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PROVENTRICULAR PATHOLOGIES WITH GENERALISED TUBERCULOSIS IN PEAFOWL (*PAVO CRISTATUS*): PATHOMORPHOLOGICAL ANALYSIS

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Abstract

The results of pathological anatomical changes in the proventriculus of a decorative peacock that died from tuberculosis were described in this article. Mixed chronic destructive multifocal ulcerative panproventriculitis with a predominance of ulcerative component without signs of healing was diagnosed. Absence of epithelialization of large ulcer and relief in this area is a sign of malignancy. Complicating pathologies were classified: rupture of proventriculus wall, hemorrhage, atrophy of glands of mucous membranes, cicatrization, deformity. Proventricular component in the pathomorphosis of ornamental peacock tuberculosis is an accessible and convenient target for the diagnostician and can significantly supplement the pathomorphological criteria used to decipher the variants of avian tuberculosis course. The severity of damage to the glandular stomach in peacocks is due to the tropism of tuberculosis pathogens to the lymphoid structures located here.

Key words*: avian tuberculosis, peafowl, proventriculus, pathomorphological analysis.*

INTRODUCTION

Ecological parks where birds of the so-called tactile group are kept have become popular in Ukraine. Visitors are invited to feed and pet birds. Sudden deaths from tuberculosis are often reported among peacocks and pheasants. This disease remains a global problem, despite all the efforts of the world community to overcome it. (Kennedy, 2017; Nitu et al., 2017). As for avian tuberculosis, it threatens the extinction of the entire collections and populations of individual bird species. In particular, because this disease is characterized by a decrease in egg productivity. Bird population management programs have been developed in different regions of Ukraine. Their goal is to improve the ecological environment and increase the ecological sustainability of the anthropogenic ecosystem. Lack of environmental education of people remains the problem. Workers and visitors to eco-parks are unaware of their own risk of likely infection with *Mycobacterium avium* complex (MAC) by contact with ornamental poultry. Particularly dangerous is the effect of MAC on the health of people with immunodeficiency, in particular, infection with viruses of the respiratory group (Bazzi et al., 2020; Crisan-Dabija et al., 2020; Azar et al., 2019; Auguste et al., 2018). Often such a contingent of people choose to rest in ecoparks. The possibility of infection of poultry from people with tuberculosis is not excluded.

Sectional examination of the corpses of ecopark peacocks and pheasants revealed both classic lesions with localization in the liver, intestines and spleen, and a number of destructive forms of pathology (Lyakhovich et al., 2020; Liakhovych et al., 2019; Liakhovych et al., 2018). During an outbreak of tuberculosis in peacocks on a private farm in Romania, researchers found damage typical of avian tuberculosis - granulomas in the lungs, liver and spleen (Iancu et al., 2017).

Lymphotropic mycobacteria, in particular, their influence on the development of pathologies in the lymph nodes and ulcers of the oral mucosa of patients with tuberculosis is known (Popescu et al., 2015; Popescu et al., 2014). This indicates a potential pattern of development in tuberculosis of birds of the corresponding lesions in organs rich in lymphoid structures, in particular, in the wall of the glandular stomach. Because physiological norm is characterized by the saturation of the wall with lymphocytes and

lymphoid nodules (Kovtun & Harchenko, 2005). Romanian researchers Ciobotaru et al. (2012), studying changes in tuberculosis in a peacock, found damage at the border of the esophagus and glandular stomach.
Specific pathologies in the wall of the glandular stomach in pigeons with tuberculosis, have also been described (Mayahi et al., 2013). At the same time, information on the proventricular localization of pathologies caused by MAC is not covered in available information sources and is not associated with probable avian tuberculosis. Therefore, each case of detection of pathologies of the proventriculus in a bird diagnosed with tuberculosis complements the data on the pathomorphosis of this disease.

MATERIALS AND METHODS

Pathologies of proventriculus of an adult (5 years old) ornamental peacock (male), an Indian breed, which died of generalized tuberculosis, was objected to this study. In summer, the bird and peacocks were kept in an aviary of a mini-ecopark. In winter, birds of different species were kept in an adapted room in crowded conditions.
The incidents of deaths from avian tuberculosis among peacocks and pheasants in the ecopark have increased recently. The aim of the study was to identify and classify the pathomorphological changes in the proventriculus of the peacock with tuberculosis. The work was done at the Department of Normal and Pathological Morphology of the Kharkiv State Zooveterinary Academy. Pathoanatomical section and its analysis, macro-microscopic examination of the peacock's proventriculus using weakly multiple optical lenses methods were used.
The diagnosis of "Avian tuberculosis" was established on the basis of comprehensive studies. Pathoanatomical examination were done in the section hall.
The corpse of the peacock was dissected at dorsal position by the method of partial evisceration according to the generally accepted rules (Dobin & Cocurichev, 1963) (Figure 1).

Figure 1. The corps of a dissected peacock that died of generalized tuberculosis

Macroscopic examination of the proventriculus was performed according to existing rules. We determined the integrity and thickness of its wall, the degree of blood supply and filling of the cavity, the state of the serous membrane (color, surface character, humidity); the presence and nature of the content (quantity, consistency, color), patency, condition of the mucous membrane (color, thickness, relief, integrity, humidity, layering), condition of muscular membrane.
Macro-microscopic examination of the organ was performed on a native planar preparation, which was studied visually using weakly multiple optical lenses under special artificial lighting.
Available parts of the body (apex, body and isthmus) were evaluated to identify possible pathological changes: inflammatory processes, changes in glandular structures (ectasia, necrosis, abscess), ulcers, mucosal erosions, hyperplasia, dysplasia, neoplasia, vascular disorders.

RESULTS AND DISCUSSIONS

Classic for tuberculosis of birds, granulomas with intestinal (Figure 2) and splenic localization were found during the pathoanatomical section of the dead peacock (Figure 3).

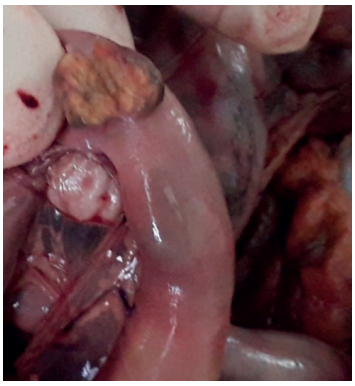

Figure 2. Mature granuloma with subserous localization in the wall of the jejunum in peacock with generalized tuberculosis

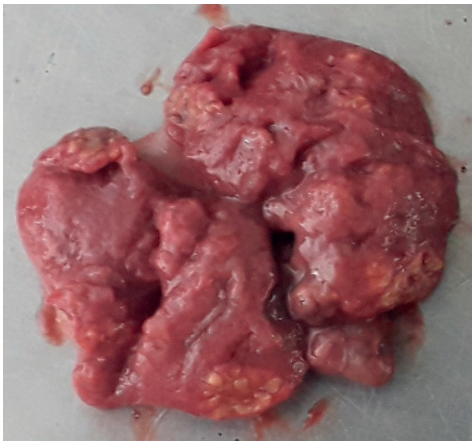

Figure 3. Spleen of Peafowl *(Pavo cristatus)*. Multiple coalescent whitish to yellow granulomas visible on cut surface

Peacock's proventriculus on macroscopic examination had a characteristic spindle-shaped, uneven wall thickness with rigidity in various parts of it. The anterior lobe (apex), posterior lobe (body) and isthmus were distinguished in the organ. The apex was located more dorsally from the heart (between the air sacs); the body of the proventriculus was located dorsal to the left lobe of the liver. Multiple ruptures of the structures connecting the dorsal edge of the liver and the proventriculus occurred due to massive hemorrhage into the thoracic-abdominal cavity from the hepatic vessels. Examination of the outer wall of proventriculus body in its front part revealed a single gap in the shape of a crescent moon, the size of 5 mm (Figure 4).

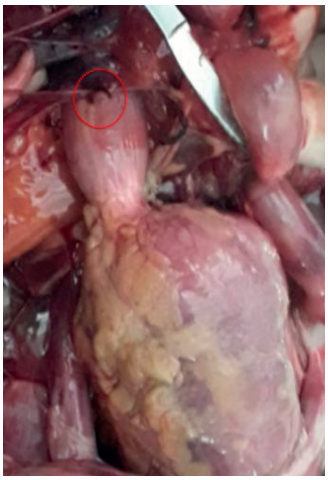

Figure 4. General view of the proventriculus and gizzard of the peacock that died from generalized tuberculosis. Area with a rupture of the outer wall of proventriculus marked with ellipse

Destruction of ventral proventricular veins *(Vv. Proventriculares ventralis*) was also estabished. The right side of the proventriculus touched the spleen and ileum, the left side - the cecum. At the border with the gizzard, the proventriculus was narrowed due to the annular sphincter located there. On the surface of the mucous membrane were visible 22 cone-shaped papillae of different heights (glands that opened with special holes) with an uneven degree of protrusion and filling with secretions after dissection of the proventriculus along its axis. The proventriculus did not contain feed masses (Figure 5). Its mucous membrane had uneven pigmentation; in the area of the body on its surface there was no specific relief (detected defect in the form of a large ulcer - d 1.5 cm). In one area, the ulcer due to the spread in the thickness of the wall, corroded the relevant vessels that passed there, which caused bleeding - a natural complication of ulcerative pathology. However, the main source of bleeding with a high degree of its activity was in the liver. The incurability of a large ulcer of the gastric mucosa was indicated by areas with its hyperemia, the presence of necrotized tissues, the depth of the defect (the wall of the gastric gland was thinned due to the destruction of mucosal structures, submucosal base/glandular components).

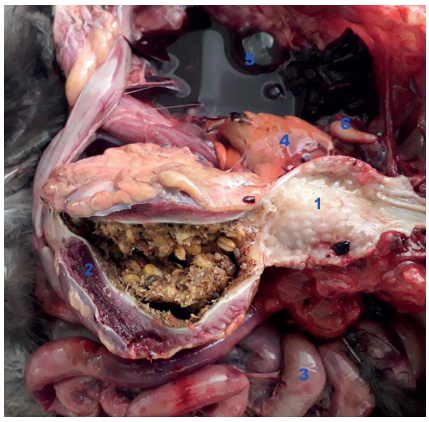

Figure 5. Visceral organs of a peacock that died of generalized tuberculosis: 1 - proventriculus in section; 2 - gizzard in section; 3 - intestinal loops; 4 - a fragment of the liver; 5 - mass of blood in the thoracic-abdominal cavity due to rupture of hepatic vessels; 6 - testis

The absence of mature granulation tissue at the edges of the ulcer defect indicates the inability to protect them and the development of regeneration of the epithelium and other components of the wall. This is due to severe damage to many systems of the bird during generalized tuberculosis. Large proventricular ulcer was complicated by scarring deformation of the organ, atrophy of the mucous glands.

New superficial ulcers in the form of peculiar niches (defects) were found on the mucous membrane in the area of transition of the proventriculus to the muscular one (Figure 5 - 2). Some of them were healed. Signs of edema and petechial hemorrhage were detected using a weakly multiple optical lens. On macroscopic examination in the externally areas, the mucous membrane of the proventriculus was painted white, had a locally swollen and edematous surface; in a large area it was excessively covered with masses of clear viscous mucus (starting from the border with the esophagus and in the body part of the proventriculus) (Figure 6). Excess mucus substances should be considered a criterion for suspicion of neoplastic pathology of mucus-producing cells.

On the background of chronic destructive pathologies of peacock proventriculus wall, which contributed to microcirculation disorders (increased blood viscosity with a tendency to thrombosis due to exicosis as a result of intestinal disorders), proteolysis of the structures within the damaged mucous membranes and other layers of gastric enzymes (with a regular seasonal and/or post-dietary increase in activity), the size of the ulcer increased due to its marginal (periulcerous) segments.

Figure 6. Proventriculus of a peacock which died of generalized tuberculosis (view from the mucous membrane): 1 - large ulcer with hemorrhage in the body of the organ; 2 - small ulcers in the isthmus; 3 - mass of mucus

Combination of randomly located areas of sclerosis and fibrosis, atrophy and hypertrophy in the periulcerous zone in the mucous membrane of the organ wall indicated the presence of persistent chronic proventriculitis in the peacock. Potentially MAC, by penetrating the body of the bird's alimentary way, can infect the epithelium of the proventriculus and submucosal layer, where the lymphoid structures are located. As a result, the proventriculus should be considered a target for mycobacteria! Following facts indicated tuberculous genesis of chronic ulcers in proventriculus of peacock in this case: generalized tuberculosis was diagnosed in this bird; with alimentary inflow of MAC to the proventriculus there were conditions of delay of the forage on the background of malabsorbtion syndrome with partial obstruction of the intestine affected by tuberculosis (this created conditions of longer than normal contact of MAC with the gastric mucosa); the wall of the proventriculus in peacocks contains lymphoid elements to which MAC exhibits tropism; actually, the topography of a large unhealed ulcer with localization inside the body of the organ, and not near the gizzard (where, on the contrary, if ulcers occur, their origin is due to anaerobic

microorganisms, because there are appropriate conditions for their reproduction); massive involvement of the structures of mucous membrane and in some areas - muscular - indicated chronicity of the ulcer. Chronic inflammation of the gastric mucosa should and other alike reasons needs to be examined as factor which provokes malignancy.

Proventriculitis was classified by type, location, etiological factors, pathomorphological picture of wall structures. Therefore, mixed chronic destructive multifocal ulcerative panproventriculitis with a predominance of ulcerative component without signs of healing was diagnosed in studied peacock.

According to such an indicator as ulcer healing (in the studied case there was no complete healing of ulcers), it is necessary to assess the actual immune status of the bird. The predominance of the destructive form of proventriculitis indicates a stable in time duration of damage to the structures of the organ wall. In the case of poultry tuberculosis, it is not possible to observe all the dynamics of damage to body systems, in particular, the gastrointestinal tract, because its life is limited to reaching the slaughter age. Corresponding changes have time to develop to a fuller picture in decorative bird. Actually, that's why it's more informative.

CONCLUSIONS

Mixed chronic destructive multifocal ulcerative panproventriculitis with a predominance of ulcerative component without signs of healing was diagnosed in peacock that died from generalized tuberculosis. Absence of epithelialization of the ulcer and relief in this area is considered a sign of malignancy. Rupture of the gastric wall, hemorrhage, atrophy of glands of mucous membranes were classified as complicating pathologies. The proventricular component in the pathomorphosis of ornamental peacock tuberculosis is an accessible and convenient target for the diagnostician and can significantly supplement the pathomorphological criteria used to decipher the variants of the course of avian tuberculosis. A combination of the following forms of pathology of glandular stomach: ulcer, which is a variant of necrosis; hemorrhage; cicatrization deformity - it is advisable to consider as pathomorphological markers of possible tuberculous damage to its mucous membrane and other structures. The severity of damage to the proventriculus in peacocks is due to the tropism of tuberculosis pathogens to the lymphoid structures located there. Absence of classic nodular forms of tuberculosis in the proventriculus of birds is probably due to anaerobic conditions. According to the physiological norm, the environment there does not promote the growth of bacteria. Also in the cavity of the proventriculus there is an objectively small space for the formation of granuloma.

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REFERENCES

Auguste, B.L., Patel, A.D, & Siemieniuk, R.A. (2018). *Mycobacterium avium* complex infection presenting as persistent ascites. *CMAJ* 190 (13):394-397. DOI: https://doi.org/10.1503/cmaj.170823

Azar, M., Zimbric, M., Shedden, K., & Caverly, L.J. (2019). Distribution and outcomes of infection of *Mycobacterium avium* complex species in cystic fibrosis. *J Cyst Fibros*. DOI: 10.1016/j.jcf.2019.07.007

Bazzi, A.M., Abulhamayel, Ye., Rabaan, A.A. & Al-Tawfiq, J.A. (2020). The impact of the coexistence of *mycobacterium avium* with *mycobacterium tuberculosis* on the result of GeneXpert and MGIT susceptibility test. *Journal of Infection and Public Health*. 13, 5, 827-829. https://doi.org/10.1016/j.jiph.2020.01.006

Ciobotaru, E., Tasbac, B., Constantinescu, C., Predoi, G. & Militaru, D. (2012). A case report of tuberculosis in peafowl *(Pavo Cristatus). Journal of Comparative Pathology, 14*(1):67 DOI: 10.1016/j.jcpa.2011.11.088

Crisan-Dabija, R., Grigorescu, C., Pavel, C.A., Artene, B., Popa, I.V., Cernomaz, A. & Burlacu, A. (2020). Tuberculosis and COVID-19: Lessons from the Past Viral Outbreaks and Possible Future Outcomes. *Can Respir J*. Sep 5;:1401053. doi: 10.1155/2020/1401053. eCollection 2020.

Dobin, M.A., & Kokurichev, P.I. (1963). *Praktikum po veterinarnoy patologicheskoy anatomii i vskrytiyu.* L.-M., Sel'khozizdat, 240. [in Russian]

Iancu, I., Degi, J., Pascu, C., Cătană, N. & Herman, V. (2017). An outbreak of avian tuberculosis in peacocks. *Lucrari Stiintifice - Universitatea de Stiinte Agricole a Banatului Timisoara, Medicina Veterinara,* 50(4):68-71.

Kennedy, S. (2017). 120 Years of Tuberculosis Research: An Historical Perspective from the Archive of the *Journal of Comparative Pathology, 156* (2–3):143-146 https://doi.org/10.1016/j.jcpa.2016.12.002

Kovtun, M. F., & Harchenko, L. P. (2005). Limfoidnyie obrazovaniya pischevaritelnoy trubki ptits: harakteristika i biologicheskoe znachenie. *Vestnik zoologii*, 39*(6)*, 51-60. [in Russian]

Lyakhovich, L.M., Ulyanizka, A.U., Zakharyev, A.V., Logachova, L.O., & Drebot, Z.M. (2020). Pathomorphological characteristic of intestinal pathologies of pheasants whith generalized tuberculosis. *Veterinary Science, Technologies of Animal Husbandry and Nature Management*, 5, 85-90. DOI: 10.31890/vttp.2020.05.16

Liakhovych, L., Shchetynskyi, I., Zakhariev, A., Ulianytska, A., Martiemianova, A., & Tkachova, K. (2018). Tuberkuloz fazaniv ta pavychiv: aspekty tanatohenezu. *Veterynariia, tekhnolohii tvarynnytstva ta pryrodokorystuvannia*, *(2)*, 56-58. DOI:10.31890/vttp.2018.02.08 [inUkrainian]

Liakhovych, L., Shchetynskyi, I., Zakhariev, A., Ulianytska, A., Martiemianova, A., Lyulin, P., & Kostyuk, I. (2019). Heparalni patolohii za tuberculosu fasaniv: patomorfolohichnyi analiz. *Veterynariia, tekhnolohii tvarynnytstva ta pryrodokorystuvannia*, (3), 37-45. doi:10.31890/vttp.2019.03.06. [in Ukrainian].

Mayahi, M., Esmaeilzadeh; S., Mosavari, N. & Asadollahi, P.K. (2013). Histopathological study of avian tuberculosis in naturally infected domestic pigeons with Mycobacterium avium subsp. avium. *Iranian Journal of Veterinary Science and Technology*, 5(1);45-5610.22067/veterinary.v5i1.13796

Niţu, F.M., Olteanu, M., Streba, C.T., Jimborean, G., Postolache, P., Man, M.A. & Trofor, A.C., Nemeş, R.M., Dragonu, L., Olteanu, M. (2017). Tuberculosis and its particularities in Romania and worldwide**,** *Romanian Journal of Morphology and Embryology.* 58(2):385-392.

Popescu, M.R., Călin, G., Strâmbu, I., Olaru, M., Bălăşoiu, M., Huplea, V., Zdrancotă, C., Pleşea, R.M., Enache, S.D., Pleşea, I.E. (2014). Lymph node tuberculosis - an attempt of clinico-morphological study and review of the literature. *Romanian Journal of Morphology and Embryology Revue Roumaine de Morphologie et Embryologie*, 55(2 Suppl):553-567 PMID: 25178325

Popescu, M.R., Plesea, I.E., Olaru, M., Strambu, I.R., Fronie, A.I., Petrescu, I.O., Petrescu, F., Stefarta, A., Postolache, P. & Popescu, M. (2015). Morphological aspects in tuberculosis of oral cavity – our experience and a review of the literature attempt, *Romanian Journal of Morphology and Embryology.* 56(3):967-987.