Research Article

Computed tomographic evaluation of anatomical variations of paranasal sinus region

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ABSTRACT

Background: With the advent of multidetector computed tomography (MDCT), imaging of paranasal sinuses prior to functional endoscopic sinus surgery (FESS) has become mandatory. CT of PNS depicts anatomical complexities of osteomeatal complex and its variations that are often found.

Methods: In the present retrospective and prospective study, we have studied anatomical variants of PNS in 200 Indian subjects with clinical suspicion of sinusitis between January 2011 to March 2016, using CT in the coronal plane complemented by axial views.

Results: In majority of patients, anatomical variations were noted with mucosal changes (78.80%). Deviation of nasal septum were the most common anatomical variation followed by Paradoxical middle turbinate, Middle concha bullosa. Other common variants included superior concha bullosa, prominent agger nasi cells, Haller's cells, bony spurs, aerated crista galli and hypoplastic frontal sinus.

Conclusions: Anatomical variations studied on CT scan are found to block the OMC and cause rhinosinusitis. Thus, knowledge of various anatomical variants is necessary for both surgeon & radiologist to avoid possible complications and improve success of management strategies.

Keywords: Anatomical variants, Paranasal sinuses, Computerized tomography, Concha bullosa, DNS, OMC (Osteomeatal complex)

INTRODUCTION

Anatomical variants on CT scan are found to block the Osteo Metal Complex (OMC) and cause chronic sinusitis. The detection of these variants to prevent potential hazards is essential for use of current endoscopic surgery on sinuses. Currently, CT scan is the standard imaging in the evaluation of PNS.

Anatomical variations

Nasal septal deviation: DNS is usually congenital but may be post traumatic in some patients. Malalignment of components of septum (septal cartilage, perpendicular ethmoidal plate and vomer) may cause deviation of nasal septum, deformity of chondrovomerine articulation or a septal spur. Jonathan-et-al classified PNS into seven types.[1]

Type I: Midline septum or mild deviations in vertical / horizontal plane, which do not extend throughout the vertical length of the septum.

Type II: Anterior vertical deviation.

Type III: Posterior vertical deviation.

Type IV: 'S' septum posteriorly to one side and anteriorly to others.

Type V: Horizontal spur to one side with high deviation to the opposite side.

Type VI: Type V + groove on the concave side.

Type VII: Combination of more than one type.

Obstruction, secondary inflammation, swollen membranes, infection of middle meatus have been all observed as a result of severe DNS.[2]

Concha bullosa: A Concha Bullosa is an aerated turbinate, most often the middle turbinate, less commonly, of the inferior and superior turbinate. A Concha Bullosa enlarges the turbinate thus obstructing middle meatus / infundibulum and may lead to mucocele formation.[3]

Uncinate process variations: The uncinate process is a superior extension of the lateral nasal wall On CT, the uncinate process can be seen attached inferiorly to the inferior turbinate with the free edge representing the posterior free margin.

Deviation: If free edge of uncinate process is deviated in a more lateral direction, may cause narrowing of hiatus semilunaris and infundibulum.

Attachment: Anatomic variations of attachment of superior tip of uncinate process may be found which include attachment to the lamina papyracea, postrecomedial wall of the aggernasi cell, the junction of the middle turbinate with the cribriform plate, the ethmoid roof and the middle turbinate.[5]

Pneumatization/Uncinate bulla: Refer to extension of air cells into the uncinte process. Pneumatization can been seen in 9% of population and rarely causes of obstruction of infundibulum.[6,7]

Haller's Cells / infraorbital ethmoid cells: These are pneumatized ethmoid air cells that project along the medial roof of the maxillary sinus and the most inferior portion of lamina papyracea, below the ethmoid bulla and lateral to the uncinate process. These cells may contribute to the narrowing of the infundibulum and may compromise adjacent ostium of maxillary sinus, thus contributing to recurrent maxillary sinusitis. Mucosal disease significantly increase in patients with medium or large Haller's cells than those with small cells.[8,9]

Onodi (sphenoethmoidal cells): Most posterior ethmoid cell, superolateral to sphenoid sinus and closely associated with optic nerve.

Identified best on axial images where the course of ON can be followed past the orbital apex and judged in relation to poseriort ethmoid and sphenoid sinus.[10,11] Mucocele in onodi cell can cause retrobulbar optic neuropathy which is extremely rare.[12]

Aggernasi cell

The cell is found in the lacrimal bone anterior and superior to the junction of middle turbinate with the nasal wall. The posterior wall of the cell forms anterior wall of frontal recess. The roof of the Aggernasi is the floor of the frontal sinus and is an important landmark for frontal sinuses surgery.

Other variants

Great ethmoid bulla, pneumatized anterior clinoid process, medial deviation/ dehiscence of lamina papyracea , aerated crista galli, asymmetry of ethmodial roof, hypoplasia of maxillary sinus, hypoplastic frontal sinus and asymmetry of both cavities of sphenoid sinus.

The study was conducted at MGMCH, Jaipur on 200 patients referred for CT-PNS with clinical suspicion of sinusitis during a period from January'2011 to March' 2016. The investigations were performed by using SIEMENS SOMATOM plus 4 single slice spiral CT scan machine and GE Optima 6-60 128 slice CT scan machine.

In all cases, coronal sections were obtained complemented by axial in selected cases.

Coronal Sections were performed with the patients in prone position and the plane perpendicular to hard palate. Direct scan 3-5 mm in thickness were made from anterior walls of the frontal sinuses to the posterior wall of sphenoid sinus. The orbitometal line was taken as reference with the patient in supine position. The exposure settings used were 130 kVP and 80-100 mAS.

Pediatric age group, pregnant women, patients with h/o RTA or past h/o surgery in parasnal region were not included in this study.
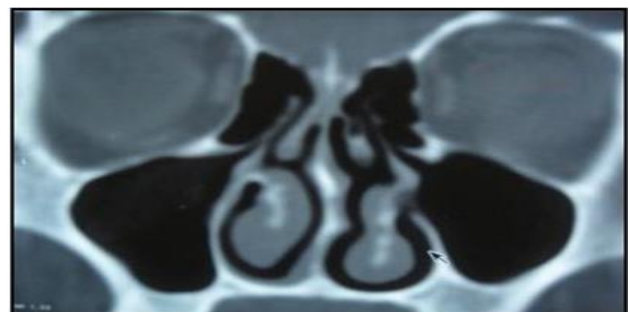
RESULTS

Figure 1: S- shape DNS Type-4, Bilateral Thickened Inferior Turbinate.

200 Patients who fulfilled inclusion criteria were studied, out of which 90(45%) were female and 110 (55%) were male.
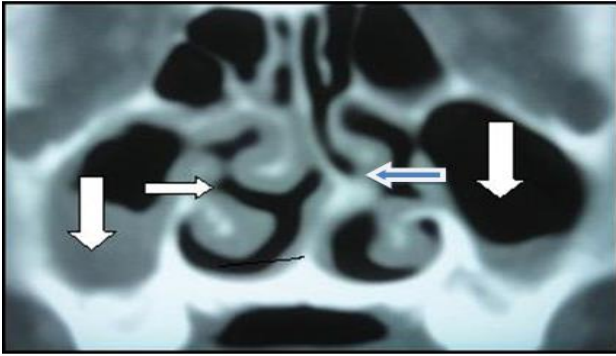
Figure 2: Bilateral maxillary sinusitis (down white arrow), paradoxical thickened RT middle turbinate (small white arrow) and anterior. LT side DNS type-2 with bony spur formation (blue arrow).

The most common incidence of age related anotomical variation was noted in the age group of 21 - 40 years.
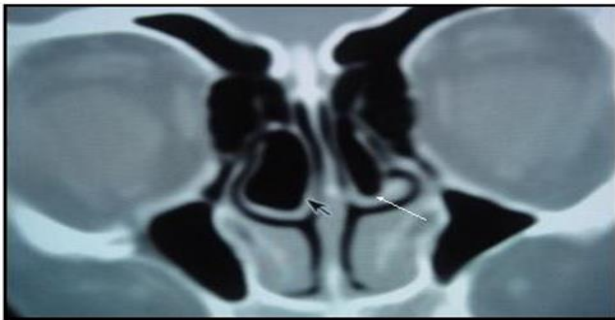

Figure 3: Bilateral large concha bullosa (both black).

The incidence of presenting complaints, in order are nasal obstruction 126 (63.30%), nasal discharge 70 (35%) cases, headache 66 (33.30%), Facial pressure 46 (23.30%) cases, sneezing 26 (13.80%) cases, facial congestion 24 (12.20%), post nasal drip 14 (7.20%), throat discomfort 12 (6.10%), fever 10 (5%), snoring 6 (3.80%).

Figure 4: CT scan PNS coronal section showing paradoxical curvature of LT middle turbinate (curved arrow) and accessory middle turbinate on the LT side (small arrow).

Incidence of involvement of different sinuses - maxillary antra were the most common (27.2%) followed by frontal (17%) and sphenoid (3%).

CT scan detection of anatomic variations - DNS was most common (156 - 78.80%), followed by paradoxical middle turbinate 92 (46.10%).

Other variants found were middle concha bullosa in 64 (32.70%), superior concha bullosa in 14 (7.20%) prominent AggerNasi cells in 4 (2.20%), Haller's Cells in 10 (5%), bony spur in 24 (12.70%).
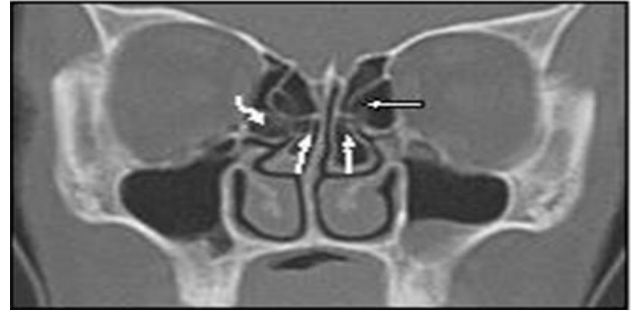

Figure 5: CT scan PNS coronal section. Bilateral concha bullosa (white arrow). Overexpansion of the ethmoid sinus on LT Side (White Arrow with Black Border). Right Haller Cells (Curved Arrow). Floors Bulge Downward, Compressing the Middle Turbinate and Compromising the Semilunar Hiatus.

Out of 180 cases, both anatomical variation and mucosal changes were found in 156 patients (78.80%).

Figure 6: CT scan PNS coronal section showing large Haller's cell on the left side (arrow).

Figure 7: CT scan PNS coronal section showing prominent AggerNasi cells on the LT side (arrow).

Most common DNS was Type II (70 patients - 45%) followed by Type III in 32 (20.50%).
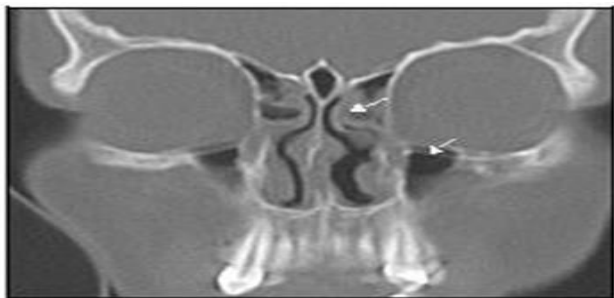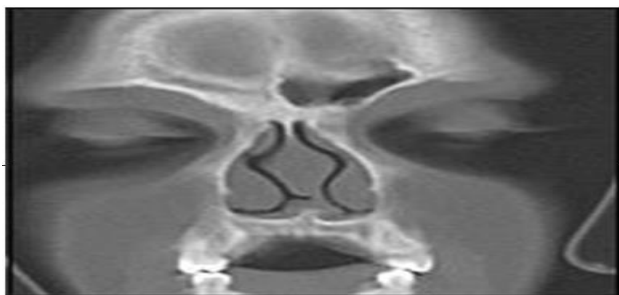
Figure 8: CT scan PNS coronal section.

Figure 9: CT scan PNS coronal section showing hypo plastic LT frontal sinus.

DISCUSSION

CT imaging is gold standard in evaluation of chromic sinusitis. Detection of any anatomic variations helps in treatment particularly in endoscopic surgeries. Among various anatomical variations, Deviated Nasal Septum was the most common (78.80%). In previous studies, percentage of DNS was found out to be 65% by H. Mamatha et al, 54% by Jaiger et al, 44% by K. Dua et al and 55.7% by Maru et al.[13-16]

Paradoxical thickened middle turbinate was next most common (46%) variation. In previous studies, the percentage was 26.10% found by Bolger et-al, 25% by Earwaker, 13% by Jaiger et al and 10% by K. Duaet al.[17] The mild increase in percentage of both DNS and Paradoxical thickened middle turbinate is due to increased number of patients in our study. Percentage of Concha Bullosa was 32.70%. In previous studies, as per Bolger et-al, it was 53%, H Mamatha et al showed 15%, Jaiger et al showed 41%, K Dua et al showed 16%. Our study shows almost same findings. Haller's Cell prevalence was 5% in present study. As per previous studies, Mamatha H et al (17.50%), Jaiger et al (8%), Tiwari R et al 3.50% Findings are consistent.[18] Aggernasi cells were 2.2% in our study.

CONCLUSION

Chronic rhinosinusitis is fairly common condition affecting 21 - 40 age group. DNS and middle turbinate variations (concha bullosa and paradoxical middle turbinate variations) are the two most common anatomical variants.

The presence of anatomical variants does not establish genesis of disease but these variations can predispose patients to intro-op complications. The radiologist, thus, must pay close attention to variants and provide road map to surgeons and help avoid possible complications.

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