RESEARCH

COMPARATIVE STUDY OF SINONASAL ANATOMIC VARIANTS BETWEEN PATIENTS WITH MINIMAL TO NO APPARENT IMAGING EVIDENCE OF RHINOSINUSITIS AND THOSE WITH RADIOLOGIC EVIDENCE OF CLINICALLY SIGNIFICANT RHINOSINUSITIS USING MULTI DETECTOR COMPUTED TOMOGRAPHY

Samudra Borah[1], Purabi Das[2]

[1]Assistant Professor, Department of Radiodiagnosis, Tezpur Medical College and hospital. Bihaguri, Tezpur, Assam, India.
[2]Registrar, Department of OBS, Tezpur Medical College and hospital, Bihaguri, Tezpur, Assam, India.

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Corresponding Author:
Dr. Samudra Borah,
Email: samudra111@gmail.com
ORCID: 0000-0002-1683-8954

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Abstract

Background: CT is the ideal method for evaluating the paranasal sinuses prior to surgery and the gold standard for identifying inflammatory sinus disease caused by blockage. Present study was aimed to compare sinonasal anatomic variants between patients with minimal to no apparent imaging evidence of rhinosinusitis and those with radiologic evidence of clinically significant rhinosinusitis using multi detector CT. **Materials and Methods:** Present study was Hospital based, prospective, observational study conducted in patients clinically diagnosed of chronic sinusitis, referred to the department of' Radio diagnosis. The patients were divided into two groups: those who have minimal to no apparent paranasal sinus disease or nasal passage obstruction and those who had evidence of clinically significant paranasal sinus disease or nasal passage obstruction. **Result:** Out of 192 patients with chronic rhinosinusitis, 105(54.6%) had radiological evidence of minimal to no disease whereas evidence of significant disease was found in 87(45.31%) cases. The most common anatomical variant observed was nasal septal deviation which was present in 96.87% of the total study group followed by agger nasi cells (82.30%), sphenoid sinus extension into posterior nasal septum (75%) and pneumatization posterior to floor of sella turcica (63.02%). Comparison of prevalence of anatomical variants between minimal and significant paranasal disease was done and no statistically significant difference was found. (p value =0.09 – 0.93). There was no statistically significant difference in the proportion of bilateral anatomic variants between the minimal and significant disease groups. (p value =0.16 – 0.78). **Conclusion:** There was no significant difference in the occurrence of any of the paranasal sinus or nasal cavity variations between patients with mild and clinically significant radiologic evidence of chronic rhinosinusitis.

INTRODUCTION

Chronic rhinosinusitis (with or without nasal polyps) in adults is defined as: presence of two or more symptoms, one of which should be either nasal blockage / obstruction / congestion or nasal discharge (anterior / posterior nasal drip), facial pain/pressure &/or reduction or loss of smell; for >12 weeks.[1] Anatomic variations are an important predisposing cause for sinus disease as these variations can compromise already narrow drainage pathways and produce significant obstruction but they do not represent disease status per se.[2,3]

For the better visualization of bone anatomy and anatomic variations, CT is obviously superior than MRI. The prevalence and degree of sinonasal illness, the nature of sinonasal secretions, and the presence of any intrasinus calcifications can all be seen on a CT scan.[4,5] As a result, CT is the ideal method for evaluating the paranasal sinuses prior to surgery and the gold standard for identifying inflammatory sinus disease caused by blockage.

Failure to recognize specific anatomic variants is a major cause of surgical complications, and radiologists have a responsibility to comment on the presence of these variants in order to reduce the risk

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of surgical complications. Present study was aimed to compare sinonasal anatomic variants between patients with minimal to no apparent imaging evidence of rhinosinusitis and those with radiologic evidence of clinically significant rhinosinusitis using multi detector Computed Tomography.

MATERIALS AND METHODS

Present study was Hospital based, prospective, observational study conducted in Department of Radio diagnosis, Assam Medical College & Hospital, Dibrugarh, India. Study duration was of One year (July 2020 to June 2021). Study approval was obtained from institutional ethical committee.

Inclusion Criteria

- Patients clinically diagnosed of chronic sinusitis, referred to the department of' Radio diagnosis, willing to participate in present study

Exclusion Criteria

- Patients with history of trauma, sinus surgery and sinonasal tumors,
- Pediatric patients less than 12 years.
- Patients with contraindications for CT like pregnancy.
- Patients not giving consent.

Study was explained to patients in local language & written consent was taken for participation & study. Patient's demographic details, clinical history, symptoms, duration of symptoms, examination findings were noted.

Images are obtained using Philips Brilliance ICT 256 CT scanner with an FOV of 14-16cm and a slice thickness of 0.625mm. Patient was positioned supine with head first and axial sections were captured with helix type of scan by fixing the tube current at 120kVp and 230 mAs. The axial plane was the inferior orbital meatal plane (anthropologic plane). Coronal and sagittal reconstructions were post processed. The CT scans were evaluated for the presence of anatomic variants of the sinonasal cavities. The CT scans were also be evaluated for degree of paranasal sinus and nasal cavity disease.

The patients were divided into two groups: those who have minimal to no apparent paranasal sinus disease or nasal passage obstruction and those who had evidence of clinically significant paranasal sinus disease or nasal passage obstruction. Minimal disease is defined as less than 1mm mucosal thickening with no obstruction of sinus drainage passages.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

RESULTS

Out of 192 patients with chronic rhinosinusitis, 105(54.6%) had radiological evidence of minimal to no disease whereas evidence of significant disease was found in 87(45.31%) cases. Among cases with radiological evidence of minimal to no disease, maximum number falls in the age group of 41-50yrs (28.57%) whereas among cases of significant disease maximum number of patients were in age group of 61-70years (33.3%). Mean age group for minimal to no disease group was 42.70 ± 15.28 years and that of significant disease group was 50.90 ± 17.89 years.

Gender distribution was found to be almost equal in both minimal and significant disease groups. Among 105 cases with minimal disease, 53 (50.48%) were male and 52(49.52%) were females and among 87 with significant disease 45 (51.72%) were males and 42 (48.28%) were females.

The most common anatomical variant observed was nasal septal deviation which was present in 96.87% of the total study group followed by agger nasi cells (82.30%), sphenoid sinus extension into posterior nasal septum (75%) and pneumatization posterior to floor of sella turcica (63.02%).

In patients with minimal to no disease most commonly observed anatomical variant was nasal septal deviation (96.19%), followed by agger nasi cell (82.86%), sphenoid sinus extension into posterior nasal septum (78.10%) and pneumatization posterior to floor of sella turcica (63.81%). in significant disease category also most commonly observed anatomical variant was nasal septal deviation (97.70%) followed by agger nasi cell (71%), sphenoid sinus extension into posterior nasal septum (62%) and pneumatization posterior to floor of sella turcica (54%). Comparison of prevalence of anatomical variants between minimal and significant paranasal disease was done and no statistically significant difference was found. (p value =0.09 – 0.93).

Sinonasal anatomic variants in minimal disease patients were evaluated for bilateral presence. Among these 71.4% of pneumatised hard palate showed bilaterality, 68.97% of agger nasi and 60.98% of partially pneumatized middle turbinates also showed bilaterality. Anatomical variants like Pneumatised hard palate, agger nasi and partially pneumatized middle turbinates when present tend to show frequent bilaterality.

Sinonasal anatomic variants in significant disease patients were evaluated for bilateral presence. Among these 92.31% of pneumatised hard palate, 73.24% of agger nasi cells and 64% each of pneumatized superior turbinate and partially pneumatized middle turbinates showed bilaterality.

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Table 1: Age & gender wise distribution

	Minimal Disease		Significant Disease	
	n	%	n	%
Age Group (in years)				
≤20	8	7.62	1	1.15
21–30	22	20.95	15	17.24
31–40	16	15.24	6	6.90
41–50	30	28.57	19	21.84
51–60	18	17.14	17	19.54
61–70	11	10.48	29	33.33
Gender				
Male	53	50.48	45	51.72
Female	52	49.52	42	48.28

Table 2: Frequency of sinonasal anatomic variants

Sinonasal anatomic variants	Minimal disease (n = 105)		Significant disease (n = 87)		Total		p value*
	n	%	n	%	n	%	
Nasal Septal Deviation	101	96.19	85	97.70	186	96.87	0.5492
Agger Nasi Cell	87	82.86	71	81.61	158	82.30	0.8216
Sphenoid Sinus Extension into Posterior Nasal Septum	82	78.10	62	71.26	144	75	0.2765
Pneumatization Posterior to Floor of Sella Turcica	67	63.81	54	62.07	121	63.02	0.8036
Prominent Ethmoidal Bulla	48	45.71	36	41.38	84	43.75	0.5467
Infraorbital Ethmoidal (Haller) Cell	37	35.24	36	41.38	73	38.02	0.3828
Partially Pneumatized Middle Turbinates	41	39.05	28	32.18	69	35.93	0.3238
Nasal Septal Spur	35	33.33	26	29.89	61	31.77	0.6095
Supraorbital Cell	24	22.86	28	32.18	52	27.08	0.1477
Pneumatized Pterygoid Process	26	24.76	24	27.59	50	26.04	0.6571
Pneumatized Superior Turbinate	31	29.52	17	19.54	48	25.00	0.1118
Concha Bullosa	24	22.86	24	27.59	48	25.00	0.4513
Pneumatized Anterior Clinoid Process	14	13.33	17	19.54	31	16.14	0.2446
Paradoxically Bent Middle Turbinate	14	13.33	14	16.09	28	14.5	0.5898
Pneumatized Hard Palate	14	13.33	13	14.94	27	14.06	0.7495
Uncinate Cells	17	16.19	7	8.05	24	12.50	0.0894
Sphenoethmoidal (Onodi) Cells	12	11.43	11	12.64	23	11.97	0.7963
Pneumatized Crista Galli	10	9.52	8	9.20	18	9.37	0.9381
Pneumatized Inferior Turbinate	1	0.95	1	1.15	2	1.04	0.8935
Dehiscent Lamina Papyracea	0	0.00	0	0.00	0	0.00	–

Table 3: Bilateral presence of Sinonasal anatomic variants in minimal disease

Sinonasal anatomic variants	Minimal disease		Bilateral	
	n	%	n	%
Nasal Septal Deviation	101	96.19	–	–
Agger Nasi Cell	87	82.86	60	68.97
Sphenoid Sinus Extension into Posterior Nasal Septum	82	78.10	3	3.66
Pneumatization Posterior to Floor of Sella Turcica	67	63.81	–	–
Prominent Ethmoidal Bulla	48	45.71	24	50.00
Infraorbital Ethmoidal (Haller) Cell	37	35.24	14	37.84
Partially Pneumatized Middle Turbinates	41	39.05	25	60.98
Nasal Septal Spur	35	33.33	–	–
Supraorbital Cell	24	22.86	8	33.33
Pneumatized Pterygoid Process	26	24.76	8	30.77
Pneumatized Superior Turbinate	31	29.52	15	48.39
Concha Bullosa	24	22.86	11	45.83
Pneumatized Anterior Clinoid Process	14	13.33	4	28.57
Paradoxically Bent Middle Turbinate	14	13.33	2	14.29
Pneumatized Hard Palate	14	13.33	10	71.43
Uncinate Cells	17	16.19	3	17.65
Sphenoethmoidal (Onodi) Cells	12	11.43	–	–
Pneumatized Crista Galli	10	9.52	–	–
Pneumatized Inferior Turbinate	1	0.95	–	–
Dehiscent Lamina Papyracea	0	0.00	–	–

Table 4: Bilateral presence of Sinonasal anatomic variants in significant disease

Sinonasal anatomic variants	Significant disease		Bilateral	
	n	%	n	%
Nasal Septal Deviation	85	97.70	–	–
Agger Nasi Cell	71	81.61	52	73.24
Sphenoid Sinus Extension into Posterior Nasal Septum	62	71.26	3	4.84
Pneumatization Posterior to Floor of Sella Turcica	54	62.07	–	–
Prominent Ethmoidal Bulla	36	41.38	13	36.11
Infraorbital Ethmoidal (Haller) Cell	36	41.38	18	50.00

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Partially Pneumatized Middle Turbinates	28	32.18	18	64.29
Nasal Septal Spur	26	29.89	–	–
Supraorbital Cell	28	32.18	12	42.86
Pneumatized Pterygoid Process	24	27.59	10	41.67
Pneumatized Superior Turbinate	17	19.54	11	64.71
Concha Bullosa	24	27.59	7	29.17
Pneumatized Anterior Clinoid Process	17	19.54	8	47.06
Paradoxically Bent Middle Turbinate	14	16.09	3	21.43
Pneumatized Hard Palate	13	14.94	12	92.31
Uncinate Cells	7	8.05	3	42.86
Sphenoethmoidal (Onodi) Cells	11	12.64	–	–
Pneumatized Crista Galli	8	9.20	–	–
Pneumatized Inferior Turbinate	1	1.15	–	–

There was no statistically significant difference in the proportion of bilateral anatomic variants between the minimal and significant disease groups. (p value =0.16 – 0.78)

Table 5: Comparison of bilateral variants in the minimal and significant sinonasal disease groups

Sinonasal anatomic variants	Minimal disease		Significant disease		p value*
	n	%	n	%	
Pneumatized Hard Palate	10	71.43	12	92.31	0.1628
Agger Nasi Cell	60	68.97	52	73.24	0.5563
Partially Pneumatized Middle Turbinates	25	60.98	18	64.29	0.7805
Prominent Ethmoidal Bulla	24	50	13	36.11	0.2044
Pneumatized Superior Turbinate	15	48.39	11	64.71	0.2778
Concha Bullosa	11	45.83	7	29.17	0.233
Infraorbital Ethmoidal (Haller) Cell	14	37.84	18	50	0.2951
Supraorbital Cell	8	33.33	12	42.86	0.4816
Pneumatized Pterygoid Process	8	30.77	10	41.67	0.4225
Pneumatized Anterior Clinoid Process	4	28.57	8	47.06	0.2929
Uncinate Cells	3	17.65	3	42.86	0.1948
Paradoxically Bent Middle Turbinate	2	14.29	3	21.43	0.6217
Sphenoid Sinus Extension into Posterior Nasal Septum	3	3.66	3	4.84	0.7256

*Fisher Exact /Chi-square Test; The p-value is not significant at 5% level of significance.

DISCUSSION

The knowledge of sinonasal anatomic variants is important before planning surgery to avoid injury to nearby structures such as orbit and brain.[3,6] The most common anatomic variations seen are nasal septal deviation, agar nasi cells, sphenoethmoidal cells (onodi cells), infra orbital ethmoidal cells (haller cells), nasal septal deviation and concha bullosa.[7]

Failure to recognise anatomic variants such as onodi cells, pneumatistaion of anterior clinoid processes, supra orbital cells, haller cells, pneumatisation of dorsum sella and dehiscence of lamina payracea can lead to complications during surgery due to proximity to blood vessels, nerves, brain and orbit.[8,9]

In present study, the most prevalent sinonasal anatomical abnormality was a deviated nasal septum, which was found in 96.87 percent of participants. Our nasal septal deviation prevalence is between 80 to 98 percent, as previously reported.[10,11] Agger nasi cells was the second most common anatomical variant in our study which was found in 82.30% of patients which was within a range of 73 – 84% according to previous studies.[7,10,11] Agger nasi was also the second most common bilateral variant in our study. Extension of the sphenoid sinuses into the posterior nasal septum, leading to areas of pneumatization of the posterior nasal septum, was the third most prevalent anatomical variant in our analysis (75 percent). Sphenoid sinus pneumatization extending posterior to the floor of the sella turcica was the fourth most common variant which was found in 63.02%. Sellar floor pneumatization was found in 69% of patients in one study.[12] Prominent ethmoidal bullae had a prevalence of 43.75% in our study, which is higher than the 28–35% reported in the literature.[5,13]

In our study, 37.5 percent of concha bullosa was bilateral. The prevalence of pneumatization of the superior turbinates in our study was 26.0 percent, which is within the previously reported range of 25–40 percent.[13,14,15] Only two patients had pneumatized inferior turbinates, confirming previous reports that this is a rare variant with at least 10 cases reported.[14]

Two studies showed no increase in incidence of paranasal sinus disease in patients with nasal septal deviation or concha bullosa.[16,17] One study showed no increase in incidence of Agger nasi cells in frontal sinus disease.[7] There was no significant association between maxillary sinusitis and infraorbital ethmoidal (Haller) cells in one study3. Patients had symptoms of some of the anatomic variants but no imaging evidence of clinically significant rhinosinusitis. Contact between a massively pneumatized turbinate and nasal mucosa, for example, can result in a headache without any signs of sinusitis.[1]

When considering functional endoscopic sinus or other skull base surgery, the presence of particular anatomical variants is critical since it may influence the surgical technique. When opening the sella in a

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transsphenoidal approach, knowing the midline of a heavily pneumatized sphenoid sinus is critical to prevent unwanted injury to the carotid artery and optic nerves.[12] In patients with postsellar pneumatization from the sphenoid sinus, particularly pneumatization of the dorsum sella, penetration of the posterior wall of the sphenoid with subsequent CSF leak can occur after transsphenoidal pituitary surgery.[12]

Patients with clinically significant sinusitis have been reported to have no or minimal evidence of sinusitis on imaging. In one study,18 34% of patients with symptomatic chronic rhinosinusitis had normal CT findings, and another 10% had minimally abnormal findings. In another study,[19] 40% of patients with symptomatic chronic rhinosinusitis had normal imaging findings. One of the limitations in our study was that the categorization of patients into minimal and clinically significant disease groups were based on imaging findings and not on clinical data. Patients with clinically significant sinusitis have been reported to have no or minimal evidence of sinusitis on imaging.

As a result, it is better to assume that all patients undergoing CT for chronic rhinosinusitis will be undergoing surgery and to include the presence of anatomic variants in their reports, such as Onodi cells, pneumatization of anterior clinoid processes, supraorbital cells, Haller cells, pneumatization of the dorsum sella, and dehiscence of the lamina papyracea. Failure to recognise specific anatomic variants is a major cause of surgical complications, and radiologists have a responsibility to comment on the presence of these variants in order to reduce the risk of surgical complications. Our findings, as well as those of several other studies, suggest that a relationship between sinonasal anatomic variations and rhinosinusitis is a common misconception.

CONCLUSION

There was no significant difference in the occurrence of any of the paranasal sinus or nasal cavity variations between patients with mild and clinically significant radiologic evidence of chronic rhinosinusitis. Variants like Sphenoethmoidal (Onodi) cells, pneumatization of anterior clinoid processes, supraorbital cells, infraorbital ethmoidal (Haller) cells, pneumatization of the dorsum sella, and dehiscence of the lamina papyracea can be diagnosed on CT scan, all should be considered important for patients considering functional endoscopic or other skull base surgery. A higher rate of surgical complications is linked to failure to detect these variations.

REFERENCES

1. Fokkens WJ, Lund VJ, Hopkins C, Hellings PW, Kern R, Reitsma S, et al. European Position Paper on Rhinosinusitis and Nasal Polyps 2020. Rhinology. 2020;58(Suppl S29):1-464. doi: 10.4193/Rhin20.600.
2. Kantarci M, Karasen RM, Alper F, Onbas O, Okur A, Karaman A. Remarkable anatomic variations in paranasal sinus region and their clinical importance. Eur J Radiol. 2004;50(3):296-302. doi: 10.1016/j.ejrad.2003.08.012.
3. Mathew R, Omami G, Hand A, Fellows D, Lurie A. Cone beam CT analysis of Haller cells: prevalence and clinical significance. Dentomaxillofac Radiol. 2013;42(9):20130055. doi: 10.1259/dmfr.20130055.
4. Fadda GL, Rosso S, Aversa S, Petrelli A, Ondolo C, Succo G. Multiparametric statistical correlations between paranasal sinus anatomic variations and chronic rhinosinusitis. Acta Otorhinolaryngol Ital. 2012;32(4):244-51.
5. Azila A, Irfan M, Rohaizan Y, Shamim AK. The prevalence of anatomical variations in osteomeatal unit in patients with chronic rhinosinusitis. Med J Malaysia. 2011;66(3):191-4.
6. Driben JS, Bolger WE, Robles HA, Cable B, Zinreich SJ. The reliability of computerized tomographic detection of the Onodi (Sphenoethmoid) cell. Am J Rhinol. 1998;12(2):105-11. doi: 10.2500/105065898781390325.
7. Eweiss AZ, Khalil HS. The prevalence of frontal cells and their relation to frontal sinusitis: a radiological study of the frontal recess area. ISRN Otolaryngol. 2013;2013:687582. doi: 10.1155/2013/687582.
8. Comer BT, Kincaid NW, Smith NJ, Wallace JH, Kountakis SE. Frontal sinus septations predict the presence of supraorbital ethmoid cells. Laryngoscope. 2013;123(9):2090-3. doi: 10.1002/lary.23705.
9. Mikami T, Minamida Y, Koyanagi I, Baba T, Houkin K. Anatomical variations in pneumatization of the anterior clinoid process. J Neurosurg. 2007;106(1):170-4. doi: 10.3171/jns.2007.106.1.170.
10. Azila A, Irfan M, Rohaizan Y, Shamim AK. The prevalence of anatomical variations in osteomeatal unit in patients with chronic rhinosinusitis. Med J Malaysia. 2011;66(3):191-4.
11. Shpilberg KA, Daniel SC, Doshi AH, Lawson W, Som PM. CT of Anatomic Variants of the Paranasal Sinuses and Nasal Cavity: Poor Correlation With Radiologically Significant Rhinosinusitis but Importance in Surgical Planning. AJR Am J Roentgenol. 2015;204(6):1255-60. doi: 10.2214/AJR.14.13762.
12. Hamid O, El Fiky L, Hassan O, Kotb A, El Fiky S. Anatomic Variations of the Sphenoid Sinus and Their Impact on Trans-sphenoid Pituitary Surgery. Skull Base. 2008;18(1):9-15. doi: 10.1055/s-2007-992764.
13. Sivasli E, Sirikçi A, Bayazýt YA, Gümüsburun E, Erbagci H, Bayram M, et al. Anatomic variations of the paranasal sinus area in pediatric patients with chronic sinusitis. Surg Radiol Anat. 2003;24(6):400-5. doi: 10.1007/s00276-002-0074-x.
14. Braun H, Stammberger H. Pneumatization of turbinates. Laryngoscope. 2003;113(4):668–72.
15. Kanowitz SJ, Nusbaum AO, Jacobs JB, Lebowitz RA. Superior turbinate pneumatization in patients with chronic rhinosinusitis: prevalence on paranasal sinus CT. Ear Nose Throat J. 2008;87(10):578-9.
16. Stallman JS, Lobo JN, Som PM. The incidence of concha bullosa and its relationship to nasal septal deviation and paranasal sinus disease. AJNR Am J Neuroradiol. 2004;25(9):1613-8.
17. Smith KD, Edwards PC, Saini TS, Norton NS. The prevalence of concha bullosa and nasal septal deviation and their relationship to maxillary sinusitis by volumetric tomography. Int J Dent. 2010;2010:404982. doi: 10.1155/2010/404982.
18. Hwang PH, Irwin SB, Griest SE, Caro JE, Nesbit GM. Radiologic correlates of symptom-based diagnostic criteria for chronic rhinosinusitis. Otolaryngol Head Neck Surg. 2003;128(4):489-96. doi: 10.1016/s0194-5998(02)23295-7.
19. Ferguson BJ, Narita M, Yu VL, Wagener MM, Gwaltney JM Jr. Prospective observational study of chronic rhinosinusitis: environmental triggers and antibiotic implications. Clin Infect Dis. 2012;54(1):62-8. doi: 10.1093/cid/cir747.

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