The Relationship of Concha Bullosa with Nasal Septal Deviation and Paranasal Sinus Disease

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ABSTRACT

Aims: (1) To find out the incidence of contralateral DNS in relation to concha bullosa. (2) To find out the incidence of PNS disease in relation to concha bullosa. (3) To determine whether there is any statistical correlation of concha bullosa with DNS and chronic sinusitis.

Materials and Methods: A prospective study was carried out in the Department of ENT, Silchar Medical College and Hospital. Study group comprised of 286 patients, from age group of 5 to 65 yrs, with Computed tomography scan of PNS showing one or more of the following findings - concha bullosa, nasal septal deviation, chronic sinusitis. Exclusion criteria included acute Sinusitis, any other anatomical aberration of the nose, prior surgery of nose and/or PNS, faciomaxillary trauma, any growth in the nasal cavity or PNS, patients who could not afford CT scan of PNS. Chi square test and Correlation Coefficient was used to evaluate statistical relevance.

Results: In our study, we found the incidence of contralateral DNS in relation to concha bullosa to be 69.41%, correlation coefficient +1 and p value <0.05. The incidence of ipsilateral PNS disease in relation to concha bullosa was 47.93%, correlation coefficient -1 and p value >0.05.

Conclusion: A positive statistical correlation was found between concha bullosa and contralateral DNS. However the relationship of concha bullosa and ipsilateral PNS disease was not found to be statistically relevant. A review of available literature has shown studies that support our results, however few studies negate it. Further large scale studies are warranted for reaching a uniform conclusion.

Key words: Concha bullosa, Deviated Nasal Septum (DNS), Paranasal Sinus (PNS) disease,Computed Tomography(CT)

INTRODUCTION

Concha bullosa(CB) is the pneumatisation of middle turbinate. It is one of the common anatomical variants of the lateral wall of nose. The interior of the CB is lined with ciliated respiratory epithelium and its ostium may drain into the frontal recess, lateral sinus or hiatus semilunaris. [8]

CB can be classified into three groups – [11]

1. Lamellar type: Pneumatisation is localized to the vertical lamella of the middle turbinate.
2. Bulbous type: Pneumatisation of the inferior bulbous part of the middle turbinate.
3. True or Extensive type: Pneumatisation of both the vertical lamella and the inferior part of the middle turbinate.
The presence of CB might be unilateral or bilateral; bilateral CB might be equal, right dominant or left dominant depending on the size.

Again, based on the amount of aeration of vertical height of the middle turbinate, CB can be:
- Small: Upto 50% pneumatisation
- Moderate: 51-75%
- Large: >75%

Occasionally, the presence of CB may lead to DNS and/or obstruct the opening of an adjacent PNS, possibly leading to recurrent sinusitis.
A number of studies have been aimed to study the relationship of CB with nasal septal deviation and paranasal sinus disease.
A Review of some available literature - Jamie et al. (2004) concluded that when a unilateral or dominant CB is present, there is no statistical relationship with any sinus disease (on either side). There is, however, a strong relationship between the presence of a unilateral or dominant CB and contralateral nasal septal deviation. [5]
Y.K. Maru et al. (2000), concluded that CB is frequently associated with diseases of adjacent osteomeatal complex. However relationship between overall incidence of inflammatory disease in osteomeatal complex in the symptomatic patients included in the study were found to be statistically insignificant. [19]
Stammberger et al. (1991) stated that after the formation of septum deviation, the air flow pattern of nasal cavity on the opposite side of the deviation, provoking the development of CB. [14]
According to Uygur et al. (2003), CB incidence doesn’t increase with nasal septal deviation. [17]
Kyle D. Smith et al. (2010) found no definitive relationship between the presence of CB or nasal septal deviation and the development of maxillary sinusitis. [6]

Ozdemir Sevine et al. (2013) found that the incidence of CB was higher in individuals with septal deviation. [9]
The aim of our study is to evaluate this association as there have been varied observations from different studies.

**Aims and Objectives**
1. To evaluate the CT scan of PNS of patients with clinical features suggestive of DNS and/or chronic sinusitis.
2. To identify CB, DNS, chronic sinusitis from the CT scan of PNS.
3. To find out the incidence of CB in relation to nasal septal deviation.
4. To find out the incidence of CB in relation to chronic sinusitis.
5. To determine whether there is any statistical correlation of CB with DNS and chronic sinusitis.

**MATERIALS AND METHODS**
**Type of study:** A prospective observational case series study.
**Place of study:** Department of ENT, Silchar Medical College and Hospital.
**Study period:** One year, from August 2014 to July 2015

**Inclusion Criteria:**
- All the patients who attended the OPD with clinical features suggestive of DNS and/or Chronic Sinusitis.
- Coronal sections of the CT Scan of PNS were reviewed.
- Any deviation of the nasal septum from the midline was considered as DNS in the study.
- Paranasal Sinus Disease was considered as any amount of mucosal thickening in the paranasal sinus.
- Any type of pneumatisation of the middle turbinate (Concha Bullosa), Lamellar; Bulbous or Extensive, of any size, were included in the study.

**Exclusion Criteria:**
Patients below 13 years, Acute Sinusitis, any other anatomical variation or aberration of the
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nose, prior surgery of nose and/or PNS, faciomaxillary trauma, any growth in the nasal cavity or PNS, pregnant women.

**Study group:**
Comprised of 286 patients, ranging from age group of 13 to 65 years, with CT scan of PNS report showing one or more of the following findings - concha bullosa, nasal septal deviation, chronic sinusitis.

**Statistics:**
All data were evaluated in Microsoft Excel 2007. The results were analyzed by applying Chi-Square test and Pearson's Correlation Coefficient using Graph Pad and Social Science Statistics software. P value less than 0.05 was considered as statistically significant.

**RESULTS**
Of the 447 patients who were advised CT scan of PNS, 286 patients, with CT scan of PNS report who met the inclusion criteria, comprised the study group. 121 out of 286 CT scan of PNS showed presence of CB. Of the 121, 58 showed unilateral CB, 63 showed bilateral CB; of the 63, 27 showed one sided dominance. 182 CT scan of PNS of patients showed presence of DNS and 168 showed presence of PNS disease.

In the study group of 286 cases, there were 160 (56%) females and 126 (44%) males.
Distribution of CB found in the study were- Lamellar type=61(50%), Bulbous type=45(37%), Extensive type=15(13%). (Fig 3). Incidences of different sizes of CB were; Small=28(23%), Moderate=50(41%) and Large=44(36%). (Fig 4). The incidence of contralateral DNS and ipsilateral PNS disease was observed to be highest in bulbous type of CB(64.44%), followed by extensive type(60%), then lamellar type(33.43%); P>0.05. (Table VI). Likewise, the incidence of ipsilateral PNS disease was the highest in bulbous type of CB (68.89%), followed by extensive type(33.33%), then lamellar type(30.07%); P>0.05.(Table VII).

In the study group, the incidence of CB was more in females (68%), P< 0.05.( Fig 1). 33.88% of the patients with CB was in the age group of 26 to 35 yrs, followed by 16 to 25 yrs (27.27%), then 36 to 45 yrs(17.35%), then 46 to 55 yrs(9.09%), then 5 to 15 yrs(7.44%), then 56 to 65 yrs(4.96%); P > 0.5. (Table I)(Fig 2). Incidence of DNS in the study group was 67.77% and PNS disease was 63.64%.

In the study group, Unilateral or Dominant CB was present in 85 cases and absent in 201 cases, which included absence of CB and bilateral equal CB. Incidence of DNS in cases having Unilateral and Dominant CB is 69.41%, incidence of DNS in cases without CB is 61.19%, incidence of absence of DNS in cases with CB is 37.64%, incidence of DNS absence in cases without concha bullosa is 5.97%;
was evident that the incidence of DNS in the presence of Unilateral or Dominant CB was more in the contralateral side; P<0.00001. In relation to left unilateral/dominant CB, right contralateral DNS was 63.88% in comparison to left ipsilateral DNS (13.89%). Likewise in relation to right unilateral/dominant CB, left contralateral DNS was 67.34% in comparison to right ipsilateral DNS (16.32%). (Table III) Incidence of PNS disease from our study was 58.74%. Incidence of adjacent PNS disease in cases with CB is 47.93%, and without CB is 60.00%, incidence of absence of ipsilateral PNS disease with CB is 51.23% and without CB is 45.45%. P>0.05 and Correlation coefficient was found out to be -1, which implied that the relationship of PNS disease in presence of ipsilateral concha is statistically irrelevant. From the study, we also found a slight higher incidence of this relationship in females (53.45%); P>0.05(Table IV). It is observed that there is increased incidence of ipsilateral PNS disease in unilateral/dominant CB (23.53%) in comparison to contralateral PNS disease (4.70%). In bilateral equal CB however, there was found to be increased incidence of bilateral PNS disease (58.33%) in comparison to unilateral PNS disease (11.11%); P<0.00001 (Table V).

DISCUSSION
In our study, the incidence of CB is found to be 42.3%. There is, however, a wide reported incidence (14-66%) of CB as assessed by CT scan of PNS findings in available literatures.[2] This wide range is attributed to the difference in defining CB. Some authors have considered only aeration of the bulbous part of middle turbinate, some have also included the upper non-bulbous part of middle turbinate, while there are studies which considered aeration of at least 50% of vertical height of middle turbinate for defining CB.[1] In our study, the presence of CB was significantly more in females (67.77%), which is slightly higher than Kyle D Smith et al’s 58.9%. [2] Most of the patients with CB were scattered in the age group of 26 to 35 years (61.16%). The incidence of DNS from our study was 63.64%, which meets Stallman’s 65% and Sazgar’s 62.9% prevalences. [6] [12] The incidence of PNS disease from our study is 58.74%, in comparison to Bolger’s study (83.2%). [18] The incidence of contralateral DNS in presence of CB is 69.41%, and it was found out to be statistically relevant as supported by Jamie et al, Stammberger et al, Ozdemir Sevine et al. [1][17][12][7] However Uygur et al, Kyle D. Smith et al found no positive statistical relationship. [3][8] In our study, this relationship between CB and DNS showed a statistically significant female preponderance (62.71%). (Table II) Moreover contralateral DNS and ipsilateral PNS disease was predominant in bulbous type of CB (64.44%, 68.89%), and in large sized CB (86%, 72%), but both showed no statistical significance.(Table VI & VII) The incidence of ipsilateral paranasal sinus disease in presence of CB was 54.89%, seen slightly higher in females (53.45%), but the relation was not found to be statistically relevant. (Table IV). This negative statistical relationship is supported by Jamie et al and Kyle D. Smith et al. [2][12] A positive correlation was however found in Y.K Maru et al’s study. [15]

CONCLUSION
There exists a statistically positive relationship between unilateral or dominant CB and contralateral DNS, indicating that the presence of CB increases the possibility of the development of contralateral DNS or vice versa. However ipsilateral PNS disease in relation to concha bullosa has shown statistically insignificant results. There were certain limitations during our study such that many patients belonged to the lower socioeconomic strata and could not afford the CT scan of the PNS; some patients being lost to follow up and hence could not be advised the CT scan of PNS despite having significant clinical features. This limited the sample size of our study. Moreover, our statistical inference is attributable only to the symptomatic population who presented in our institution. No final
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...such a conclusion about the general population can be made from our study results. Although there are literatures which support our findings, there are certain studies which negate our study results. Such non-uniformity of results warrants further studies in this respect, probably with a larger study group and with definitive criteria of selection of the study group.

ACKNOWLEDGEMENT
We acknowledge the support of the Department of Radiodiagnostics, Silchar Medical College and Hospital for timely assistance in conduction and evaluation of the CT scan of PNS of the patients.

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Female</th>
<th>Male</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 – 15</td>
<td>4</td>
<td>5</td>
<td>9/121 (7.44%)</td>
</tr>
<tr>
<td>16 – 25</td>
<td>22</td>
<td>11</td>
<td>33/121 (27.27%)</td>
</tr>
<tr>
<td>26 – 35</td>
<td>28</td>
<td>13</td>
<td>41/121 (33.88%)</td>
</tr>
<tr>
<td>36 – 45</td>
<td>16</td>
<td>5</td>
<td>21/121 (17.35%)</td>
</tr>
<tr>
<td>46 – 55</td>
<td>8</td>
<td>3</td>
<td>11/121 (9.09%)</td>
</tr>
<tr>
<td>56 – 65</td>
<td>4</td>
<td>2</td>
<td>6/121 (4.96%)</td>
</tr>
<tr>
<td></td>
<td>82/121 (67.77%)</td>
<td>39/121 (32.23%)</td>
<td>121</td>
</tr>
</tbody>
</table>

Table I: Age and Sex Distribution of patients with Concha Bullosa

<table>
<thead>
<tr>
<th>U/L or Dominant Concha bullosa absent</th>
<th>No DNS</th>
<th>DNS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12/201 (5.97%)</td>
<td>Females</td>
</tr>
<tr>
<td></td>
<td>72/123 (58.54%)</td>
<td>51/123 (41.46%)</td>
</tr>
<tr>
<td></td>
<td>123/201 (61.19%)</td>
<td></td>
</tr>
<tr>
<td>U/L or Dominant Concha bullosa present</td>
<td>32/85 (37.64%)</td>
<td>Females</td>
</tr>
<tr>
<td></td>
<td>37/59 (62.71%)</td>
<td>22/59 (37.29%)</td>
</tr>
<tr>
<td></td>
<td>59/85 (69.41%)</td>
<td></td>
</tr>
</tbody>
</table>

Table II: Relationship of Contralateral DNS with Unilateral or Dominant Concha bullosa and the sex distribution

<table>
<thead>
<tr>
<th>No ipsilateral PNS disease</th>
<th>Ipsilateral PNS disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>No PNS disease</td>
<td>Contra PNS disease</td>
</tr>
<tr>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>No concha bullosa</td>
<td>75/165 (45.45%)</td>
</tr>
<tr>
<td></td>
<td>99/165 (60.00%)</td>
</tr>
<tr>
<td>Concha bullosa</td>
<td>51/121 (42.15%)</td>
</tr>
<tr>
<td></td>
<td>62/121 (51.24%)</td>
</tr>
</tbody>
</table>

Table IV: Relationship of ipsilateral Paranasal Sinus Disease with concha bullosa and the sex distribution
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Table V: Incidence of unilateral and bilateral PNS disease in unilateral/dominant concha bullosa, bilateral equal concha bullosa and no concha bullosa

<table>
<thead>
<tr>
<th>Concha bullosa</th>
<th>Unilateral PNS disease</th>
<th>Bilateral PNS disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ipsilateral</td>
<td>Contralateral</td>
</tr>
<tr>
<td>Unilateral and</td>
<td>20/85 (23.53%)</td>
<td>4/85 (4.70%)</td>
</tr>
<tr>
<td>Bilateral Dominant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilateral equal</td>
<td>4/36 (11.11%)</td>
<td>21/36 (58.33%)</td>
</tr>
<tr>
<td>No concha bullosa</td>
<td>99/165 (60%)</td>
<td>16/165 (9.69%)</td>
</tr>
</tbody>
</table>

Table VI: Incidence of contralateral DNS and ipsilateral PNS disease in different types of conchae

<table>
<thead>
<tr>
<th>Type of Concha</th>
<th>Contralateral DNS</th>
<th>Ipsilateral PNS disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamellar Concha (61)</td>
<td>21 (34.43%)</td>
<td>22 (30.07%)</td>
</tr>
<tr>
<td>Bulbous Concha (45)</td>
<td>29 (64.44%)</td>
<td>31 (68.89%)</td>
</tr>
<tr>
<td>Extensive Concha (15)</td>
<td>9 (60%)</td>
<td>5 (33.33%)</td>
</tr>
</tbody>
</table>

Table VII: Incidences of contralateral DNS and ipsilateral PNS disease in different sizes of conchae

<table>
<thead>
<tr>
<th>Size of Concha</th>
<th>Contralateral DNS</th>
<th>Ipsilateral PNS disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>6 (23%)</td>
<td>18 (11%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>35 (71%)</td>
<td>97 (58%)</td>
</tr>
<tr>
<td>Large</td>
<td>37 (86%)</td>
<td>121 (72%)</td>
</tr>
</tbody>
</table>

Figure 1: Pie chart showing sex distribution of Concha bullosa in the study group

Figure 2: Bar diagram showing age distribution of concha bullosa
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Figure 3: Bar diagram showing incidences of different types of CB

Figure 4: Showing incidences of different sizes of CB

Figure 5: A coronal section of CT scan of PNS showing right unilateral concha, with left sided DNS, and right sided maxillary and ethmoidal sinusitis.
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Figure 6: Coronal section of CT scan of PNS showing a right dominant concha with mucosal thickening in the right maxillary sinus.

Figure 7: Coronal section of CT scan of PNS showing bilateral equal conchae, with no DNS or paranasal sinus disease.

ABBREVIATIONS:
DNS - Deviated Nasal Septum
PNS - Paranasal Sinus
CT - Computed Tomography
CB - Concha Bullosa

BIBLIOGRAPHY
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