The study of Osteomeatal complex and its anatomical variations in Government Medical College and superfacility Hospital of Azamgarh

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Abstract
The present study was a hospital based study carried out in 50 patients in department of anatomy, otolaryngology and radiology of the government medical college and superfacility hospital Azamgarh U.P. The aim of this study to study the role of anatomical variations of osteomeatal complex in rhinosinusitis. Lateral nasal wall of each nasal cavity provides the final common pathway of drainage of mucociliary clearance of frontal, maxillary and anterior ethmoid air cells. Anatomical variants like concha bullosa, hallier cells, aggernasi cells, enlarged bulla ethmoidalis may obstruct the drainage pathway and cause rhinosinusitis. In our study computed tomography(CT) was done for assessment of paranasal sinuses, nasal fossae and their anatomical variants. Computed tomography offer detailed study of anatomical variation and it is invaluable tool for managing clinical decision and planning surgical strategies. It has become imperative for radiologist and clinicians to improve understanding of osteomeatal complex.

Keywords: Osteomeatal complex, Paranasal sinuses, Sinusitis, Anatomical variation, Medial body line,Computed tomography (CT).

Introduction
Throughout the history of medicine numerous attempts have been made to illuminate and examine the inside of various hollow cavities located within the body. The introduction of the endoscope as a tool to help sinus surgery along with philosophy of aerating and restoring mucociliary clearance has simulated interest in both anatomy and pathophysiology of paranasal sinuses(Jones 2002).(1) In the present study osteomeatal complex defined as a functional unit of anterior ethmoidal complex representing the final common pathway for drainage and ventilation of frontal, maxillary and anterior ethmoidal sinuses(Freitas & Boasquevisque 2008).(2) The blockade in the osteomeatal complex (OMC) leads to impaired drainage of maxillary, frontal and anterior ethmoid sinus thus causing rhinosinusitis. Dua et al.(2005)(3) reported that removal of disease in osteomeatal complex region is the basic principle of functional endoscopic sinus surgery(FESS), which is best appreciated on CT scan. The health and normal function of nose and paranasal sinuses and their lining mucus membrane depend primarily on two important features: Ventilation and drainage. Normal ventilation of paranasal sinuses requires both a patent ostium and a patent pathway (prechamber) connecting the ostium to nasal cavity (Tonai & Baba 1996). (4) Different type of anatomical variants of osteomeatal complex present distinct relation with either clinical or tomographical sinus disease. Main anatomical variants are middle concha bullosa, hallier and aggernasi cells, nasal septum deviation and enlarged ethmoidal bulla. Description of various anatomical variants of osteomeatal complex is main aim of our study. Stammberger and Hawke(1993)(5) have shown that CT examination of paranasal sinuses will provide an anatomic road map of paranasal sinuses to identify the significant anatomic abnormalities. Liu et al.(6) have demonstrate the greater the size of anatomical variants the higher the frequency of association with paranasal sinus mucosal alteration at CT.

Development and Anatomy of Paranasal sinus at CT: The development of paranasal sinuses starts early in the fetal period as nasal cavity invaginations. Only the maxillary and ethmoidal sinuses present at birth. The frontal and sphenoidal sinuses develop from first year of life (Dutra & Marchiori 2002)(7) and attained maturity up to the age of 12-14 years (Kronemer & Mcalister 1997),(8) (Scuderi et al 1993).(9) The ethmoidal cells pneumatization process may originate some variant cells like aggernasi, concha bullosa and hallier’s (Kronemer & Mcalister 1997, Scuderi et al 1993),(8,9) By the 63rd -70th day prenatal development six major furrows develop in the lateral nasal wall along with their corresponding folds called the ethmoturbinals. Stammberger 1991(10) divides these folds into two anatomical components, an anterior-ascending portion and posteroinferior- descending portion. The ascending portion remain as the aggernasi and descending portion of the first ethmoturbinal remain as uncinate process. Therefore on the embryological basis uncinate process is the basal lamella of first ethmoturbinal, ethmoid bulla evolve from second basal lamella and middle turbinate from third basal lamella. The nasal cavity is divided into right and left sides by osseo-cartilagenous nasal septum. The lateral nasal wall consist of superior, middle and inferior turbinates. The middle meatus is most
important with an opening – semilunar hiatus- which receives main drainage pathways from the paranasal
sinuses the drainage to this fissure is done by the frontal
sinus, through the frontal recesses, and the maxillary
sinus, through the infundibula, middle and anterior
ethmoidal cells. The semilunar hiatus and surrounding
structures together compose the osteomeatal complex
(Laine & Smoker) and obstruction of this narrow
region is a key factor in the development of chronic
sinusitis (Tonai & Baba, Isaacson, Zinreich). Hence presence of anatomical variations around
osteomeatal complex may adversely affect the drainage
and ventilation of frontal, maxillary and anterior
ethmoidal air cells causing rhinosinusitis, is the focus of
present study.

**Materials and Method**

The present study has been done in department of
anatomy, otolaryngology, and radiology of the
Government Medical College and Superfacility
hospital, Azamgarh, UP. This study was conducted
from November 2013 to October 2015. This study was
done on the coronal CT scan of the paranasal sinuses of
the 50 patients suffering from rhinosinusitis.
Informed consent was obtained from the patients. Following CT
scan, data was collected and analysed using software
for radiological measurements. CT scan was done with
single slice spiral computed tomographic scanner with
the slice thickness 2-5 mm. Table increment 3-4 mm in
each step and gantry angulation perpendicular to
orbitomeatal base line, kv peak 120 mA/s 150-200. The
data was collected in pretested semi-structured
questionnaire using software for radiological
measurements.

**Operational definitions:** Reference line in this study
was the medial body line (MBL) extending from lower
extent of crista galli to the base of nasal septum. Variations like concha bullosa, aggernasicells and
haller cells were measured from this reference line.

**Results and Observations**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Right bulla ethmoidalis</th>
<th>Left bulla ethmoidalis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance From MBL (mm)</td>
<td>5.42 0.03</td>
<td>5.43 0.04</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>6.9 0.22</td>
<td>7.02 0.3</td>
</tr>
<tr>
<td>Breath (mm)</td>
<td>6.31 0.3</td>
<td>6.32 0.26</td>
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<tr>
<td>Height (mm)</td>
<td>6.34 0.22</td>
<td>6.35 0.17</td>
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<tr>
<td>Volume (mm³)</td>
<td>148.01 10.18</td>
<td>149.66 7.67</td>
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<table>
<thead>
<tr>
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<td>4.70 0.56</td>
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<tr>
<td>Length (mm)</td>
<td>5.06 0.42</td>
<td>4.84 0.25</td>
</tr>
<tr>
<td>Breath (mm)</td>
<td>5.23 0.12</td>
<td>4.91 0.46</td>
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<tr>
<td>Height (mm)</td>
<td>6.91 0.22</td>
<td>6.31 0.25</td>
</tr>
<tr>
<td>Volume (mm³)</td>
<td>85.12 2.97</td>
<td>69.47 1.11</td>
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<table>
<thead>
<tr>
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<th>Right concha bullosa</th>
<th>Left concha bullosa</th>
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<td>2.31 0.17</td>
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<tr>
<td>Length (mm)</td>
<td>8.44 0.02</td>
<td>9.25 0.15</td>
</tr>
<tr>
<td>Breath (mm)</td>
<td>8.31 0.08</td>
<td>9.38 0.28</td>
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<tr>
<td>Height (mm)</td>
<td>10.40 0.28</td>
<td>10.32 0.18</td>
</tr>
<tr>
<td>Volume (mm³)</td>
<td>384.53 3.13</td>
<td>365.10 2.99</td>
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</table>

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Right Haller cell</th>
<th>Left Haller cell</th>
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<td>Distance From MBL (mm)</td>
<td>10.38 0.09</td>
<td>10.31 0.30</td>
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<tr>
<td>Length (mm)</td>
<td>6.32 0.27</td>
<td>6.20 0.21</td>
</tr>
<tr>
<td>Breath (mm)</td>
<td>4.23 0.09</td>
<td>4.15 0.17</td>
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<tr>
<td>Height (mm)</td>
<td>4.54 0.31</td>
<td>4.24 0.17</td>
</tr>
<tr>
<td>Volume (mm³)</td>
<td>66.33 0.19</td>
<td>66.22 0.20</td>
</tr>
</tbody>
</table>

Fig. 1: Coronal CT slice at the level of osteomeatal complex showed bulla ethmoidalis (arrow)

Fig. 2: Coronal CT slice at osteomeatal complex level showed aggernasicells(A)
Clinically 77% of study population had presenting symptoms of sneezing 58% and 37% had presenting the symptom of rhinorrhea and headache respectively. Among 50 studied patients, 14% have concha bullosa, 12% have paradoxical middle concha, 20% have haller cells, 16% have aggernasi cells.

In this study population, bulla ethmoidalis, which is formed by pneumatisation of bulla lamella, or second ethmoid basal lamella and is like a bleb on lamina Stammberger et al.1995(14) and it is described in Table 1. The mean distance of right bulla ethmoidalis from MBL is 5.42 mm with standard deviation of 0.03. The mean distance of left bulla ethmoidalis from MBL is 5.43 mm with Standard deviation of 0.04. Mean length, breath, height and volume of right bulla is 7.02 mm, 6.32 mm, 6.35mm and 149.66mm^3. In the Fig 1 coronal CT slice at the level of osteomeatal complex showed bulla ethmoidalis (arrow).

Aggernasi cell, which is the most anterior ethmoidal cell, represents the pneumatisation of lacrimal bone due to ethmoidal extension. Table 2 shows dimensions of aggernasie cell. It shows mean length, breath, height and volume of right aggernasi cell to be 5.06mm, 5.23mm, 6.91mm and 85.12 mm^3 respectively. The distance from MBL is 4.78mm. In Fig 2 coronal CT slice at osteomeatal complex level showed aggernasi cells(A). The mean length, breath, height and volume of left aggernasi cell is 4.84mm, 4.91mm, 6.31mm and 69.47 mm^3 respectively. Mean distance from MBL is 4.7 mm.

The concha bullosa is the pneumatized middle turbinate. Its dimensions are noted in Table 3. It shows length, breath, height and volume of right concha bullosa to be 8.44m, 8.31mm, 10.40mm and 384.53 mm^3 respectively. Its distance from MBL is 1.33 mm. The length, breath, height and volume of left concha bullosa is 9.25mm, 9.38mm, 10.32mm and 265.10 mm^3. Its distance from MBL is 2.31 mm. In Fig 3a coronal CT slice showed concha bullosa (arrow) and Fig 3b showed paradoxical concha(arrow).

Haller cells are the cells which grow in bony orbital floor constitute the roof of maxillary sinus. Zinreich et al(15) and Kennedy et al(16) described haller cells as ethmoid air cells inferior to ethmoid bulla adhering to roof of maxillary sinus in continuity with the proximal infundibulum. They are considered asethmoid cells that grow into floor of orbit and may narrow the ostium of the maxillary sinus especially if they become infected (Lloyd et al).17 Table 4 shows dimensions of haller cells. It shows length, breath, height and volume of right haller cell to be 6.32 mm, 4.23mm, 4.54mm and 66.33 mm^3 respectively. Distance from MBL is 10.38 mm. The length, breath, height and volume of left haller cell is 6.20mm, 4.15mm, 4.24mm and 66.22 mm^3 respectively. Distance from MBL is 10.31 mm. In Fig 4 coronal CT slice at osteomeatal complex level showed haller cells( ).

Discussion
The role of anatomical variants in the rhino sinusitis pathogenesis can be evaluated by comparison between prevalence in populations with sinusopathy and prevalence in population free from sinusinal problems.

Osteomeatal complex is the final common pathway for the drainage and ventilation of frontal, maxillary and anterior ethmoidal cells. Various anatomical variants like enlarged bulla, aggernasi cells, concha bullosa and haller cells compromise this pathway leading to pathogenesis of rhinosinusitis.
In the present study, 77% patients presented with the symptom of sneezing, 58% with rhinorrhea and 37% with headache. Tonai and Baba\(^4\) showed that 76% of the study population in their study was symptomatic (having chronic sinusitis), but Bolger et al\(^{18}\) stated that 82% of study subjects were symptomatic. 18% were asymptomatic or those who were non-sinus symptoms.

Concha bullosa (pneumatised middle turbinate) causes negative influence on paranasal sinus ventilation and mucociliary clearance in middle meatus region, result in development of recurrent chronic sinusitis. In our present study, conchal bullosa has been found in right side in 10% study population and on left side in 6% population. In 6% cases, it was found on both sides. Total number of concha bullosa in this study was 14%, which was similar to the findings of Mamatha et al\(^{19}\) and Lloyd\(^{20}\) who found 15 and 14% of their study population having concha bullosa.

Presence of agger nasi cells may obstructs the drainage pathway of frontal sinuses. In this study, we found 16% of the study population showing agger nasi cells, which is similar to the study by Riello and Boasquevisque\(^{21}\) and Wani et al\(^{22}\) who findings were 13.5% and 9.33% cases.

The prevalence of hallér’s cells in our study was found to be 18% of study population. Similar findings were observed by Mamatha et al\(^{19}\) documented 17.5% cases in their study population.

**Summary and Conclusion**

According to Nassar et al\(^{23}\) many factor are responsible for genesis of rhinosinusitis and the physiological factor (mucociliary clearance disorder) is as important as mechanical obstruction factor. Different variants of osteomeatal complex compromise the pathways of mucociliary clearance. Assesment of anatomical variants in coronal CT scan of paranasal sinus is of utmost important in surgical treatment of rhinosinusitis.

**Recommendations**

Study of CT scan of Paranasal sinus in coronal and axial section is very much informative for the surgical as well as medical intervention in treatment of rhinosinusitis. It further helps otolaryngologists in performing functional endoscopic sinus surgery.

**References**