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Diagnosis of Bone Erosion in Patients of Allergic Fungal Rhinosinusitis on Computerized Tomography Scan

Muhammad Tahir Shah[1], Salman Ahmed Mangrio[2], Murtaza Ahsan Ansari[3], Tahir Hussain Khan[4], Ashfaq Hussain Rana[5], Muhammad Moiz Ullah Khan[6], Muhammad Imran Malik[7]

[1]Assistant Professor ENT, Fazaia Medical College PAF Hospital, Islamabad
[2]Assistant Professor ENT Dow international medical college DUHS
[3]Associate Professor ENT-HEAD & Neck Surgery Dow University of Health Sciences, Karachi
[4]Consultant surgeon ENT Kulsumbai Valika Post Graduate Teaching Hospital, Karachi
[5]Associate Professor ENT Jinnah Postgraduate Med College, Karachi
[6]Senior Registrar ENT Bahria University Medical and Dental College, Karachi
[7]Senior Registrar, Fazaia Medical College PAF Hospital, Islamabad

Author`s Contribution

[1,2]Substantial contributions to the conception or design of the work; or the acquisition,[4,6,7]Active participation in active methodology,[2,3]analysis, or interpretation of data for the work, [5]Drafting the work or revising it critically for important intellectual content

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Address of Correspondent
Dr Muhammad Tahir Shah
Assistant Professor ENT,
Fazaia Medical College PAF Hospital, Islamabad
227tahirshah@gmail.com

ABSTRACT

Objective: To determine the frequency of bone erosion on computerized tomography (CT) scans in patients with allergic fungal Rhinosinusitis in Pakistan.

Methodology: A Prospective observational study was conducted at ENT department of Pak Fazaia Medical College PAF Hospital, Islamabad City, from Feb 2023 to Jan 2024.A total of 125 patients diagnosed with Allergic Fungal Rhinosinusitis according to Bent and Swain criteria were enrolled. Patients were then categorized based on the extent and site of bone erosion. SPSS version 27 selected for data analysis, after initial calculation of mean and standard deviations or frequency percentages test of significance (chi square test for categorical variables and t-test for numerical variables) was applied. P values ≤0.05 was taken as significant.

Results: Out of 47 bone erosion patients, 51.1% patients had mild, 19.1% had moderate and 29.8% patients had severe level of disease. The distribution of site and subsite in bone erosion patients were shown in table. II. Ethmoid was seen in 27.7% patients, frontal was seen in 17.0% patients, sphenoid was seen in 25.5% patients, andmaxillay was seen in 29.8% patients.

Conclusion: Allergic Fungal Rhinosinusitis often leads to significant bone erosion, which can be effectively detected through a CT scan. The maxillary sinus is the most commonly affected site among the paranasal sinuses.

Keywords: Allergic Fungal Rhinosinusitis, Bone erosion, Computed Tomography, Sinusitis.

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Introduction

In the world about 400,000 fungal species are known, out of them around 400 are linked with human illness.[1] The role of fungi in the nose and paranasal sinuses is unclear. In human fungi can be cultivated from the mucus and droplets from respiratory tract of healthy persons. In humans few specific fungal diseases are associated with high mortality rate.[2]Fungi play an uncertain role in the nose and paranasal sinuses, which can be diagnosed with nasal cultures of healthy persons. However, many types of fungal infections can lead to the death. Allergic Fungal Rhinosinusitis (AFRS) is a specific subtype of rhino-sinusitis that affects individuals with healthy immune systems, often linked to a history of allergic rhinitis.[2]

It is believed to originate from an allergic response triggered by airborne environmental fungi, primarily dematiaceous species such as bipolaris (Curvularia, Alternaria), and occasionally involving Aspergillus.[3] Clinical manifestations include nasal polyps, eosinophilic mucin accumulation, and the presence of fungal hyphae within the nasal cavities and sinuses.[4,5]Bone erosion in AFRS is a recognized occurrence, typically affecting the orbit and base of the skull, with its prevalence varying significantly across different regions, ranging from 20% to 90%.[6]

Managing AFRS involves a multi-pronged approach, integrating medical and surgical interventions.[7] Notably, Functional Endoscopic Sinus Surgery (FESS) poses potential life-threatening complications, particularly in instances of bony boundary dehiscence.[8] Hence, conducting a thorough assessment of CT scans to pinpoint areas of bone erosions and gauge disease severity is crucial for ensuring the safety and effectiveness of surgical intervention.[9, 10]

Despite the known association between AFRS and bone erosion, there may be limited data on the frequency and characteristics of bone erosion in this patient population. Conducting this study can fill this research gap and contribute to the body of knowledge on AFRS.

Methodology

A Prospective observational study was conducted at ENT department of Pak Fazaia Medical College PAF Hospital, Islamabad City,from Feb 2023 to Jan 2024. Approval from the hospital ethics committee was obtained. A total of 125 patients diagnosed with Allergic Fungal Rhinosinusitis according to Bent and Swain criteria were enrolled. Patients of all ages and genders were considered eligible, while those who were immunocompromised, diabetic, using immunosuppressive medications, antibiotics, steroids, or diagnosed with sinonasal tumors excluded.

Preoperatively, all patients underwent CT scans of the paranasal sinuses without contrast, including sagittal, coronal and axial sections, which were reported by a qualified radiologist focusing on bone erosions and extension of soft tissue within specific sinus subsites. MRI scans were additionally conducted for patients with uncertain diagnoses, soft tissue or intracranial extensions, or suspected tumors.

On CT scans, Allergic Fungal Rhinosinusitis (AFRS) typically presents with distinct features, including bilateral or unilateral opacification of multiple sinuses, central hyperattenuation, double-density shadows, mucoceles, and sinus expansion. Additionally, intrasinushyperattenuation is regarded as a key diagnostic criterion for AFRS. This study also evaluated the frequency and location of bone erosion within the sinuses, identifying the most commonly affected sinuses. Patients were subsequently categorized based on the severity of bone erosion.Single site erosion were classified as mild, while those with erosion at double sites were labeled as moderate, and those with erosion at more than two sub-sites were considered severe cases.

SPSS version 27 selected for data analysis, after initial calculation of mean and standard deviations or frequency percentages test of significance (chi square test for categorical variables and t-test for numerical variables) was applied. P values ≤0.05 was taken as significant.

Results

The mean age of the patients was 54.17±5.41 years, in which 88 (71.4%) males and 37 (29.6%) females. (Table. I). In this study, bone erosion was seen in 47 (37.6%) patients. (Figure I) The average age of disease having bone erosion was 19.45±2.03 years. Out of 47 patients having bone erosion, bilateral and unilateral was seen in 29 (61.7%) and 18 (38.3%) patients, respectively. In unilateral, 11 (23.4%) had right sided and 7 (14.9%) had left sided disease. (Figure II)

Table I: Demographic characteristics

Variable	Mean± SD
Age (years)	54.17±5.41
Gender	N(%)
Male	88 (71.4)
Female	37 (29.6)

Table II: **Site and subsites distribution in bone erosion patients.**

Sinus	Subsite	N (%)	Total
Ethmoid	Lamina Paprycea	8 (61.5)	13 (27.7%)
	Ethmoid Roof	5 (38.5)	
Frontal	Ant Wall	2 (25.0)	5 (17.0%)
	Post Wall	1 (12.5)	
	Floor	5 (62.5)	
Sphenoid	Planum	1 (8.3)	12 (25.5%)
	Post Wall	3 (25.0)	
	Lat Wall	4 (33.3)	
	Clivus	4 (33.3)	
Maxillay	Roof	5 (35.7)	14 (29.8%)
	Ant Wall	4 (28.6)	
	Post Wall	2 (14.3)	
	Lat Wall	3 (21.4)	

Out of 47 patients with bone erosion, 24 (51.1%) had a mild level of disease, 9 (19.1%) had a moderate level, and 14 (29.8%) had a severe level (Figure III). The distribution of sites and subsites in patients with bone erosion is shown in Table II. The ethmoid bone was affected in 13 patients (27.7%), the frontal bone in 8 patients (17.0%), the sphenoid bone in 12 patients (25.5%), and the maxilla in 14 patients (29.8%) (Table II).

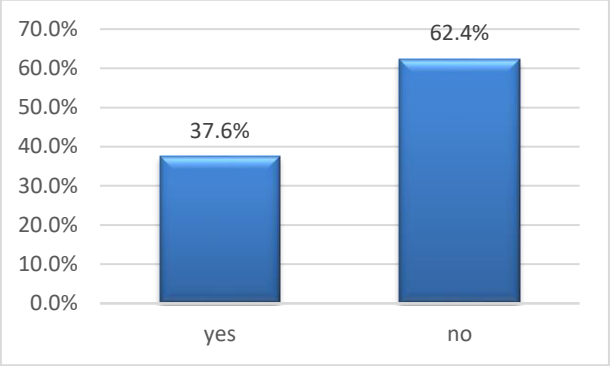

Figure I. Bone erosion disease in the study patients.

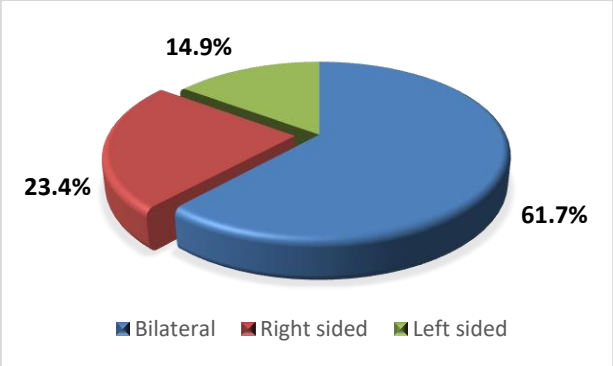

Figure II. Laterality of the disease.

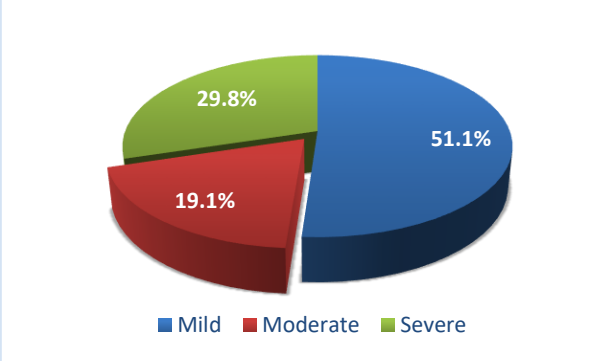

Figure III. Severity of disease in bone erosions patients

Discussion

Allergic fungal sinusitis is a subclass ofRhinosinusitis that primarily affects the persons who are immunocompetent. Unlike invasive fungal infections, AFS is caused by airborne fungus and commonly presents in individuals with allergic rhinitis. The condition is known as collection of eosinophilic mucus, nasal polyps growth in the affected sinuses, and nearly pathognomonic findings on CT scans[11].Ali et al[12] study revealed that this condition is characterized by the emergence of nasal polyps, the buildup of eosinophilic mucin in the sinuses, and recognizable CT scan patterns, typically observed in younger's with an average onset age of 21.9 years, affecting both genders equally. In this study, mean age was 54.17±5.41 years, comprising 71.4% males and 29.6% females.

A study conducted by Mughal et al[13] found that 56% of patients with allergic fungal Rhinosinusitis (AFRS) experienced bone erosion that was 37.6% in our study. Additionally, the study showed that African American men are 15 times more likely to be affected by AFRS compared to Caucasian men and African American women combined.

In a prior study, bone erosion was found to occur in approximately 20% of cases of Allergic Fungal Rhinosinusitis (AFRS) in Western countries.[14] In contrast, a review in Japan reported that incidence of bone erosion 52.6% of cases of AFRS.[15]

Identification of areas of bone erosion is important for surgical planning in the base of the skull and orbit, aiming to prevent serious complications. Among 125 cases of Allergic Fungal Rhinosinusitis(AFRS) screened, 37.6% exhibited bone erosion on CT scan. According to Tanveer et al[16], the frequency of bone erosion in AFRS ranges from 20% to 90%. Despite AFRS being associated with hot and humid climates, research by Mulhem et al[17] from Saudi Arabia documented a lower frequency of bone erosion at 20%.

In our study, the maxillary sinus emerged as the most frequently involved sinus at 29.8%, with the maxillary sinus following closely at 27.7%. This distribution aligns with findings from Loftus et al[18], who reported bone erosion frequencies in ethmoid sinus 77%, in maxillary sinus 68%,in sphenoid sinus 58%, and in frontal sinus 53%.In another study Chakarbarti et al[19] reported that within the ethmoid sinus, lamina paprycea as the most commonly eroded site at 24.3%, consistent with its thin structure and narrow area, as noted in various other studies.

In this study out of 47 bone erosion patients, 51.1% patients had mild, 19.1%moderate and 29.8% severe level of disease. In a study carried out by Khan et al[20] which examined 85 patients with bone erosion, the severity of the condition varied among the participants. Of the total patients studied, 15 individuals, representing 17.6% of the sample, experienced severe illness. Meanwhile, 22 patients, accounting for 25.8% of the group, had a moderate level of disease. The largest portion of the group, 48 patients, equaling 56.1% of the participants, were found to have mild disease.

In this study out of 47 patients having bone erosion, bilateral and unilateral was seen in 61.7% and 38.3% patients, respectively. In a study by Makihara et al[21] it was found that allergic fungal Rhinosinusitis (AFRS) generally presents with unilateral CT shadows, although it can occasionally be bilateral, as seen in 16.7% of cases.

Conclusion

Allergic Fungal Rhinosinusitis often leads to significant bone erosion, which can be effectively detected through a CT scan. The maxillary sinus is the most commonly affected site among the paranasal sinuses.

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