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STUDY OF NORMAL ANATOMICAL VARIATIONS IN PARA-NASAL SINUSES USING COMPUTED TOMOGRAPHY SCAN: A CROSS SECTIONAL STUDY FROM CENTRAL INDIA

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ABSTRACT:

Background: The standard imaging in the assessment of the para-nasal sinuses is currently computed tomography scanning. This provides an applied anatomical view of the area as well as the common anatomical variants. The advancement and improvement of computed tomography scans has provided for a comprehensive evaluation of patients' para-nasal sinuses, allowing Functional Endoscopic Sinus Surgery surgeons to operate with a guide chart.

Objectives: To study normal anatomical variations in para-nasal sinuses using Computed Tomography.

Material and Methods: This research took place in a tertiary healthcare center's radiology department over the course of two years. Axial para-nasal sinuses cuts were taken using a multi-slice (128 slice scanner), followed by coronal and sagittal reconstruction.

Results: The most common anatomic variation, according to the findings, was nasal septal deviation. The rarest variation in our sample was Haller cell and pneumatized septum. There was also a close connection between unilateral Concha bullosa and contra-lateral septal deviation, as evidenced by the research.

Conclusion: A wide range of lesions can affect the para-nasal sinus area. Normal anatomical differences and congenital abnormalities in this area are significant because they can have pathological consequences or cause difficulty/complication during surgery.

Keywords: Para-nasal sinuses, Computed Tomography, Functional Endoscopic Sinus Surgery.

INTRODUCTION

The air-containing pockets in the skull are known as the para-nasal sinuses (PNS). The maxillary, ethmoid, frontal, and sphenoid sinuses are the para-nasal sinuses. They lighten the skull, humidify the air, and give the voice resonance. It is important for clinicians to have a thorough understanding of the anatomy of the para-nasal sinuses[1]. To prevent intra-operative complications in the age of Functional Endoscopic Sinus Surgery, the surgeon requires an accurate preoperative depiction of the anatomy, variations, and extent of pathology[2]. The para-nasal sinuses can be assessed using a number of imaging modalities. In the case of diseases of the maxillary and frontal sinuses, conventional radiography is helpful. However, it is only useful for evaluating the nasal cavity, ethmoid, and sphenoid sinuses. Conventional radiography does not display the osteo-meatal complexes. CT scans of the para-nasal sinuses provide a clear image of the anatomy, anatomical variants, and the extent of disease in and around the sinuses[3]. Computed Tomography provides the most accurate information about the adjacent bones and soft tissues, making it the imaging modality of choice for determining para-nasal sinuses. Direct coronal scanning and sagittal reconstructions, in addition

to axial sections; provide precise delineation of micro anatomic locales and disease in the para-nasal sinuses[4]. The investigation of choice for a thorough examination of the osteo-meatal complexes and the recesses of the para-nasal sinuses is Coronal Computed Tomography. For practical endoscopic sinus surgery, computed tomography offers a preoperative road chart. In the treatment of para-nasal sinus disorders, a combination of computed tomography and diagnostic endoscopy has become the gold standard. In patients undergoing Computed Tomography scan evaluation for different rhinologic purposes, anatomic variations of the para-nasal air sinuses must be assessed. Awareness of anatomic differences helps understand recurrence of disease and encourages one to adjust the operative procedure, which decreases surgical complication rates during Functional Endoscopic Sinus Surgery[5]. The normal imaging in the assessment of the para-nasal sinuses is currently computed tomography scanning. This provides an applied anatomical view of the area as well as the popular anatomical variants. The advancement and improvement of computed tomography scans has provided for a comprehensive evaluation of patients' para-nasal sinuses, allowing Functional Endoscopic Sinus Surgery surgeons to operate with a guide chart.

Objectives: To study normal anatomical variations in para-nasal sinuses using Computed Tomography & to assess the frequency of occurrence of these variations.

Methodology

This was a two-year cross-sectional retrospective research performed in the Department of Radio-diagnosis at a Tertiary care centre in Central India. Patients with PNS symptoms who were referred from the ENT OPD and wards, as well as those who decided to participate in the study after receiving written consent. Exclusion criteria: Changes in sino-nasal anatomy or obscuration caused by inflammatory diseases (When bony detail was obscured by polypoid mucosal disease). Sino-nasal surgery in the past (excluding naso-antral window antrostomy), Pregnancy, facial trauma, and para-nasal sinus neoplasm cases were excluded from the study.

Results:

Table 1: Distribution according to age

Age group in years	Frequency	Percent
21-30	30	24%
31-40	38	30%
41-50	16	13%
51-60	22	17%
>60	20	16%
Total	126	100%

In our study, total 126 patients were included who fulfilled the inclusion criteria out of which maximum (30%) were in the age group of 31 to 40 years followed by those in the age group of 21 to 30 years.

Table 2: Distribution according to gender

Gender	Frequency	Percent
Male	84	67%
Female	42	33%
Total	126	100%

Out of total 126 subjects, 67% were male and the remaining 33% were females.

Table 3: Distribution according to anatomical variation number

Anatomical variation	Frequency	Percent
Single	42	33%
Multiple	84	67%
Total	126	100%

When we analyzed our 126 study participants for the anatomical variations in para-nasal sinuses, we found out that maximum cases had multiple variations (67%) and the remaining subjects were having single anatomical variation.

Table 4: Distribution according to CT detected anatomical variation

Anatomical variation	Frequency	Percent
Deviated nasal septum	106	84%
Agger nasi cell	74	59%
Concha bullosa	64	51%
Prominent bulla ethmoidalis	58	46%
Intumescentia septi nasi anterior	34	27%
Pneumatised uncinate process	22	18%
Medialised uncinate process	18	14%
Onodi cell	14	11%
Frontal cell	12	10%
Paradoxical middle turbinate	10	8%
Pneumatisation of septum	6	5%
Haller cell	4	3%

When we deeply analyzed for the type of anatomical variation in the total 126 study subjects, we found out that maximum patients

were having deviated nasal septum (84%) followed by agger nasi cells (59%) and then Concha bullosa in 51% cases. Apart from these, 46% cases had prominent bulla ethmoidalis, 27% cases had Intumescentia septi nasi anterior, 18% cases had Pneumatised uncinate process, 14% cases had Medialised uncinate process, 11% cases had Onodi cell, 10% cases had Frontal cell, 8% cases had Paradoxical middle turbinate, 5% cases had Pneumatisation of septum & 3% cases had Haller cell.

Table 5: Regions involved and anatomical variations associated with it

Region involved	Anatomical variations associate with it
Frontal sinus region	Aggger nasi cell
Anterior nasal cavity	Concha bullosa
Posterior nasal cavity	Septal deviation
Sphenoid sinus region	Onodi cell

When we region-wise compared the commonly observed variation we found out that, Aggger nasi cell was more commonly situated in Frontal sinus region, Concha bullosa was more commonly situated in Anterior nasal cavity, Septal deviation was more commonly situated in Posterior nasal cavity & Onodi cell was more commonly situated in Sphenoid sinus region.

Discussion

A wide range of lesions can affect the para-nasal sinus area. Normal anatomical differences and congenital abnormalities in this area are significant because they can have pathological consequences or cause difficulty/complication during surgery. According to Stammmberger et al[6], stenosis of the osteo-meatal complex, caused by either anatomical structure or hypertrophied mucosa, can cause secretion obstruction and stagnation, which can lead to infection or perpetuation. The concha bullosa (pneumatized middle turbinate) has been proposed as a potential etiological factor in chronic sinusitis recurrence. That's because it has a detrimental effect on PNS ventilation and mucociliary clearance in the middle meatus. The existence of a concha bullosa has been identified in studies ranging from 4% to 80%; our data showed a 51 percent occurrence, which is lower than Bolger's[7] 54 percent but higher than Zinreich S et al[8] (36 percent), Dua K et al[9] (16 percent), and Perez et al[10] (25 percent). The wide range of occurrence is due to the pneumatisation criteria used. The middle turbinate may be paradoxically bent, meaning it bends backwards. This can result in sinusitis due to impingement of the middle meatus. It was discovered in 18 patients (14%) in our sample – 12 unilaterally and 6 bilaterally. The incidence of 14 percent in our sample is similar to the 58 percent reported by Perez et al[10]. The uncinate method can be curved or twisted, according to Zinreich et al[8]. It can make sinus ventilation difficult, especially in the anterior ethmoid, frontal recess, and infundibulum. Curved uncinate was observed in 10 patients unilaterally (8%) and 8 patients bilaterally (6%) in the current study, for a total of 14 percent. It is significantly higher than Bolger et al[7] estimates of 2.5 percent. Sinusitis may be caused by a markedly medially bent or pneumatized uncinate form, as well as a corresponding area of extensive contact with the middle turbinate. In contrast to the effect of a single variant, combining some anatomic variations such as uncinate bulla and Haller's cell can increase pathogenic effect. Uncinate bulla was found in 6 (5%) of the patients, 4 unilaterally and 2 bilaterally. This is close to the 5% reported by Mecit et al[11] and higher than the 0.4 percent reported by Zinreich S et al[8] and Bolger et al[7] (2.5 percent). Ethmoid air cells that extend beyond the ethmoid labyrinth into the maxillary sinus are known as Haller's cells. They are ethmoid cells that expand into the orbit's floor and can narrow the ostium adjacent to them (In our sample, there were 4 (3%) cases of Haller's cells – 2 unilateral and 2 bilateral. The incidence recorded by Zinreich et al[8] was 10%, which is higher than ours. It's also higher than Bolger et al[7] (46%) and Asruddin et al[12] (25%). (28 percent). The antero-superior connection of the middle turbinate and frontal recess is just anterior to the agger nasi cells. These may infiltrate the lacrimal bone or the maxillary ascending process. In our study, these cells were found in 74 patients (59 percent). The rate is lower than Bolger et al[7] estimate of 98.5 percent. It is more than what Dua K et al[9]. have observed (40 percent). Onodi cells are posterior ethmoid cells that lie medial to the optic nerve and stretch posteriorly, laterally, and occasionally superiorly to the sphenoid sinus. When the bony canal of the nerve is dehiscent, the chances of peri-operative optic nerve damage are increased. The majority of researchers have found an occurrence

of 8–14 percent, with Perez[10] reporting 11 percent and Bogler[7] reporting 11 percent. In our research, it was discovered unilaterally in 14 patients (11 percent). Anatomical variants of the nasal sinus region are contentious in terms of their clinical importance. The majority of CT scans of the sinus area have been performed in patients that have a clinical syndrome that suggests inflammatory sinus pathology. Zinreich S et al[8] discovered that 62% of his patients had at least one anatomic variant, compared to just 11% in the normal control group. These findings tend to point to a connection between anatomical variations and the development of inflammatory sinus pathology. Bolger et al[7] observed 131 anatomical variations in a series of 202 patients analyzed by computed tomography, but the incidence of patients with sinus pathology was close to that of people studied for other reasons. Anatomical variations were found in patients studied for sinus problems as well as those studied for other purposes, according to Bolger et al[7] & Stammmberger et al[6]. They came to the conclusion that the mere existence of variants does not suggest a predisposition to sinus pathology, unless other variables are present. Yousem et al[13], on the other hand, assume that anatomical variations can be predisposing factors depending on their size. Out of the 74 patients with mucosal changes in our sample, 50 had anatomical variations. As a result, 68 percent of people were affected. In our research, 36 patients with anatomical differences were found out of 52 who had no mucosal changes. As a result, 69 percent of people were affected. The existence of anatomical variations does not indicate a predisposition to sinus pathology, according to our findings. However, surgeons must be mindful of differences that may predispose patients to a higher risk of intra-operative complications. In the preoperative assessment, the radiologist must pay careful attention to anatomical variants in order to prevent potential complications and maximize the effectiveness of management strategies.

Conclusion

In patients undergoing Computed Tomography scan evaluation for different rhinologic purposes, anatomic variations of the para-nasal air sinuses must be assessed. Awareness of anatomic differences helps understand recurrence of disease and encourages one to adjust the operative procedure, which decreases surgical complication rates during Functional Endoscopic Sinus Surgery. The most common anatomic variation, according to the findings, was nasal septal deviation. The rarest cells in our sample were Haller cell and pneumatized septum. There was also a close connection between unilateral Concha bullosa and contra-lateral septal deviation, as evidenced by the research.

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