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Computed Tomographic Characterization of the Nose and Paranasal Sinuses at a Tertiary Hospital in Northern Tanzania

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Abstract

Background

Attribution of the anatomical variations of the nose and paranasal sinuses in blockage of osteomeatal complex is an important etiological factor in the pathogenesis of sinus diseases. Functional endoscopic sinus surgery aims to restore the function of the nose and PNS by addressing the natural ostium. However, anatomical variations of the nose and PNS may hamper surgery hence cross-sectional imaging remains to be crucial to operating otorhinolaryngologists.

Broad objective

This study aimed to characterize anatomical variations of the nose and paranasal sinuses among patients who underwent paranasal sinuses computerized tomography scans at a tertiary hospital in Northern Tanzania.

Methodology

A descriptive cross-sectional study was conducted at a tertiary hospital, all computerized tomography scan images of patients referred for paranasal sinuses computerized tomography scans were retrieved in axial and multiplanar reformat slices, reviewed by a board-certified radiologist for the presence of anatomical variations. Data were analyzed using the statistical package for social sciences version 20 and summarized in terms of frequencies and proportions for categorical variables. Relationship between independent and dependent variables was established using the Chi-square test where a p-value of <0.05 was considered to be statistically significant.

Results

There were ninety patients where forty-eight (53.3%) were females and forty-two (46.7%) were males with a mean age of 48.1 ±19.75. years. Of the studied subjects, 81 (90%) had at least one anatomical nose and paranasal sinus variant. The most common variant found in this study was Agger nasi cell 47(52.2%) followed by septal deviation 45(50%) and concha bullosa 44(48.9%). Other variants included Haller cells 14(15.56%) and Onodi cells 10(11.1%), laterally rotated uncinate process 1(1.1%) and dehiscent lamina papyraceae 11(12.2%).

Conclusion

Anatomical variants of the nose and paranasal sinuses were found to be quite predominant in our hospital setting thus of paramount importance to be well known to otorhinolaryngologists. Each of the anatomical variant has its clinical implication and therefore of significance in management of patients with diseases involving the nose and sinuses.

Keywords: *Anatomical variations, Computerized tomography, Nose, Paranasal sinuses, Tanzania.*

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Introduction

Paranasal sinuses (PNS) are air filled cavities named according to the bones in which they are found and includes maxillary, frontal, sphenoid, and ethmoid sinuses and being lined by a respiratory mucoperiosteum. Paranasal sinuses start to develop in utero and usually reach their adult size by early adolescence (1).

During their course of growth and development, three projections emerge from the lateral wall of the nose as the sinuses primordium, where the superior projection becomes ethmoidal air cells, the anterior one forms the Agger nasi cell while the inferior develops into the maxillary sinus, and the inferior turbinate (1,2). The embryology and anatomy of the nose and paranasal sinuses remain to be complex thus making their clinical assessment to be difficult.

The reported prevalence of the anatomical variation of PNS from various studies in different ethnic groups outside Africa showed such prevalence as follows; Septal deviation (14.1% to 80%) (3), Haller cells (2 to 70.3%) (4), concha bullosa ranges (14 to 80%) (5), the Onodi cells (8 to 13%) (6), and Agger nasi cell (10 to 98.5%) (7).

Studies from West Africa showed the prevalence of anatomical variations to be 91% with concha bullosa and septal deviation being the commonest variations (1,8) and such observation was comparable to those from a study that was conducted in Kenya where Haller cells and concha bullosa were the prevalent anatomical variants (9).

There are anatomical variants of the paranasal sinuses as they may be depicted in patients undergoing paranasal sinuses computerized tomography scan (CT scan) and are best viewed and appreciated in the coronal plane. Thus, radiologists and otorhinolaryngologists must be aware of such variants since they have an important role in the management of disease affecting the nose and paranasal sinuses. A wider understanding of the paranasal sinuses variants enables safe endoscopic transnasal surgeries in patients with diseases of the nose and paranasal sinuses.

There is no study to date that has been conducted in Tanzania to evaluate anatomical variations in patients undergoing PNS CT despite an enormous number of patients undergoing such imaging in various regional and tertiary hospitals in the country. This study aimed to address such an existing gap.

Methodology

Study design, setting, sampling technique and participants

A descriptive hospital-based cross-sectional study was conducted in the Department of Radiology at Kilimanjaro Christian Medical Centre (KCMC), which is the only and largest tertiary hospital in Northern Tanzania. The study was conducted from September 2017 to March 2018 where paranasal sinuses CT scans of patients who underwent such imaging were evaluated. Both axial and coronal plane images were studied. Patients older than 17 years were included in this study and a total of 90 paranasal sinuses CT scans were studied.

Data collection methods

Ninety (90) PNS CT scan images of patients older than 17 years were reviewed after excluding patients with a previous history of paranasal sinuses surgery, PNS destructive lesions or facial trauma. A board-certified radiologist reviewed the images and ascertained the presence of anatomical variants and characterized them in detail.

Data analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 20 and results were presented in tables and figures. The relationship between independent and dependent variable was established using Chi-square test. A variable with a p-value less than 0.05 was considered to be statistically significant.

Ethical considerations

Ethical clearance was obtained from the Senate Research and Publications Committee of the Kilimanjaro Christian Medical University College (KCMUCo). Permission to conduct the study was sought from the Department of Radiology at Kilimanjaro Christian Medical Centre.

Results

A total of 90 PNS CT scan images were analyzed in this study. There were 82 (91.1%) PNS anatomical variations in the studied images and 60 (66.7%) had Keros type II (Table 1). Agger nasi was the most common variation 47(52.2%), septal deviation was found in 45 (50%), concha bullosa 44(48.9%), Haller cells 14(15.56%) and Onodi cells in 10(11.1%) images (Figure 1). Lateral deviation of the uncinate process (rotated uncinate process) was found in 1(1.1%), while dehiscent lamina papyracea accounted for 11(12.2%) cases. (Figure 2).

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Table 1: Prevalence of anatomical variations (n=90)

Anatomical variations	n (%)
Anatomical variants	
Absent	8 (8.9)
Present	82 (91.1)
Keros types	
I	25 (27.8)
II	60 (66.7)
III	5 (5.6)

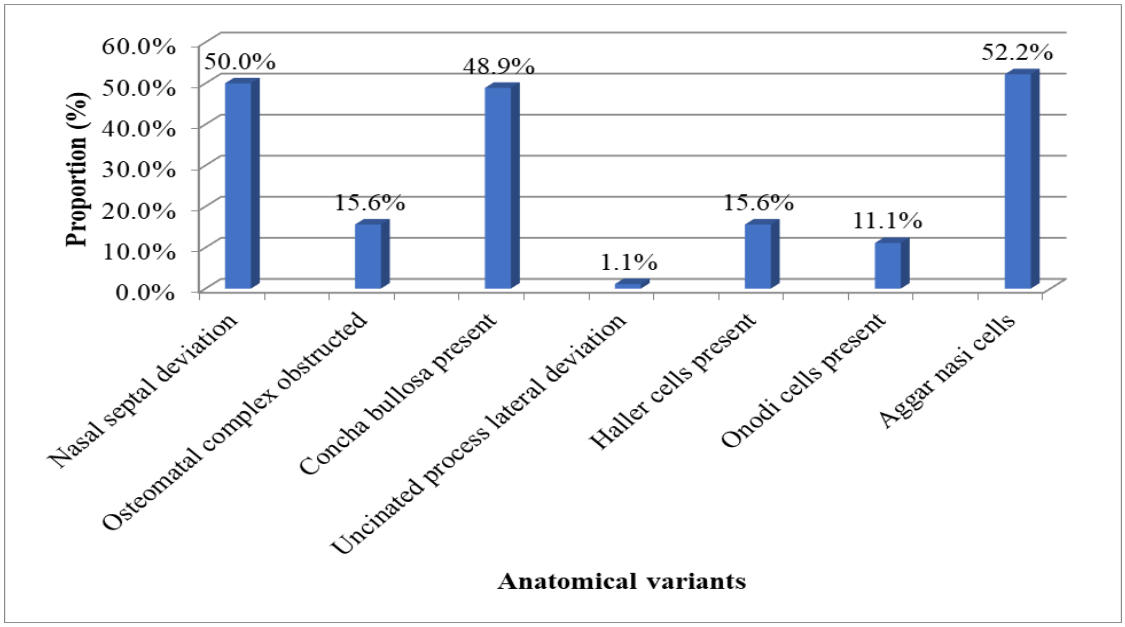

Figure 1. Proportion of anatomical variants (n=90)

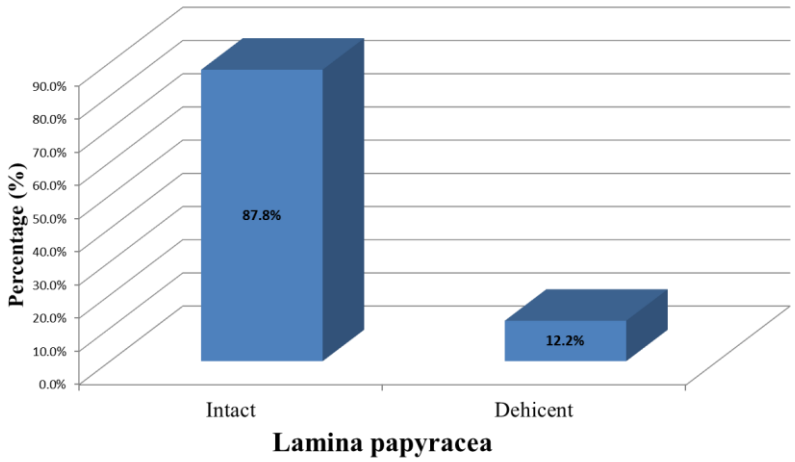

Figure 2. Lamina papyracea status (n=90)

Discussion

Variations in the anatomy of the nose and paranasal sinuses contribute to the blockage of osteomeatal complex leading to diseases of the paranasal sinuses (2). The endoscopic surgical approach to patients with diseases affecting the paranasal sinuses is of importance in restoration of the function of nose and paranasal sinuses rather than surgical attempts to remove all diseased mucosa (10). The aim of the study was to characterize the anatomical variants in patients who underwent CT scans of the paranasal sinuses at the largest tertiary hospital in Northern Tanzania. The details of the variations are as discussed hereunder.

Deviated nasal septum

Deviation of the nasal septum from the midline may involve the cartilaginous, osteocartilaginous or osseous part and has been invariably reported from the available literatures. Deviated nasal septum was found to account for half of the cases (50%) and such findings appear to be similar to what was found in the study that was conducted in Spain (7). Such findings appear to be dissimilar to those from India where a lower prevalence of deviated nasal septum was found (11).

Concha bullosa

Depending on the degree of pneumatization of the middle turbinate which may involve the vertical lamella, bulbous segment or both, concha bullosa is also a common variation that has great implication in diseases affecting the nose and paranasal sinuses. This study found concha bullosa to account for 48.9% of cases and such lower prevalence appears to be similar to the finding from the study that was conducted in India (35.4%) (10) though lower than what was found in Spain (73%) (7).

Ethmoidal sinus variations

The predominant ethmoid air cell variation in this study was the Agger nasi cell. Our study finding was comparable to that from India (4), but dissimilar to that from the United States of America that reported a higher prevalence, (12) while a study from India reported a lower prevalence (13). Differences in the established findings may be due to differences in the definition criteria, i.e., whether an Agger nasi cell was only reported when it was sufficiently hyper-pneumatized to obstruct frontal sinus drainage.

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Olfactory fossa depression

In this study, determination of the olfactory fossa depression was defined through Keros Classification where Keros type II was found to be quite prevalent (66.7%) similar to what was found in Brazil (14). Such Keros types are surgically important in predicting complication during Endoscopic Sinus Surgery such as cerebrospinal fluid rhinorrhea. A low-lying cribriform plate is highly vulnerable to injury during exenteration of ethmoid air cells.

Conclusion

Paranasal sinuses variants were found to be prevalent in our hospital setting. Paranasal sinuses computerized tomography scans remain to be important when instituting management of patients with diseases of the nose and paranasal sinuses.

Competing interests

The authors declare no competing interests.

Authors' contributions

PAK contributed to study design, analysis and prepared this manuscript, DCC designed the study, collected data and performed data analysis and comments to the manuscript draft, FHAM contributed to study design, analysis and comments to the manuscript drafts. AAK and ZSA contributed to study design, data analysis and reviewed this manuscript. All authors have read and approved the final manuscript.

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Abbreviations

CT scan	Computerized tomography
KCMUCo	Kilimanjaro Christian Medical University College
PNS	Paranasal sinuses
SPSS	Statistical Package for Social Sciences

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