Diagnostic Accuracy of Ct Para Nasal Sinuses in Allergic Fungal Rhino Sinusitis

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Abstract
Allergic fungal rhinosinusitis is the most common form of fungal sinusitis and its clinical resemblance with chronic bacterial sinusitis often makes the diagnosis difficult. The diagnostic criteria for AFRS are rigid in nature involving multiple parameters to be satisfied. This calls for a reliable pre-operative screening modality. This study is to determine the diagnostic accuracy of CT Para nasal sinuses in CRS patients to diagnose AFRS.82 CRS patients who were managed surgically satisfying inclusion and exclusion criteria were selected and all underwent blood investigations, plain CT PNS, diagnostic nasal endoscopy, histopathological examination and fungal staining of the surgical specimen, KOH staining and fungal culture. Our study showed the most common CT finding as heterodensity along with bilateral multiple sinus opacification with bone remodelling, in all 17 diagnosed AFRS cases as per the Bent and Kuhn criteria. The presence of heterodensity was found to be statistically significant with a p value of <0.0001.Th e sensitivity was 100%, specificity 60% and diagnostic accuracy 68.29%.Hence CT PNS can be a reliable pre-operative diagnostic modality to screen the AFRS patients and to limit further tests of fungal aetiology to these patients alone.

I.   Introduction:

Allergic fungal rhino sinusitis is the most common fungal sinusitis accounting for 45% of the fungal sinusitis cases and 12-47% of the chronic rhino sinusitis patients requiring surgery. The diagnosis is often difficult due to its similar clinical presentation as the common bacterial chronic rhino sinusitis. The Bent and Kuhn criteria and the recently defined St. Paul's Sinus Centre criteria is specific for the diagnosis of AFRS and is by 5 major criteria where all must be satisfied. This needs several tests which are time and money consuming and the diagnosis is confirmed only after histopathological examination, fungal staining and fungal culture that may take upto 6 weeks post operatively.

This calls for a pre-operative screening test which is both reliable and sensitive in predicting the disease and also to limit further investigations in such patients alone. The role of Plain CT of the para nasal sinuses to predict an AFRS patient pre operatively as a single screening tool is analysed here.

II.   Objectives:

To determine the diagnostic accuracy, the sensitivity and specificity of Plain CT scan para nasal sinuses in diagnosing patients with allergic fungal rhino sinusitis.

III.   Materials And Methods:

This is a hospital based prospective observational study on 82 consecutive patients who came to the out-patient E.N.T department of our institute, diagnosed as chronic rhino sinusitis based on the AAO-HNS defining criteria for chronic rhino sinusitis.

Inclusion criteria:
1.   Patients 18-70 years of age.
2.   Patients requiring surgical management after failed medical therapy for not less than 3 months.
3.   Patients who are willing to undergo all investigations required for this study.

Exclusion criteria:
1.   Patients diagnosed as invasive fungal sinusitis post-operatively in the histo pathological examination.
2.   Patients diagnosed as sino-nasal malignancy post-operatively in the histo pathological examination.
3.   Patients where anti-coagulants cannot be stopped for surgery.
Study method:

All the patients were asked to sign a consent form for their participation in this study and their written informed consent was obtained for undergoing all investigations required for this study as well as for endoscopic sinus surgery.

All patients underwent blood investigations including serum total and absolute eosinophil count, Plain CT para nasal sinuses-5 mm cuts axial, coronal and sagittal views. The CT findings were noted keeping the diagnostic characteristics of AFRS in mind.

They also did a diagnostic nasal endoscopy for the presence of allergic mucous which is thick sticky peanut butter or axle grease like secretions which are relatively resistant to suction clearance.

All of them under went endoscopic sinus surgery under antibiotic coverage and use of intra venous / oral/ intra nasal steroids were individualised according to the need and disease extend.

Post operatively, the surgical specimen was sent in 10% formalin for histopathological examination for the presence of allergic mucin in particular and also fungal staining with Gomorri's methenamine silver stain.

The sino nasal washings sent in normal saline was mounted in KOH for the presence of fungi and also for fungal culture and sensitivity as a supporting category and also to diagnose other forms of fungal sinusitis.

The study variables were collected in a proforma that included:
1. *Age*
2. *Sex*
3. *Presence of Allergy*
4. *Presence of polyp*
5. *Ct findings*
6. *Diagnostic nasal endoscopy findings*
7. *Histo pathology report*

Allergic fungal rhino sinusitis was diagnosed in all patients who satisfied the major parameters of the Bent and Kuhn criteria which are:
1. *presence of type I hypersensitivity*
2. *nasal polyposis*
3. *characteristic CT findings*
4. *eosinophilic mucin*
5. *fungal staining*

The diagnostic accuracy, sensitivity and specificity of plain CT PNS in detecting   AFRS cases were then calculated using cross tabulation in SPSS software.

IV.   Results:

Out of the 82 patients studied, 17 patients were diagnosed as allergic fungal rhino sinusitis based on the presence of all major parameters of the Bent and Kuhn Criteria.

The CT findings in these patients were analysed in detail and the following findings were noted.

TABLE 1: Frequency and Percentage of AFRS patients showing characteristic CT findings.

CT FINDING	NO OF AFRS PATIENTS	PERCENTAGE OF AFRS PATIENTS
Double density sign	17	100
Bilateral multiple sinus involvement	12	70.5
Unilateral multiple sinus involvement	5	29.4
Expansion and re-modelling	15	88.2
Thinning bone erosion	2	11.7

FIGURE 1: Percentage of AFRS patients showing characteristic CT findings.
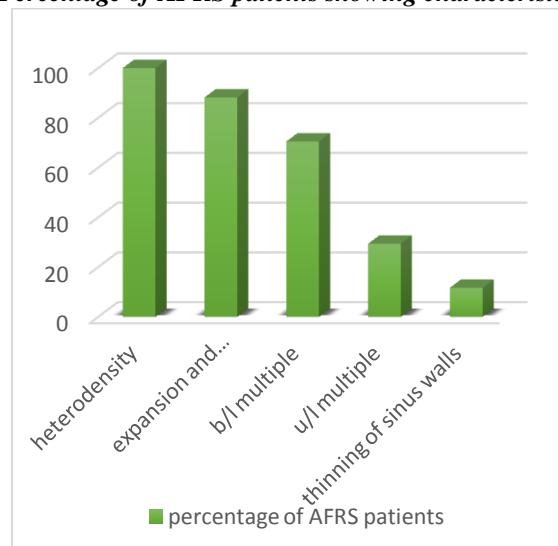

TABLE 2: Combinations of various CT findings as present in each AFRS case with its frequency and percentage

COMBINATIO-NS OF CT FINDINGS	NO.OF AFRS PATIENTS	% OF AFRS PATIENTS
1. Hetero density, 2. b/l multiple sinus opacification, 3. expansion and remodelling of sinus	9	52.9
4. 1,2,3 + thinning of sinus walls	1	5.88

5. Hetero density 6. u/l multiple sinus opacification 7. expansion and remodelling	4	23.5
8. 5,6,7 + thinning of sinus walls	1	5.88
9. Hetero density and b/l multiple sinus opacification alone without expansion	2	11.7

FIGURE 2: Comparison of heterodensity in CT between AFRS and non AFRS patients in percentage-bar diagram
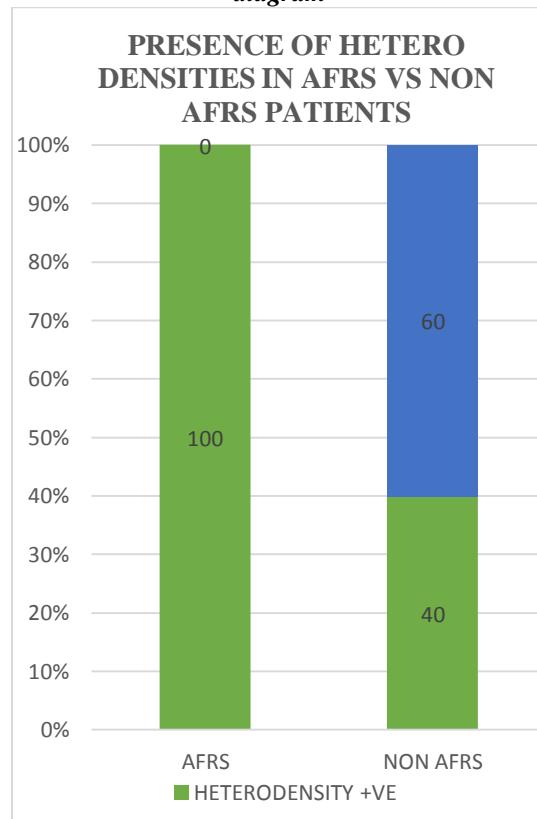

Table 3: Statistical analysis of hetero density in CT

hetero density in CT	HPE			
	AFRS		Non AFRS	
	n	%	n	%
present	17	100	26	40
absent	0	0	39	60
Total	17	100	65	100

χ^2	48.115
Df	1
P value	<0.0001

Based on this, the CT PNS is analysed as a diagnostic test for AFRS pre operatively.

Table 4: Hetero density in AFRS v/s non AFRS-cross tabulation

HETERO DENSITY	AFRS	NON AFRS	TOTAL
+VE	17	26	43
-VE	0	39	39
TOTAL	17	65	82

- **SENSITIVITY OF CT PNS :**

$$\text{True positive rate } = \frac{No.\,of\,True\,positives}{No.\,of\,patients\,with\,disease}$$

$$= \left(\frac{17}{17+0}\right) 100$$

= 100 % sensitive.

- **SPECIFICITY OF THE CT PNS**

$$\text{True Negative rate } = \frac{No.\,of\,True\,Negatives}{No.\,of\,truly\,disease\,free\,patients}$$

$$= \left(\frac{39}{39+26}\right) 100$$

= 60 % specific.

- **THE OVERALL DIAGNOSTIC ACCURACY OF CT PNS:**

$$\text{Diagnostic accuracy of CT } = \frac{true\,positives\,+\,true\,negatives}{Total\,study\,population}$$

$$= \left(\frac{17+39}{82}\right) 100$$

= 68.29 % accuracy

DISCUSSION:

The various combinations of CT findings among the 17 diagnosed cases of AFRS was also observed.

It is evident that in AFRS patients, 52.9 % cases had the combination of:

- hetero density
- bilateral multiple sinus involvement
- Sinus expansion and remodelling.

The next common finding was:

- unilateral multiple sinus involvement instead of bilateral
- the same double density sign
- expansion of sinus

Also the combination that was noted from the maximum number of AFRS cases were:

Hetero density with expansion and remodelling of the sinus in 15 out of 17 cases formed 88.2% of the CT findings.

The next common finding was of hetero densities with bilateral sinus opacification noted in 12 patients forming 70.5% of the cases.

The unilateral asymmetrical involvement of the disease in AFRS as noted in the Bent and Kuhn criteria was observed in only 29.4% of the cases

This was similar to the previous studies on the imaging features of fungal sinusitis by Aribandi et al, in 2007,Ilica et al, in 2012, and Basha et al in 2013 where the same CT features in AFRS patients were reported as the most common.

FIGURE 3: hetero densities in right maxillary sinus

FIGURE 4: B/L multiple sinus opacification

FIGURE 5: heterodensity with multiple sinus involvement

On comparison of the most common CT finding of the presence of heterodensity in the AFRS and non AFRS patients we obtained a chi squared value of 48.115 and the p value obtained is 0.0001 which is <0.05. Hence this CT finding is statistically significant in diagnosing AFRS patients.

The sensitivity of CT obtained for the double density sign noted in all the AFRS patients was 100%, specificity was 60% and diagnostic accuracy was 68.29 %.

The low specificity and diagnostic accuracy obtained was because of the inclusion of the other fungal sinusitis patients like the EMRS and the fungal ball in the control group. Thus to diagnose AFRS among the rest of the CRS patients CT is highly sensitive and can be used to screen the patients to detect the true positive cases.

Our reference used for the sample calculation was a study by Naz et al in 2016 on the diagnostic accuracy of CT in fungal diseases. He selected 98 CRS patients with features of CRS and fungal cases were diagnosed based on the HPE reports. The high sensitivity in this study noted was because he included all the invasive and non-invasive fungal cases and not AFRS alone in the test group.

He noted 91.8% patients showing double density sign, 80.6 % with sinus expansion and 59% with bone erosion and thinning. He noted a sensitivity of 89.3%, specificity of 86.9% and diagnostic accuracy of 88.7%.

Another study taken as reference was by Iqbal et al, in 2017 studied the diagnostic accuracy of CT and selected 120 patients with features suggestive of fungal aetiology. He noted a sensitivity of 96.19%, specificity

of 93.33% and diagnostic accuracy of 95.83%. The high values obtained here was because the study group included only patients clinically suspicious of fungal aetiology and not the whole CRS patients.

V.   Conclusion:

From our study, it can be concluded that plain CT para nasal sinuses showing the double density sign can be used as a reliable diagnostic modality to detect cases with AFRS pre operatively.

Also the need for diagnosis of immunological evidence of allergy and other tests to demonstrate fungi and allergic mucin in tissues can be limited to cases showing evidence of fungal aetiology in CT.

This can avoid further investigations of the Bent and Kuhn criteria in the rest of the non-fungal CRS group detected as per CT scan.

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