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Original Research Article

Computed tomography analysis of haller cells: Prevalence and its association with ipsilateral maxillary sinusitis

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ABSTRACT

Background: Haller cells (HCs) are anatomical variations, which observed as incidental findings on CT scan of paranasal sinuses, which may contribute to sinusitis. Medial aspect of orbital floor and lateral to the maxillary infundibulum is common location, which causes recurrent maxillary sinusitis. The aim of the study is to assess the prevalence of HCs and to see its association with ipsilateral maxillary sinusitis.
Materials and Methods: This Hospital based retrospective study was conducted in Department of Radiology, RL Jalappa Hospital and Research Centre, Kolar. In this study, CT images of 680 patients were collected and analyzed.
Results: Overall prevalence of HC was 15.6%, of which 74.2% of cells was associated with maxillary sinusitis. Large sized HCs and ipsilateral maxillary sinusitis showed an association. However, small and medium size of HCs and ipsilateral maxillary sinusitis not showed any association.
Conclusion: The present study may conclude that presence of HCs cannot be attributed to maxillary sinusitis, size of the air cell should be considered, these are the anatomical variations associated with maxillary sinus pathologies. HCs may be one of the causes for sinusitis.

1. Introduction

Haller air cells (HCs) are ethmoidal air cells located along orbital floor on medial side, extending into the maxillary sinus. The initial description of maxillo-orbital cells is attributed to Albert yon Haller,[1] an anatomist who lived during 19^{th} century, and have thereby been designated as Haller's cells. They may vary in size from relatively small to quite large.

Based on the size and location of HCs, normal mucociliary clearance may be disturbed and which occur due to narrowing of maxillary sinus ostium. In view of this, it is essential to identify these variations in the paranasal sinuses (PNS) for proper diagnosis.[2,3] The most commonly used diagnostic method is Computed tomography (CT) scan to assess the paranasal sinuses and the coronal plane is preferred for assessment of osteomeatal complex.[4]

Even though, HCs are anatomical variations during the paranasal sinuses development, medial aspect of orbital floor and lateral to the maxillary infundibulum is most common location, which predisposes to recurrent maxillary sinusitis and HCs depending on size can cause difficulties during endonasal procedures.[5–7] HCs can be identified using wider windows (bone algorithm) and thinner sections are more likely to reveal their presence.[8] The study aimed to assess the prevalence of HCs and to assess its association with ipsilateral maxillary sinusitis.

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2. Materials and Methods

This retrospective hospital based study was conducted in Department of Radio-diagnosis, Sri Devaraj Urs Medical College, attached to RL Jalappa Hospital and Research Centre, Tamaka, Kolar, Karnataka, India. In this study, a total of 340 (680 maxillary sinuses were analysed) subjects were included. Scans of both genders above the age of 16 yrs were included. Institutional Ethical Committee approval was obtained for this study. Inclusion criteria as follows-all patients who underwent non-contrast computed tomography (NCCT) brain and paranasal sinuses. Post-operative status and road traffic accident involving Maxillay bone/sinus were excluded from the study.

Criteria for correct identification of HCs is been taken from Mathew et al.[9] Maxillary sinusitis was identified with radiological findings of thickening of sinus mucosa and/or fluid accumulation, followed by measurement of size of the HCs at the maximum mediolateral dimension.

Depending upon the size of the HCs, they were sub-divided into small (less than 2mm), medium (2–4mm) and large (greater than 4mm).

2.1. Statistical analysis

Data was expressed in percentages. To find the association between the HCs and ipsilateral maxillary sinusitis Chi-Square test was used. Odds ratios were calculated.

3. Results

In this study, total sample size was 680, among them males were 438 and females were 242.

Out of this 680 maxillary sinuses studied, 106 reported to have HCs. The prevalence of HCs in this study was 15.6% (Table 1). The mean age of the subjects was 43.6±17.3 years. However, the mean age of the male subjects was 43.6±16.7 years and female subjects were 43.6±18.2 years. The mean age of the subjects presented with HCs was 41.8±16.0 years. The mean age of the sinusitis patients was 43.0±17.6 years. Mean of the patients with sinusitis in males and females was 41.9±17.2 years, 47.3±19.1 years respectively. Of the 106 patients with HCs, 32 (16.0%) patients belongs to 18-30 years, 37 (19.1%) belongs to 31-45 years and 23 (14%) in the 46-60 years. In this, 67 (15.3%) were male and 39 (16.1%) were female (Table 2). In this study, prevalence of Maxillary sinusitis is 13.4% (95% CI: 10.9 – 16.2).

Of the 91 patients with Maxillary sinusitis, 35 (17.5%) were belongs to 18–30 years of age, 14 (7.2%) belongs to 31–45 years of age and 27 (16.5%) were in the age group of 46–60 years (Table 2). Among the 91 patients with Maxillary sinusitis, males were 72 (16.4%) and females were 19 (7.8%) (Table 3).

Fig. 1: CT scan coronal reformatted image in bone window showing a large size Haller air cell (>4 mm) (arrow) on right side causing significant narrowing of osteomeatal complex (line) and causing maxillary sinusitis (star).

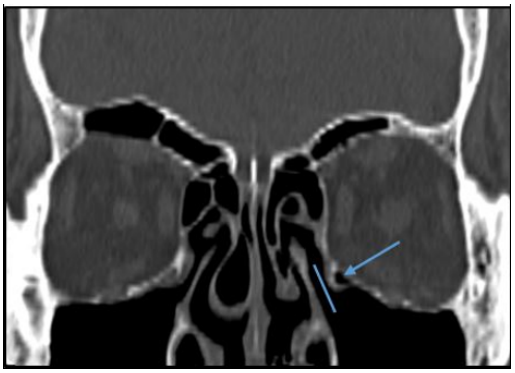

Fig. 2: CT scan coronal reformatted image in bone window showing a small size Haller air cell (<2mm) (arrow) on left side. No evidence of maxillary sinusitis. Osteomeatal complex is normal (line).

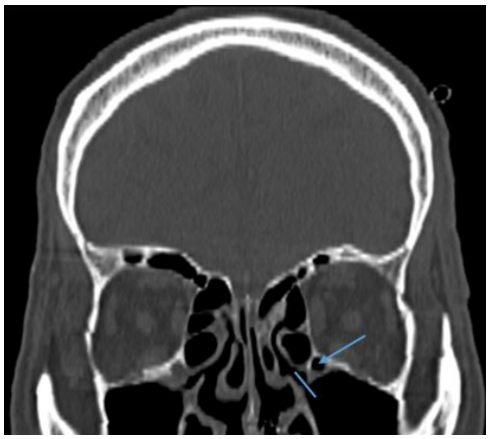

Fig. 3: CT scan coronal reformatted image in bone window showing a medium size Haller air cell (~ 3.5 mm) (arrow) on left side. No evidence of maxillary sinusitis. Osteomeatal complex is normal (line).

Table 1: Prevalence of age and gender distribution, Haler cells, and Maxillary sinusitis (n=680)

Characteristics	Frequency (%)
Age categories	
Less than 30 years	200 (29.4%)
31 – 45 years	194 (28.5%)
46 – 60 years	164 (24.1%)
More than 60 years	122 (18.0%)
Mean (SD) age in years	43.6 (17.3)
Sex	
Male	438 (64.4%)
Female	242 (35.6%)
Prevalence of Haller cells	
Absent	574 (84.4%)
Small	49 (7.2%)
Medium	42 (6.2%)
Large	15 (2.2%)
Maxillary sinusitis	
Present	91 (13.4%)
Absent	589 (86.6%)

Table 2: Association between age, gender, and presence of Haller cells with Maxillary sinusitis (n=680)

Characteristics	Total	Maxillary sinusitis present (n=91)	Maxillary sinusitis absent (n=589)	Odds ratio (95%CI)	P value
Age categories					
Less than 30 years	200	35 (17.5%)	165 (82.5%)	1.51 (0.78 – 2.90)	0.213
31 – 45 years	194	14 (7.2%)	180 (92.8%)	0.55 (0.25 – 1.19)	0.132
46 – 60 years	164	27 (16.5%)	137 (83.5%)	1.40 (0.71 – 2.77)	0.326
More than 60 years	122	15 (12.3%)	107 (87.7%)	Ref	-
Sex					
Male	438	72 (16.4%)	366 (83.6%)	2.30 (1.35 – 3.93)	0.002
Female	242	19 (7.8%)	223 (92.2%)	Ref	-
Prevalence of Haller cells					
Absent	574	72 (12.5%)	502 (87.5%)	Ref	-
Small	49	3 (6.1%)	46 (93.9%)	0.45 (0.14 – 1.50)	0.196
Medium	42	9 (21.4%)	33 (78.6%)	1.90 (0.87 – 4.13)	0.105
Large	15	7 (46.7%)	8 (53.3%)	6.10 (2.14 – 17.32)	0.001

Table 3: Association between age, gender, with presence of Haller cells (n=680)

Characteristics	Total	Haller cells present (n=106)	Haller cells absent (n=574)	Odds ratio (95%CI)	P value
Age categories					
Less than 30 years	200	32 (16.0%)	168 (84.0%)	1.47 (0.75 – 2.88)	0.262
31 – 45 years	194	37 (19.1%)	157 (80.9%)	1.81 (0.93 – 3.52)	0.077
46 – 60 years	164	23 (14.0%)	141 (86.0%)	1.26 (0.62 – 2.56)	0.526
More than 60 years	122	14 (11.5%)	108 (88.5%)	Ref	-
Sex					
Male	438	67 (15.3%)	371 (84.7%)	0.94 (0.61 – 1.44)	0.778
Female	242	39 (16.1%)	203 (83.9%)	Ref	-

Table 4: List of authors who observed association of Haller cells in Maxillary sinus pathology

Author	Incidence of Haller air cells(Percentage)	Findings (Haller cells and associated maxillary sinus pathology)
Wanamaker et al.[10]	20.0	Suggested that headache and sinus disease may be due to Haller air cell
Bolger et al.[5]	45.1	Indicated equal prevalence of Haller's cells in cases with and without sinus disease was noted
Earwaker et al.[11]	20.0	Emphasized that sinus diseases can occur equally in patients with and without HCs
Milczuk et al.[12]	5.3	Reported HCs associated with ipsilateral sinus disease in 66.7% of patients
Our study	15.6%	46.7% of large size Haller's cells associated with ipsilateral sinus disease.

4. Discussion

Haller cells (HCs) are anatomical variations; they may predispose some of the patients to sinus diseases and may also lead to inflammatory disease. Hence, HCs diagnosis has become important to rule out the cause of sinusitis.

The large sized HCs can narrow osteomeatal complex (Figure 1), that may cause blockage to the sinus drainage pathway. These may also associate with frontal headache followed by periorbital area.[13] The relationship between HCs and Maxillary sinusitis has been documented in few studies by using different imaging modalities [Table 4].

Equal prevalence of Haller's cells and other variants in cases with and without Sinus disease was noted in the studies of Earwaker et al.[11] and Bolger et al.,[14] whereas Milczuk et al.[6] found Haller's cells associated with ipsilateral sinus disease in 66.7% of his patients. The presence of Haller's cells, then, seems not by itself to represent a disease state but to predispose the patient to the development of sinonasal pathology by obstructing normal ventilation and drainage pathways. Bolger et al.[14] suggest that the role of Haller's cells in sinus disease be examined on an individual basis considering factors such as cell size, proximity of the cell to the maxillary ostium, evidence of inflammation, and mucosal contact.

In the current study, association was observed between Large sized HCs and ipsilateral maxillary sinusitis (Figure 1). Stackpole and Edelstein[15] and Yousem et al.[16] reported a significantly elevated maxillary sinus mucosal disease in patients with medium and/or large sized HCs (45.8%) vs those with small HCs (28.9%). They concluded that large sized HCs are etiological factors in maxillary sinusitis and cause substantial narrowing of the maxillary infundibulum.[15,17] However, small and medium size of HCs and ipsilateral maxillary sinusitis not showed any association.

Small Haller cell size was associated with a 6.1% incidence of maxillary sinusitis, medium Haller cell size was associated with a 21.4% incidence of maxillary sinusitis whereas larger cells had a 46.7% incidence, which was significant by chi-square analysis. Thus, smaller Haller cells and medium size Haller air cells may be associated with a lower incidence of maxillary sinusitis (Figures 2 and 3), than compared to larger Haller cells.

The significant difference between these rates suggests that HCs are important in the etiology of maxillary sinusitis only when they are large enough to cause substantial narrowing at the osteomeatal complex (Figure 1). In the setting of a narrowed infundibulum, the normal mucociliary flow is disturbed, and causes local obstruction. This evidence supports the intuitive concept that the larger the size of an obstruction, the greater the buildup of debris or infection behind it. However, the association of obstruction and disease is limited to maxillary sinusitis as defined by radiologic criteria, and larger sized Haller cells.

Haller cells may be surgically relevant in patients with obstruction of the infundibulum, or with significant maxillary sinusitis. Removing the inferior bony margin of a large cell may decrease the obstruction that may not be fully addressed by excision of the uncinate process. The preoperative CT scan functions as a roadmap for disease with this variant as with many others, such as concha bullosa, which have been implicated in the etiology of obstruction of mucociliary flow in the ostiomeatal complex. However, Haller cells that are not obstructive may play no active role in a patient's development of sinusitis. Therefore, Haller cell patients require analysis of the configuration of the osteomeatal complex, the size of the Haller cells, and the presence of radiologic sinusitis, as well as careful correlation with clinical symptoms on an individual basis for optimal treatment.

5. Conclusion

The present study may conclude that presence of HCs cannot be attributed to maxillary sinusitis, size of the air cell should be considered, which are important anatomical variations in maxillary sinus pathologies. HCs may be one of the causes for sinusitis. It should be considered as an important anatomical variation in maxillary sinus pathologies as these cells do play a pivotal role in ventilation and drainage of maxillary sinus.

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No financial support was received for the work within this manuscript.

7. Conflicts of Interest

No conflicts of interest.

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