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Role of Radiology in Diagnosis of Allergic Fungal Sinusitis

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ABSTRACT

Objective: Investigate the role of serrated turbinates, radiographic abnormalities, and existing literature in aiding the diagnosis of Allergic Fungal Sinusitis (AFS).
Study Design: Cross-sectional study
Place and Duration of Study: ENT Department Combined Military Hospital, Rawalpindi, Pakistan from Jan 2020 to July 2023.
Methodology: One hundred and twenty individuals with computerized tomography scans were included. Patients identified as having Allergic Fungal Sinusitis (AFS) following tests for allergies and/or fungi were placed in the first group, while those identified as having rhinosinusitis (other than AFS) were placed in the second group. CT scans were examined for polyps, bone degradation, the serrated appearance of the turbinate, and CT hyper-density.
Results: While comparing the radiology of AFS and non-AFS, it was discovered that the presence of serrated turbinate was prevalent in AFS (p<0.05), with no differences in terms of bone degradation, polyps, or CT hyper-density (p>0.05). The mean age was 36.81±11.24 years. There were 120 patients; 86(72%) were AFS (-ve), and 34(28%) were AFS (+ve) individuals. Out of them, 19(16%) of the AFS (+ve) patients were females, whereas 15(12%) were males.
Conclusion: Serrated turbinates may serve as helpful radiological signals in the diagnosis of AFS. For assessing bone erosion in relation to other structural changes, it is important to specify bone density for sinus opacification.

Keywords: Allergic fungal sinusitis, Bone erosion, Fungal culture, Radiology.

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INTRODUCTION

Previously thought to be rare, fungal sinusitis has been observed more frequently, especially in countries with warmer temperatures like the Southern United States and Australia.[1] Five subtypes make up fungal sinusitis classification, which has been changed during the past 20 years.[1-3] Fungal mycetoma and allergic fungal sinusitis (AFS) were categorized as fungal sinusitis (non-invasive); the invasive group includes acute invasive fungal sinusitis, chronic invasive fungal sinusitis, and chronic granulomatous invasive fungal sinusitis.[4] Each variety has varied prognoses and treatment plans depending on characteristic CT scan features.[5]

Heterogeneous mucin-induced regions in paranasal sinuses on the CT scans were generally considered characterizing aspects of the condition. The combined MRI and CT scan results have made the radiographic appearance highly specific for AFS available. Recent perspectives claim that the diagnosis of AFS cannot be made solely on radiological data.[6,7]

Even though the Kuhn and Bent criteria for AFS diagnosis are beneficial, recent research has revealed that this disease is much more prevalent than anticipated. As a result of the rise in AFS diagnoses, it may be necessary to reevaluate the radiological diagnostic criteria.[5] In our investigation, we sought to determine whether there were any differences in the radiological findings between AFS and non-AFS patients and whether the existence of the serrated turbinate, a novel radiological outcome that may aid in diagnosing AFS, was present.

METHODOLOGY

The cross-sectional study was conducted at Ear Nose Throat Department, Combined Military Hospital Rawalpindi, Pakistan, from January 2020 to July 2023. The Hospital Ethical Review Committee (Certificate number: 423, dated 20 February 2023).

The WHO sample size calculator calculated sample size by keeping the prevalence of chronic rhinosinusitis (CRS) measured in epidemiologic studies is 5% to 12%.[8] Patients who experienced a paranasal sinus CT exam at our facility from January 2020 to July 2023 with a preliminary sinusitis diagnosis, 120 participated in our study. Consent was obtained from the examination subjects before filling out the questionnaire for the study.

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Inclusion Criteria: Patients who underwent testing for allergies and/or fungi and patients diagnosed with allergic fungal sinusitis (AFS) have rhinosinusitis unrelated to AFS were included.

Exclusion Criteria: The patients under the age of 18, patients with a history of paranasal sinus surgery, and eight patients with invasive or mass pathology.

The General Electric IQTM 32-Detector Spiral MSCT device was used for CT scans. A radiologist and an otolaryngologist with knowledge of radiological anatomy assessed the axial plane photographs retroactively, together with coronal and sagittal reformat images. On CT images, the existence of polyps, the presence of bone degradation, the presence of serrated turbinate morphology, and hyper-density in the sinus are examined (Figure).

The Statistical Package for Social Sciences version 26.0 was used to analyse the data. The chi-square test was also used to evaluate categorical data. The threshold for significance was $p \leq 0.05$.

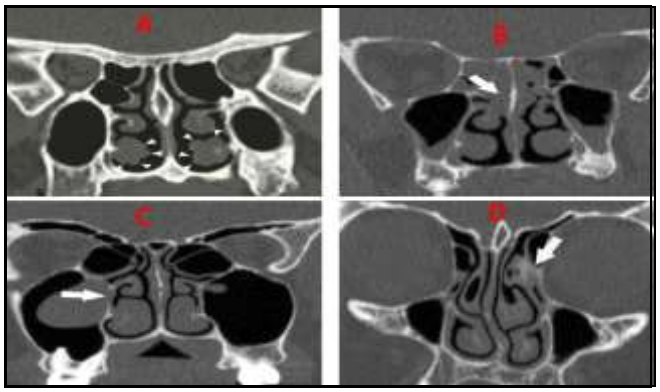

Figure: A=Serrated turbinate, B=Polypoid lesion, C=Bone erosion, and D=Hyperdense lesion

RESULTS

One hundred twenty adult patients between the ages of 18 and 63, equally split between male and female, met the inclusion criteria for our study. The mean age was 45.81±9.78 years. There were 120 patients; 86(72%) were AFS (-ve), and 34 (28%) were tFS (+ve) individuals. Out of them, 19 patients (16%) of the AFS (+ve) patients were female, whereas 15 patients (12%) were male.

Polyp formation, gender, serrated concha appearance, hyperintensity and bone erosion on CT are compared between AFS (+ve) and AFS (-ve) individuals. Only the serrated concha morphology on CT (p=0.05) was statistically significant among the characteristics in Table-I.

Patients with positive and negative serrated concha are evaluated on CT for polyp growth, bone erosion, and hyper-density. Serrated concha positivity and negativity were shown to differ statistically. However, there was no statistically significant difference in bone erosion and hyper-density characteristics on CT between positive and negative patients (Table-II).

Table-I: Comparison of Positive and Negative Allergic Fungal Sinusitis (AFS) Patients (n=120)

	Allergic Fungal Sinusitis (AFS)		
	Negative (%)	Negative (%)	
Male	45(42%)	15(44%)	0.88
Female	41(48%)	19(56%)	0.24
Polyp			
Negative	52(60%)	17(50%)	0.3
Positive	34(40%)	17(50%)	
Serrated Turbinate			
Negative	71(82%)	21(62%)	0.01*
Positive	15(18%)	13(38%)	
Bone Erosion			
Negative	45(42%)	17(50%)	0.82
Positive	41(48%)	17(50%)	
Hyper-density			
Negative	41(48%)	14(41%)	0.52
Positive	45(42%)	20(59%)	

Table-II: Comparison of Morphology of Serrated Concha on CT Scan (n=120)

Morphology	Serrated Concha		*p*-value
	Negative (%)	Positive (%)	
Polyp Growth			
Negative	53(58%)	16(57%)	0.96
Positive	39(42%)	12(43%)	
Bone Erosion			
Negative	46(50%)	16(57%)	0.51
Positive	46(50%)	12(43%)	
Hyper-density			
Negative	44(48%)	11(39%)	0.42
Positive	48(52%)	17(61%)	

DISCUSSION

AFS is a kind of chronic sinusitis characterized by type I, IgE-mediated hypersensitivity to fungi, eosinophilic mucus with the fungal hyphae in sinuses, and chronic sinusitis. Because of eosinophil-predominant inflammation and inflammatory responses to diverse species of fungus, pathological findings in AFS can vary.[9,10] The four fungi most frequently observed in AFS are Alternaria, Aspergillus, Curvularia, and Bipolaris. According to several studies, the prevalence of AFS among people with chronic sinusitis ranges from 4 to 24 per cent, and in temperate areas, it may even be greater.[11,12]

Even though AFS is a comparatively new condition, there are several types of research in literature, particularly on aspects of radiological imaging. The studies offer a wealth of knowledge on the MRI and CT pictures in the AFS2.[4] The major and minor criteria of Bent and the Kuhn criteria are utilized to diagnose the AFS. History of the type 1 hypersensitivity determined through an in-vitro test or a skin test, the nasal polyposis, findings of characteristic CT scan (the areas of the serpiginous hyper-attenuation), the existence of eosinophilic mucin deprived of signs of invasion, and the existence of fungal cells in surgically removed tissue are the main requirements. Patients must satisfy all essential diagnostic requirements except positive fungal cell culture.[13,14] Minor requirements include peripheral eosinophilia, Charcot-Leyden crystals, and unilateral disease predominance. Minor requirements are diagnostic but do not support the diagnosis.[15] Although CT can also be used to diagnose sinusitis and show bone degradation, it was shown to be insufficient in detecting the cause of sinusitis.[16] While "ground-glass", "serpiginous", or "starry-sky" patterns, often known as "double-density" pictures in CT scans, are frequently linked to the AFS, it has been claimed that the look is also present in further fungal illnesses.[17-20] In later studies, the three specific results (high Aspergillus-directed IgE antibody titers, hyper-attenuation foci in sinuses on the CT scan, and the nasal polyps) were recognized as specific and consistent indicators for pre-operative diagnosis of the AFS. According to Bent and Kuhn, all AFS patients displayed polyposis and hyper-attenuation on their CT scans[5]. According to some reports, nasal polyps are not connected to allergies. However, they could be connected to AFS.[2] The existence of the heavy metal deposits (such as manganese and iron) and precipitation of calcium salt in allergic fungal mucin is most likely the reason for the hyper-density in CT.[11] Hyper attenuation and the development of polyps were not statistically significant in our investigation. Although the literature analysis referred to the CT finding as hyper-density, no study provided a definite Hounsfield Unit (HU) number. Due to the content of the inflammatory sinus of the soft tissue density, we cannot utilize the phrase "sinus opacification" that we previously used to assess sinus radiography. This different language usage may cause this proportionate discrepancy; to address this, it could be helpful to provide particular HU values in future investigations.

Radiological imaging findings still include bone erosion and growth even though AFS is recognized as a non-invasive sinusitis.[21] According to numerous research studies, bone degradation occurs between 20 and 80 per cent of the time.[22, 23] It is hypothesized that as mucin production in the sinus rises, decalcification, mucocele development, and bone remodelling may occur in the paranasal sinus affected.[21] The mucin and localized inflammatory alterations may cause the sinuses to expand and remodel.[23] While bone erosion is not always indicative of an invasive disease, resorption of local bone is far more frequent in the AFS than in the other types of chronic sinusitis. It might result from mucin's pressure-related actions.[24] Therefore, it is inappropriate to regard bone erosion as a sign of AFS. As Kuhn and Bent noted, it is regrettably impossible to disagree with researchers who said that due to the disease's novelty, there are several misconceptions about AFS. That misdiagnosis of the condition is common despite intervening 27 years.[5] In our investigation, the frequency of bone degradation was likewise not statistically substantial. This might be because we excluded remodelling from our study's erosion definition.

Our attention was drawn to the serrated turbinate look, one of the coincidental results in the paranasal sinus topographies El Khateeb and Zain-Al-Abdeen discussed in their study.[25] The serrated turbinate look may be mistaken for the mucosa's cobblestone appearance while discussing serrated turbinate with professionals. However, this morphology was not identified as a radiological finding in the literature. Surprisingly, when we added the serrated turbinate morphology to our investigation, we discovered a statistical correlation between this morphology and the AFS (p<0.05). However, because our study primarily focuses on the AFS, more extensive research is required to determine how the serrated turbinate shape relates to other allergic rhinitis and fungal sinusitis subtypes.

Our research has some drawbacks. Since our study was retrospective and MRI pictures of the patients were unavailable, they were omitted. Another limitation of our study is the small number of patients with AFS who received a diagnosis. This study is the first to examine the relationship between paranasal serrated turbinate shape and AFS, and more investigation is required before larger patient populations can be evaluated.

LIMITATIONS OF STUDY

The study has several limitations that should be acknowledged. The lack of MRI data and the limited availability of patients diagnosed with allergic fungal sinusitis (AFS) further constrain the comprehensiveness and statistical power of the analysis. Given the heterogeneity of AFS presentation and the subjective interpretation of radiological images, interpretation bias may have influenced the results.

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CONCLUSION

To diagnose AFS, a fungal infection in immune-competent people must be suspected, and it must be evaluated radiologically, microbiologically, histopathologically, and immunologically with the examination of ENT. This is true even though AFS is a clinical entity only recently described. In cases treated as AFS in our investigation, no diagnostic criteria were discovered, which is consistent with the literature. In order to properly establish the value of the radiological findings, particularly the serrated turbinate, for the diagnosis of AFS, we require significant and impartial research.

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Authors' Contribution:

Following authors have made substantial contributions to the manuscript as under:

NJ & JAA: Data acquisition, critical review, approval of the final version to be published.

MK & KZM: Conception, study design, drafting the manuscript, approval of the final version to be published.

FM & NRB: Data analysis, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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