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Research Article

Computed Tomographic Study of the Haller Cell in Adult Nigerians

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Abstract

Introduction: Knowledge about the Haller cell is key in understanding the pathophysiology of recurrent sinusitis and in planning for safe endoscopic sinus surgery. This study explicates the occurrence of the Haller cell in adult patients seen at a Teaching Hospital in Delta State Nigeria.

Materials and Methods: This study utilized brain Computed Tomography images of 137 female and 199 male patients with an age range of 20-99 years. These images were acquired over a 5-years period and stored in the Radiology Department of Delta State University Teaching Hospital. Ethical approval for this study was sought from the Hospital's ethical board before accessing the radiological database. Using coronal images, an air cell located beneath the ethmoid bulla, lamina papyraecea, or orbital floor on either side was identified as the Haller cell. We employed the Statistical Package for Social Sciences version 23 to analyze the data. Chi-square test was used to evaluate the association between the Haller cell with gender and side and this was considered significant at $P < 0.05$.

Results: The Haller cell had a prevalence of 44,13.1%, with higher unilateral (42,12.5%) than bilateral (2,0.6%) occurrence. Its unilateral existence was greater on the right side (27,8%) than on the left (15,4.5%). This cell did not show any significant relationship with side (*P* 0.637) or with gender on each side (*P* 0.945, 0.295).

Conclusion: The occurrence of the Haller cell is side and sex independent. Therefore, its radiological identification is imperative in the diagnosis of recurrent sinusitis and obligatory for better surgical planning with minimal complications.

Keywords: Haller Cell; Maxillary Sinusitis; Surgery

Introduction

The Haller cell (HC) is an extramural cell formed by the extension of an anterior ethmoidal cell inferior to the ethmoid bulla and the orbital floor. Its pneumatization also spreads laterally to the lamina papyraecea along the maxillary sinus (MS) roof [1]. It is also referred to as infraorbital or maxilloethmoidal cell [2]. These cells were named after Albert von Haller, a Swiss anatomist in 1765, who observed this type of pneumatization on the floor of the orbit [3]. The infraorbital cell is surrounded by the ethmoidal capsule which distinguishes it from the infraorbital recess of the maxillary sinus [4].

Studies carried out in different racial or ethnic groups and different geographical regions have reported discrepancies in the prevalence of the Haller cell, with a range of 5.5%-49.5% [1-5]. This cell has often been a coincidental radiological finding with no potential pathological role [3]. However, when large, a HC may interrupt the mucociliary clearance of the paranasal sinuses by blocking the osteomeatal complex, subsequently causing sinus infection and inflammation with associated sinogenic headache, orofacial pain, and orbital edema [4]. Furthermore, otorhinolaryngologists need to be cognizant of the existence of infraorbital cells to abate inadvertent penetration into the orbits during endoscopic sinus surgery [6].

Computed Tomography (CT) has the exceptional capability of depicting the precise and detailed anatomy of the sinonasal region with their subtle variations. The coronal plane provides the preeminent orientation for assessing the drainage pathway and vital relations of the paranasal sinuses hence providing an accurate surgical guide [7]. Accordingly, this study elucidates the prevalence of the Haller cell in Delta State Nigeria using CT.

Materials and Methods

This cross-sectional study was retrospectively conducted in the Radiology unit of Delta State University Teaching Hospital. Permission to carry out this study was sought from the Hospital's Research and Ethics committee (EREC/PAN/2020/030/0371). Brain CT images used in this study were accessed in the Picture Archiving Communications Systems (PACS) software. This study only included the images acquired within a 5-years timespan ranging from 1st of June 2015 to 30th June 2020. These images were captured using a 64 slice CT scanner (Toshiba Aquilon, Japan) and the acquisition parameters were set at 120kV and 300mA.

The brain CT images used belonged to patients (137 females and 199 males) aged between 20-99 years who presented to the Radiology department for imaging. The indications for imaging included suspected intracranial lesions such as tumors, hemorrhage or thrombi, suspected pulmonary embolism and complaints of chronic headache. We excluded CT images with evidence of sinonasal infection such as thickening of mucosa and air fluid levels. Images indicating sinonasal polyposis, previous sinus surgery, facial trauma, as well as images of patients aged below 20 years were also barred. Furthermore, images with inadequate exposure of the sinonasal region, and those showing any evidence of patient rotation, or artifacts such as metal, motion, and beam hardening artifacts were excluded. The Haller cell was identified bilaterally on coronal reformatted CT images as an air cell of any size that is located beneath the ethmoid bulla, lamina papyraecea, or orbital floor [1]. We tabulated the findings on data sheets and used Statistical Package for Social Sciences (SPSS) Version 23.0 (IBM® Armonk, New York) to carry out the analysis of data and later present the frequencies in tables. Chi-Square was used to assess for the relationship between the HC in relation to side and gender and these were significant when p value was < 0.05.

Results

The total images evaluated belonged to 336 patients and their average age was 53.29±18.18 years (Range 20-99 years). The gender distribution of the studied sample comprised 199 males (59.2%) and 137 females (40.8%). Out of all the images included in this study, the HC was observed in 44 patients (13.1%). The comparison of the prevalence of Haller cells in different population groups is shown on Table 2. The prevalence was slightly higher in females (20,14.6%) than in males (24,12.1%). The majority of patients studied had the cell occurring unilaterally (42, 12.5%). The unilateral HC had a higher frequency on the right (27,8%) than on the left (15, 4.5%) side. However, this infraorbital cell lacked significant association with the side of occurrence (*P* 0.637). We recognized their bilateral existence in 2 (0.6%) patients only. Nonetheless, there was no significant relationship between the gender of the patient and the existence of Haller cell on both sides (*P* 0.945, 0.295) (Table 1 and Figure 1).

Side	Females		Male		Total		*P* value
	N	%	N	%	N	%	
Right	12	8.8	17	8.5	29	8.6	0.945
Left	9	6.6	8	4.0	17	5.1	0.295

Table 1: Prevalence of Haller cell.

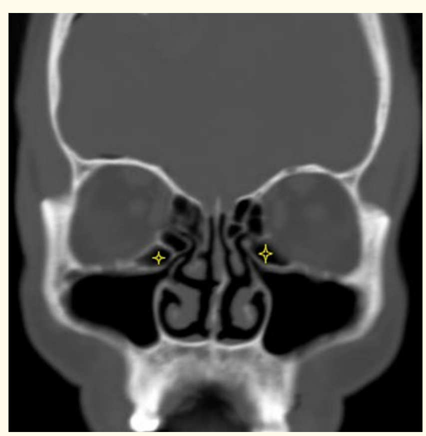

Figure 1: Coronal reformatted cranial CT image showing bilateral Haller Cells (yellow asterisks).

Discussion

The HC was identified in 13.1% of the patients evaluated. This was higher than 3.5% and lower than 20.91% documented in previous CT studies in Nigeria's Osun and Rivers States respectively [8,9]. The variation could be ascribed to dissimilarities in sample size and methodology used in different studies and varied environmental factors in the different study regions. Higher frequencies have been documented in Sudan (39%), Belgium (49.5%), Philippines (41.6%), Turkey (27.5%), and Portugal (32.1%) [2,4,10-12]. Conversely, scholars in Saudi Arabia, Brazil, and Mexico documented a prevalence of 10.2%, 9.6%, and 5.5% respectively which were lower than our findings [1,5,13]. Our prevalence was within the documented frequency range in the Indian population (2.6%-27.2%) (Table 2) [14,15].

Authors	Country	N	Haller cell (%)
Simoes., *et al*. [1]	Brazil	1005	9.6
Badawi., *et al*. [2]	Sudan	61	39.4
Kamdi., *et al*. [4]	Belgium	200	49.5
Kantun., *et al*. [5]	Mexico	110	5.5
Oghenero., *et al*. [8]	Nigeria	114	3.5
Onwuchekwa and Alazigha, [9]	Nigeria	110	20.91
Espinosa., *et al*. [10]	Philippines	60	41.6
Gungor and okur, [11]	Turkey	132	27.5
Pereira., *et al*. [12]	Portugal	112	32.1
Mohammed et al. [13]	Saudi Arabia	392	10.20
Shrestha., *et al*. [14]	India	76	2.6
Sheikh., *et al*. [15]	India	852	27.2
Current study	Nigeria	336	13.1

Table 2: Comparison of the Prevalence of Haller Cell in different study populations.

Congruent with our observations, Badawi., *et al.* [2] and Johari., *et al.* [16] did not establish any significant gender differences in the distribution of HC among the Sudanese and Iranians respectively. Conversely, Shahab., *et al.* [6] and Ozcan., *et al.* [3] observed a significant female preponderance of HC. Disparities in the gender distribution of HC in different populations have been accredited to the varying recruitment of patients irrespective of gender [17].

The HC existed unilaterally in 12.5% and bilaterally in 0.6% of patients. These frequencies were lower than the findings by Neha., *et al.* [7] and Shahab., *et al.* [6] in India and Iran correspondingly. Corresponding with our observation, Shahab., *et al.* [6] documented a higher prevalence of unilateral HC on the right compared to the left side. On the contrary, Chaudhari., *et al.* [17] reported more bilateral than the unilateral occurrence of HC as well as more unilateral prevalence on the left than on the right side. These scholars further established that the laterality of this variant cell was not statistically significant [6,17].

The variations in the existence of HC in different populations could be accredited to race, environmental and geographical factors. Furthermore, the use of different study designs, sample sizes, patients' age groups, and methodology may perhaps contribute to this variation. For instance, subjective judgment regarding the existence of HC, inconsistency in definition of HC, discrepancies in the elucidation of HC based on size and location, and the use of different imaging modalities and techniques [3,16,18]. Most studies used conventional CT while others like Kamdi., *et al.* [4] used Cone Beam Computed Tomography (CBCT). CBCT has a higher advantage of thin slices, higher spatial resolution, and accuracy [3]. The thinner slices of CT images can identify minute cells and this may be responsible for the high prevalence in some studies [4].

The HC cell varies in size and when large, it may compromise the patency of the already narrowed osteomeatal complex, MS ostium, and ethmoid infundibulum [18]. This impedes mucous outflow from the paranasal sinuses consequently impairing sinus ventilation [8]. Subsequently, this predisposes to infection and recurrent acute sinusitis with symptoms such as nasal obstruction with compromised nasal breathing, severe orofacial pain, headache, mucocele, and chronic cough [7,17]. Blockage of the main maxillary sinus ostium leads to the formation of an accessory maxillary ostium [3]. On the contrary, Akay., *et al.* [19] reported no significant relationship between HC and sinus disease.

Owing to their close proximity with the orbit, an infected HC may extend into the orbit subsequently causing orbital cellulitis and orbital edema [7]. An inflamed HC has hypertrophied mucosa that may obscure coexisting dehiscence or suture on the floor of the orbit through which infection spreads into the orbit [16]. Infraorbital cells pose difficulties during endonasal surgical procedures by restricting access to MS and anterior ethmoidal cells [7]. During middle meatal antrostomy and ethmoidectomy, failure to recognize the cell, which in some cases masks the position of the orbital wall, increases the risk of iatrogenic injury to the orbit and violation of the lamina papyraecea [6].

Conclusion

The existence of the HC is side and sex-independent in the studied population herein. Therefore, its radiological identification is imperative in the diagnosis of recurrent sinusitis and obligatory for better surgical planning and minimal complications.

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Conflict of Interest

The authors have no conflict of interest to declare.

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