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Prevalence of Nasal Septal Deviation, Concha bullosa, and Infundibular Size and their Association with Maxillary Sinusitis by Computed Tomography in Filipinos with Paranasal Sinus Disease

Paolo Generato Sogono[1]*, Catherine Gozun Songco[2]

1. Department of Radiation Oncology, Benavides Cancer Institute, University of Santo Tomas Hospital, Espana Boulevard, Sampaloc, Manila, Philippines.
2. Department of Radiology, Makati Medical Center, Amorsolo St., Legaspi Village, Makati City, Philippines.

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***Corresponding Author**:
Dr. Paolo G. Sogono
Email:
paolo.sogono@gmail.com

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Abstract

Background: Data are limited regarding anatomic variations of the paranasal sinuses (PNS) in the Filipinos. Although several studies have described the relationship between concha bullosa as well as nasal septal deviation and PNS disease, only few have investigated the relationship between the infundibular size and maxillary sinusitis.

Aim: This study aims to report the prevalence of nasal septal deviation, concha bullosa, and infundibular size, and to determine their association with CT-confirmed maxillary sinusitis in Filipino patients.

Methods: We retrospectively reviewed CT-scans of 200 patients from June 2015 to June 2016. Examinations requested intended to evaluate the symptoms referable to sinonasal disease. The presence of maxillary sinusitis, concha bullosa, nasal septal deviation, and infundibular size were recorded. Anatomic variants and infundibular size as well as their relationship with maxillary sinusitis were evaluated using logistic regression.

Results: Maxillary sinusitis was diagnosed in 98 (49%) patients, and in 146 of 400 (36.5%) sinuses. Concha bullosa was reported in 74 (37%) and nasal septal deviation in 130 (65%) patients. Most of the septal deviations were <9 degrees (93.8%), and none were severe. A greater proportion of males had maxillary sinusitis (p=0.017). Patients with maxillary sinusitis had a larger infundibular size compared to patients without sinusitis (p=0.017). Only male gender (p=0.004) and infundibular size (p=0.023) had an association with maxillary sinusitis.

Conclusion: No association was seen between nasal septal deviation or concha bullosa and maxillary sinusitis. Increase in infundibular size led to increased odds of maxillary sinusitis, though the results should be interpreted with caution due to differences in group characteristics.

Conflicts of Interest: The Authors declare no conflicts of interest.
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Introduction

Sinusitis is one of the most common conditions seen by general practitioners and otorhinolaryngologists (1). Each year, it affects 1 in 7 adults in the US, and is diagnosed in 31 million patients (1). Another European study reported that the over-all prevalence of chronic sinusitis was around 10.9% (2). Presence of sinusitis is due to infection or dysfunction of mucociliary clearance (3).

There are many other contributing factors that predispose an individual to middle meatal obstruction, and some studies suggest that this could also be due to the difference in the anatomy of the paranasal sinus (PNS). Anatomic variants such as Haller cells (4) and Agger nasi cells (5) contribute to sinusitis.

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For the maxillary sinus, its pathway is described as cilia draining into the maxillary ostium further into the infundibulum and eventually to the middle meatus (6). Anatomically, obstruction at the middle meatus and narrowing of the maxillary sinus ostium (7) contribute to maxillary sinusitis. Other variants such as concha bullosa and nasal septal deviation have been studied regarding their relationship with maxillary and ethmoid sinusitis, but with varying results (10). Anatomic differences that interfere with drainage through this pathway such as a narrowed infundibulum or any tortuous path can impede mucociliary clearance and increase the risk for maxillary sinusitis.

Studies detailing the common anatomic variants in the PNS of the Filipino are limited. Available data on Filipinos have focused on the relationship between concha bullosa and sinusitis, where a study by Santos (8) showed that type I septal deviation is most prevalent. However, to the best of our knowledge, there has been no study that relates both concha bullosa, nasal septal deviation, and infundibular size with the presence of sinonasal disease in the Filipino population. The purpose of this study is to report the prevalence of nasal septal deviation, concha bullosa, and infundibular size in adult Filipino patients with paranasal sinus disease, and to determine their association with CT-confirmed maxillary sinusitis.

Methods

We retrospectively identified patients 13 years and older, who underwent a dedicated CT-Scan for the paranasal sinuses at Makati Medical Center from the period of June 2015 to June 2016. This study was approved by the institutional review board. The Picture Archiving Communication Systems (PACS) by NovaWeb was used to generate a list of eligible patients. Patients who had a gross tumor (malignant or benign) and had prior history of head and neck surgery were excluded. Images were obtained using 2 scanners (Siemens Sensation 16 and Siemens Definition 128, Siemens, Erlangen, Germany) to generate 0.6 mm and 1.0mm axial and coronal images of the PNS. Clinical information and patient demographics were compiled from patient records. Radiographic measurements were confirmed to be correct by a board-certified radiologist with 20 years of experience.

The following radiographic parameters were recorded for each patient: 1) Maxillary sinusitis; defined as presence of mucosal opacities of at least 3mm thickness (9). 2) Concha bullosa; defined as more than 50% of the vertical height of the middle turbinate being pneumatized (10). 3) Nasal septal deviation; defined as deflection of the nasal septum laterally from the midline. The angle of deviation in the coronal image which correlated best with the ostiomeatal complex (7, 11), and the severity of deviation was graded as mild (>9 degrees), moderate (9-15 degrees) and severe (>15 degrees) according to Gencer et al (12). 4) Infundibular size; defined as the bony canal/lumen connecting the maxillary sinus ostium to the hiatus semilunaris, which was measured by obtaining the size in millimeters of the maxillary sinus infundibulum as measured on the coronal view of CT images according to Bhattacharyya (11) and Ono (7) (Figure 1). Laterality or bilaterality was recorded for each parameter if applicable.

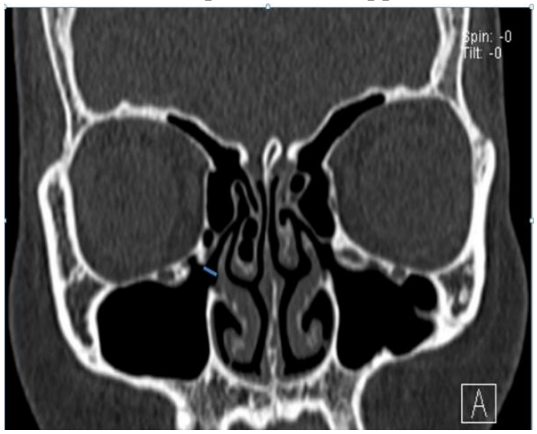

Figure 1. Measurement of the infundibular size on computed tomography coronal view of the paranasal sinus study; The blue line indicates the length of measurement of the infundibulum.

Statistical Analysis

Descriptive statistics were used to summarize the clinical characteristics of the patients. Frequency and proportion were applied for

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nominal variables, median and range for ordinal variables, and mean and SD for interval/ratio variables. Independent Sample T-test, Mann-Whitney U test, and Fisher's Exact/Chi-square test were also used to determine the difference of mean, median, and frequency between with and without maxillary sinusitis, respectively. Binary logistic regression analysis was employed to determine predictors of CT-confirmed maxillary sinusitis using data from individual sinuses. All valid data will be included in the analysis. Missing variables were neither replaced nor estimated. Null hypothesis was rejected at 0.05 α-level of significance. SPSS 23 for Windows (SPSS Inc., Chicago IL) was used for data analysis.

Results

Two hundred (200) patients with a total of 400 sinuses were included in our analysis. Reasons for requesting a CT-Scan of the paranasal sinuses were due to clinical problems such as headache, sinus tenderness, nasal discharge, epistaxis, or other head and neck symptoms. Maxillary sinusitis was diagnosed in 98 (49%) patients and in 146 (36.5%) sinuses. Demographic characteristics and presence of anatomic variants were compared between patients with and without sinusitis. Both groups were similar in terms of age, presence of concha bullosa and nasal septal deviation. There was a higher proportion of male patients with maxillary sinusitis (54% males with sinusitis vs. 37% males without sinusitis, p=0.017).

Overall, the presence of concha bullosa was reported in 74 (37%) patients. A similar proportion had unilateral and bilateral conchae (19% and 18%, respectively). Of the 130 (65%) patients with nasal septal deviation, the majority (122, 61%) had a deviation less than 9 degrees (mild deviation). The average infundibular size for the whole cohort was 1.70±0.72 mm. The patients with maxillary sinusitis had a statistically significant larger infundibular size compared to patients without sinusitis (1.82±0.75 mm vs 1.64±0.7, p=0.017). Binary logistic regression was conducted to determine predictors of maxillary sinusitis. Male gender increased the odds of diagnosing maxillary sinusitis by 2.49 times (95% CI 1.33 to 4.67, p=0.004). For infundibular size, every unit (1 mm) increment increased the odds of diagnosing maxillary sinusitis by approximately 1.4 times, after adjusting for sex, as well as presence of concha bullosa and nasal septal deviation. The logistic regression model was significant and accounted for 4.9% variations of being diagnosed to have maxillary sinusitis, which correctly classified 65.3% of the cases (p=0.05).

Table 1. Demographic and clinical profile of the patients who underwent CT scan (n=200)

	With Maxillary Sinusitis (n=98)	Without Maxillary Sinusitis (n=102)	p-value
	Frequency (%)		
Age (Mean±SD)	42.72±14.8	40.02±14.3	0.192‡
Gender			
Male	53 (54.08)	38 (37.25)	0.017*
Female	45 (45.92)	64 (62.75)	
With Concha bullosa			
Any concha	35 (35.7)	39 (38.2)	0.548*
Left only	11 (11.22)	9 (8.82)	
Right only	10 (10.2)	8 (7.84)	
Bilateral	14 (14.29)	22 (21.57)	
With Nasal septal deviation			
Any	62 (63.2)	68 (66.6)	0.904§
Mild	58 (59.18)	64 (62.75)	
Moderate	4 (4.08)	4 (3.92)	
Severe	0	0	
Infundibular size (mm)	1.82±0.75	1.64±0.7	0.017‡

Statistical Tests Used: ‡- Independent Sample T test; *- Chi Square test; §- Fisher's Exact test

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Table 2. Prevalence of anatomic variants among patients with paranasal sinus disease (n=200)

Clinical Profile	Frequency (%)
With Concha bullosa	
Any (All)	74 (37)
Unilateral	38 (19)
Bilateral	36 (18)
With Nasal septal deviation	
All	130 (65)
Mild	122 (61)
Moderate	8 (4)
Severe	0
Infundibular size (mm; mean±SD)	
All	1.70±0.72
Left	1.76±0.68
Right	1.66±0.77

Table 3. Predictors of CT-confirmed maxillary sinusitis

Patients (n=200)	**With Maxillary Sinusitis** (n=98)	**Without Maxillary Sinusitis** (n=102)	**Adjusted Odds Ratio** (95% CI)	**p-Value**
	Frequency (%); Mean+SD			
Age				
40 years and up	55 (56.12)	48 (47.06)	1.5 (0.82 to 2.74)	0.186
Below 40 years	43 (43.88)	54 (52.94)	(reference)	-
Sex				
Male	53 (54.08)	38 (37.25)	2.49 (1.33 to 4.67)	0.004
Female	45 (45.92)	64 (62.75)	(reference)	-
Sinuses (n=400)	**With Maxillary Sinusitis** (n=146)	**Without Maxillary Sinusitis** (n=254)	**Adjusted Odds Ratio** (95% CI)	p-Value
	Frequency (%); Mean+SD			
Concha bullosa				
With concha bullosa	37 (25.34)	73 (28.74)	1.01 (0.62 to 1.63)	0.963
Without concha bullosa	109 (74.65)	181 (71.25)	(reference)	-
Nasal septal deviation				
With nasal septal deviation	51 (34.93)	83 (32.67)	1.01 (0.64 to 1.56)	0.983
Without nasal septal deviation	95 (65.06)	171 (67.32)	(reference)	-
Infundibular size	1.82±0.75	1.64±0.7	1.40 (1.04 to 1.87)	0.023

p-value=0.005; R^2=4.9%

Discussion

The presence of radiographic maxillary sinusitis found in our study (49%) is comparable to what has been reported in literature for patients undergoing CT-Scan of paranasal sinuses: 53% as noted by Hansen, et al[13] and 49% as noted by Shoib, et al (14). We observed that more men had radiologically detected sinusitis compared to women. While some have suggested that maxillary sinusitis is more common in women (13), Yehouessi-Vignikin and Vodouhe and Bahemmat et al. reported that gender did not prove to be associated with its occurrence (15, 16). For anatomic variants, there is wide variations in the prevalence of concha bullosa, with studies reporting 35%[9] up to 68% exhibiting at least a unilateral concha[17]. This variation in data may

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be largely due to the differences in the definition of a concha bullosa. Following the definition of Stallman et al, 37% of our patients had at least a unilateral concha, which was similar to what they reported[7]. Likewise, there are varying data on the prevalence of nasal septal deviation, though most studies have noted that its prevalence is around 50% (18,19). Although the majority of our patients had a radiographic septal deviation (65%), most were mild (122 of 130) and none were severe. Regarding the predictors of diagnosing maxillary sinusitis, only the male gender and infundibular size were significant. A peculiar finding in our study was that infundibular size was larger in patients with maxillary sinusitis. This may have led to increased odds of having maxillary sinusitis per unit increase in infundibular size. Several studies contradict our observations, explaining that narrowing of the maxillary sinus infundibulum disturbs the mucociliary clearance, therefore predisposing the person to sinusitis (7, 20). We believe that these conflicting results may be due to the unbalanced comparison between groups; the proportion of males in the maxillary sinus group was significantly greater. Infundibular size may have been influenced by dimensional or volumetric measurements which are expected to be larger in males compared to females (21). Lastly, there are also studies showing that predisposition to sinusitis is multifactorial (22), and that anatomic variation alone is not sufficient to explain propensity for sinus inflammation. Others have measured airflow resistance in considering the presence of infundibular narrowing, which was not performed in this study. A limitation of this study was the lack of a balanced comparison between groups. We therefore recommend a matched comparison in follow-up studies. Since our study analyzed patients with paranasal sinus symptoms, we recommend to investigate infundibular measurements in a healthy cohort.

Conclusion

In conclusion, no significant association was observed between the presence of nasal septal deviation or concha bullosa and CT-scan confirmed maxillary sinusitis. The increase in the infundibular size led to an increase in the odds of having maxillary sinusitis; however, the results should be interpreted with caution due to differences in group characteristics.

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Conflicts of Interest

The Authors declare no conflicts of interest.

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