Clinical Significance of Anatomical Variations in Ostiomeatal Complex As Detected By MDCT

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Abstract
Infections involving paranasal sinuses and nasal cavities is one of the common public health problem in all age groups. Functional endoscopic sinus surgery has revolutionized in the treatment of sinusitis. MDCT has been the most ideal investigation in the assessment of paranasal sinuses especially in the identification of various anatomical variations that predispose to development of sinus infection. The present study was done to detect the presence of significant anatomical variations in the ostiomeatal complex, the main drainage point of sinus in 300 symptomatic patients.

Keywords- ostiomeatal complex, anatomical variations, sinusitis

Introduction
OMC is the most important drainage route for the paranasal sinuses in the skull of which the anterior OMC is the major draining ostia, as it drains the maxillary sinus, frontal sinus, anterior part of ethmoidal sinus whereas posterior OMC drains posterior part of ethmoid and sphenoid sinus. The components that form OMC are maxillary ostium, ethmoidal infundibulum, anterior ethmoidal air cells, frontal recess. Various anatomical variations in the development of these structures critically affect the drainage of sinuses resulting in recurrent sinus infections. Besides the OMC other structures that form the lateral wall of nasal cavity also aid in the development of sinusitis.

The major anatomical variations that predispose to development of sinus infections are uncinate process anomalies, pneumatization/concha, haller air cell expansion and giant ethmoidal bulla.

Materials and Methods
A retrospective analysis of the coronal CT scan images of paranasal sinus was done in 300 patients who are referred with clinical diagnosis of sinus disease. CT scan was performed on 16 slice MDCT Evanto 16 of semens ltd at 1mm thin coronal images.
The main anatomical points that were consider in the study include 1) uncinate process 2) nasal turbinate or concha 3) nasal septum 4) ethmoidal air cell variants.

Discussion
MDCT is the most essential imaging in the detect nasal cavities and paranasal sinuses (1,2,3,4,5). OMC is the main anatomical unit that aids in the drainage of paranasal sinuses. The structures included in OMC are maxillary sinus ostium, infundibulum, middle meatus complex, anterior and middle ethmoidal air cells osea and frontal recess (6). Precise anatomy of the OMC is very crucial in performing the Functional endoscopic sinus surgery in patients presenting with recurrent and persistent sinusitis. Many significant anatomical variations in the development of OMC have been described in the literature, which are responsible for the recurrence of sinus infection due to obstruction to mucociliary clearance. According to different studies reported the most frequent anatomical variation being concha bullosa (7,8,9) followed by deviated uncinate process (10), deviated nasal septum (11,12,13) and paradoxical thickened middle turbinate (14).

The most frequent anatomical variation involving uncinate process, concha, ethmoidal infundibulum of which uncinate process anomalies are the most common type seen in sinusitis (15). The variations in the uncinate process include a) elongation b) medial deviation c) lateral deviation d) pneumatization e) spur f) absent uncinate process. Elongation of uncinate process is the most common anomaly of uncinate process followed by pneumatization. Pneumatization of concha also called as concha bullosa is also relatively common anomaly usually involves the middle turbinate. Expanded concha bullosa compresses the uncinate process and narrows the ethmoidal infundibulum. Other anomalies of turbinate that similarly affect the ethmoidal infundibulum including accessory turbinate, duplicate turbinate, paradoxical turbinate and giant ethmoidal bulla, expanded haller air cells. Deviated nasal septum is one of the common clinical problem seen in sinusitis. DNS results in compensatory hypertrophy of turbinate and bulla on opposite side.

Uncinate process is one of the most important structure in the nasal cavity as various types of anatomical variations has been documented in the literature (16,17,18,19). After uncinate process the next most important bone structure that shows developmental variation is turbinate or concha, though all the different variation may not result in nasal obstruction. Concha bullosa/pneumatization of the concha is the most frequent variation noted in major studies (20), involving middle concha mostly, also can occur in superior, inferior concha. Pneumatization of concha is classified into lamellar, bulbous and extensive depends on the location of pneumatization (21). We found no significant relationship between sinus disease and a type of concha bullosa. Besides the common pneumatized turbinate (22), often found bilateral paradoxical superior turbinate, unilateral paradoxical inferior turbinate, unilateral accessory middle turbinate. Pneumatization of multiple turbinate was reported (20). Extremely rare cause of anomalies like septal concha bullosa (23), absent middle turbinate also reported (24).

A strong association has been reported between the presence of concha bullosa and contralateral deviation of nasal septum with no significant increase in incidence of sinus disease (25).

In the present retrospective study of CT imaging of paranasal sinuses in 300 patients all age groups were covered.

<table>
<thead>
<tr>
<th>Age distribution</th>
<th>0-10</th>
<th>11-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-60</th>
<th>61-70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>4</td>
<td>36</td>
<td>111</td>
<td>89</td>
<td>37</td>
<td>16</td>
<td>7</td>
</tr>
</tbody>
</table>
Males are more frequently affected than females.

The most frequent anomaly noted was nasal septal deviation 226 out of 300 (75%) followed by anomalies of middle turbinate

<table>
<thead>
<tr>
<th>List of anomalies</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>septum</td>
<td>226</td>
</tr>
<tr>
<td>Turbinate</td>
<td>153</td>
</tr>
<tr>
<td>Uncinate process</td>
<td>119</td>
</tr>
<tr>
<td>Giant ethmoid</td>
<td>62</td>
</tr>
<tr>
<td>Haller cells</td>
<td>20</td>
</tr>
</tbody>
</table>

The nasal septal deviation to either side was more or less equal.

**Septal anomalies**

<table>
<thead>
<tr>
<th>Right</th>
<th>85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>72</td>
</tr>
<tr>
<td>Right with spur</td>
<td>26</td>
</tr>
<tr>
<td>Left with spur</td>
<td>23</td>
</tr>
<tr>
<td>S shape</td>
<td>20</td>
</tr>
</tbody>
</table>

Pneumatization is the most frequent anomaly noted in middle turbinate (33%). In 5 patients superior turbinate showed pneumatization which was extremely rare finding. In one case middle turbinate was absent. In 44 cases pneumatization or hypertrophied turbinate was associated with contralateral deviation of nasal septum.

<table>
<thead>
<tr>
<th>Middle turbinate pneumatization</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paradoxical turbinate</td>
<td>27</td>
</tr>
<tr>
<td>Hypoplastic turbinate</td>
<td>26</td>
</tr>
<tr>
<td>Superior turbinate pneumatization</td>
<td>5</td>
</tr>
<tr>
<td>Absent middle turbinate</td>
<td>1</td>
</tr>
</tbody>
</table>

Medial or lateral deviation of uncinate process was with equal incidence in some patients.

**Uncinate process anomalies**

<table>
<thead>
<tr>
<th>Medial</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral</td>
<td>39</td>
</tr>
<tr>
<td>Elongated</td>
<td>18</td>
</tr>
<tr>
<td>Pneumatization</td>
<td>17</td>
</tr>
<tr>
<td>Absent</td>
<td>5</td>
</tr>
</tbody>
</table>

Expanded ethmoid sinus or bulla also causes narrowing of ethmoidal infundibulum by displacing the uncinate process laterally. In our study we found 62 cases of giant ethmoidal bulla (20.6%) compromising OMC. M

Air cells seen at inferomedial wall of orbit also called as haller air cells also block the maxillary sinus ostium. We found 20 cases of haller air cells (6.6%) obstructing or displacing the uncinate process.

The incidence of various anatomical variations in our study was almost as par with other similar studies done previously.

Precise anatomical evaluation or detection of variations was found with MDCT using thin sections. These type of anomalies before planning functional endoscopic sinus surgery will result in precise patient care or management by avoiding complications during surgery.

CT coronal imaging showing Septal spur to right side

CT coronal imaging showing Bilateral concha bullosa
CT PNS coronal imaging showing Congenital absence of left middle turbinate

CT PNS coronal imaging showing bilateral medial deviation of uncinate process

CT PNS coronal image showing Right pneumatized uncinate

CT PNS coronal image showing bilateral elongated Uncinate process

CT PNS coronal image showing Bilateral giant ethmoid bullae

CT PNS coronal image showing bilateral elongated Uncinate process

CT PNS coronal imaging showing left haller cell.
Conclusion
MDCT is most valuable in the evaluation of paranasal sinus in patients with sinusitis before contemplating functional endoscopic sinus surgery.

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