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CRANIOTOPOGRAPHIC CHARACTERISTICS OF RECTUS SINUS OF THE DURA MATER OF THE BRAIN IN PEOPLE OF MATURE AGE IN HEALTH

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For our investigation, we collected cadaveric material from 40 people of different ages and gender. We have prepared corrosive preparations of the rectus sinus of the dura mater of the brain. Our research has a variety of research methods for morphological research: topographic-anatomical preparation on the macroscopic and microscopic levels, cranial-morphometric examination of the rectus sinus, hardening of acrylic plastic for the preparation of corrosive preparations for the rectus sinus of the dura mater of the brain, injection method. The mophometric indicators we collected from the rectus sinus were subject to variation-statistical analysis. We also use the method of computer-graphic analysis. The data from our research can be used in planning surgical interventions on the structures of the dura mater of the brain – first for everything on the rectus sinuses of the dura mater of the brain.

Key words: human, mature age, dura mater of the brain, rectus sinus, craniotopographic method.

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КРАНІОТОПОГРАФІЧНА ХАРАКТЕРИСТИКА ПРЯМОЇ ПАЗУХИ ТВЕРДОЇ ОБОЛОНКИ ГОЛОВНОГО МОЗКУ У ЛЮДЕЙ ЗРІЛОГО ВІКУ У НОРМІ

Для нашого дослідження був використаний трупний матеріал від 40 людей різного віку та статі. Нами були виготовлені корозійні препарати прямого синуса твердої оболони головного мозку. У нашому дослідженні були використані різноманітні методи дослідження для морфологічних досліджень: топографо-анатомічне препарування на макроскопічному та мікроскопічному рівнях, краніо-морфометричне дослідження прямої пазухи, застосування акрилової пластмаси для виготовлення корозійних препаратів прямого синусу твердої оболони головного мозку, метод ін'єкції. Отримані нами мофометричні показники щодо прямої пазухи піддавалися варіаційно-статистичному аналізу. Також нами був застосований метод комп'ютерно-графічноного аналізу. Дані нашого дослідження можливо використати при плануванні оперативних втручань на структурах твердої оболони головного мозку – перш за все на прямих пазухах твердої оболони головного мозку.

Ключові слова: людина, зрілий вік, тверда оболонка головного мозку, пряма пазуха, краніотопографічний метод.

The study is a part of the research project "Morphofunctional study of human internal organs and laboratory animals in various aspects of experimental medicine", state registration No. 0121U108258.

Vascularization of the human brain was and is the subject of close attention and the object of careful study by specialists in theoretical and practical medicine. However, the need for further study of the sinuses of the dura mater is due to the anatomical and functional importance of this part of the venous system of the brain [7–9].

Despite the fact that recently a considerable number of works devoted to the sinuses of the dura mater of the human brain have been published, there are quite a few literary sources devoted to the anatomical and topographic features of the direct sinus of the dura mater of the brain [3, 8, 9].

Rectus sinus is the second venous collector that provides blood outflow from the brain and is one of the complex formations of the dura mater of the brain and performs the transport function of blood outflow, while connecting the vena magna Galeni and the confluens sinuum. Quite a lot of information has been devoted to these issues in recent years [2–4, 6, 11–13, 15].

Modern medicine of the 21st century is evidence-based medicine. At the current stage of development of such a branch of medicine as neurosurgery, specific data are needed that relate to the planning of surgical interventions.

In recent years, according to literary sources, interest in the structures of the dura mater of the brain has not decreased [9–11].

In order to carry out diagnostic manipulations and operative interventions on the structures of the hard shell of the brain, thorough theoretical knowledge is required for their justified implementation.

Therefore, studies of the craniotopographic features of the direct sinus of the dura mater, which is one of the main venous collectors of the brain, are of undeniable scientific interest.

The purpose of the study was to determine the craniotopographic features of the rectus sinus of the dura mater of the brain in people mature age in health.

Materials and methods. For our investigation, we collected cadaveric material from 40 people of different ages and statistics. We have prepared corrosive preparations of the rectus sinus of the dura mater of the brain. Our research has a variety of research methods for morphological research: topographic-anatomical preparation on the macroscopic and microscopic levels, cranial-morphometric examination of the rectus sinus, hardening of acrylic plastic for the preparation of corrosive preparations for the rectus sinus of the dura mater of the brain, injection method. The mophometric indicators we collected from the rectus sinus were subject to variation-statistical analysis. We also use the method of computer-graphic analysis [1, 5, 7, 14].

This study was carried in the conditions of the patho-anatomical departments of the Donetsk region (oblast) of the Department of Health of the Donetsk Regional State Administration and the Department of Human Anatomy, Physiology and Pathological Physiology of the Donetsk National Medical University (Lyman, Kropyvnytsʹkyy) for the time period of 2015–2019 (obtaining material), and 2020–2023 – data processing and summarizing.

Results of the study and their discussion. The most difficult position among the sinuses of the dura mater is occupied by the rectus sinus, which collects blood from the internal structures of the brain. In addition to the superior sagittal sinus, the tributaries of the magna cerebral vein (the vein of Galen), which is formed of a diverse number of intra-organ cerebral veins, flow into its anterior area. Numerous venous branches that go from all lobes of the brain, as well as venous plexuses near the lateral ventricles and pathways that carry the liquor, open into the magna cerebral vein of the brain.

The rectus sinus begins with an ampulla (expansion), which is located at the rear edge of the corpus callosum and flows into the anterior part of the confluens sinuum**.** The lateral (right and left) walls of the back part of the collector are split leaves of the basis falx cerebri, and the inferior wall is a leaf of the tentorium cerebelli. In this regard, this collector, as a rule, has a triangular shape, which ensures sufficient outflow of blood from the deep formations of the brain (Fig. 1).

According to our data, the length of the rectus sinus in people of mature age from 3.0 to 5.5 cm and is subject to changes due to individual features of the structure of the skull (Table 1).

Table 1

Individual anatomical variability of the rectus sinus in people of mature age (in cm)

No.	Head Shape / Research parameters	Dolichocephals	Mesocephals	Brachycephals
1.	Length	4.2–5.5	3.9–4.8	3.0–4.3
2.	Width of the front section	2.5–3.3	2.7–3.5	2.8–3.8
3.	The width of the middle section	3.0–3.6	3.2–3.8	3.2–4.2
4.	The width of the rear section	3.9–4.8	3.9–5.0	4.1–6.0
5.	Clearance height	0.20–0.24	0.29–0.36	0.30–0.38

Along its length, the rectus sinus receives venous blood from the falx cerebri, the tentorium cerebelli, and individual vessels from the surface of the cerebellar hemispheres (Fig. 2).

Thus, the rectus sinus is basically a continuation of the vena magna Galeni of the brain, which consists of three groups of deep veins: internal basal, lateral partial and veins of the posterior horn of the lateral ventricles. Accordingly, the rectus sinus together with the inferior sagittal sinus and the influx vena magna Galeni occupies the margo inferior of the basis of the falx cerebri, forming a single arcus vessel. The latter presents certain difficulties during surgical access to this collector.

Along with this, it was established that, on average, 4–6 tentorial veins and 6–12 veins of the falx cerebri flow into the rectus sinus. Their ostium is located at the junctions of the sinus's walls, and the diameter ranges from 250 to 800 microns. Sometimes parallel to this collector there are peculiar intratentorial and intrafalx channels of the "parasinus" type, which have different lengths and widths.

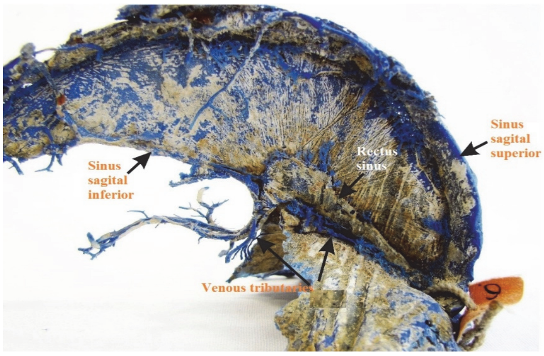

Fig. 1. The classic position of the rectus sinus with characteristic venous tributaries.

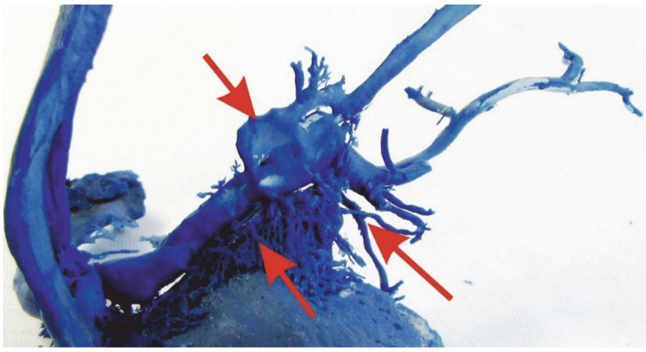

Fig. 2. Venous tributaries of the rectus sinus, which come from the processes of the dura mater encephali (indicated by arrows).

The initial part of the rectus sinus always has an expansion, which is called an ampulla. It is formed from the confluence of the superior sagittal sinus, the vena magna Galeni, and intraorgan veins. The length of this formation does not exceed 1.5–2.0 cm, and the width is 1.0–1.7 cm.

The back part of the rectus sinus has a pronounced expansion of all walls, an increase in the height of the lumen due to the tension of the falx cerebri, the leaves of which form the lateral sinus walls.

At the current level of development of neurosurgery, interest in transvascular therapy is growing, in particular, in transvenous endovascular intervention. This, in turn, is a reason for practitioners of neuroscience to gain at least a basic understanding of the cerebral venous system [6].

Using the method of magnetic resonance imaging with contrast enhancement, arachnoid granulations protruding in the cranial sinuses of the dura mater of the brain [15]. In a study by Tsutsumi S. et al. (2021) arachnoid granulations in the dura mater sinuses such as the transverse, sigmoid, and rectus, as well as the confluens sinuum were examined using contrast-enhanced thin-section magnetic resonance imaging [15].

Perimesencephalic subarachnoid hemorrhage is a group of diseases characterized by bleeding around the brain stem. In recent years, it has been suggested that perimesencephalic subarachnoid hemorrhage is related to the venous system [10]. Sakashita K. et al. (2022) described a case of perimesencephalic subarachnoid hemorrhage caused by stenosis of the connection between the vein of Galen and the rectus sinus [10]. Data from our study also support the connection between the vein of Galen and the straight sinus.

But in the studies of the listed authors, there were no data on the individual anatomical variability of the direct sinus in adults. In our study, we had these data by body type (dolichocephalic, brachycephalic, mesocephalic) according to such investigated characteristics as length, width of the front section, width of the middle section, width of the rear section, height of the lumen.

Comprehensive understanding of venous anatomy is a key factor in the approach to a multitude of conditions. Moreover, the venous system has become the center of attention as a new frontier for treatment of diseases such as idiopathic intracranial hypertension, arteriovenous malformation, pulsatile tinnitus, hydrocephalus, and cerebrospinal fluid venous fistulas. Its knowledge is ever more an essential requirement of the modern brain physician [11].

Damage to the inferior intercavernous sinus during transsphenoidal, transsellar surgery could lead to serious vascular complications. Accurate radiological evaluation based on anatomical knowledge is essential for a safe surgical approach [3].

The specialized literature contains quite a bit of information about such a significant issue of modern neurosurgery and neuromorphology as the crani-otopographical structure of the sinuses of the dura mate of the cranial vaultof adults, the rectus sinus in particular [2, 3, 4, 6, 11, 12, 13, 15].

Based on the above facts, we can confidently state that the data obtained in our study regarding the craniotopographic features of the rectus sinuses as drainage pathways for blood outflow from the structures of the cranial cavity in adults normally provide a theoretical and practical basis for modern neuromorphology and neurosurgery.

Conclusions

1. The length of the rectus sinus in mature aga ranges from 3.0 to 5.5 cm and is subject to changes due to individual features of the skull structure.

2. The rectus sinus together with the inferior sagittal sinus and the influx vena magna Galeni occupies the margo inferior of the basis of the falx cerebri, forming a single arc vessel.

3. On average, 4–6 tentorial veins and 6–12 veins of the sickle of the falx cerebri into the rectus sinus. Their influx are located at the junctions of the sinuses walls, and the diameter ranges from 250 to 800 microns.

4. The initial part of the rectus sinus always has an expansion, which is called an ampulla. It is formed from the confluence of the superior sagittal sinus, the vena magna Galeni, and intraorgan veins. The length of this formation does not exceed 1.5–2.0 cm, and the width is 1.0–1.7 cm

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