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Sphenoid Sinus Pneumatization Assessment in Sudanese Population; MRI Study

Yasser Seddeg Abdulghani[1*]

[1]Anatomy Department, Faculty of Medicine, The National Ribat University, Sudan.

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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Original Research Article

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ABSTRACT

Aim: The purpose of this study was to assess the variations in the of sphenoid sinus pneumatization in the Sudanese.
Materials and Methods: The study is a cross sectional observational descriptive study included 100 patients (50 males, 50 females) who underwent Magnetic Resonance Image (MRI) of the paranasal sinuses. The paranasal sinus was assessed for the type of pneumatization.
Results: The conchal, presellar, and sellar types comprised 1%, 17%, and 82%, of participants. No significant differences were found between males and females of the study group. These results were relatively different when compared to the Indians but relatively the same with Turkish.
Conclusion: The type of pneumatization of the sphenoid sinus has different prevalence worldwide, so meticulous assessment of sphenoid sinus is mandatory before sellar and skull base surgery.

Keywords: Pneumatization; conchal; sellar; presellar; pituitary tumors; sphenoid sinus; transnasal endoscopic surgery.

1. INTRODUCTION

The sphenoid sinuses are paired spaces within the body of the sphenoid bone. They are located as the most posterior of the paranasal sinuses and communicating with the nasal cavity through the spheno-ethmoidal recess. They are located antero-inferior to the sella. The two sinuses are

**Corresponding author: E-mail: yasseranatomy@gmail.com;*

separated by a septum from each other which is not usually be in the midline [1].

Its blood supplyfrom sphenopalatineand posterior ethmoidalarteries, and it is innervated by the posterior ethmoidalnerve and the orbital branch of the pterygopalatine ganglion. Lymphatic drainage from sphenoid sinus travels via afferent vessels leading into the retropharyngeal nodes [1].

The sphenoid sinus has a number of ridges and depressions that are in direct relation to nearby structures; the internal carotid artery, the pituitary gland, and the optic nerve [2].

Sphenoid sinus is developed as a potential space cavity at the time of birth then gradually continue to develop during the first years of life ,firstly, it expands backward into the presellar area then the areas below and behind the sella turcica.It reaches its original size at puberty. The sphenoid sinus completes its maturation by the age 14, but its pneumatization continues until the age of 25 [3,4].

Sphenoid sinus becomes one of the most important areas to reach different pathologies in the brain and skull base through the transsphenoidal surgery approaches. The internal carotid artery or optic nerve injuries are rare and fatal complications [5], so to keep a safe and skillful and uncomplicated approach, To keep a safe and skillful and uncomplicated approach, the aim of the study was to evaluate the incidence of anatomic variations of the sphenoid sinus in a Sudanese population sample using magnetic resonance imaging (MRI).

The sphenoid sinus is irregular, and variations of pneumatization can be observed; ranging from absent to complete pneumatization [6].

According to degree of pneumatization in the adults; the sphenoid sinus can be classified in to three groups: type I. conchal, type II. presellar, and type III. sellar type [7].

In the conchal type, the area below the sella is a solid bone without an air cavity. In the presellar type, the sphenoid sinus has moderate air cavity with no sellar indentation. In the sellar type, which is the most common, the body of the sphenoid is pneumatized with full indentation of the sella into the sinus and expands posteriorly to the clivus.The conchal type is most common in children [3].

Some authors further classify the sellar type into complete and incomplete sub-types. Also lateral extensions of sphenoid sinus was classified into extension into lesser wing or greater wing of sphenoid bone [8].

The aim of the study was to evaluate the incidence of anatomic variations of the sphenoid sinus in a Sudanese population sample.

2. MATERIALS AND METHODS

This retrospective study included 100 adults' participants (50 males, 50 females) who underwent MRI of the paranasal sinuses. The Study was carried out at Antalia radiological center –Khartoum-Sudan between November 2020 and March 2021. The age of the patients ranged between 26-80 years (52.6±18.1).

The type of sphenoid sinus pneumatization and its relation to sella turcica was studied using sagittal T1-weighed Magnetic Resonance Images (MRIs) of 1.5-Tesla field strength.

3. RESULTS

This study included 100 Sudanese adults (50 males, 50 females). In our study, the most common type of the sphenoid sinus was the sellar type (82%; n=82/100) for the whole study group. Out of the 100participants 17 % (n= 17/100) had presellar type and 1 % (n=1/100) had conchal type of sphenoid sinus (Fig. 1).

In the females of the study group, sellar type was present in 80% (n= 40/50) whereas presellar type was 18% (n=9/50) and conchal type was 2 % (n=1/50). In males, the incidence of the sellar type was 84% (n=42/50), presellar type was 16 % (n=8/50) and the conchal type was 0.0% (n=0/50) ;(Table 1).

4. DISCUSSION

The sphenoid sinus starts to develop in the 3rd month of intra uterine life as bilateral invaginations of nasal mucosa into the recesses of the nasal cavity.Before that, sphenoid bone developed from paraxial mesoderm and neural crest at about the 4thweek of intra-uterine life [9].

The sphenoid sinusafter birth is filled with bonemarrow. During childhood, maturation of thebone from red to yellow marrow takes place in the anterior part of the sphenoid bone [9]. Aoki et al. [10,11], hypothesized thatpneumatization

promotes the conversion of thesphenoid marrow. Pneumatization expands inferiorly and posterolaterally and does not reach the spheno occipital junction. Its expansion is completed the age of 14 years, but pneumatization continues till the age of 25 [12].

Yonetsu et al. [11]., reported that size of the sphenoid sinus decreases after the 4th decade of life and the size becomes two thirds of its maximum volume in the seventh decade of life.

The degree of pneumatization of sphenoid sinusis an important factor for the decision of surgery of sellarregion. For skillful and proper surgical approach and prevention ofcomplications, detailed preoperative imaging of sphenoidsinus and sellar region by CT and MRI is needed [4].

Conchal type of sphenoid sinus is not a contraindication for transsphenoidal approach after the use of high-speed drills, but a bony work is needed to reach the sella. In pre-sellar type , the sellar floor is not reaching the sphenoid sinus [13]. Pneumatization extends only as far as the tuberculum sellae. The anterior wall can be reached but in order to open the base of sella, clivus has to be drilled. In sellar type of sphenoid sinus, pneumatization extends beyond the tuberculum sellae into the body of the sphenoid and may extend to clivus, permitting total exposure of the base of sella during transsphenoidal approach [12].

Inthis current study in Sudan, the incidence of conchal type was 0% for males,2 % for females and1 % for the whole study group. The incidence of conchal type is reported to be ranged between 1 % and 3% in some literature [6, 11,12,13].

In the current study, presellar type was present in17% of the whole study group and it was found 20% in males and 16% in females. The incidence of presellartype was reported to be up to 27% in the literature [3,5,6,12].

In our study the percentage of sellar type was 82 % in the whole study group whereas it was found to be 82% in males and 80f% in females. In the literature, reported incidence of the sellar type of sphenoid ranges 59% to 86% [3,12]. Table (2) below shows comparison of the prevalence of Sphenoid sinus pneumatization in different studies in literature.

One other issue to be put in mind is the excessive pneumatization and lateral extensions of the sinus; including surrounding structures extending to the optic nerves and the carotid arteries laterally which needs careful evaluation. Depending on the degree of pneumatization of sphenoid sinus the bony structures overlying internal carotid artery and the optic nerve can bevery thin or may never exist. In such case these structures are vulnerable.

Detailed evaluation of CT and MR images is essential to understand the anatomy of normal structures and their anatomical variations, comprehensively. Detailed knowledge of the sphenoidal sinus and adjacent structures are needed for preoperative planning for safe skillful and uncomplicated surgery.

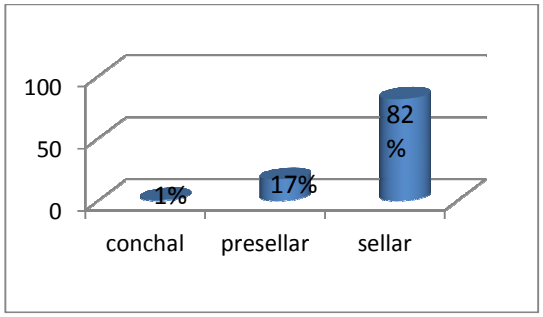

Fig. 1. Type of the sphenoid sinus pneumatization among the study group (n=100)

Table 1. Type of the sphenoid sinus pneumatization among the study group (n=100)

Sinus type	Males (n=50)	Females (n=50)	Whole study group (n=100)
Conchal	0	1	1
Presellar	8	9	17
Sellar	42	40	82

Table 2. Comparison of prevalence of Sphenoid sinus pneumatization in different studies

Study	Sphenoid sinus pneumatization type		
	Conchal type	**Presellar type**	**Sellar type**
Baskin et al. [5]	3%	5.5%	86%
Shivaprakash B et al. [2]	0%	1.2%	98.8%
Hamid et al. [8]	2.6%	27%	70.4%
Wang et al. [14]	0%	2%	98%
OzdemirSevinc et al. [4]	0.5%	16.6%	83%
Current (Sudan)	1.%	17.0%	82%

5. CONCLUSION

Transnasal transsphenoidal approaches are become important in minimal invasive surgeries of the sella and skull base pathologies. From the results of this study and in comparison with different studies, the type of pneumatization of the sphenoid sinus has different prevalence worldwide, so detailed assessment of sphenoid sinus is mandatory before sellar and skull base surgery.

CONSENT AND ETHICAL APPROVAL

Ethical approval was obtained from The National Ribat University ethical committee. Informed consent was obtained from all participants after explanation of the study aims.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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