

# Allergic bronchopulmonary aspergillosis: A clinical review of 24 patients: Are we right in frequent serologic monitoring?

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## Abstract:

**BACKGROUND:** Allergic Broncho Pulmonary Aspergillosis (ABPA) is a rare disease characterized by an allergic inflammatory response to the colonization by aspergillus or other fungi in the airways. The aim was to study the clinical, radiological, and serological characteristics of patients of ABPA.

**MATERIALS AND METHODS:** A prospective observational study of patients with breathlessness, chronic cough, blood eosinophilia, and infiltrates on chest X-ray were evaluated with serologic and allergic skin fungal tests using 15 common fungal antigens. Total of 24 patients were diagnosed as ABPA.

**RESULTS:** Total 24 patients, 15 males (62%), 9 females (38%). Age range: 14-70 years, mean 49.13, standard deviation (SD) 14.12. Central bronchiectasis — sixteen patients, bronchocoele — one patient, consolidation — five patients, collapse with mucous plugging with areas of consolidation — three patients, one patient had bronchiectasis, consolidation with hemorrhagic pleural effusion. Fifty-eight percent of patients had received anti-tuberculosis medications prior to diagnosis. Serum total IgE varied from 340 to 18100 IU/mL. Two patients had IgE levels below 1,000 IU/mL. The mean decrease in Serum total IgE levels at the end of 1 month was 26.1% (range: 0.7-71.9%) and at the end of 2 months was 58.9% (range: 11.11-93.26%) (*P* value of 0.004). Two patients had skin sensitivity to fungal antigens other than *aspergillus species*.

**CONCLUSION:** ABPA is a disease with varied clinical, radiological, and serological patterns. Serum IgE monitoring may be done at the end of 2 and 6 months. Further studies are required to simplify the diagnosis and treatment algorithms in resource-limited countries.

## Key words:

Allergic, aspergillosis, bronchopulmonary, radiological, serological

Allergic Broncho Pulmonary Aspergillosis (ABPA) is a rare disease characterized by an allergic inflammatory response to the colonization by aspergillus or other fungi in the airways. It is estimated that ABPA complicates around 7-14% of cases of asthma.<sup>[1]</sup> ABPA should be ruled out in every case of uncontrolled asthma. Diagnostic criteria for ABPA include the presence of bronchial asthma, immediate skin test reactivity to *A fumigatus*, elevated serum IgE levels, total and *A fumigatus*-specific, pulmonary infiltrates (transient or fixed), central bronchiectasis, peripheral blood eosinophilia, and presence of serum precipitins against aspergillus antigen.<sup>[2]</sup> The currently employed diagnostic criteria have varying sensitivity and specificity.<sup>[3]</sup> A number of experts have proposed algorithmic approaches to the diagnosis of ABPA with some variations in the steps.<sup>[3]</sup>

## Aim

The aim was to study the clinical, radiological and serological characteristics of patients of ABPA.

## Materials and Methods

**Design and setting:** This was a prospective observational study of patients presenting to our specialty respiratory clinic either by referral from primary care physicians or directly presenting in the out patients department with complaints of breathlessness and chronic cough. This study was done from August 2008 till August 2012, presenting at a single outpatient center. A total of 2,295 patients were diagnosed with bronchial asthma and of these, 490 asthmatics were screened for suspicion of ABPA. Rests were dropped from the study for various reasons. This is a first study from western India on ABPA. In this study, we try to answer whether there are any regional variations in ABPA and whether frequent serologic monitoring as recommended in guidelines is mandated in resource limited settings.

## Eligibility

All patients presenting in the outpatient department (OPD) with history and examination

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and fulfilling the diagnostic criteria suggesting ABPA were included in the study. Greenberger and Patterson's criteria were used to diagnose ABPA.<sup>[4]</sup> Those patients who did not wish to participate in the study were excluded. Refer Table 1.

**Data collection**

*Clinical data*

Patient personal details — age, sex, education, occupation, family income, and addictions were recorded. Detailed history taking was done and complaints of cough, breathlessness, and sputum production were noted. General examination and respiratory system examinations were done. Clubbing was noted. Coarse crepts, palpable crepts were noted on respiratory system examination. Patients were specifically enquired about anti-tuberculosis medications in the past or present and the same was recorded.

*Laboratory data*

All patients were subjected for skin prick test using the standard 15 fungal allergens manufactured by Creative Drug Industries Limited, Mahape, Navi Mumbai. The various fungal allergens were *Aspergillus fumigatus*, *Aspergillus niger*, *Aspergillus flavus*, *Fusarium solanii*, *Rhizopus nigricans*, *Aspergillus tamari*, *Curvularia lunata*, *Penicillium sp.*, *Cladosporium herbarum*, *Alternaria alternate*, *Candida albicans*, *Trichoderma sp.*, *Phoma tropicalis*, *Helminthosporium sp.*, *Aspergillus versicolor*. The readings were compared with controls using saline and histamine. The readings were measured according to Shivpuri's criteria.<sup>[5]</sup> The patients showing skin prick test positivity to any fungal antigen were subjected to Serum total IgE and High Resolution Computed tomography of the Chest (HRCT). Bronchiectasis was diagnosed on HRCT pattern.<sup>[6]</sup> Location of bronchiectasis was noted as central when it extended within medial one-half of the lung fields and peripheral when it extended outside the medial half. Patients were also subjected for pulmonary function testing (PFT) and specific IgE for *Aspergillus fumigatus*. We followed the algorithm recommended by Greenberger and Patterson.<sup>[3,7]</sup> Here, skin prick test was used as the screening test followed by serum total IgE. When these were positive, then specific IgE for *Aspergillus fumigatus* was done by Immunocap method and then HRCT chest was done to determine the abnormalities. Those patients with normal computed tomography (CT) chest were labeled as ABPA-serologic and excluded from the study ( $n = 96, 19.6\%$ ).

*Treatment data*

Patients diagnosed with ABPA were started on prednisolone or its equivalent, at a dose of 0.5 mg/kg per day for 1 month (maximum of 40 mg per day) followed by tapering of 5 mg every 2 weeks till 5 mg, given every other day after a month which was continued till 6 months.<sup>[8]</sup> After 6 months, patients were evaluated for symptomatic improvement and thereafter either stopped or continued for a further period of 3 months on alternate days. Itraconazole was given to patients whose serum IgE levels did not taper in 6 months and continued to have clinical symptoms ( $n = 2$ ). These patients received 200 mg of itraconazole daily for a period of 3-6 months. All the patients were started on oral and inhaled bronchodilators, oral N acetyl cysteine, multivitamins, calcium, and protein supplements. Patients were vaccinated with influenza and pneumococcal vaccinations. Patients were advised follow-up visits at monthly intervals to record for symptoms and were noted for compliance of therapy, any exacerbations, adverse events due to medications, and any non-institutional consultations for exacerbations or any adverse events. Patients were followed for about 2 years and recorded for outcome: Remission, relapse, corticosteroid dependence, and end-stage fibrotic. All visits were separately recorded. Serum IgE was recorded at monthly intervals for 2 months and thereafter bimonthly till the end of 6 months. In our study, one patient had pleural effusion [Figures 1a and b].

**Statistical analysis**

Statistical analysis was done with Windows Statistical Package for the Social Sciences (SPSS) version 18. Descriptive statistics were completed using medians and means, as appropriate. P values (determined by  $\chi^2$  or Fisher's exact tests) were reported; alpha was inferred at 0.05. Analysis of variance (ANOVA) was used to compute the values of serum IgE over various months and the decline of the IgE over the same period. An informed consent was obtained from all patients.

**Results**

Total numbers of patients were 24 (4.8% of the total asthmatics screened). There were 15 males (62%) and 9 females (38%). Age range: 14-70 years, mean 49.13, standard deviation (SD) 14.12. The mean duration of asthma in our study was 14.79 years. Duration of cough and breathlessness varied from 1-39 years. Clubbing was noted in 25% patients ( $n = 6$ ). In our study, four patients had no prior history of asthma. Of these,

**Table 1: Diagnostic criteria of patients according to the Greenberger's criteria**

Greenberger criteria	Patients, n = 24																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Asthma	P	P	P	P	P	P	N	N	P	N	P	P	P	P	P	P	P	P	P	N	P	P	P	P
Serum total IgE >1,000 IU/MI	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	N	P	P	P	N	P	P	P
Immediate cutaneous reactivity to <i>Aspergillus species</i> or <i>A. fumigatus</i>	P	P	P	P	P	P	P	P	P	P	N	P	P	P	P	P	P	P	P	P	N	P	P	P
Elevated specific IgE for <i>Aspergillus fumigatus</i>	N	N	N	N	P	P	P	P	P	P	N	P	P	P	P	P	P	P	P	N	N	P	P	P
Central bronchiectasis	P	P	P	P	P	N	P	P	P	P	P	P	P	P	N	P	N	N	N	N	P	N	N	P
Chest X-ray infiltration	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Serum precipitating antibodies to <i>Aspergillus fumigatus</i>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Y = Yes, ND = Not done, P = Positive, N = Negative

three of these patients had reduction in Forced Expiratory Flow (FEF)<sub>25-75%</sub> on spirometry with partial bronchodilator reversibility. Twenty two patients had skin sensitivity to *Aspergillus fumigatus* alone. Two patients had skin sensitivity to antigens other than *Aspergillus fumigatus*. They were sensitive for *helminthosporium, alternaria, and fusarium solanii*. One patient tested positive for both *Aspergillus fumigatus* and *Aspergillus flavus*. A total of 58.3% patients received anti-tuberculosis treatment in our study ( $n = 14$ ) before the diagnosis of ABPA. HRCT features were as follows: Central bronchiectasis alone was seen in 67% of patients ( $n = 16$ ). Consolidation was seen in 20.8% of patients ( $n = 5$ ) in addition to central bronchiectasis. Bronchocoele was seen in one patient. A total of 12.5% patients had collapse of a segment or lobe with mucous plugging with patchy areas of consolidation ( $n = 3$ ) [Figure 2]. There was no evidence of bronchiectasis in these patients. One-third of our patients showed other radiologic features (ABPA-CB-ORF) with or without central bronchiectasis ( $n = 8$ ). One patient had unilateral hemorrhagic pleural effusion in addition to bronchiectasis and consolidation [Figures 1a and b] which grew *Aspergillus fumigatus* on fungal culture.

Serum total IgE varied from 340 IU/mL to 18,100 IU/mL on presentation. Two patients had IgE levels below 1,000 IU/mL on presentation. In our study, patients with ABPA-CB-ORF (other radiologic features) were more likely to have higher total IgE values as compared to ABPA-CB (central bronchiectasis alone). The mean total IgE in ABPA-CB-ORF was 11,740 IU/mL while in ABPA-CB was 5,588 IU/mL. This was statistically analyzed and significant difference was found in the values ( $P$  value of 0.02). The average forced expiratory volume in 1 second (FEV1) was 61%, range 33-82%. Specific IgE for *Aspergillus fumigatus* was done in all patients and was positive in 17 out of 24 patients (70.8%). Minimum level of specific IgE was Class IV, i.e., 3.90 kU/l or greater. Seven patients had a negative specific IgE. The serum IgE values over 6 months were computed and the differences observed. Refer Table 2. The mean IgE at the end of 1 month was 4,425 IU/mL (SD 4,218), at the end of 2 months was 1,821 IU/mL (SD 1,215), and that at the end of 6 months was 1,911 IU/mL (SD 1,106). The mean decrease in serum total IgE levels at the end of 1 month was 26.1% (range: 0.7-71.9%, SD 24.93), at the end of 2 months was 58.9% (range: 11.11-93.26%, SD 24.39), and at the end of 6 months was 60.8% (range: -20-95%, SD 39.64;  $P$  value of 0.03). Refer Table 3. In our study, 21% of patients had a drop of more than 35% ( $n = 5$ ) from the baseline IgE levels at the end of 1 month and 83% of patients at the end of 2 months ( $n = 21$ ). At the end of 6 months, only two patients did not have

significant (>35%) decline in serum IgE levels. Itraconazole was started in these two patients. These two patients improved symptomatically and serum IgE levels decreased by more than 35% from baseline at the end of 1 year.

Complications were as follows: One patient developed pulmonary tuberculosis. One death was seen because of gram-negative bacterial (pseudomonal) sepsis.

### Discussion

We reviewed all the original articles by Indian authors<sup>[6,9-18]</sup> as well as some of the international<sup>[19-23]</sup> original articles on ABPA and compared with our study. ABPA is seen commonly between third and fifth decades of life<sup>[3,19]</sup> and rarely in infants.<sup>[20]</sup> ABPA is predominantly seen in asthmatics with duration of asthma varying from 8.8 years to 12.5 years.<sup>[6,9-18]</sup> Rarely, ABPA is also seen in non-asthmatics. In two different studies by Behera *et al.*<sup>[10]</sup> and Chakraborty *et al.*<sup>[14]</sup>, a total of 12 patients have been reported with no prior history of

**Table 2: Analysis of Serum IgE values over 6-month period**

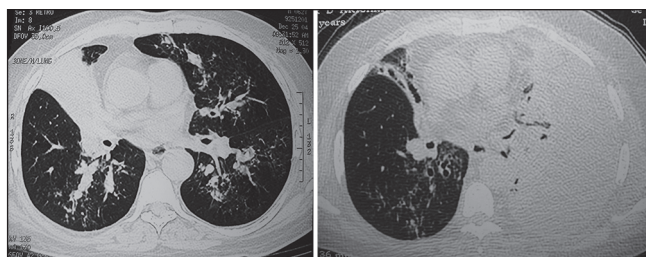
ANOVA table				
Source	Σ of Sq.	%	Mean Σ-sq	df
Explained	12,789,8197	26.18	42,632,732	3
Unexplained	360,706,847	73.82	11,272,089	32
Total	488,605,044	100%		35

F value: 3.7822; P value: 0.01982  
Residual standard error: 3357.4  
ANOVA = Analysis of variance

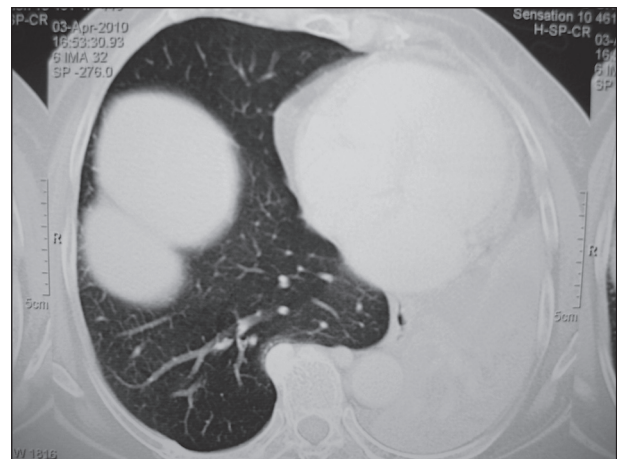
**Table 3: Decline in serum IgE values over 6 months**

ANOVA table				
Source	Σ of Sq.	%	Mean Σ-sq	df
Explained	6,411.9	24.87	3,205.9	2
Unexplained	19,372	75.13	807.18	24
Total	25,784	100%		26

F value: 3.9718; P value: 0.03235  
Residual standard error: 28.411  
ANOVA = Analysis of variance



**Figure 1:** (a) HRCT of patient with ABPA showing collapse consolidation in right middle lobe with both lower lobes showing dilated mucous filled bronchi. (b) HRCT of same patient after a gap of 5 years showing right middle lobe bronchiectasis with complete collapse of left lung with moderate pleural effusion



**Figure 2:** HRCT of patient with ABPA showing complete left lung collapse due to mucous plug obstruction



asthma. Glancy *et al.* in 1981 have reported 11 cases of ABPA without asthma ( $n = 42$ ).<sup>[23]</sup> Hogan<sup>[24]</sup>, Anirban Sarkar *et al.*,<sup>[9]</sup> and Glancy *et al.*<sup>[23]</sup> have reported sensitization to fungi other than *Aspergillus fumigatus*. Hence, the name ABPA is a misnomer. ABPM is a more appropriate term for this disease. Misdiagnosis of tuberculosis varied from 29% in the study by Chakraborti *et al.*<sup>[14]</sup> to 38.4% in Kumar *et al.*<sup>[18]</sup> to as high as 91% in the study by Prasad *et al.*<sup>[16]</sup> This shows that the awareness of this disease among primary care physicians is still very low all over the country. Central bronchiectasis is the commonest presentation as in various studies (69-100% of the cases)<sup>[6,9-18,21,25,26]</sup>. Rarely, pleural effusions have been reported in literature. Mintzer *et al.*<sup>[22]</sup> reported a single patient with pleural effusion out of 20 total patients. Agarwal *et al.*<sup>[6]</sup> also noted pleural effusions to be a relatively rare presentation in ABPA.

In the landmark study by Ricketti and Greenberger *et al.*,<sup>[27]</sup> the serum IgE ranged between 1,527–5,8000 ng/mL. The mean IgE in varied from 1,020 to 14,300 IU/mL in the study by Kumar *et al.*<sup>[18]</sup> and 6,265 IU/mL in the Aggarwal *et al.*<sup>[6]</sup> study. Ricketti *et al.* have suggested a cut off greater than 417 IU/mL for diagnosis of ABPA.<sup>[27]</sup> Mahdavinia and Grammer<sup>[28]</sup> have reported the controversy on the threshold for total IgE with some centers using 1,000 IU/mL and others using 417 IU/mL. In the latest study by Kumar *et al.*,<sup>[18]</sup> higher mean IgE value (14,300 IU/mL) was seen in the ABPA-CB-ORF group as compared to ABPA CB (1,020 IU/mL). Serial IgE monitoring has been suggested by various authors to monitor control of the disease.<sup>[1,8]</sup> Chupp has recommended monthly monitoring of IgE.<sup>[1]</sup> Ricketti and Greenberger have recommended monitoring every 8 weeks<sup>[2,27]</sup>. However, there are no clear consensus on the frequency of serum IgE level monitoring. In resource-limited settings intermittent checking of serum total IgE levels may be cost-effective. Agarwal *et al.* have suggested that checking serum IgE levels at the end of 6 weeks did not predict clinical outcome.<sup>[29]</sup> To our best knowledge, there are no studies which have compared the declines in serum IgE values over 6 months. We propose that serum IgE may be done at the end of 2 months to detect immunological control of the disease and at the end of 6 months to detect treatment failures and steroid dependence.

Itraconazole is a well-documented drug used in ABPA as a steroid sparing agent. Stevens *et al.* have shown the efficacy of itraconazole in steroid-dependent patients in a randomized controlled trial.<sup>[30]</sup> However, in treatment naïve patients the guidelines for the use of azoles is still not clear. Mahdavinia and Grammer<sup>[28]</sup> and other authors<sup>[2,31]</sup> have recommended the use of itraconazole only after a trial of steroids has proven to be insufficient. Itraconazole use is still prohibitive due to the high cost and potential adverse effects of this drug. Chishimba *et al.*<sup>[32]</sup> have shown in their recent retrospective study that itraconazole is associated with 40% treatment failure and newer azoles may be effective in controlling asthma and reduction in IgE levels.

## Conclusion

ABPA is a disease with varied clinical, radiological, and serological patterns. Patients with other radiologic features have a severe clinical and serological disease. Allergic bronchopulmonary mycosis is an appropriate term for the

disease. Serum IgE monitoring may be done at the end of 2 months and 6 months. Further studies are required to simplify the diagnosis and treatment algorithms in resource limited countries.

## Limitations

This study was a descriptive study in a small cohort of patients. A large number of patients data needs to be analyzed before a guideline be made on serial monitoring of serum IgE. Newer treatments for ABPA need to be undertaken as case-control studies with a large number of patients.

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