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Acarofauna of dwelling and sensibilization to allergens of house dust mites among patients with asthma

Key words: bronchial asthma, house dust mite, specific IgE to the components of mite allergens.

Bronchial asthma (BA) remains nowadays an urgent issue of medicine, whereas, despite the expansions of notion regarding this disease nature, development of new possibilities of therapy, the results of treatment leave much to be desired. According to results of many foreign and domestic researches, which analyzed the reasons for the lack of control over BA in certain patients, it can be stated that this situation is largely caused by rising trigger load. [5, 15, 16]. It has been proved nowadays that major trigger factor of asthma exacerbation is household dust. The first mention of the house dust as a cause of allergy symptoms dates back to 1923. House dust is multi-component by its allergen composition; its allergic profile is determined by mite-borne, fungal, epidermal, chemical and other components [3, 11, 16]. Therefore, patients with asthma showed hypersensitivity towards both mixed house dust allergen and its individual components. In 1964, Dutch professor R. Voorhst together with his employees proved the existence of cause-effect relations between house dust mites and the development of human allergic diseases [12]. Since then, the problem of allergies to house dust mites has not lost its topicality. Moreover, it has been proved nowadays that the most powerful allergenic factor of the household dust is namely mite allergen. The study of the problem of allergies to dust mites is done not only by health professionals but also biologists, since this problem involves two aspects: acarological and immunological [5, 8, 14, 17, 19, 21].

World fauna of the house dust mites amounts to above 150 species [9, 12]. However, it has been proved that the main

source of allergens is a family of mites *Pyroglyphidae*. The dominant position in acarocenosis of the house dust mites is usually taken by the mites of *Pyroglyphidae* – *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae* families. They both are widely spread geographically, however, *Dermatophagoides pteronyssinus* exists only in house dust though *Dermatophagoides farinae* may also occur in chaff, flour, etc. The mites of family *Acaridae* occupy the second place after *Pyroglyphidae* according to the detection rate and quantity in house dust acarofauna; their allergens can also trigger allergic disease development [8, 11, 18].

The situation described above necessitates studying the structure of house dust acarocomplexes in different regions that allows assessing the mite allergens exposure in the immediate human environment. The comparative analysis of the acaric studies results conducted around the world indicates that house dust acarocomplex has a regional specific character [1, 7, 9, 11]. However, the identification of mite-borne allergens in house dust samples allowed proving that even the number of mites in apartments of patients with asthma reaches 165 mg/g [8, 14]. In Ukraine faunal studies of house dust mites were conducted only in the Zaporizhzhia region, where they found their 8 species: 4 species of *Pyroglyphidae* (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Euroglyphus longior*, *Euroglyphus maynei*), 1 species of *Glycyphagidae* (*Glycyphagus domesticus*), 1 species of *Acaridia* (*Acarus siro*), 1 species of *Cheyletus* (*Cheyletus eruditus*) and 1 species of acaroidea (*Proctolaelaps domestica*) [2, 8, 13].

A scientific interest in the problem of allergy to house dust mites makes it possible to create a series of works, which confirmed its role in the manifestation of asthma in most patients [3, 5]. Advances in the field of recombinant allergens led to the development of a new concept for allergy diagnostics – diagnostics based on allergen components or allergy molecular diagnostics.

Currently, scientists have discovered and characterized a large number of allergen components from different sources and their list in the course of scientific advances is constantly growing. In particular, there have been distinguished components of dust mites allergens *Dermatophagoides pteronyssinus* (*Der p1*, *Der p2* i *Der p10*), *Dermatophagoides farinae* (*Der f1*, *Der f2*) [4, 19]. The distinguished allergen components differ from each other by their ability to bind antibodies, particularly immunoglobulin E, which laid the basis for division of mite allergens components into the main (or major) (IgE-antibodies to them are found in 50 % of sensitized people) and secondary (or minor) (IgE-antibodies are found in less than 10 % of patients) [10, 16].

The research conducted recently in Lviv region showed that house dust mites allergens are one of the most significant factor for patients with asthma. Whereas, the fauna of house dust mites in Lviv city has not been studied.

Therefore, the situation described above defined the topicality and aim of the research.

Aim of the research is to study regional peculiarities of dwelling acarofauna and to estimate level of sensibilization to house dust mites among asthmatic people.

Study materials and methods. To study the structure of house dust mites acarocomplex in October-November 2014 in Lviv city there were examined 30 apartments. Asthmatic patients resided in 23 apartments and in other 7 (control group) there resided healthy people. While selecting apartments for study the following characteristics were taken into account: type of building, its area (number of rooms), number of dwellers, presence of pets and mould. According to the above said features, the apartments of healthy and ill dwellers were identical.

In the course of study, we have analyzed household habits of the dwellers: age of soft furniture, frequency of wet cleaning, handling with vacuum cleaner of bed and carpets etc. The dust in each apartment was collected in three biotopes: pillow, mattress and blankets. As a basis for study there was taken a method of household dust collecting suggested by O.V. Dubinina and B.D. Pletniyov [5]. Subject to the instructions received the residents collected house dust with their own vacuum cleaners. For this purpose a piece of fabric was inserted between the vacuum cleaner tubes and each sample was collected during 5–10 minutes of cleaning. The obtained samples of dust were placed in jars with tightly closed plastic lid. To expose the mites the method of acarian analysis was applied, which currently remains the «gold standard» in the mites load assessment [13]. During the study there were made 24 regular medications in which mites were kept in Canadian balsam. Number of mites in the sample was expressed by a number of specimens per 1 gram of dust. Analysis of the results was performed by the following parameters: species detection rate in the premises under study

(in %), the percentage of species records in the total number of mites species (in %).

To estimate house dust mites sensibilization rate of people with asthma there have been analyzed 899 outpatients who were under observation for 5 years (2010–2014) by allergological office of Advisory Clinic of Lviv Regional Clinical Hospital.

Determination of specific IgE to mite allergen components was conducted by means of fluorescent method by using the device of ImmunoCAP 100 (manufacturer PhadiaAV, Uppsala, Sweden). It is known that the selection of components for allergen diagnostic tests should be based on the clinical medical record of a patient. Based on the fact that the dominant position in acarocenosis of house dust mites belongs to *Dermatophagoides pteronyssinus*, we conducted determination of specific IgE to his major component of *Der p1* and to minor allergenic component of house dust mites – tropomyosin (*Der p10*). Performance measured in specific units - kU/L, considered normal value < 0,35 kU/L. The indices were measured in specific units – kU/L, the indices < 0,35 kU/L were considered normal.

Results

Based on many studies conducted in recent years in different countries, it is proved that the internal environment of the home, where the patient spends most of his life, should be considered as a factor that significantly influences the development of asthma [3, 14].

We have studied the structure of household dust acarocomplex in 30 apartments; all of them were located in similar houses. Almost half (46,7 %) of the families had poor housing conditions (old building, high humidity, total area per person is less than 10 m²). Residential rooms were equipped with central or individual gas heating. Repair works had done above 5 years before by 47,8 % of families suffering from asthma and 42,86 % of families from the control group.

To study the structure of house dust acarocomplex in every apartment the dust was collected there in three biotopes: pillow, mattress and blankets. Totally there were received 70 samples of the dust.

During residing premises examination there was found dust mites fauna represented by 3 species belonging to 2 genera, 2 families and 1 order:

Order Acariformes, suborder Astigmata

1. *Family Pyroglyphidae (Dermatophagoides pteronyssinus* Trouessart, 1897; *Dermatophagoides farinae* Hughes, 1961);

2. *Family Acaridae: (Tyrophagus longior).*

Dermatophagoides pteronyssinus and *Dermatophagoides farinae* predominated in number and by prevalence over all other *Pyroglyphidae* species found in the house dust in Lviv city. The first species was detected in 72,8 % of the dust samples and the second – in 21,4 %. Though, *Dermatophagoides Pteronyssinus* prevailed over *Dermatophagoides Farinae* in number and prevalence.

It is known that *Pyroglyphidae* mites usually inhabit bed, wall carpets, soft furniture, carpets, etc. However, the main biotope for them is bedclothes in particular, where their number could reach 30,000 specimens per 1 gram of dust. According to some recent data, *Dermatophagoides*, found

in the fauna of bedclothes, may reach 92% of the total number of all mites [5, 6, 12]. In our studies *Dermatophagoides* mites in the same biotope reached 96,1 % of the total number of mites. It is known that the main factors affecting the population of mites are humidity and air temperature. The optimal humidity content, suitable for mite reproduction constitutes 60 % at the temperature of 21°C and by 75 % at 16 °C. Thus, the most convenient microclimate for *Dermatophagoides* mites is created in bed as there are the least temperature and humidity fluctuations in comparisons with other biotopes. Especially favorable conditions for mites development is found in feathers and wool, which absorb well moisture and retain heat.

In these environments, relevant humidity increases by 2–8 % reaching 82 % and temperature ranges from 25°C to 34°C. In addition, the house dust by its nature is a loose hygroscopic substrate that is well aerated and thus the air contacting with it is more humid. For example, if the relative humidity in the room is 40 %, it rises to 70–90 % in the dust [8, 12]. Moreover, in addition to humidity and temperature, food factor also limits significantly the growth of mites' population. It is believed that the main source of food for *Dermatophagoides* mites is dead epidermis particles which are found mostly in bedclothes.

The analysis of house dust acarocomplex of each apartment revealed the fact that mites were found in 52,17 % of the observed apartments which belonged to patients with asthma and in 28,57 % of healthy people apartments. Most frequently, in 39,13 % of cases (9 out of 23 apartment), there was found only one mite species, namely *Dermatophagoides pteronyssinus*. It is well known that this synanthropic cosmopolitan species exists together with other types of mites, though it always predominates in number and prevalence. According to our research results, the number of mites *Dermatophagoides pteronyssinus* depends on biotope. In particular, samples of dust from mattress showed the number ranging from few individuals to 123 specimen/g, samples of pillow dust contained from 3 to 18 individuals, while in samples from blankets there were met only singular specimen.

The second *Pyroglyphidae* species of *Pyroglyphidae farinae* was found in 3 apartments only, moreover, in two apartments it was discovered together with other mites (*Dermatophagoides pteronyssinus* i *Tyrophagus longior*). In the meantime it should be noted that the number of *Dermatophagoides farinae* and *Tyrophagus longior* was rather inconsiderable.

In the healthy people apartments, the house dust comprised singular mites of *Dermatophagoides pteronyssinus*.

The studies have shown that some patients were collecting dust in bad faith. Moreover, the fabric from one apartment contained neither dust, not even a trace of vacuum cleaner tube. This situation necessitates more broad educational work with patients.

To estimate the rate of mite allergens sensibilization of people with asthma there have been analyzed 899 medical records of the outpatients who were undergoing specific skill allergy testing for 5 years by allergological office of Advisory Clinic of Lviv Regional Clinical Hospital. In the course of skill allergy testing, high sensitization to house dust mites was found as a result in 78,8 % of the patients.

Determination of specific IgE to mite allergen components was conducted in 36 patients with asthma by which there have registered hypersensitivity to mite allergens under the skin allergy test. Increasing of specific IgE indices (above 0,35 kU/L) to the major component of *Dermatophagoides pteronyssinus* (*Der p1*) was found in 26 (72,22 %) patients. Moreover, in 9 (25,0 %) patients the levels of specific IgE *Der p1* was higher 50 kU/L, and among them above 100 kU/L was found in 5 (13,89 %) cases. Meanwhile, the indices of specific IgE to minor allergen component of house dust mites, tropomyosin (*Der p10*), were kept at standard values in all examined patients. Thus, the conducted immunological tests proved the dominant role of *Dermatophagoides pteronyssinus* allergens in the development of allergy to mites in asthmatic patients.

Thus, the performed by us acararian examination of residential premises in Lviv city found that structure of house dust acarocomplex is characterized not only by general features but also it has individual regional peculiarities, which are reflected in their taxon composition, proportion of different taxa, their prevalence and strength.

Likewise in many countries of the world, mites family *Pyroglyphidae* completely prevails over other species in house dust of the apartments in Lviv. The detection rate and specific weight of *Pyroglyphidae* mites is consistent with similar study results conducted in several cities of Russia and Ukraine (Zaporizhzhya). The occurrence of mites in house dust of the apartments with asthmatic dwellers gives evidence of existence of powerful allergenic background in these apartments.

Our studies suggest that sensitization level to specific allergens depends on the load made by these allergens. Analysis of the sensitization detection rate to mite allergens conducted on the basis of skin testing and molecular allergy component testing methods allows to confirm this assumption. In addition, the study of house dust mites acarocomplex structure provides basing of algorithm for introduction of house dust mites combating measures.

The received data should serve as a prerequisite for creation of much broader diagnostic panel of allergens. Thus, in Lviv city in particular, during allergy testing it is reasonable to use *Tyrophagus longior* mite allergens apart from allergens of *Dermatophagoides pteronyssinus* and *Dermatophagoides farina*.

Conclusions

1. House dust mites are found in 52,17 % apartment with asthmatic dwellers.
2. Species of mites *Dermatophagoides pteronyssinus* dominates in number and occurrence rate in the house dust of Lviv apartment as it was found in 72,8 % of dust samples.
3. A wide spread occurrence of mites in the house dust of asthmatic dwellers' apartments gives evidence of the powerful allergenic background existence which is proved by positive results of 78,8 % patients who have undergone skin allergy testing by mites allergens.
4. Increasing of specific IgE indices to the major component of *Dermatophagoides pteronyssinus* (*Der p1*), which was found in 72,22 % patients proved the dominant role of this species allergens in the development of allergy to mites in asthmatic patients.

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АКАРОФАУНА ЖИЛИЩА И СЕНСИБИЛИЗАЦИЯ К АЛЛЕРГЕНАМ КЛЕЩЕЙ ДОМАШНЕЙ ПЫЛИ СРЕДИ БОЛЬНЫХ БРОНХИАЛЬНОЙ АСТМОЙ

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Резюме

Изучение структуры акарокомплекса домашней пыли проведено в 30 квартирах, в 23 проживали больные бронхиальной астмой (БА), в 7 — здоровые люди. Для оценки частоты клещевой сенсибилизации проанализированы результаты кожного алерготестирования 899 больных БА. Определение специфических IgE к компонентам клещевых аллергенов проведено у 36 пациентов. Акарологическое обследование жилищ показало, что в домашней пыли квартир г. Львова доминирует — как по численности, так и по встречаемости — вид клещей *Dermatophagoides pteronyssinus*. Высокое содержание клещей в домашней пыли свидетельствует о наличии сильного алергизирующего фона в квартирах, где живут больные БА, что подтверждено положительными результатами кожного тестирования. Повышение показателей специфического IgE к мажорному компоненту аллергена *Dermatophagoides pteronyssinus*, установленное у 72,22 % обследованных, подтверждает доминирующую роль аллергенов этого вида клещей в развитии клещевой аллергии у больных БА.

Ключевые слова: бронхиальная астма, клещи домашней пыли, специфические IgE к компонентам клещевых аллергенов.

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DOMESTIC ACAROFAUNA AND SENSITIZATION TO THE MITE ALLERGENS OF HOUSE DUST AMONG PATIENTS WITH BRONCHIAL ASTHMA

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Summary

The study of structure of acarocomplex of domestic dust was conducted in 30 apartments; including 23 were lived patients with bronchial asthma, and 7 residences of healthy people. Analysis of the results of skin allergic testing was performed in 899 patients with bronchial asthma for an estimation of prevalence of sensitization to acarid allergens. Specific IgE to the components of mite allergens was determined in 36 patients. Acarologic inspection showed predominance of *Dermatophagoides pteronyssinus* in domestic dust of Lviv apartments, both in quantity and prevalence of exposure. High content of ticks in a house dust suggested the existence of powerful allergic trigger in the place of residence of asthmatic patients that had been confirmed by positive results of skin allergic testing to acarid allergens. Increased levels of specific IgE to the major component of *Dermatophagoides pteronyssinus* allergen was found in 72,22 % of examined subjects that allowed to confirm the dominant role of allergens of this acarid type in the development of mite allergy in asthmatic patients.

Key words: bronchial asthma, house dust mite, specific IgE to the components of mite allergens.

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