I. EXPERIMENTAL PROBLEMS

ANATOMICAL PECULIARITIES OF SPHENOID SINUS WITH A VIEW TO THEIR CLINICAL SIGNIFICANCE FOR PROFUSE EPISTAXIS

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Sphenoid sinus (SS) development begins in the third foetal month. It enlarges rapidly in post-puberty and finishes definitively its development approximately in the 20th–22nd year of life (1–3, 7, 9–12, 14, 15). There are some definitions in the literature available only of main kinds of SS concerning their distribution towards sella turcica. However, single authors' data are rather contradictory (table 2). There is also no analysis of single sinus kinds and of their structure with a view to reasons for appearance and to their importance for the clinical course of profuse epistaxis (PE). That is why we decided to study the structure and anatomical peculiarities of SS with a view to their clinical significance for PE in cases of traumatic or spontaneous rupture of the internal carotid artery in its cavernous portion (ICA).

Material and Methods

Blocks were prepared including sellar and parasellar regions, dura mater (DM) and ICA in the carotid sulcus from cranial basis of 65 cadavers. There were 51 males and 14 females. After anatomical object preparing SSs were investigated and their kind and structure were determined. Main kinds of SS on 1000 profile cranial roentgenograms of various kinds as well as on cranial roentgenograms of 32 records of diseases of PE patients from archive fund of N.N. Burdenko Neurological Institute, Moscow, Soviet Union were studied. We examined SS walls, aperturae, septi, kind and structural type.

Results and Discussion

Both SSs are separated one from each other as well as from neighbour structures by six walls. The upper one is formed by hypophyseal fossa bottom and sphenoidal planum. Carotid sulcus presents a lateral wall of SS and it is the thinest one, especially in its upper third – 0.34 mm thick. Septa sinuum sphenoidalium plays the role of medial wall for every sinus individually. The upper portion of the wall of nasal cavity and of nasopharynx forms the lower wall of SS but clivus – the posterior one. SS anterior wall is either vertical, or declined. In its upper thinned portion aperturae sinuum sphenoidalium can be seen. Examination of SS walls does not reveal any differences when comparing our findings with SS descriptions in literature sources available (3–5, 11, 14).

Aperturae are oval or round, 3–6 mm in diameter and most commonly symmetrical – in 29 cases. However, they are asymmetric on 17 preparations – the one is greater than the other and they differ in shape. Four symmetric aperturae are established on 8 preparations each – two aperturae one over the other each in the left and in the right side thus dividing S into 4 cavities by a transversal and a horizontal partitions. Multichamber SSs with numerous asymmetric, lying at different planes aperturae are detected on other 6 preparations. SS consists of a

large cavity with only one wide aperture occupying almost the whole anterior wall in 3 of our cases. Our data from the examination of the aperturae coincide with these of other investigators (11, 14).

Partitions differ in amount, thickness, location as well as in their wholeness. There is one partition completely separating both SSs from each other on 48 preparations. We find multichamber SS structure determined by several partitions lying at different planes on 14 preparations. A horizontal partition separates SS into a superior and inferior chamber, a frontal one – into anterior and posterior chamber, and a sagittal one – into left and right chamber. However, we do not observe any partitions on three preparations as SS presents a single cavity. Besides there are two kinds of partitions: complete and incomplete. Complete partition separates totally SS into two separate cavities while in case of incomplete partition there are communications between both cavities. There are 56 complete (86 per cent) and 6 incomplete (9 per cent) partititions on our preparations. Their thickness varies on different preparations between 0.3 and 2.5 mm without being equal along their whole length. Their medial third is the thinest part while the superior and inferior portions where they bind to corresponding upper and lower SS walls are wider and denser. There are thiner partitions when sellar and presellar kinds of SS are concerned as compared with these of other SS kinds. Lang's (1985) description of intrasinuidal partitions deals with their localization only and is the only one at present in the literature available.

We determine four main kinds of SS in our study (table 1). Both sellar and presellar kinds appear most often and show an almost equal distribution according to sex and side (left-right). Hyperpneumatic kind is observed on one preparation only. It presents two giant cavities with wide apefturae separated by strongly thinned partitions. Because of sphenoid bone hyperpneumatization the whole block-preparation is transparent to light. No shell-like kind of SS (i.e. agenesia) is established.

One can see on table 1 that sellar and presellar kinds of SS are most frequent and almost equally distributed according to sex and side. Concerning the frequency of single SS kinds, our data correlate with these of Johnson et al. (1985) (table 2). In the literature available we could not find data about frequency distribution or any descriptions of subsellar, one-chamber, multichamber or hyperpneumatized kinds of SS.

We determine three structural types of SS in dependence on quantity or absence of intrasinuidal partitions: 1. multichamber SS, 2. one-chamber SS (united cavity) combining both cavities of one preparation, and 3. mixed variant. We establish 25 multichamber (19 per cent) and 3 one-chamber (2 per cent) structural SS types on our block-preparations. SS is bilaterally multichamber on 11 preparations. In 7 cases its kind is bilaterally sellar but in 3 ones – presellar. Multichamber structure is unilateral on 3 preparations. One-chamber SS structure presents an united giant cavity with one wide aperture and lack of partition in it. The two one-chamber cavities have sellar kind and the third one – presellar one. Mixed variant of distribution of different SS kinds on one and the same preparation, namely one kind left and another – right, is observed in 15 cases (23 per cent) (table 2). Sellar kind is right and presellar – left on 10 preparations; sellar kind is left and presellar – right on 3 ones, and subsellar is left and presellar – right in one case. On preparation No 59 a very rare combination of three SS kinds is seen, namely sellar kind left, a small subsellar kind below it while SS is presellar kind of multichamber structure in the right side. There is only one communication in the literature available describing a mixed variant of SS (6). In our opinion, it should not be considered a single SS kind but a mixed variant or combination of two or more SS kinds of one and the same preparation.

When studying 1000 cranial roentgenograms in profile projection (without data about any pathological alterations of sella turcica and sinus sphenoidalis) we determine in dependence on sinuidal cavity dissemination related to sella turcica the following SS kinds abiding mainly by the classification of Hamberger et al. (1980): 1. Presellar kind – the posterior limit of its cavity reaches up to the anterior wall of fossa hypophysialis. Such a kind is observed in 347 cases

Table 1

Distribution of the kinds of sphenoid sinus according to sex and laterality in 65 preparations

Kind of sphenoid sinus	males and females (n = 130)						males (n = 102)						females (n = 28)					
	left		right		total		left		right		total		left		right		total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1. Sellar	36	55	42	64	78	60	27	52	32	62	59	57	9	64	10	71	19	67
2. Presellar	25	38	20	30	45	34	20	39	16	31	36	35	5	35	4	28	9	32
3. Subsellar	4	6	2	3	6	4	4	7	2	3	6	5	0	0	0	0	0	0
4. Hyperpneumatic	1	2	1	2	2	2	1	2	1	2	2	2	0	0	0	0	0	0

Table 2

Incidence of the kinds of sphenoid sinus according to literature data

Author, year		Kind of sphenoid sinus (in %)							
		sellar	presellar	subsellar	hyperpneumatic	shell-like	multi-chamber*	uni-chamber	mixed
1. Hamberger et al., 1960		86	11	–	–	3	–	–	–
2. Hammer & Radberg, 1961		59	11	–	–	2.5	–	–	27
3. Renn & Rhoton, 1975		80	20	–	–	in adults not found	–	–	–
4. Fudjii et al., 1979		76	24	–	–	in children up to 12 years	–	–	–
5. Johnson et al., 1985		64.2	32.4	–	–	3.2	–	–	–
6. Avramov, 1987	related to 65 preparations	60	34	4	2	–	19	2	25
	related to 1000 craniographies	50.4	34.7	2.3	12.1	0.5 children up to 14 years	–	–	–

* These three structural types of the sphenoid sinus occur within the four main types and, therefore, they present a part of them in relative share percentages.

(34.7 per cent). 2. Subsellar kind – SS is located only below the bottom of hypophyseal fossa (with 23 cases, 2.3 per cent). 3. Sellar kind – SS envelops anterior portions of sphenoid bone, expands below the hypophyseal fossa and reaches the slope (504 cases, 50.4 per cent). 4. Shell-like kind – underdevelopment or agenesia of SS is established in children up to 14 years only. SS presents a small chamber in the anterior-superior portion of sphenoid bone. We establish this SS kind only in 5 cases (0.5 per cent). 5. Hyperpneumatized kind – in cases with sphenoid bone hyperpneumatization in the shape of giant cavity occupying the whole sphenoid bone body (121 cases, 12.1 per cent) (table 2). Because of peculiar structure of one- and multichamber sinuses it is impossible to determine them and the mixed variant as well on cranial roentgenograms.

We determine on profile cranial roentgenograms SS kinds of 32 PE patients from records of diseases. There is sellar kind with 21 cases and presellar in the rest 11 ones.

The present work contributes to more profound investigation of the anatomical preconditions for PE from ICA.

Anatomical study of block-preparations in the parasellar region shows that bone lamella of carotid sulcus separating ICA siphon from SS cavity presents its lateral wall. The upper third of carotid sulcus where anterior knee of ICA siphon is located is the thinnest one. With ageing osteoporotic alterations appear more frequently here while degenerative (atherosclerotic) changes set in of arterial wall in the region of ICA siphon worsening hemodynamics in it. Degenerative age alterations of this bone lamella and of ICA wall present predisposing factors for the appearance of profuse arterial epistaxis after traumatic ICA damage and outer DM layer lesion (this layer covers carotid sulcus). Thinned bone lamella gives in to mechanical damage easily, particularly with fractures of the cranial basis, thus opening a free way to blood stream flowing from ICA under strong pressure towards SS and from here towards nasopharynx. Epistaxis is rather dramatic and exsanguination sets in for some minutes only. SS kind, structure, intrasinuidal partition presence as well as apertura shape and size are of importance for the speed of blood outflow. Hyperpneumatized, sellar or presellar kinds, e.g., as well as large one-chamber SS would facilitate blood outflow into nasal cavity. In this aspect, another additional factor is also the presence of incomplete intrasinuidal partitions or even their absence as well as the presence of wide aperture. Epistaxis will not become profuse if there is subsellar or multichamber SS kind with numerous partitions and narrow aperturae. However, on the account of that blood will flow intracranially, subdurally, i.e. into the cavernous sinus.

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АНАТОМИЧЕСКИЕ ОСОБЕННОСТИ КЛИНОВИДНОЙ ПАЗУХИ С УЧЕТОМ ИХ КЛИНИЧЕСКОГО ЗНАЧЕНИЯ ДЛЯ ПРОФУЗНЫХ КРОВОТЕЧЕНИЙ ИЗ НОСА

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РЕЗЮМЕ

Исследованы анатомические особенности клиновидной пазухи с целью установить их клиническое значение для профузных кровотечений из носа.

Был изучен следующий материал: а) блок-препараты, изготовленные из 65 трупов. Блок-препараты включали область ямки гипофиза и прилежащие к ней области, твердую оболочку мозга и внутреннюю сонную артерию в сонной борозде; б) 1000 профильных краниорентгенографий, которые послужили материалам для изучения основных видов клиновидной пазухи; в) краниорентгенографии 32 больных с профузными кровотечениями из носа. Исследовались стенки клиновидной пазухи, число, форма и величина их апертур, число, толщина расположение и целость перегородок внутри клиновидной пазухи. На основе данных, полученных при исследовании, описаны различные виды и типы строения клиновидной пазухи.

Автором сделана попытка найти зависимости между перечисленными различиями анатомических особенностей клиновидной пазухи и особенностями протекания профузных кровотечений из носа.