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# A CLINICORADIOLOGICAL STUDY OF ANATOMICAL VARIATION OF PARANASAL SINUS LABYRINTH IN SINONASAL POLYPOSIS

Otorhinolaryngology

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## ABSTRACT

**Background:** Chronic Rhinosinusitis with Nasal Polyposis (CRSwNP) is a multifactorial inflammatory condition often influenced by anatomical variations of the paranasal sinuses. This study aimed to evaluate the prevalence and clinical significance of these variations in CRSwNP patients. **Methods:** A prospective descriptive study was conducted on 45 patients at R.G. Kar Medical College, Kolkata, from October 2022 to March 2024. All patients underwent Diagnostic Nasal Endoscopy (DNE) and Multiplanar CT of the Nose and Paranasal Sinuses. Data were analyzed using MS Excel and JAMOVI 2.3.18. **Results:** Deviated Nasal Septum was the most prevalent variation (84.4%, $p < 0.00001$), followed by medialised uncinate process (51.1%, $p < 0.00001$) and enlarged ethmoidal bulla (33.3%, $p = 0.00174$). Most patients had multiple polyps (77.6%, $p < 0.00001$) and multisinus involvement (80.0%, $p < 0.00001$). **Conclusion:** Anatomical variations are significantly associated with CRSwNP. Accurate endoscopic and radiological evaluation is crucial for effective diagnosis and surgical management.

## KEYWORDS

Anatomic Variations, Chronic Rhinosinusitis, Paranasal Sinuses, Computed Tomography

## INTRODUCTION

Anatomy of nasal cavity and paranasal sinuses is one of the most varied regions in human body. Chronic Rhinosinusitis (CRS) is a chronic inflammation of nose and paranasal sinuses (PNS) which has a poorly defined multifactorial pathophysiology. Nasal polyps represent the end stage of local manifestation of chronic inflammatory disease of sinonasal tract.

This study aims to evaluate the prevalence of clinically significant anatomical variations of the paranasal sinuses in patients with Chronic Rhinosinusitis with Nasal polyposis (CRSwNP) and to study the correlation between presence of anatomical variations and the paranasal sinuses involved.

**Case Definition:** According to EPOS 2020 guidelines[1], CRS is characterised by

A. either two or more of following symptoms-
1. Nasal blockage/ obstruction/congestion or nasal discharge( ant/post nasal drip)
2. +/- facial pain or pressure
3. +/- reduction or loss of smell

B. And either endoscopic signs
1. Polyps
2. +/- mucopurulent discharge primarily from middle meatus
3. +/- edema or mucosa obstruction primarily in the middle meatus

C. And/or CT changes
-for more than 12 weeks.

Normal physiology of mucous membrane of PNS is maintained by two most important factors: Drainage and Ventilation. Anatomical variations of this paranasal sinus labyrinth are frequently seen and have an important role in dysfunctional drainage of the sinuses, generally resulting in CRS[2]. The most widely accepted classification system divides CRS into Chronic rhinosinusitis without nasal polyposis (CRSsNP) and CRSwNP based on nasal endoscopy. Current research has revealed that the etiology and pathogenesis of either form of CRS are much more complex. Morphologically nasal polyps are edematous grape like protrusion most often originating from upper part of nose and around OMC on the lateral wall.

Here Diagnostic Nasal Endoscopy (DNE) and Multiplanar Computed Tomography of Nose and Paranasal Sinuses (CT N-PNS) guided us as imaging investigation so that iatrogenic damage can be avoided. Inadvertent violation of the cribriform plate causing CSF leak, direct penetration trauma to the dura, serious intracranial and intracerebral complications are few inadvertent consequences during surgery and must be prevented. CT N-PNS has very much emerged in preoperative diagnosis of structural variations and allow for accurate patient selection. It helps in chronic or recurrent cases, especially in those who have surgical indication. It also has a very important meaning on the refractory acute cases with the clinical therapy on the situations that has any complications suspected.

Functional endoscopic sinus surgery (FESS) has become a popular technique, being applied in chronic and recurrent sinusitis with polyposis in recent years. In FESS, a minor manipulation of these key sites in the lateral nasal wall helps to resolve enormous pathologies in the sinuses by enhancing the surgeon's ability to visualize specific anatomical key areas of sinonasal structures[3] .

## MATERIALS AND METHODS

This was a Prospective type of Descriptive study on randomly selected Patients, attending Outpatient department (OPD) and Indoor of Department of Otorhinolaryngology and Head & Neck Surgery, R.G.KAR MCH, KOLKATA, during October 2022 to March2024. A consecutive sample of 45 patients of Chronic rhinosinusitis with sinonasal polyposis as per the criteria described in EPOS 2020[1], of either sex with age started from 13years upto 50 years , who are not responding to 12 weeks apropriate medical line of treatment [1] has included. Patient presented with acute rhinosinusitis, fungal sinusitis ,with comorbidities like diabetes mallitus, immunocompromised status, malignant sinonasal mass, pregnancy and breastfeeding mother ,previously treated cases of sinonasal disease with recurrence, nasal trauma, facial dysmorphosis are excluded from the study. Approval for this study was obtained from Institutional Ethical Committee.

All the patients were enrolled into the study and written informed consent was taken. Detailed history was documented followed by relevant clinical examinations , routine blood and urine investigations. All of them underwent Diagnostic Nasal Endoscopy(DNE) before having CT N-PNS.

As per protocol, DNE was performed in the office with a 0 degree and 45-degree 4mm Hopkins rigid nasal endoscope. Patients with narrow nasal cavities and in younger patients, 2.7-mm endoscope was used. The endoscope was passed after decongestion and topical anaesthesia to look for the status of mucosa ; Presence or absence of (1) mucosal edema (2) watery or purulent discharge and (3) polyps (4) any identifiable anatomical variation was recorded. Each patient was then prepared for CT N-PNS scan. During DNE all the secretions were suctioned, decongestion was done, and then patient was sent for CT N-PNS. CT scan was performed with 1 mm cuts, within consecutive days of nasal endoscopy. Multiplanar CT N-PNS scan; axial and coronal cuts with saggital reconstruction was done. Each individual under the study has undergone functional endoscopic sinus surgery(FESS). Careful evaluation and intraoperative photodocumentation were performed in each case. Notable examples of each variation are shown. Familiarity with these anatomical variations should increase the safety and effectiveness of FESS. Data for anatomical variations, endoscopic findings and CT findings were tabulated in Case Data Sheet and

analysed manually. Thereafter at the end of the study datas are evaluated by suitable analysis applications and methods using MS Excel and JAMOVI 2.3.18 .

**RESULTS AND ANALYSIS**

Total 45 patients of CRSwNP were enrolled in the study,most of them were 15-20 years old ; the mean Age (mean±s.d.) of patients was 26.60± 10.463. Most of them, 36 (80.0%) patients had unilateral or bilateral Nasal obstruction.The result is significant at $p < .05$. Significant number of them 30 (66.7%) had Nasal discharge .Other symptoms included 14 (31.1%) patients had Post nasal discharge ,25 (55.6%) patients had Smell disturbances, 9 (20.0%) patients had Sneezing, and few with Headache and Earache.

In our study, 38 (84.4%) patients had Deviated Nasal Septum (DNS) which is the most common anatomical variation found with the significant p value at < .00001. Among them 17 (37.8%) patients had Deviated 'S' shaped nasal septum.

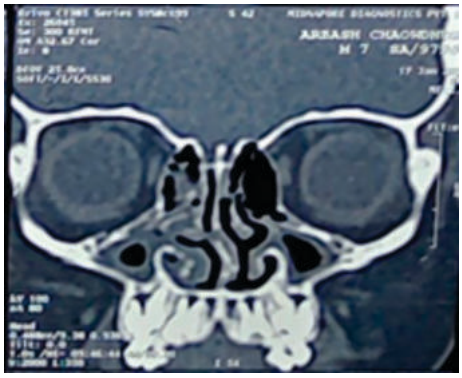

**Fig No1.: Deviated Nasal Septum with Bilateral Maxillary and Right Ethmoidal Polyposis**

Incase of 17 (37.78%) patients it was found Middle Terbinate Hypertrophy(MTH), among them 12 (66.67%) patients had Concha bullosa (CB) and 5 (27.78%) patients had Polypoidal middle turbinate. Thinning of middle turbinate found in a few cases. Paradoxically curved middle turbinates (PcMT) were found in 7 (15.6%) patients.

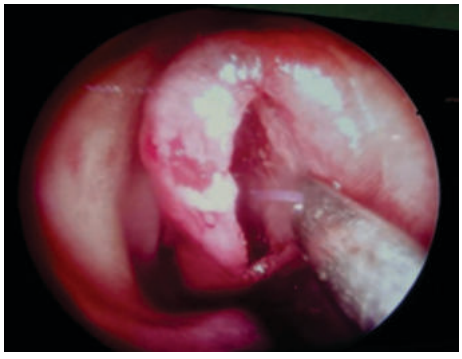

**Fig No.2: Intraoperative Finding Showing Concha Bullosa**

**Fig No.3: CT Scan Showing Bilateral Paradoxically Curved Middle Turbinates with OMC Obstruction**

To check for the uncinate process(UP) mostly we have found Medialised UP in 23 (51.1%) patients, 17 (37.8%) patients had Hypertrophied or polypoidal UP and in 2 (4.4%) patients UP has found attached to anterior skull base in DNE . Besides these variations 3 (6.7%)patients had lateralised UP who were presented with panpolyposis.

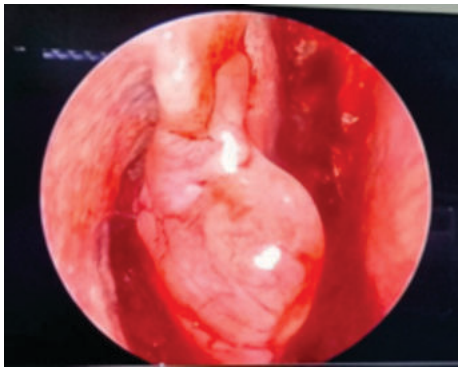

**Fig No.4: DNE Showing Right Sided Polypoidal UP**

The anatomical variations adjacent to frontal sinus drainage pathway has been inspected in coronal and sagittal section of CT N-PNS in all patients under study. 14 (31.1%) patients had varied Agger Nassi(AN), that are multiple tiers of Supra Agger cells and Supra Aggar Frontal cells identified in CT-Nose and PNS. 10 (22.2%) patients had frontal sinus Polyposis and 21(46.7%) patients had normal Frontal Recess(FR) and Sinus(FS).

**Fig No.5: CT Scan Showing Obliteration of Frontal Sinus Drainage Pathway : Supra-bullar Cells**

We have found variations of Anterior Ethmoidal Pneumatisation (AEP) associated with Ethmoidal, Frontal or Maxillary sinus polyposis . In CT N-PNS 7 (15.56%) patients had Haller cells and 15 (33.3%) patients had enlarged Bulla,1(2.22%) patient had Supra bullar cell .22 (48.9%) patients showed no significant variation that is roof of Bulla Ethmoidalis found attached to anterior skull base intraoperatively.

**Fig No. 6: CT Scan Showing Right Sided Haller Cell with Bilateral OMC Blockage**

We also found 11 (24.4%) patients with enlarged Lateral Recess, which is significant at $p< .05$ . 3(6.7%) patients with Onodi Cell, 2 (4.4%) patients with Septation attached to optic nerve and 9 (20.0%) patients had Septations within sinus.

The sinuses were involved bilaterally in 24 (53.3%) patients and unilaterally in 21 (46.7%) with a homogenous density of polyposis where as 36 (80.0%) patients had multiple sinuses involvment and 9 (20.0%) patients had single sinus involvement.

**Table 1: Anatomical Variations of PNS with their Frequencies and Percentage**

| No. | Title | Z score | p Value | Variations found | Frequency | Percentage |
|---|---|---|---|---|---|---|
| 1. | Radiological anatomical variations of Nasal Septum | 6.5354 | <.00001 | Deviated L | 12 | 26.7 |
| | | | | Deviated R | 9 | 20.0 |
| | | | | Deviated S | 17 | 37.8 |
| | | | | Non Deviated | 7 | 15.6 |
| | | | | | | |
| 2. | Frequency of Inferior Turbinate Hypertrophy | 0.6325 | .5287 | No | 24 | 53.3 |
| | | | | Yes | 21 | 46.7 |
| | | | | | | |
| 3. | Frequency of Middle Turbinate variations | 1.8851 | .05876 | Concha bullosa | 12 | 26.7 |
| | | | | Hypotrophied | 11 | 24.4 |
| | | | | Non polypoidal | 10 | 22.2 |
| | | | | PcMT | 7 | 15.6 |
| | | | | Polypoidal | 5 | 11.1 |
| | | | | | | |
| 4. | Frequency of variations of Uncinate Process | 4.9421 | <.00001 | Lateralised | 3 | 6.7 |
| | | | | Polypoidal | 17 | 37.8 |
| | | | | Medialised | 23 | 51.1 |
| | | | | Attached to Skull base | 2 | 4.4 |
| | | | | | | |
| 5. | Variations of Anterior Ethmoidal Pneumatisation | 3.1305 | .00174 | Haller cells | 8 | 17.8 |
| | | | | no significant variation | 22 | 48.9 |
| | | | | Enlarged Bulla | 15 | 33.3 |
| | | | | | | |
| 6. | Bony anatomical Varations within Sphenoid Sinus | 4.415 | <.00001 | Enlarged Lateral Recess | 11 | 24.4 |
| | | | | No Significant Variation | 20 | 44.4 |
| | | | | Onodi Cell | 3 | 6.7 |
| | | | | Septation attached to optic nerve | 2 | 4.4 |
| | | | | Septations within sinus | 9 | 20.0 |
| | | | | | | |
| 7. | Anatomical variations of Frontal Recess | 2.4401 | .01468 | Varied AN | 14 | 31.1 |
| | | | | Polyposis | 10 | 22.2 |
| | | | | Single pneumatised AN | 21 | 46.7 |
| | | | | | | |
| 8. | Frequency of polypoidal involvement of sinuses | 8.4488 | <0.00001 | Maxillary polyp | 13 | 28.9 |
| | | | | Maxillary and Ethmoidal polyps | 16 | 35.6 |
| | | | | Ethmoidal polyp | 10 | 22.2 |
| | | | | Panpolyposis | 6 | 13.3 |
| 9. | Nnumber of Sinus involvement | 0.6325 | .5287 | Bilateral | 24 | 53.3 |
| | | | | Unilateral | 21 | 46.7 |
| | | 5.6921 | <.0001 | Multiple | 36 | 80.0 |
| | | | | Single | 9 | 20.0 |

## DISCUSSION

Shankar D et al [4] (2018) observed that DNS was the most common anatomical abnormality (70%) followed by large bulla ethmoidalis 17%. In our study, 38 (84.4%) patients had Deviated Nasal Septum (DNS) which is the most common anatomical variation found with the significant p value at < .00001. Among them 17 (37.8%) patients had Deviated 'S' shaped nasal septum. In different studies , Devaraja K et al [5] (2019) also observed nasal septal deviation (DNS) in 83.4% patients.

Similar study by Devaraja K et al [5] (2019) observed that the studied characteristics in the CT images included the deviated Onodi cell (OC) 23%. The optic nerve relationship with sphenoid sinus were studied separately, where in 24% patient unsafe attachment of sphenoid septation noted , most of which attached to carotid canal, some to optic canal and few to both canals. In our study, we found significant bony anatomical variations within sphenoid sinus (p<0.00001) among which enlarged lateral recess was found in 24.4%, onodi cells in 6.7 % and septation attached to optic nerve in 4.4% cases.

The patients with middle turbinate variations concha bullosa (CB) was noted among 12 patients (26.7%) which is comparable with the study of Deosthale NV et al[6]. with significant correlation (P<0.05) between presence of CB and maxillary sinusitis.Result is also comparable to the study of Perez P et al.[7] (24.7%).We observed Paradoxically curved Milddle Turbinate(PcMT) in 7(15.6%) patients with no significant association with sinusasal polyposis similar to Perez P et al.(10%)[7].

We have found [23(51.1%)] have medialised UP where as Saxena R et al.[8] found (55%) with medialised UP in CT PNS.Deosthale NV[6] noted significant association between Frontal, Anterior ethmoidal and maxillary sinusitis with medialised UP.

A greater number of patients had enlarged Ethmoidal Bulla [15 (33.3%)]. It was statistically significant (p=.00174) with a correlation between maxillary and anterior ethmoidal sinonasal polyposis, which is comparable with the study of Deosthale NV et al.[6] and Fadda et al[9] found it in (32.8%) in their study.

Similar study by Deosthale NV et al.[6] observed that a statistically significant relationship was found between agger nasi cells, Onodi cells, hypertrophy of middle concha, concha bullosa, bulla, and the medial and lateral deviations of uncinate process with sinusitis.Within our study, 21(46.7%) patients had single pneumatised Agger Nasi where as Deosthale NV et al.[6] and Fadda et al.[9] respectively observed this in 27.86% and 24.3% in their study with a significant association with frontal sinusitis.

We observed Haller cell in 8(17.8%) patients which is comparable with the study of Deosthale NV et al.[6](16.39%) and Fadda et al.[9] (22.8%) where no significant association have found with obstruction of sinus drainage pathway.This differs from the study of Bolger et al.[10] where significant association have found between blockage of maxillary antrum with presence of Haller cell (45%).

The study conducted by Deosthale NV et al [6] (2014) observed that in DNE and CT Nose and PNS of 122 patients of chronic rhinosinusitis, maxillary sinus (68.03%) was the most commonly affected sinus due to chronic sinusitis followed by anterior ethmiod sinusitis (60.66%).

We found that, most number of patients had Maxillary and Ethmoidal polyp [16 (35.6%)]. It was statistically significant (p< .00001), (z=8.4488). We found that, higher number of patients had maxillary Polyp [13 (28.9%)]. A greater number of patients had Multiple NOSI [36 (80.0%)], which was statistically significant (p<0.0001), (z=5.6921)

**Limitations:** In spite of every sincere effort ,the notable short comings of this study are: the sample size was small, the study has been done in a single centre and was carried out in a tertiary care hospital, so hospital bias cannot be ruled out.

## CONCLUSION

This prospective investigation found a statistically significant link between lateral wall nose morphological variations and paranasal sinus pathology. This study further emphasizes the importance of rigorous examination and CT in chronic rhinosinusitis patients, especially those undergoing endoscopic surgery, to detect paranasal sinus structural abnormalities that may be linked to the condition. This helps detect and manage variability linked to disease persistence or recurrence. Finally, we hypothesize that some paranasal sinus structural changes may contribute to chronic rhinosinusitis and raise sinus mucosal disease risk.

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