

AVIAN TUBERCULOSIS AND COMORBIDITY OF DOMESTIC CHICKENS: POSTMORTEM EXAMINATION

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Abstract

Avian tuberculosis is actively studied by researchers all over the world. But, as a rule, its variants are described as the main disease, when the death of the organism is caused by tuberculosis-specific injuries. At the same time, the predisposition of tuberculosis to a chronic course, allows the emergence of the so-called natural model of its association with other diseases and / or certain pathological processes. This fact is not always taken into account by veterinarians. The method of pathological autopsy of domestic chicken carcasses and the method of analysis of obtained results were used. The diagnosis of "bird tuberculosis" was based on the results of complex studies. There were diagnosed comorbid pathology: tuberculosis/reproductive syndrome at infectious bronchitis of chickens; tuberculosis/fatty hepatosis of domestic chicken based on analysis of pathological investigation. It was found that pathomorphosis of avian tuberculosis had certain differences due to its associated course with other pathologies.

Key words: avian tuberculosis, comorbidity, domestic chickens, fatty hepatosis, infectious bronchitis, pathomorphological analysis.

INTRODUCTION

Scientists all over the world are studying various aspects of avian tuberculosis, including the properties of its causative agent – *Mycobacterium avium* (Sattar et al., 2021; Tsiouris, 2021; Liakhovych & Maslak, 2021; Iancu et al., 2017; Kindu & Getaneh, 2016; Kriz et al., 2013; Macovei et al., 2013; Mayahi et al., 2013; Ciobotaru et al., 2012; Klanicova et al., 2011; Kul et al., 2005). This disease is a problem for birds and at the same time, its causative agent, like other atypical mycobacteria, is dangerous to humans, animals and fish (Lu et al., 2021; Urdes & Loh, 2021; Crilly et al., 2021; Mochizuka et al., 2021; Izumi et al., 2019; Yeh et al., 2019; Procopie et al., 2018; Beck et al., 2015; Lorencova et al., 2013; Miranda et al., 2012). Given the data of Romanian researchers Sarbu et al. (2018), who found mycobacteria in extreme conditions - sulfur caves (Puturosu Mountain, Romania), the ubiquity of these microorganisms is impressive. And this fact once again emphasizes the danger of tuberculosis pathogens. It is also important that wild and synanthropic birds carry different species of mycobacteria over a long distances,

contributing to their spread (Muzyka & Stehni, 2012). People with immunodeficiency are especially sensitive to *Mycobacterium avium* and other atypical mycobacteria. This category of the population is a potential consumer of egg and meat products that can be infected with these pathogens. In Ukraine chicken from private mini-farms is traditionally in grate demand, where, according to labels, ecologically clean poultry is obtained (at natural slaughter).

At the same time, these products are not always safe, as they often fall out of the quality monitoring system. Objective information on the quality of the products of private poultry farms helps to prevent the infection of its consumers and producers with pathogens common to birds and humans, in particular *Mycobacterium avium*. In most cases, the bird's body is an environment for pathogens of various diseases (there is an associated course). The phenomenon of disease association in the modern nomenclature of terms is called comorbidity (Valderas et al., 2009). The issues of comorbidity of avian tuberculosis are not fully investigated according to literature data. Knowledge of the pathological picture in this case can help in understanding of pathogenesis

and appropriate tactics of prevention, treatment and diagnosis of avian pathologies by veterinarians.

MATERIALS AND METHODS

The subject of the study were macroscopic changes in the carcasses of adult domestic Rhode Island Red meat-and-egg chickens aged from two to three years ($n = 8$) from a tuberculosis-prone private mini-farm. There were detected signs of tuberculosis-specific liver damage in some individuals of chickens that were slaughtered for domestic purposes.

The owner of the farm was regularly consulted by veterinarians: after the slaughter of chickens, the carcasses were carefully checked for safety for human consumption. Chickens were kept for egg and meat products. The territory of the mini-farm is a place of residence and transit of many birds species (synanthropic and wild, including migratory): sparrows, turtle doves, buzzards, pheasants, crows, magpies, jackdaws, cuckoos, white and black storks, partridges (*Perdix perdix*), woodpeckers (*Crex crex*), owls, small woodpeckers and others. During the warm season, chickens could go to the open space, where they could have a potential contact with representatives of synanthropic and wild fauna and the likelihood contamination of food with various pathogens. Naturopathy - (treatment by natural means) prevailed in keeping chickens. The owner of the farm is guided by the principle formulated by Hippocrates: "Our food must be medicine and our medicine must be edible". Moistened mixtures of cereal grains, sunflower seeds, watermelons, melons, and pumpkins; depends on the season - grapes, raspberries, cherries, plums; chopped pumpkins, zucchini, potatoes, beets, carrots, cabbage; milk, sour milk cheese, shredded tulle of the Black and Azov Seas (*Clupeonella delicatula*), onions, garlic; striped garden snails (*Cepaea hortensis*), common earthworms (*Lumbricus terrestris*) were used to feed the chickens. Outbreaks of infectious bronchitis had occurred among chickens in the winter, and the owner has successfully used inhalations with pine essential oil (*Pinus sylvestris* L.), which has antiviral, immunostimulatory, antispasmodic, analgesic, anti-inflammatory,

and expectorant properties, to treat respiratory symptoms (Hrodzynskyi et al., 1992). All individuals of chickens recovered, in this birds normalized appetite.

However, in laying hens, egg laying was disrupted and / or stopped. Some hens laid defective eggs: yolk-free, with watery protein and abnormal brown-red inclusions (Figure 1).



Figure 1. Type of egg of a chicken suffering from infectious bronchitis: lack of yolk, watery protein, abnormal brown-red inclusions

As a result metabolic processes slowed down: the usual amount of food led to an excess of calories that not consumed by the body and, accordingly, to - lipid excess (fat accumulation). The owner was forced to kill the hens due to the cessation of egg laying. There were made veterinary and sanitary examination of chicken carcasses, in accordance with generally accepted rules (Dobin & Cocurichev, 1963). The affected organs of chickens were additionally examined if tuberculosis was suspected. The diagnosis of Tuberculosis avium was established postmortally in two of the eight chicken carcasses (based on the complex studies). The aim of this study was to identify and classify pathological changes in the carcasses of slaughtered chickens in the associated course of tuberculosis and infectious bronchitis; tuberculosis and general obesity. The work was done at the Department of Normal and Pathological Morphology of the State Biotechnology University. Methods of clinical observation, pathological autopsy of chicken carcasses and their analysis were used.

RESULTS AND DISCUSSIONS

We found changes that characterise of avian tuberculosis in two female chickens during sectional studies. Among them, in particular, there were classic for this disease granulomas with a typical localization in the intestinal wall. They were easily visualized in the jejunum, where they were visible on examination of the serous membrane. The tubercle nodules were light yellow, ranging in diameter from three to five millimeters (Figure 2).



Figure 2. Fragment of the colon of a domestic adult chicken with comorbidity of tuberculosis / infectious bronchitis. Tuberculous granulomas on the serous membrane (arrows)

Within the duodenum, the tuberculous nodules were smaller than in the jejunum, were dense, some of them had elongated (ellipsoidal) shape, and light pink-yellow in color, ranging in diameter from two to four millimeters (Figure 3).



Figure 3. Fragment of the U-shaped duodenum and pancreas of a domestic adult chicken with comorbidity of tuberculosis / infectious bronchitis. Single tuberculous granulomas on the mesentery and serous membrane (arrow)

Tuberculous nodules localized in the mesentery was an interesting finding. Such their placement is relatively rare in poultry. At the same time, these nodules were quite dense due to mineralization, had different diameters and different colors - from white to light pink-yellowish; placed along the vessels of the mesentery (Figure 4 A and B).



Figure 4 A. Small tuberculous nodules with localization at the root of the mesentery of an adult domestic chicken

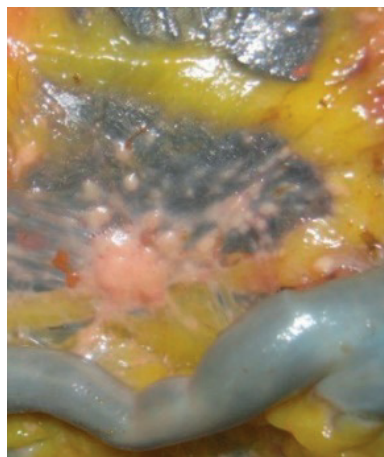


Figure 4 B. Draining mineralized tuberculous nodules with localization in the mesentery of an adult domestic chicken

For the study of tuberculous intestinal lesions in ornamental pheasants and peacocks never have these formations had such a density as in this case in domestic chickens (Lyakhovich et al., 2020; Liakhovych et al., 2018).

In people with tuberculosis, healing in areas of tuberculous changes, in particular, is associated with resorption and proliferation processes (scarring, compaction, encapsulation, hyalinization, calcification) (Helberg et al., 2018). In birds, an important sign of tuberculosis, according to researchers (Dhama et al., 2011; Skoric et al., 2010), is granulomatous lesions without calcification. However, Özen et al. (2016) reported the phenomenon of mineralization of tuberculous granulomas, in particular, in the lungs of long-legged buzzard (*Buteo rufinus*) - a bird of prey of the hawk family (*Accipitridae*). Trophic specialization of these birds differs significantly compared to domestic chickens.

After all, buzzards, like other members of the hawk family, eat, in particular, smaller birds, small mammals, fish. The trophic component is considered the leading source for the process of mineralization of tuberculous granulomas, as reported by Özen et al. (2016), and taking into account the information obtained on the feed diet in the studied chickens, which was rich in calcium. The formation of calcinates in the mesentery of the studied chickens, according to the existing classification of tuberculosis, should be classified as residual (post-tuberculosis). Their presence indicates a favorable variant of tuberculosis in the studied birds, especially taking into account the feeding rations and naturopathic direction, which is practiced by the owner of the mini-farm. In all specimens of the studied chicken carcasses in the thoracic cavity and internal organs contained significant accumulations of fat of a bright consistency of bright yellow color. Combination of specific liver lesions and steatohepatosis should be considered as favorable for tuberculosis process in another adult female chickens with generalized tuberculosis. On the background of steatohepatosis there were unfavorable conditions for the development of mycobacteria and changes for tuberculosis, in particular, the formation of specific granulomas (as evidenced by single tuberculous granulomas in the liver of the studied chicken). In this case, macroscopically, the chicken liver was deformed, sharply enlarged (had blunt edges, tight and in some areas - destroyed capsule), its surface was shiny, unevenly colored orange-beige-brown with pale yellow nodules (Figure 5), on the blade of the knife after the incision of the liver remained a fatty plaque; areas of complete disintegration (lysis) of the liver parenchyma with the formation of lipid cysts were detected. The consistency of the organ was flabby (the liver was easily torn during its examination). During the flotation test, liver fragments located on the water surface. In this model of liver pathology, tuberculous changes could not compete with lesions of steatosis relative to the common target (locus) of the lesion. Similar changes in tuberculosis of pheasants, the authors observed in the liver of those birds in the diet of which used rancid fats (Liakhovych et al., 2019). The authors also

found steatohepatosis in generalized tuberculosis in an ornamental peacock (Liakhovych et al., 2021).

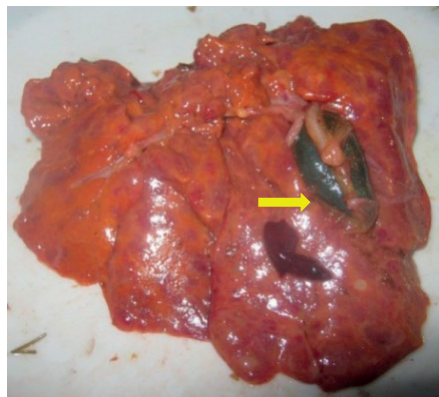


Figure 5. View of the liver and gallbladder of an adult chicken with steatohepatosis associated with tuberculosis (single tuberculous granulomas - arrow)

Researchers note that a high-energy diet to keep chickens in a cage provokes fatty liver syndrome (Rozenboim et al., 2016). The studied chickens in the winter were kept in crowded conditions without the possibility of active exercise. Infectious chicken coronavirus bronchitis is defined as a polysystemic disease with immune suppression (Shahnas et al., 2020). Herein is certain similarity of infectious bronchitis of chickens and tuberculosis. An important symptom of infectious bronchitis in chickens in adult females is the violation or even cessation of egg laying (Pereira et al., 2019). With the cessation of egg laying in the studied chickens due to the lack of folliculogenesis (it was possible the age reason or - due to exposure to infectious bronchitis), important chemical changes happens, in particular, the level of calcium in the body. It is also important that such a bird predisposable to general obesity. Therefore, in the body of adult chickens with comorbidity of tuberculosis/infectious bronchitis a certain gradual (evolution) of changes can be expected: cessation of egg laying - steatohepatosis, according to that tuberculous liver damage will not be intense - general obesity - the appearance of tuberculous lesions, that localized in mesentery (moreover, with mineralization, because in the body of such birds there is an excess of minerals due to the

cessation of egg laying and - accordingly - the absence of egg shell formation). That is, minerals in such individuals are used to heal areas affected by tuberculosis.

CONCLUSIONS

Comorbidity was diagnosed on the basis of results of pathological examinations of domestic adult chickens carcasses: tuberculosis/infectious bronchitis; tuberculosis/steatohepatosis. The pathological picture of tuberculosis in domestic chickens due to comorbidity with infectious bronchitis and steatohepatosis had certain features. They were caused by processes that developed in the body of sick chickens. Due to the cessation of egg laying in the studied chickens, which recovered from infectious bronchitis, level of calcium increased, which is normally used by the body of an adult female to form an eggshell. Excess calcium was also facilitated by foods rich in it (in particular, cheese, fish, snails). In the liver parenchyma severe destructive changes with the formation of so-called lipid cysts have been developed as a result of steatohepatosis. The formation of intense classical tuberculous granulomas in such conditions is impossible. The comorbidity of infectious bronchitis of chickens and tuberculosis increases immunosuppression, which explains the natural impossibility of forming tuberculosis-specific nodules. After all, for tuberculous granulomas requires the appropriate phasing of immune cells. Therefore, the comorbidity model: steatohepatosis/hepatic tuberculosis is imposably. The predisposition of tuberculosis to a chronic course allows the emergence of a natural model of its association with other diseases and/or individual pathological processes. In such cases, the pathomorphosis of tuberculosis of domestic chickens has differences due to the associated course with other diseases.

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