaging, radiography, and computer tomography [5].

Thus, there is a necessity to study the above-mentioned anatomical structures for modern neuromorphology and neurosurgery.

The aim of our study was to determine the range of metric individual differences in the length, width, height parameters of the head (skull) and lateral ventricles in adults, as

well as to carry out the craniometric analysis of the relationships of the venous and cerebrospinal fluid systems of the brain of adults of both sexes.

Material and methods. The material of our research was dura mater with its sinuses, ventricles of the brain and vault of the skull.

In our research, we used a complex of macro – and microanatomy techniques: macro – and microdissection of brain anatomical objects; cranio – and morphometry of veins, sinuses of dura mater and cerebrospinal structures of the brain; production of corrosive (acrylic) casts-preparations of veins, sinuses of the dura mater and cerebrospinal fluid formations; injection technique; variational-statistical analysis of morphometric data; computer graphic analysis; stereotopographic method.

This study was performed on 100 cadavers of people of different ages and sexes with the production of native preparations of the brain with meninges and cerebrospinal fluid structures. Distribution of morphological objects (Table 1): 70 preparations of veins and sinuses of the dura mater of adults; 30 preparations of the cerebrospinal fluid system of adults.

We determined the head (cranial) index, so dolichocephals (dolichocranes), mesocephals (mesocranes), brachycephals were differentiated.

The main (cranial) index was calculated for each preparation according to the formula:

$$\text{Ind} = \frac{\text{transverse dimension (width) of the skull (in cm)}}{\text{longitudinal dimension (width) of the skull (in sm)}} \times 100$$

Table 1. Number of Anatomical Objects Depending on the Age and the Sex

№	Periods / gender	Age of Male	Number of Male	Age of Female	Number of Female
1.	First mature	22-35	15	21-35	8
2.	Second mature	36-60	45	36-57	32
3.	Total		60		40

The work was performed in accordance with the requirements of the “Instructions on Conducting a Forensic Medical Examination” (order of the Ministry of Health of Ukraine No. 6, 17.01.1995), in accordance with the requirements and norms, the standard regulation on ethics of the Ministry of Health of Ukraine No. 690, 23.09.2009, “The Procedure of Removing Biological Objects from the Dead, whose Bodies are Subject to Forensic Medical Examination and Patho-anatomical Examination, for scientific purposes” (2018).

Research results.

In our research, it has been revealed that there are limit parameters of head (skull) length, cranial cavity and lateral ventricles in men and women of mature age, depending on their extreme type of structure (Table 2).

According to the obtained data, the longi-

tudinal parameters of the head, skull cavity and lateral ventricles usually prevail in male and female representatives who have a dolichocephalic head shape (long-headed people). Accordingly, certain craniotopographic relationships with the right and left lateral ventricles are formed.

In women, the similar range of individual variability of the longitudinal parameters of the head, cranial cavity, and lateral ventricles is observed.

To understand the existing individual differences in the location and depth of the lateral ventricles inside the brain, firstly craniometric correlations between the transverse dimensions of the studied objects were revealed (Table 3).

Table 2. Range of Individual Differences in the Longitudinal Dimensions of the Head, Cranial Cavity and Lateral Ventricles in Men and Women of Mature Age (in cm)

№	Shape of the Head Parametres	Sex	Shape of the Head		
			Dolichocephals	Mesocephals	Brachycephals
1.	Length of the heads	male	17.5–19.0	17.4–18.6	16.7–18.1
		female	17.1–19.0	17.1–17.9	16.3–17.8
2.	Length of the cranial cavity	male	15.2–17.5	15.2–16,3	14.5–15.0
		female	15.0–16.7	15.0–16.0	14.2–15.0
3.	Length of the right lateral ventricle	male	9.4–9,7	9.1–9.5	8.8–9.1
		female	9.2–9.5	9.0–9.3	8.3–8.9
4.	Length of the left lateral ventricle	male	9.4–9,7	9.2–9.5	8.8–9.2
		female	9.1–9.5	9.0–9.4	8.3–8.8

Table 3. Range of Individual Differences in the Width of the Head, Cranial Cavity and Lateral Ventricles in Men and Women of Mature Age (in cm)

№	Shape of the Head Parametres studied	Sex	Shape of the Head		
			Dolichocephals	Mesocephals	Brachycephals
1.	The width of the head	male	13.0–14.0	13.9–14.9	13.7–16.0
		female	12.8–13.9	13.5–14.0	13.6–15.0
2.	The width of the cranial cavity	male	11.0–12.6	12.2–13.2	13.0–15.0
		female	11.0–12.6	11.8–12.8	12.8–14.0
3.	The width of the left lateral ventricle	male	0.7–0.9	0.8–0.9	1.1–1.4
		female	0.7–0.9	0.8–0.9	1.1–1.4
4.	The width of the right lateral ventricle	male	0.7–1.2	0.8–0.9	1.2–1.4
		female	0.7–1.0	0.7–0.9	1.0–1.3

Table 4. Range of Individual Differences in the Height of the Head, Cranial Cavity and Lateral Ventricles in Adults (in cm)

№	Shape of the Head Parametres studied	Dolichocephals		Mesocephals		Brachycephals	
		Male	Female	Male	Female	Female	Female
1.	Height of the head	13.0–14.8	13.5–14.3	13.3–15.0	14.0–14.8	14.0–15.2	14.0–14.8
2.	Height of the cranial cavity	12.0–13.7	12.0–13.3	12.3–14.0	13.0–13.8	13.3–15.0	13.5–14.2
3.	Height of the left lateral ventricle	1.8–2.2	1.8–2.3	2.2–2.5	2.1–2.4	2.3–2.9	2.2–2.7
4.	Height of the right lateral ventricle	1.9–2.2	1.9–2.2	2.1–2.4	2.1–2.3	2.2–2.9	2.3–2.7

Regardless of gender, there is a characteristic trend of gradual increase in the width of the head, skull cavity and lateral ventricles from dolicho – to meso – and brachycephals. The first have minimum values of the transverse parameter of the head. In brachycephals, on the contrary, there is the maximum value of this head parameter.

The important indicator is the correlation between the height of the head, the cavity of the skull and the central part of the lateral ventricles, which allows us to specify the craniotopography of this part of the cerebrospinal fluid system.

Taking into consideration the extreme types of head structure, the range of their differences in mature people has been found (Table 4).

According to obtained data, the height of the head and the cranial cavity gradually increases from dolicho to brachycephalic due to the predominance of the transverse dimensions and the total volume of the brain in the brachicephals.

The obtained craniometric data are important for purposeful and rational puncture of the lateral ventricles, which allow to determine and take into account the distance of their location in relation to the bones of the skull vault.

Taking into consideration the needs of modern neurosurgery and the necessity to operate within the borders of the venous-sinus and cerebrospinal fluid-ventricular complexes of the brain, the research on their relationships has been carried out. It has been found out that there are natural craniotopographic and morphometric relations between the main

sinuses of the the dura mater of the cranial vault and the parts of the lateral ventricles.

We singled out two extreme types of relationships between venous-sinus formations of the dura mater of the cranial vault and cerebrospinal fluid-ventricular parts of the brain. The first is the loose (scattered) type, which is characterized by a large number of venous inflows in the pools of the superior saggital and transverse sinuses (**Fig. 1**).



Fig. 1. Loose type of sinus-liquor relationships of the brain of a mature person

In this case, there are 18–25 superficial veins that flow into the superior saggital sinus on both sides, as well as up to 12–14 main tributaries that form the venous basins of the left and right transverse sinuses. Their diameter is small and ranges from 0.5 to 1.0 mm on average. Between them there is a fine looped dense venous network, formed by dichotomous division throughout the entire structure.

The second is the trunk type, which has a

limited number of venous tributaries in the pool of the above-mentioned sinuses of the dura mater, which looks as follows in relation to the cerebrospinal fluid system (**Fig. 2**).



Fig. 2. Trunk Type of Venous–liquor Relationships of the Brain of a Mature Person

In this type, there is a reduced number of venous trunks, which flow into the lumen of the superior sagittal sinus (no more than 9-10 veins), 5-6 veins flow into the transverse sinuses. Their diameter varies between 1.0-2.0 mm. At the same time, there is no anastomotic network between the venous tributaries and relatively “vascularless” zones are formed in the convexital part of the dura mater.

In addition, there are numerous intermediate forms of these relationships, which differ in length and different concentration of separate groups of venous tributaries along the superior sagittal and transverse sinuses (**Fig. 3**).



Fig. 3. Intermediate forms of venous-cerebral relations of the brain of a mature person

Discussion. In our research, we studied the features of the structure of such parts of the liquor-ventricular system of the brain as the lateral ventricles in adults, as well as the types of structure and branching of the venous tributaries that flow into the superior sagittal sinus (SSS).

The lateral ventricles are located inside the cerebral hemispheres. Based on the needs of neurosurgical practice, we additionally studied the craniotopographic features of these formations, taking into account individual differences in the structure of the head and skull cavity.

Currently, a lot of attention is paid to the cerebrospinal fluid-ventricular system of the brain. For example, issues of ontogenesis, anatomical variations, 3D modeling are considered [6, 7, 8].

Modern neurology and neurosurgery require clear parameters for the diagnosis and treatment of pathological conditions of the cerebrospinal fluid-ventricular system. For neurosurgery, performing surgical interventions on the above-mentioned brain structures requires an obvious necessity for further study of the variability of the sinus-cerebral fluid relationship depending on the extreme forms of the structure of the head and skull of people of mature age and gender [9,10].

Our study shows new data on the craniotopography and morphometry of the sinus-cerebrospinal fluid formations of the brain of a mature person, depending on the individual anatomical variability of the shape and size of the head.

It has been demonstrated that there are two types of structure and branching of the venous tributaries that flow into the SSS. The 1st type is trunk, which is characterized by a small number of vessels throughout the sinus. The second type is loose, which is characterized by a large number of tributaries on each side (12 or more).

With this information we have confirmed the already known data, according to which three types of fusion of the sinuses of the dura mater are distinguished: loose (scattered), which is more common in mesocephals; intermediate – in dolichocephals; trunk – in brachycephals. Experimental studies of the superior sagittal sinus, in which various parts

were bandaged, showed significant compensatory capabilities of the superficial veins of the brain and the functioning of sinus-vascular anastomoses [11].

In this way, avascular areas have been determined along the entire length of the SSS, their localization is important while performing “safe” punctures and inserting a catheter into the body cavity or the horns of the lateral ventricles.

Conclusions. The craniotopographic and craniometric correlations of the sizes of the head (skull), the cranial cavity and the lateral ventricles in adults of both sexes have been studied for the first time. Taking into consideration the practical necessity of puncture

and catheterization of various formations of the cerebrospinal fluid system of the brain, a range of their longitudinal and transverse dimensions has been established, which allows correct orientation during surgical interventions. It has been revealed that there are limit parameters of the length of the head (skull), cranial cavity and lateral ventricles in men and women of mature age, depending on their extreme type of structure. Based on practical goals, the craniometric analysis of the relationships of the venous and cerebrospinal fluid systems of the brain of an adult, based on stereotopography, has been carried for the first time.

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ИНДИВИДУАЛЬНЫЕ РАЗЛИЧИЯ ПАРАМЕТРОВ ЧЕРЕПА И БОКОВЫХ ЖЕЛУДОЧКОВ С ТИПАМИ ВЕНОЗНО-ЛИКВОРНЫХ ВЗАИМООТНОШЕНИЙ У ЛЮДЕЙ ЗРЕЛОГО ВОЗРАСТА

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Резюме. Представлены результаты исследования, проведенного с целью определения диапазона метрических индивидуальных различий длины, ширины, высоты параметров головы (черепа) и боковых желудочков у взрослых, а также проведение краниометрического анализа взаимоотношений систем венозной и спинномозговой жидкости головного мозга у взрослых людей обоего пола.

Материалом для исследования послужила твердая мозговая оболочка с ее синусами, желудочки мозга и свод черепа. В исследовании использовался комплекс методов макро- и микроанатомии.

Было показано, что продольные параметры головы, полости черепа и боковых желудочков обычно преобладают у представителей мужского и женского пола, имеющих долихоцефалическую форму головы (длинноголовых людей). Соответственно, формируются определенные краниотопографические соотношения с правым и левым боковыми желудочками. Установлены краниометрические соотношения между поперечными размерами изученных объектов ликворной системы. Определено, что независимо от пола наблюдается тенденция постепенного увеличения ширины головы, полости черепа и боковых желудочков от долихо- к мезо- и брахицефалам. Краниометрические данные имеют значение для целенаправленной и рациональной пункции боковых желудочков.

Было выделено два крайних типа взаимоотношений между венозно-пазушными образованиями твёрдой оболочки головного мозга свода черепа и ликворо-желудочковыми отделами головного мозга. Первый – рассыпной тип, второй – магистральный тип. Кроме того, существует целый ряд промежуточных форм этих взаимоотношений, отличающихся протяженностью и различным скоплением отдельных групп венозных притоков вдоль верхней стреловидной пазухи и поперечных пазух.

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