Factors influencing the clinical presentation of hypersensitivity pneumonitis in pigeon breeders in Minia governorate: an Egyptian experience

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Abstract

Background: Bird fanciers’ lung (BFL) is a very famous type of hypersensitivity pneumonitis (HP) produced by airborne exposure to avian antigens. Immunological response and duration of exposure to the avian protein increase the risk of developing BFL. The current study investigates the risk factors and the clinical characteristics of BFL in pigeon breeders. This study aimed to determine the risk factors and clinical characteristics of HP in pigeon breeders.

Results: This cross-sectional observational study included 67 hypersensitivity pneumonitis patients with a history of pigeon breeding. Patients were subjected to history taking (age, smoking history and duration, and type of exposure to birds), clinical examination, chest X-ray, high-resolution computed tomography (HRCT), oxygen saturation, and spirometry.

Most of BFL patients were females (83.6%) and non-smokers (86.6%). Breathlessness, cough, fever, and crackles were the most common findings. Sweeping for birds was associated with more reduction of forced vital capacity (FVC) (p value 0.02). Patients who were exposed in closed places had a rapid onset of symptoms (p value 0.01).

Conclusion: In this study, most of the patients with BFL are females and non-smokers. Sweeping for birds and exposure in closed areas are important risk factors of HP in BFL.

Keywords: Hypersensitivity, Pneumonitis, Pigeon, Bird breeders

Background

Hypersensitivity pneumonitis (HP) is an induced, non-immunoglobulin E (IgE)-mediated immunologic lung disease resulting from recurrent exposure to a variety of inhaled organic dust [1].

Bird fanciers’ lung (BFL) is one of the common causes of hypersensitivity pneumonitis [2]. It is an immunologically mediated lung disease caused by inhalation of bird dropping extracts and antigens in feathers [3]. A clinical prediction rule can help accurate diagnosis of active HP [4].

Immunological response and duration of exposure to the avian protein increase the risk of developing BFL [5]. HP is less frequent in smokers than in nonsmokers [6]. There was a significant relation between heavy exposure and case deterioration [7].

Avian antigens are complex proteins found in the feathers, droppings, and serum of turkeys, chickens, geese, ducks, parakeets, parrots, pigeons, doves, and love birds. Immunoglobulins are released from both birds’ feathers and intestinal mucin which is largely produced by flying birds such as pigeons and parakeets [8].

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Although bird breeding at houses in Egypt is a common practice, yet there is a paucity of studies that assess the bird fanciers’ lung among Egyptians particularly in Upper Egypt. Therefore, the objective of this study was to determine the risk factors and clinical characteristics of hypersensitivity pneumonitis in pigeon breeders in Egypt.

Methods

Study design

This cross-sectional observational study enrolled 67 patients with HP randomly selected from patients who sought medical advice in the outpatient clinics of the Chest Department of Minia Cardiothoracic University Hospital during the period from May to November 2018.

The study was approved by the Faculty of Medicine Ethics Committee, Minia University. All patients provided written informed consent.

Study population

The study participants were patients consulting the chest outpatients’ clinic in Minia University Hospital throughout the study period. The total number of patients during the study period was 70 hypersensitivity pneumonitis patients, of whom 3 patients refused to participate in the study, leaving 67 patients with a response rate of 95.7%. The inclusion criteria in the study were patients with a history of breeding of birds and confirmed diagnosis of hypersensitivity pneumonitis according to these criteria [9]: evidence of exposure to a provocative antigen, HRCT scan shows “classic” features (e.g., small centrilobular nodules, ground-glass attenuation, and lobular areas of decreased attenuation and vascularity [10]) and bronchoalveolar lavage (BAL) lymphocytosis > 40%.

Inclusion criteria were as follows:

1. Patients with significant exposures, e.g., those who work in stone cutting, cement industries, or any other exposures known to affect the lung parenchyma.
2. Chronic obstructive pulmonary disease.
3. Patients with significant clinical or laboratory evidence of connective tissue diseases.
4. Patients with typical usual interstitial pneumonia (UIP) pattern in HRCT especially basal sub-pleural honeycomb appearance.

A structured interview questionnaire was designed and included inquiries about sociodemographic characteristics of the participants, smoking history, detailed history of breeding of birds, and general and respiratory symptoms.

Patients were subjected to clinical examination. Chest X-ray, high-resolution chest computed tomography (HRCT), and oxygen saturation (O2 sat) were done. Spirometry and bronchodilator reversibility were performed using a spirometer (ZAN 300, Germany) according to the American Thoracic Society Standard [11]. Forced expiratory volume in one second (FEV1)% predicted, forced vital capacity (FVC)% predicted, and FEV1/FVC% were measured.

Statistical analysis

Data entry and analysis were all done using software called SPSS for windows version 22.

Quantitative data were presented by mean and standard deviation, while qualitative data were presented by frequency distribution. Chi-square test was used to compare between proportions. Student t test was used to compare between means of two groups.

Pearson correlation analysis was used to describe the association between numerical variables within each group.

A statistically significant level was considered when p value was less than 0.05.

Results

This study includes 67 patients, whose ages ranged between 15 and 65 years with a mean of 38.12 ± 13.07 years. Almost 83.6% of the patients were females, and the majority of them, 86.8%, were non-smokers. Over 90% of the patients had no family history of HP. About 71.6% of patients were sweeping for pigeons with a mean duration of exposure of 53.92 ± 66.1 months.

The mean interval from initiation of exposure until symptoms was 16.41 ± 10.8 months (Table 1).

Cough and dyspnea were the most common clinical symptoms (97% and 94% respectively), and nearly 76.1% had grade II dyspnea at diagnosis. On clinical examination, basal crepitations were heard on more than half (52.2%) of patients (Table 2). Restrictive ventilatory impairment was the most frequent functional pattern (86.6%) (Table 2).

The most frequent radiologic finding was basal veiling in 4/40 (35%) of patients. Common chest CT features were ground-glass areas and a mosaic pattern (61%) (not shown in tables).

Patients who had a history of exposure to smoking had a better FVC (61.6 ± 16.9) compared to those of whom had never exposed (48.7 ± 17.8) (Table 3).

When comparing the pattern of exposure, it was found that patients who were exposed in closed places had a more rapid onset of symptoms after exposure than those who were breeding in open areas (11.39 ± 10.9 vs 22.8 ± 20.21) respectively. However, there were no statistically significant
differences between the two patterns of exposure as regards FVC, grades of dyspnea, and O2 saturation (Table 4).

Regarding sweeping, it was found that patients who sweep had a more rapid onset of symptoms after exposure than those who not sweep (12.6 ± 4.4 vs 16.3 ± 6.4) respectively. Additionally, patients who had a history of sweeping for birds had a significant reduction in their FVC compared to those who never sweep for birds (53.18.8 ± 18.8 vs 60.3 ± 2.31). There were statistically significant differences between the two groups as regards the grades of dyspnea (Table 5).

### Table 1 Demographic and epidemiological data

| Variables                              | Number (%)       |
|----------------------------------------|------------------|
| **Age**                                | 15–65, 38.12 ± 13.07 |
| **Gender**                             |                  |
| Male                                   | 11 (16.4%)       |
| Female                                 | 56 (83.6%)       |
| **Smoking status**                     |                  |
| None smoker                            | 58 (86.6%)       |
| Ex-smoker                              | 9 (13.4%)        |
| Current smoker                         | 0 (0%)           |
| **Biomass exposure**                   |                  |
| No                                     | 29 (43.3%)       |
| Previous exposure                      | 30 (44.8%)       |
| Current exposure                       | 8 (11.9%)        |
| **Passive smoking exposure**           |                  |
| No                                     | 45 (67.2%)       |
| Yes                                    | 22 (32.8%)       |
| **Family history of HP**               |                  |
| Yes                                    | 4 (6%)           |
| No                                     | 63 (94%)         |
| **Duration of exposure to birds (month)** | 3–240, 53.92 ± 66.1 |
| **Place of exposure**                  |                  |
| Closed place                           | 28 (41.8%)       |
| Open place                             | 39 (58.2%)       |
| **Sweeping for pigeons and birds**     |                  |
| Yes                                    | 48 (71.6%)       |
| No                                     | 19 (28.4%)       |
| **Other species of birds in association** | 56 (83.6%)     |
| Yes                                    |                  |
| No                                     | 11 (19.4%)       |
| **Interval from initiation of exposure until symptoms (months)** | 1–60, 16.41 ± 10.8 |

Data presented as no.%, range and mean ± SD

HP hypersensitivity pneumonitis

### Table 2 Symptoms, physical examination, and pulmonary function tests

| Variable               | Number (%)       |
|------------------------|------------------|
| **Symptoms**           |                  |
| Cough                  | 65 (97%)         |
| Dyspnea                | 63 (94%)         |
| Flu-like symptoms      | 43 (64.2%)       |
| Wheezing               | 44 (65.7%)       |
| Fever                  | 14 (20.9%)       |
| Loss of weight         | 6 (9%)           |
| **Physical examination** |                 |
| Basal crepitation      | 35 (52.2%)       |
| Diffuse crepitation    | 4 (6%)           |
| Wheezes                | 6 (9%)           |
| Digital clubbing       | 4 (6%)           |
| **Pulmonary function** |                  |
| Restrictive pattern    | 58 (86.6)        |
| Normal                 | 9 (14.3)         |

Discussion

Reed et al. were the first to diagnose pigeon breeder’s lung [12]. A noninvasive testing like antigen exposure, recurrent symptoms after exposure, inspiratory crepitations, and weight loss could have a high probability of 98% of diagnosing HP, so BAL or lung biopsy would be unnecessary for the confirmation especially with consistent HRCT findings [13].

In the present study, all the diagnosed subjects gave a significant history of exposure to pigeons. The mean age was 38.12 ± 13.07 which is younger than most previous studies. In a large Spanish study of 86 BFL [5], the mean age was 47 years.

Moreover, Selman et al. [14] reported similar results where the mean age of BFL patients was 49 years.

### Table 3 Effect of smoking and biomass exposure on FVC and FEV1

| Exposure to smoking | FVC       | FEV1       |
|---------------------|-----------|------------|
| No                  | 48.7 ± 17.8 | 54.8 ± 18.5 |
| Yes                 | 61.6 ± 16.9 | 63.7 ± 15.9 |
| p value             | 0.02      | 0.1        |

| Biomass exposure    | FVC       | FEV1       |
|---------------------|-----------|------------|
| No                  | 56.8 ± 16.3 | 60.0 ± 18.2 |
| Yes                 | 51.87 ± 19.6 | 56.86 ± 17.4 |
| p value             | 0.3       | 0.6        |

Data presented as mean ± SD

FVC forced vital capacity, FEV1 forced expiratory volume in first second
The close contact to birds of which sweeping is the most prominent feature in Egypt could be considered one prominent factor of rapid and early onset of the disease, so the presentation occurs at younger age.

High proportion of disease among females is anticipated as they spent more time at home. In confirmation of that, the current study found that 56 (83.6%) of patients were females. Several studies found the same finding [5, 10, 14]. Also, in our community, women are usually more concerned with caring and sweeping for birds as a part of their daily activities.

As regards smoking history, 58 (86.6%) of our patients were nonsmokers. This could be attributed to the predominance of females in the current study where smoking habit is rare in Egyptian community. Similarly, Selman et al. reported that 83% of BFL were never-smokers [13]. Also, in a large Spanish study, 78% of BFL patients were non-smokers [5]. The incidence of HP in non-smokers is higher than smokers, as smokers had a lower level of expression of immunostimulatory molecules such as peripheral membrane protein B7 on their alveolar macrophages [15].

As shown in the results, most patients were not exposed to biomass fuel and this can be explained in two ways, first is the decreased use of biomass fuel in general in our community and the other may be the same biologic effect of smoking on macrophages. Hirschmann et al. [16] reported that heredity may play an important role in HP, with families positive for HLA-DR7, HLA-B8, and HLA-DQw3 showing a stronger predisposition.

We also found that 7.7% of patients had a positive family history of HP. As regards the clinical manifestation of HP in our study, 63 patients (94%) presented with dyspnea, and 65 (97%) patients presented with cough. Physical examination revealed crackles in 58.2% of patients. Finger clubbing was observed in 6% of patients. In the same line, Morell et al. [5] found that 98% of patients presented with dyspnea, 82% presented with cough, and only 7% had finger clubbing. Contrary, Sansores et al. [17] found a larger percentage (51%) of clubbing in BFL.

A restrictive pulmonary function is almost the case in BFL, but sometimes, patients had normal pulmonary functions after resolution of acute stage [18].

In the present study, 9 (14.3%) had normal pulmonary functions.

Tsutsui et al. [19] found a more rapid deterioration in clinical and functional state in BFL cases exposed to a

### Table 4 Effect of the pattern of exposure on different clinical and functional parameters

| Variables                                | Pattern of exposure | p value |
|------------------------------------------|---------------------|---------|
|                                         | Closed place        | Open place |     |
| Duration of symptoms (months)            | 51.6 ± 67.56        | 30.7 ± 57.27 | 0.2 |
| FVC                                      | 48.13 ± 20.94       | 57.8 ± 15.47 | 0.09 |
| Oxygen saturation                        | 95.5 ± 2.35         | 96.1 ± 2.26 | 0.4  |
| Interval from initiation of exposure until symptoms (months) | 11.39 ± 10.9 | 22.8 ± 20.21 | 0.01 |
| Dyspnea grade                            |                     |           |     |
| Grade 2                                  | 24 (85.7%)          | 27 (77.1%) | 0.4  |
| Grade 3                                  | 4 (14.3%)           | 6 (17.1%)  |       |
| Grade 4                                  | 0 (0%)              | 2 (5.7%)   |       |

**FVC** forced vital capacity

### Table 5 Effect of the sweeping on different clinical and functional parameters

| Variables                                | Sweep | p value |
|------------------------------------------|-------|---------|
|                                         | Yes   | No      |     |
| Duration of symptoms (months)            | 41.4 ± 63.4 | 6.89 ± 1.4 | 0.02 |
| FVC                                      | 53.6 ± 18.8 | 60.3 ± 2.31 | 0.02 |
| Oxygen saturation                        | 95.7 ± 2.2 | 98.0 ± 0.2 | 0.01 |
| Interval from initiation of exposure until symptoms (months) | 12.6 ± 4.4 | 16.3 ± 6.4 | 0.008 |
| Dyspnea grade                            |       |           |     |
| Grade 2                                  | 32 (72.7%) | 19 (100%) | 0.04 |
| Grade 3                                  | 10 (22.7%) | 0 (0%)   |       |
| Grade 4                                  | 2 (4.5%)  | 0 (0%)   |       |

**FVC** forced vital capacity
higher concentration of avian antigens collected from their household environments. This gives a clear explanation for two significant findings in the present study which are as follows: first, the more rapid onset of symptoms after the onset of exposure in patients who were exposed to pigeons in closed areas than those breeding in open areas (p value 0.01), and second, the significant reduction in FVC%, O2 saturation, increase in dyspnea grade, and more rapid onset of symptoms after exposure in patients who had a history of sweeping for birds (p value 0.02, 0.01, 0.04, and 0.008 respectively) which is also a common habit in our community.

Conclusion
In a study of HP in bird breeders in Minia governorate, Egypt, most of the patients were young-aged females and non-smokers.

Sweeping for birds which is a common habit among Egyptian females especially in upper Egypt is an important risk factor of developing more rapid, early symptoms, long duration of symptoms, and functional deterioration of HP in Egyptian bird fanciers.

Our study is limited by its small number of patients. An accurate quantification of avian antigens is required for the future management of BFL.

Supplementary information
Supplementary information accompanies this paper at https://doi.org/10.1186/s43168-020-00019-w.

Additional file 1: STROBE checklist.

Abbreviations
BFL: Bird fanciers lung; HP: Hypersensitivity pneumonitis; HRCT: High-resolution computed tomography; FVC: Forced vital capacity; IgE: Immunoglobulin E; BAL: Bronchoalveolar lavage; O2 sat: Oxygen saturation; FEV1: Forced expiratory volume in one second

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Authors’ contributions
NM collected the patients’ data and revised the methods and results. ZS conceived the publication design and prepared the manuscript. EG performed the statistical component. All authors have read and approved the final manuscript.

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Ethics approval and consent to participate
This study was approved by the hospital’s research ethics board of Minia University, and informed consent was obtained from either patients themselves or their relatives. Committee’s reference number not available.

Consent for publication
Not applicable

Competing interests
No competing interests

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