

Mould counts and exacerbations of allergic bronchopulmonary aspergillosis

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(Received 1 March 1982; accepted for publication 11 May 1982)

Summary

The purpose of this study was to determine whether exacerbations of allergic bronchopulmonary aspergillosis (ABPA) were associated with the total outdoor mould counts in the Chicago area. From 1976–1980, forty-nine flares of ABPA (new pulmonary infiltrate with elevation in total serum IgE) occurred in nineteen patients. Thirty-eight (77.5%) of flares occurred during months June through November in association with increased outdoor mould counts in Chicago. This association confirms earlier observations from the U.K. where during the peak mould season which occurs in winter months, there was an increased number of pulmonary infiltrates and average prednisone doses required in ABPA.

Introduction

Allergic bronchopulmonary aspergillosis (ABPA) is thought to be precipitated by an immune response to the antigens of *Aspergillus fumigatus* in the airways (Rosenberg *et al.*, 1977). It is classically characterized by wheezing, eosinophilia, pulmonary infiltrates, fever and golden brown sputum plugs containing hyphae of *A. fumigatus* (Hinson, Moon & Plummer, 1952); however, some patients may be asymptomatic (Saferstein *et al.*, 1973). Pepys (1969) reported an increase in episodes of asthma and pulmonary infiltrates in the winter months of the U.K. in association with increases in total mould counts. This was also suggested by Saferstein *et al.* (1973), in a 5-year retrospective study. They reported an increase in the average daily dose of prednisone during the peak mould season to prevent pulmonary eosinophilia in ABPA patients. Nobel and Clayton (1963) have shown a 1000-fold increase in *A. fumigatus* spores recovered indoors from October to February in London and Cardiff. The purpose of this study was to determine whether exacerbations of ABPA were associated with the

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total outdoor mould counts in the Chicago area. Such an association would have implications regarding therapy of exacerbations of ABPA.

Materials and methods

Patients

Nineteen patients with ABPA were evaluated over a 5-year period for exacerbations (flares) in their disease. A flare is defined as a new pulmonary infiltrate without a demonstrable infection or other etiology in association with a rise in total serum IgE. Three patients receiving chronic steroid therapy for asthma, were considered to have had flares although the total serum IgE did not rise with appearance of pulmonary infiltrates. Criteria for the diagnosis of ABPA are presented in Table 1.

Mould counts

Total mould counts were supplied by Mr Herb Peak of the Hinsdale Sanatorium and Hospital, Hinsdale, Illinois, using the Durham gravity method. The weekly total mould count was tabulated and totaled as monthly counts. The average monthly mould counts from 1976 to 1980 were calculated and are shown in Fig. 1.

IgE

The total serum IgE of all sera was determined by the double antibody radioimmunoassay of Gleich, Averbek and Swedlund (1971).

*Specific IgE and IgG against *A. fumigatus**

The polystyrene tube radioimmunoassay technique was used to demonstrate IgE and IgG antibodies against *A. fumigatus* and has been described previously by Wang *et al.* (1978).

Precipitin reactions

Precipitins against *Aspergillus* antigen were determined by the double-gel-diffusion technique of Ouchterlony (1958).

Results

Mould counts in the Chicago area

The average monthly total mould counts in the Chicago area for the years 1976

Table 1. Criteria for diagnosis of ABPA

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- | | |
|----|--|
| 1. | Positive prick test to <i>A. fumigatus</i> |
| 2. | Increased total serum IgE (more than 2,000 ng/ml) |
| 3. | History of pulmonary infiltrates |
| 4. | Central bronchiectasis |
| 5. | Positive precipitins to <i>A. fumigatus</i> |
| 6. | Elevated specific IgE and IgG antibodies against <i>A. fumigatus</i> * |
| 7. | Asthma |
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* Compared with *A. fumigatus* prick positive asthmatics without evidence for ABPA (Wang *et al.*, 1978).

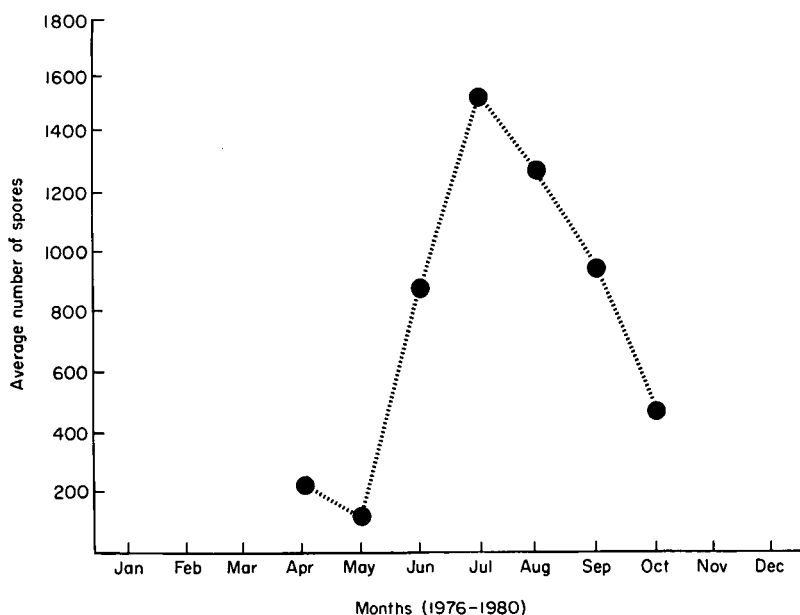


Fig. 1. Average total monthly mould counts in the Chicago area from 1976 to 1980 inclusive.

through 1980 are presented in Fig. 1. Mould counts before April and after October of each year were not available because climatologic conditions did not favour significant outdoor mould growth because of sub-freezing temperatures.

Seasonal relation of ABPA exacerbations

Flares of ABPA were concentrated between July and November (Fig. 2). A total of forty-nine flares during the 5-year period, 1976 to 1980, occurred in nineteen patients. Thirty-eight (77.5%) of those flares were between June and November. One patient accounted for six flares during that period: 11/77, 7/78, 9/78, 11/78, 8/79, 12/79. Two newly diagnosed cases presented with symptomatic pulmonary infiltrates in August and October, 1980, respectively. They are included in Fig. 2.

Discussion

Allergic bronchopulmonary aspergillosis is thought to be caused by an immune response to the *A. fumigatus* antigens (Rosenberg *et al.*, 1977). It has been suggested as an immunopathogenic mechanism that the organism colonizes the airway of the asthmatic, probably using bronchial mucous as a culture medium (Patterson, Rosenberg & Roberts, 1976). The antigens released from the organism stimulate several immune reactants of the host—IgE, IgG and IgA and lymphocytes (Forman *et al.*, 1978). The immunologic mechanisms thought to contribute to the pathogenesis of ABPA include IgE, IgA and IgG antibodies to *A. fumigatus*, (Patterson *et al.*, 1980, 1979), complement activation by both the classic and alternative pathways (Geha, 1977; Marx & Flaherty, 1976) and cell-mediated immunity (Rosenberg *et al.*, 1977). The inhalation of spores of *A. fumigatus* during high seasonal concentrations of mould sporulation appeared to relate to exacerbations of ABPA. This association is consistent with exacerbations of ABPA and increases in total mould counts reported

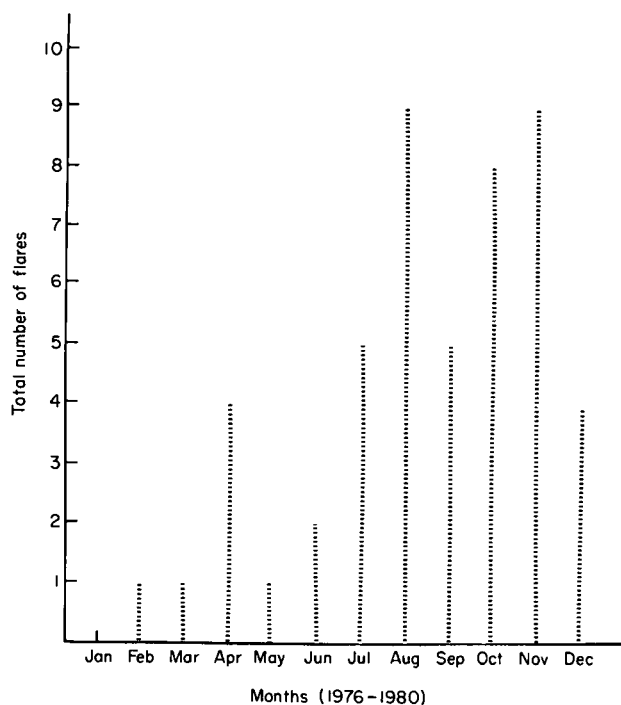


Fig. 2. Total number of flares of ABPA in any given month between 1976 to 1980 inclusive.

by Pepys (1969) in the U.K. where the mould season peaks during the winter months. Saferstein *et al.*, (1973) has reported an increase in asthma symptoms, pulmonary infiltrates and prednisone doses in patients with ABPA during these months of high mould concentrations. In contrast, the peak mould season in the upper mid-western U.S.A. is during the summer months with a marked reduction in spore burden once freezing weather occurs. Interestingly, Solomon, Burge and Boise (1978) have reported much lower recoveries of *A. fumigatus* within and outside of the University of Michigan Hospital when compared with the findings of Noble and Clayton (1963) in London and Cardiff. Further, only a slight increase in outdoor *A. fumigatus* counts were demonstrated during summer months in south-east Michigan by Solomon *et al.* (1978) compared with winter recoveries.

We have demonstrated an increase in ABPA flares during the summer and fall months, although two flares occurred in February and March in the 5-year observation period. This may be attributable to the concentrations of *A. fumigatus* in the home. Solomon (1976) has detected species of *Aspergillus* in the winter in forty-seven of 150 homes in Michigan. Certainly, the host immunologic response to antigens of *A. fumigatus* in the bronchi is important in development of new pulmonary infiltrates in ABPA as suggested by Vernon and Allan (1980), who found similar personal environmental exposure to sources of *A. fumigatus* in eight patients with ABPA and five atopic control patients.

The occurrence of ABPA flares in association with the total mould counts confirms earlier reports from the U.K. and emphasizes the necessity for close observation of patients with ABPA, especially during months of high mould sporulation. Following

the total serum IgE level monthly has been shown to be a valuable indicator of disease activity in ABPA and often increases before pulmonary infiltrates occur (Rosenberg *et al.*, 1977, 1978).

Acknowledgments

This work was supported by USPHS Grant AI 11403 and the Ernest S. Bazley Grant.

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