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ORIGINAL ARTICLE

Endoscopic Assessment of the Nasal Anatomical Variations among Adult Patients with Chronic Rhinosinusitis in Dar es Salaam, Tanzania

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ABSTRACT

Background: Chronic rhinosinusitis (CRS) tends to affect people of all ages. Diagnosis of CRS in resource-limited settings relies mainly on detailed clinical evaluation without nasal endoscopy and CT scans, which are mainly inevitable in the management of such patients. Data on endoscopic nasal anatomical variations among adult patients with CRS are scarce.

Methods: A prospective hospital-based study was conducted at a private hospital from January to December 2022 in Dar es Salaam. Cases were diagnosed to have CRS according to the Task Force criteria, while controls were individuals who attended outpatient clinics due to otological or laryngological complaints and had no symptoms of CRS. Cases and controls were matched in a 1:1 ratio. The rule of standard pass on each side was adhered to endoscopically. Data was analysed using the Statistical Package for Social Sciences version 23.

Results: A total of 120 patients with CRS and an equal number of controls were recruited. Patients and controls were equally aged between 18 and 70 years. Male patients predominated, 70 (58.3%), while female patients were 50 (41.7%), and the male-to-female ratio was 1.4:1. Among controls, males predominated, 68 (56.7%), while females were 52 (43.3%), and the male-to-female ratio was 1.3:1. Endoscopic nasal anatomical variations were found in 107 (89.2%) patients. Nasal septal deviation/nasal spur was the predominant anatomical variant in 51 (42.5%) patients, followed by concha bullosa in 27 (22.5%), a paradoxically curved middle turbinate in 22 (18.3%), and the least anatomical variant was a large bulla ethmoidalis, 7 (5.8%). Of the 120 controls, only 5 (4.2%) participants had endoscopic nasal anatomical variations, and 4 (3.3%) controls had septal deviation/spur, whereas 1 (0.8%) participant had a paradoxically curved middle turbinate. Regarding laterality of the observed endoscopic nasal anatomical variations, the majority of the variations had unilateral presentation, such as septal deviation (90.2% being unilateral), concha bullosa (81.5% being unilateral), and a paradoxically curved middle turbinate being unilateral in 77.3% of patients. Chronic rhinosinusitis was found to be significantly associated with septal deviation *(P*=.001), concha bullosa (*P*=.001) and a paradoxically curved middle turbinate (*P*=.001), while there was no significant association between CRS and large bulla ethmoidalis (*P*=.1).

Conclusion: Septal deviation/spur was the commonest nasal anatomical variant, 51(42.5%) and the least anatomical variant was a large bulla ethmoidalis 7(5.8%). Chronic rhinosinusitis was found to be significantly associated with septal deviation (*P*=.001), concha bullosa (*P*=.001) and a paradoxically curved middle turbinate (*P*=.001), and there was no significant association between CRS and large bulla ethmoidalis (*P*=.1).

BACKGROUND

Rhinosinusitis is a terminology that has been used widely and not "sinusitis" since rhinitis and sinusitis tend to co-occur in the majority of the individuals.[1-4] *Chronic rhinosinusitis (CRS)* is a group of disorders characterised by inflammation of the mucosal lining of the nose and paranasal sinuses of at least 12 weeks' duration.[4,5] Chronic rhinosinusitis has been a commonly encountered disease in clinical practice, affects people of all ages globally and has a significant impact on the quality of life.[6] The disease affects more than 16% of the adult population annually in the United States of America.[7] In a study that was done in Dar es Salaam, Tanzania at Muhimbili National Hospital, the prevalence of chronic rhinosinusitis was found to be 1.07%.[6]

Anatomical variations of the nose and paranasal sinuses tend to predispose patients to CRS.[4,8] Blockage of the osteomeatal complex plays a key role in the pathogenesis of CRS and therefore the important etiological factor in the pathogenesis of CRS, is the attribution of the anatomical variations of the nose and paranasal sinuses.[8]

There has been a variable prevalence of the anatomical variations of the nose and paranasal sinuses upon nasal endoscopy, where a study that was done in India showed such prevalence to be as follow: Deviated nasal septum (85.36%), septal spur (39%), concha bullosa (9.75%), rotated uncinate process (6.09%) and paradoxical middle turbinate (7.3%).[9] Similarly, a study that was done in India found the following anatomical variations: deviated nasal septum (86%), bulge due to agger nasi cell (69%), concha bullosa (26%) and paradoxical middle turbinate (11%).[10]

Studies in West Africa have shown the prevalence of anatomical variations of the nose and paranasal sinuses to be 91% with deviated nasal septum and concha bullosa having been reported to be the predominant variations.[11,12] These findings appear to be similar to those from Kenya, where the commonly reported anatomical variants of the nose and paranasal sinuses among patients who underwent paranasal sinus CT scan were concha bullosa and Haller cells.[13]

In Tanzania, there are a few studies that explored anatomical variations of the nose and paranasal sinuses; a study done in Northern Tanzania found 90% of the participants had at least one anatomical variant of the nose and paranasal sinuses. In this study the most common variant was the agger nasi cell (52.2%), followed by septal deviation (50%) and concha bullosa (48.9%), and also other variants included Haller cells (15.56%) and Onodi cells (11.1%), laterally rotated uncinate process (1.1%) and dehiscent lamina papyraceae (12.2%).[18]

Utility of nasal endoscopy in areas with limited or no access to CT scans permits early diagnosis and treatment of patients with CRS and thus a need for such a prototype study to be designed in Tanzania. There is no any study to date that has been conducted in Tanzania to evaluate endoscopically nasal anatomical variations in patients with rhinosinusitis, though a few available studies in Tanzania focused on exploring anatomical variations among patients undergoing paranasal sinuses' computerised tomography scans. This study was designed to address this gap in otorhinolaryngology practice.

METHODS

Study Design and Duration

It was a prospective hospital-based case-control study conducted between January and December 2022.

Study Area

Participants were recruited on an outpatient basis in the department of otorhinolaryngology at Ekenywa Specialised Hospital, which is located in Dar es Salaam, Tanzania. The hospital has several departments, such as otorhinolaryngology, paediatrics and child health, obstetrics and gynaecology, dermatology, internal medicine, orthopaedics and traumatology, urology, and ophthalmology. The hospital attends about 300 patients in the general outpatient department and 100 patients in the department of otorhinolaryngology outpatient clinic. The study was designed and conducted at Ekenywa Specialised Hospital since the hospital serves a significant number of patients with ear, nose, and throat diseases in Dar es Salaam, Tanzania.

Sampling Technique

The convenience sampling technique was utilised to recruit the study participants. The sampling technique was chosen by the principal researcher since it's ideal in hospital settings to obtain the desired number of participants when the chance of obtaining them is on a more convenient basis. Cases were individuals with CRS, and the diagnosis was established based on the task force criteria, and controls consisted of individuals without CRS symptoms. Matching of cases and controls was done in a 1:1 ratio.

Inclusion Criteria

Adult patients (aged 18 years and above) who attended the outpatient otorhinolaryngology department at the hospital and diagnosed clinically to have CRS and consented to participate.

Exclusion Criteria

Patients with rhinosinusitis of less than 12 weeks duration, patients with a history of previous sinonasal surgeries, patients with allergic rhinitis, patients with extensive sinonasal polyposis obscuring the anatomy of the nose and paranasal sinuses, patients aged <18 years.

Diagnostic Criteria for CRS

The clinical diagnosis of CRS was based on subjective symptoms as defined by the American Academy of Otolaryngology- Head and Neck Surgery (AAO-HNS) task force criteria, which was revised in 2002 by the Sinus Allergy Health Partnership (SAHP) task force.[2,14,15] The guidelines define that the patient must have at least two major factors or one major factor with two or more minor factors, or nasal purulence upon rhinoscopy. Facial pain is not considered to be a symptom of CRS without other nasal signs and symptoms. The signs and symptoms should persist for at least 12 weeks to qualify as a case of CRS.[9] The presenting symptoms are either major or minor according to the task force criteria as follows;

Major Symptoms

These were nasal obstruction/blockage, nasal discharge/purulence/discolored postnasal discharge, hyposmia/anosmia, facial congestion/fullness, facial pain/pressure (facial pain must be accompanied by another major factor to qualify for CRS)

Minor Symptoms

There were fever, halitosis, headache, cough, fatigue, dental pain, ear pain/ear pressure or fullness.

Sample Size Estimation

Sample size for this study was calculated using the formula developed by Kish and Leslie as follows:

$N = \underline{Z^2P\ (1-P)}/E^2$,

where N = the minimum required sample size, Z = standard normal deviate = 1.96 for 95% confidence level, P = proportion of cases and controls with identified septal deviation and paradoxically curved middle concha being taken as 82.6%[4], and E = margin of error, which is 5%, N = 221 study participants.

Adjusting for the non-response rate and assuming the non-response rate (f%) to be 10% (Smith and Day - 1984); then n¢ = n x adjusted factor, adjusted factor = (100% / 100% - f%) n¢ = n x (100% / 100% - f %) n¢ =

221 x (100% / 100% - 10%), n' = 246.

Therefore, the minimum sample size estimated was 246 study participants, amounting to 123 cases and an equal number of controls, though in this study 120 cases and an equal number of controls were chosen.

Rigid Nasal Endoscopy

Study participants underwent thorough ear, nose and throat examination after adequate nasal preparation was done using cotton balls which were soaked in 2% xylocaine mixed with 1:200,000 dilution of adrenaline solution. The well-soaked cotton balls were positioned in the following positions; nasal floor, between nasal septum and inferior turbinate, and towards the middle turbinate, and waited for 10 minutes. Consequently, nasal endoscopy was done for all the study participants by following the rules of standard passes. Under local anaesthesia using topical 4% lidocaine hydrochloride, rigid nasal endoscopy was done using 30° 4 mm diameter rigid nasal endoscope.

Data Collection Tools

Semi-structured questionnaires adopted from previously published studies and thereafter modified to suit the objectives of this study were utilised to collect data.[4,9,10] The questionnaires comprised both open and close-ended questions.

Data Processing and Analysis

The collected data were cleaned and analysed using the Statistical Package for Social Sciences version 23 software package from the University of Sussex in England. Descriptive statistics were performed to present frequency distribution for demographic characteristics and endoscopic nasal anatomical variations.

Ethical approval and consent to participate

The hospital research ethics committee approved the study. Ethical clearance was granted on 05th December 2021 with number Ref: ESH/2021/01. Individual informed consent, both verbal and written, was obtained from the study participants after they had been fully informed about the set goals for the study. Participants were informed that no penalty or denial of health services at our hospital would be imposed on them if they declined to participate, and also names of the study participants were recorded in the questionnaire, but rather coding was done using numbers on the questionnaires to maintain privacy and confidentiality. Participants were guaranteed their right and freedom to withdraw from participating in this study at any point in time when willing to do so.

RESULTS

Demographic Characteristics of Participants

A total of 120 patients with CRS and with an equal number of controls were recruited. Patients were aged between 18 and 70 years. Male patients predominated, 70 (58.3%), while female patients were 50 (41.7%), and the male-to-female ratio was 1.4:1. Individuals belonging to controls were also aged 18 to 70 years, with males predominating, 68 (56.7%), while female controls were 52 (43.3%), and the male-to-female ratio was 1.3:1. The majority of both the patients were aged 48-57 years (Table 1).

Endoscopic Nasal Anatomical Variations among Patients with CRS and Controls Free from the Disease

Out of 120 patients recruited, endoscopic nasal anatomical variations were found in 107 (89.2%) patients. Nasal septal deviation/nasal spur was the predominant anatomical variant in 51 (42.5%) patients, followed by concha bullosa, 27 (22.5%); a paradoxically curved middle turbinate, 22 (18.3%); and the least common anatomical variant, large bulla ethmoidalis, 7 (5.8%). Of the 120 controls, only 5 (4.2%) participants had endoscopic nasal anatomical variations, where 4 (3.3%) had septal deviation/spur and 1 (0.8%) participant had a paradoxically curved middle turbinate (Table 2).

Lateralization of anatomical variations among patients with CRS

The majority of patients with CRS in this study had unilateral anatomical variations, 87 (81.3%), whereas bilaterality was reported in 20 (18.7%) patients (Table 3).

Association between endoscopic nasal anatomical variations and CRS

Chronic rhinosinusitis was found to be significantly associated with septal deviation (P=.001), concha bullosa (P=.001) and a paradoxically curved middle turbinate (P=.001), and on the other hand, there was no significant association between CRS and large bulla ethmoidalis (*P*=.1). (Table 4).

TABLE 1: Age Distribution of Patients with CRS and Controls Free from Disease

Age group (years)	Patients, n (%)	Controls, n (%)
18-27	13 (10.8)	12 (10.0)
28-37	17 (14.2)	15 (12.5)
38-47	25 (20.8)	21 (17.5)
48-57	48 (40.0)	57 (47.5)
58-67	15 (12.5)	14 (11.7)
68-77	2 (1.7)	1 (0.8)
Total	120 (100)	120 (100)

TABLE 2: Endoscopic Nasal Anatomical Variations among Patients with CRS and Controls Free from Disease (N=120)

Anatomical variations	Patients, n(%)	Controls n(%)
Septal deviation/nasal spur	51 (42.5)	4 (3.3)
Concha bullosa	27 (22.5)	0 (0.0)
Paradoxical middle turbinate	22 (18.3)	1 (0.8)
Large bulla ethmoidalis	7 (5.8)	0 (0.0)
Total	107(89.2)	5 (4.2)

TABLE 3: Lateralization of Anatomical Variations among Patients with CRS

Anatomical variations	Patients with unilateral variation n (%)	Patients with bilateral variation n (%)	Total, n (%)
Septal deviation/nasal spur	46 (90.2)	5 (9.8)	51 (47.7)
Concha bullosa	22 (81.5)	5 (18.5)	27 (25.2)
Paradoxical middle turbinate	17 (77.3)	5 (22.7)	22 (20.6)
Large bulla ethmoidalis	2 (28.6)	5 (71.4)	7 (6.5)
Total	87 (81.3)	20 (18.7)	107 (100)

TABLE 4: The Association Between Endoscopic Nasal Anatomical Variations and CRS (N=120)

Anatomical variations	Patients n (%)	Controls n (%)	P-value
Septal deviation/nasal spur	51 (42.5)	4 (3.3)	.001
Concha bullosa	27 (22.5)	0 (0.0)	.001
Paradoxical middle turbinate	22 (18.3)	1 (0.8)	.001
Large bulla ethmoidalis	7 (5.8)	0 (0.0)	.1

DISCUSSION

Being a commonly encountered disease in otorhinolaryngology practice, CRS may be caused by a variety of aetiologies such as anatomical variations of the nose and paranasal sinuses, infections, trauma, nasal foreign bodies or allergies.[10] It well known that anatomical variations of the nose and paranasal sinuses on their own can predispose patients to CRS.[4]

Regarding the predominance of anatomical variations among patients with CRS and controls free from the disease, they were found to be more common among patients (89.2%) compared to controls (4.2%). Such findings are in line with those from the study done in Sokoto, Nigeria, where anatomical variations were predominant in patients (89.4%) compared to controls (51.5%).[4]

Pertaining to the predominant anatomical variations of the nose established upon nasal endoscopy, the predominant variation among patients with CRS was nasal septal deviation/spur (42.5%), followed by concha bullosa (22.5%), a paradoxically curved middle turbinate (18.3%), and the least anatomical variant was a large bulla ethmoidalis (5.8%). These findings are similar to the findings of a study in Nigeria where nasal septal deviation/spur was the predominant nasal anatomical variation (43.2%), followed by concha bullosa (18.2%), large bulla ethmoidalis (17.4%), and paradoxically curved middle turbinate (10.6%).[4] Similar findings have also been reported in a study in India where the predominant nasal anatomical variation in patients was deviated nasal septum (86%). Other variants were Agger nasi (86%), inferior turbinates hypertrophy (32%), concha bullosa (26%), and paradoxical middle turbinate (11%).[10]

Regarding laterality of the observed endoscopic nasal anatomical variations, majority of the variations had unilateral presentation such as septal deviation (90.2% being unilateral), concha bullosa (81.5% being unilateral), paradoxically curved middle turbinate being unilateral in 77.3% of patients. On the other hand, large bulla ethmoidalis had bilateral presentation (71.4%) in the studied patients. Such pattern appears to be in line with that observed in the study done in Sokoto Nigeria where deviated nasal septum was unilateral in 78% of patients and bilateral in 8% of patients. Moreover, distribution of variants based on laterality are as follows; Agger nasi being bilateral in 57% of patients and unilateral in 12% of patients; inferior turbinate hypertrophy being unilateral in 30% of patients and bilateral in 2% of patients; concha bullosa being unilateral in 21% of patients and bilateral in 5% of patients; paradoxical middle turbinate being unilateral in 10% of patients and bilateral in 1% of patients. [10]

When the association between endoscopic nasal anatomical variations and CRS is to be considered, this study found CRS to be significantly associated with septal deviation (*P*=.001), concha bullosa (*P*=.001) and a paradoxically curved middle turbinate (*P*=.001), and on the other hand, there was no significant association between CRS and large bulla ethmoidalis (*P*=.1). Such a pattern of statistical association appears to be in line with what was established in the study done in Nigeria, where CRS was significantly associated with nasal septal deviation (*P*=.01), concha bullosa (*P*=.001), and paradoxically curved middle concha (*P*=.001). There was no significant association between CRS and large bulla ethmoidalis air cells (*P*= 1).[4] Similarly, in the study that was done in India, there was a significant association between CRS and deviated nasal septum (*P* =.042) and also concha bullosa (*P* =.0003).[40]

The strength of the study lies in the ability to establish the association between endoscopic nasal anatomical variations and chronic rhinosinusitis.

The limitations of this study include a smaller sample size, and also the study is based on a single health facility, and therefore, findings are not generalisable.

CONCLUSION AND RECOMMENDATION

This study has found septal deviation/spur to be the commonest nasal anatomical variation, while a large bulla ethmoidalis was the least common anatomical variation. There was significant association between chronic rhinosinusitis and septal deviation, concha bullosa, and a paradoxically curved middle turbinate. But there was no significant association between CRS and large bulla ethmoidalis.

Due to the well-established association between CRS and endoscopic nasal anatomical variations, surgical interventions such as septoplasty, turbinoplasty, and conchotomy should be considered alongside functional endoscopic sinus surgery to prevent recurrence of CRS once it is successfully treated.

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