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Prevalence of pneumatization patterns of the sphenoid sinus in patients with chronic rhinosinusitis in the delta region

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Abstract
Background: Multiple classifications of the types of Sphenoid Sinus (SS) pneumatization exist as Conchal, presellar, sellar and postsellar according to extension of the pneumatization to the sellar turcica. The pneumatization patterns of the SS have significant surgical implications due to their associated inconsistent neurovascular relations.
Aim: To study the pneumatization patterns of SS in patients with Chronic Rhinosinusitis (CRS) in the Delta Region.
Methods: This is a prospective prevalence study which was performed on 200 CONSECUTIVE patients with CRS proved by radiological signs. Patients selected from the outpatient clinic of the Otorhinolaryngology Department of Tanta University Hospital during the period between February 2021 to July 2021.
Results: There was significant statistical difference between ethmoidal, sphenoidal CRS and other types (maxillary, frontal and pansinusitis) in relation to SS pneumatization patterns. Ages of patients range between 16 years to 60 years.
Conclusions: The sellar type of SS pneumatization was found to be the most clinically relevant variant among our population in 35% of the patients. There was significant statistical difference between ethmoidal, sphenoidal CRS and other types of rhinosinusitis in relation to sphenoid pneumatization patterns. There were no significant statistical differences between either gender or age in chronic rhinosinusitis. The preoperative CT evaluation of the sellar region is a necessary whenever transsphenoidal surgery is considered to determine the location and extent of SS walls, to shorten the operative time, and to minimize morbid consequences.

Keywords: Pneumatization, sphenoid sinus, chronic rhinosinusitis

Introduction
CRS defined as the presence of two or more symptoms one of which should be either nasal blockage/obstruction/congestion or nasal discharge (anterior/posterior nasal drip) with/without facial pain/pressure and with/without reduction or loss of smell for 12 weeks or more [1]. About 4.5 to 12% of population suffer from CRS [2]. Moreover, CRS has been shown to have negative impacts on sinonasal symptoms, sleep, mood, and lower airway function, quality of life and work productivity [3-8]. CT is the investigation of choice for the evaluation of patients with CRS. It is an important aspect of pre-operative planning [9]. It gives an idea about pneumatization of paranasal sinuses, severity of the disease and anatomical and pathological variations better than other methods [10]. The SS is located centrally and posteriorly within the body of the sphenoid bone, and it is posteriorly and superiorly bounded by the sellar turcica [32]. Each sinus opens into the roof of the nasal cavity via apertures on the posterior wall of the sphenoethmoidal recess directly above the choana, the apertures are located high on the anterior walls of the sinuses themselves [33]. Several important structures have a close relation to the SS, including the internal carotid artery, the optic nerve [34], cavernous sinus and hypophyseal gland [32]. Such a close anatomical relationship raises particular dangers during the surgery [35]. Therefore, anatomical variations in the SS as well as clear anatomical landmarks are critical for the rhinologist and skull base surgeon to assure safe surgery [36].

Multiple classifications of the types of SS pneumatization exist, many authors usually describe three types of SS pneumatization; conchal, presellar, and sellar [11]. Lang added the fourth type and named it postsellar where extension of the pneumatization was posterior to the sellar turcica [12]. Non-Contrast Computed Tomography (NCCT) is now a reference standard for visualization of different types of SS pneumatization preoperatively [13]. Different pattern of SS pneumatization would affect incidence of sphenoiditis and preoperative planning of sellar and parasellar surgeries. Among the published studies there was some degree of ethnoracial differences in the prevalence of SS types, but this cannot be ruled out considering that we studied Egyptian population as there is no national figures [37, 38].

Patients and Methods

This prospective prevalence study includes 200 patients as calculated by applying Epi-Info software statistical package and the power of the study was 80%. Patients had diagnostic criteria of CRS according to EPOS 2020 [1]. Presence of two or more symptoms, one of which should be either nasal blockage/obstruction/congestion or nasal discharge (anterior/posterior nasal drip), with or without facial pain/pressure and with or without reduction or loss of smell. For≥12 weeks; without resolution of symptoms. Radiological signs of CRS, and ages of patients range between 16 years to 60 years. Cases were allocated from February 2021 to July 2021 from the outpatient clinic of Otorhinolaryngology Department of Tanta University Hospital.

Patients having previous sinonasal surgery, crani ofacial trauma, congenital facial abnormality, mass obscuring SS in CT and absence of proper radiological signs for CRS were excluded from the study. The study was undertaken after an ethical approval was granted by Tanta University Hospital Ethics Committees. Informed consent was received from all participants prior to enrolment in the study.

Radiological imaging

By CT coronal, sagittal and axial sections of paranasal sinuses, nose and skull base. Documentation of paranasal sinuses inflammation with any mucosal thickening. Evaluation of SS pneumatization either conchal, presellar, sellar or postsellar.

Results

A total of 200 patients with CRS were assessed with CT, whose ages were ranging from 16 to 60 years. (Mean of age with/without standard deviation = 39.245+/-12.151). Age from 16 to 30 years includes 50 (25%) patients, age from 31 to 45 years includes 81 (40.50%), and age from 46 to 60 years includes 69 (34.50%) patients.

The study population comprised 50.50% females (101) and 49.50% male patients (99).

As regard to SS pneumatization patterns there were four types; conchal, presellar, sellar, and postsellar. Conchal cases are 22(11.00%) patients, presellar cases are 42(21.00%), sellar cases are 70(35.00%), and postsellar cases are 66(33.00%).

Table 1: Number of patients in relation to gender

Gender		
Patient	**N**	**%**
Male	99	49.50
Female	101	50.50
Total	200	100.00

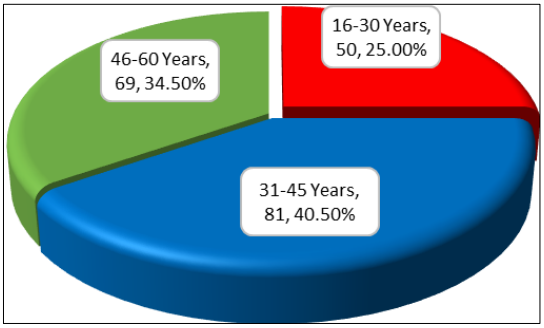

Fig 1: Age distribution of the study

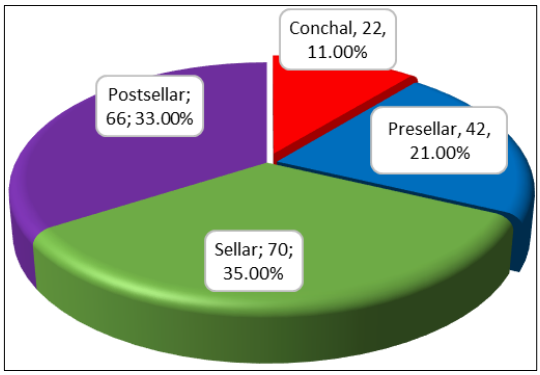

Fig 2: of individual SS pneumatization pattern on CT scan

According to clinical findings and radiological investigations in these patients with CRS there was single sinus inflammation or multiple sinuses inflammations as follow; maxillary sinusitis in 189 patients, ethmoidal sinusitis in 101, frontal sinusitis in 5, sphenoidal sinusitis in 7, and pansinusitis in 6.

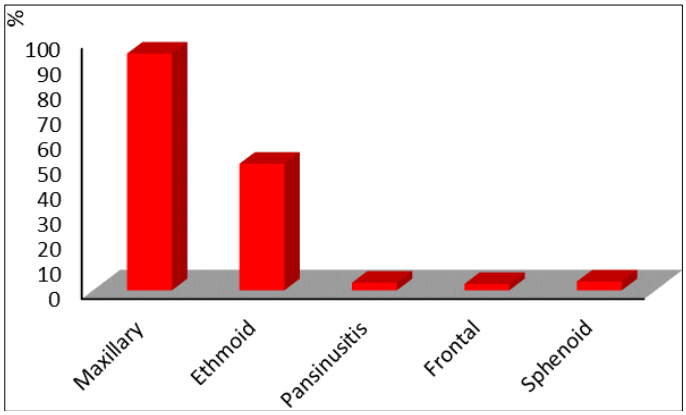

Fig 3: Prevalence of individual paranasal sinus group involvement on CT scan

There was no significant statistical relation between age groups and CRS.

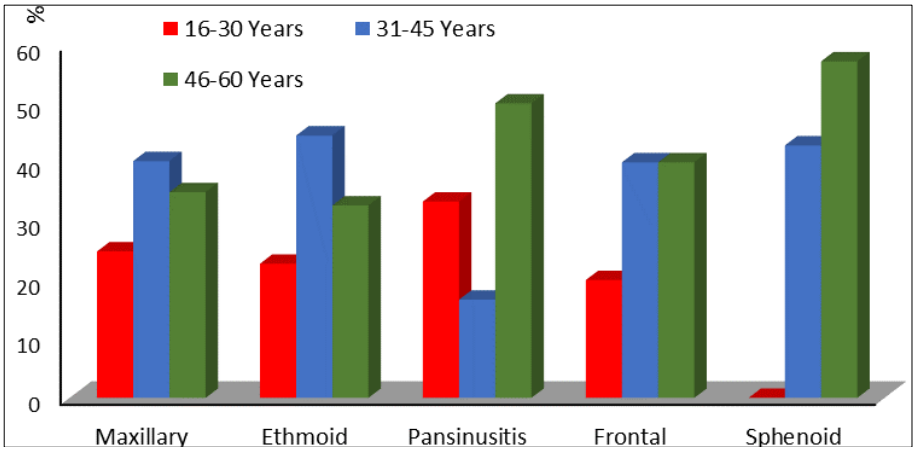

Fig 4: Distribution of age groups in individual paranasal sinus group

There was no significant statistical relation between gender and CRS.

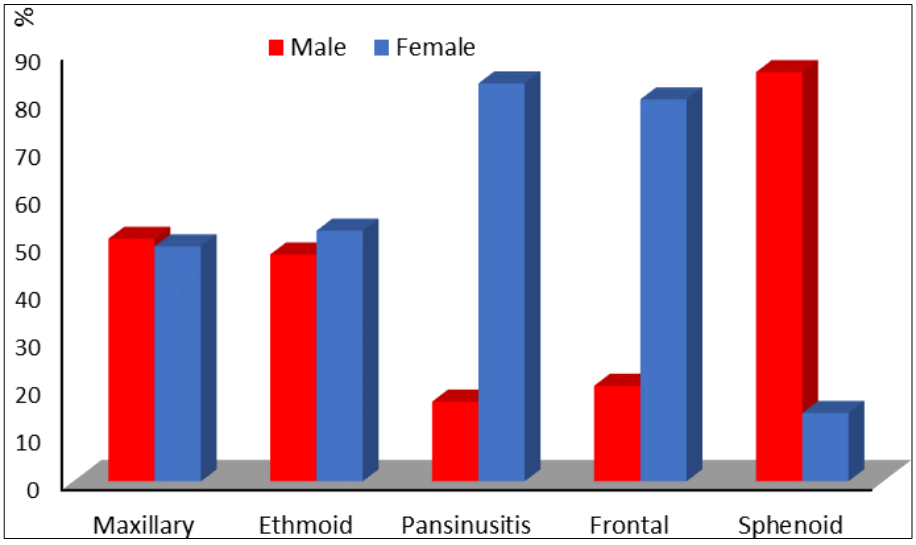

Fig 5: Distribution of gender of patients in individual paranasal sinus group

There was significant statistical relation between ethmoidal, sphenoidal CRS and sphenoid pneumatization patterns.

Table 2: The relation between in sphenoid pneumatization pattern and individual paranasal sinus group on CT scan.

CRS	Sphenoid Pneumatization Pattern								Chi-Square	
	Conchal		Presellar		Sellar		Postsellar			
	N	%	N	%	N	%	N	%	X^2	P-value
Maxillary	20	10.58	41	21.69	64	33.86	64	33.86	1.370	0.713
Ethmoidal	8	7.92	16	15.84	35	34.65	42	41.58	7.900	0.048*
Pansinusitis	1	16.67	0	0.00	3	50.00	2	33.33	1.946	0.584
Frontal	0	0.00	2	40.00	2	40.00	1	20.00	1.796	0.616
Sphenoidal	0	0.00	2	28.57	0	0.00	5	71.43	8.881	0.031*

Discussion

SS pneumatization were classified into conchal, presellar, and sellar types initially by Hammer and Radberg, Lang, [12, 14]. Added the fourth type and named it postsellar where extension of pneumatization was posterior to the sellar turcica. There are some modifications to this classification system. For example, Cho, *et al.* [14]. Subdivided the sellar type into the complete and incomplete sellar types, and Li, *et al.* [12] divided the SS into six types: no development, conchal, presellar, half sellar, full sellar, and postsellar. Congdon originally classified the SS into three types based on the level of pneumatization [15]. In our study sellar pattern was the most prevalent pattern in 35% of patients and this result agrees with previous studies [24, 15, 17, 23, 30, 31]. However, other studies not in line with our results as; Liao *et al.* Li, *et al.* Xian & Tian [26, 28, 29] where postsellar was the most frequent in the cases not the sellar. In our study postsellar pattern was the second frequent type as seen in 33% of the patients. This result agrees with previous studies by; Hamid, *et al.* Jae Hoon Cho, *et al.* [24, 25]. However not corresponding with other previous studies [26, 28, 29]. Also result of Zhou [27] study not corresponding with our result as

postsellar pattern in his study was the third frequent pattern. In our study presellar pattern founded in 21% of our patients as the third frequent type. The presellar type is usually intermediate in frequency in previous studies conducted [24] as Hamid *et al*, Jae Hoon Cho, *et al.* [16, 25]. On the other hand, our result not corresponding with Liao, *et al.* Zhou, Li, *et al.* Xian & Tian [26-29] as presellar pattern was the second frequent pattern in these studies. In our study conchal pattern was the least common as seen in 11% of the patients. This result in accordance with previously reported data by Lazaridis, *et al.* Hamid, *et al.* Aydin, *et al.* Liu & Huang [39, 16, 21, 22]. However, Tan & Ong's study of adult Asian cadavers exhibited a much higher proportion of conchal type, with 28% of their specimens, [23]. The conchal type is thought to exist mostly in children because SS pneumatization begins at 6 months to 4 years of age and usually is completed by 18 years of age, it is usually found to be the least common of the three configurations initially described by Congdon, often around 2% in most studies dealing with adult radiologic studies or specimens [16-19]. In our study here was no significant statistical difference in the prevalence of various types of SS pneumatization between male and female subjects (p-value >0.05). The SS is a mucosal lined variably pneumatized posterior extension of the paranasal sinuses, it is located within the sphenoid bone in the middle cranial fossa [40]. Its relations are ethmoid air cells anteriorly, the cavernous sinus laterally, the pituitary fossa and planum sphenoidale superiorly, and the choana inferiorly [41]. Postero-superior ethmoidal air cells can grow into the body of the upper sphenoid bone and may surround the optic canal and nerve and extend to the sellar turcica, resulting in the development of an Onodi cell [42]. It develops super laterally to the SS and pushes it downward. The SS and the Onodi cell share a wall; the posterior wall of the Onodi cell is the anterior wall of the SS [43]. So this may be the reason for our results as regard the relation between chronic ethmoidal sinusitis and SS patterns; as with increasing SS pneumatization there was increasing in chronic ethmoidal sinusitis frequency by increasing sinus mucosal surface area of infection and inflammation (Conchal, presellar, sellar, and postsellar: 8, 16, 35 and 42 respectively). The postsellar type is frequently observed this may suggest that the postsellar type is a potential risk factor for sinusitis: a possible explanation may be found in the elongated shape of SS in postsellar category, which may hinder the drainage of secretions from the post posterior space. This explains our results as there was significant statistical relation between ethmoidal, sphenoidal CRS and SS pneumatization patterns.

Conclusion

The sellar type of SS pneumatization was found to be the most clinically relevant variant among our population in 35% of the patients, and this result agrees with the reported literatures. There was significant statistical difference between ethmoidal, sphenoidal CRS and other types in relation to SS patterns. There were no significant statistical differences between either gender or age in CRS. The preoperative CT evaluation of the sellar region is a necessary whenever transsphenoidal surgery is considered to determine the location and extent of SS walls, to shorten the operative time, and to minimize morbid consequences.

Author's Contribution

Not available

Conflict of Interest

Nil

Financial Support

Nil

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