Section: ENT

Original Research Article

ANATOMICAL VARIATION OF OMC IN CRS PATIENTS

Madurya Gowr B M[1], K N Satish Kumar[2], Samatha K J[3]

[1]*Junior Resident, Department of Ear, Nose and Throat (ENT), Mysore Medical College and Research Institute, Mysuru, Karnataka, India.*
[2]*Professor, Department of Ear, Nose and Throat (ENT), Mysore Medical College and Research Institute, Mysuru, Karnataka, India*
[3]*Assistant Professor, Department of Ear, Nose and Throat (ENT), Mysore Medical College and Research Institute, Mysuru, Karnataka, India*

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Corresponding Author:
Dr. Samatha K J,
Assistant Professor, Department of Ear, Nose and Throat (ENT), Mysore Medical College and Research Institute, Mysuru, Karnataka, India.
Email: samathakj@gmail.com

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ABSTRACT

Background: The aim is to Identify specific anatomical variations of osteomeatal complex and its importance when considering as an etiological factor for chronic sinusitis.

Materials and Methods: The present study is a prospective, cross sectional observational study done in patients presenting with features of symptomatic Chronic Rhinosinusitis to ENT Department at Krishna Rajendra Hospital, Mysore.

Results: In our study we saw the association between various sinusitis and the anatomic variations of theostiomeatal complex and we found that concho bullosa, enlarged bulla ethmoidalis, and paradoxical middle turbinate found to have a strong significant association with maxillary sinusitis and anterior sinusitis.

Conclusion: Chronic Rhinosinusitis is more common in the age group of 21 to 30. There is a male preponderance among the patients of chronic rhinosinusitis. The most commonly effected sinus in chronic sinusitis was found to be maxillary sinus.

Keywords: Rhinosinusitis, prospective, cross sectional observational study, sinusitis.

INTRODUCTION

The term “sinusitis” refers to a group of disorders characterized by inflammation of the mucosa of the paranasal sinuses. Chronic rhinosinusitis occurs when the duration of symptoms is greater than 12 weeks.[1]

Chronic rhino sinusitis (CRS) is a very common condition in ENT practice affecting approximately 1/6th of the Indian population. The National Institute of Allergy and Infectious Diseases (NIAID) estimated that 1in 8 Indians suffer from CRS and this disease is more widespread than diabetes, asthma or coronary heart disease.[1] The chronic nature and the debilitating symptoms of the disease are a cause of significant morbidity in CRS patients and greatly impair their quality of life.[2]

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. 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. Haller’s cell, pneumatization of agger nasi cell, a pneumatised and or medialized uncinate process, paradoxical middle turbinate and enlarged ethmoidal bulla. However, their roles in pathogenesis of rhinosinusitis are still unclear.[2]

CT scan and nasal endoscopy are preferred diagnostic modalities to determine the mucosal abnormalities and bony anatomic variations of paranasal sinus and assess the possible pathogenicity of these findings in patients undergoing evaluation for sinusitis. 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.[2]

Anatomical variations like nasal septal deviations, concha bullosa, paradoxical middle turbinate, pneumatized or medially bent uncinate etc. can

encroach upon the Osteomeatal unit and narrow oseiomeatal channels. This leads to impaired drainage and dysventilation of the paranasal sinuses which are primary predispositions for development of sinusitis. Some less common variations like presence of haller cell, onodi cell can also hinder sinus drainage and contribute to the development of sinusitis. Surgical clearance of these chronically infected sinuses while maintaining their ventilation and drainage is the treatment of choice. To achieve this goal, there should be some diagnostic modalities which guide us towards exact diagnosis and safe intervention. 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.[2]

MATERIALS AND METHODS

The present study is a prospective, cross sectional observational study done in patients presenting with features of symptomatic Chronic Rhinosinusitis to ENT Department at Krishna Rajendra Hospital, Mysore.

The study was conducted on 113 patients presenting with features of symptomatic Chronic Rhinosinusitis presenting to the outpatient department and fulfilling the inclusion and exclusion criteria during the period from 1st September 2022 to 29th February 2024 after taking informed consent. Institutional Ethical Committee Clearance was obtained before the commencement of the study.

Inclusion Criteria

1. Patient's age between 18 to 75 years
2. Patients giving consent
3. Patients fulfilling EPOS criteria for Chronic sinusitis

Exclusion Criteria

1. Patients with facial trauma and nose and paranasal tumors
2. Patients with history of previous sinus surgery

Detailed Steps of The Study

1. History and clinical examination: All patients who were being included in the study after taking informed consent were subjected to a thorough history taking and complete ENT examination.
2. Anterior Rhinoscopy: All patients underwent anterior rhinoscopy examination after taking informed consent.
3. Diagnostic nasal endoscopy (DNE): All patients aged >18 years and <75 years underwent DNE using 0° rigid endoscope. Patients were explained about procedure and consent was taken. Prior to procedure, nasal decongestion and anaesthesia was achieved by packing the nasal cavity with 4% lignocaine combined with 1:1,00,000 adrenaline. Endoscopic evaluation was done using a three – pass technique.

First pass – Endoscope passed along the nasal floor to visualise the septum, inferior turbinate, nasopharynx (eustachian tube orifice, fossa of Rosenmuller). Any mucopurulent post nasal drainage was noted.

Second pass – Endoscope passed medial to the middle turbinate to visualise sphenoethmoid recess, superior turbinate and sphenoid ostium.

Third pass – Endoscope was passed into the middle meatus to visualize mucopurulent discharge, polyp, accessory ostia or other pathology if any.

4. CT Nose and PNS: Performed in all patients to confirm the diagnosis and find anatomical variations of osteomeatal complex .

Patient data was entered into a proforma for further statistical analysis.

Statistical Method: Data was captured in MS Excel and analyzed using SPSS version 25.0.Data was represented in the form of descriptive statistics (proportions, percentages, bar graphs and pie charts).

Sample Size Estimation:

Sample size:

Sample size, n is calculated using the formula: n=z2pq/d2 where p is the prevalence of chronic sinusitis. According to previous records p= 5-12% i.e p=8% q=1-p i.e., 92% d=level of precision in terms of absolute error i.e. 5% z=standard normal variate for

5% alpha error i.e. 1.96 Therefore, n=113

RESULTS

A cross sectional study of 113 patients with features of symptomatic Chronic Rhinosinusitis was undertaken.

Table 1: Age and gender wise distribution of the study subjects.

Age group (yrs)	Gender		Total (%)
	Male (%)	Female (%)	
10–20 y	12 (18.5)	6 (12.5)	18 (15.9)
21–30 y	19 (29.2)	12 (25)	31 (27.4)
31–40 y	12 (18.5)	11 (22.9)	23 (20.4)
41–50 y	8 (12.3)	9 (18.8)	17 (15)
51-60 y	11 (16.9)	5 (10.4)	16 (14.2)
>60 y	3 (4.6)	5 (10.4)	8 (7.1)
Total	65 (100)	48 (100)	113 (100)
Mean ± SD	35.47±14.44	38.18±14.80	36.62±14.6

In this study, the age of patients ranged from 18 to 75. The commonest age group to have symptomatic

chronic rhinosinusitis was 21 – 30 years. And the least common age group was above 60 years. Out of which 65 were male and 48 were female.

Age distribution in relation to sex: In this study, 18 patients in the group of < 20 years included 12 males(18.5%) and 6 females (12.5%), followed by 31 patients in the group 21-30 years included 19 males (29.2%) and 12 females (25%) and 23 patients in the group of 31-40 years included 12 males (18.5%) and 11 females (22.9%). 17 patients were in the group of 41 – 50 years which included 8 males (12.3%) and 9 females (18.8%) and 16 patients in the group 51-60 years included 11 male (16.9%) and 5 female (10.4%). 8 patients were > 60 yrs old 3 males(4 . 6 %) and 5 females(10 . 4 %) . youngest patient was 18 yrs old and oldest was 73 yrs old.

Table 2: Distribution of the various Symptoms presented among the study subjects (n=113).

Symptoms	Frequency	Percentage (%)
Nasal obstruction	111	98.2
Nasal discharge	85	75.2
Headache	77	68.1
Postnasal drip	32	28.3
Hyposmia	3	2.7
Facial pain	58	51.3
Facial pressure	59	52.2

Among 113 study subjects 111(98.2%) patients presented with nasal obstruction, 85(75.2%) presented with nasal discharge, 77(68.1%) patients presented with headache, 32(28.3%) patients presented with postnasal drip, 3(2.7%) patients presented with hyposmia, 58(51.3%) patients presented with facial pain, 59(52.2%) patients presented with facial pressure.

Table 3: Distribution of the study subjects based on their presence of sinusitis.

Sinusitis	Frequency (n=113)	Percentage (%)
Maxillary sinusitis	106	93.8
Frontal sinusitis	71	62.8
Anterior ethmoid sinusitis	87	77.0
Posterior ethmoid sinusitis	64	56.6
Sphenoid sinusitis	39	34.5

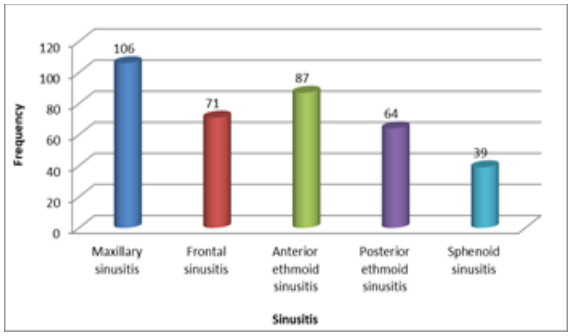

Figure 1: Distribution of the study subjects based on their presence of sinusitis.

Among 113 patients, 106(93.8%) patients was found to have maxillary sinusitis, 71(62.8%) patients was found to have frontal sinusitis, 87(77%) patients was found to have anterior ethmoidal sinusitis, 64(56.6%) patients presented with posterior ethmoid sinusitis, 39(34.5%) patients presented with sphenoid sinusitis.

Among 113 subjects various osteomeatal complex variations were noted by studying the computerized tomography scan of their nose and paranasal sinuses and following results were noted. 98(86.7%) patients had deviated nasal septum, 36(31.9%) patients had presence of concha bullosa, 21(18.6%) patients had presence of aggernasi cell, 21(18.6%) patients had enlarged bulla ethmoidalis, 20(17.7%) patients had uncinate process variations, 19(16.8%) patients had presence of haller cell, 9(8%) patients had paradoxical middle turbinate, 8(7.1%) patients had presence of onodi cell and 7(6.2%) patients had presence of frontal cell.

Table 4: Distribution of the various anatomical variations of the osteomeatal complex among the study subjects (n=113).

Anatomical variations of the osteomeatal complex	Frequency	Percentage (%)
Deviated nasal septum	98	86.7
Aggernasi	21	18.6
Concha bullosa	36	31.9
Enlarged bulla ethmoidalis	21	18.6
Paradoxical middle turbinate	9	8.0
Uncinate process variation	20	17.7
Frontal cell	7	6.2
Haller cell	19	16.8
Onodi cell	8	7.1

Table 5: Association between sinusitis and the various anatomical variations of the osteomeatal complex among the study subjects.

Anatomical variations of the osteomeatal complex	Maxillary sinusitis (n=106)	Frontal sinusitis (n=71)	Anterior ethmoid sinusitis (n=87)	Posterior ethmoid sinusitis (n=64)	Sphenoidal sinusitis (n=39)
	N (%)	N (%)	N (%)	N (%)	N (%)
Deviated nasal septum (n=98)	92 (93.9)	64 (65.3)	78 (79.6)	60 (61.2)	35 (35.7)
Uncinate process variation (n=20)	20 (100)	11 (55)	14 (70)	12 (60)	8 (40)
Concha bullosa (n=36)	35 (97.2)	19 (52.8)	30 (83.3)	19 (52.8)	13 (36.1)
Enlarged bulla ethmoidalis (n=21)	19 (90.5)	18 (85.7)	15 (71.4)	12 (57.1)	10 (47.6)
Paradoxical middle turbinate (n=9)	9 (100)	4 (44.4)	4 (44.4)	4 (44.4)	2 (22.2)
Haller cell (n=19)	19 (100)	14 (73.7)	19(100)	17 (89.5)	8 (42.1)
Frontal cell (n=7)	7 (100)	6 (85.7)	7 (100)	4 (57.1)	4 (57.1)
Onodi cell (n=8)	8 (100)	5 (62.5)	5 (62.5)	5 (62.5)	4 (50)
Aggernasi cell (n=21)	19 (17.9)	15(21.1)	17 (19.5)	8 (12.5)	7 (17.9)
Test statistics	X2=220.658 ; p<0.001	X2=155.53 8; p<0.001	X2=198.85 7; p<0.001	X2=156.38 3; p<0.001	X2=77.82 4; p<0.001

Deviated Nasal Septum (n=98): Found in 92 (93.9%) cases of maxillary sinusitis, 64 (65.3%) cases of frontal sinusitis, 78 (79.6%) cases of anterior ethmoid sinusitis, 60 (61.2%) cases of posterior ethmoid sinusitis, and 35 (35.7%) cases of sphenoidal sinusitis.

Uncinate Process Variation (n=20): Present in 20 (100%) cases of maxillary sinusitis, 11 (55%) cases of frontal sinusitis, 14 (70%) cases of anterior ethmoid sinusitis, 12 (60%) cases of posterior ethmoid sinusitis, and 8 (40%) cases of sphenoidal sinusitis.

Concha Bullosa (n=36): Observed in 35 (97.2%) cases of maxillary sinusitis, 19 (52.8%) cases of frontal sinusitis, 30 (83.3%) cases of anterior ethmoid sinusitis, 19 (52.8%) cases of posterior ethmoid sinusitis, and 13 (36.1%) cases of sphenoidal sinusitis.

Enlarged Bulla Ethmoidalis (n=21): Seen in 19 (90.5%) cases of maxillary sinusitis, 18 (85.7%) cases of frontal sinusitis, 15 (71.4%) cases of anterior ethmoid sinusitis, 12 (57.1%) cases of posterior ethmoid sinusitis, and 10 (47.6%) cases of sphenoidal sinusitis.

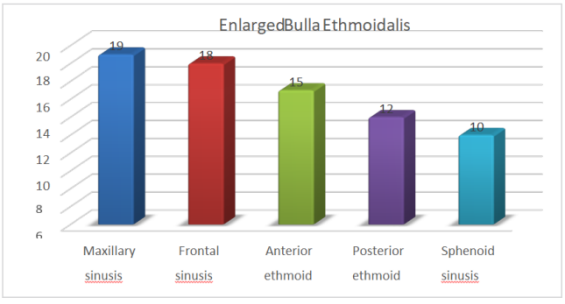

Figure 2: Relationship of Enlarged Bulla Ethmoidalis With Sinusitis

Paradoxical Middle Turbinate (n=9): Found in 9 (100%) cases of maxillary sinusitis, 4 (44.4%) cases of frontal sinusitis, 4 (44.4%) cases of anterior ethmoid sinusitis, 4 (44.4%) cases of posterior ethmoid sinusitis, and 2 (22.2%) cases of sphenoidal sinusitis.

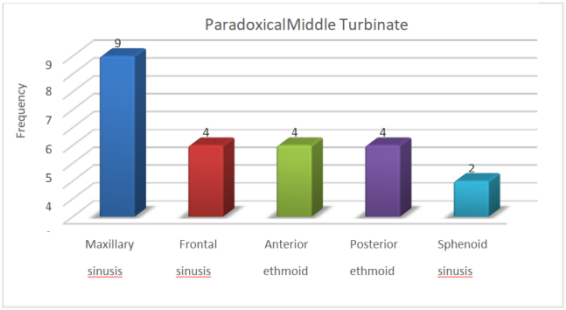

Figure 3: relationship of paradoxical middle turbinate with inusitis haller cell (n=19):

Present in 19 (100%) cases of maxillary sinusitis, 14 (73.7%) cases of frontal sinusitis, 19 (100%) cases of anterior ethmoid sinusitis, 17 (89.5%) cases of posterior ethmoid sinusitis, and 8 (42.1%) cases of sphenoidal sinusitis.

Frontal Cell (n=7): Observed in 7 (100%) cases of maxillary sinusitis, 6 (85.7%) cases of frontal sinusitis, 7 (100%) cases of anterior ethmoid sinusitis, 4 (57.1%) cases of posterior ethmoid sinusitis, and 4 (57.1%) cases of sphenoidal sinusitis.

Onodi Cell (n=8): Found in 8 (100%) cases of maxillary sinusitis, 5 (62.5%) cases of frontal sinusitis, 5 (62.5%) cases of anterior ethmoid sinusitis, 5 (62.5%) cases of posterior ethmoid sinusitis, and 4 (50%) cases of sphenoidal sinusitis.

Agger Nasi Cell (n=21): Seen in 19 (90.5%) cases of maxillary sinusitis, 15 (71.4%) cases of frontal sinusitis, 17 (81.0%) cases of anterior ethmoid sinusitis, 8 (38.1%) cases of posterior ethmoid sinusitis, and 7 (33.3%) cases of sphenoidal sinusitis.

Overall, the chi-square (X^2) test results indicate significant associations between these anatomical variations and different types of sinusitis, with p-values all less than 0.001.

DISCUSSION

The osteomeatal unit is not a discrete anatomic structure but refers collectively to several middle meatal structures. It is bounded by middle turbinate medially, lamina papyracea laterally, and basal lamella superiorly and posteriorly. The inferior and anterior borders of the OMC are open. The space before the basal lamella is called anterior OMC, and the space behind the basal lamella containing the posterior ethmoid cells is referred to as posterior OMC.[3]

The osteomeatal unit is a functional rather than an anatomic designation, coined by Naumann in discussing the pathophysiology of sinusitis.1 Although chronic sinusitis is a clinically diagnosable condition, imaging studies are essential for assessing the extent of the disease and planning for surgical treatment.[4] According to Mackay and Lund the osteomeatal complex acts as a drainage pathway for maxillary, anterior ethmoids and frontal sinuses.[5]

Anatomic variations like nasal septal deviation, concha bullosa, agger nasi cells, paradoxical middle turbinate, uncinate bulla, medially of laterally bent uncinate process, oversized ethmoidal bulla etc. These anatomic variants infringe on the patency of already narrow intricate osteomeatal channels, thus, predisposing to sinusitis by interfering with mucociliary clearance of osteomeatal area.[6]

CT provides a good perspective of sinonasal anatomy and pathology of both the bone and the soft tissue components, and thus is considered superior to plane radiography and nasal endoscopy.[7] In our study CT nose and paranasal sinuses coronal sections were used to study the anatomical variations.

The study population was 113 patients with 65 males (57.52%) and 48 females (42.47%). The mean age was 36.62+/-14.6 years. Majority of the study subjects (31) belonged to the age group of 21 to 30 this was in consensus with the study done by Gulgun et al, Baradaranfar et al and Parul Sachdeva.[8-10] In this study male preponderance was seen (57.52%males and 42.47% females), studies conducted by Wani et al, Sheet et al and Gupta et al had also shown male predominance in developing chronic rhinosinusitis.[11-13]

In our study maxillary sinuses (93.8%) are the commonest sinuses to be involved in our study, followed by Anterior ethmoid sinuses (77%), Frontal sinuses (62.8%), Posterior ethmoids(56.6%) and Sphenoid sinuses (34.5%) and the results of our study was almost in par with the study conducted by Fadda et al.[14]

In our study the commonest anatomical variation found was deviated nasal septum (86.7%) and it was 55% in the study done by Maru et al,[15] (2011) and 60% was quoted by Fadda et al,[14] and studies had shown the incidence of DNS between 18–80%.

In the present study most common anatomical variation was deviated nasal septum which was present in 98 (86.7%) patients. The second most common anatomical variation was concha bullosa in 36 (31.9%) patients. Agger nasi cell was present in 21 (18.6%) patients, enlarged bulla etmoidalis was present in 21(18.6%) patients, followed by uncinate process variations in 20 (17.7%), haller cell in 19(16.8%) patients. Paradoxical middle turbinate found in 9(8%) patients. onodi cell seen in 8 (7.1%) patients and frontal cell in 7(6.2%) patients.

In the study conducted by Tiwari et al,[16] 85 patients of chronic rhinosinusitis were examined for presence of various anatomical variations in relation to chronic rhinosinusitis. Of the 85 patients of the study group, 75 had DNS either to left/right/bilateral side, 65 had concha bullosa, prominent ethmoidal bulla was seen in 54(63.5%) cases. The abnormal uncinate process found in 9(10.5%) cases. There were 6(7%) cases who had agger nasi cells and 3(3.5%) had Haller cells and 1(1.6%) patient had onodi cell.

In our study enlarged bulla ethmoidalis was found most prevalent in maxillary, frontal and ethmoidal sinusitis, uncinate process variation was prevalent in maxillary and anterior ethmoidal sinusitis, Haller cell in maxillary, anterior ethmoid and frontal sinusitis, agger nasi was found found to be most prevalent in frontal sinusitis.

Overall in this study, the chi-square (X2) test results indicate significant association between anatomical variations of osteomeatal complex and sinusitis, with p-values all less than 0.001.

CONCLUSION

In our study we assessed the anatomical variations of osteomeatal complex and their association with different sinusitis by studying coronal sections of computed tomography scan of nose and paranasal sinuses. 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.

Hence to Conclude

1. Chronic Rhinosinusitis is more common in the age group of 21 to 30.
2. There is a male preponderance among the patients of chronic rhinosinusitis.
3. The most commonly effected sinus in chronic sinusitis was found to be maxillary sinus.
4. Most common anatomical variation was found to be deviated nasal septum.
5. Anatomical variations of osteomeatal complex was found to have significant association with sinusitis.

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