Original Research Article

Correlation of anatomical variations of Paranasal sinuses and Chronic Rhinosinusitis

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Abstract

Background: The anatomy of the nose and paranasal sinuses is complex, and many anatomical variations have been thoroughly studied. There is impact of these variations on the occurrence and severity of sinusitis. Computed Tomography (CT) scan is the modality of choice for evaluation of variable anatomical variations and different forms of sinusitis.
Materials and methods: The aim of this research was to study the relation between recurrent sinusitis and anatomical variations of the osteomeatal complex and nasal structures by CT. A cross section prospective observation study was performed. We collected data of 120 patients subjected to CT of the paranasal sinuses.
Result: Anatomical variations found by CT, nasal septal deviation represented the most common variation (75%), followed by concha bullosa and uncinate hypertrophy.
Conclusion: There was a statistically significant correlation between nasal septal deviation, uncinate process anomalies and some patterns of sinusitis with the p value = <0.05.Computed tomography of the paranasal sinus has improved the visualization of paranasal sinus anatomy and variations and has allowed greater accuracy in evaluating paranasal sinus disease.

Key words

Paranasal sinuses, Osteomeatal complex, Sinusitis, CT, Anatomical variation.

Introduction

The term sinusitis refer to group of disorders characterized by inflammation of mucosa of sinuses. Chronic rhinosinusitis (CRS) is an episodes of inflammation of the nasal cavity and paranasal sinuses lasting more than 90 days, despite medical treatment. Chronic rhinosinusitis (CRS) is a disease of the nasal and paranasal cavities, which impairs the quality of life, decreases workplace productivity and causes considerable treatment costs. The main pathophysiology of these chronic airway cases is poorly found and seems to be multifactorial [1-5]. With the arrival of Functional Endoscopic Sinus Surgery, the approach to the patient with CRS has been changed. Certain anatomical variations of lateral wall of nose are important as they contribute in blockage of osteomeatal complex, ventilation and drainage of paranasal sinuses. 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. The non-invasive cross-sectional CT imaging techniques and magnetic resonance imaging enabled soft tissue discrimination and spatial resolution in sinonasal variations .It guide to find about anatomical variants with some associated pathologies for pre- and intra-operative management. The information before functional endoscopic sinus surgery provided by CT will make it safer and will reduce the complications [6]. The aim of this study is to investigate the potential relations between nasal and paranasal sinus anatomical variations and increased risk for occurrence of chronic rhinosinusitis. Reported frequency of anatomic variations in patient with chronic sinusitis is as follow: Agger Nasi cellss in 15%, Haller cells in 7%, conchae bullosa in 30%, paradoxical middle turbinate in 24% and septal deviation in 21% of patients.

Materials and methods

A prospective analysis of 120 computed tomography (CT) examinations of patients with rhinosinusitis was conducted to determine the prevalence of clinically significant anatomical variations of the paranasal sinuses. A total of 120 CT scans were included from June 2015 to June 2016. The statistical analysis to assess the relationship between anatomic variations and sinusitis was evaluated using the Fisher's exact test.

Inclusion criteria

Adult patients presenting with a history of nasal obstruction, nasal discharge, postnasal discharge and headache, clinically diagnosed to have chronic rhinosinusitis (symptoms for a period of 12-week or more despite adequate medical treatment). Adult of all age group and both sex were included in the study.

Patients giving informed consent for the procedure.

Exclusion criteria

- Patients with rhinosinusistis less than 12 weeks.
- Patients with allegic rhinitis.
- Patients with previous history of sinonasal surgery.
- Patients with extensive nasal polyposis.
- Patients with craniofacial anomalies, facial and head trauma, nasal or facial neoplasms, immunodeficiency or cystic fibrosis.
- Patients younger than 18 years of age.

CT scan was done for all patients who had Chronic Rhino-sinusitis. The patients had CT scan PNS 5 mm Coronal, Sagital and axial sections done, they were analyzed for anatomical variations.

Results

CT scan detection of anatomical variations: Deviated Nasal Septum (DNS) was the most common variation among patients, followed by Choncha bullosa. Other variations found were

Uncinate Deviation/ Hypertrophy, Aggar Nasi Cell, Paradoxical Middle turbinate, Haller cell, Onodi Cell and Pneumatization of vomerine bone (**Table - 1**).

Table – 1: Anatomical variations.

Anatomical Variation	Frequency	%
DNS	90	75
Chonchabullosa	50	41.6
Uncinate Deviation/ Hypertrophy	15	12.5
Paradoxical Middle Turbinate	10	8.3
Aggar Nasi Cells	8	6.6
Onodi Cells	5	4.1
Haller cells	2	1.6
Pneumatization of Vomerine Bone	2	1.6

The mucosal disorders of the paranasal sinuses and the ostiomeatal complex status were scored based on the Lund - Mackay staging system, while a sinus with no opacification was considered zero, score of 1 for a sinus with partial opacification and score of 2 for a sinus with full opacification (**Table - 2**).

Table – 2: Mucosal thickening in different anatomical part of sinuses.

Involved sinus	Frequency	%
Maxillary	80	66.6
Ethmoid	60	50
Sphenoid	40	33.3
Frontal	20	16.6

Discussion

During fetal development, paranasal sinuses originate as invagination of nasal mucosa into lateral nasal wall, frontal, ethmoid, maxilla and the sphenoid bone. These sinuses grows with age and pneumatisation completed by the age of 20.The anterior ethmoiditis has been reported as the commonest to be involved, followed by posterior ethmoid, maxillary, fontal sinusitis and sphenoid [7]. Anatomical variations in the sinonasal region are common. Recent advances in CT Scanning and the widespread of ESS, has made the extent of these variations apparent. Local anatomic variations including concha bullosa, deviated nasal septum (DNS), Haller cells, paradoxical middle turbinates, agger nasi cells and many others may be the source of middle meatal obstruction and subsequent rhinosinusitis.

Deviated nasal septum causes a decrease in the critical area of the osteomeatal unit predisposing to obstruction and related complications. In our study 75% of cases had DNS, similar finding were observed by Perez, et al., who reported the prevalence of deviated nasal septum to the about 80%. Infarct in various studies the finding of nasal septal deviation ranged from 14.1% to 80%. Dua, et al. [16], and Asruddin, et al. [11], found prevalence of 44% and 38% of deviate nasal septum in their respective studies. Stallmann, et al. [8] also reported lesser prevalence of 60 % deviated nasal septum in chronic rhino sinusitis cases respectively.

Concha bullosa was seen in 41.5%of the chronic rhinosinusitis cases which is almost similar to as reported by Bolger, et al., and Yousem, et al., respectively. Perez-Pinas, et al., Scribano, et al., reported higher prevalence of concha bullosa i.e.73% and 67% in chronic rhino sinusitis cases. The prevalence of concha bullosa in our study is on the higher side when compared to the findings of Stallmann, et al. [8], Maru, et al. [9], Wani, et al. [13], Dua, et al. [16], Asruddin, et al. [11], and Llyod, et al. [15], reported further less prevalence of about 36%, 30%, 28%, 16%, 15%, and 14% respectively.

Stammberger and Wolf [10] accepted paradoxical curvature of the middle turbinate as an etiological factor for CRS because it may cause obliteration or alteration in nasal air flow dynamics. It was found in 8.3% of the patients; the prevalence is similar to that of 12% by Asruddin, et al. [11] and 15% Llyod [12]. Hypertrophied uncinate process causes narrowing of the hiatus semilunaris and the

ethmoid infundibulum. It has also been suggested as a predisposing factor for impaired ventilation of the anterior group of sinuses and frontal sinus. Hypertrophy of the uncinate process was observed in 12.5% of the cases which is very less as compared to the findings of Wani, et al., who reported it to be 21% in chronic rhino sinusitis cases [13].

Aggar nasi cells lie just anterior to the anterosuperior attachment of the middle turbinate and frontal recess. These can invade the lacrimal bone or the ascending process of maxilla. These cells were observed in 6.6% of patients in our study. Similar results were observed by Liu X, et al. [14], and Llyod, et al. [15], who reported the prevalence of aggar nasi cells as 7.8% and 8.5% in chronic rhinosinusitis cases whereas in the study by Dua, et al. [16], agger nasi cells were found to be present in 9 patients (8%). The prevalence is very less as compared to 98.5% by Bolger [17], 88.5% by Maru [18], 86.7% by Tonai and Baba [19] and 48% by Asruddin [20]. The prevalence of Haller's cells in our study was 1.6%. Similar findings were observed by Liu X, et al. [21], who reported the prevalence of about 1% of Haller cells in 297 chronic rhino sinusitis cases in a study conducted in Sun Yat Sen University of Medical Sciences. This is again very less as compared to that reported by Kayalioglu, et al. [22], 5.5%, Dua, et al. [23], 16%, Llyod, et al. [24], 15%, Perez-Pinas, et al. [25].

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 emphasizes the clinical importance of considering this anatomic variation prior to any attempt for invasive intervention. The surgeon must pay close attention to the occasional Onodi cell in pre-operative evaluation to avoid potential complications of ESS. Onodi cell was found in 5 (4.1%) patients in the current study. Other studies have reported Onodi cell presence from 0% to 9% [26, 27].

Conclusion

It was concluded that the Anatomical variations are common in the osteomeatal complex. Prevalence of multiple anatomical variations was more common in our study in comparison to single anatomical variation. Deviated nasal septum was the most common anatomical variation encountered in our study followed by concha bullosa and paradoxically bent middle turbinate. There is significant correlation between nasal septal deviation, uncinate prosess anomalies to paranasal sinusitis (p value <0.05 for each).CT scan assists the surgeon as a road map during endoscopic sinus surgery. We hope this manuscript will inspire the investigators to study more about the role of these variants in CRS. Further investigations are needed to confirm the outcomes.

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