ISSN2515-8260 Volume 08,Issue 04,2021

The frequency of anatomical variations of paranasal sinuses on computed tomography

[1]Dr. Pavan Kumar B,[2]Dr. Mohan Kumar,[3]Dr. M Ramya,[4]Dr. Manohar Kumar KR

[1,3]Assistant Professor, Department of Radiology, Mamata Academy of Medical Sciences, Bachupally, Hyderabad,Telangana, India
[2]Associate Professor, Department of Radiology, Adichunchanagiri Institute of Medical Sciences,Bellur,Karnataka, India
[4]Consultant Radiologist, Gopala Gowda Shanthaveri Memorial Hospital,Mysore, Karnataka, India

Corresponding Author: Dr. Manohar Kumar KR

Abstract
Paranasal sinuses are the group of air-filled spaces developed as an expansion of the nasal cavities. These air filled cavities mostly shows the complex design and also shares relations with the adjacentstructures.Ventilation and drainage are the two most important factors in the maintenance of normal physiology of paranasal sinuses and their mucous membranes. During the study period, a total of 100 cases were evaluated who were referred from Department of ENT to the Department of radio diagnosis to evaluate the paranasal sinuses by computed tomography. The cases in acute phase of the disease were treated conservatively with a course of antibiotics, topical and oral decongestants and the cases referred after persistent symptoms and signs were counselled regarding imaging of nose and PNS by CT scan, Written informed consent was taken and data regarding the patient was collected in a case proforma. The intersphenoid septum was left sided in majority of cases i.e. 43 (43%). It was right sided in 38(38%) and in 43(%) of cases it was in central.
Keywords: Anatomical variations, paranasal sinuses,computed tomography

Introduction

There are various sinonasal pathologies encountered in day to day clinical practice by otorhinolaryngologists. These pathologies sometimes do not respond to medical therapy. Computed tomography (CT) is the method of choice for evaluating these cases, particularly in patients, requiring surgical intervention[1]. Endoscopic surgery demands a meticulous assessment and a detailed description of both nasal and paranasal cavities and structures[2].
In the last few years the anatomical CT variations and pathological findings were registered and supposed as a possible element which is favouring development of sinus pathology and shows symptoms usually connected with sinusitis[3].The success of functional endoscopic surgery depends on adequate knowledge of the complicated anatomy of the paranasal sinuses, which is variable. It is important to recognize the clinical and surgical significance of these variations. Considering that the main objective of this type of surgery is to reopen the natural

ways of drainage of paranasal cavities, it is very relevant that the radiologist is aware of the ostiomeatal complex variants, by describing them in a comprehensible way for the otorhinolaryngologist.[4]

Paranasal sinuses are the group of air-filled spaces developed as an expansion of the nasal cavities. These air filled cavities mostly shows the complex design and also shares relations with the adjacent structures.Ventilation and drainage are the two most important factors in the maintenance of normal physiology of paranasal sinuses and their mucous membranes.[5]Anatomical variations of paranasal sinuses have been implicated in the etiology of chronic recurrent sinusitis, CT imaging of the paranasal sinuses in coronal sections has been routinely used in the evaluation of the patient with chronic sinus complaints.

Another Diagnostic method called 'Nasal endoscopy is a complement to CT. Howeverthis nasal endoscopy has limitations, it may not give complete visualization of the ethmoid infundibulum or maxillary sinus ostium and also deep mucosal changes and anatomical variations cannot be assessed in detail by this endoscopy.

Anatomical variations like 'nasal septal deviations, concha bullosa, paradoxical middle turbinate, pneumatized or a medially bent uncinate' etc. can encroach upon the OMU causes narrowing of the osteomeatal complex channels.[6] This will leadsto impairment in drainage and ventilation of the paranasal sinuses. these are the primary predisposing causes for development of sinusitis and other less common variations like the presence of haller cell, supraorbital cell and an onodi cell can also causes obstruction to the drainage pathway, ultimately leads to the development of sinusitis, and the other disorders which produce any additional stenos is of these narrow areas causes mucus retention and inflammation of adjacent structures by the contact of opposing mucosal areas. The frequency of these abnormalities in 'normal' population is less frequent than in individuals with chronic rhinosinusitis.

Methodology

Study design

Cross Sectional Study.

Method of collection of data

Details of the study protocol was explained to the subjects.

The cases were subjected to multi detector CT scans of PNS taking 5mm slices with 1mm retro reconstruction THOSHIBA SYSTEM-HI SPEED 16 SLICE CT. The images were reviewed in axial and coronal sections for both bone and soft tissue algorithms.

Study population

The study population included all adults aged 12 years and above of about 100 cases who were referred from the Department of E.N.T.

Inclusion criteria

All cases who were referred for computed tomography scan of Para nasal sinuses and above 12 years of age after excluding as per exclusion criteria.

All cases who were referred to radiology department for CT evaluation of PNS clinically present with a history of nasal obstruction, nasal discharge, postnasal discharge and headache, clinically diagnosed to have chronic rhino sinusitis and are willing for CT evaluation.

ISSN2515-8260 Volume 08,Issue 04,2021

Exclusion criteria

1) Facial trauma.
2) Previous sinonasal surgery.
3) Children under 12 years of age.

Sample size

A total of 100 cases who met the inclusion criteria were taken up in this study.
During the study period, a total of 100 cases were evaluated who were referred from Department of ENT to the Department of radio diagnosis to evaluate the paranasal sinuses by computed tomography. The cases in acute phase of the disease were treated conservatively with a course of antibiotics, topical and oral decongestants and the cases referred after persistent symptoms and signs were counselled regarding imaging of nose and PNS by CT scan, Written informed consent was taken and data regarding the patient was collected in a case proforma.
CT scan was done for these 100 cases with THOSHIBA Multi detector 16 slice CT machine. 0.5mmhigh resolution with 1mm reconstruction, coronal,sagittal and axial sections were reviewed. The presence of anatomical variations and sites of involved sinuses based on CT findings were investigated.
For statistical analysis of the data showing relationship of anatomical variation and presence of sinusitis Odds ratio and Chi Square test was used as tests for significance. The statistical analysis were done using SPSS-16 software.

Results

Total 65% cases had deviation ofnasal septum, in that 32% cases had DNS to left side and 23% cases had deviation to right side. S shaped DNS was seen in 10%cases.

Table 1: Deviated Nasal Septum Distribution

Total number of cases with DNS	Distribution of DNS		S shaped
65	Left	Right	
	32	23	10

Total 65 (65%) cases had a deviated nasal septum. 34 (52.3%) cases were female and 31 (47.7%) cases were males.
52% of cases had Concha Bullosa in the middle turbinate and in that 33% were unilateral and in 19% were bilateral.

Table 2: Middle Turbinate Concha distribution

Noumber of cases withConcha bullosa		
52	Unilateral	Bilateral
	33	19

Unilateral choncha bullosa was more common and was seen in 33% of cases and bilateral choncha bullosa was seen in 19% cases.
In the present study,paradoxical middle turbinate was found in 21(21%) cases.Among these, we had bilateral in 3(3%). Right sided in 10(10%) and left sided in 8(8%) of cases.

Table 3: Paradoxical Middle Turbinate Distribution

Total number of cases with Paradoxical MiddleTurbinate			
79(79%)	Unilateral		Bilateral
	Right	Left	3(3%)
	10(10%)	8(8%)	

Haller cells were seen in 24% of cases out of which 8.8% of cases had haller cells on right side 16.16%of cases had it on left side.

Table 4: Haller Cell Distribution

Total number of caseswith Haller Cells	Left sided Haller Cell	Right sided Haller Cell
24 (24%)	16(16%)	8 (8%)

Onodi cells were found in 26(26%) cases.

Table 5: Onodi cells

Number of cases with Onodicells	Number of cases withoutOnodi Cells
21(21.21)	79 (79%)

The Right sided AggerNasi cells were found in 14(14%) cases, left sided AggerNasi cells seen in 15% of cases, bilateral Agger cells were seen in 6% of cases. In majority i.e. 65% cases there were no Agger Nasi cells found.

Table 6: Agger Nasi Cell Distribution

Number of cases with AggerNasi Cell	Left sided AggerNasi Cell	Righ sided AggerNasi Cell	Bilateral AggerNasi Cell
35(35%)	15 (15%)	14 (14%)	6(6%)

We had majority 85%of cases with Keros type 2 and 10% of type 1 cases and 5% of type 3 cases.

Table 7: Keros Classification

Keros Type	Type 1	Type 2	Type 3
	10	85	5

The Intersphenoid septum was left sided in majority of cases i.e. 43 (43%). It was right sided in 38(38%)and in 4343(%) of cases it was in central.

Table8: Inter sphenoid septum

Inter-Sphenoid Septation Number ofCases	
Central	19(19%)
Left	43(43%)
Right	38(38%)

Sellar type of Sphenoid pneumatization pattern was seen in majority of cases i.e. 67% followed by pre sellar type i.e. 33%.

Table9: Sphenoid pneumatisation pattern

Sphenoid pneumatization pattern	Number ofcases
Pre-sellar	33(33%)
Sellar(includingcomplete andincomplete type)	67(67%)
Conchal	0

Discussion

The prevalence of anatomic variations of nose and para nasal sinuses causing diseases has been variously described, ranging from pure anatomic descriptions to descriptions based on computed tomography examinations.

The present study included of 100 patients in the study period. An in depth analysis of CT scans of PNS, in axial, sagittal and coronal planes with special attention to bony anatomical variations was done. In our study, we encountered anatomical variations like deviated nasal septum, Concha Bullosa (pneumatized middle turbinate),Agger Nasi cell, Pneumatized septum, Paradoxical middle turbinate, Haller cell (infra-orbital cell).

Pneumatized uncinate process medial and lateral deviation of uncinate process and Septated maxillary sinus.Variations in pneumatization pattern of sphenoid sinus along with its extension into anterior and posterior clinoid process,great wing of sphenoid, pterygoid process and extension into the clivus were also noted.

In the present study out of the 100 subjects 46% were males and 54% were females showing a female preponderancevarious studies have also shown a female preponderance of sinusitis. Female preponderance was also reported by US national Center for health statistics. It was reported that female dominance was due to hormonal changes that occurs during puberty, pregnancy, menstruation and sexual excitement due to vasomotor imbalance leading to frequent sinusitis in females.

There are a few studies where the authors have found higher incidence of sinusitis in males.

The most frequently encountered age group in our study was 31-40 years which comprised of 35 cases, followed by 25 cases in the age group of 21-30 years. Youngest patient was 12 years old and eldest was 67 years old. Mean age was 34.42±11-61 years.

Nasal septal deviation has an important role in causing sinusitis. Asymmetric nasal septum can force nasal turbinates laterally and result in narrowing of the middle meatus and ultimately blocking drainage of the ipsilateral Maxillary, anterior ethmoid and frontal sinuses.

In current study Deviation of nasal septum was the commonest anatomical variations observed. Septal deviation was seen in 65 cases (65%) out of 100 cases. In 32 cases (49.23%) the deviation was to the left whereas in 23 cases (38.31%) the deviation was to right. S Shaped eviation was seen in 10(16.6%) cases.

DNS was the most common anatomical variation with high prevalence rate ranging from 13% to 80% in several studies. Majority of the studies showed DNS as the most common anatomical variations, as does the present study. Similar results were observed in studies of Talaiepour*et al*. [7], H. Mamatha *et al*. [8] and recently A.K. Gupta *et al*. [9]with prevalence rate of DNS as studies 65%, 65% and 65.2% in their respective studies. These correlates with our study.Which showed prevalence of DNS as 65% Different criteria applied to diagnose and consider septum to be deviated in different studies, accounted for variation in prevalence.

Badia*et al*. [10]Considered notable DNS, only when it was more than 4 mm deviation and found its prevalence to be only 13%-20%. On the other hand, Perez-Pinas*et al*. [11]considered DNS, when any visually detectable nasal deviation from the midline was seen and observed a prevalence of it to be 80% Our study didnot correlate with the prevalence of deviation of nasal septum as reported by various workers in their studies areK. Dua*et al*. [12]

Extensive pneumatization of the middle turbinate also called concha bullosa, can be a possible etiological factor in the pathogenesis of recurrent sinusitis due to its negative

ISSN2515-8260 Volume 08,Issue 04,2021

influence on ventilation and mucociliary clearance of sinuses. There has been a lot of variability in the reported incidence ofconcha bullosa. Ranging from 10% to55%.

The true concha bullosa is produced following pneumatisation of both portions (vertical lamina and inferior bulb) of the middle nasal concha. Lamellar pneumatisation and conchalpneumatization both were included in Choncha bullosa in our study.Using this criteria the prevalence rate in our study was 52%.

In the present study the incidence of concha bullosa was seen in 52%. It was unilateral in 33 cases and bilateral concha bullosa was seen in 19 cases. Which correlated with study of Bolger *et al*.[17]1991 who had the prevalence rate of 53.6%. and Earwaker[14] (1993) in his series of 800 patients noted an incidence of 55%.

Lower prevalence was noted in following studies, Talaiepour*et al*. [7]had seen Concha Bullosa in 35% subjects and Perez Pinas*et al*. [11]reported the incidence as 23.6% Jones *et al*. in his study of 100 patients with chronic rhinosinusitis reported concha bullosa in 10% cases.. The wide discrepancy in the reported incidence may be attributed to the inherent differences in study population.

Paradoxical curvature of the middle turbinate is described as a convexity pointing toward the middle meatus, and is reported as a possible cause for closed OMU and mucosal pathologies as a result of impingement. However it is not associated with any change in the normal middle turbinate attachments. This may lead to impingement of the middle meatus and thus causing sinusitis or other mucosal diseases of sinus.

In our study unilateral paradoxical middle turbinate was seen in 85.5% of cases Bilateral paradoxical middle turbinate was seen in 14.5% cases this was similar to erwakarstudy. In his study Unilateral paradoxical middle turbinate was seen in 84.2% where bilateral in 15.8%.

In a study by Charu Singh *et al*. 62.5% were unilateral and bilateral in 37.5% which did not correlate with our study.

Mucosal abnormalities of the sinuses were evaluated ranging from minimal thickening to total opacification. Mucosal abnormalities were most commonly observed in the maxillary sinus 63% followed by anterior ethmoids 62%, posterior ethmoids 55%, Sphenoid sinus 41% and frontal sinus 38%.

Similar to our study all the above mentioned studies showed that anterior ethmoid sinus and maxillary sinus involvement was more common than other sinus involvement.

Conclusion

- The maxillary sinus was the most commonly involved sinus 63(63%) cases followed by anterior ethmoids 62(62%) and posterior ethmoids55(55%).
- Association of Maxillary sinusitis with presence of an Osteomeatal (OMU) Block was analyzed and the correlation was found to be statistically significant (p value of<0.0001).

References

1. De Freitas LinharesRiello P, BoasquevisqueEM. Anatomical Variants of the Ostiomeatal Complex: Tomographic Findings in 200 Patients, RadiologiaBrasileira. 2008;41(3):149-154.
2. LudwickJJ,TaberKH,ManolidisS*et al*., A Com-PutedTomographic Guide to Endoscopic Sinus Surgery: Axial and Coronal Views, Journal of Computer Assisted Tomography. 2002;26(2):317-322. Doi:10.1097/00004728-200203000- 00026.
3. Lactic A,Milicic D,Radmilovic K,DelibegovicM, Samardzic J. Paranasal Sinus CT Scan Findings in Patientwith Chronic Sinonasal Symptoms, Acta Informatica Medica. 2010;18(4):196-198.
4. Dutra LD, MarchioriE. TomografiaComputado-RizadaHelicoidal dos SeiosParanasaisnaCriança: Aval-iação das SinusopatiasInflamatórias, Radiologia Bra-

Sileira. 2002;35(3):161-169. doi:10.1590/S0100-39842002000300007

5. Jora, Neetu and Nandal, Naveen. (2020), Investors Attitude towards Cryptocurrency-based on Gender, Turkish Journal of Computer and Mathematics Education, 11(2), pp. 622 - 630
6. Aarushi, Naveen Nandal and Anuradha, Satyam Computers Scam- Pre and Post Analysis, International Journal of Psychosocial Rehabilitation, Volume 24, Issue 6, pp. 1817-1824.Nguyen VD, Tyrrel R. Klippel-Feil Syndrome: Patterns of Bony Fusion and Wasp-Waist Sign. Skeletal Radiol. 1993;22:519-523.
7. Stammberger Heinz. Functional Endoscopic Sinus Surgery: The Messerklinger Technique, 1991, 17-18.
8. Stammberger H, Wolf G. Headaches and Sinus Diseases: The Endoscopic Approach. Ann OtolRhinolLaryngol, 97(134):3D23.
9. Talaiepour AR,SazgarAA, BagheriA. Anat-omic Variations of the Paranasal Sinuses on CT Scan Images, Journal of Dentistry, Tehran University of Me-dical Sciences. 2005;2(4):142-146.
10. Mamatha H,ShamasundarNM,BharathiMB, PrasannaLC. Variations of Osteomeatal Complex and Its Applied Anatomy: A CT Scan Study,Indian Journal of Science and Technology. 2010;3(8):904-907.
11. Gupta AK,GuptaB,GuptaN, GuptaN. Com-PuterizedTomography of Paranasal Sinuses: A Roadmap to Endoscopic Surgery, Clinical Rhinology: An International Journal. 2012;5(1):1-10.
12. BadiaL,LundVJ,WeiW, HoWK. Ethnic Variation in Sinonasal Anatomy on CT-Scanning, Rhi-Nology. 2005;43:210-214.
13. Pérez-PiñasJ, SabatéA, Carmona *et al.*, Anatomical Variations in the Human Paranasal Sinus Region Studied by CT, Journal of Anatomy. 2000;197(2):221-227.
14. DuaH, ChopraAS Khurana, MunjalM. CT Scan Variations in Chronic Sinusitis, Indian Journal of Radiology and Imaging. 2005;15(3):315-320.