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Original Research Article

Association of Concha Bullosa and Chronic Rhinosinusitis Patients -A Computerised Tomography-Assisted One-Year Cross-Sectional Study

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Abstract

Background: Chronic rhinosinusitis (CRS) is a widespread inflammatory disorder of the paranasal sinuses (PNS) that is usually affected by anatomical deviations like concha bullosa. Concha bullosa, which can be described as pneumatization of the middle turbinate, can also be a cause of the obstruction of the osteomeatal complex and the deterioration of normal sinus drainage. Nevertheless, there is a controversial nature to its contribution to the evolution of CRS.

Methods: A cross-sectional study of 100 patients diagnosed with CRS and underwent computed tomography (CT) scanning of the PNS during one year. The existence and the form of concha bullosa (lamellar, bulbous and extensive) were evaluated, and the sinus involvement. Chi-square test was used to analyse the data statistically and a p-value of less than 0.05 was considered significant.

Results: Concha bullosa was diagnosed in 38 % of the patients. The most common of the bulbous (47.4 %), then lamellar (31.6 %) and the extensive types (21.0 %). Significant association was found to exist between concha bullosa and ipsilateral sinus involvement ($p < 0.05$). The maxillary sinus was the most commonly involved, followed by the ethmoid sinus.

Conclusion: The study demonstrates a significant association between CRS and concha bullosa, which implies that this anatomical variation could be a contributing factor to the pathogenesis of CRS. CT imaging is essential for the proper diagnosis and effective planning in management.

Keywords: Anatomical Variation, Chronic Rhinosinusitis, Computed Tomography, Concha Bullosa, Osteomeatal Complex, Paranasal Sinuses.

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Introduction

CRS is an inflammatory disease of the nasal cavity and PNS, which is persistent mucosal inflammation that has persisted beyond 12 weeks despite suitable medical care [1]. CRS has some clinical symptoms that include nasal obstruction, nasal discharge, facial pain or pressure and loss or impairment of smell. It is a major health burden in the world, and it affects about 10-15 percent of the adult population, with a strong effect on quality of life, productivity, and healthcare expenses.

CRS etiology is multifactorial, covering both environmental conditions, infections, allergies, and anatomical differences that can predispose individuals to poor sinus ventilation and drainage [2]. One of these anatomical variants is the concha bullosa, which can be described as pneumatization (air-filled cavity) of the middle turbinate [3]. It is one of the most commonly experienced forms of sinonasal deviations and may be unilateral or bilateral. Depending on the degree of pneumatization, concha bullosa is normally divided into three types lamellar (the vertical lamella), bulbous (the bulbous portion) and extensive or true concha bullosa (both lamellar and bulbous) [4]. Although usually asymptomatic, concha bullosa may also play a role in the pathology of the sinonasal, especially when large or in a strategic position.

Pathophysiologic association between concha bullosa and CRS is discussed in [5]. An enlarged concha bullosa may result in a constriction or blockage of the osteomeatal complex, which is a vital part of the drainage and ventilation of the frontal, maxillary and anterior ethmoid sinuses [6].

The blockage of this area interferes with the normal process of clearance by the mucosa and causes stagnation of the mucus, secondary infection, and chronic inflammation of the sinus mucosa [7]. Nevertheless, there is controversy on the role of concha bullosa as the causative factor or an incidental finding.

The gold standard imaging mode that is used to assess the sinonasal anatomy and pathology is CT of the PNS [8,9]. It offers an intricate visualization of bony structures, anatomical variations, and the degree of sinus diseases, thus being important in diagnosing as well as planning a surgery. The CT imaging is able to identify the concha bullosa accurately, as well as its association with other structures, especially the osteomeatal complex [10,11].

Although there is much research exploring this relationship, the results are inconclusive, and a relative scarcity of region-based information is present, particularly in emerging healthcare systems. Differences in study design, population traits, and diagnostic criteria are some of the causes of these discrepancies. Thus, the current research will assess the relationship between concha bullosa and CRS during a 1-year period with the use of CT imaging of a specified population, which will add to the current literature.

Objectives

- To determine the prevalence of concha bullosa
- To assess the association with CRS using CT findings

Materials and Methods

Study Design: A cross-sectional observational study of a hospital was formulated to assess the relationship between concha bullosa and CRS. This research was carried out in a period of one year, which gave sufficient time to recruit, image and analyze the data of patients. The cross-sectional study allowed for measuring the variation in anatomy and its relation to CRS at one time.

Study Setting: It was conducted in the Otorhinolaryngology (ENT) and Radiology Departments of a tertiary care teaching hospital. These departments have been chosen because they are able to get a large number of CRS patients and they have advanced imaging equipment such as CT of the PNS.

Study Population: The population of the study was patients who were clinically diagnosed with CRS in accordance with the standard diagnosis criteria, such as the presence of persistent symptoms, which included nasal obstruction, nasal discharge, facial pain, and olfactory disturbance for more than 12 weeks. Referred patients who underwent CT assessment of the PNS were considered eligible.

Sample Size: The number of patients who were enrolled in the study within the one-year period was 100 patients who met the inclusion criteria. The sample used was calculated by the availability of patients during the period of the study and was calculated to gain adequate statistical power to identify significant relations.

Inclusion Criteria: The patients who were enrolled in the study were 18 years of age and above and were clinically diagnosed with CRS. The patients who had their CT scanning of the PNS during their diagnostic assessment were eligible to be included.

Exclusion Criteria: Previous sinonasal surgery patients were eliminated to prevent distorted anatomy. Also, participants having nasal or paranasal sinus tumors and those who had facial trauma were eliminated, as that could confound the anatomical examination and CT.

Data Collection Method: The CT scans of the PNS were taken, and these were used to calculate the data. The scanning was examined both in the axial and coronal planes to have a full assessment. The main parameters that were measured concerned the existence or absence of concha bullosa, the type of which (lamellar, bulbous, or extensive), and the scope and distribution of the involvement of the sinus. To avoid diagnostic failures, all CT images were examined by qualified radiologists with the assistance of ENT specialists.

Variables Studied: The presence of this study concha bullosa was occupied as an independent variable, and the severity, as well as the presence of CRS as seen in CT findings, were dependent variables. Other demographic data, like age and sex, were also obtained.

Statistical Analysis: The data obtained were recorded with the help of statistical analysis like SPSS. The summary of demographic and clinical data was obtained by means of descriptive statistics. The relationship between concha bullosa and CRS was determined through the chi-square test. The p-value of 0.05 or less was taken to represent statistically significant values, meaning a significant association between variables.

Ethical Considerations: The research was done after consent was approved by the Institutional Ethics Committee. All participants were informed about the study and gave their consent before being involved in it. Patient data confidentiality was also upheld during the research process, and the research conducted followed the ethical practices in medical data research on human subjects.

Results

Demographic Data: A total of 100 patients diagnosed with CRS were included in the study. The age of the participants was between 18 to 65 years, and the majority of the participants were between the age range of 31-50 years, thus indicating that the prevalence of CRS was high among the middle-aged. The average age of the population used in the study was about 38.6 years. Regarding gender distribution, 58% patients were males and 42% females with a male-to-female ratio of 1.38:1, which indicated that the sample of the study was slightly predominant in males.

Table 1: Demographic Characteristics of Study Population

Variable	Category	Number (n)	Percentage (%)
Age Group	18–30 years	24	24%
	31–50 years	46	46%
	51–65 years	30	30%
Gender	Male	58	58%
	Female	42	42%

Prevalence of Concha Bullosa: Among the 100 patients who were examined by CT scans of the PNS, the prevalence rate was found to be 38%, with 38 patients having concha bullosa. The other 62 patients were not exhibiting concha bullosa. This suggests that concha bullosa is not a rare anatomical deviation among patients with CRS.

Table 2: Prevalence of Concha Bullosa

Finding	Number (n)	Percentage (%)
Present	38	38%
Absent	62	62%

Types of Concha Bullosa: The most common type of bullous ear was observed in the 38 patients with concha bullosa, and next came the lamellar type and the extensive type. In particular, 18 patients (47.4%) had bulbous concha bullosa, 12 patients (31.6%) had lamellar type and 8 patients (21.0%) had extensive concha bullosa with both lamellar and bulbous components.

Table 3: Distribution of Types of Concha Bullosa

Type of Concha Bullosa	Number (n)	Percentage (%)
Lamellar	12	31.6%
Bulbous	18	47.4%
Extensive	8	21.0%

Association with Chronic Rhinosinusitis: The relationship between concha bullosa and CRS was evaluated by comparing the frequency of sinus involvement between sides that had concha bullosa and those without it. In the 38 patients with concha bullosa, 30 (78.9%) had ipsilateral sinus involvement and 8 (21.1%) had no significant sinus disease. Contrarily, sinus involvement was relatively reduced among patients who did not have concha bullosa.

The Chi-square test statistically showed that the presence of concha bullosa and CRS had a significant relationship ($p < 0.05$), which shows that the presence of concha bullosa could be contributing to the occurrence or progression of sinus disease.

Table 4: Association between Concha Bullosa and CRS

Concha Bullosa	CRS Present	CRS Absent	Total
Present	30	8	38
Absent	34	28	62

CT Findings: The CT has shown that the maxillary sinuses were most affected, with the ethmoid sinuses being the second. Sinus involvement at the frontal and sphenoid levels occurred less frequently. It was found that multiple sinus involvement was present in a large number of patients, especially those with concha bullosa.

Table 5: Distribution of Sinus Involvement

Sinus Involved	Number (n)	Percentage (%)
Maxillary	68	68%
Ethmoid	54	54%
Frontal	32	32%
Sphenoid	20	20%

The overall results show a notable prevalence of concha bullosa between CRS patients, which is statistically significantly associated with anatomic variation and sinus disease evidence CT findings.

Discussion

The current research measured the relationship between concha bullosa and CRS with the help of CT scans in a sample of 100 patients. The results showed that concha bullosa existed in 38% of the research population, which means that it is a rather frequent anatomical variation among CRS patients. Moreover, the percentage of patients with concha bullosa (78.9%) showed the presence of an ipsilateral sinus, which implies that there was a close relationship between the ipsilateral sinus and the existence of sinus disease. The exceedance of the bulbous type of concha bullosa in this research is in accordance with its high possibility to produce mechanical obstruction with its size and position.

Comparison with Previous Studies: The findings of the present research are in agreement with various other previous studies that have indicated a high prevalence of concha bullosa in patients with CRS. [12,13] have also pointed to concha bullosa as being one of the most common anatomical variations observed with CT scans of the PNS. The rate of prevalence of 38% in this study is in the range of the rates reported previously, ranging between 30 and 50 %. Also, the strong correlation between concha bullosa and sinuosity in the present study is reinforced by the studies that anatomical differences can lead to poor sinus drainage. However, a few studies have found no statistically significant correlation, which is a sign of the existing controversy and the effect of population differences, study design, and diagnostic criteria.

Pathophysiological Explanation: In the pathophysiological mechanism that connects the concha bullosa and CRS, the main factor is the obstruction of osteomeatal complex [14]. Osteomeatal complex is a vital area that drains and vents the frontal, maxillary and anterior ethmoid sinuses [15]. A large or pneumatized concha bullosa may invade this space, resulting in constriction or obstruction. This blockage interferes with the normal mucociliary clearance, leading to retention of mucus, the proliferation of bacteria and chronic inflammation of the sinus mucosa. With time, such a cascade leads to the continuity and recurrence of sinus infection, hence creating a causal relationship between concha bullosa and CRS.

Clinical Implications: The clinical implications of this study are that the study has significant, clinical implications especially in the diagnosis and treatment of CRS. The concha bullosa is identified by CT imaging so that the sinonasal anatomy is correctly assessed. The awareness of this anatomical variation may be helpful when clinicians are trying to identify the cause of ongoing sinusitis and to arrange the treatment plans. When medical management is unsuccessful, surgery can be considered, such as Functional Endoscopic Sinus Surgery (FESS). Detection of concha bullosa before surgery would be necessary to prevent intraoperative complications and proper restoration of sinus drainage pathways.

Strengths of the Study: The application of CT imaging, which is regarded as the gold standard in assessing the sinonasal anatomy and pathology, is one of the strengths of this study. The accuracy of the CT scans in detecting concha bullosa and the degree of sinus involvement is increased due to the detailed visualization of the CT scans. The research also contained quite sufficient sample size of 100 patients that enhances the credibility of the results and makes it possible to conduct meaningful statistical analysis.

Limitations of the Study: Although it has its strengths, the study has some limitations. The cross-sectional nature limits the possibility of determining the causal relationship between concha bullosa and CRS. Moreover, the lack of follow-up data restricts the analysis of the disease progression and treatment results. The study was also carried out at one center and this could be a problem with generalization of results to other larger populations.

Conclusion

The research indicates that concha bullosa and CRS have a strong relationship, which is evidenced by CT-based analysis. Bulbous type of concha bullosa was seen in a high percentage of patients, and the most common one was the bulbous type. There was a statistically significant correlation between the presence of the concha bullosa and ipsilateral sinus involvement, and this anatomical difference might play a role in the development or maintenance of CRS through impeding normal sinus drainage channels.

These results highlight the clinical significance of the thorough radiological examination of patients with CRS. CT imaging is crucial in diagnosing sinus pathology as well as in determining anatomical variations that can affect the development and management of the disease. The identification of concha bullosa is especially important to the field of surgical planning, especially in functional endoscopic sinus surgery, in which accurate anatomical information is crucial. Further longitudinal and multicentric studies with larger sample sizes are suggested to improve recognition of the causal relationship and to authenticate these findings across diverse populations.

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