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*Incidence of different types of concha bullosa in patients
with chronic sinusitis – CT images*

Sinusitis is one of the most common health problems worldwide, and there is evidence that it is increasing in prevalence and incidence. It is estimated to affect approximately 31 million Americans annually and is more widespread than arthritis or hypertension (1). Anatomic variations in paranasal sinus region have been shown to be of clinical importance. The role of anatomic variants of turbinates and of osteomeatal complex in sinusitis remains still controversial. *Concha bullosa*, as the most frequent anatomic variant of the turbinates has been shown to correlate with paranasal sinus inflammatory diseases and osteomeatal complex (OSM) disease (2).

Concha bullosa is a hypertrophy and pneumatization of the nasal turbinate, occurring most often in the middle, and less commonly, in the inferior or superior turbinate. Its association with high incidence of sinus infection is not sure. Some authors have shown the correlation of recurrent and chronic sinusitis with the presence of concha bullosa and emphasized a surgical treatment (8, 9). There were some cases in which an abnormally large *concha bullosa* appeared to obstruct the osteomeatal complex causing secondary infection of the ethmoid, frontal and maxillary sinuses. It is more common in septal deviation and associated with anterior ethmoid disease (2, 13). Some other authors show the correlation of maxillary hypoplasia with the size, location and presentation of *concha bullosa* (10). At the same time, other authors deny all correlation between *concha bullosa*, especially asymptomatic, and the increased incidence of sinusitis (7, 8, 11).

As this anatomic variation may be clinically important, we assessed its frequency and type in patients with chronic sinusitis examined at our Department in the years 2000–2006.

MATERIAL AND METHODS

We have retrospectively reviewed CT scans in 100 consecutive patients, aged 14–67 (mean 40.5), 56 women and 44 men, with chronic sinusitis. The patients had taken anti-inflammatory treatment for the previous 6 months and at the time of examination showed no symptoms of an inflammatory disease. Patients with previous sinus surgery, acute sinusitis or malignant disease were excluded from the study. In all cases 2-mm thick contiguous high-resolution CT coronal sections were obtained with Somatom A.R.T. or Emotion scanners (Siemens). They were placed in a supine position with the head bent backwards in order to obtain an optimal examination plane (lamp voltage 130 kV, current intensity 70–100 mAs). High-resolution reconstructions were done from axial images. Images were evaluated in bone window (W 3000 C 300).

Two observers independently reviewed each CT examination. They assessed the frequency rate of different types of middle turbinate *concha bullosa* (CB) in patients with chronic sinusitis and investigated the prevalence of each type of CB. CB was classified in 3 types, following the earlier classification by Lam et al. (7): I) pneumatization involving the head of the middle turbinate (Fig. 1), II) pneumatization involving the vertical lamina of the middle turbinate (Fig. 2), III) pneumatization of the horizontal lamina of the middle turbinate (Fig. 3).

Chronic inflammation was defined as ongoing inflammatory process for at least 6 months or more. Any discrepancies between the observers were resolved by consensus. For the descriptive analysis, each half-head was considered as a separate entity, thus giving finally the analysis of 200 half-heads.



Fig. 1. *Concha bullosa* involving the head of the middle turbinate (type I) on the right side. Additional nasal musosal thickening on the left and in both maxillary sinuses



Fig. 2. *Concha bullosa* of the vertical lamina of the middle turbinate on the left (type II) and of the head of the middle turbinate (type I) on the right. Mucosal thickening in the left maxillary sinus with the right one totally opacified



Fig. 3. Pneumatization of the horizontal lamina of the middle turbinate on the right – *concha bullosa* type III and co-existing *concha bullosa* type I on the right

RESULTS

CB of the middle turbinate was found in 86 cases (86%), it was bilateral in 48 cases (48%) and unilateral in 38 cases (38%) (Fig. 4). On the right side, CB type II was the most frequent (53 cases), followed by CB type I (24 cases) and CB type III (13 cases). On the left side, CB type II was also the most frequent (44 cases), followed by CB type I (21 cases) and CB type III (13 cases).

In general, CB type I was observed in 45 half-heads (22.6% of cases), CB type II in 98 half-heads (48.8% of cases) and CB type III in 26 half-heads (13.1% of cases). Additionally, a paradoxical curve of the nasal concha was observed in 16 cases and its hypertrophy in 5 cases.



Fig. 4. Bilateral concha type I on the right and type II on the left. Thickening of the nasal mucosa

DISCUSSION

The *concha bullosa* is a common anatomic variant of the middle turbinate. Its prevalence in healthy adults varies from 4% to 17%, but was shown to be more common in patients with sinus disease (2), ranging even up to 80% (8). In our study it was found in 86% of patients examined by CT for investigation of chronic sinusitis. Such a wide discrepancy between frequency results has been supposed to be dependent on criteria for pneumatization or result from inherent differences in the populations studied (7). For that reason, in our study we defined *concha bullosa* as any, even small, aeration of middle turbinate.

CT examination proves to be the best method to evaluate sinus pathology. It images easily all sinus and osteomeatal complex anomalies (6). Spatial reconstructions and high resolution algorithms turned out to be very useful to visualize the anomalies of the orifice-duct complex and any pathological masses in the sinus lumen (4). Virtual sinusoscopy based on CT images enables an exact morphology and spatial proportions of maxillary sinuses (5).

The etiological role of *concha bullosa* in chronic sinusitis has been controversial (13). It was suggested that an enlarged, pneumatized middle turbinate may predispose to sinus disease. This hypothesis was based on the fact that the aerated middle turbinate can compress the uncinate process and occlude the infundibulum, with subsequent blockage of the entrance to the middle meatus, resulting in osteomeatal unit disease. Lloyd et al. (8) and Calhoun et al. (3) confirm such hypothesis and find a high incidence of pneumatization of the middle turbinate in patients with chronic sinus complaints. This would be consistent with our findings in the population of patients with chronic sinusitis complaints. Scribano et al. (10), on the other hand, concluded that the contact of the mucosal surface, and not the size of *concha bullosa*, is the pathogenic clue to the sinus pathology. They make a hypothesis that a contact between opposed mucosal surfaces causes the immobilization or slowing of the ciliar movement, with the consequent blockage of the mucociliary transport, and therefore, predispose to viral and bacterial growth. Obviously the larger the variation, the more likely the mucosal contact. Some authors have also shown the correlation of *concha bullosa* and nasal deviation (12, 14). At the same time, we have not encountered many studies concerning different types of pneumatization of the middle turbinate, being the most common variation of OMU. However, some authors deny the association of *concha bullosa* and sinus disease (2, 8, 13). Lam et al. (7) studied the relationship between the location of *concha bullosa* and different chronic sinusitis patterns and did not find any significant association between them. Bolger et al. (2) studied also different types of *concha bullosa* and did not show a statistical importance of the pneumatization of the vertical part.

We examined therefore the frequency rate of different types of pneumatization of the middle turbinate in patients with chronic sinusitis, assuming that different types or localization of pneumatization inside the middle turbinate may have different effects on the osteomeatal drainage and could explain the contradictory data concerning the possible etiopathogenic role of *concha bullosa* in chronic sinusitis. We have shown the pneumatization of type II, concerning the vertical part of the middle turbinate, to be the most common in our group of patients. We think that in this type of pneumatization, *concha bullosa* narrows the middle meatus partially, but on a large surface, which could be responsible for bigger turbulences and ventilation problems of paranasal sinuses.

We conclude that middle turbinate *concha bullosa*, especially of type II, is the most prevalent in chronic sinusitis.

CONCLUSIONS

The high frequency rate of *concha bullosa* of the middle turbinate may prove its important role in etiopathogenesis of chronic sinusitis. The pneumatization type II is the most important anomaly of this anatomic variation as in our group of patients it was the most frequent.

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SUMMARY

The etiological role of *concha bullosa* in chronic paranasal sinusitis is unclear. We assessed therefore the frequency rate of middle turbinate *concha bullosa* (CB) in 100 adult patients admitted to our department in the years 2000–2006 with chronic sinusitis complaints, and examined whether there existed a difference in the frequency rate of different types of middle turbinate pneumatization.

All patients underwent HRCT examination performed in 2 mm coronary sections. CB of the middle turbinate was found in 86 cases (86%), it was bilateral in 48 cases (48%) and unilateral in 38 cases (38%). On the right side, CB type II was the most frequent (53 cases), followed by CB type I (24 cases) and CB type III (13 cases). On the left side, CB type II was also the most frequent (44 cases), followed by CB type I (21 cases) and CB type III (13 cases). In general, CB type I was observed in 45 half-heads (22.6% of cases), CB type II in 98 half-heads (48.8% of cases) and CB type III in 26 half-heads (13.1% of cases). Additionally, a paradoxical curve of the nasal concha was observed in 16 cases and its hypertrophy in 5 cases. We conclude that the high frequency rate of *concha bullosa* of the middle turbinate may prove its important role in etiopathogenesis of chronic sinusitis. The pneumatization type II is the most important anomaly of this anatomic variation as in our group of patients it was the most frequent.

Występowanie różnych typów *concha bullosa* u pacjentów z przewlekłym zapaleniem zatok w obrazach TK

Rola etiologiczna *concha bullosa* w przewlekłym zapaleniu zatok przynosowych jest wciąż niejasna. Celem pracy jest ocena częstości jej występowania (CB) u 100 dorosłych pacjentów z przewlekłym zapaleniem zatok oraz zbadanie ewentualnych różnic w występowaniu typów pneumatyzacji małżowiny środkowej. U wszystkich pacjentów wykonano badanie TK zatok w przekrojach 2 mm. Pneumatyzacja małżowiny środkowej została stwierdzona w 86 przypadkach (86%), obustronnie w 48 przypadkach (48%) i jednostronnie w 38 przypadkach (38%). Po stronie prawej *concha bullosa* typu II była najczęstsza (53 przypadki), następnie CB typu I (24 przypadki) i CB typu III (13 przypadków). Po stronie lewej *concha bullosa* typu II była także najczęstsza (44 przypadki), następnie CB typu I (21 przypadków) i CB typu III (13 przypadków). CB typu I obserwowano ogólnie w 45 przypadkach, biorąc pod uwagę stronę prawą i lewą (ogółem 22,6% pacjentów), CB typu II w 98 przypadkach, po zsumowaniu obu stron (48,8% pacjentów) i CB typu III w 26 przypadkach (13,1% pacjentów). U 16 pacjentów obserwowano dodatkowo paradoksalne skrzywienie konchy, a u 5 pacjentów jej przerost. Wnioskujemy, że wysoka częstość występowania pneumatyzacji małżowiny środkowej nosa może dowodzić jej ważnej roli w etiopatogenezie przewlekłych stanów zapalnych zatok. Najczęstsze występowanie pneumatyzacji typu II sugeruje, że jest to najważniejsza anomalia tego wariantu anatomicznego.