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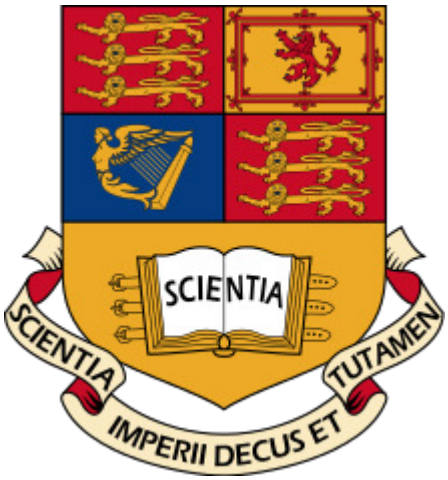

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Anatomic-physiological peculiarities of the development and built of the paranasal sinus in humans

Abstract: The research deals with the analysis of the paranasal sinus built and functions in phylo-and ontogenesis. While comparing the anatomic-morphological data in phylogenesis before and after palate development, we can state that some animals have changes in the maxillary sinus. Here we suggest the sinus has possible thermoregulation functions for the brain.

Keywords: paranasal sinuses in humans and animals, functional importance of the sinuses, thermoregulation of the brain.

Topicality. In humans brain and facial skull are separated by a net of very thin bones including numerous intraosseous cavities. All these formations are connected with the upper and middle nasal passages due to which they are generally called paranasal sinuses. This is logical but still needs more investigation, especially the functional significance in breathing, olfaction, speech. Thus, the paranasal sinuses functional significance still remains a contradictory topic.

The aim of the research is to analyze the paranasal sinuses development peculiarities in phylo-and ontogenesis and clarify its functional significance.

Materials and methods. In the research we used data of the comparative anatomy of the paranasal sinuses of the humans and animals in phylo-and ontogenesis. We have analyzed the morpho-functional peculiarities of the internal nose.

Results of the research. The built of the paranasal sinuses and their importance for fish, amphibians, reptiles, birds and mammals is different. Initially they

appeared as olfactory pits, canals, sockets in coldblooded animals; in mammals and humans they received new characteristics which are not investigated yet. It's commonly thought that the paranasal sinuses serve for moisturizing and warming the inhalant air, decrease the skull mass, improving the sound resonance, increase of the olfactory epithelium surface, innernasal pressure regulation [1, p. 116]. Each of these statements has possible significance though real significance can be clarified on the basis of the phylo-and ontogenesis data received in the morpho-functional researches.

In the main end of the body the olfactory organ in the form of olfactory pits first appears in chordates. In some fish these pits connected by a special canal have a special opening. Though, only in double breathing fish first appears connection of olfaction and respiratory system. The olfactory organ starts actively take part in the respiratory act in amphibians. Their olfactory sac already has a nostril and a primary choana opening in the roof of the mouth cavity. In reptiles on the exterior surface of the oral nasal cavity first appears an evident pit - the maxillary concha, that is additional bosom. Dislocation of the primary choanae to the back, development of the maxillary concha accompanies by the development of the side palatal folds and development in some reptiles (crocodiles, turtles) elements of the secondary palate which allows breathing during grasping and pushing food in the oesophagus. In birds on the nasal sides there develop three more pits (conchas), besides they all are connected with the base of the brain skull.

In mammals paranasal sinuses have more complicated built which is connected first of all with the sphenoid and ethmoid bones' development. In the range of the axial skeleton bones the ethmoid bone ossification is observed in the last moment.

It's worth to admit that these bones develop from cartilages of the axial and original cranium. While dividing the cranium on brain visceral these bones belong to the brain skull. In some mammals sinuses are placed in parietal (elephants) and temporal bones. Most investigators determine sinuses functions as air-breathing, air-warming, and serving for alleviation of the skull mass.

In ontogenesis in an embryo nasal additional bosoms start developing on the 3rd month of the embryonic development that is after the soft and hard palate development. On the external nasal side till the end of the 3rd month in the epithelial tissue appear limited fissured outgrowths which further develop maxillary, frontal,

ethmoid bosoms. Frontal sinus first is observed on the 4th month of the embryonic development and the anlage of the sphenoid bone is the latest to develop [2, p. 4]. Final development of the paranasal sinuses in humans finishes till 17-20, that means till the time of the growth completion.

Results of the discussion. It's known that while coming through the nose from the paranasal sinuses the air mixes with the inhalant and warms it [1, p. 117]. The given fact can be possibly explained though comparing the volumes of the inhalant air and the sinuses volume we doubt the mention fact. Thus, total volume of the paranasal sinuses is in average from 30 to 65 sm3 [1 p. 119, 3 p. 711]. At the same time the volume of the inhalant air is 0,5-0,6 l. and with the full inspiration - from 1,5 to 2 l [4, p. 94]. Thus, the air from the paranasal sinus cannot possibly warm the inhalant air of larger volume.

To our mind the paranasal sinuses function is better to investigate together with the skull basis and the brain contact. In the form of innerbone cavities the bosoms are in a close contact with the eye-socket, frontal cranial pit to the Turkish saddle. Thus, being inside of the sphenoid bone the main bosom through a quite thinned bone borders the hypophysis, bridge of Varolius, inner carotid, internal optic nerve, cavernous sinus [3, p. 527].

The ethmoid bone is in the direct contact with the brain through the ethmoid plate, besides the top point of the ethmoid bosom roof can be placed 17 mm higher the ethmoid plate level [5 p. 82]. Blood circulation of the ethmoid sinuses is implemented by the systems of the externals and internal carotid arteries, besides the frontal ethmoid artery goes through the eye-socket, ethmoid bone cells – in the frontal cranial pit. Thus, the closeness of the brain to the paranasal sinuses is evident. The sinuses development happens later than the secondary palate development, in 3-4 months term of the embryonic development and continues after birth. Comparatively smaller size of the medium zone of the child's face are connected with the gradual development of the dentition (transitional dentition), bland nutrition (not hot, mostly soft food), which does not presuppose special thermoisolation of the developing brain by the paranasal sinuses [6, 7].

In adults the need in thermoregulation is much higher, due to this the system of the inner bone cavities is developed more. Besides, from the mouth cavity these cells are limited by bone sides of the upper jaw, thermostable mucous membrane of the hard palate. Mucous membrane of the maxillary bosom is 2-3 times thicker than

the mucous ethmoid maze and the main bosom [8, 9]. Thus, the recommended temperature of the first course, tea and coffee is 75^0.

At the same time brain as a highly energetic structure has a high temperature 38^0C (due to different data it differs from the human nucleus for 0,39 - 2,5^0C). The brain temperature is higher for 1-2^0C from nasopharenginal [10, 11, 12, 13]. The temperature difference of the new cortex and hypothalamus is 1^0C. Despite the fact the human brain is a part of the body it presents a physiologically autonomous system with the main characteristics of metabolism, central blood circulation, temperature, water and ionic exchange. We have found out that the temperature of the brain is connected with the temperature of the brain basis [14, 15]. Data on the arterial blood temperature influence on the brain temperature are not identified and need further investigation, but closeness of the big arterial vessels to the paranasal sinuses and the direct contact of the vessel side with the bosom cavity with the bone absence is well-known in anatomy [3 p. 371]. At the same time brain areas with the high temperature don't contact with the environment only through the paranasal sinuses. Brain is very sensitive to temperature change; thus, temperature higher for 2-3^0C during very short period of time can be critical for all the body.

Thus, we believe that the paranasal sinuses function of thermoregulation is supposed to be one of the most important and significant.

In phylogenesis the differentiation of the olfactory organ in fish, amphibians and reptiles developed on the way of the pits increase, folds, cells development increasing the area of the olfactory epithelium.

During the secondary palate formation, brain development and nutrition character change in mammals (warmblooded) paranasal sinuses start playing a protecting and thermo regulating role. The prototype is the principle of the cellular material use for warming an apartment widely used in building construction.

Thus, the partansal sinuses are a protector and a thermoregulator for the structures of the brain and skull, having an intensive energetic exchange and high (subfebrile) temperature.

Conclusions

1. Function of warming and moisturizing of the inhalant air by the air from paranasal sinuses is important for the human body but not the main for the sinus.

2. The paranasal sinuses are presented in the form of the thermoregulative structure between the skull basis, brain and hard palate with the thick mucous membrane.

3. One the functions of the paranasal sinus is thermoregulation.

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