CT Scan Evaluation of Anatomical Variations of Paranasal Sinuses in Patients with Complaints Related to Paranasal Sinuses–An Exploratory Study

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1. Introduction

The nasal fossae and paranasal sinuses constitute an anatomical and functional unit. Covered by the same mucosa, the paranasal sinuses communicate with the nasal cavities via small openings and narrow ducts that allow both aeration and sinus drainage[1].

Computed tomography provides detailed picture of the anatomy, the anatomical variants and the extent of the disease in and around the paranasal sinuses. Optimal information about the adjacent bones, soft tissues is available with CT,making it the imaging modality of choice for assessing PNS along with the axial sections, direct coronal scanning and sagittal reconstructions provide accurate delineation of the micro anatomic locales and disease in the PNS. Coronal CT is the investigation of choice for the detailed evaluation of the osteomeatal complexes and the recesses of the PNS[2].

Coronal plane computerized tomographic scanning has dramatically improved the imaging of paranasal anatomy as compared to sinus radiographs. Increasingly, subtle bony anatomic variation and mucosal abnormalities of this region are being dectected[3].

With the advent of functional endoscopic sinus surgery (FESS) and coronal computed tomography imaging, considerable attention has been directed towards paranasal region anatomy. Detailed knowledge of anatomic variations is critical for surgeons performing endoscopic sinus surgery as well as for radiologist involved in the preoperative work up [4].

Aim:
To explore the anatomical variations of paranasal sinuses using CT scan.

Objectives
1) To identify anatomical variations of paranasal sinuses using CT scan
2) To document the frequencies of the anatomic variants of paranasal sinuses.

2. Materials and Methods

This was a prospective study performed to assess the anatomical variations of paranasal sinuses in patients presenting with complaints related to paranasal sinuses. 550 patients were included in my study after ethical clearance from ethical committee of Yenepoya University. Patient was informed about the study with written consent taken.

Duration of Study
24 months (November 2015 to October 2017).

Equipment
GE BRIGHT SPEED 16 SLICE(Single source 16 detector row CT unit GE medical system USA)

Inclusion Criteria
- Patients included in the study were those with complaints related to PNS referred for CTscan at Yenepoya medical college

Exclusion Criteria
- Facial trauma
- Previous sinonasal surgery (excluding nasoantral window antrostomy).
- Sinonasal anatomy alteration or obscuration due to inflammatory diseases (When bony details were obscured by polypoid mucosal disease).
- Paranasal sinus neoplasm
- Paediatric age group, pregnant women

3. Statistical Analysis

IBM SPSS 16 software was used for analysis of data. Descriptive statistics like Frequency (%) for categorical variable, and expressed in charts and diagrams.

4. Discussion

The paranasal sinus region is subject to a large variety of variations. 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.

Rao jj et al observed that the most common type of DNS in patients with complaints of sinusitis is type V (46%) followed by type VI(17%), type III and type IV (10%), type VII (7%), and the least common is type I, where as in patients without sinusitis most common type of DNS observed was Type I (56%)[5].

Perez et al observed that the most common variation observed was nasal septum variation having 55% out 110 patients studied[1]. Shpilberg KA et al observed that the most common anatomic variant was nasal septal deviation with (98.4%) out of 192 patients presenting with complaints of sinusitis.[6]

In two other studies Murthy DD et al and Lingaiah RK et al observed that Deviated Nasal Septum was the most common variation with (73.2%) and (62%) respectively.[7] Findings noted in our study is also consistent with the above mentioned studies of para nasal sinuses with devisated nasal septum being the most common type of variation, with (59.1%) in 550 patients studied, of which 28.7% was type I, 12% was type II, 8.7% was TYPE III, 2.2% was type IV, 3.8 % was type V, 2.4% was type VI and 1.3 % was type VII.

Concha bullosa (pneumatised middle turbinate) has been implicated as a possible aetiological factor in the causation of recurrent chronic sinusitis. It is due to its negative influence on PNS ventilation and mucociliary clearance in the middle meatus region. The presence of a concha bullosa has ranged between 4% and 80% in different studies; our data gave 24.7% which is similar compared to (24.5%) observed by Peres et al, more compared to incidence reported by Dua K (16%)[8] and less compared to Zinreich S et al (36%)[4]. Such a wide range of incidences is due to the criteria of pneumatisation adopted. Sinus ventilation in the anterior ethmoid, frontal recess and infundibulum regions can be impaired by a curved uncinate process as observed by Zinreich et al [4]. In the our study curved uncinate process was found in 17 patients unilaterally (2.9%) and 2 patient bilaterally (0.4), a total of 3.3%. Bolger et al reported a total incidence of 2.5% in his study.[3]

Pneumatisation of uncinate process or curvature to medial side will have an extensive contact with the middle turbinate, which can cause sinusitis. Anatomic variations like uncinate bulla and infraorbital cells may elevate the pathogenic effect when seen along with pneumatised uncinate process compared to the effect of single variant. We encountered uncinate process pneumatisation in 24 patients (4.4%) out of which 22 were unilateral (4%) and 2 were bilateral (0.4%). This is in consistent with 5% reported by Mecit et al [9] and more compared to Zinreich (0.4%)[4] and Bolger et al (2.5%)[3].

5. Results

Table 1: Gender distribution of anatomical variation of PNS (n=550)

Sex	Frequency	Percentage
Female	215	39.1
Male	335	60.9
Total	550	100

Table 2: Frequency and types of deviated nasal

Types	Frequency	Percent
I	158	28.7
II	66	12.0
III	48	8.7
IV	12	2.2
V	21	3.8
VI	13	2.4
VII	7	1.3

Table 3: Frequency of Concha bullosa

	Frequency	Percent
B/L	37	6.7
L	51	9.3
R	48	8.7

Table 4: Summary of frequency of anatomical variations of PNS

	Anatomical Variation	Unilateral		Bilateral		Total	
		NO	%	NO	%	NO	%
1	Concha Bullosa	99	18	37	6.7	136	24.7
2	Paradoxicalmiddle Turbinate	23	4.2	2	0.4	25	4.6
3	Curved Uncinate Process	15	2.9	2	0.4	17	3.3
4	Uncinate Process Pneumatition	22	4.0	2	0.4	24	4.4
5	Haller Cell	19	3.5	7	1.3	26	4.8
6	Agar Nasi Cell	18	3.3	9	1.6	27	3.9
7	Onodi Cell	29	5.2	4	0.7	33	5.9
8	Hypoplastic Frontal Sinus	7	1.3	9	1.6	13	2.9
9	Sphenoid Sinus Septations	77		14%		77	14%

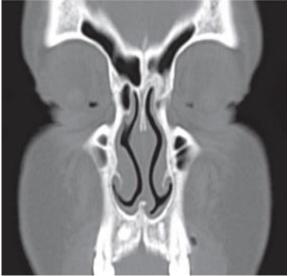**Coronal CT scan PNS showing right uncinate process pneumatisation.**

Ethmoid roof keros type II with right concha bullosa

CT scan PNS Coronal sections showing agger nasi cell on the right side

Coronal CT Scan PNS showing left Paradoxical middle turbinate

6. Conclusion

Computed Tomography of the paranasal sinus has improved the imaging of paranasal sinus anatomy and has allowed greater accuracy in evaluating paranasal sinus disease for anatomical variants and inflammatory diseases affecting the sinuses. Advances in FESS and CT technology has concurrently increased interest in the paranasal region anatomy and its variations. Radiologists must report the anatomical variations that may predispose patients to increased risk of intraoperative complications and help avoid possible complications and improve success of management strategies.

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