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Chronic Rhinosinusitis: Correlation between its Clinical Features and Computed Tomography Findings in Patients Attending a National Hospital, Tanzania

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Abstract

Background

Chronic rhinosinusitis (CRS) is a common and significant health problem with negative impact on quality of life and socioeconomic welfare of patients.

Objective

This study associated the clinical features of CRS with findings of computed tomography of paranasal sinuses (CT PNS).

Methodology

This hospital based descriptive cross-sectional study recruited 126 participants aged 10 years and above who fulfilled the criteria of Chronic Rhinosinusitis according to rhinosinusitis symptom inventory (RSI) developed by the American Academy of Otorhinolaryngology Head and Neck Surgery from October 2019 to January 2020. Data was analyzed using SPSS program version 26 and a p value of < 0.005 was considered to be statistically significant.

Results

Most participants were in age group 31 - 40 (23.8%) years, age ranged from 12 years to 77 years. Females were 61.9%. The commonly reported symptom was nasal obstruction/congestion (89.7%). Nasal endoscopy revealed secretion (thin and/or thick) in all participants (100%), with nasal polyps seen in 61.9% of them. Computed tomography of PNS showed opacification was frequent in maxillary sinus (93.7%). Bone thickening was seen in 61.1% of the patients. Anatomical variations were seen in 52.4% of participants; of which deviated nasal septum (56.1%) was the most common. There was a strong correlation between CT scan (Lund Mackay) score and nasal endoscopy (Lund Kennedy) score with Pearson correlation coefficient of 0.66. Sensitivity and positive predictive value were 100% and 96% respectively.

Conclusion and Recommendation

Nasal endoscopy and CT scores have a strong correlation; the use of nasal endoscopy and/or CT scan supports in making specific diagnosis and treatment.

Key words: *Rhinosinusitis, Clinical features, Nasal endoscopy, Computed tomography.*

Introduction

Chronic rhinosinusitis is a common universal disease. Disease-related financial expenses and inability of patient to perform work-related duties result in social economic burden and cause negative impact on patient's wellbeing, affecting the patient's quality of life. The Rhinosinusitis Task Force (RSTF) defined chronic rhinosinusitis based on duration and symptoms and stated that any form of rhinosinusitis lasting for more than 12 weeks and having 2 or more major symptoms or 1 major and 2 minor symptoms, out of twelve major and minor symptoms (1).

The epithelial lining of paranasal sinuses is ciliated, pseudostratified columnar epithelium. Irreversible damage to these cilia contributes to stasis and thus chronic rhinosinusitis (1,2). Causes and pathogenesis in chronic rhinosinusitis are unclear, and most circumstances are idiopathic. However, in some cases there is association of chronic rhinosinusitis with genetic disorders (Kartagener syndrome, cystic fibrosis (CF), autoimmune disorders (sarcoidosis, Wegener granulomatosis, systemic lupus erythematosus), or systemic immunodeficiencies (HIV). The emerging theories suggest that idiopathic chronic rhinosinusitis is a result of a dysfunctional interaction at the sinonasal mucosal surface between the host immune system and the resident microbiome in which bacteria, viruses, fungi, allergens and other foreign materials interface with the sinonasal epithelium, leading to persistent inflammation and the resultant symptom complex associated with the disorder (3,7).

Drainage and ventilation of paranasal sinuses are important for the normal function which in turn depends on effective mucociliary clearance. Anatomical variants cause blockage of the sinus ostia, thus interfering with normal function and predispose to recurrent or chronic rhinosinusitis (8,9, 16-19). Signs and symptoms associated with CRS are important in its diagnosis. The RSTF developed a list of major and minor criteria (signs and symptoms) to aid in diagnosis of rhinosinusitis whereas CRS is probable if the patient has two or more major factors or one major and two or more minor factors for more than 12 weeks (6).

Nasal endoscopy provides an enlarged view of the nasal mucosa, turbinates, helps in assessing the integrity of the mucosa, along with directly seeing mucosal changes, polyps, crusting, and/or discharge. Cultures may also be obtained endoscopically. Lund- Kennedy score is a nasal endoscopy scoring system, in which nasal discharge, polyps and mucosal edema are considered for grading, and are consistent with CRS.

Imaging CT scan is a very important investigation done and has the value of gold standard test for CRS. CT can confirm the presence and assess the extent of inflammation in the sinonasal cavity beyond what is permitted by endoscopy. It is effective in indicating

predisposing causes of chronic rhinosinusitis such as anatomical distinction, variation, tumor and trauma.

The purpose of this study was to compare the clinical features of chronic rhinosinusitis with CT scan findings.

Methodology

Study design, setting, sampling technique, and participants

This hospital based descriptive cross-sectional study was conducted at otorhinolaryngology clinic at Muhimbili National Hospital (MNH) from October 2019 to April 2020. The study included patients aged 10 years and above who fulfilled the criteria of chronic rhinosinusitis clinically. Patients with medical contraindications for CT scan were excluded from the study.

Data Collection

Pre-tested structured questionnaire was used to ascertain the existence of sinusitis symptoms, according to RSTF symptoms criteria. The participant met the RSTF symptom criteria for CRS if the subject had two or more major symptoms or one major and two or more minor symptoms that lasted for more than 12 weeks. Nasal endoscopy was performed and enumerated using the Lund - Kennedy scoring system. According to this system, the endoscopic appearance of the nose was quantified for the presence of polyps, discharge and edema. The diagnostic evidence of CRS was defined by a Lund-Kennedy endoscopic score of equal or greater than 2. Computed tomography of the paranasal sinuses was taken and staged using the Lund Mackay CT scoring system which bases on the appearance of each paranasal sinus on the CT scan. The diagnostic evidence of CRS was defined by a Lund-Mackay score of equal or greater than 4.

Data Analysis

Data were analyzed using Statistical Package for social Sciences (SPSS) version 26. A 95% confidence interval was used for judging significance whereby a variable with P value of less than 0.005 was considered statistically significant. The correlation between variables was explored with Pearson correlation test.

Ethical Approval

Ethical approval to conduct the study was sought from the Muhimbili University of Health and Allied Sciences (MUHAS) Research Ethics Committee in 5th November 2019, with a reference number DA.287/298/01A/. Written informed consent was obtained from

participants or parents/legal guardians prior to recruitment into the study, with adherence to the Declaration of Helsinki.

Results

Demographic characteristics

Total of 126 patients who fulfilled the RSTF criteria were enrolled in the study. Age ranged from 12 years to 77 years, with the mean age of 41.17(SD 15.69), and median of 39. Most patients were in age group 31 - 40 (23.8%) years. There were 48 (38.1%) males, and 78 (61.9%) females, with a male to female ratio of 1:1.6 (Table 1).

Table 1: Age and sex distribution of patients with chronic rhinosinusitis

Variable	n (%)
Age (years)	
<20	13 (10.3)
21-30	22 (17.5)
31-40	30 (23.8)
41-50	25 (19.8)
51-60	16 (12.7)
>60	20 (15.9)
Sex	
Male	48 (38.1)
Female	78 (61.9)

Clinical Features of Chronic rhinosinusitis

The most frequently reported symptom was nasal obstruction/congestion 113 (89.7%), followed by hyposmia/anosmia 90 (71.4%), and upon nasal endoscopy, all patients (100%) exhibited nasal secretion (thin and/or thick), while 61.9% had polyps (Table 2).

For nasal endoscopy, Lund-Kennedy score was calculated, which ranged from 1 to 10, with a mean of 4.67 (SD 2.12) (Figure 1). Taking Lund Kennedy score of greater or equal to 2 for diagnosis of CRS, 124 (98.4%) patients were CRS positive, 2 (1.6%) patients were CRS negative.

Table 2: Distribution of RSTF symptoms criteria

Criteria	Yes (%)	No (%)	Total (%)
Major criteria			
Nasal obstruction/congestion	113 (89.7)	13 (10.3)	126 (100)
Facial pressure/facial congestion	89 (70.6)	37 (29.4)	126 (100)
Facial pain	47 (37.3)	79 (62.7)	126 (100)
Purulent nasal and/or postnasal drip	73 (57.9)	53 (42.1)	126 (100)
Hyposmia/anosmia	90 (71.4)	36 (28.6)	126 (100)
Minor criteria			
Headache	84 (66.7)	42 (33.3)	126 (100)
Fever	0 (0)	126 (100)	126 (100)
Halitosis	21 (16.7)	105 (83.3)	126 (100)
Fatigue	27 (21.4)	99 (78.6)	126 (100)
Cough	27 (21.4)	99 (78.6)	126 (100)
Dental pain	36 (28.6)	90 (71.4)	126 (100)
Ear pain	34 (27.0)	92 (73.0)	126 (100)
Nasal endoscopy			
Presence of polyp	88 (61.9)	38 (38.1)	126 (100)
Presence of Edema	120 (95.2)	6 (4.8)	126 (100)
Presence of nasal secretions (thin/thick)	126 (100)	0 (100)	126 (100)

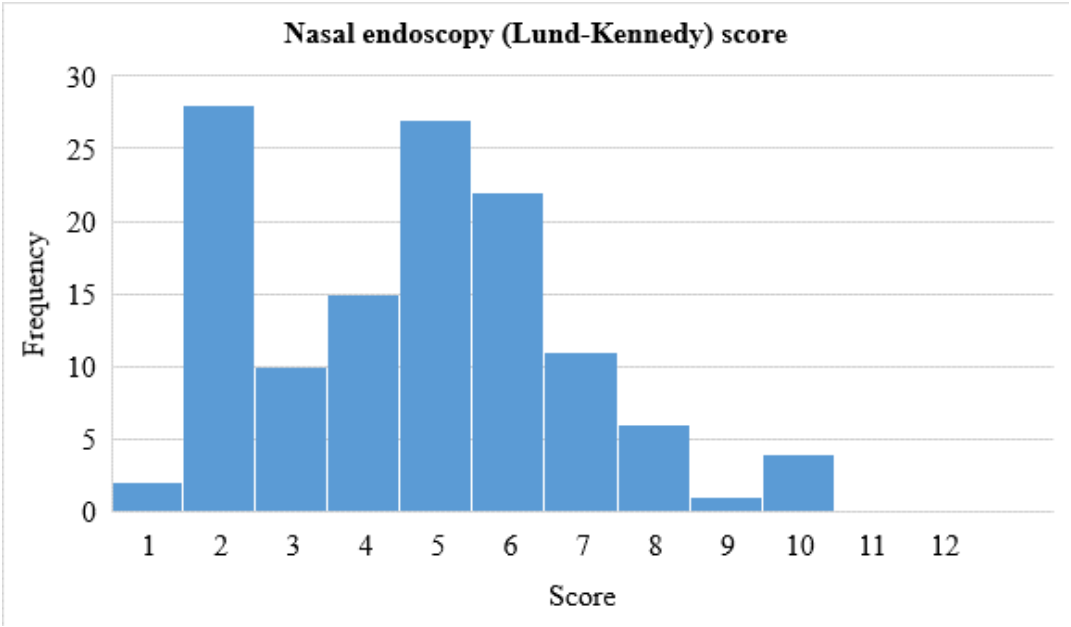

Figure 1. Distribution of nasal endoscopy (Lund – Kennedy) score

Radiological features of patients with Chronic Rhinosinusitis

The CT scans showed opacification of at least one paranasal sinus in all patients, with involvement of more than a single sinus seen in 94.4% of patients. The maxillary sinus was the most commonly involved sinus (93.7). Homogenous opacification was identified in 58.7% of patients (Table 3).

Table 3: Radiological features of patients with Chronic Rhinosinusitis

Opacification in the paranasal sinuses and ostiomeatal complex (Sinus involved)	**n (%)**
Maxillary sinus	118 (93.7)
Anterior ethmoid sinus	115 (91.3)
Posterior ethmoid sinus	99 (78.6)
Frontal sinus	92 (73)
Sphenoid sinus	49 (38.9)
Ostiomeatal complex (OMC)	106 (84)
Type of Opacification	
Homogenous	74 (58.7)
Heterogenous	52 (41.3)

Presence of anatomical variations was seen in 52.4% of patients, of which deviated nasal septum was the most frequently identified variations (56.1%), followed by concha bullosa (21.2%) (Figure 2).

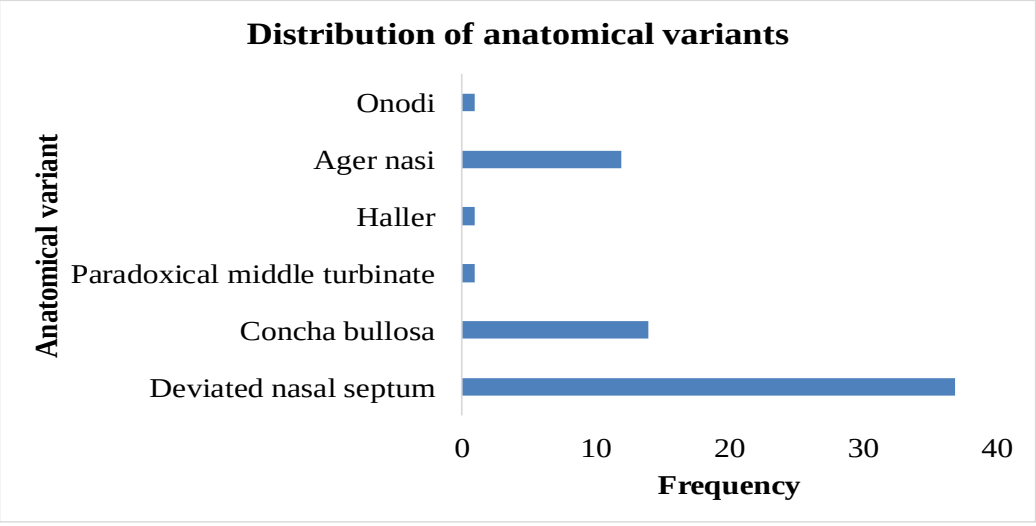

Figure 2. Distribution of anatomical variants

Correlation of CT scan (Lund Mackay) and Nasal endoscopy (Lund Kennedy) scores

There was a strong positive correlation between CT scan (Lund Mackay) score and nasal endoscopy (Lund Kennedy) score with Pearson correlation coefficient of 0.66 (Figure 2). This correlation was statistically significant (P-value 0.000). Taking Lund-Kennedy score of 2 or more for diagnosis of CRS and taking CT scan as gold standard with Lund MacKay score of 4 or more, the sensitivity was 100%, specificity was 33.3%, positive predictive value was 96%, and negative predictive value was 100% when the scores were compared.

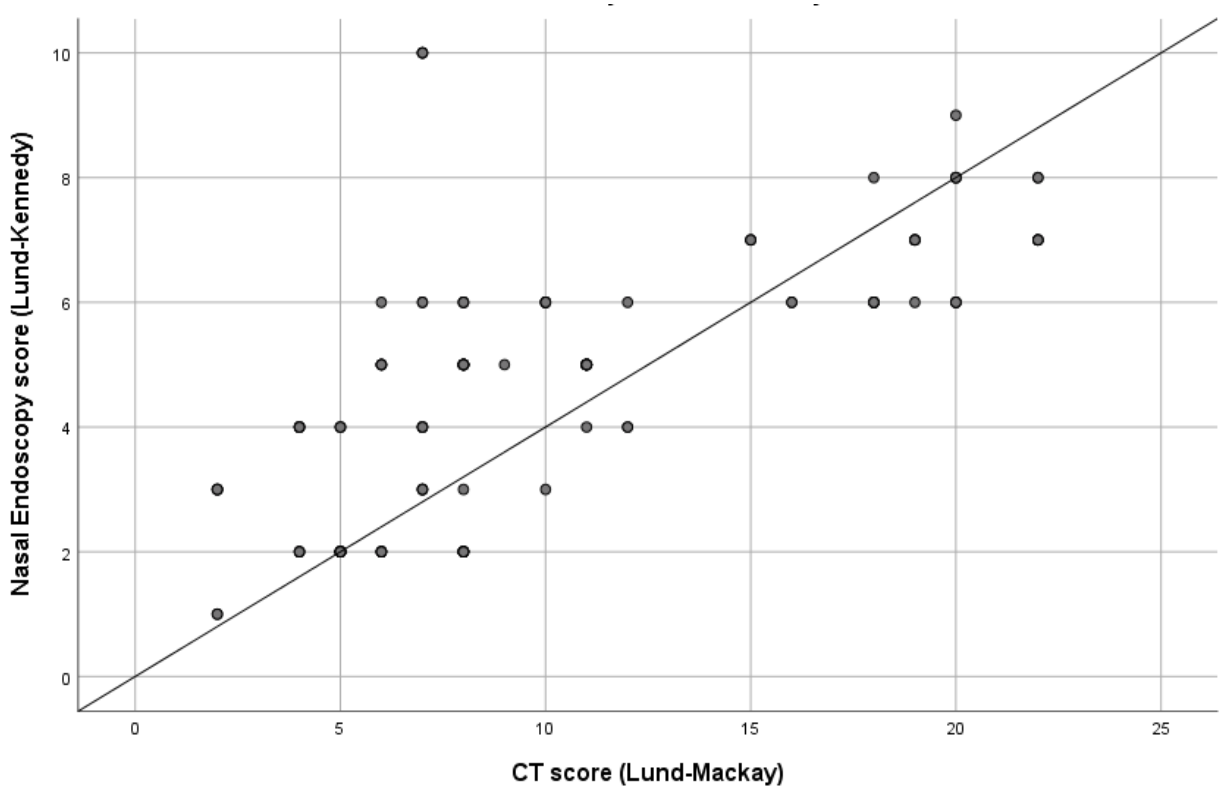

Figure 3. Correlation of Lund – Kennedy and Lund – Mackay scores

Discussion

Rhinosinusitis (RS) poses a major health problem, substantially affecting quality of life, productivity, and finances. An understanding of the disease process and its presentation and correlation of nasal endoscopic findings with CT findings has an essential role in accurate diagnosis and treatment of CRS.

In this study, age ranged from 12 years to 77 years, with a median age of 39 years. This is in accordance with studies done in United States of America which found a range of 18 to 75 years and mean age of 37 years (1), in India a study reported a range of 13 to 73 years with

a mean age of 38.5 years (25). In a study done in Kenya age of the participants ranged from 18 to 73 years, with a mean age of 41.4 (13). Majority of the patients in this study were in the third decade of life, similar to a study done in India (25). Also, in this particular study, females were more affected than males, with a male to female ratio of 1:1.6. This is similar to studies done in USA, Nepal, and Kenya (5,11,13). However, contrary to studies done by Abhishek et al and Amodu et al which reported a male predominance (2,12). Nasal obstruction/congestion, hyposmia/anosmia, facial pressure/congestion, headache and purulent nasal discharge/post nasal drip were the most frequently reported symptoms in this study, comparable to studies done in USA, India and Kenya (2,13,23,26).

In nasal endoscopy, nasal secretion and mucosa edema were the most common findings in this study, supported by studies done by sancheti et al and Jeelani et al (27,28). However studies done by Rathor et al and Baruah et al revealed nasal polyps as the commonest finding(14,29), this may be explained by the predominance of the allergic conditions such as asthma which are associated with nasal polyps (30).

In CT scan of PNS, opacification was commonly identified in the maxillary sinus either alone or with involvement of other sinuses, followed by OMC, anterior and posterior ethmoid sinuses, with sphenoid sinus being the least involved. These findings were consistent with studies done by Jeelani et al, Deosthale et al, Suri et al, Fadda et al, and Abdikadir et al (13,15,18,23,28). The narrowing of maxillary ostium contributes to the higher frequency of maxillary rhinosinusitis. Anatomically, the most likely site of mucosal contact is in the narrow mucosa-lined channels of the middle meatus and the ethmoid infundibulum, which results in maxillary sinusitis. OMC involvement commonly associated with mucosal thickening in the maxillary, ethmoid and the frontal sinuses. This could be explained by the fact that the OMC is a common draining channel most commonly involved in chronic rhinosinusitis. The presence of OMC swelling may cause the opposition of the mucosal layer that will lead to stenosis or obstruction. Obstruction to the flow of complex and narrow passages in return causes mucocilliary clearance disruption and thus causes stagnation of secretion in the maxillary, ethmoid and frontal sinuses which can be prone to inflammation.

In this study, homogenecity and heterogenecity of opacification was assessed, in which homogenous opacification was commonly identified, similar to a study done by P. Karthikeyan et al (31). Bone thickening of the sinuses walls was a common finding in our study, as compared to bone thinning, similar to a study done in South Korea (32). The extent of bone remodeling including thickening is likely associated with the degree of inflammation of the mucous membrane.

Deviated nasal septum and concha bullosa were the commonest anatomical variations identified in this study, this was similar to studies done by Sarkar et al, Surapaneni et al, Adeel et al (anatomic variations2), Fadda et al, and Tiwari et al (8,10,15,17,33). Anatomical variations may cause obstruction of sinuses ostia, causing stagnation of secretions that may become infected or initiate infection. When severe, the deviated septum may compress the middle turbinate bone laterally, narrowing the middle meatus and causing obstruction. Larger concha bullosa occur in proximity to the maxillary sinus infundibulum, and agger nasi cells are close to the frontal sinus recess may compress or obstruct these ostia. These may explain the frequent findings of CRS involving the maxillary, ethmoid and frontal sinuses.

In this study, overall nasal endoscopy (Lund - Kennedy) scores correlated well with overall CT scan (Lund Mackay) scores. This means, patients who had high nasal endoscopy scores were more likely to have a higher CT scan score and vice versa. These findings are supported by other studies done by Kasapoglu et al, Deepthi et al, Deosthale et al, and Lohiya et al (20,22,23,26).

Conclusion and recommendations

Endoscopy and CT scores have a strong correlation; although the diagnosis of CRS as per the Task Force criteria is based on clinical grounds, the use of nasal endoscopy and/or CT scan helps in making specific diagnosis and treatment. Pertaining to the sensitivity of nasal endoscopy, CT scan may be done for assessing the extent/severity of CRS. We recommend that CT scan to be used when assessing the severity of the disease, failure of conservative treatment and prior to surgery.

Conflict of interest

Authors have no conflict of interest to declare.

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Authors' contribution

NDC conducted research, worked on analysis and interpretation of data, and writing of final article draft. KM conceived and designed the study, conducted research, and collected and organized data. He also worked on analysis of data and writing of initial and final draft of the article. KAA worked on analysis and interpretation of data and writing of final article draft. RE conducted data collection and worked on writing the final draft of the article. AZS provided

research materials and worked on writing the final draft. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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Abbreviations

CRS	Chronic Rhinosinusitis
CT	Computed Tomography
MNH	Muhimbili National Hospital
MUHAS	Muhimbili University of Health and Allied Sciences
MoH	Ministry of Health
OMC	Ostiomeatal complex
PNS	Paranasal sinuses
RSI	Rhinosinusitis Symptoms Index
RSTF	Rhinosinusitis task force
SPSS	Statistical Package for Social Sciences

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