Original Research Article

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A CT and DNE study of osteomeatal complex variations and their correlation in chronic rhinosinusitis patients

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ABSTRACT

Background: CRS is a global burden reducing the productivity at work. This study was done to evaluate the occurrence of anatomical variations of osteomeatal complex (OMC) and to assess its relation in causation of chronic rhinosinusitis in the study population.

Methods: A 100 patients diagnosed with CRS in the outdoor of Dept. Of ENT between November 2012 – November 2015 were subjected to CT Imaging and DNE and the frequency of anatomical variations and involvement of paranasal sinuses were evaluated. The correlation between them was established using chi-square test.

Results: Agger nasi cells were the most common variant seen in 73 (73%) patients with 12% being unilateral and 61% bilateral. Other variants seen were: deviated nasal septum in 68%, uncinate process variations in 58%, concha bullosa in 30%, enlarged bulla ethmoidalis in 25%, paradoxical middle turbinate in 18%, haller's cells in 6% and accessory maxillary ostia in 2%. We could establish a correlation between a few of these variants and the affected sinuses.

Conclusions: The importance of CT and nasal endoscopy is emphasized in patients with persistent symptoms to identify the anatomical variations that may contribute to the development of chronic sinus mucosal disease.

Keywords: Chronic rhinosinusits, Osteomeatal complex, Anatomical variations, CT scan, DNE

INTRODUCTION

Chronic rhinosinusitis (CRS) is a common disease affecting over 30 million individuals globally each year with more than 200,000 people annually requiring surgical intervention.1

The criteria of Rhinosinusitis Task Force of AAO-HNS to define and diagnose chronic sinusitis is, presence of two or more major factors or one major and two minor

factors and duration for >12 consecutive weeks or >12 weeks of physical findings. Importantly, the sinus and allergy health partnership (SAHP) 2003 also incorporates CT imaging of the sinuses and endoscopy for confirming the diagnosis. The clinical diagnosis of chronic sinusitis is somewhat difficult, due to difficulty in defining the disease and a variety of presenting signs and symptoms.²

Patency of pathways through which the sinuses drain is crucial for adequate mucociliary function and subsequent

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sinus drainage.³ Stammberger and Kennedy define osteomeatal complex as a functional unit of the anterior ethmoid complex representing the final common pathway for drainage and ventilation of the frontal, maxillary and anterior ethmoid sinuses.⁴

OMC is a narrow anatomical region consisting of middle turbinate, uncinate process, bulla ethmoidalis, frontal recess, ethmoidal infundibulum, middle meatus, and anterior ethmoidal, maxillary and frontal sinus ostia. The coronal plane best shows the osteomeatal unit, relationship of the brain to the ethmoids roof and correlates closely with the surgical orientation, thus is the primary imaging orientation for evaluation in all patients with inflammatory sinus disease. Nasal endoscopy combined with CT has made the approach to sinonasal disease more specific, rational and accurate. The normal OMC is visualized on 2 or 3-mm thick coronal CT section.

Messerklinger reported that infundibulum and middle meatus were the most common sites influenced by anatomic variation of OMC and Stammberger found that more than 90% of this disease is caused by anatomic variation of OMC. The keystone of functional endoscopic sinus surgery is the ability to accurately treat even minor changes in OMC. CT scan and nasal endoscopy provides the ability to accurately access this area for evidence of localized disease or any anatomic defect that compromises ventilation and mucociliary clearance.

The present study was aimed at studying the anatomical variations of osteomeatal complex and their role in causation of chronic rhinosinusitis in patients attending the outdoor of Dept. of ENT, Govt. Medical College and Rajindra Hospital, Patiala.

METHODS

A total of 100 adult patients, who attended the outdoor between November 2012 – November 2015 with symptoms of nasal discharge, obstruction, headache, post nasal drip, facial pain, hyposmia or anosmia were included in the study. Patients with alteration in paranasal sinus anatomy due to facial trauma, tumors, previous sinus surgery, nasal mass, acute infection or bleeding disorders were excluded.

The scanning was done with patient placed prone with head in extension. Scan was done from the nasion to the posterior extent of sphenoid. 3mm thick coronal films were taken to study both bone and soft tissue window. For DNE, patient was tested for xylocaine sensitivity, placed in supine position with head end raised 30 degrees and procedure was performed with 0 or 30 degrees endoscope using the standard three pass technique.

The results obtained were analyzed using the chi-square test. P value was calculated to check for any significant correlation between the anatomical variation and sinus involved.

RESULTS

Majority of patients were found in 18-24 years of age group (29%) with males dominating the study (M:F = 1.7:1). 70% of the patients had symptoms for a duration of 1-5 years. Headache was the most common symptom (85%) followed by post nasal drip (80%) in Table 1. Incidence of various anatomical variations is shown in Table 2.

Percentage **Symptoms** No. of patients Headache 85 85% Post nasal drip 80 80% Anterior nasal discharge 72 72% Nasal obstruction 54 54% Hyposmia 20 20%

Table 1: Prevalence of symptoms.

Table 2: Incidence of anatomical variations.

Anatomical variation	Unilateral		Bilateral		Total	
	No. of patients	%	No. of patients	%	No. of patients	%
Agger Nasi Cell	12	12	61	61	73	73
Deviated Nasal Septum	-	-	-	-	68	68
Uncinate process variations	17	17	41	41	58	58
Concha Bullosa	26	26	4	4	30	30
Enlarged Bulla Ethmoidalis	18	18	7	7	25	25
Paradoxical Middle Turbinate	12	12	6	6	18	18
Haller's Cells	6	6	-	-	6	6
Accessory Maxillary Ostia	2	2	-	-	2	2

Table 3: Incidence of mucosal hypertrophy on CT scan.

Diseased area	Unilateral		Bilateral		Total	
	No. of Patients	%	No. of Patients	%	No. of Patients	%
Osteomeatal complex	40	40	48	48	88	88
Maxillary sinus	41	41	47	47	88	88
Anterior ethmoids	30	30	37	37	67	67
Posterior ethmoids	25	25	25	25	50	50
Frontal sinus	15	15	25	25	40	40
Sphenoid sinus	7	7	13	13	20	20%

Table 4: Stastically significant correlation between anatomical variations and sinusitis

Anatomical variation	Sinusitis	P value
Concha bullosa	Maxillary sinusitis	0.0006 (<0.05)
Medial rotation of uncinate process	Anterior ethmoid sinusitis	0.0001 (<0.05)
Agger nasi cells	Frontal sinusitis	0.0001 (<0.05)
Paradoxical middle turbinate	Maxillary sinusitis	0.0034 (<0.05)

Osteomeatal complex and maxillary sinus were the most frequently involved regions seen in 88% patients each (Table 3). This was followed by anterior ethmoids, posterior ethmoids, frontal sinus and lastly the sphenoid sinus. Statistical correlation between the anatomical variations of OMC and the sinus affected is shown in Table 4. The incidence of variations on DNE was same as that on CT scan except for deviated nasal septum which increased to 70% cases.

DISCUSSION

Instructive role of CT scan in guiding surgeons intraoperatively cannot be over-emphasized. It is like a road map, which is very handy for nasal endoscopic surgeons, not only for uneventful surgery but for avoiding possible complications. CT scan clearly shows the fine bony anatomy of the osteomeatal complex. Anatomic variations of paranasal sinus structures may predispose patients to recurrent rhinosinusitis and in selected cases, to headache. However, the relative importance of anatomic variations is still a matter of discussion and variable results have been reported.

The study included patients in the age group of 18-66 years with maximum cases (29%) in the 18-24 group. Males dominated the study population at 63%. This correlates well with studies by Wani et al, Sheetal et al and Gupta et al. ^{6,10,11}

Agger nasi cells (Figure 1) are present in the area anterior and superior to the insertion of middle turbinate and it's relationship on CT is essential for diagnosis of chronic frontal sinusitis. It was found in 73% patients and it's prevalence varies widely in studies by different authors i.e. Stoney et al, Dua et al, Midilli et al, Leunig et al, Wani et al, Gupta et al and Kaygusuz et al at 15%, 40%, 80.4%, 80%, 9.3%, 68, 8% and 64.6% respectively. 6.11-16

Nasal septum isn't a part of osteomeatal complex, but marked deviation causes a decrease in critical area of the OMC. Mere presence of septal deviation doesn't suggest pathology. It was seen in 68% patients in our cases. It correlates well with studies by Dua et al, Cagici et al, Mamatha et al, Gupta et al, Biswas et al and Kaygusuz et al in 72.3% patients.44%, 52%, 65%, 65.2%, 78% and 72.3% respectively. ^{11,13,16-19}

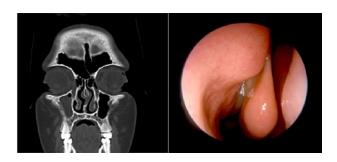


Figure 1: Agger nasi cell (A-CT picture, B-DNE picture).

DNE reported it in 70% cases. The cartilaginous septal deviation is often missed on CT scan is inferred from our study.

Uncinate process is a key bony structure of lateral wall of nasal cavity. Lateral deviation causes narrowing of semilunar hiatus and infundibulum, medially deviated makes contact with middle nasal meatus, threatening it's permeability. 200 sides were studied and 170 could be assessed. Typical in 35% sides, medially rotated in 32%, laterally rotated in 15%, hypoplastic in 2% and pneumatised in 1% sides. Mamatha et al found medially rotated uncinate in 25% and was closest to our study. Fadda et al and Krzeski et al showed a presence of laterally rotated uncinate in 21.4% and 9.5% respectively. The study by Arslan et al found pneumatisation in 2% and correlates well with ours. 22

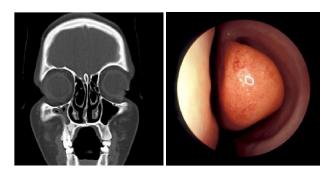


Figure 2: Concha bullosa (A-CT picture, B-DNE picutre).

Concha bullosa (Figure 2) is a ballooned out middle turbinate that can cause blockage of middle meatus entrance and hence sinus disease. It's prevalence varies due to differing opinions regarding degree of pneumatisation. Our study found it in 30% patients which coincides with the studies of Arslan et al and Wani et al. 6,22 Paradoxical middle turbinate is a reversal of normal outward concavity of middle turbinate and can cause alteration in nasal airflow dynamics. It was found in 18% patients similar to a study by Al-Qudah. 23



Figure 3: Deviated nasal septum (A-CT picture, B-DNE picture).

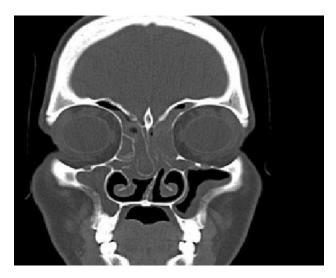


Figure 4: Bilateral blocked OMC (CT picture).

Haller's cells also called as the infraorbital ethmoidal cells, can cause narrowing of maxillary sinus ostium or

infundibulum, predisposing to recurrent maxillary sinusitis. It's prevalence varies widely and was seen in 6% patients. Bolger et al, Arslan et al and Wani et al found them in 45.1%, 6% and 8.66% respectively. 6,22,24 The nasal fontanelles are sites for accessory ostia of maxillary sinus and were seen in 2% patients. Mamatha et al reported them in 22.5% cases. 18

Osteomeatal complex (Figure 4) and maxillary sinus were the most commonly involved i.e. in 88% patients. Mamatha et al, Fadda et al and Madani et al correlated well with our study showing maxillary sinus to be the most common sinus involved. 18,20,25

Fadda et al observed in their study, statistical correlation between concha bullosa and maxillary sinusitis, between medial deviation of uncinate process and anterior ethmoid sinusitis, between agger nasi cells and frontal sinusitis and between septal deviation and maxillary sinusitis. These correlations are similar to the ones found in our study.

CONCLUSION

The various anatomical variations with their clinical significance have been described. The variations in frequencies with studies by certain authors could be a result of different genetic and environmental factors. More studies with a larger number of patients are required to further review this. The significance of variations is that they impair normal drainage pathway, hinder endoscopic access to distal areas and increase the risk of endoscopic mishaps. Hence, the importance of CT scan and nasal endoscopy is emphasized in patients with persistent symptoms to identify the anatomical variations that may contribute to the development of chronic sinus mucosal disease.

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