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Correlation between Different Anatomical Conical Variations and Maxillary Sinusitis: A Retrospective Cross-Sectional Study

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A B S T R A C T

Concha bullosa (CB) is a common normal anatomical variation of the paranasal sinus, and it's classified into lamellar, bulbous, and extensive types. Concha bullosa has been considered a potential contributory factor in maxillary sinusitis because of its role in blocking the osteomata complex drainage. The association between CB and maxillary sinusitis has been widely debated in the literature. This study is carried out in radiology department in Al-Baida medical center AMC, to evaluate the association between maxillary sinusitis and various anatomical variation of concha bullosa, a descriptive retrospective cross-sectional study was conducted by collecting the data from archived electronic dataset of picture archiving communication system (DICOM) for 400 cases in the past 2 years 2023/ 2024. The scans were performed using a Toshiba Acquisition Prime (TSX-303A),128-MDCT scanner, GE Optima. Data was filled in an Excel file, then imported and analyzed by using Statistical Package for Social Sciences (SPSS 24, IBM Corp), the p-value was considered statistically significant at a level <0.05. For correlation analysis, a cross-table via Pearson's chi-square was used. In addition, the frequency rate and descriptive analysis were calculated as well. The result of the study showed no significant association between the presence of CB and maxillary sinusitis (x^2=0.23, p=0.63). Although concha bullosa is a frequent anatomical variation of PNS, the association between maxillary sinusitis and CB is uncertain.

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INTRODUCTION

Maxillary sinusitis is a prevalent inflammatory condition of the paranasal sinuses. It has been postulated that some anatomical variations in the paranasal sinuses are a predisposing factor for maxillary sinusitis. Concha bullosa is a pneumatized middle turbinate, it well recognized anatomical variation has been proposed as a potential contributor to sinusitis due to its role in altering nasal airflow and obstructing osteomeatal complex drainage, Therefore, concha bullosa promoting the accumulation of secretions, which in turns creates an optimal environment for bacterial infestation [1-6]. In addition, some extended research stated the presence of a significant correlation between the size and location of these bullae and the severity of sinusitis [7-9].

Despite the significant body of evidence found in literature supporting the above postulation, other researchers argue that such anatomical variations may be incidental [10-12]. Therefore, the aims of this humble paper to evaluate the association between various anatomical variation of concha bullosa (classified as unilateral or bilateral, lamellar, bulbous and extensive) and maxillary sinusitis by using an observational retrospective cross-sectional study, that carried out in radiology department, Al-Baida medical Centre AMC, to providing evidence to clarify conflicting findings in existing literature.

METHODS

This is a descriptive retrospective cross-sectional study. The data collected from the archive of the past 2 years2023 and 2024. The ethical form approval to conduct the study was obtained from the radiology department, Al-Baida Medical Centre. The population number is 400, and the inclusion criteria: all patients who underwent a non-traumatic paranasal sinus computed tomography (PNS-CT) study. Exclusion criteria: any patient with previous trauma and known cases of paranasal sinus mass or tumors.

The scans were performed using a Toshiba Acquisition Prime (TSX-303A),128-MDCT scanner GE Optima, the scout was taken in supine position. The following parameters were used: 120kV, 0 gantry tilt, and the FOV adjusted according to the patient's size. No intravenous contrast had been administered. Following the acquisition, the images were reported by two radiologists.

Data are collected from an archived electronic

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dataset of picture archiving and communication system (DICOM). The following parameters are collected: age, sex, presence/absence of maxillary sinusitis, presence/ absence of concha bullosa, type of concha bullosa (unilateral, bilateral, lamellar, bulbousa, extensive). Data was filled in an Excel file, then imported and analyzed by using Statistical Package for Social Sciences (SPSS 24, IBM Corp), whereby the p value is considered statistically significant at the level <0.05. For correlation analysis, a cross-table via Pearson's chi-square was used. In addition, the frequency rate and descriptive analysis were calculated as well.

RESULTS

The mean age of the patients was 40.6 ± 15 years of age, with a range of 18 to 82 years. Of the 400 scans evaluated, 60.5% (242) were from male patients and 39.5% (158) were from female patients. Table 1 summarizes the age and gender distribution of the population examined.

Table 1. Age distribution of the male and female population.

Age Range	Number	Percentage	Male	Female
<20	36	9%	26	10
21- 40	181	45.3%	115	66
41- 60	135	33.7%	76	59
>61	48	12%	25	23
total	400	100%	242	158

pneumatization of the concha was found in 42.5 % (170) of scanned patients. From the 400 scans, 11% (44) were located in one of the right conchae, 10.3% (41) involved the left conchae, and 21.3% (85) were bilaterally distributed. The majority of concha bullosa were located in the middle concha. Of the 170 patients with conchae bullosa, 26% (107) were lamellar type,9% (37) were bulbous type, and 5.8% (23) were concha bullosa extensive.

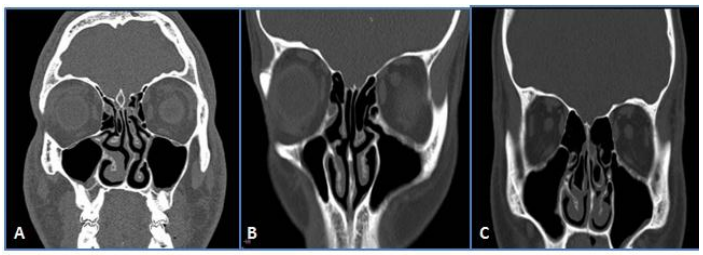

Figure 1. CT scan coronal images: Right concha bullosa lamellar, with chronic maxillary sinusitis (A), concha bullosa lamellar left side (B), Bilateral concha bullosa bullbuos (C).

Maxillary sinusitis was evident in 27% (108). From the 400 scans, 4.3% (17) were located in one of the right maxillary sinuses, 5% (20) involved the left maxillary sinus, and 17.8% (71) were bilaterally involved.

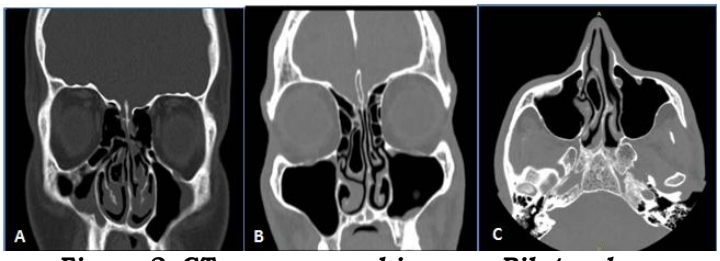

Figure 2. CT scan coronal images: Bilateral conchabullosa, with bilateral maxillary sinusitis (A), concha bullosa right side with left maxillary sinusitis (B), axial image, right concha bullosa(C).

There was no statistical significance when comparing the relationship of patients with concha bullosa (42.2%) and those with sinusitis (27%). The number of patients had a combination of both concha bullosa and sinusitis were 48 patients (12%), 122 patients (30.5%) had concha bullosa without evidence of sinusitis, and 60 patients (15%) had sinusitis in the absence of concha bullosa (**x^2 =** 0.23, p=0.63) (Table 2).

Table 2: Relationship of concha bullosa and maxillary sinusitis.

Concha bullosa	**Absent**	**Present**
Maxillary sinusitis	170(42.5 %)	122(30.5%)
	60(15%)	48(12%)

No significant association exists between different types of conchae bullosa (lamellar, bulbous, and bullosa extensive) and maxillary sinusitis. The results show no statistically significant association, with chi-square results as follows: for lamellar (**x^2 =**0.29, p = 0.59), Table 3. For concha bullosa bulbous (**x^2 =**1.37, p=0.24) table 4; and for concha bullosa extensive (**x^2 =** 2.41, p=0.12), Table 5.

Table 3. Relationship of concha bullosa lamellar and maxillary sinusitis.

Concha bullosa lamellar	**Absent**	**Present**
Maxillary sinusitis	216(54%)	76(19%)
	77 (19.3%)	31 (7.8%)

Table 4. Relationship of concha bullosa bulbous and maxillary sinusitis.

Concha bullosa bulbous	**Absent**	**Present**
Maxillary sinusitis	268(67%)	24(6%)
	95(23.8%)	13(3.3)

Table 5. Relationship of concha bullosa extensive and maxillary sinusitis.

Concha bullosa extensive	**Absent**	**Present**
Maxillary sinusitis	272(68%)	20(5%)
	105(26.3%)	3(0.8%)

DISCUSSION

There are a number of anatomical variations related to the lateral wall of the nose, these involved concha bullosa, septal deviation, and oversized bulla.

Concha bullosa, considered the most frequently encountered anatomical variation, contributes to middle meatal obstruction [1]. This is because of its negative impact on the ventilation of PNS and clearance of mucociliary in the middle meatus [13]
The relationship between concha bullosa (CB) and maxillary sinusitis remains a topic of argue in otolaryngology. This descriptive retrospective cross-sectional study investigated the relationship between anatomical variations of the concha bullosa and maxillary sinusitis. Amongst 400 patients assessed, 60.5% (242) were male patients and 39.5% (158) were female patients. This similar to result of Kalaiarasi et al 2018 where the percentage of male was higher than female [14], however, a different pattern was documented in other studies, one study found female patients 60% was higher than male patients [15] also the study of smith et al (2010) showed higher incidence in female 56.3% comparing with male 43.6% [11]. Our study demonstrated an elevated frequency of concha bullosa in the age group of 21 to 40 years. This result is close to the result of a study by Rahman et al. (2020), who found the higher rate was at the age of 21 to 30 years [15], and Tuli et al (2013) found that the most frequently affected age group was between 21-35 years.[16] In this study, among 400 patients evaluated, 42.5% exhibited CB, predominantly in the middle turbinate, with lamellar CB (26%) being the most common subtype. Maxillary sinusitis was identified in 27% of cases, with bilateral involvement accounting for the majority (17.8%). However, statistical analysis revealed no significant association between the presence of CB and maxillary sinusitis (x^2=0.23, p=0.63).
The lack of a significant association aligns with several studies. For example, Kalaiarasi et al. (2018) found no direct causal link between CB and chronic sinusitis, emphasizing instead the multifactorial nature of sinus disease [14]. Other studies also found no correlation between CB prevalence and sinusitis [11,12,17-19].
On the other hand, some studies propose a potential link. A study of Rahman et al (2022) found a significant association between CB and sinusitis, especially chronic maxillary sinusitis [15]. In addition, another study documented a case where extensive CB contributed to ostial obstruction, leading to secondary maxillary sinusitis [9].
Although Kalaiaras et al 2018 found no significant statistical correlation between sinusitis and concha bullosa, however, sinusitis was more evident with the extensive type of CB than with other types [14]. In our study, we considered any grade of pneumatization, despite of the location or the size, as concha bullosa, and no correlation was observed between specific CB subtypes (lamellar, bulbous, or extensive) and sinusitis. The discrepancy in findings could result from differences in study design, sample size, or diagnostic criteria. For example, this study's retrospective approach may have introduced selection bias, as only patients undergoing PNS-CT were included, potentially overlooking a symptomatic individual with CB.
This highlights the complexity of sinusitis etiology, where isolated anatomical variations may not suffice to drive pathology.

CONCLUSION

Concha bullosa is well well-documented anatomical variation that has been suggested as a possible cause of sinusitis because of its role in obstructing the osteomeatal complex drainage. In this study, an effort was made to evaluate the correlation between different anatomical conical variations and maxillary sinusitis, and we found no significant association between the presence of CB and maxillary sinusitis. These findings confront the hypothesis that while CB represents a common anatomical variation, its role in sinus pathology appears to be incidental rather than causative. Nevertheless, this study evaluated symptomatic patients, assumed to have sinus disease; therefore, it does not apply to the general population.

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