Avian zoonoses - a review

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Abstract

Birds are one of the most interesting and most colourful groups of animals, but they can also be a source of zoonotic factors dangerous for humans. This paper describes the threats to human health from contact with birds. The most vulnerable occupational groups associated with birds are veterinarians, owners of poultry farms, breeders of ornamental birds, zoo personnel, and poultry slaughterhouse workers. Ornithosis is the most dangerous zoonosis of the avian bacterial diseases. Among other hazardous bacterial factors, Salmonella and Campylobacter are responsible for gastrointestinal diseases. Avian influenza is the most dangerous of the viral diseases. It should be noted, however, that avian influenza is a disease of birds, not humans. The recent threat which has appeared is infection with West Nile virus. The results of serological examinations of birds and humans indicate that the virus exists in our ecosystem. Allergic alveolitis connected with the pigeon tick and the Dermanyssus gallinae mite also merits mention. In any case, where people have contact with birds or their droppings and secretions, special precautions should be taken. This way the negative effects of birds on human health can be minimised or eliminated.

Keywords: birds, health hazards, zoonoses.

Introduction

Birds are one of the most interesting and most colourful groups of animals. According to the International Council for the Protection of Birds (Bird Life International) there are nearly 9000 bird species all over the world. Approximately 1030 species are threatened with extinction, which is close to 11% of the total population. The reason for this situation is, as with other animal species, loss of habitat, feeding, and breeding grounds. The birds which live in our ecosystem are on the one hand a very important constituent of it, and on the other hand a source of zoonotic agents dangerous for human health (31). This paper describes the threats to human health from contact with birds.

Zoonoses are infectious or parasitic diseases transmitted from animals to humans, either directly (through contact with the animal organism) or indirectly (through contact with faeces or secretions) (29). There are five transmission categories of zoonoses: direct: the pathogen is transmitted via direct or indirect contact, and does not pass through the life cycle; metazoonosis: by biological and mechanical vectors; saprozoosis: spread by the alimentary tract; cyclozoonosis: vertebrates are intermediate hosts and xenozoonosis: by transplantation of organs from infected animals.

The occurrence of zoonoses depends on a number of factors, among which are: the duration of exposure, virulence of the pathogen and its survival, route of infection and transmission, vectors, etc. Human health problems resulting from contact with birds are associated with bacterial, viral, fungal, and allergenic agents (Table 1) (2).

The most vulnerable occupational groups associated with birds are veterinarians from poultry farms, farms owners, and breeders of ornamental birds. Workers in zoological gardens and shops stocking exotic birds could be also exposed. Additionally, the operating staff of fairs and exhibitions where birds are on display, employees of the poultry meat processing industry, and people not related to poultry but having casual contact with free-living birds and poultry prepared for consumption (2, 10, 11, 37).
Table 1. Selected zoonotic agents associated with birds

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**Bacterial diseases.** One of the most important and most serious bacterial diseases is ornithosis or parrot disease (*psittacosis*). The aetiologic agent of the disease is *Chlamydia psittaci*, an organism endemic in *Psittaciformes*, but infections are also found in domestic poultry and wild birds.

Faeces and respiratory secretions of birds are the main source of infection. So far no vertical transmission of *Chlamydia psittaci* through eggs has been reported. Turkeys, ducks, and pigeons are most susceptible to infection, but parrots and pigeons are the biggest source of human infection (17, 18).

After entering the bird by the inhalation route, the microorganism propagates in the lungs, pericardium, and air sacs, and then spreads *via* blood into the liver, spleen, and kidneys. In the birds which are the greatest hazard to humans the disease can occur in mild, severe, or asymptomatic forms. Among the symptoms of the respiratory tract are purulent outflow from the nostrils and rales. There is also diarrhoea, often with blood and consequently the birds rapidly lose body weight visible symptoms may also occur in the form of ataxia.

Human infection occurs mainly by inhalation. Then the microorganism spreads through the blood to the reticuloendothelial system. The incubation period of the disease is 5-14 d. *Chlamydia psittaci* targets the lungs, heart, liver, and sometimes the central nervous system. The disease is biphasic. In the first phase, there are non-specific symptoms such as fever, chills, fatigue, myalgia, pains, and even symptoms of central nervous system effects. The second phase is dominated by respiratory system symptoms: dry cough and chest pain. In very severe cases, acute respiratory failure, sepsis, and even septic shock can occur. Death occurs in approximately in 1% of cases. It should be noted that in our study the presence of specific antibodies against *Chlamydia psittaci* was proven in 7.3 % of flocks of reproductive 5 to 22-weeks old geese, which were located in seven provinces of Poland (5).

A study done in the USA by the Centers for Disease Control and Prevention found 66 cases of *Chlamydia psittaci* infection in humans between 2005-2009 (35). According to a report by the National Institute of Public Health - National Institute of Hygiene (NIPH-NIH), two cases of ornithosis in the Lodz region and one case in Silesia were found in Poland in 2013 (40).

The use of appropriate personal protective equipment by people in contact with birds is very important in the prevention of this disease, as are also such measures as sanitising accommodation and cages for birds, and, in the case of importation, quarantine lasting between a month and a month and a half.

Another dangerous disease, known to have an avian reservoir, is salmonellosis, which has been reported in poultry since 1899. A subclinical form of the disease was described in breeding poultry, game birds, and free-living wild birds. *Salmonella* serovars are aetiological agents of the disease. Those of them pathogenic for poultry are divided into two categories: the first is serovars specific for poultry (*S. Pullorum* and *S. Gallinarum*), which are usually not pathogenic for humans and other animals but in birds cause high morbidity, carriage, and shedding; and the second category comprises serovars non-specific to birds but pathogenic for humans. The most important serovar in this category is *S. Enteritidis*. Generally the serovars in this category cause of mass infections and poisoning in humans.

Salmonellosis occurs in all species of birds of every age. The infection may occur through vertical transmission or indirect contact, when sick birds pass it to healthy birds. Infected birds-become carriers after colonisation of their gastrointestinal tract and shed the
microorganisms into the environment. Serovar S. Enteritidis is isolated most frequently from hens, chickens, and people, while S. Typhimurium is identified in waterfowl (ducks and geese) and pigeons (7, 36).

Prevention of Salmonella infection in birds is very difficult, primarily due to a long and often asymptomatic carriage. It is believed that it may last for several days or weeks and for some serovars even a lifetime.

Food, mainly poultry meat and eggs, plays the most important role in the epidemiology of salmonellosis in humans. After the incubation period, which ranges from 8 to 48 h, the infection proceeds mainly in the form of gastrointestinal catarrh (gastroenterocolitis), accompanied by symptoms such as increased body temperature, chills, and myalgia. Depending on the virulence of the bacteria, they can also produce enterotoxins (7). Among clinical symptoms, nausea, vomiting, and foul-smelling watery diarrhoea of greenish colour are observed most frequently. In addition, headache, chills, and symptoms from the cardiovascular system and urinary tract occur. A very dangerous complication of salmonellosis is bacteraemia with metastatic infections that can lead to cerebrospinal meningitis, myelitis, or endocarditis (36, 39).

According to an NIPH-NIH report and the Chief Sanitary Inspectorate, 9549 cases of food poisoning caused by Salmonella were recorded in Poland in 2010, of which 6656 (69.7%) required hospitalisation. The number of cases in 2011 was about 900 lower at 8652, including 6006 (69.4%) treated with a hospital stay.

Statistics show that the majority of cases in 2011 were recorded between June and October: 1053 in June (12.17%), 1285 in July (14.85%), 1452 in August (16.78%), 1104 in September (12.76%), and 1044 in October (12.17%). From the total number of 8652 cases, 5153 (59.55%) were reported in cities, while 3499 (40.45%) came to notice in rural areas (40).

The NIPH-NIH report also records 8267 cases in Poland in 2012, of which 5706 (69.0%) required hospitalisation. In 2013, 7407 cases were reported and hospital admission ensued in 5334 (72.0%) of them. Most cases were reported in August when there were 1150 (15.5%) and in September, a month of 1064 cases (14.4%). In 2014, the number of cases increased to 8206, and 5677 (69.2%) were hospitalised (40).

At the beginning of 2014, the European Food Safety Authority (EFSA) published a report regarding the occurrence of zoonotic diseases in 2012. The report showed that since 2006 a downward trend has been observed in the number of cases of Salmonella infections in people. In 2012, 30 countries which provided data to EFSA recorded 93 684 cases of Salmonella infections in humans, including 91 034 cases in the 27 EU countries. The average incidence rate was 22.2 /100 000 people. Compared to 2011, there was a 4.7% decrease. Sixty-one deaths were reported and 45.1% of the cases put the patient in hospital (28). According to EFSA statistics, in 2013 in the EU, 82 694 incidences of salmonellosis were recorded, and hospitals admitted 7841 people with it. There were also 59 deaths. In general, an increase in the incidence of the disease in humans by 7.9% compared to 2012 was observed. The percentage of infections with S. Enteritidis and S. Typhimurium decreased in 2013 from 1.3% to 1.0% (32).

Another dangerous disease which can be caused by birds is campylobacteriosis. The aetiological agent of the disease is a Gram-negative bacterium moving in a characteristic manner with flagellum. In poultry, there are three types of the bacterium: Campylobacter jejuni, Campylobacter coli, and Campylobacter lari, but C. jejuni is most often isolated. These bacteria are not important in avian pathology; however, they are a source of serious food poisoning in humans. The bacteria are also isolated from free-living birds, pigeons, and wild birds. It is believed that 80% of broiler flocks are infected with C. jejuni. Therefore, it is important to maintain the ideal state of bioassurance. This can be achieved by excluding mice and rats from the farm, careful disinfection of buildings and equipment, etc.

As in birds, 90% of the strains isolated from humans are C. jejuni. In people living in a temperate climate the campylobacteriosis may be a seasonal disease (spring-summer), which is contingent upon bacterial enviromental requirements (23). Human infections occur as a result of the consumption of poultry meat which has not been subjected to proper heat treatment. In cases where birds are the source of infection, the oral route plays an important role.

In humans, the disease develops in the form of stomach and intestine inflammation. After 3–6 d, these symptoms usually disappear, but in case of a longer course, antibiotics should be used. General symptoms in the form of diarrhoea, elevated body temperature, pain, enlargement of the liver and spleen, endocarditis, arthritis, and meningitis quite often appear (23). Campylobacteriosis data from the NIPH-NIH show that 375 cases were diagnosed in 2010 in Poland and 156 (41.6%) required hospitalisation. In 2011, the number of cases was lower and amounted to 354 but 204 (57.6%) cases merited the sufferer being admitted to hospital (40). According to the Institute, 431 cases were diagnosed and 247 (57.3%) were hospitalised in 2012. In 2013, the figures were 552 and 394 (71.4%), and in 2014, 654 and 487 (74.5%) respectively.

The EFSA reported that campylobacteriosis was a common zoonosis in humans in 2012 and poultry meat was usually the main source of thermotolerant campylobacter strains. A total of 1810 (23.6%) positive samples of poultry meat contaminated with campylobacter strains were found (28) in this year. In people, 215 cases of campylobacter infection were recorded in 2012. The average incidence rate was 55.49/100000 people. There were 31 deaths, of which
20 occurred in the United Kingdom (28). In 2013, 214,779 cases were recorded in European Union countries; 11,922 were inpatient cases and 56 deaths were noted (28). As for the source of the infection, the majority of infections in broiler chickens were recorded in the Scandinavian countries. In the EU, the infection was detected in 15.1% of poultry flocks and generally in 30.4% of all animals tested (32).

Another disease is colibacteriosis. The aetiological agent of the disease is *Escherichia coli*, which is a part of the physiological flora of the gastrointestinal tract. These bacteria are rather a confounding factor in birds, however, some strains are responsible for inflammation of the yolk sac, coligranulomatosis, peritonitis, and colisepticaemia. The bacteria are excreted in the faeces and thus could be transmitted by free-living wild birds, which may exist in the immediate vicinity of poultry farms and people (36). Under unfavourable conditions, a sudden proliferation of the bacteria and emergence of opportunistic infections take place. These conditions include immune deficiency, poor hygiene facilities, stress, and viral infections.

In humans, colibacteriosis may occur in the form of sepsis, infection of the urinary tract and reproductive system, diarrhoea, and inflammation of the mammary glands (12, 36). In 2010 in Poland, 794 cases of *E. coli* infection were recorded, and 610 (76.8%) of them were treated in hospital. The numbers of the cases in the following year were 650 and 503 (77.4%) respectively (40).

An often overlooked zoonotic bacterial disease is yersiniosis, also called paratuberculosis. The disease is caused by bacteria of the genus *Yersinia*, mainly *Y. enterocolitica* and *Y. pseudotuberculosis*. *Y. enterocolitica* was isolated from farmed and wild birds (gulls, terns, ducks, and starlings). These bacteria are also isolated from pigeons and sparrows (17). The source of infection is contaminated water and food. Infection from an animal or person as a result of poor hygiene or damaged skin was also reported. In humans, the disease occurs usually in the form of food poisoning, enteritis, inflammation of mesenteric and intestinal lymph nodes, etc. The bacteria may also induce pharyngitis, pneumonia, meningitis, and urinary tract infections (19, 36).

Looking at Poland again, in 2010, 206 cases occurring in the form of enteric infection were recorded, while in 2011 the case tally was 238 (40).

Taking NIPH-NIH numbers, in Poland yersiniosis was detected in 201 cases in 2012, in 199 cases in 2013, and in 216 cases in 2014. Nearly half of the cases became hospital patients each year (40). According to EFSA, in 2013 in the EU 6471 cases were reported, 481 cases were hospitalised, and 2 deaths were noted (32).

An important disease entity is listeriosis caused by *L. monocytogenes*. It usually occurs in young birds, mainly broilers. Weakness, diarrhoea, and signs of effects on the central nervous system are the main clinical symptoms of the disease. Symptoms of nervous system impairment appear also in goslings. Listeriosis in humans can occur in several forms: foetal and neonatal sepsis, infections of the central nervous system, and likewise of the gastrointestinal tract.

In Poland, 49 cases of the infection were detected in 2012, 54 cases in 2013, and 81 cases in 2014. Almost all of these cases required hospitalisation and 8 people died (40). According to the EFSA, in 2013 1763 cases of listeriosis were detected in the EU and 191 deaths were recorded. Overall, the EU showed an increase (by 8.6%) in the number of cases of listeriosis in 2013 compared to 2012 (32).

The last bacterial zoonotic disease discussed in this paper is erysipeloid. It is caused by a Gram-positive microorganism *Erysipelothrix rhoduisopathiae*. The bacterium is very resistant to environmental factors, as well as to meat curing, smoking, and salting. Pigs are the primary reservoir of the bacterium, but quite often it is isolated from birds (geese, ducks, and turkeys). The infection in poultry may be at any age, but reported cases have usually concerned older birds. Infected birds are carriers for several weeks after infection. It is believed that the birds are asymptomatic carriers and expel the bacteria with faeces into the environment.

Humans are infected among other ways, by wounds, abrasions, skin, or by oral and inhalation routes. Following infection, the clinical symptoms in humans may be in the form of a rose-coloured skin infection or sepsis. This symptom mostly presents as focal inflammation of the fingers. The septicaemic form occurs very rarely and usually in people with immune defects (22).

**Viral diseases.** In addition to the above mentioned bacterial diseases, particular emphasis should be put on viral diseases, among which avian influenza is the most dangerous.

Influenza viruses in humans and animals belong to the *Orthomyxoviridae* family. Three types - A, B, and C are distinguished, but the type A viruses are the most important. They infect both animals and humans (8). The pathogenicity of influenza viruses results from their significant antigenic variation. There are two types of variation: antigenic drift and antigenic shift. Antigenic shift is the formation of small changes in the segments encoding surface antigens. They appear as a result of new antigenic variants of the virus. Antigenic drift occurs when the host cell is simultaneously infected by two different viral strains. This causes an exchange of genetic material between the viruses. As a result, 256 progeny strains can potentially develop (3, 34).

Avian influenza A viruses are isolated from domestic, wild, and ornamental birds. The most sensitivity to infection occurs in turkeys, chickens, and other gallinaceous poultry. It is believed that wild birds are the natural reservoir of the virus, and most notably these four avian orders: *Anseriformes, Ciconiiformes,*
Gruiformes, and Passeriformes. Birds are infected horizontally (through direct contact with sick birds or infected asymptomatic birds) or indirectly through environmental contamination (30).

It should be emphasized that avian influenza is a disease of birds, not humans. It may appear among the human population as a result of poor hygiene or prolonged contact with infected birds, their secretions or excretions. Symptoms of avian influenza in people are similar to the symptoms observed during ordinary seasonal influenza. Fever, cough, sore throat, myalgia, joint pain, conjunctivitis, and parenchymal pneumonitis usually occur. However, it pursues a much more severe course than classic influenza. In recent time, the H7N9 avian influenza virus strain has gained pandemic importance (34).

According to information from the World Health Organization (WHO) dated August 12, 2013, 135 cases of avian influenza H7N9 in humans were reported, including 44 fatal cases (27). Another dangerous subtype for humans is H5N1. It appeared in 1997 on chicken farms in Hong Kong and was the first time that the virus had been transferred from bird to human. Since then, the subtype H5N1 of avian influenza virus has become endemic and spread to practically the whole world (4, 34). A WHO report sheds light on the extent, stating that between 2003 and 2015, 718 cases had been confirmed by the ECDC, to 4 September 2014, EU and 557 cases in neighbouring countries (32).

The virus is transmitted to humans by direct contact with infected birds, their secretions or excretions. The incubation period can range from 2 to 10 d. In the beginning, there are no typical symptoms such as headache, malaise, and muscle pain. In more severe cases, meningitis and encephalitis symptoms occur. Furthermore, there also are ataxia, paresis, and optic neuritis. Mortality ranges from 4% to 14%, increases with age, and is higher in people with defects of the immune system (33).

Research conducted in Poland since 1995 leads to a safe presumption that WNV already exists in our ecosystem. Using the haemagglutination inhibition test, specific antibodies were demonstrated in 2.8% of house sparrows and in 12.1% of tree sparrows between 1995 and 1996. In 2006, contact between Warsaw Zoo’s storks and WNV-infected birds was also observed (20).

Continuous monitoring of wild bird populations for infection with WNV has been carried out in the National Research Institute in Pulawy since 2009. The material is collected annually from the Polish Wild Bird Rehabilitation Centres, zoological gardens, hunting organisations, Bird Migration Research Station, and from veterinarians. So far, there has been no genetic material in the test samples, which of course does not prove conclusively that the virus is not present in wild birds. Positive ELISA results obtained during sera testing of wild birds are indirect proof of its existence.

Specific WNV antibodies are detected in humans, although the virus has not been isolated so far from people suspected of being infected. This was evidenced by the fact that approximately 30% of serum samples obtained from foresters from Podlasie and Świętokrzyskie provinces revealed the presence of neutralising antibodies to WNV (21).

West Nile fever was detected in 250 people, of whom 16 were affected in Greece, Italy and Hungary (32). In 2013, West Nile fever was detected in 250 people, of whom 16 died. Geographically, like in previous years, most people were affected in Greece, Italy and Hungary (32).

Beyond the EU as well as within it, the European Centre for Disease Prevention and Control (ECDC) monitors WNV transmission from June to November in all EU and neighbouring countries. In the 2013 season, the ECDC reported 228 cases among people living in the EU and 557 cases in neighbouring countries (32). According to the ECDC, to 4 September 2014, EU countries had reported 20 cases of the infection, and 48 cases had been diagnosed in neighbouring countries, mostly in Serbia (16).

Another viral disease is Newcastle disease (ND) caused by Newcastle disease virus (NDV) also known as avian paramyxovirus serotype 1 (APMV-1). This is one of the most dangerous diseases of birds. It is...
notifiable and requires prompt steps for eradication. The virus is very resistant to environmental factors; however, some disinfectants were found to be effective. Many domestic and wild bird species are susceptible to the infection. Only adult water fowl are usually impervious to it because the resistance increases with age and the birds become virus shedders.

In humans, the infection course has been described so far as mild. It has been noted in people working with live vaccines against ND in laboratories or veterinarians performing prophylactic vaccination against ND by aerosol route or having direct contact with sick birds. The incubation period is 1-2 d. Clinically, single or double-sided redness of the conjunctiva, watery eyes, swollen eyelids, and subconjunctival ecchymoses are observed. Symptoms usually resolve quickly or last up to three weeks, and do not affect the cornea. Occasionally, there may be chills, headache, and fever. So far, there have been no reports of transmission of the infection from person to person, although a horizontal route is possible (3, 26).

**Fungal diseases.** The bacterial and viral diseases previously briefly discussed do not exhaust the problem of zoonotic agents associated with birds. These agents also include fungal infections such as histoplasmosis and cryptococcosis.

Histoplasmosis is a disease whose aetiological agent is the fungus *Histoplasma capsulatum*. This fungus is present in soil contaminated by bird or bat droppings and in caves and avian nests, especially those of starlings. The fungus can survive for several years in favourable environmental conditions.

Human infection occurs by inhalation of fungus microconidia. After about a two-week incubation period, the acute form of respiratory symptoms like chest pain and dry cough may occur. Such symptoms as malaise or fever also arise, however the disease can also occur without symptoms. Without treatment, it may lead to chronic pneumonia and even to death. Among other forms of the disease, a cutaneous form can occur, which is characterised by the formation of ulcers on the skin and even lymphadenopathy (6).

It is believed that in the USA between 60% and 70% of people residing in areas located along the Ohio and Mississippi Rivers are exposed to the spores of this fungus. Most infections in these areas are reported in people over 65 years of age. The infections are frequently observed in people with HIV/AIDS and other disorders of the immune system. Recent studies have confirmed that this fungus occurs across almost the entire United States (15).

Studies between January 1995 and December 1999 also showed the presence of the fungus in Europe. Out of 118 confirmed cases of the disease, in 62 cases general symptoms, in 31 cases acute pneumonia, and in 6 cases chronic pneumonia were observed. In 17 patients who were diagnosed with a fungal infection lung cancer was also found. Many patients had previously travelled to areas where the fungus was endemic (1).

Cryptococcosis is a fungal infection caused by the fungus *Cryptococcus neoformans*. The fungus is present in soil contaminated with bird droppings. Birds almost never get sick, since their internal temperature is higher than the highest temperature tolerable for the growth of the fungus. This fungus was isolated from chickens, pheasants, and pigeons.

In humans, the infection occurs through inhalation. The disease occurs most often in people with low immunity. The infection induces acute or chronic cryptococcosis meningitis, which manifests itself in headache, malaise, and in the final stage a stiff neck and fever, and may even lead to the death of the patient. Infection can also affect the lungs and skin (14).

According to the epidemiological data, fungal infection occurs mainly in people with HIV. This was confirmed by research conducted by the European Confederation of Medical Mycology. Sixty-two patients suspected of *C. neoformans* infection were examined. Forty-four patients lived in Germany, 14 in Switzerland, and 5 in Austria. HIV was confirmed in 37 patients. Sixty-six percent of patients were males and 33.9% were females and their age frequently ranged from 21 to 40 years. *C. neoformans* was confirmed in 44 patients (38).

**Other problems.** In the description of bird-derived human health problems, arthropods, mainly pigeon tick, and allergens in bird feathers, droppings, and epithelium should not be omitted.

The pigeon tick (*Argas reflexus*) is a species of “soft tick”. It is found in Europe, North America, Africa, and Asia Minor, especially in those places where there are flocks of wild doves and pigeons for breeding. The ticks are particularly dangerous for people after the removal of birds from buildings because at this time they are looking for a new host. In addition to pigeons, *Argas reflexus* also attacks swallows, crows, jackdaws, sparrows, but also domestic fowls.

After piercing by the tick, the skin in humans aged up to a year and a half may develop lesions. Usually, the most common allergic reactions occur but in very sensitive patients, so called tick paralysis may develop, causing difficulty in breathing. In the most severe cases anaphylactic shock and the death of the patient is possible. In addition, ticks can be a vector of pathogens of other diseases: Lyme disease, Q fever, salmonellosis, and tick-borne encephalitis (9).

Besides ticks, mites often found in the bird environment are also disease vectors not to be overlooked. One of the most dangerous of the “red blood mites” is *Dermanyssus gallinae*. It is a mite most often associated with wild pigeons. It may also infect other species of birds, including pet birds. *Dermanyssus gallinae* usually attacks at night, but the
consequences of infection are visible by day. Reactions occurring in human skin are not specific and difficult to diagnose. They are manifested by pruritic papules and occasionally by vesicles, urticaria, and or erythema. The mites are most commonly seen on the legs, but not on the skin between the fingers or genital skin. Poultry farmers are also exposed to infection with the mites (13).

The allergens contained in feathers and droppings are associated with so called allergic alveolitis “bird breeders’ lung” (hypersensitivity pneumonitis). It is an allergic reaction to re-contact with the allergen. Non-specific clinical symptoms cause diagnostic problems. It is believed that there are about 300 factors which cause this disease, which can occur at any age.

Specific and non-specific mechanisms are involved in the pathogenesis of the disease. The basic mechanism of the disease is a type III allergic reaction. The antigens penetrate the bronchioles and alveoli, where they are brought into connection with IgG or IgM. The complement binds to the complex. After the release of vasoactive amines, there is an increase in vascular permeability.

An increasingly important role in the pathogenesis of this disease is attributed to type IV (cellular) reactions. Such reactions are attributed to the activation of T lymphocytes and macrophages. They are involved in the formation first of alveolitis, and subsequently the development of lung lesions.

Occurrence of sensitisation signs can vary from several months to several years after antigen exposure. Three forms of the disease are distinguished: acute, subacute, and chronic. In the acute form, symptoms of respiratory infection appear within a few hours after exposure to an allergen. In the subacute form, symptoms are almost never found or are difficult to see, but in the chronic form, the disease may not be visible for several months (24). In the initial phase, the lung radiograph may be normal, but sometimes darkening is observed in the middle and lower parts of the lungs. In the chronic form, the most common changes are visible in the form of so called “honeycomb lung”.

Among the functional changes in the respiratory system are impaired ventilation, a reduction in total lung capacity (TLC) and vital capacity (VC), and reduced lung capacity, often of obstructive type. There may also be abnormal bronchial flow (25).

This paper presents only the most important and dangerous factors to humans connected with birds. Of course there are many more factors, but in any case during contact with birds, or their droppings and secretions, special precautions should be taken. This way the negative effects of birds on human health can be minimised or eliminated.

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