Cross-sectional Study

Prevalence of frontal cells and their relation to frontal sinusitis among patients who underwent functional endoscopic sinus surgery: A prospective cross-sectional study in Tanzania

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ABSTRACT

Background: A narrow confine of frontal recess area and its variable anatomy has been a great surgical challenge to otorhinolaryngologists. There are several frontal cell types that have been described in frontal recess area. There is limited data in our setting on detailed description of frontal cells in patients who underwent functional endoscopic sinus surgery and their correlation to sinusitis.

Objective: To determine the magnitude of frontal cells and their correlation to sinusitis involving frontal sinuses among patients who underwent functional endoscopic sinus surgery at a private health facility in Tanzania’s largest populated city.

Methods: A prospective cross sectional study was conducted where both coronal and axial computerized tomography (CT scans) views of paranasal sinuses of 45 patients admitted at a private hospital ready to undergo functional endoscopic sinus surgery were reviewed to identify agger nasi cells, frontal cells and frontal sinus disease. Data were collected for right and left sides.

Results: Of the reviewed 90 sides, 75(83.3%) had agger nasi cells and 65(72.2%) had frontal cells. Similarly, 25 (27.8%) were mucosal disease free, 15 (16.7%) had partial opacification and 48(53.3%) had total opacification. Two frontal sinuses (2.2%) were not assessed for the presence of mucosal disease since they were aplastic or severely hypoplastic. There was no any statistically significant difference found in frontal sinus mucosal disease in presence or absence of frontal cells or agger nasi cells.

Conclusion: The study has depicted frontal cells to be prevalent and higher than what has been reported in literature.

1. Introduction

With advances in endoscopic surgeries, functional endoscopic sinus surgery (FESS) is becoming one of the global routine surgeries in otorhinolaryngology \([1,2]\) though to date its performed by limited number of same specialists in Tanzania and this may be accounted by limited exposure during postgraduate training and lack of availability of equipment. Knowledge on the anatomy of the nose and paranasal sinuses (PNS) has improved markedly following widespread adoption of FESS though to date, frontal recess area has been posing challenges to otorhinolaryngologists which is attributed by its limited boundaries and varying anatomy \([1,3]\).

Anatomically, the medial border of the frontal recess is formed by the middle turbinate while lamina papyracea forms the lateral wall. The posterior wall of the frontal recess when intact is formed by the bulla lamella which when pneumatized forms the ethmoid bulla \([1,4]\). The bulla is deficient at the roof of the ethmoid near the skull bases since its incomplete in most cases and hereby the frontal recess may communicate directly with the suprabullar and retrobullar recesses \([1,5]\). On the other hand, frontal recess has a variable pattern of pneumatization thus posing challenges in terms of diagnosis and treatment due to complexity in visualizing imaging. The recess can be well appreciated when both anterior and posterior walls of the ethmoid bulla fuses superiorly \([1,3,5]\). Intraoperatively, a surgeon must be keen when approaching the bulla lamella since the anterior ethmoid artery is usually located 1–2 mm behind the bulla lamella \([1,6]\). The frontal process of the maxilla forms...
the anterior wall of the frontal recess and tends to thicken anteriusorly to form the frontal beak while the lateral wall of the olfactory fossa lies at the superior and posteromedial regions of the frontal recess and its well known to be the thinnest part of the anterior skull base [1, 5].

Frontal recess area that Schaeffer described as a surgically interesting anatomical area in 1916 was termed as the “nasofrontal region” [1, 7, 8]. However, the first detailed description of the various cells in the frontal recess area was made in 1941 by van Alyea who used the term “frontal recess” rather than “nasofrontal duct” and frontal cells meant different types of ethmoidal cells pneumatizing in this area. These included the frontal cells (sometimes called the frontoethmoidal cells), as described by Kuhn et al., the agger nasi cells, the interfrontal sinus septal cells, and the supraorbital cells [1, 9]. Other cells that have also been described in this area include the suprabullar cells and the frontal bulla cells [1, 10].

Regarding the prevalence of frontal cells, they tend to occur in 20–41% of the paranasal sinuses [1, 11]. Similarly, the agger nasi occurs in 98.5% of patients and is well known to be the most constant cell being located in the frontal recess [12]. Frontal cells carries the synonym frontoethmoidal cells and they are referred to as a group of anterior ethmoidal air cells [1, 9]. These air cells have been classified into four (4) types by Kuhn. By description, Type I is known to be a single frontal cell above an agger nasi cell while Type II is a tier of cells in the frontal recess above the agger nasi cell. Type III is a large cell pneumatizing from the frontal recess into the frontal sinus and Type IV is a cell being totally isolated within the frontal sinus [1, 5, 11].

In our routine clinical practice, we noticed that the PNS CT scans of patients admitted for FESS had more frontal cells thus they may have been under reported in the available literatures. The aim of the study was thus to address such an existing gap.

2. Materials and methods

Coronal and axial PNS CT scans of 45 consecutive patients admitted for FESS from June 2016 to December 2020 were reviewed as a part of routine audit of endoscopic procedures in the Department of Otorhinolaryngology. PNS scans were reviewed to identify the agger nasi and the frontal cells as classified by Kuhn et al. [9]. The studied air cells were based on both sides (left and right) on separate basis. The Lund and Mackay system was used to identify and score the frontal sinus mucosal disease being encountered in the ipsilateral side [13]. Other types of frontal recess cells like interfrontal sinus septal cells, supraorbital cells, suprabullar cells, and frontal bulla cells were excluded in this study.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20 (IBM SPSS) and Fisher’s exact test and Chi-square test with Yates’ correction for tables with 1 of freedom was used to test the statistical significance of the difference between the occurrence of frontal sinus disease in presence of agger nasi or frontal cells and also occurrence of disease in a similar sinus in absence of the mentioned cells. Since this study was part of the routine departmental endoscopic audit, no approval from the ethics committee was required. The work has been reported in line with the STROCSS criteria [14].

3. Results

A total of 90 sides of PNS CT scans were reviewed. Among the 45 patients involved in the study, there were 35 males and 10 females. The age ranged from 15 to 72 years with a mean age of 54.15 (±12.23).

The Agger nasi cells were found to be predominant accounting for 75 (83.3%) of the studied sides. All four types of frontal cells were found in our study accounting for 65 (72.2%) of the studied sides where type I frontal cells were found in 20 (22.2%) of the studied sides, type II frontal cells were found in 32 (35.6%) of the studied sides, type III frontal cells were found in 10 (11.1%) of the studied sides and type IV frontal cells were found in 3 (3.3%) of the studied sides.

Among the studied frontal sinuses, 25 (27.8%) had no mucosal disease on PNS CT scans and that is, had a score zero on Lund-Mackay system, 15 (16.7%) had partial opacification and that is, had a score 1 on Lund-Mackay system and 48 (53.3%) had total opacification and that is, had a score 2 on Lund-Mackay system.

Two frontal sinuses (2.2%) were not assessed for the presence of mucosal disease since they were aplastic or severely hypoplastic.

Upon comparison between disease in the frontal sinus mucosa in the presence and absence of agger nasi cells and frontal cells as a group and also in the presence and absence of each of the four types frontal cells on separate basis, no significant difference was found between frontal sinus mucosal disease in the presence or absence of any of these cells using both Fisher’s exact test and chi-square test.

4. Discussion

Our study reviewed ninety PNS CT scans where males outnumbered females with male to female ratio was 3.5:1. Regarding agger nasi cells, it was found to account for 83.3% of cases but frontal cells accounted for 72.2% of the studies sided with type I (22.2%) and type II (35.6%) were the commonest frontal cell types. Similarly 27.8% of the frontal sinuses had no mucosal disease on PNS CT scan and 2.2% of the frontal sinuses were not assessed for the presence of mucosal disease since they were aplastic or severely hypoplastic.

The first comprehensive description of frontal cells in 41% of the specimens in the frontal recess area during cadaveric dissections was made by van Alyea in 1941 [15]. He included frontal cells, interfrontal sinus septal cells, the agger nasi and supraorbital cells [9]. Such incidence of frontal cells was most likely an underestimate since many studies later on reported the agger nasi cells to be much common than what was found in Van Alyea’s results.

Our study has found the prevalence of agger nasi cells to be 83.3% and such findings appears to be somehow similar to what has been found in other studies like the study which was conducted by Bolger et al. where he found agger nasi cells to be present in 98.5% of the studied sides [12] and also Han et al. in their cross-sectional study in Beijing found agger nasi cells to be present in 94.1% of the studied sides [16]. Similarly, a study from Poland by Krzeski et al. found agger nasi cells to be present in 52.87% of the studied sides of patients with chronic rhinosinusitis [17].

The magnitude of frontal cells and the relationship between frontal cells and frontal sinus disease has been rarely studied. Our study found the prevalence of frontal cells to be 72.2% and such findings appears somehow dissimilar to what was found by Krzeski et al. who identified frontal cells in 23.56% of the studied sides of PNS CT scans in their incidence study in Poland [16] and Meyer et al. who found the prevalence of frontal cells to be 20.4% in their cross-sectional study from the United States of America [17]. On the other hand our results have shown a significantly higher incidence of frontal sinus disease in the presence of type I and II frontal cells. The prevalence of frontal cells in our study was 72.2% higher than what has been reported in the United Kingdom and United States of America [1, 18] and such observed difference may be attributed by inclusion of all the cells that were described by Kuhn et al. regardless of their size [9] while some of these cells were found to be remarkably small thus may have not been considered by other authors due to their limited surgical implication.

Moreover, our study established that presence or absence of frontal cells or agger nasi cells did not have a significant influence on sinusitis. This may be supported by the fact that patients recruited in our study were suffering from chronic rhinosinusitis and they were scheduled for FESS, and thus the prevalence of the frontal cells in these patients might not represent the actual magnitude among persons in the general population.

Our study similar to other cross sectional studies done in the United Kingdom and Japan [1, 3] found no relationship between frontal cells...
and frontal rhinosinusitis and it is likely that the magnitude of frontal cells in patients with chronic rhinosinusitis does not differ from the normal general population prevalence.

5. Conclusion

The Agger nasi and frontal cells were found to be predominant in the frontal recess area in our hospital setting thus frontal cells may have been invariably underreported in the available literatures and also the presence of these cells does not seems to influence the presence of frontal rhinosinusitis.

Provenance and peer review

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Ethical approval

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Author contribution

ZSA contributed to study design, analysis and prepared this manuscript while AAK contributed to study design and reviewed the manuscript. All authors have read and approved the final manuscript.

Registration of research studies

1. Name of the registry: Not a registry
2. Unique identifying number or registration ID: Not applicable
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): Not applicable

Guarantor

Dr. Zephania Saitabau Abraham takes full responsibility of the work.

Consent

No consent was obtained since it was mainly based on review of images.

Conflicts of interest

None.

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