



EVALUATION OF ANATOMICAL VARIATIONS OF PARANASAL SINUS REGION-A CASE CONTROL STUDY

Anatomy

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ABSTRACT

Objective: Evaluation of anatomical variations in patients suffering from chronic rhinosinusitis (CRS) and to compare them with normal population. **Design:** This is a case control study. A prospective study of anatomic variations was done on 175 computed tomography (CT) scans of patients with chronic rhinosinusitis. Anatomic variations in control group were assessed by studying 175 CT scans of non-CRS patients. **Results:** Though proportion of almost all anatomical variations was equal in number among chronic rhinosinusitis patients compared to normal individuals, there were statistically not significant. Only there was significant difference in the prevalence of septal deviation and paradoxical middle turbinate, in chronic rhinosinusitis patients compared to normal individuals. Other anatomical variations such as concha bullosa, agger nasi cell, haller cell, onodi cell, uncinate process variations were non-significant in both control and case group. **Conclusion:** Our study reveals that the presence of anatomical variants does not mean a predisposition to sinus pathology. The anatomical variations may predispose to pathological changes only if they are bigger in size. It is important for surgeon to be aware of variations that may predispose patients to increased risk of intraoperative complications.

KEYWORDS

chronic rhinosinusitis; computed tomography; anatomical variations.

INTRODUCTION:

Paranasal Sinus Disease is one of the commonest diseases prevalent all over the world. The disease of the paranasal sinuses especially sinusitis is one of the most common disease treated by primary care physicians. Adults as well as children suffer from common cold 3-4 times/year on an average and 0.5% of viral upper respiratory infections are complicated by sinusitis.¹ Inflammation of the mucosa of the paranasal Sinuses is called sinusitis. The European Academy of Allergology and Clinical Immunology (EAACI) defines chronic rhinosinusitis (CRS) as well-defined as a set of disorders as nasal congestion or nasal blockage lasting for more than 12 weeks accompanied by one of the following symptoms: facial pain or pressure, purulent nasal discharge or post-nasal drip, or hyposmia.²

Some of the anatomical variations such as septum deviation, concha bullosa, paradoxical middle turbinate curvature, agger nasi cell, haller cell, uncinate process variations, could play roles in the etiology of the disease, other such as Onodi cell, anterior clinoid process pneumatization is important for determination of limits during functional endoscopic sinus surgery (FESS). These anatomical variations in the paranasal sinuses may interfere with normal nasal function and predispose to recurrent or chronic sinusitis.³ The incidence of anatomical variations are seen in a normal population is less frequent than in those individuals with chronic sinusitis. Some of the anatomic variants have been reported to be associated with chronic rhinosinusitis, possibly leading to inflammation by obstructing drainage pathways from the sinuses and nasal cavity.^{4,5} However, in some studies no relationship was found between the anatomic variants and sinus diseases. Since there are controversial views with regarding to association between sinonasal anatomical variants and rhinosinusitis in the literature this study was proposed. Very few Indian studies are available for association between anatomical variants and chronic rhinosinusitis. In regard with the above previous mentioned differences in the reports, carried out this study to determine the prevalence of anatomical variations in patients suffering from chronic rhinosinusitis (CRS) and to compare them with normal population.

MATERIALS AND METHODS:

A hospital based prospective, case-control observational study was carried in the department of anatomy, in collaboration with department of otorhinolaryngology and Radio diagnosis, S.M.S medical college, and Hospital, Jaipur. Before starting study all ethical consideration for the subjects were taken in accounts permission was obtained from ethical committee of college. An informed consent was obtained from each patient for inclusion in this study. Total 350 patients were selected

with age ranges between 20 to 70 years in present study. All the subjects were divided into two groups.

Control group: The control group comprising of 175 were chosen from the ENT, non ENT and neurology clinic patients, who had undergone CT scan of the paranasal sinus region for a reason other than chronic rhinosinusitis for example, trauma, evaluation of headache and was not having any evidence of chronic rhinosinusitis.

Case group: The case group comprising 175 patients from otorhinolaryngology department with a clinical diagnosis of chronic rhino sinusitis not responding to medical management, who were referred for a sinus CT scan to Department of Radiodiagnosis of S.M.S medical College and hospital, Jaipur, by ENT specialists.

The CT scans were selected depending on the following inclusion/exclusion criteria:

INCLUSION CRITERIA

- Age was 20-70 years for all subjects.
- Clinical diagnosis of chronic rhino sinusitis for case group.
- Written consent was taken from all participants before study.

EXCLUSION CRITERIA

- Any other disease of paranasal sinus disease was excluded.
- Patients with history of previous nasal surgery
- History of sinonasal malignancy or tumour

Examination Protocol:

Simple random sampling was done by taking every eligible in the study. Patients selected for the study were subjected to detailed history such as: name, age, sex, ethnicity, address, religion, occupation, detailed nasal and sinus symptoms history, duration, throat and ear symptoms, relevant medical history, family history of Sino- nasal disease were completed for each patients. Patients who have one or more of the following symptoms: facial pain, facial fullness, nasal obstruction, nasal discharge, hyposmia or anosmia, headache, fever, fatigue, dental pain, cough and ear pain or fullness more than 12 weeks; suspected chronic rhinosinusitis. CT scan was performed in a Philips ingenuity CT scanner in Soni hospital CT & MRI Centre, S.M.S medical College and hospital, Jaipur. For direct coronal scanning, the patient is placed prone on the scanner table, with the chin hyperextended, taking the hard palate as reference axis. The scanner gantry is angled perpendicular to the hard palate. When direct coronal scanning becomes difficult due to patient's positioning, axial CT images taken with coronal reconstructions are performed. The scans

were recorded in the form of DICOM (Digital imaging and Communications in Medicine) format. The CT scans was evaluated for the presence of anatomical variants of the paranasal sinus region and associated sinusitis. Anatomical findings of each patient was carefully scrutinized and recorded on the patient's data sheet. Analysis is performed using (M.S Excel, SPSS 23.0 trial version). Data will be analyzed in terms of the number, and percentage of the variations of the paranasal sinuses. Two proportions Z test will be applied to assess the significant prevalence between non- sinusitis and sinusitis patients.

RESULTS:

Total 350 patients were selected with age ranges between 20 to 70 years in present study, most common age group to be between 25-35yrs. Out of 175 CRS group 60(34.3%) were female and 115(65.7%) were male. Out of 175 non-CRS group 65 (37.1%) were female and 110(62.9%) were male. When the presenting symptom or chief complaints of the Chronic Rhinosinusitis patients were analyzed, we found that 128 (73.1%) cases had nasal discharge, 135 (77.1%) cases had nasal obstruction, 75 (42.9%) had headache as the main complaint. 60 cases had post nasal discharge, 35 (20.0%) cases had epistaxis, 4 (2.28%) cases had facial pain and 3 (1.71%) cases others symptoms which were include fever, sneezing etc.[Table -1] Maxillary sinus was the most commonly involved (158 patients - 90.3%). This was followed by ethmoid sinus (67 patients -38.3%), the sphenoid sinus (46 patients -26.3 %) and frontal sinuses (30 patients - 17.1%), which was minimally involved. Pansinusitis was in 30 patients (17.1%).[Table 2] Table -3 is showing distribution of anatomical variations between control group and chronic sinusitis group. In present study nasal septal deviation was the most common anatomic variation found in our study. It was observed in 123(70.3%) cases of chronic rhinosinusitis and in 90(51.4%) cases of non-CRS group. The Concha bullosa was observed in 52(29.7%) cases of chronic rhinosinusitis and in 68(38.3%) cases of non-CRS group. Superior concha bullosa was observed in 11(6.3%) and 14(8.0%) cases in CRS and normal group respectively. Paradoxical middle turbinate was observed in 28(16.0%) cases of chronic rhinosinusitis and in 9(5.1%) cases of non-CRS group. The agger nasi cells were observed in 66(37.3%) cases of chronic rhinosinusitis and in 63(36.0%) cases of non-CRS group. Haller cells were observed in 24(13.7%) cases of chronic rhinosinusitis and in 17(9.7%) cases of non-CRS group. Onodi cells were observed in 35(20.0%) cases of chronic rhinosinusitis and in 25(14.3%) cases of non-CRS group. Uncinate Process Pneumatization was observed in 8(4.6%) cases of chronic rhinosinusitis and in 11(6.3%) cases of non-CRS group. Superior attachment of uncinate process was to lamina papyracea48.6%, to middle turbinate 13.7%, to skull base 20.0% and free 17.1% in sinusitis and in control group, attachment was to lamina papyracea50.3%,to middle turbinate 9.7%, to skull base 14.9% and free 25.1%. Anterior clinoid Process Pneumatization was observed in 29(16.6%) cases of chronic rhinosinusitis and in 25(14.3%) cases of non-CRS group. There was no significant difference in the prevalence of anatomical variations in chronic rhinosinusitis patients compared to normal individuals, except septal deviation and paradoxical middle turbinate. (≤ 0.05)

Table 1: Symptom profile of chronic sinusitis patients.

Chief Complaints In Cases (175)	
	Number (%)
Nasal discharge	128(73.1)
Nasal obstruction	135(77.1)
Headache	75(42.9)
Post nasal discharge	60(34.28)
Epistaxis	35(20.0)
Facial pain	4(2.28)
others	3(1.71)

Table 2 : Distribution of the patients according to presence of sinusitis.

CHRONIC RHINOSINUSITIS (175)			
Sinusitis	Side of involvement	Number (%)	Total
Frontal Sinusitis	Right	4(1.14)	30(17.1%)
	Left	3(0.86)	
	Bilateral	23(6.57)	
Ethmoid Sinusitis	Right	23(6.57)	67(38.3%)
	Left	7(2)	
	Bilateral	37(10.57)	
Sphenoid Sinusitis	Right	12(3.43)	46(26.3%)
	Left	4(1.14)	
	Bilateral	30(8.57)	

Maxillary Sinusitis	Right	42(12.0)	158(90.3%)
	Left	40(11.14)	
	Bilateral	76(21.7)	
Pan Sinusitis	Absent	145(82.8)	30(17.1%)
	Present	30(17.1)	

Table 3: Anatomical variations of paranasal sinus using CT scan between Control group and Chronic sinusitis group.

Anatomical variations	Controls Number (%)	Cases Number (%)	Total	Two proportions Z test	
				Z value	P value
Deviated nasal septum	90 (51.4)	123 (70.3)	213 (60.8)	3.680	0.000
Concha bullosa	68 (38.9)	52 (29.7)	120 (34.3)	1.810	0.070
Superior concha bullosa	14 (8.0)	11 (6.3)	25 (7.1)	0.620	0.533
Paradoxical middle turbinate	9 (5.1)	28 (16.0)	37 (10.6)	3.360	0.001
Aggar nasi cell	63 (36.0)	66 (37.7)	129 (36.1)	0.330	0.740
Haller cell	17 (9.7)	24 (13.7)	41 (11.7)	1.170	0.244
Onodi cell	25 (14.3)	35 (20.0)	60 (17.1)	1.420	0.155
Uncinate Process Pneumatization	11 (6.3)	8 (4.6)	19 (5.4)	0.711	0.479
Uncinate Process Attachment To Lamina Papyracea	88 (50.3)	85 (48.6)	173 (49.4)	1.000	0.316
To Middle Turbinate	17 (9.7)	24 (13.7)	41 (11.7)	0.590	0.554
To Skull Base	26 (14.9)	35 (20.0)	61 (17.4)		
Free	44 (25.1)	30 (17.1)	74 (21.1)		
Anterior clinoid process Pneumatization	25 (14.3)	29 (16.6)	54 (15.4)	0.340	0.736
Frontal sinus hypoplasia	5 (2.9)	4 (2.3)	9 (2.6)		

DISCUSSION:

The paranasal sinus region is subject to a large variety of lesions. Congenital anomalies and normal anatomical variations in this region are important as they may have pathological consequence or may be the source of difficulty/ complication during surgery. Stumberger et al proposed that stenosis of the osteomeatal complex, from either the anatomical configuration or hypertrophied mucosa, can cause obstruction and stagnation of secretions that may become infected or perpetuate infection.(Stammberger H et al) Any anatomic abnormality that impedes sinus drainage can potentially cause (chronic) sinus inflammation. Zinreich found that 62% of his patients presented at least one anatomic variant, against 11% in the normal control group. These findings seem to suggest a positive correlation between anatomical variants and the appearance of inflammatory sinus pathology. However, Bolger et al studied on 202 patients by CT and observed in 131 patients with anatomical variants. Bolger et al. and Stammberger & Wolf detected the presence of anatomical variants both in patients studied for sinus problems and in those studied for other reasons. They concluded that the simple presence of variants does not mean a predisposition to sinus pathology, except when other associated factors are present. This opinion is not shared by Yousem, who claimed that the anatomical variants may be predisposing factors, depending on their size.

In a study by Scribno, found the remarkable difference between the prevalence of these anatomic variants among their patients as compared with the normal population lead to the conclusion that these anatomic changes probably increase the risk of sinus inflammatory diseases by bringing the mucosal lining of the osteomeatal unit in contact with the mucosal lining of the paranasal sinuses.

Among the anatomic variants, concha bullosa (especially the larger ones), occur in the vicinity of maxillary sinus infundibulum, and agger nasi cells are close to the frontal sinus recess. Therefore, they can

compress these outlets. (Cummings). It can be proposed that concha bullosa compress hiatus semilunaris that is in continuity with maxillary sinus infundibulum, and the mucosal linings of these parts come into contact this sets the stage for mucosal inflammation, which persist as long as the anatomic abnormality is present, causing chronicity (A. A. Ameri et al). Also in a Swiss study, S-Nadas reported that 35% of 151 patients with chronic sinusitis had middle turbinate concha bullosa, and after resecting the anterior third of the pneumatized turbinate, 80% of the patients showed improvement in their symptoms (Pochon N et al). Moreover, Massegur reported 4 cases of concha bullosa with chronic sinusitis who underwent endoscopic operation on the middle turbinate, and all the 4 patients were relieved of their symptoms.

In A Azila et al study presence of paradoxical middle turbinate 14 in CRS and 27 in controls was possible for a risk for development of chronic rhinosinusitis. Azila et al concluded that the major consequence of paradoxical middle turbinate variations is narrowing of the middle meatus which can lead to obstruction of infundibular drainage. However the degree of convexity of the middle turbinate is the most important factor to cause the obstruction which will lead to rhinosinusitis.

Fadda et al Found that the prevalence of agger nasi cells was 34 (24.3%) patients with chronic paranasal sinusitis which was statistically significant which exclude with present study results probably because this study included one group of patients who had sinusitis without taking another control group to compare the results with it. For the haller cells, normally we do not expect serious pressure effect or a higher prevalence of chronic sinusitis, since they occur away from the osteomeatal unit. In similar studies by Tatli et.al and Unlu et.al, no relationship was found between the anatomic abnormalities and chronic sinusitis.

Identification of some anatomic variants is crucial in the planning of functional endoscopic sinus or other skull base surgery, because the presence of these variants may influence the surgical approach. Most notably, the presence of Onodi cells is associated with increased risk of injury to the optic nerves or carotid arteries during surgery. (Kantarci M et al Nouraei SA et al) Pneumatization of the anterior clinoid process increases the incidence of CSF rhinorrhea after skull base surgery, such as for access to cavernous sinus lesions requiring anterior clinoidectomy. However, there is no significant association between anterior clinoid pneumatization and spontaneous CSF leaks. (Mikami T et al). Pneumatization of the anterior clinoid process also increases the risk of injury to the optic nerve during endoscopic sinus surgery (Nouraei SA et al)

CONCLUSION:

From this observation our study reveals that the presence of anatomical variants does not mean a predisposition to sinus pathology, except when other associated factors are present. There is a limited impact of the anatomic variants on the physiopathology of chronic rhinosinusitis. However, it is important for surgeon to be aware of variations that may predispose patients to increased risk of intraoperative complications.

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