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Concha Bullosa: It's Relationship with Ostiomeatal Complex

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Abstract

AIM: To assess different types of concha bullosa and its relationship with ostiomeatal complex , sinusitis and frontal recess disease.

Materials And Methods: Computed tomography (CT) studies of 100 patients diagnosed with concha bullosa were reviewed retrospectively. All examinations were performed for evaluation of a symptom referable to sinonasal region. Concha bullosa cases were grouped according to the location of pneumatization of middle concha as lamellar, bulbous, and extensive. Each group was compared according to sinus, ostiomeatal and frontal recess disease. We have assessed the location of ostium (frontal recess, air cells along the basal la-mella, hiatus semilunaris) with respect to the types of concha bullosa.

Results: There was not a significant relationship between concha bullosa types and sinus disease, ostiomeatal dis-ease, and frontal recess disease ($p>0.05$). The location of ostium of the bulbous type was the hiatus semilu-naris ($p<0.05$) and that of the extensive type was the frontal recess ($p<0.05$) preferentially.

Conclusion: There is no statistically significant difference between lamellar, bulbous and extensive type concha bullo-sas in terms of sinus disease, ostiomeatal disease and frontal recess disease incidence. Bulbous type prefer-entially drains into the hiatus semilunaris, and exten-sive into the frontal recess.

Keywords: Turbinates, Sinusitis, Tomography, X-Ray, Computed

Introduction

Sinonasal disease is a serious health problem commonly observed in the society. Although sinusitis is a clinical diagnosis, imaging studies are used to assess the extent of the disease and demonstrate sinonasal anatomy. Endoscopic sinus surgery was introduced first by Messerklinker in 1978 (1). Preoperative evaluation of the ostiomeatal unit gained importance afterwards. Radiographs have limited value in the assessment of this region. Currently, computed tomography (CT) is the method of choice for morphologic evaluation of the ostiomeatal unit. Coronal plane is the most commonly used plane by surgeons because of its similarity with the surgical orientation.

Concha bullosa (CB) is the pneumatization of the concha and is one of the most common variations of the sinonasal anatomy. A 14%-53.6% frequency of concha bullosa was reported by various studies (1). Pneu-matization of the concha, regardless of the amount and the location, was defined as concha bullosa (2). Bolger et al. have classified pneuma-tization of the concha based on the location as lamellar concha bul-losa (LCB), bulbous concha bullosa (BCB) and extensive concha bullosa (ECB) (3).

There are studies in the literature suggesting that CB may have a role in sinusitis etiology. There are also studies which suggest the opposite (1-15). The reason of this dilemma may be the exclusion of the lamel-lar and bulbous conchae bullosa in some studies (1). Bulbous type con-chae bullosa, especially large ones, were considered to be predisposing to sinusitis by ear, nose, and throat (ENT) specialists (2). There are many studies in the literature that assess the role of the dimensions of concha bullosa in sinusitis etiology. The same situation is not valid for other types of CB. In this study, whether there exists a significant statistical relationship between the concha types and the incidence of sinusitis, os-tiomeatal disease (OMD) and frontal recess disease (FRD) was evaluated. Ostial location of each type was also determined. We expect that this study would enlight the pathophysiology of the commonly encountered sinus diseases in the community and contribute to development of new management strategies.

Materials and methods

A total of 76 patients, who were admitted to siddhartha medical college hospital in department of otorhinolaryngology between September 1, 2017 and september 1, 2018, with sinusitis and headache symptoms and had paranasal CT studies that showed pneumatization of the middle concha, were included in this study. Eight patients who had previous sinus surgery and massive sinonasal polyposis were excluded from the study. A total of 115 concha bullosa were detected in 68 patients who were included in the study.

Images were obtained in the coronal plane using 3mm slice thickness from the anterior wall of the frontal sinus to the posterior wall of the sphenoid sinus. Scan parameters ranged between 120-160 kVp and 60-300 mA. Studies were interpreted in the bone window. Two radiologists performed the evaluations independently from each other; however, consensus was reached in conflicting cases. Radiological detection of mucoperiosteal thickening and opacification of the sinuses were regarded as evidence of sinus disease. Mucous retention cysts were spared. Pneumatization of the middle concha was classified depending on the pneumatisation of the lamellar and bullous portions of the middle concha as lamellar and bullous, respectively. Pneumatization of both the lamellar and bullous portionsof the middle concha was classified as the extensive type. Mucosal thickening in the middle meatus was interpreted as ostiomeatal disease. Mucosal thickening in the frontal recess was defined as frontal recess disease. Conchae bullosa bullosa were divided into three groups according to the location of their ostiums, as draining either to the frontal recess or the hiatus semilunaris or adjacent air cells along the basal lamina. Statistical analyses were made using a dedicated software program. Fisher exact test was used for comparison of frontal recess disease frequency and ostiomeatal disease frequency with concha bullosa types. Chi-square test was used for comparison of concha bullosa types with sinus disease frequency. Chi-square test was also used to determine the relation between concha bullosa types and ostium locations of the conchae bullosa. The p values < 0.05 in chi-square and Fisher exact tests were considered statistically significant.

Results

The mean age of the patients included in the study was 30, ranging from 14 to 59. There were 39 females (57.35%) and 29 males (42.64%). A total of 100 conchae bullosa were detected. Of the conchae bullosa, 52 were located at the right and 48 at the left side. Eighteen of the conchae bullosa were lamellar type, 27 were bulbous type and 55 were extensive type (Table 1). Thirty- two (47.05%) of

the conchae bullosa were right dominant, 30 (44.11%) were left dominant and 6 (8%) were co-dominant.

Table 1: The location of the ostium in concha bullosa types

	Frontal recess	Adjacent to basal lamina	Hiatus semilunaris	Total
Lamellar	8(44.44%)	6(10.9%)	4(22.22%)	18
Extensive	18(32.72%)	16(29.09%)	21(38.18%)	55
Bulbous	8(29.62%)	0	19(70.37%)	27
Total	34	22	44	100

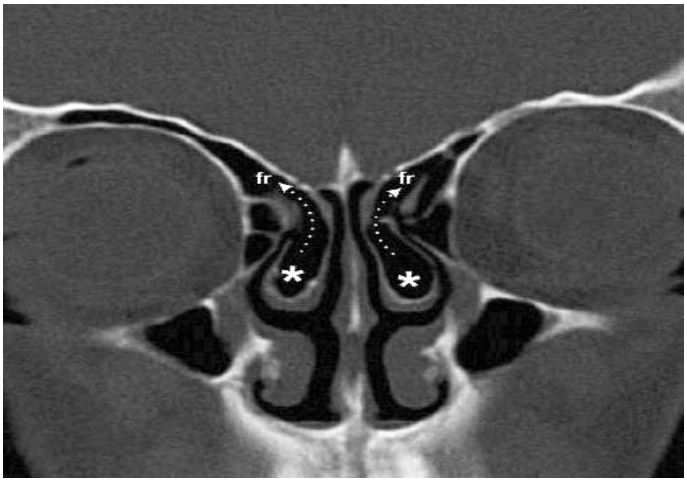

Figure 1:On the coronal CT image, lamellar concha bullosa *(asterisk)* drains into the frontal recess (fr) on the left and the left frontal recess is open. On the right, extensive type concha bullosa *(asterisk)* drains into the air cells adjacent to the basal lamina (blk) *(arrows)*. Both ostiomeatal units are open *(dashed arrows)*.

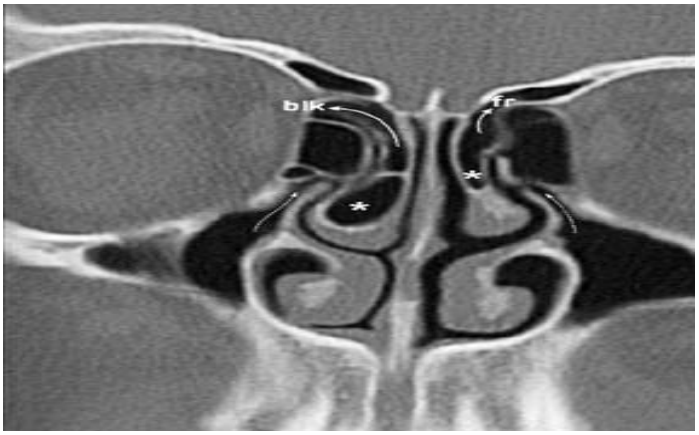

Figure 2: On the coronal CT image, the ostium of extensive type concha bullosa *(asterisk)* on both sides drain into the frontal recesses (fr) and both recesses are open *(dashed arrows)*.

Table 2. Frequency of ostiomeatal disease in relation to concha bullosa types Osteomeatal disease*

	OMD(-)*	OMD(+)*	Total
Lamellar	17(94.44%)	1(5.55%)	18
Extensive	42(76.36%)	13(23.63%)	55
Bulbous	23(85.18%)	4(14.81%)	27

Table 3.Frequency of frontal recess disease in relation to concha bullosa types

	FRD(-)	FRD(+)	Total
Lamellar	16	2	18
Extensive	46	9	55
Bulbous	20	7	27

Figure 4. Extensive type concha bullosa *(asterisk)* ostium drains into the air cells adjacent to the basal lamina (blk) on both sides *(dashed arrows)* on this coronal CT image. There is prominent mucosal thickening in the right maxillary sinus.

There were no statistically significant differences between the presence of lamellar, bulbous and extensive types of concha bullosa on the right side and ostiomeatal disease on the same side (p>0.05). Again, no statistically significant differences were noted between the presence of lamellar, bullous and extensive type of concha bullosa and ostiomeatal disease on the left side (p>0.05) (Table 2). Similarly, no statistical differences were found between the presence of disease in left and right frontal recesses and types of concha bullosa (p>0.05) (Figure 3). There were also no differences between types of concha bullosa and the presence of sinus disease on the same side (p>0.05) (Table 4).

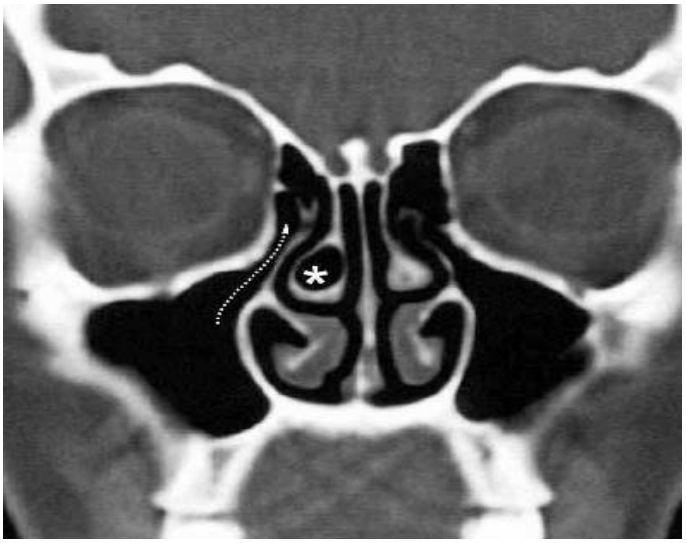

Figure 5. Bulbous type concha bullosa *(asterisk)* is present on the right in this CT study. Right ostiomeatal unit is open *(dashed arrows)*.

Table 4. Frequency of sinus disease in relation to concha bullosa types

		SD[a] (-)	SD (+)	Total	p
Right	Lamellar	5 (35.7%)	9 (64.3%)	14	>0.05
	Extensive	16 (57.1%)	12 (42.9%)	28	>0.05
	Bulbous	11 (55%)	9 (45%)	20	>0.05
Left	Lamellar	5 (50%)	5 (50%)	10	>0.05
	Extensive	8 (30.8%)	18 (69.2%)	26	>0.05
	Bulbous	6 (35.3%)	11 (64.7%)	17	>0.05

[a]Sinus disease

Discussion

Concha bullosa is the pneumatisation of the concha and the most frequent variation of the sinonasal anatomy (1). It is most commonly encountered in the middle concha. It is rarely found in the superior and inferior conchae. Bolger et al. have divided the pneumatization of the middle concha into three groups: lamellar type is the pneumatization of the vertical lamella of the concha; bulbous type is the pneumatization of the bulbous segment (Figures 1, 3 and 5); pneumatisation of both the lamellar and bulbous parts is called extensive concha bullosa (3) (Figures 1-4). The middle concha is formed by the medial part of the ethmoid bone. As it elongates in the nasal cavity, anterior-superior stabilization is provided by the cribriform plate, posterior and lateral stabilization is provided by the lamina papyricea. The bony structure that allows attachment to the lamina papyricea is called Ethmoid air cell groups form in the 5th and 6th months of embryonic period by extension of the nasal epithelium to the lateral nasal cartilage wall. The origin of this extension forms the ostium of the cell.

The cells continue to grow and enlarge. Their enlargement is limited by the adjacent cells and the presence of bone. Finally ethmoid bone consists of air cells like honeycomb, separated by thin septations.

Pneumatization of the middle concha is mostly via the anterior ethmoidal cells. Pneumatizations through the posterior air cells or both are also reported. There are studies which state that concha bullosa ostiums drain mostly to the frontal recesses, less frequently to the adjacent air cells through the basal lamina and to the hiatus semilunaris (4, 7, 8). Our study

revealed the same results. Among a total of 100 cases, 34% was draining to the frontal recess, 22% to the

adjacent air cells through the basal lamina and 44% to the hiatus semilunaris. When

concha bullosa types were compared regarding the location of their orifices, the extensive type was mostly draining to the frontal recess and the bulbous type to the hiatus semilunaris ($p<0.05$)

The concha bullosa incidence in the literature ranges from 14-53%.

Some authors have not included small sized or lamellar type conchae bullosa in their studies (1). Scribano et al. have reported incidences up to 67% and Perez-Pinas et al. up to 73% (9, 10). Presence of bilateral conchae bullosa ranges from 45%-61.5% (1-15). Concha bullosa was bilateral in 70.58% of the cases in our study. There is no concensus on the frequency of concha bullosa or frequency of types of concha bullosa. In our study these values were determined as 55 for ECB, 27 for BCB and 18 for LCB (Table 5). The variances may be due to differences between the study groups, differences in pneumatization parameters and the analytical methods used. There is conflicting data on whether CB is a cause of sinusitis or not. Some authors insist that CB plays a role in recurrent sinusitis by compressing the uncinate process and obstructing or narrowing the infundibulum and the middle meatus (1, 3, 7, 11, 12).

Lloyd et al. have stated that when CB fills the space between the septum and the lateral nasal wall, there may be total obstruction of the middle meatus orifice (11, 12). Comparative studies involving asymptomatic patients and sinusitis patients have reported that CB is more frequently encountered in patients with sinusitis (11-13). It is significant to note that the comparative studies which failed to show a significant association between the sinus disease and concha bullosa were performed only on the symptomatic groups (4, 5). Similarly, in our study cases consisted of patients in whom sinus disease was suspected after clinical assessment there are studies pointing out that the size of concha bullosa is important for the presence of symptoms (7, 14). Yousem et al. have advocated that CB is not one of the causes of sinusitis yet the size has implications (6).

Stallman et al. have demonstrated no significant association between the concha bullosa size and sinusitis (5). No consensus was achieved regarding this matter. We did not classify conchae bullosa by their sizes. So far, it is known that some authors have not included lamellar concha bullosa types and small sized bulbous type concha bullosa in their studies. Given that no agreement was reached on this matter, this may also be one of the causes why there were conflicting results from the studies. ENT specialists believe that especially bulbous type concha bullosa with large dimensions may have a role in sinus disease (2).

We studied the importance of concha bullosa location (lamellar, bullous and extensive) in relation with sinusitis. In the most extensive study on this topic by Ünlü et al., no significant relation was demonstrated between CB and OMD; however, when the bulbous-extensive type was compared with the lamellar type, a significant correlation was found regarding OMD (4). They thus concluded that pneumatization of the inferior portion of the middle concha has a role in OMD development (4) No significant difference was found between the bulbous and extensive types in their study (4). Although there are similar studies, there is no other study in the literature, to our knowledge, that has evaluated the relationship between concha bullosa location and the frontal recess, ostiomeatal disease, and sinusitis. No significant difference was noted in our study between concha bullosa types and OMD, FRD and sinus disease incidence on the same side (Tables 2-4).

Table 5. Frequency of concha bullosa types in the literature

	Extensive type CB[a] %	Lamellar type CB %	Bulbous type CB %
Tonai and Baba (15)	52	2	19
Bolger et al. (3)	15.7	46.2	31.2
Uygur et al. (14)	10.8	55.3	33.9
Ünlü et al. (4)	34.2	45.23	20.63
Hatipoğlu et al.	46.95	20.86	32.17

[a]Concha bullosa

One of the limitations of our study was that we did not take concha bullosa dimensions into consideration. Though Yousem et al. have not demonstrated any direct relationship between CB and sinus disease, they have pointed out that size should be taken into account (6). However, Stallman et al. failed to show a relationship with sinusitis in a study by which CB was classified according to size (5). The patients included in our study were symptomatic cases suspected of having sinonasal disease. Therefore the statistical interpretations of the conclusions of our study are valid only for the symptomatic population. The results should not be generalized to the whole population. In conclusion, bilateral concha bullosa is the most common variation in the nasal region. No statistical difference is present between concha bullosa types and sinus, ostiomeatal, and frontal recess disease. The ostium of the bulbous type preferentially drains into the hiatus semilunaris and the extensive type into the frontal recess.

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