

Anatomical variations of paranasal sinuses in patients with chronic sinusitis

Abstract

Introduction: Rhinosinusitis is the inflammation of the nasal mucosa of one or several paranasal sinuses. In a radiological practice, anatomical variations are common in tomographic studies. The importance of these variants resides in their predisposition to mechanical obstruction, which can cause sinus disease. Few studies have quantitatively defined the influence of each variable and its relation to rhinosinusitis disease.

Objective: Determine the frequency of the anatomical variations of the paranasal sinuses in patients diagnosed with chronic rhinosinusitis, in RGH No.1 of Tijuana, Baja California.

Methods: A descriptive, analytical and retrospective study was carried out in patients with chronic rhinosinusitis in the RGH No. 1 of IMSS, in Tijuana during July to September 2018. It received prior authorization by the local research committee. The studied variables were: age, gender, presence of septum deviation, sinus involved and anatomical variation. A descriptive statistics analysis was carried out, with measures of central tendency and dispersion for quantitative variables, and frequencies for qualitative ones. Pearson's Chi-Squared test and Cohen's Kappa Index were also used with the SPSS statistical program.

Results: The most frequent anatomical variants in the paranasal sinuses of patients diagnosed with chronic rhinosinusitis were the deviation of the nasal septum, presence of bullous shells and pneumatization of the sphenoid sinus. After applying Cohen's Kappa, these results were found to be consistent with the results of two independent observers. Meanwhile, the Chi-Square test identified that anatomical variants are not related to age and sex.

Conclusion: The majority of patients presented only one anatomical variation. Patients aged 18 to 24 years old were the most affected and deviation of the nasal septum was the most frequent variation. Suggestions for future studies include researching the relationship between age or degree of clinical involvement and the anatomical variations.

Keywords: anatomical variations, paranasal sinuses, sinusitis, tomography, multislice computed tomography

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Introduction

Rhinosinusitis is the inflammation of the nasal mucosa of one or more paranasal sinuses (PNS).¹ The nasal anatomy varies from one person to another, so it is common to identify various anatomical variants in the general population. Some of them are considered to be predisposing factors for mechanical obstruction, which can lead to sinus disease.^{2,3} Some of the most common variants are: bullous shells, prominent agger nasi cells, Haller or Onodi cells, paradoxical middle turbinate, prominent ethmoid bulla, pneumatization of the sphenoid sinus or crista galli, and deviation of the lamina papyracea or nasal septum.⁴ Through computed tomography (CT), it is often possible to assess the nasal and PNS anatomy with great detail.⁵ This has resulted in a greater interest in anatomical variants and their relationship with various diseases. One of the most prominent studies was the one conducted by Fadda et al.,⁶ where it was determined that various anatomical variants are associated with sinusitis.⁶ The present study sought to assess the frequency of variations in paranasal sinus anatomy in patients diagnosed with chronic rhinosinusitis at the Regional General Hospital No. 1 (RGH No. 1) of the Mexican Institute of Social Security (IMSS) in Tijuana, Mexico. Additionally, it wanted

to determine the most frequent variation, number of variations per patient and the level of association of each variation.

Methods

A cross-sectional, retrospective, and analytical study was carried out in the RGH No. 1 of IMSS, a second-level hospital in the border city of Tijuana, Baja California, Mexico. A non-probabilistic sample was used, consisting of patients who underwent simple PNS tomography, referred by the otolaryngology service from January to June 2018. Inclusion criteria included: age ≥ 18 , chronic rhinosinusitis diagnosis determined by an otorhinolaryngologist and simple PNS CT scan study. Patients with incomplete records or who were subjected to surgical treatments were excluded. After being authorized by the local research committee, the analysis of the radiology service database was performed, identifying the PNS tomographic studies and selecting those that met the inclusion requirements. The interpretation of the studies was performed by the main researcher (a radiology resident) and two independent radiologists. The degree of inter-observer concordance was estimated through the Cohen's Kappa statistical test. The studied variables were: age, gender, presence of

septum deviation, affected side, involved sinus, and number and type of anatomical variations. The study was conducted in accordance with the 1964 Helsinki Declaration, Mexico's General Health Law regarding health research, as well as IMSS national guidelines. Due to its nature, signed informed consent was not required.

Statistical analysis

Descriptive statistics were used; qualitative variables were studied via measures of central tendency and measures of dispersion. Pearson's Chi Squared test was applied for a bivariate analysis and to estimate the predictability of association between age and gender with PNS variations. Data processing was performed with the SPSS statistical program.

Results

After applying the inclusion and exclusion criteria, a total of 110 patients were identified; 58.2% (n=64) were women and 41.8% (n=46) were men. The most common age groups were 18-24 and 25-31 years old (Figure 1). Regarding the frequency of the anatomic variants of the PNS, nasal septum deviation was the most common anatomical variant (n=42, 38%), followed by a bullous shell (n=23, 20.9%). Prominent ethmoid bullas and paradoxical middle turbinates were the least common variants (each n=4, 3.6%) (Table 1). According to the side of occurrence, the left side had more cases (n=51, 46.4%), while 48 (43.6) cases were observed on the left side. There were 11 cases (10.0%) of bilateralism. It was observed that 40.9% (n=45) of the patients presented only one anatomical variant and 26.4% (n=29) two anatomical variations per patient; 20.0% did not show any variation (Figure 2). Within the female population, the most frequent variation was the nasal septum deviation (n=27, 42.2%), followed by pneumatization of the sphenoid sinus (n=11, 17.22%). Amongst male patients, the nasal septum deviation was also the most common variation (n=15, 32.6%), followed by bullous shells (n=14, 30.4%) (Table 2). Regarding the PNS variations by age, in the 18-24 and 25-31 age groups, the most common variations were deviated nasal septums and bullous shells. In the 32-38 age groups, deviated nasal septums and pneumatization of the sphenoid sinus were the most frequent finding. Among the 46-52 year olds, bullous shells and prominent agger nasi cells were common. A relationship between PNS variations and patient gender or age could not be established with the Chi-Squared test. Cohen's kappa coefficient was used to measure the degree of concordance of the observations done by the main researcher and two independent observers (radiologists). The results showed a high agreement rate. With the first radiologist, there was agreement in six variants; and with the second one, four (Table 3).

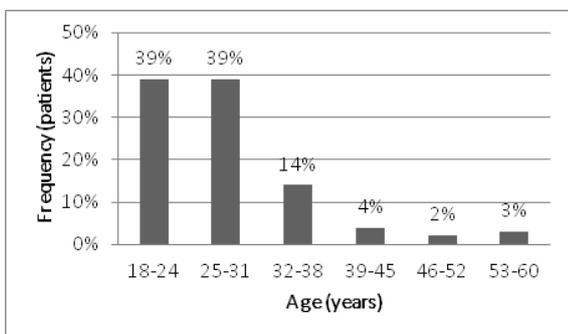


Figure 1 Patient distribution by age groups.

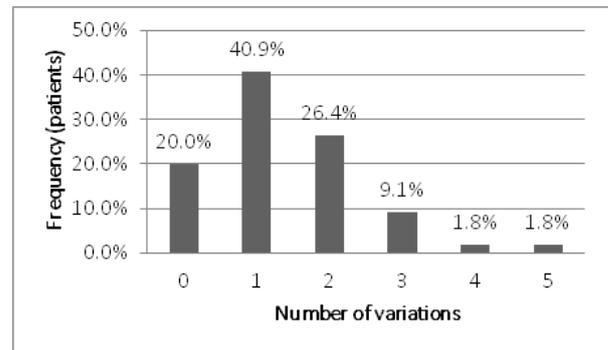


Figure 2 Number of PNS per patient.

Table 1 Frequency of anatomical variations in patients with chronic rhinosinusitis

Anatomical variations	Positive cases		Negative cases	
	n	%	n	%
Bullous shell	23	20.9	87	79.1
Deviated lamina papyracea	11	10	99	90
Deviated nasal septum	42	38.2	68	61.8
Haller cells	6	5.5	104	94.5
Onodi cells	8	7.3	102	92.7
Paradoxical middle turbinate	4	3.6	106	96.4
Pneumatization of crista galli	6	5.5	104	94.5
Pneumatization of the sphenoid sinus	15	13.6	95	86.4
Prominent agger nasi cells	10	9.1	100	90.9
Prominent ethmoid bulla	4	3.6	106	96.4
Unciform apophysis variations	11	10	99	90
Other variations	11	10	99	90

Table 2 Frequency of PNS anatomical variations by gender

Anatomical variation	Gender			
	Female		Male	
	Positive cases (n)	%	Positive cases (n)	%
Bullous shell	9	14.1	14	30.4
Deviated lamina papyracea	7	10.9	4	8.7
Deviated nasal septum	27	42.2	15	32.6
Haller cells	3	4.7	3	6.5
Onodi cells	1	1.6	7	15.2
Paradoxical middle turbinate	1	1.6	3	6.5
Pneumatization of crista galli	3	4.7	3	6.5
Pneumatization of the sphenoid sinus	11	17.2	4	8.7
Prominent agger nasi cells	5	7.8	5	10.9
Prominent ethmoid bulla	2	3.1	2	4.3
Unciform apophysis variations	6	9.4	5	10.9
Other variations	6	9.4	5	10.9

Table 3 Concordance test of investigator findings with observer 1 and 2

Anatomical variation	Observer 1			
	Non-agreement	Agreement	Kappa value*	Level of agreement
Deviated nasal septum	68	42	1	Almost perfect
Other variants	99	11	1	Almost perfect
Pneumatization of the sphenoid sinus	95	13	0.918	Almost perfect
Prominent ethmoid bulla	106	3	0.853	Almost perfect
Bullous shell	87	18	0.851	Almost perfect
Deviated lamina papyracea	99	8	0.828	Almost perfect
Pneumatization of crista galli	104	4	0.791	Substantial
Prominent agger nasi cells	100	4	0.548	Moderate
Onodi cells	102	3	0.527	Moderate
Unciform apophysis variations	99	4	0.507	Moderate
Haller cells	104	2	0.486	Moderate
Paradoxical middle turbinate	106	1	0.391	Fair
Anatomical variation	Observer 2			
	Nonagreement	Agreement	Kappa value*	Level of agreement
Prominent ethmoid bulla	106	4	1	Almost perfect
Other variants	99	11	1	Almost perfect
Deviated nasal septum	68	40	0.961	Almost perfect
Pneumatization of crista galli	104	5	0.904	Almost perfect
Pneumatization of the sphenoid sinus	95	10	0.776	Substantial
Deviated lamina papyracea	99	7	0.759	Substantial
Prominent agger nasi cells	100	6	0.732	Substantial
Unciform apophysis variations	99	6	0.684	Substantial
Bullous shell	87	13	0.673	Substantial
Onodi cells	102	2	0.382	Fair
Haller cells	104	1	0.274	Fair
Paradoxical middle turbinate	106	0	0	None

*Values ≤ 0 are interpreted as having no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement. Data obtained through analysis with SPSS

Discussion

Deviation of the nasal septum was the variation with the highest incidence in this population of patients with chronic rhinosinusitis, in addition to bullous shells and pneumatization of the sphenoid sinus, which coincides with the studies carried out by Fadda et al.,⁶ Ahmed et al.⁷ and Nobre et al.⁸ Increased prevalence of septal deviation with age was reported by Van der Veken, which can explain its higher prevalence, although other variations were more commonly identified in older patients. The study by Stallman et al.⁹ reported that bullous shells are related to the presence of sinusitis, though it did not increase the incidence of, specifically, chronic sinusitis. Though Fadda et al.⁶ established that rhinosinusitis has a high index of bilateral involvement, in our study, 90% had a unilateral involvement. As for the affected population, majority of patients were women between 18 and 24 years. Anatomical variations were typically found on the left side of the paranasal sinuses in this population sector. In contrast to the data presented by Braun et al.¹⁰ and the Nigerian Health Institution,¹¹ in the present study, the most frequent types of pneumatization of the sphenoid sinus were not established. In Mexico, only two studies have been done in the subject, one in the central and one in the southeast part of the country. Both describe characteristics of the most frequent anatomical variations, which they conclude are present in the middle, superior and supreme turbinate.^{12,13} For future studies, a more thorough investigation into the relationship that the age factor has with the PNS variations could be done comparing pediatric and adult populations. Likewise, the degree of clinical involvement and the location of the anatomical variations should also be taken into account. This will provide more evidence for preventative measures or possible complications caused by this disease.¹⁴

Conclusion

The deviation of the nasal septum was the most frequent anatomical variation. Unilateral involvement was more frequent. The 18 to 24 and 25 to 31 age groups registered the most cases. Most of the patients presented only one variation. The results of Cohen's Kappa test showed a high rate of agreement regarding the PNS variations. A relationship between PNS variations and patient gender or age could not be established.

Acknowledgments

None.

Conflicts of interest

Author declares that there is no conflict of interest.

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