Original Research Article

Study of chronic sinusitis to radiological and diagnostic nasal endoscopic examination findings

V Chandrasekhar[1*], Kireet Yathati[2]

[1]Professor and HOD, [2]Post Graduate
Department of ENT, SV Medical College, Tirupati, India
[*]Corresponding author email: **kireet2000@gmail.com**

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Abstract

Introduction: Chronic sinusitis is a very common problem in ENT practice. Variations have an anatomic and surgical significance, each and every case should be individually studied in detail before surgery to maximize patient benefit and avoid serious complications.
Aim: To study the anatomical variations in relation to radiological findings occurring in nose and PNS in chronic sinusitis patients using CT scan PNS and DNE (Diagnostic nasal endoscopic examination).
Materials and methods: Study done on 50 patients in duration of study 2 years, cases of chronic sinusitis chronic sinusitis with symptoms such as purulent rhinorrhea, nasal congestion, headache, facial pain or pressure persisting beyond 12 weeks who had not demonstrated symptom resolution despite 3-6 weeks antibiotic therapy, with systemic steroids, decongestants and nasal saline irrigation were included in the study.
Results: In this study 42 cases showed anatomical variations out of 50 cases (ranging from 2.3% to 57.1%). Mixed signs and symptoms are most common observation, Incidence of Symptoms ranges from 20% to 90% and Signs ranges from 10% to 90%. More than one sinus bilaterally involved (68%).
Conclusion: CT scan of the paranasal sinuses is the investigation of choice. Diagnostic nasal endoscopic examination is the clinical guide to evaluate the disease and the severity of the anatomical abnormality.

Key words

Chronic sinusitis, CT scan, Paranasal sinuses.

Introduction

Chronic sinusitis is the chronic inflammation of mucous membrane of nose and one or more of Paranasal sinuses. It may be unilateral or bilateral, Acute or chronic. When the symptoms and signs persist for 12 or more weeks with no complete resolution it is said to be chronic [1].
Several authors have assessed the relationship between sinonasal anatomic variants and the incidence of rhinosinusitis [2]. There is now worldwide interest among otolaryngologists in radiological definition of paranasal regional anatomy.

Certain anatomic variations forming the lateral wall of the nose are very important because they can contribute to the blockage of the ostiomeatal units, drainage and ventilation, and can thereby increase the risk of sinus mucosal disease [3]. Moreover, anatomic variants with a potential impact on surgical safety occur frequently and need to be specifically sought as part of preoperative evaluation [4]. Anatomic variations, such as deviation of the nasal septum, concha bullosa or paradoxical middle turbinate, ethmoidal bulla hypertrophic, agger nasi cell, lateral or medial bending of uncinate process (UP) and Haller cell are common and emphasized in routine evaluation of computed tomography (CT) images.

Appropriate radiologic imaging and accurate interpretation play an important role in the diagnosis and management of these conditions. CT plays a central role in the modern management of chronic rhinosinusitis due to its ability to delineate mucosal disease, to demonstrate a primary obstructive pathology and to image distal structures such as the posterior ethmoid sinus that cannot be viewed with direct endoscopy. In this study, we reviewed the CT scans with at least one anatomical variation of a total of 50 cases, suffering from chronic rhinosinusitis to investigate the common and uncommon anatomic variations and correlate them with the presence of radiologic evidence of sinus mucosal disease. Anatomic variants that have a potential impact on surgical safety were also assessed.

Materials and methods

Aim of present was to study these variations a prospective study was conducted at Department of ENT, and Head and Neck Surgery, SVRRGGH, Tirupati. Study was done on 50 patients in duration of study 2 years i.e. October 2012 to October 2014.

Inclusion criteria

Only cases of chronic sinusitis with symptoms such as purulent rhinorrhea, nasal congestion, headache, facial pain or pressure persisting beyond 12 weeks who had not demonstrated symptom resolution despite 3-6 weeks antibiotic therapy, intranasal or systemic steroids, decongestants and nasal saline irrigation were included in the study.

Exclusion criteria

Known cases of facial bone trauma**,** Chronic Sinusitis with complications (viz orbital cellulites, osteomyelitis, meningitis, mucoceles), Malignancies of paranasal sinuses and Patients who either had previous surgery or had invasive diseases.

A detailed clinical history was taken and complete Ear, Nose, Throat, and Head and Neck examination. All hematological investigations, X-ray paranasal sinuses (water's view), CT scan of paranasal sinuses (coronal section with 3mm cuts at OMC) and Diagnostic Nasal Endoscopic examination (DNE): polyps/ discharge / edematous mucosa in middle meatus.

Diagnostic Nasal Endoscopic Examination: Procedure

- Decongestant and anesthetic spray is usually applied to allow full examination of the nasal cavity.
- In nasal endoscopy examination we look for
- Nasal mucosa status (allergic, edema, polyps, crusting), Vestibule, Nasal valve, septum, Inferior turbinate and meatus, Middle turbinate and meatus, hiatus semilunaris, Olfactory groove, Sphenoethmoidal recess, superior turbinate and sphenoid ostium, Choanae and nasopharynx.

Systematic endoscopic examination of the nose is divided into three steps.

- **First pass**- along the floor of the nose to posterior choana for the examining tubal orifice, fossa of rosenumller, nasopharynx, posterior part of septum and inferior nasal meatus.
- **Second pass**-examination of the middle turbinate middle meatus, unicate process, hiatus semilunaris as well as the cleft behind and above the latter. Antero superior direction can examine frontal recess.
- **Third pass** – Examining the middle turbinate to the upper edge of the choana and from here upward into the sphenoethmoid recess. The superior turbinate and possibly a supreme turbinate with their corresponding nasal meatus are visualized (**Photo – 1 to 8**).

Photo – 1: CT PNS showing right DNS.

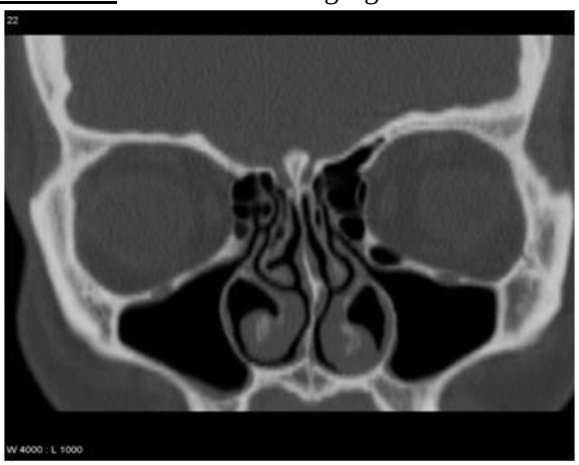

Photo – 2: Right CB and left PMT.

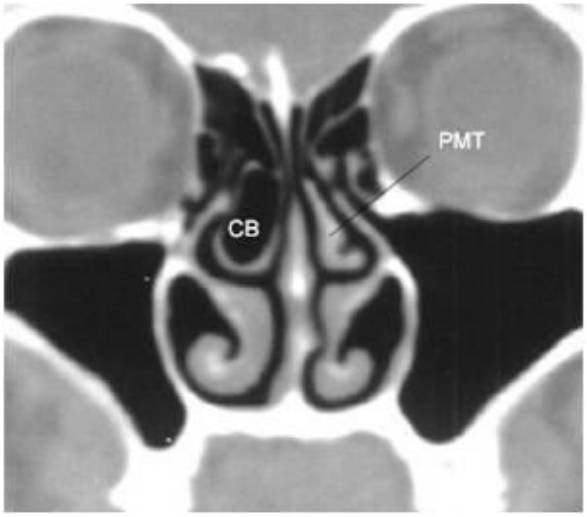

Photo – 3: Haller cells.

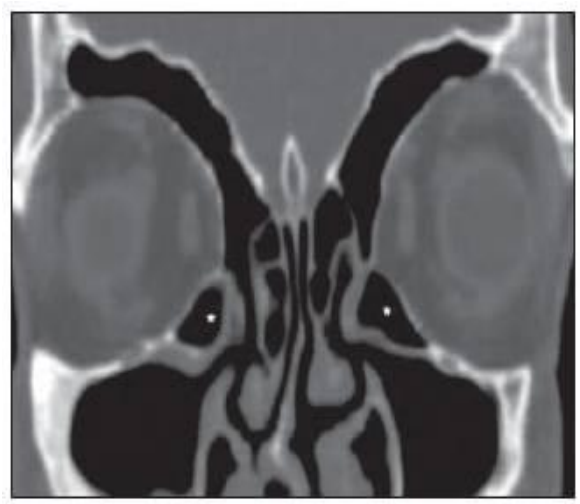

Photo – 4: B/L onidi cell.

Photo – 5: Paradoxical middle turbinate – DNE.

Photo – 6: Double middle turbinate – DNE.

Results

In this study, 42 cases showed anatomical variations out of 50 cases (ranging from 2.3% to 57.1%). The prevalence of Deviations of nasal septum was most common (**Table – 1**).

Mixed Symptoms and Mixed Signs were most commonly observed in study, Incidence of Symptoms ranged from 20% to 90% and Signs ranged from 10% to 90% (**Table – 2**). More than one sinus bilaterally involved (68%) as per **Table - 3**.

Table - 1: Anatomical variations.

Anatomical Variation	Incidence	%
DNS	24/42	57.1
CB	7/42	16.6
Paradoxical MT	2/42	4.7
Double Middle Turbinate	2/42	4.7
Accessory ostium	3/42	7.1
Haller Cell	2/42	4.7
Onidi Cell	1/42	2.3
Prominent agger nasi	1/42	2.3

Table - 2: Symptoms and signs in study.

Symptoms	Incidence	%
Nasal Obstruction	22/50	44
Head Ache	10/50	20
Nasal Discharge	18/50	36
Mixed Symptoms	45/50	90
Signs		
MPD	15/50	30
Polypoidal changes	16/50	32
PND	5/50	10
Sinus Tenderness	14/50	28
Mixed Signs	45/50	90

Table - 3: Involvement of Sinus.

CT Scan PNSPNS	Incidence	%
1 Sinus Involved	6/50	12
>1 Sinus U/L	10/50	20
> 1 B/L Sinus	34/50	68

Discussion

Rhinosinusitis is an extremely prevalent disorder that has a significant impact on the quality of life of affected individuals. Symptoms lasting longer than 12 weeks are classified as chronic. Fewer than 2% of colds in adults and up to 30% of colds in children progress to bacterial RS. The causes of chronic rhinosinusitis are multiple and include infectious (viral, bacterial, and fungal), allergic, anatomic, mucociliary, (e.g., cystic fibrosis, primary or acquired ciliary dyskinesia), and systemic disorders. In chronic sinusitis anatomical variations in nose and paranasal

sinuses are common and these variations must be noted in order to attain a full understanding of pathogenesis and accurate diagnosis of chronic sinusitis.

A total of 50 cases were taken and their various anatomical factors, pathophysiology different variations of lateral wall of nose leading to osteomeatal complex block and their clinical features were studied. The appropriate investigations required for these cases were done & were treated surgically by endoscopic approach. The findings obtained are subjected to comparison with the observation available in the literature.

Improvements in functional endoscopic sinus surgery (FESS) and computed tomography (CT) have concurrently increased interest in the anatomy of the paranasal region. The maxillary sinus was most commonly involved, followed by the anterior ethmoid, frontal sinus, posterior ethmoid and sphenoid sinus. Statistically significant association was found between the presence of common anatomic variations – septal deviation, bilateral concha bullosa, medial deviation of uncinate process, Haller cell, ethmoidal bulla hypertrophic, agger nasi cell – and the presence of sinus mucosal disease.

Anatomic variations of paranasal sinus structures may predispose patients to recurrent sinusitis and, in selected cases, to headache [3]. However, the relative importance of anatomic variations is still a matter of discussion and variable results have been reported [5]. Lerdlum, et al., and Stallman, et al. showed no specific association of anatomic variations in rhinosinusitis, and claimed that local, systemic, environmental factors or intrinsic mucosal disease were more significant in the pathogenesis of rhinosinusitis [6, 7].

Septum

Nasal septal deviation is present in 20-31% of the general population, and severe deviation has been noted as a contributing factor for sinusitis. However, some studies have not demonstrated a causal relationship between nasal septal deviation and sinusitis [8]. DNS has a number of definitions. The present study defined it as any deviation that blocked at least half of the nasal cavity. It may be cartilaginous, osteocartilaginous or osseous. Severe DNS may result in compression of the inferior or middle turbinate, causing obstruction of the normal mucous flow and, consequently, secondary inflammation and infection. DNS was found in 24 (57.1%) cases in the present study. In other studies, this finding ranged from 14.1% to 80%.

Air cells in the nasal septum are commonly found within the posterior portion of the septum and communicate with the sphenoid sinus, allowing PNS infection to spread to these cells. Additionally, if these cells are prominent, they may block the drainage of the middle meatus. In the present study no septal pneumatisation was seen.

Middle turbinate or middle concha:

CB is referred to as pneumatisation of the middle turbinate. The term *concha bullosa* was coined by Zinreich describe pneumatization of the middle turbinate, and its incidence was reported to range from 9% to 20% based on initial anatomical dissections. The significance of this most common anatomic variation of the middle turbinate lies in the potential secondary deformity of the turbinate, which increases the probability of obstruction of the middle meatus and lead to recurrent ethmoid sinusitis [9].

According to Lothrop's researchers, the Concha aeration could be because of three reasons:

- The anterior ethmoid cell originated from middle meatus (55%)
- The posterior ethmoid cell originated from upper meatus (45%)
- The anterior ethmoid cell originated from frontal recess (5%)

Also, in some other CT-scan studies the Concha bullosa was reported in 33%-36% of patients that had chronic sinusitis. Another important point was that in high percentage of aerated Concha

bullosa was as a result of considering any degree of aerated Concha and in lower percentages they just considered the bigger ones.

The present study considered aeration in either site as CB. Presence of CB not only limits the exposure of surgical field, but may also block ostiomeatal complex (OMC) and, hence, sinus disease. Middle turbinate aeration was found in 7 (16.6%) of patients in the present study. Other studies have found prevalence [3, 6, 7] ranging between 4% and 73%. According to data from the literature, the incidence of positive CT findings for concha bullosa varies from 14% to 62%. In particular, incidences of 37.5%, 44% and 48.1%, respectively, were reported by Stallman, et al. [7] and Ozcan, et al. [10]. Multivariate analysis showed that bilateral concha bullosa was associated with sinusitis bilateral maxillary in agreement with previous reports, while other studies found no direct relationship. Stallman JS, et al. reported a significant relationship between the presence of concha bullosa and deviation of the nasal septal on the contralateral side [7].

Paradoxical Middle Turbinate

PMT is a laterally projected curvature of the middle turbinate, which may lead to the narrowing of the middle meatus. Typically, the curved portion of the middle turbinate points toward the nasal septum. In cases where the curvature unusually occurs toward the opposite side, they are called paradoxical turbinates[5] .One study reported PMT as an etiologic factor for chronic rhinosinusitis because it may cause impaired ventilation of the OMC. In the present study PMT was seen in 2 (4.7%) scans.

In the present study, 3 patients were found with paradoxical middle turbinates (6%). Arslan, et al. [11] have found this variant in 3% of cases, Bolger, et al. [12] in 26,1%, Earwaker [13] in 43%, and Tonai and Baba [14] in 28%.. Other studies found it from 11-25% [10-12].

Onidi Cell

Onodi cell is the most posterior ethmoid air cell that extends laterally. This extension is near the carotid canal and close to the optic nerve, which emphasises the clinical importance of considering this anatomic variation prior to any attempt for invasive intervention. Onodi cell was found in 1 (2.3%) patients in the current study. Other studies have reported Onodi cell presence from 0% to 9%).

Infraorbital ethmoid cells or Haller cells

Another common anatomic variant was the presence of infraorbital ethmoid cells, also known as Haller cells. These are found between the maxillary sinus and the orbit and can increase the risk of orbital injury during ethmoidectomy. Haller cells are a clinically significant anatomic variation because they have been implicated as a possible aetiologic factor in recurrent maxillary sinusitis due blockage of the OMC. In previous studies, a variable incidence of Haller cells has been noted. In particular, Kennedy, et al. [15] reported rates of 10%, while Arslan, et al. [11] reported an incidence of 6% and Bolger, et al. [12] an incidence of 45.1%. One study demonstrated a significant increase in maxillary sinus mucosal disease in patients with medium or large Haller's cells (45.8%) versus those with small cells (28.9%) [15]. Other studies, however, found no significant correlation between Haller's cell and chronic sinus disease [16, 17]. In the present study, the prevalence of Haller's cell was 2 (4.7%). In other studies, this finding ranged from 1% to 36% [6, 7, 9].

Agger nasi

The agger nasi is the most superior remnant of the first ethmoturbinate, which persists as a mound or tuberosity immediately anterior and superior to the insertion of the middle turbinate. An agger nasi cell results when this area becomes pneumatized. Agger nasi cells present a close relationship with five different cranial bones: lacrimal bone, maxillary bone, ethmoid bone, frontal bone and nasal bone.

Zinreich, et al. [9], based on their experience with CT of paranasal sinuses, nasal endoscopy

and functional endoscopic surgery, have demonstrated that agger nasi cells are air cells under the frontal sinus extending anterosuperiorly toward the frontal recess, reaching the lacrimal fossa inferolaterally, and laterally adjacent to the nasal bones. Frequently, agger nasi is the antero-inferior border of the frontal recess, and agger nasi aeration may be implied in cases of chronic frontal sinusitis.

The reported prevalence of the agger nasi cell varies widely among investigators. In anatomic dissection, Messerklinger [16] encountered the agger nasi cell in 10- 15% of specimens. Kantarci, et al. [17], however, noted this cell in 47% of specimens, Kennedy and Zinreich noted the presence of the agger nasi cell in nearly all patients evaluated [9, 15]. Similarly, Bolger, et al. reported that it was present in 98.5% of cases [12]. In our study, agger nasi cells were detected in 1 (2.3%) of cases. The incidence rates reported in the literature, from 3% to 100% may in part be related to the different method of analysis employed by Krzeski, et al. [18].

Unicinate Process

The UP is another important structure in relation to paranasal sinus drainage, and the incidence of variations in this structure is generally from 15.9% to 44.3% [1]. In the present study, pneumatization of the uncinate process was found in 0% cases, whereas other authors have reported prevalence rates of 6.3% to 7.4%.Medial deflection of UP was previously described in 3-19% of cases. Herein, it was observed in 0% of patients, while lateral deflection of UP was observed in 0% of cases.

Maxillary Sinus Hypoplasia

Maxillary sinus hypoplasia (MSH) is the most important anatomical variation among those involving the maxillary sinus (MS). MSH typing was done by Bolger, et al. [12]. Since MSH is often associated with orbital enlargement, thickening of the bony sinus wall, mucosal pathology, anterior ethmoidal cell variation or frontal sinus hypoplasia, it is important to identify these anatomical variations for proper surgical planning to prevent complications. The incidence of MS septae was found to vary from 20-31% in previous reports. There was no significant correlation between these anatomical variations and mucosal pathologies, in agreement with literature data.

Hypoplastic Frontal Sinus

Hypoplastic frontal sinus was detected in 18.5% of patients by zinreich's study [9]. Also, in another study in germany the hypoplastic frontal sinus was seen in 2.9% of male and 5.6% of female patients [11] and in this study it was detected in 10.6% of patients (3.4% male and 7.2% of female.). In the present study there is no hypoplastic frontal sinus.

Extensive external approaches and prolonged hospital stays have been replaced by a minimally invasive procedure called endoscopic sinus surgery (FESS). This involves opening the obstructed ostia to provide normal ventilation with preservation of adjacent mucosa and removal of disease. Literature has reported excellent results with ESS. However, due to close proximity of PNS to important structures such as the orbit and the skull base, if complications occur in surgery, they are usually dangerous and harmful. Sinonasal region have many different anatomical variations. Although their role in the development of sinusitis remains unclear, but complete knowledge of these variations is important before the surgical procedure to avoid dreadful complications.

Conclusion

Since all variations have an anatomic and surgical significance, each and every case should be individually studied in detail before surgery to maximise patient benefit and avoid serious complications. CT scan of the paranasal sinuses is the investigation of choice to identify and to study the anatomical abnormality and integrity of nasal bony structures. Diagnostic nasal endoscopic examination is the clinical guide to evaluate the disease and the severity of the

anatomical abnormality. Endoscopic anatomy shows a lot of variations and a CT scan done prior to endoscopic surgery can provide vital information about pathology and also anatomical variations. Concha bullosa is usually associated with a septal deviation in majority of the patients. Most common sinus affected due to anatomical obstruction was maxillary sinus. Nasal obstruction and headache were the common symptoms in majority of the patients.

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