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KEY WORDS: Agar Nasi, Anatomical Variations, Concha Bullosa, Haller Cell, Onodi Cell.

ANATOMICAL VARIATIONS OF PARANASAL SINUS REGION: A COMPUTED TOMOGRAPHY STUDY

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ABSTRACT

Introduction: Facial pain syndrome is a headache secondary to mucosal contact points in the sinonasal cavities. This headache may also result due to anatomical variations. These variants may determinate contact points between nasal structures, stimulating "trigger" points and determining facial pain crisis.

Aims and Objectives: The aim of this study is to assess the prevalence of anatomical variations – concha bullosa, Haller cells, Agger nasi cells and Onodi cells.

Materials And Methods: Data comprised paranasal sinus computed tomography images of 50 patients (25 males and 25 females) that were retrieved from archives and analyzed for presence of anatomical variations, such as concha bullosa and air cells – Agger nasi cell, Haller cell, and Onodi cell. Data obtained were analyzed with Chi-square test and Mann–Whitney test.

Results: The highest incidence was seen in Agger nasi cells (64%) followed by concha bullosa (62%), Haller cells (54%), and Onodi cells (36%). We found no statistical significance when comparing the relationship of anatomical variations with age, side, and gender.

INTRODUCTION:

Facial pain syndrome or rhinogenic headache is a headache secondary to mucosal contact points in the sinonasal cavity, wherein there is absence of inflammatory signs, hyperplastic mucosa, purulent discharge, and sinonasal polyps or masses.1 This headache may also result from pressure on the nasal mucosa due to anatomical variations. 2,3 Common anatomical variations include deviated nasal septum, concha bullosa, air cells – Agger nasi, Haller cell, and Onodi cell.2 These variants may determinate contact points between nasal structures, thereby, stimulating "trigger points" and determining facial pain crisis. Facial pain may be localized to periorbital, frontal, or temporozygomatic region, which might be unilateral or bilateral.4 Three-dimensional (3D) imaging of paranasal sinuses is mandatory for diagnosis and treatment of the underlying anatomical variations, as these variations could be a cause for sinonasal symptoms, facial pain symptoms, and headache.5-7 Endoscopic sinus surgery is the treatment of choice for refractory sinusitis.7 Hence, understanding the complex anatomy of skull base is crucial for safe endoscopic sinus surgery to prevent from complication.

AIMS AND OBJECTIVES:

- To assess the prevalence of anatomical variations of paranasal sinus region
- To determine the relationship of these variations with age, side, and gender of an individual.
- To ascertain the frequency and co-relationship of these variants to age and sex.

MATERIALS AND METHODS

This study was carried out in the Department of Radiodiagnosis. The source of data for our study were retrospectively selected paranasal sinus computed tomography (CT) images of 50 patients (25 males and 25 females) randomly collected from CT archives in the age group of 18 to 70 years.

Inclusion Criteria

- The CT paranasal sinus images in axial, coronal, and saggital planes.
- Age group 18 to 70 years.

Exclusion Criteria

- The CT images with alteration of paranasal sinus anatomy due to surgery, tumor, or facial trauma
- Patients less than 18 years.

All the patients underwent CT scan of the paranasal sinus region. The sections were taken with slice thickness of 5 mm. The exposure settings used were 130 kVp and 35 mA and reviewed for the presence of concha bullosa, air cells – agar nasi, Haller cell, and Onodi cell in axial, coronal, and sagittal views. The data collected were subjected for statistical analysis.

RESULTS

The most common anatomical variation observed was Agger nasi cells (64%) followed by concha bullosa (62%), Haller cells (54%), and Onodi cells (36%).

Table 1: Incidence And Gender Wise Comparison Of Anatomical Variations Among Study Participants Using Chi-square Test

Anatomical variations	*Incidence (%)*	*Unilateral (%)*	*Bilateral (%)*	*Males (n = 50)*		Females (n = 50)		$\chi 2$ *value*	*p-value*
				n	%	n	%		
CB	62	55	7	31	50	31	50	0	1
ANC	64	27	37	27	42.2	37	57.8	2.2	0.14
HC	54	39	15	23	42.6	31	57.4	1.2	0.25
OC	36	36	0	21	58.3	15	41.7	0.74	0.38

CB: Concha bullosa; ANC: Agger nasi cell; HC: Haller cell; OC: Onodi cell

Table2: Unilateral distribution of anatomical variations of paranasal air sinuses using Chi-square goodness of fit test.

Anatomical variations	Side	n	%	*c2value*	*p-value*
CB	Left Right	21 33	38.9 61.1	1.1	0.26
HC	Left Right	17 21	44.7 55.3	0.23	0.67
ANC	Left Right	15 11	57.7 42.3	0.29	0.58
OC	Left Right	13 23	36.1 63.9	1.14	0.25

CB: Concha bullosa; DNS: Deviated nasal septum; ANC: Agger nasi cell; HC: Haller cell; OC: Onodi cell

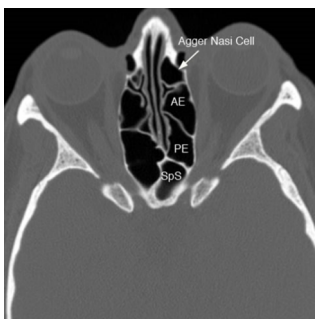
As per our study, out of 50 scans analyzed, Agger nasi cells were observed in 64%, out of which 27% were present unilaterally and 37% bilaterally. Also, 57.7% were found on left side and 42.3% on right side. We revealed no statistical significance between gender and presence of Agger nasi cells (p = 0.14). Out of the 50 scans analyzed, concha bullosa was perceived in 62%, out of which 55% were present unilaterally and 7% present bilaterally. Also, 61.1% were noted on right side and 38.9% on left side. We noticed no statistical difference between gender and presence of concha bullosa (p = 1). Of the 50 scans analyzed, Haller cells were seen in 54%, out of which 39% presented unilaterally and 15% bilaterally. Also, 55.3% were noted on right side and 44.7% on left side. We found no statistically difference between gender and the presence of Haller cells (p = 0.25). Of the 50 scans, Onodi cell were observed in 36%, noted only unilaterally, out of which 63.9% were noted on right side and 36.1 on left side. We revealed no statistically significance between gender and presence of Onodi cells (p = 0.3). According to our study, we found no statistical significance between the mean age group and presence of anatomical variations (concha bullosa p = 1, Agger nasi p = 0.63, Haller cells p = 0.18, Onodi cells p = 0.73,).

DISCUSSION

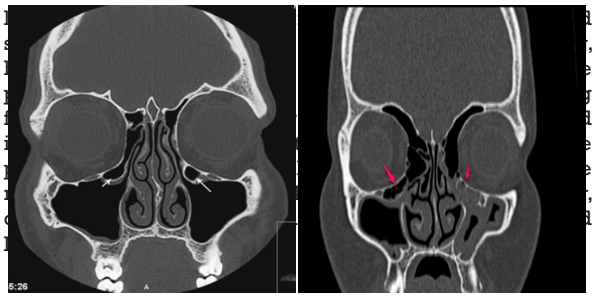
Nasal cavity and paranasal sinuses together configurate a single anatomical and functional unit.8 This region is subject to a large number of anatomical variations and a variety of lesions. The potential role of anatomical variations of the paranasal sinus region is mainly predisposed to recurrent sinusitis and, in selected cases, headache.9 Also, these variants may determine contact points between nasal structures leading to facial pain crisis.4 These variants are important in two distinct viewpoints: Firstly, their relationship to disturbing drainage and ventilation system and secondly, the potential impact on operative technique and surgical safety.9-14

Concha Bullosa A concha bullosa is a pneumatized (air-filled) cavity within a nasal concha, also known as a turbinate. Bullosa refers to the air-filled cavity within the turbinate..2,15,16 It has been implicated as a possible etiological factor in recurrent sinusitis due to its postulated negative influence on ventilation of paranasal sinus and mucociliary clearance in the middle meatus region. In cases of extensive pneumatization, it may cause significant problems, such as headache and nasal blockage.14 Frequency of concha bullosa ranges from 14 to 80%.14 However, as per this study, the prevalence of concha bullosa was 62%, out of which 55% were present unilaterally and 7% present bilaterally, and 61.1% were noted on right side and 38.9% on left side. Our findings correlated with the findings of Bolger et al,16 Scribano et al,9 Pérez-Piñas et al,13 Khojastepour et al,17 Talaiepour et al,18 Narendrakumar and Subramanian,12 Fadda et al,19 and Wani et al.6 The great variation in the reported prevalence may be due to diverse study populations and different criteria for pneumatization.

Agger Nasi Cell Agger nasi air **cells** are the most anterior ethmoidal air **cells** lying anterolateral and inferior to the frontal recess and anterior and above the attachment of the middle turbinate. They are located within the lacrimal bone and therefore have as lateral relations the orbit, the lacrimal sac and the nasolacrimal duct. 11 It can pneumatize posteriorly to narrow the frontal recess. Its clinical importance has been defined by Brunner et al27 in 1996. The extensive pneumatization with consequent narrowing of the frontal sinus ostium causes significant persistent frontoethmoid pain and chronic frontal sinusitis.6 The reported prevalence of Agger nasi cell in the previous literature varies from 10 to 98.5%.11,20 In our study, the prevalence of Agger nasi cells was 64%, out of which 27% were present unilaterally and 37% bilaterally, and 57.7% were noted on left side and 42.3% on right side. Our findings are almost consistent with previous studies conducted by Fadda et al,19 Talaiepour et al,18 and Narendrakumar and Subramanian.12



HallerCellsHallercells,also known as infraorbital ethmoidal air cells, are ethmoid air cells located lateral to the maxillo-ethmoidal suture along the inferomedial orbital floor. This cell was first described by an anatomist Albert Haller in 1765.20,21 When enlarged, it can cause obstruction of the posterior aspect of the ethmoidal infundibulum and ostium



Onodi Cells Onodi cells refer to extension of the posterior-most ethmoidal air cells superolateral to the sphenoid sinus, into the anterior clinoid processes.24 They are ethmoid cells that have migrated to the anterior region of the sphenoid sinus, with anterosuperior location, and intimately related to the optic nerve, causing optic neuropathy in case of certain conditions that affect such cells. Onodi cell is the most posterior ethmoid air cell that extends laterally.26 The prevalence of Onodi cells varies from 8 to 13%,12 according to Turna et al (13.5%),10 Fadda et al (8.5%),19 and Narendrakumar and Subramanian (6%).,12, Herein, the prevalence of Onodi cells in this study was 36%, seen only unilaterally and out of which 63.9% were seen on right side and 36.1% on left side. The prevalence in our study is comparatively higher as compared with previous literature. This may be due to small sample size and confined to only one ethic group (South Indian population).

CONCLUSION

Different anatomical variants may often be found in paranasal sinus region and 3D imaging is the modality of choice to evaluate these variants since conventional radiographs do not provide adequate information because of structural superimposition. These variants may determinate contact points between nasal structures stimulating "trigger" points and determining facial pain crisis. Identification of these variants plays an important role while guiding the surgeons preoperatively and preventing iatrogenic complications. Since this is a preliminary study, our findings could be used in future studies with larger sample size.

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