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Diagnostic accuracy of CT scans in allergic fungal sinusitis: A cross sectional study

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Introduction

Fungal sinusitis, with passage of time, has become one of the common entities among a long list of inflammatory diseases involving mucosa of the sinonasal tract [1]. By definition, AFS is a collection of cellular debris and mucus in result of an allergic response to fungal colonization in sinus mucosa [2]. The patients are young, atopic with good immunity suffering from nasal blockage, congestion, nasal discharge (purulent or watery), anosmia or headache for several years [1]. On clinical examination nasal polyps are seen [3,4]. The causative organisms are vastly from species of Aspergillus but dermatiaceous fungi are also seen such as Bipolaris, Alternaria, Curvularia and Fusarium [5].

There are a number of controversies regarding its diagnosis and management [6]. In 1994 Bent and Kuhn defined a diagnostic criterion for AFRS focusing on certain characteristic of the disease. This include presence of nasal polyp, CT scan opacity of sinuses, presence of fungus on culture, allergic mucin containing fungus without tissue invasion [7,8]. According to Schubert there are four diagnostic criteria for AFS, they include, identification of allergic mucin, positive fungal stain/positive surgical sinus culture for fungus, No necrosis or fungal invasion and sinus mucosa showing eosinophilic and lymphocytic infiltrates [5]. The characteristic radiologic findings include hyperplasia of sinus mucosa, hyper density within sinuses outlined by inflamed mucosa which is hypo dense given the "double density sign" [1,5,9]. Thinned out involved sinus walls, expansion and remodeling can be seen [10]. The preoperatively available radiological features are not specific to AFS and are evident with varying frequency in other sinus mucosa diseases [8]. In 2013, Nasreen et al. Reported the sensitivity of CT scan 89.3% and specificity 86.9% [11].

On histopathological examination, Charcot-Leyden crystals and eosinophil granulocytes can be seen, but the gold standard for the diagnosis of allergic fugal sinusitis is the presence of allergic mucin on the histopathology. Intra operatively, one may find yellow-green or sometimes gray-black purulent discharge, nasal polyps and fungal debris [1]. But even in absence of fungal hyphae, presence of allergic mucin is the gold standard [5].

The objective of our study is to assess the accuracy of CT scan in preoperative diagnosis of Allergic Fungal Sinusitis. As there is deficient local data, these results will help us in preoperative planning and counseling prior to the treatment of a patient suffering from AFS. An exact preoperative diagnosis can guide the surgeon to decide the extent of surgical resection and possible adjuvant medical therapy.

Patients and methods

This prospective cross sectional, descriptive study was conducted in the department of Otolaryngology and Head & Neck surgery, Aga Khan University Hospital, Karachi from February 2020 to August 2020 after the approval of ethical review committee. Based on the previous studies keeping sensitivity as 89.3%, specificity 86.9%, prevalence 26.7% [7] desired preci-

sion 14% and confidence interval 95% [3], sample size calculated to be 72. We included all the male or female patients from 18 years to 60 years old, who were diagnosed to have allergic fungal sinusitis, the duration of their symptoms was at least 6 months and they were planned for Functional Endoscopic Sinus Surgery (FESS). Patients who had any nasal surgery in the past, suffering from some autoimmune disorder or with incomplete data were excluded.

The preoperative CT scans of the patients were reported by a single senior radiologist. Global criteria for presence or absence of fungal sinusitis were used for reporting. Sino nasal contents removed during surgery were sent for histopathology. The final diagnosis of AFS was made on the basis of final histopathology. Positive CT scan findings suggesting allergic fungal sinusitis were compared to the final histopathology and culture results to calculate the diagnostic accuracy of CT scans.

SPSS version 21 was used for data entry and statistical testing. The results were tested for diagnostic accuracy keeping histopathological diagnosis the gold standard for diagnosis.

Mean and standard deviation were calculated for quantitative variables like age. Frequency and proportion were calculated for qualitative variables like gender, CT scan findings and final histopathology. Sensitivity and specificity of CT scans were calculated after comparison with final histopathology. Effect modifiers like age and gender were addressed through stratification post-stratification. The diagnostic accuracy was evaluated in relation to sensitivity, specificity, positive predictive value and negative predictive value keeping final histopathology as reference value.

Results

72 patients were included in the study. Among them 58.3% were males and 41.7% were females. The mean age of the patients was 39.10 years, with SD of 16.08. In order to measure the sensitivity and specificity CT scans were compared with final histopathology as the gold standard.

The sensitivity of CT scan in diagnosing an allergic fungal sinusitis was 100% and specificity 15.8%. The positive predictive value of computed topography was found to be 23.8% while 100% negative predictive value was seen. The diagnostic accuracy came out to be 57.9%. Stratification according to age was also performed.

In a group ranging from 18 to 30 years, the diagnostic accuracy came out to be was 55.8% while in the group of patients with age 31 years and above, diagnostic accuracy was 58.9%.

Discussion

Allergic fungal sinusitis occurs as an allergic response to the growth of noninvasive fungal growth in the sinuses where mucus drainage is not adequate [12,13]. In literature, allergic fungal sinusitis is defined as localized inflammatory disease which causes allergic (eosinophilic) mucin to accumulate in the sinuses. Allergic mucin is a thick eosinophilic secretion that contains fungal hyphae. It gives characteristic radiographic feature, the double density sign on the CT scan [14]. Such radiographic features were also seen in the CT scans of our patients too. Features like double-density sign and bony remodeling were used to label a sinonasal disease as allergic fungal sinusitis on a CT scan.

In our study, majority of the population included were males 58.3% and 41.7% were females. The mean age of the patients was 39.10 years, with SD of 16.08. Nasreen et al. published a study on diagnostic accuracy of CT scans, 51.1% of the patients in that study were males and 48.9% were females [11]. The incidence of allergic fungal sinusitis varies in different geographical settings. In Pakistan, its incidence is 18.9%, which happens to be higher than UK and Saudi Arabia that is 4% and 12.1% respectively [15]. India on the other hand has higher incidence of 56%-57% [16,17].

CT scan is one of the important investigations that are commonly done before proceeding for the endoscopic sinus surgery for the treatment of allergic fungal rhino sinusitis. Another study from Karachi Pakistan reports the diagnostic accuracy of CT scans to be 88.7% while in our study the diagnostic accuracy of CT scans in allergic fungal rhino sinusitis came out to be 57.9% [11]. In the same study, Nasreen, et al. has reported the sensitivity of CT scan to be 89.3% and specificity to be 86.9%. Whereas, in our study the sensitivity and specificity of CT scan by taking histopathology findings as gold standard was 100% and specificity 15.8% respectively [11]. We further analyzed the results by dividing it in to 2 groups. One group with consisted of patients with age ranging from 18 years to 30 years and the other group included patients with age ranging from 31 years and above. Diagnostic accuracy of CT scans was found to be 55.8% in former and 58.9% in the latter group.

Although, according to the Bent and Kuhn criteria CT scan characteristic are important to diagnose a patient with allergic fungal sinusitis, but in a developing country like Pakistan, majority of the population cannot afford this costly investigation. Khalid et al. conducted a study to evaluate specificity and sensitivity of endoscopic features for the diagnosis of allergic fungal sinusitis in the clinic. The conclusion of his study focused on intrapolypoidal white particles for the diagnosis of allergic fungal sinusitis that has sensitivity and specificity of 85.71% and 65.63% respectively. Intrapolypoidal white particles have diagnostic accuracy of 71.74%. Another common endoscopic sign was expansion of sinus that was seen in 52.2% of the population [18]. Therefore, in future if we can diagnose allergic fungal sinusitis in the clinic with the help of reliable endoscopic features, we can save the patient from expenses of a CT scan. But the question regarding the extent of surgery will still remain unanswered on sole endoscopic examination.

Another low cost investigation commonly done for visualizing sinuses is plain x-ray. But it has quite a limited role in diagnosing sinusitis [19]. Few features that can be appreciated on x-ray para nasal sinuses include complete opacification of sinus, air-fluid levels and mucosal thickening. The limitation behind the use of x-ray for sinusitis is that the features are non-specific for the diagnosis. Another drawback of x-ray para nasal sinuses is the high frequency of false positive results. Due to the overlap between bony structures and para nasal sinuses, its interpretation is difficult for a clinician [20,21]. Such limitations do not make x-ray an ideal imaging modality to diagnose sinusitis appropriately.

CT scan happens to be the most reliable investigation for

the diagnosis allergic fungal sinusitis in today's date, till we can find a cheaper and better investigation [22]. CT scan not only helps to identify the characteristic features of the disease, but helps to appreciate the anatomical variations including septal deviation, concha bullosa, haler cells, depth of olfactory fossa by Kero's classification [23]. This makes CT scan a good modality not only for the purpose of diagnosis but also as an important investigation for correct identification of surgical landmarks before the procedure.

Functional endoscopic sinus surgery is the treatment modality of choice to cure the patients with sinonasal diseases, including allergic fungal sinusitis. Being one of the most advanced surgical intervention, it also carries risks of a number of complications including cerebrospinal fluid leak, injury to internal carotid artery, orbital hematoma, optic nerve injury and injury t extra-ocular muscles [24]. The incidence of minor and major complications while performing endoscopic sinus surgery range from 1.1-20.8% and 0-0.15%, respectively [25]. Keros in 1962 presented a classification system to categorize the depth of olfactory fossa in three types. In Keros classification type-I, the depth of olfactory fossa is 1-3 mm, type-II 4-7 mm and type-III 8-16 mm [26]. Keros type-II is the most common type, followed by type-I and type-III. Patients with Keros type-III, where the olfactory fossa is deepest, are more prone to iatrogenic injury at cribriform plate or lateral lamella of cribriformplate [27]. Since, the base of skull has a slopping shape, it limits the utilization of Keros classification. Therefore, surgeons also consider Gera classification to predict possible challenges during endoscopic sinus surgery. This classification is based on the angle of lateral lamella with respect to a horizontal line passing through the plane of cribriform plate. Gera classification is divided in to 3 classes; class 1 (low risk, >80 degrees), class 2 (medium risk, 45-80 degrees) and class 3 (high risk, <45 degrees) [26,28]. Therefore, CT scan in addition to the diagnosis, also helps to evaluate the depth and angle of olfactory fossa prior to surgery. Such accurate evaluation is not possible in endoscopic examination or plain x-rays.

Conclusion

CT scan is an important investigation in order to assess bony erosions and remodeling secondary to the disease. It also helps us to determine the extent of disease. Our study shows high sensitivity and reasonable specificity of CT scans for allergic fungal sinusitis.

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