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Prevalence of Frontal Cells and Their Relation to Frontal Sinusitis in Egyptians: A Computerized Tomography Study

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ABSTRACT

Background: The frontal sinus is frequently regarded as the most difficult location to reach in functional endoscopic sinus surgery (FESS). There have been numerous reports of significant variations in the capacity, symmetry, and morphology of the frontal sinus. **Aim of Study:** this study aimed to look at the prevalence of frontal cells in Egyptians and their relationship to chronic frontal sinusitis using the International Frontal Sinus Anatomy Classification (IFAC).

Material and Methods: This prospective cross-sectional study was conducted in ENT and Radiology Departments, Faculty of Medicine, Zagazig University. 60 cases underwent CTPNS were reviewed during the period from March 2022 to September 2022. High-resolution multislice CT scan was done for each patient.

Results: Frontal sinusitis was present in 36.6% of cases and was absent in 63.4% of the studied cases. There was statistically significant difference between both frontal positive sinusitis and frontal negative sinusitis studied groups as regards supra agger cells where it was present in 18.2% of positive sinusitis cases.

Conclusion: Despite having the lowest frequency, frontal sinusitis is highly correlated with both SOECs and SACs.

Keywords: Frontal, Sinusitis, Recess, Frontal.

INTRODUCTION

The development of the frontal sinuses, which are made up of a pair of pneumatic cavities, are formed in the fourth month of the life of the foetus and continues up until the age of 20. Always asymmetrical, the two sinus chambers are partitioned off from one another by a septum and leak into the frontal bone's orbital region [(1)].

To avoid problems and prevent illness recurrence, planning a successful Frontal sinus surgery necessitates an understanding of sinus anatomy and drainage, and frontal recess cells [(2)]. The frontal recess cells, which come in a variety of forms with varied sizes, arrangements, and extents, have an impact on the frontal sinus drainage. Numerous efforts were made to identify and categorise these cells, demonstrating how they affect frontal sinus outflow, and they were known by a variety of different names and descriptions [(3)].

Endoscopic frontal sinus surgery (EFSS) success is heavily reliant on frontal recess cells [(4)]. For EFSS to fail, frontal recess cells completely removed, the frontal sinus ostium must be correctly identified, mucosal disease must return, and the frontal recess, also known as the frontal sinus drainage area must be intentionally injured [(5)]. Frontal recess cells have been categorised in a number of ways. The four different types of frontal cell variants were differentiated in accordance with the CT scan's coronal slices by **Bent and colleagues** [(6)] in 1994, who named them as type I–IV cells.

The therapeutic importance of frontal cells identified using earlier classification methods has been the subject of numerous investigations in the past [(7)]. Numerous studies have found a link between frontal sinusitis and frontal recess constriction by Kuhn cells [(8, 9)]. Furthermore, it has been demonstrated that the presence of fronto-ethmoidal cells (types III-IV), suprabullar cells, and frontal bullar cells has a significant impact on the progression of frontal's sinusitis. These three cell types make up the frontal bullar cells and suprabullar cells, respectively [(10)]. The goal of this study was to examine the prevalence of frontal cells in Egyptians and how those cells relate to chronic frontal sinusitis. The IFAC was used to guide the research process.

MATERIALS AND METHODS

This prospective cross-sectional study was conducted in ENT and Radiology Departments, Faculty of Medicine, Zagazig University on 60 cases underwent CTPNS during the period from March 2022 to September 2022.

This study was conducted on 60 Patients in a row (120 sides) who complained of symptoms of chronic rhino sinusitis, symptoms including nasal obstruction, nasal discharge, pain or pressure in the face, or a diminished or lost sense of smell may be experienced.

Inclusion criteria: Patients with symptoms of headache, nasal obstruction or other symptoms of chronic rhino sinusitis for whom CT paranasal sinuses is indicated, patients aged 18 years or more and both sexes.

Exclusion criteria: Patients under the age of 18, patients with a history of sinus surgery, patients with a maxillofacial fracture, lesions that disrupt the frontal recess anatomy as sinonasal malignancy, fungal sinusitis and frontoethmoidal mucocele, lesions hindering frontal cell identification and pregnancy.

In two steps, Frontal sinus, recess cells were assessed. The first step was to examine maxillofacial none contrast

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CT scans. Each side (120 sides) was evaluated independently by assessing each cell's presence, extending, type, and involvement by mucosal thickening. If the CT scan shows sinus pacification or mucosal thickening, the frontal cell type is assessed for frontal sinusitis.

IFAC was used to study the cells in the anterior recess. Some types of anterior cells are the Agger nasi cell (ANC), the supra Agger cell (SAC), and the supra Agger frontal cell (SAF) (SAFC). Suprabulla cell (SBC), suprabulla frontal cell (SBFC), and supra orbital ethmoid cell are examples of posterior cells (SOEC). One of the middle cells is the frontal septal cell (FSC).

Radiological Assessments:

A high-resolution multislice CT scan was performed on all patients. Frontal cells were classified using the International Frontal Sims Anatomy Classification, and the incidence of each cell type was estimated using these axial images. Axial cuts with a thickness of 0.8 mm were obtained for each patient. On both the right and left sides of each scan, indications of chronic frontal sinusitis, which is defined as a thickening of the sinus mucosa by at least 3 millimeters, were looked for.

Ethical Approval:

After explanation of the all rights, an informed consent was signed by each patient before participation in this study. Before conducting the study, an ethical approval (No. 9368) was delivered in a manner that was in compliance with the recommendations made by the Institutional Review Board of the Zagazig University Faculty of Medicine. The conduction of the current study was matched with the Declaration of Helsinki Guidelines for Human Research.

Statistical Analysis

SPSS analysed the data (Statistical Package for the Social Sciences) and Graph Pad Prism version 5.0 software (USA). Numbers and percentages (%) or mean ± standard deviation (SD) were used to represent data.

RESULTS

As shown in table (1), the mean age was 31.38 ± 11.49 years. More than half of cases (60%) were females.

Table (1): Patients basic characteristics of the studied group

Variables		Study group (n=60)	
		No.	(%)
Age	Mean ±SD	31.38±11.49	
	Median (IQR)	28.5 (21.25-40)	
Sex	Male	24	40
	Female	36	60

As illustrated in table (2) regarding cell types, Agger nasi cells were present in 95% of cases, supra agger cells was present in 40.8% of cases, frontal supra agger cell was present in 13.3%, supra bullar cell was present in 61.7%, supra bullar frontal cell was present in 27.5%, supra orbital ethmoidal cells were present in 14.2% and frontal septal cells were found in 23.3% of cases.

Table (2): Frequency distribution of different cells types within the studied group (n=120)

Variables		Study group (n=120)	
		No.	(%)
Agger nasi cell	Present	114	95
	Absent	6	5
Supra agger cell	Present	49	40.8
	Absent	71	59.2
Supra agger frontal cell	Present	16	13.3
	Absent	104	86.7
Supra bullar cell	Present	74	61.7
	Absent	46	38.3
Supra bullar frontal cell	Present	33	27.5
	Absent	87	72.5
Supra orbital ethmoidal cell	Present	17	14.2
	Absent	103	85.8
Frontal septal cell	Present	14	23.3
	Absent	46	76

As shown in table (3), frontal sinusitis was present in 36.6% of cases and was absent in 63.4% of the studied cases.

Table (3): Prevalence of frontal sinusitis in the studied group

Variables		Study group (n=120)	
		No.	(%)
Sinusitis	Present	44	36.6
	Absent	76	63.4

As illustrated in table (4) regarding cell types in right side, agger nasi cells were present in 93.3% of cases, supra agger cells were present in 35% of cases, supra agger frontal cells were present in 13.3%, supra bullar cells were present in 56.7%, supra bullar frontal cell was present in 28.3% and supra orbital ethmoidal cell was present in 11.7% of cases. Regarding cell types in left side, agger nasi cells were present in 96.7% of cases, supra agger cells was present in 46.7% of cases, supra agger frontal cells was present in 13.3%, supra bullar cells were present in 66.7%, supra bullar frontal cells were present in 26.7% and supra orbital ethmoidal cells were present in 16.7% of cases.

Table (4): Cells type of the right and left side within the studied group:

Variables		Study group (n=60)	
		No.	(%)
Right side			
Agger nasi cell	Present	56	93.3
	Absent	4	6.7
Supra agger cell	Present	21	35
	Absent	39	65
Supra agger frontal cell	Present	8	13.3
	Absent	52	86.7
Supra bullar cell	Present	34	56.7
	Absent	26	43.3
Supra bullar frontal cell	Present	17	28.3
	Absent	43	71.7
Supra orbital ethmoidal cell	Present	7	11.7
	Absent	53	88.3
Left side			
Agger nasi cell	Present	58	96.7
	Absent	2	3.3
Supra agger cell	Present	28	46.7
	Absent	32	53.3
Supra agger frontal cell	Present	8	13.3
	Absent	52	86.7
Supra bullar cell	Present	40	66.7
	Absent	20	33.3
Supra bullar frontal cell	Present	16	26.7
	Absent	44	73.3
Supra orbital ethmoidal cell	Present	10	16.7
	Absent	50	83.3

As shown in table (5), frontal sinusitis on right side was present in 33.3% of cases and was absent in 66.7% of the studied cases, while left frontal sinusitis was present in 40% of cases and was absent in 60% of the studied cases.

Table (5): Prevalence of right and left-side frontal sinusitis in the studied group

Variables		Study group (n=60)	
		No.	(%)
Right-side			
Sinusitis	Present	20	33.3
	Absent	40	66.7
Left-side			
sinusitis	Present	24	40
	Absent	36	60

Table (6) showed no statistically significant difference between both frontal positive sinusitis and frontal negative sinusitis studied groups as regards Agger nasi cell. However, there was a statistically significant difference between frontal positive sinusitis cells and supra bullar frontal cells as well as frontal negative sinusitis cells and supra bullar frontal cells studied groups as regards supra agger cells where it was present in 18.2% of positive sinusitis cases.

Table (6): Comparing cell type between the studied group in relation to sinusitis

Variables		Frontal positive sinusitis group (n=44)		Frontal negative sinusitis group (n=76)		test	P value
		No.	(%)	No.	(%)		
Agger nasi cell	Present	42	95.5	72	94.7	0.030	0.862
	Absent	2	4.5	4	5.3		
Supra agger cell	Present	8	18.2	41	53.9	14.754	<0.001*
	Absent	36	81.8	35	46.1		
Supra agger frontal cell	Present	7	15.9	9	11.8	0.399	0.528
	Absent	37	84.1	67	88.2		
Supra bullar cell	Present	28	63.6	46	60.5	0.114	0.736
	Absent	16	36.4	30	36.5		
Supra bullar frontal cell	Present	12	27.3	21	27.6	0.002	0.966
	Absent	32	72.7	55	72.4		
Supra orbital ethmoidal cell	Present	12	27.3	5	6.6	9.814	0.002*
	Absent	32	72.7	71	93.4		

As shown in table (7), there was no statistically significant difference between both frontal positive sinusitis and frontal negative sinusitis studied groups as regards frontal septal cells.

Table (7): Comparing Frontal septal cell between the studied group in relation to frontal sinusitis:

Variables		Frontal positive sinusitis group (n=20)		Frontal negative sinusitis group (n=40)		test	P value
		No.	(%)	No.	(%)		
Frontal septal cell	Present	4	20	10	25	0.186	0.666
	Absent	16	80	30	75		

DISCUSSION

In this study, we discovered that Agger nasi cells were present in 95% of cases, supra agger cells were present in 40.8% of cases, supra agger frontal cells were present in 13.3%, supra bullar cells were present in 61.7%, 27.5% had supra bullar frontal cells, 14.2% had supraorbital ethmoidal cells, and frontal septal cells were present in 23.3% of cases.

The International Classification of Frontal Sinus Anatomy states that ANCs are the most prevalent cell type (95.5%), followed by posterior-based cells (SBCs, 60.8%), anterior-based cells (SACs, 50.0%), medial-based cells (FSCs, 8.3%), and frontal-based cells (SACs, 60.8%), and their relationships to frontal sinusitis. Furthermore, in their study to evaluate analysis of frontal cell prevalence using computed tomography, **Choby *et al.*** [5] found that, the International Frontal Sinus Anatomy classification, ANCs were the most common type of anteriorly based cell (91.9%, 925 sides). This was followed by SACs (28.7%, 289 sides) and SAFCs (15.9%, 159 sides). SBCs made up the vast majority of posteriorly based cells, accounting for 59.7%, or 601 sides. This was followed by SBFCs, which made up 25.8%, or 260 sides, and SOECs, which made up 6.9%, or 69 sides. There was evidence of FSCs, also known as medially based cells, in 14.3% (144 sides) of the CT images.

We discovered that in 93.3 percent of cases, agger nasi cells were present, while supra agger cells were absent were present in 35% of cases, supra agger frontal cells were present in 13.3%, supra bullar cells were present in 56.7%, supra bullar frontal cells were present in 28.3%, and supra orbital ethmoidal cells were present in 11.7%. Supra agger cells were found in 46.7% of cases, 13.3% supra agger frontal cell, 66.7% supra bullar cell supra bullar frontal cell in 26.7%, and supra orbital ethmoidal cell in 16.7% of cases on the left side. This corresponds to the findings of **Vepamininti *et al.*** [12], there were 12 supra-bullar cells (20%), 8 frontal bullar cells (13.3%), 2 frontal intersinus septal cells (3.3%), and 27 supraorbital cells (45%). The cells on the right were different from those on the left. Agger nasi cells were located on the right side with a greater percentage than they were on the left side (76% on the left & 86% on the

right). The right side of the orbit contained a significantly higher percentage of supraorbital cells than the left side did (50% versus 40 %). On the other hand, suprabullar cells were discovered on the left side more frequently than they were discovered on the right side (16% right & 23% left). Additionally**, Fawzi *et al* [(11)** showed that among all frontal cell variations, ANCs have the highest occurrence (95.5%), and the incidence is consistent with other studies that found incidences ranging from 90 to 98%. ANC is one of the most dependable anatomical indications for accessing the frontal recess during surgery on account of its great prevalence and relatively stable position. It is the reference cell for the great majority of frontal cell classification methods for the same reason.

There was no statistically significant difference found in this study between the groups of people who had frontal positive sinusitis and those with frontal negative sinusitis in terms of agger nasi cells, supra agger cells, or bullar frontal cells. However, there was a statistically significant difference in supra agger cells between the frontal positive sinusitis group and the control group and frontal negative sinusitis studied groups. Supra orbital ethmoidal cells, found in 27.3% of positive sinusitis cases, demonstrated a statistically significant difference between the frontal positive sinusitis and frontal negative sinusitis studied groups.

Fawzi *et al.* [(11) discovered a significant relationship between SOEC ($p = 0.001$) and SAC ($p = 0.044$) and the emergence of frontal sinusitis. The development of frontal sinusitis was not significantly correlated with any of the other frontal cell variations. Furthermore, according to the International Classification of Frontal Sinus Anatomy, **Nofal *et al.* [(13)** found no discernible difference in frontal recess cell prevalence between infected and uninfected frontal sinuses (IFAC). 97% of individuals with infected frontal sinuses had the ANC, whereas 97.1% percent of cases without infected frontal sinuses had it. The SAC was present in 44.9% of frontal sinus cases without infection and 54.9% of those with infection. The SAFC was discovered in 19.4% of frontal sinus infections and 7% of non-infections.

We found no statistically significant differences in frontal septal cells between the frontal positive sinusitis and frontal negative sinusitis groups in this study.

Osman *et al.* [(14) reported that there was no correlation between the presence of frontal sinusitis and the presence of frontal septal cells ($p > 0.05$), which support our findings.

We discovered in this study that the supra agger frontal cells, the supra agger cells, the supra bullar cells, the supra orbital ethmoidal cells, and the supra bullar frontal cell did not statistically differ significantly between the sexes. However, there was a statistically significant difference between the study groups for frontal positive sinusitis and frontal negative sinusitis with regard to the supra agger nasi cell, which was present in 91.7% of female cases. This cell was found in the nasal cavity of patients with frontal positive sinusitis. Furthermore, in their study to assess the Frequency of Anatomical Variations of the Paranasal Sinuses as seen on computed tomography scan images of Turkish patients, **Borahan *et al.* [(15)** discovered that there was no statistically significant difference in the incidence rates of supra agger frontal cells, supra agger cells, supra bullar cells, supra orbital ethmoidal cells, and supra bullar frontal cells according to gender ($p > 0.05$). This difference is thought to be caused by racial differences between study groups.

In this study, we found no statistically significant difference in frontal septal cells between the genders of the studied groups.

Seth *et al.* [(16) confirmed our findings, finding no statistically significant differences in frontal septal cells between males and females ($P > 0.05$). Furthermore, **Borhan *et al.* [(15)** discovered no statistically significant difference in frontal septal cell incidence rates based on gender ($p > 0.05$).

CONCLUSION

Apart from ANCs, posterior-based cells (SBCs and SBFCs) outnumber anterior-based cells (SACs and SAFCs). Despite their low prevalence, SOECs and SACs are both associated with the development of frontal sinusitis.

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