International Journal of Otorhinolaryngology and Head and Neck Surgery
Shrestha A et al. Int J Otorhinolaryngol Head Neck Surg. 2024 Apr;10(2):166-171
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20240694

Original Research Article

Study on anatomical variations of nose and paranasal sinuses in patients with sinonasal polyposis

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Received: 05 February 2024
Revised: 12 March 2024
Accepted: 14 March 2024

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ABSTRACT

Background: Knowledge regarding the sinonasal variations plays an important role in the management of sinonasal diseases. Despite being postulated as one of the risk factors for sinonasal diseases, its role in the pathogenesis of nasal polyp is still unclear. This study was done to determine the prevalence of sinonasal anatomical variations by CT imaging and examine its association with sinonasal polyposis (SNP).
Method: A descriptive cross-sectional study was conducted from January, 2019 to January, 2020 at a tertiary care center after receiving ethical approval from the institutional review committee of the hospital. Patients above 17 years of age having sinonasal polyp and not responding to 3-4 weeks of medical treatment were included in the study. Convenience sampling was done. Data were collected and entered in Microsoft excel and analyzed using statistical package for the social sciences version 24.0.
Results: Among 72 patients, 86.11% of the patients were found to have anatomical variations of nose and paranasal sinuses with Agger nasi (79.09%) and deviated nasal septum (DNS) (72.5%) being the most common variations noted, 29% of patients were found to have a single variation while multiple variations were seen 70.9% of patients.
Conclusions: Our study showed that patients with sinonasal polyps have a higher prevalence of sinonasal anatomical variations and severity of polyp increased with the presence of more than one variation in a patient.

Keywords: Computed tomography scan, Sinonasal anatomical variations, Sinonasal polyp

INTRODUCTION

Arising from the mucosa of the nasal cavity and/or one or more of the paranasal sinuses, usually at the outflow tract of sinuses, nasal polyps (NP) are of the common benign non-cancerous lesions.[1] Because of the complex anatomical presence of osteo-meatal complex, a considerable amount of effort has been made to understand these variations and their impact on sinus surgeries.

Despite limited knowledge regarding the etiology, anatomic variations are known to be one of the risk factors for the etiopathogenesis of sinonasal polyps as these variations alter the drainage pathway of the paranasal sinuses leading to stasis of the secretions which provide a source for inflammation of the mucosal lining of the sinuses. Studies regarding the prevalence of anatomical variations in sinonasal polyp patients are lacking in our country. The aim of this study was to determine the prevalence of sinonasal anatomical

variations based on the computerized tomography (CT) imaging and look for its association with SNP.

METHODS

A descriptive cross-sectional study was conducted from January, 2019 to January, 2020 in the department of otorhinolaryngology and head and neck surgery of a tertiary care center of Eastern Nepal. The study was started after obtaining ethical approval from the institutional review committee of the hospital. All patients above 17 years of age attending ear, nose and throat (ENT) OPD, having sinonasal polyp unilateral or bilateral, single or a massive polyposis and not responding to 3-4 weeks of medical treatment (intranasal corticosteroids, systemic steroids, course of macrolide antibiotics, nasal decongestants, and anti-histaminic) were included in the study. Any patients with trauma of nose/paranasal sinus (PNS)/facial, previous nose/PNS surgery, destructive disease of the nose and PNS, premalignant conditions/ malignancy of the nose and PNS, expecting and nursing mothers, unwilling patient and any contraindication for radiological evaluation were excluded from the study. Informed written consent was signed before enrolling them in the study.

The 72 cases attending ENT OPD were subjected to detail history, general examination and thorough ENT examination. Following this, nasal endoscopy and CT scans of the nose and paranasal sinus was done. CT scan was performed with 3 mm thickness in axial, coronal and sagittal planes having standard bone and soft tissues windows. All films were taken without contrast and the staging was done according to Lund-Mackay system.[2] The Lund-Mackay system was scored on 0-2 depending on the absence, partial or complete opacification of each sinus system and of the osteo-meatal complex on computed tomography scan. A minimum score of 12 per side was given and the score was increased with increasing grade of polyposis (Table 1).

Table 1: Lund Mackay system.

Lund Mackay system		
Sinus	**Score (right)**	**Score (left)**
Maxillary		
Anterior ethmoid		
Posterior ethmoid		
Sphenoid		
Frontal		
Osteomeatal complex		
Sinus		
0	No abnormality	
1	Partial opacification	
2	Total opacification	
Osteomeatal complex		
0	Not occluded	
2	Occluded	

The strengthening the reporting of observational studies in epidemiology (STROBE) checklist has been taken into consideration as the reporting guideline for this study.[3]

Data were entered and analyzed using the statistical package for the social sciences version 21.0. P values less than 0.05 was taken as statistically significant.

RESULTS

A total of 72 patients having sinonasal polyp with their age ranging from 17-70 years were included in the study. The maximum number of patients were between 31-40 years (30.55%) with 37 male (51.4%) and 35 female (48.6%).

Based on the study, the prevalence of anatomical variations in sinonasal polyp patient was found to be 86.11% (62 patients). A total of 14 different variations were identified, common being Agger nasi cell (Figure 6) (79.09%) and DNS (Figure 1) (72.5%). Other less common variations were concha bullosa (Figure 5 and 7) (24.1%), supraorbital cell (Figure 2) (16.1%), intumescent septi nasi (12.9%), frontal cell (12.9%), Onodi cell (Figure 8) (12.9%), anterior clinoid pneumatization (3.2%), pneumatized uncinate process (3.2%), supreme turbinate (Figure 3) (3.2%), paradoxical middle turbinate (Figure 4) (3.2%), pneumatized crista Gali (1.6%), Haller's cell (1.6%) and pneumatized septum (1.6%) (Table 2).

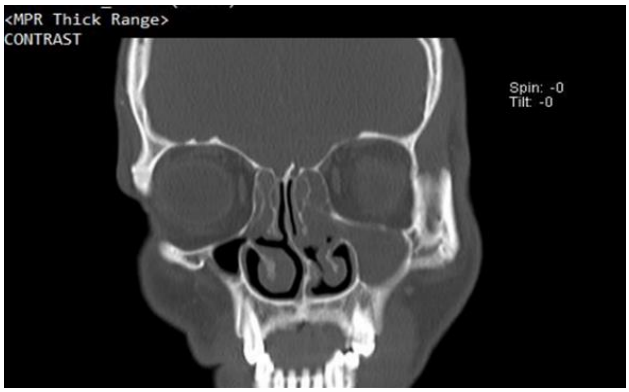

Figure 1: Left sided DNS.

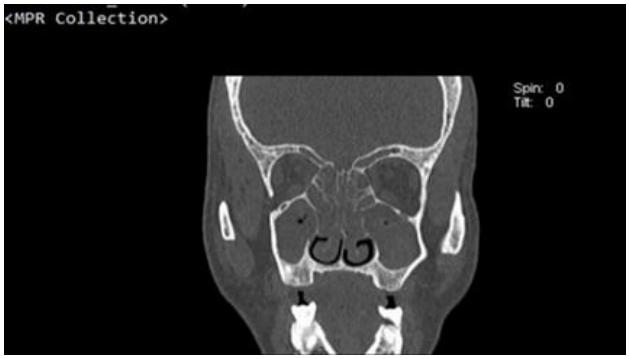

Figure 2: Bilateral supraorbital cell.

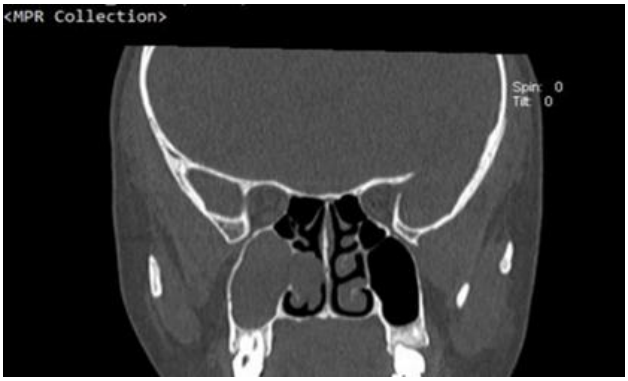

Figure 3: Bilateral supreme turbinate.

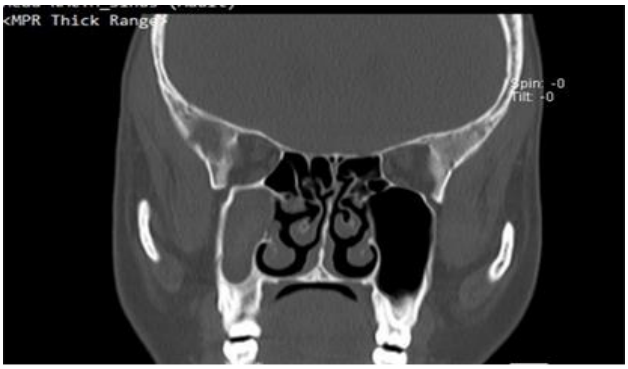

Figure 4: Left paradoxical middle turbinate.

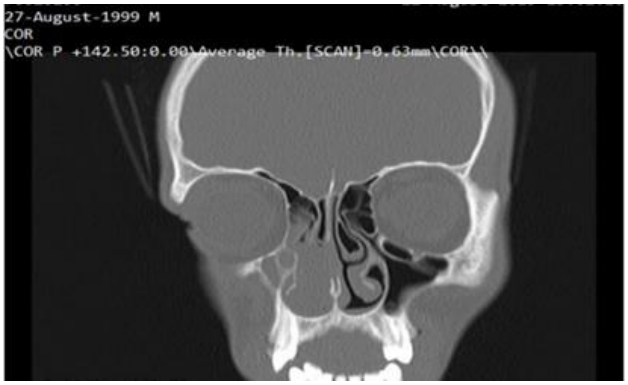

Figure 5: Left Concha bullosa and left Haller's cell.

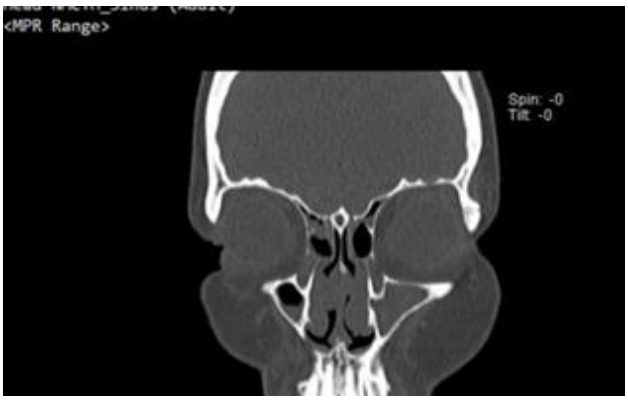

Figure 6: Bilateral agger cell.

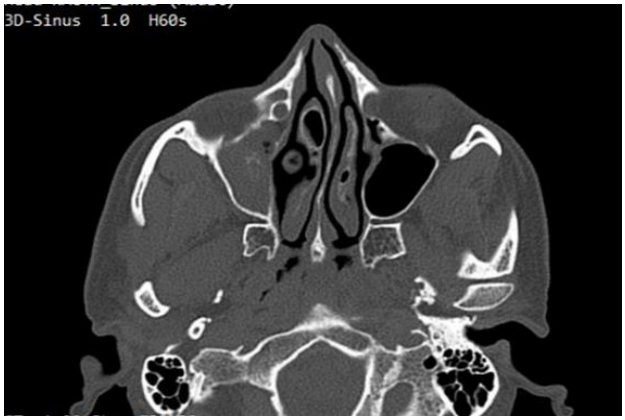

Figure 7: Right concha bullosa and left sided DNS.

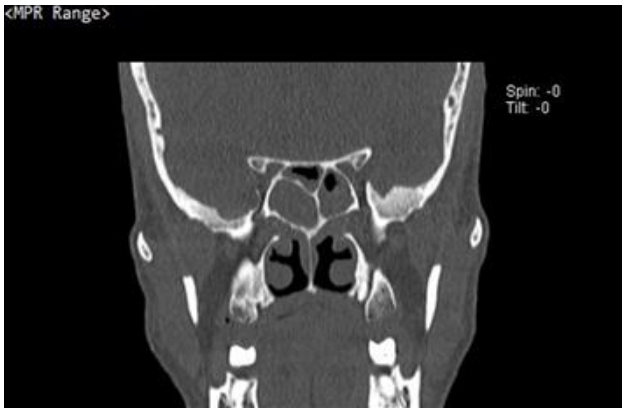

Figure 8: Right Onodi cell.

Table 2: Distribution of anatomical variations of sinonasal polyps.

Variations	N	Percentage (%)
Agger nasi cells	49	79.09
DNS	45	72.5
Concha bullosa	15	24.1
Supraorbital cell	10	16.1
Intumescent septi nasi	8	12.9
Frontal cell	8	12.9
Pneumatized anterior clinoid process	2	3.2
Pneumatized uncinate process	2	3.2
Supreme turbinate	2	3.2
Paradoxical middle turbinate	2	3.2
Pneumatized crista galli	1	1.6
Haller's cell	1	1.6
Pneumatized nasal septum	1	1.6

Table 3: Distribution of anatomic variations.

Lund Mackey score		P value
Single variation	**Multiple variation**	0.000*
4.67±1.73	16.76±4.6	

Student's t-test. *statistically significant.

DISCUSSION

SNP is known to be one of the manifestations of chronic inflammatory disease of the sinonasal tract with an uncertain etiology and a tendency to recur.[4] They are known to have a very remarkable effect on the quality of life with nasal obstruction, epistaxis and obstructive sleep apnea being very common presentations. With blockage in the drainage of the secretions and stasis, anatomic factors play an important role in initiation of the inflammatory cascade. They are found to appear predominantly at structurally tight areas of the sinonasal pathway when drainage is compromised ultimately leading to release of pro-inflammatory cytokines from epithelial cells which results into cellular infiltrate and ultimately causing obstruction in the sinonasal pathway.[4]

Sinonasal anatomic variations like Agger nasi cell (68.1%), DNS (62.5%), Concha bullosa (22.2%) were commonly found whereas supraorbital cell, intumescent septi nasi, frontal cell, Onodi cell, anterior clinoid pneumatization, pneumatized uncinate process, paradoxical middle turbinate, pneumatized crista Gali, supreme turbinate, Haller's cell and pneumatized septum were found to be less common. It was similar to findings in various studies.[6-10]

DNS was one of the common variations encountered in our study (72.5%) which was comparable to other studies by Pereira et al (72.7%), Gouripur et al (70%), Maru and Gupta et al (55.7%) and Shrestha et al (64%).[8-11] The prevalence of Agger nasi cells had previously been reported to vary from 10-15% being reported by Messerklinger et al upto 65% being reported by Davis et al.[12,13] Similarly, Bilge et al reported agger nasi in 48% of patients with sinonasal polyp which was less as compared to our study.[6] Agger nasi cells are known to be closely associated with frontal recess as the secretions from the frontal sinus usually take the route through frontal recess to the posterior and medial surface of agger nasi cells. Therefore, if a large agger nasi cell is opened and mistaken for a frontal sinus during surgery, the remaining supero-posterior wall of the agger nasi cell may scar posteriorly involving the ethmoid roof leading to iatrogenic stenosis or obstruction of the nasofrontal connection.[14]

Concha bullosa has been implicated as a possible etiological factor in the causation of recurrent chronic sinusitis. Many studies done in the past have shown the prevalence of concha bullosa to be in the range of 24% to 55% of the population.[16] Concha bullosa was seen in 24.1% of our study population which was less as compared to studies by Maru and Gupta et al (42.6%) and Bolger et al (53.6%) but comparable to studies done by Shrestha et al (19.7%), Yadav et al (28%), Llyod et al (24%) and Madani et al (17.47%).[7,8,11,16-18]

Paradoxically curved middle turbinate may lead to impingement of the middle meatus which ultimately lead to inflammation of the paranasal sinuses. Paradoxical middle turbinate was present in 3.2% of the patients in our study which was less as compared to that of 8% by Bilge et al 27% by Bolger et al 9.9% by Varshney et al 12% by Yadav et al and 15% by Llyod et al.[6,7,19,16,17]

Similarly, pneumatization of uncinate process was seen in 3.2% of the patients in our study. However, it varied from 2.8% to 10% of the patients in other studies.[6,13,20]

Haller cells have previously been reported to be present in 6% to 10% of the patients with sinonasal polyp.[14,21] However, in this study, Haller's cells were found to be present in lower number of patient (1.6%) as compared to Gouripur et al (14%) and Pereira et al (29.1%).[9,10]

Onodi cells are the posterior ethmoid cells that invade the posterior ethmoid capsule or migrate to the medial aspect of the optic nerve leading to increased chances of injury to optic nerve. We reported that Onodi cells are present in 12.9% of the patients. However, they have been found to be present in 14% of the patients by Bilge et al 6% by Gouripur et al 29.1% by Pereira et al 3% by Varshney et al.[6,9,10,19]

Frontal cells are cells encroaching on the frontal recess or frontal sinus. Gouripur et al showed higher occurrence of frontal cells (50%) compared to this study (13.9%). Pneumatized crista galli was seen in 1.6% of the patients in this study which was same as the study done by Maru and Gupta (1.6%).[8,9]

In this study, single variation was found in 29% and multiple variations in 70.9% of the patients. Presence of more than one variation in a patient has been known to play a role in the pathogenesis of SNP through various mechanisms. The narrowing of the nasal passage, increased mucosal contact, and negative pressure with Bernoulli effect may lead to mucosal edema and swelling. Javadrashid et al postulated that simultaneous presence of nasal septal deviation and concha bullosa was found to be associated with paranasal sinusitis.[22] Another study by Bilge et al reported simultaneous presence of septal deviation and concha bullosa in 100 (64%) patients with SNP which was similar to this study.[6] Presence of multiple anatomic variations increased Lund Mackay staging and statistically significant association was found between the two, $p<0.05$%. Hence, the presence of more than one sinonasal anatomical variations increases the severity/extent of sinonasal polyp.

Limitations

There were some limitations of studies. This study evaluated only symptomatic patients and hence, no correlation between symptomatic and asymptomatic patients. The correlation of anatomical CT variations in the etiology/causation of sinonasal polyp could not be stressed upon without the control group. The CT scoring system does not have a cut off value for differentiating

disease from non diseased paranasal sinus. The findings can be missed out while reading scans by a single observer. Extensive polyposis can make important anatomical variations to be missed out.

CONCLUSION

Sinonasal variations are very common in patients in patients with SNP. Therefore, proper knowledge and identification of both common and uncommon sinonasal variations could help in better surgical planning and overall management of sinonasal disorders. CT of the para nasal sinuses has improved the visualization of para nasal sinus anatomy and has allowed greater accuracy in evaluating the extent of nasal polyp and para nasal sinus disease. It evaluates the osteomeatal complex anatomy which is not possible to such an extent with plain radiographs. Therefore, preoperative CT scans is important for proper evaluation of anatomic variations which reduces inadvertent complications during surgery and also ensures the complete clearance of the disease for effective endoscopic sinus surgery.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Shrestha A, Kattel K, Rana S, Devkota S, Shrestha A, Piya P. Study on anatomical variations of nose and paranasal sinuses in patients with sinonasal polyposis. Int J Otorhinolaryngol Head Neck Surg 2024;10:166-71.