RESEARCH

RADIOLOGICAL ASSESSMENT OF SINONASAL ANATOMIC VARIANTS USING 256 SLICE MULTIDETECTOR COMPUTED TOMOGRAPHY IN PATIENTS WITH CHRONIC RHINOSINUSITIS

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Abstract

Background: Computed tomography plays an important role as diagnostic tool and for preoperative planning of paranasal sinuses. 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. The purpose of this study was to radiologically assess sinonasal anatomic variants using 256 slice multidetector computed tomography in patients with chronic rhinosinusitis. **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. **Result:** In present study, 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 (96.87 %) 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 significant association found between severity of nasal septal deviation and significant sinus disease. (p value = 0.7587). **Conclusion:** 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 should all be considered important for patients considering functional endoscopic or other skull base surgery.

INTRODUCTION

Computed tomography plays an important role as diagnostic tool and for preoperative planning of paranasal sinuses.[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]

The knowledge of sinonasal anatomic variants is important before planning surgery to avoid injury to nearby structures such as orbit and brain.[3,4] 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.[5]

Failure to recognize anatomic variants such as onodi cells, pneumatization of anterior clinoid processes, supra orbital cells, haller cells, pneumatization of dorsum sella and dehiscence of lamina payracea can lead to complications during surgery due to proximity to blood vessels, nerves, brain and orbit.[6,7] The purpose of this study was to radiologically assess sinonasal anatomic variants using 256 slice multidetector computed tomography in patients with chronic rhinosinusitis.

MATERIALS AND METHODS

Present study was Hospital based, prospective, observational study conducted in Department of

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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. The scheme started with patient's serial number, name, age, sex, hospital/ MRD number, date of examination. A case history was taken through a structured questionnaire, first symptoms, and duration of symptoms then regarding socio demographic factors.

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. Following anatomic variants were evaluated

1. Nasal Septal Deviation
2. Agger Nasi Cell
3. Sphenoid Sinus Extension into Posterior Nasal Septum
4. Pneumatization Posterior to Floor of Sella Turcica
5. Prominent Ethmoidal Bulla
6. Infraorbital Ethmoidal (Haller) Cell
7. Partially Pneumatized Middle Turbinates
8. Nasal Septal Spur
9. Supraorbital Cell
10. Pneumatized Pterygoid Process
11. Pneumatized Superior Turbinate
12. Concha Bullosa
13. Pneumatized Anterior Clinoid Process
14. Paradoxically Bent Middle Turbinate
15. Pneumatized Hard Palate
16. Uncinate Cells
17. Sphenoethmoidal (Onodi) Cells
18. Pneumatized Crista Galli
19. Pneumatized Inferior Turbinate
20. Dehiscent Lamina Papyracea

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

In present study, out of 192 patients, maximum number falls in the age group of 41-50yrs (25.52%) followed by age group of 61-70years (20.83 %). Mean age was 50.90 ± 17.89 years. Among study group male female distribution was almost equal, 98 were male and 94 were females. Gender distribution was found to be almost equal in both minimal and significant disease groups. 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 (96.87 %) 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%).

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.

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). Also, there was no significant association found between severity of nasal septal deviation and significant sinus disease.

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)

There was no significant association found between severity of nasal septal deviation and significant sinus disease. (p value = 0.7587)

Table 1: General characteristics

Characteristic	Frequency	Percentage
Age group (in years)		
≤20	9	4.69%
21–30	37	19.27%

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31–40	22	11.46%
41–50	49	25.52%
51–60	35	18.23%
61–70	40	20.83%
Total	192	
(Mean ± SD)	50.90 ± 17.89 years	
Gender		
Male	98	51.04%
Female	94	48.96%
Chronic rhinosinusitis		
Minimal disease	105	54.69%
Significant disease	87	45.31%

Table 2: Frequency of sinonasal anatomic variants

Sinonasal anatomic variants	No. Of patients	
	n	%
Nasal Septal Deviation	186	96.87
Agger Nasi Cell	158	82.30
Sphenoid Sinus Extension into Posterior Nasal Septum	144	75
Pneumatization Posterior to Floor of Sella Turcica	121	63.02
Prominent Ethmoidal Bulla	84	43.75
Infraorbital Ethmoidal (Haller) Cell	73	38.02
Partially Pneumatized Middle Turbinates	69	35.93
Nasal Septal Spur	61	31.77
Supraorbital Cell	52	27.08
Pneumatized Pterygoid Process	50	26.04
Pneumatized Superior Turbinate	48	25.00
Concha Bullosa	48	25.00
Pneumatized Anterior Clinoid Process	31	16.14
Paradoxically Bent Middle Turbinate	28	14.5
Pneumatized Hard Palate	27	14.06
Uncinate Cells	24	12.50
Sphenoethmoidal (Onodi) Cells	23	11.97
Pneumatized Crista Galli	18	9.37
Pneumatized Inferior Turbinate	2	1.04

Table 3: Anatomic variants in the minimal and significant sinonasal disease groups

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

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

Table 4: Comparison of bilateral variants in minimal and significant sinonasal disease groups

Sinonasal anatomic variants	Minimal disease		Significant disease		p value*
	n	%	n	%	
Agger Nasi Cell	60	68.97	52	73.24	0.5563
Sphenoid Sinus Extension into Posterior Nasal Septum	3	3.66	3	4.84	0.7256
Prominent Ethmoidal Bulla	24	50.00	13	36.11	0.2044
Infraorbital Ethmoidal (Haller) Cell	14	37.84	18	50.00	0.2951
Partially Pneumatized Middle Turbinates	25	60.98	18	64.29	0.7805
Supraorbital Cell	8	33.33	12	42.86	0.4816
Pneumatized Pterygoid Process	8	30.77	10	41.67	0.4225

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Pneumatized Superior Turbinate	15	48.39	11	64.71	0.2778
Concha Bullosa	11	45.83	7	29.17	0.2330
Pneumatized Anterior Clinoid Process	4	28.57	8	47.06	0.2929
Paradoxically Bent Middle Turbinate	2	14.29	3	21.43	0.6217
Pneumatized Hard Palate	10	71.43	12	92.31	0.1628
Uncinate Cells	3	17.65	3	42.86	0.1948

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

Table 5: Comparison of nasal septal deviation in minimal & significant sinonasal disease groups

Nasal septal deviation (in mm)	Minimal disease		Significant disease		p value*
	n	%	n	%	
>1	64	63.37	52	61.18	
≤1	37	36.63	33	38.82	0.7587
Total	101	100.00	85	100.00	

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

DISCUSSION

Rhinosinusitis is currently defined by the European position paper on rhinosinusitis and nasal polyps (EPOS) as a clinical diagnosis based on the presence of certain symptoms and objective evidence of mucosal inflammation.[8] Chronic sinusitis is a complication of acute sinusitis that is resistant to therapy and is caused by blockage of the normal mucociliary outflow of paranasal sinuses.

For all patient who comes with sinusitis, imaging is not usually suggested or performed. Diagnostic imaging for patients with acute or subacute sinusitis should be avoided unless an intraorbital or cerebral complication is feared, according to the American Academy of Otolaryngology's clinical practice guidelines from 2007. Imaging is indicated in individuals who do not respond to medical treatment, have recurrent sinusitis or when alternative diagnosis of neoplasia or fungal infection is suspected in cases with unilateral recurring disease.[9]

In our analysis, the most prevalent sinonasal anatomical abnormality was a deviated nasal septum (96.87 %). 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 (82.3 %), which was within a range of 73 – 84% according to previous studies.[5,10,11]

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 (75 %). Sphenoid sinus pneumatization extending posterior to the floor of the sella turcica was the fourth most common variant (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.[13,14] This could be due to the lack of objective criteria for determining the size of the ethmoidal bullae.

Uncinate cells has a prevalence of 12.5%, which according to the literature occur in 7–14% of patients.[11,13,14] The prevalence of Haller cells in our study was 38.02% it falls within the 32–40% reported range,[11,12] as was the prevalence of supraorbital cells that is 27.08% (24–35% previously reported),[6] Onodi cells at 11.97% (8–20% previously reported),[11,12,13] and a pneumatized crista galli at 9.37% (8-13% previously reported).[13,14,15] Pneumatization of anterior clinoid process has a prevalence of 16.14% which falls within the range of 5 to 15% described in literature.[8,16,17] There was 26.4% prevalence of pneumatization of pterygoid process which falls within the previously reported range of 21 to 30%.[13,17]

Cocha bullosa has a prevalence of 25 % in which the previously reported range is 14 – 32%,[10,13,18] pneumatized lamina of the middle turbinate at 35.93% (30–46.2% previously reported) and paradoxically bent middle turbinates at 14.5% (13–22% previously reported) was similar to those described in the literature.[10,13,16]

Between the significant and minimal diseases groups in our analysis, there was no statistically significant difference in the prevalence of any nasal cavity or paranasal sinus anatomic variations. There have been several other studies that have come up with similar results, but none of them have found a link between the existence of anatomic variations and imaging evidence of rhinosinusitis.

Majority of the patients in our study had at least one paranasal sinus or nasal cavity anatomic variation. Our study did not look at the relationship between different anatomic variants, which could be a limitation. We then looked at the number of different variants that were bilateral and discovered that there was no significant difference between the minimal and clinically significant rhinosinusitis groups in terms of the frequency of bilateral variants.

Another limitation of our study was that it only looked at the prevalence of pneumatization of the uncinate process, despite the fact that there are multiple additional uncinate process variations.[13] Other variations in the uncinate process include medial deflection (18%) and lateral deflection (20%).[13] We also didn't look at the prevalence of different types of frontal cells, which were found to be unrelated to frontal sinusitis in two separate studies.[5,19]

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Patients with clinically significant sinusitis have been reported to have no or minimal evidence of sinusitis on imaging. In one study,[20] 34% of patients with symptomatic chronic rhinosinusitis had normal CT findings, and another 10% had minimally abnormal findings. In another study,[21] 40% of patients with symptomatic chronic rhinosinusitis had normal imaging findings.

CT scan for patients undergoing surgery for chronic rhinosinusitis, will be helpful to note the presence of anatomic variants, 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 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 of surgical complications.

CONCLUSION

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 should all be considered important for patients considering functional endoscopic or other skull base surgery. 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.

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