

Relationship between various anatomical variations and maxillary sinusitis by using computed tomography scan

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Abstract

Identifying the predisposing factors is therefore important in understanding the pathophysiology of chronic rhino sinusitis. Main etiology of respiratory CRS includes structural anatomical obstruction, recurrent upper airway infections, common allergies, biofilm formation and less commonly mucosal ciliary dyskinesia, MPS (mucopolysaccharidosis) and cystic fibrosis. These etiological factors which impairs the mucociliary clearance and causes stasis of secretions which constitutes the primary pathophysiology for the chronic rhino sinusitis. CT scan was done for these 100 cases with THOSHIBA Multi detector 16 slice CT machine. 0.5mm high 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. Maxillary sinusitis was seen in 63 cases out of which, 34 cases of maxillary sinusitis were associated with anatomical variations. Ethmoid bulla in 2 cases. Uncinate process pathologies noted in 2 cases.

Keywords: Anatomical variations, maxillary sinusitis, computed tomography

Introduction

In some cases if infection occurs in smaller or larger areas of sub acutely or chronically diseased mucosa which may persist without any significant effects. Frequently these areas are the most common sites for origin of the polyps. Chronic nasal pathologies especially chronic Rhino Sinusitis is a very common condition in ENT practice affecting approximately 1 in 6 of the Indian population^[1]. The chronic nature and the debilitating symptoms of this disease causes significant morbidity which greatly effect on their quality of life. Factors which cause the immunosuppression or any blockage of normal pathway for sinus drainage are also responsible for this condition.

Identifying the predisposing factors is therefore important in understanding the pathophysiology of chronic rhino sinusitis. Main etiology of respiratory CRS includes structural anatomical obstruction, recurrent upper airway infections, common allergies, biofilm formation and less commonly mucosal ciliary dyskinesias, MPS (mucopolysaccharidosis) and cystic fibrosis. These etiological factors which impairs the mucociliary clearance and causes stasis of secretions which constitutes the primary pathophysiology for the chronic rhino sinusitis^[2].

Traditionally, conventional radiography was used to examine the paranasal sinuses. The standard radiographic views for sinuses mainly consist of four views: lateral view, Caldwell's view, Waters view and Sub mento vertex or base views. These views have many drawbacks. They cause superimposition and inability to see all borders clearly, and also lack radiographic evidence regarding soft tissue involvement.

Therefore a better modality is required to provide better information to the surgeon regarding anatomical variants to plan the treatment more effectively and efficaciously^[3, 4].

Radiologic examination of the sinuses is designed to give the additional information which is complementary to clinical findings. Surgeon can only perform Safe, meticulous and complete surgery if he has a sound knowledge of radiological findings and has a ability to interpret them.

CT scan was first introduced in the mid-1970s. Since then they have evolved leaps and bounds in terms of quality and accuracy. The availability of CT scan is constantly increasing now a days in developing countries. They provide greater details than the conventional radiography.

However CT scan use is commonly questioned when it comes to over diagnosing of asymptomatic individuals, cost-effectiveness and a potential radiation hazard that they pose for the patient. However in complex anatomical locations especially for evaluation of inaccessible areas of nose and paranasal sinuses (PNS), CT still is undoubtedly the modality of choice though most of the anatomical variations are identifiable on a CT scan not all contribute to development of sinusitis or other pathological condition^[5].

Stammerger and Wolf^[6]. Concluded that mere presence of anatomical variations doesn't mean a predisposition to sinusitis except when other associated factors are present.

Functional endoscopic sinus surgery is the mainstay in treatment of chronic sinusitis. The application of endoscopy to paranasal sinus surgery is not new and detected by Kennedy *et al.* probably dates to 1901 when Hirschmann used a modified cystoscope to examine the sinuses. Modern paranasal endoscopic sinus surgery may be subjectively divided into the Messerklinger and Wigand approaches. In the Wigand procedure, a total sphenoidectomy and supra-middle turbinate antrostomy are performed. In Messerklinger approach, the surgeon starts at the ethmoid bulla and normally works anteriorly to the frontal recess, this approach has been described as functional surgery. Both the Messerklinger and Wigand approaches share the common idea that once aeration of the sinuses is re-established, mucous membrane will return to its previous state.

The success of FESS (functional endoscopic sinus surgery) depends on understanding the underlying various anatomical variations and their role in pathophysiology of sinusitis and other pathologies. Hence the present study was undertaken to know the various anatomical variations of para nasal sinuses and their predisposition to chronic sinusitis and various pathologies.

Methodology

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. 0.5mm high 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.

Inclusion criteria

- 1) 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.
- 2) 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.

Exclusion criteria

- Facial trauma.
- Previous sinonasal surgery.
- Children under 12 years of age.

Sample size

A total of 100 cases who met the inclusion criteria were taken up in this study.

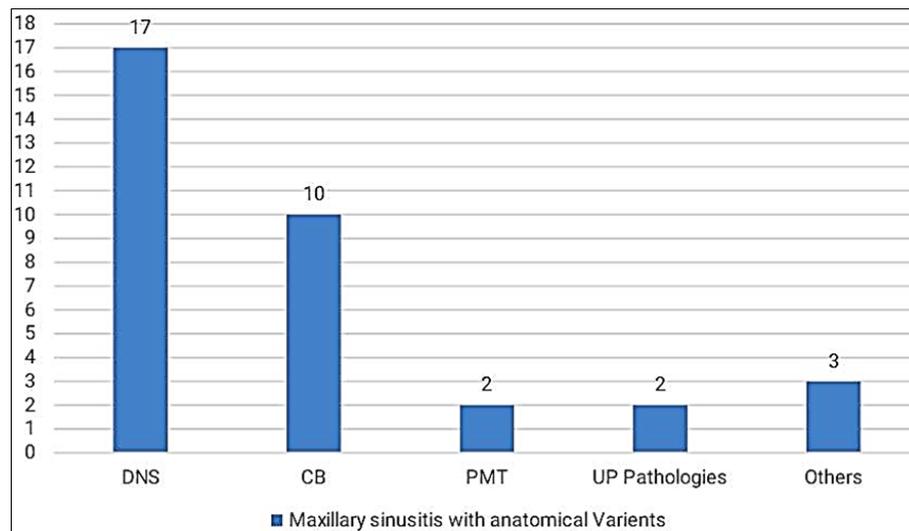
Results

Maxillary sinus was involved in 63% of cases. Right sided maxillary sinusitis was noted in 20.19% of cases left sided was seen in 22.21% and bilateral maxillary sinusitis was found in 27.35% cases.

Table 1: Maxillary Sinus Involvement

Total number of cases with Maxillary Sinus involvement	Left sided maxillary sinus involvement	Right sided Maxillary sinus involvement	Bilateral maxillary sinus involvement
63	22(22.21%)	20(20.19%)	21(21.21%)

Relationship between various anatomical variations and maxillary sinusitis: Maxillary sinusitis was seen in 63 cases out of which, 34 cases of maxillary sinusitis were associated with anatomical variations. Ethmoid bulla in 2 cases. Uncinate process pathologies noted in 2 cases.



Graph 1: Relationship between various Anatomical variations and maxillary sinusitis

In our study DNS and Chocha bullosa, paradoxical middle turbinate and uncinata pathology were found to be associated with maxillary sinusitis. However DNS and choncha bullosa showed statistically significant association with maxillary sinusitis as per P values <0.001, 0.003 respectively.

Discussion

The anatomy of paranasal sinuses has always remained a mystery to man. The literature of anatomy and physiology of paranasal sinuses extends back to Galen (130-201AD) who referred to them as porosity of the bones of the head. He explained them as having been created to make the head less heavy. Bernfeld stated that; “The variability of pneumatization of sinuses of nose is a consequence of manifold processes in the development of the bones of the skull”. Goss states that bony surfaces develop in response to muscular attachment.

Messerklinger observed mucociliary clearance in patients with symptoms by using endoscopies and he had taken time lapse photographs in fresh autopsy specimens. He stated that wherever adjacent two mucosal layers come into contact, there will be a localized disruption in mucociliary clearance, which leads to retention of secretions which ultimately increases risk for infections even in the absence of ostial closure. Anatomically, these areas are middle meatus and ethmoidal air cell system. In chronic and recurrent infections, Messerklinger observed ventilatory defects, these are most commonly found in the middle meatus, anterior and middle ethmoids. Mucosal inflammation and hyperplasia following an infection, as a result of anatomic malformations interrupts the normal mucociliary clearance which leads to potential risk for recurrent infections within the sinuses.

Messerklinger observed retrograde mucociliary drainage from frontal recess of the ethmoid, through internal OS to the frontal sinus causing potential route for spread of infection, based on this he concluded that in majority of cases the infection starts in ethmoids and extends to the maxillary and frontal sinuses causing secondary infection.

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. DNS was the most common anatomical variation with high prevalence rate ranging from 13% to 80% in several studies. A number of studies have been made on the prevalence and incidence of various anatomical variations of the paranasal sinuses with the help of computerized tomography.

Rashid Al Abri *et al.*^[7] The findings showed abnormal Agger Nasi cells in 49% of cases,

concha bullosa in 49%, Haller cells in 24%, asymmetry in anterior ethmoidal roof 32%, Onodi cells in 8%. The type of skull base were as follows; Type 1 was 30%, Type 2 was 34% and Type 3 was 36%. Many other surgically significant anatomical variations in small numbers (1-3) were incidentally identified.

H. Kaplanoglu *et al.*^[8] The mean height of the lateral lamella cribriform plate (LLCP) was 4.92 ± 1.70 mm. The cases were classified as 13.4% Keros Type I, 76.1% Keros Type II, and 10.5% Keros Type III. There was asymmetry in the LLCPC depths of 80% of the cases, and a configuration asymmetry in the fovea in 35% of the cases. In 32% of the cases with fovea configuration asymmetry, there was also asymmetry in the height of the right and left LLCPC. The most frequent variations were nasal septum deviation (81.8%), Agger Nasi cells (63.8%), intralamellar air cells (45%), and concha bullosa (30%).

Aramani *et al.*^[9] was observed that 53.7% of the chronic sinusitis cases had two or more anatomical variations and 33.3% of the cases had single anatomical variation. Deviated nasal septum was found to be the most common amongst the anatomical variations in chronic sinusitis cases in the present study which was followed by unilateral concha bullosa and paradoxically bent middle turbinate. Agger Nasi cell and Haller cell were seen in one case each.

Fadda *et al.*^[10] A detailed analysis of CT scans showed that 140 of 200 (70%) patients had anatomic variations. In particular, 122 patients (87%) were affected by common anatomic variations and 18 patients (13%) with uncommon variations. There were 85 (60.7%) male and 55 (39.3%) females with ages ranging from 13 to 77 years (mean 45.5 years). 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 ($p < 0.05$). There was no significant correlation between other common and uncommon anatomic variations and mucosal pathologies.

A. K. Gupta *et al.*^[11] In his study he saw the association between various sinusitis and the anatomic variations of the ostiomeatal complex and we found that concho bullosa found to have a strong significant association with maxillary sinusitis (43.6%) and anterior ethmoid sinusitis (42.1%). Most of the patients with posterior ethmoid sinusitis (53.8%) had a statistical significant association in developing deviated nasal septum type of anatomical variant and majority of the patients with sphenoidal sinusitis had a onodi cell type of anatomical variant and their association was found to be statistical significant ($p < 0.05$).

Maru *et al.* V gupta *et al.*^[12] Out of the 61 patients with chronic sinusitis like symptoms the most common anatomical variation associated were Agger Nasi Cells (88.5%), Concha Bullosa (42.6%) and Deviation of the Septum % were (55.7%). The incidence of Right sided deviation (55.9%) more. Haller's cells were noted in 36.1% and Paradoxical curvature of middle turbinate (Fig. IV) in 11.5% cases. Onodi Cells (Fig. V) were seen in 9.8% patients and uncinate process variations also in 9.8% patients. None of the C.T. scans showed uncinate bulla.

Conclusion

- Deviated nasal septum was the most commonly observed anatomical variation observed in 65% of the sample.
- Concha bullosa (52%) and other variations of the middle turbinate such as paradoxical middle turbinate (21%) were the other common anatomical variations observed.
- Other variations of the ethmoid air cells like the Haller and the Agger Nasi cells were studied, they were found to be 24% and 35% respectively.

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