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Biological Properties Of Infectious Bursal Disease Virus.

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ABSTRACT

The industrial poultry industry in Russia is characterized by the creation of large industrial enterprises of various technological areas. Under conditions of concentration of a huge population in a limited area, rapid changes in the bioecological niche occur, the transformation of a wide range of infections, primarily viral etiology, the genetic evolution of viral agents in the direction of increasing pathogenicity and infectious activity. Currently, vaccination is the most effective way to prevent infectious diseases of birds. However, the changes taking place in the microcosm require constant improvement and the creation of new means of specific prophylaxis. This requires knowledge of the biological properties of pathogens of infectious diseases. One of the actual viral diseases of birds is infectious bursal disease. The causative agent has immunosuppressive properties, directly affects the state of the immune system and, as a result, the effectiveness of preventive and anti-epizootic measures.

Keywords:pathogens, diseases, viral, infectious, bursal, immunosuppressive

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SHORT REVIEW

Infectious bursal disease (IBD, Gumboro disease, infectious bursitis) is a highly contagious viral disease of 2–20 weeks old chickens that accompanies the lesion of the fabrication bag, to a lesser extent other lymphoid organs and kidneys, and hemorrhages in the muscles of the thigh, chest, wing and mucous membranes the shell of the glandular stomach [1,2].

For the first time, Gumboro disease (BG) was established in the northeastern United States in 1957 in the state of Delaware, in the village of Gumboro [3]. Currently, BG is registered in almost all countries of the world with developed industrial poultry farming [1,3].

In 1972, Allan W.H. other. [4] found that infection with IBB virus (VIBB) at an early age leads to immunosuppression.

Immunosuppression that occurs after the birds have had a paralysis, infection, killing, infection, infection, infection, infection, infection, infection, endocrinosis, necrotizing enteritis [2]. Also, as a result of immunosuppression in chickens, there is an unsatisfactory response to vaccination against Newcastle disease, infectious bronchitis of chickens, Marek's disease [2.5], and infectious laryngotracheitis [5].

The Gamborough disease virus is an RNA-containing virus belonging to the family Birnaviridae, the genus Avibirnavirus [3,4,6,7,8]. The size of viral particles is 55-65 nm, with a diameter of capsomers 8-12 nm. Floating density in cesium chloride is 1.31-1.34 g / ml [4]. The capsid has asymmetry, with a triangulation coefficient T = 13 [9]. The virus has an icosahedral (cubic) type of symmetry [10,11]. Studies using electron microscopy have shown that the virus has a spherical shape, a single-layer capsid, which consists of hollow capsomers that do not have a shell. The peripheral region of capsomers can be viewed in the form of a crown [6]. In the process of morphogenesis of VIBB, the formation of tubular virus-like structures with a spiral type of symmetry, covered with a single layer of capsomeres measuring 8–9 nm, was established. The arrangement of tubular structures is single or in groups of 2-6 elements, parallel or at an angle relative to each other [12,13,14]. The role of these structures in VIBB morphogenesis and the pathogenesis of the disease, as well as the reasons for their formation, have not been studied. According to Bakulin V.A. [15] The presence of tubular structures in the vaccinated material may affect the biological properties of VIBB, since they interact more actively with cell membrane receptors than particles with a cubic type of symmetry.

The genome of the virus is 2-chain RNA, with a mass component of 10% by weight of the virion [6], including 2 segments (A and B) [15]. The virion is represented by 5 polypeptides: VP1, VP2, VP3, VP4 and VR5 with a molecular mass of 90 kD, 41 kD, 32 kD, 28 kD, 21 kD, respectively. VPH or pVP2 protein, which are precursors of VP2, have also been found [16]. Segment A consists of 3400 bp. and contains 2 open reading frames (OPC), segment B includes 2800 bp and contains one reading frame [6]. Segment A encodes the VP2 and VP3 structural proteins, VP4 autoprotease and the non-structural peptide VR5, which is partially overlapped by ORF encoding VR234. Segment B encodes the VP1 protein [15]. Polyprotein VR234, from which viral proteins VP2, VP3, VP4 block the division of B cells, as a result of the splitting in the process of reproduction of the virus, probably as a result of interference with the cell cycle [17].

The VP2 and VP3 proteins are the major structural proteins of VIBB. In serotype 1 viruses, they constitute 51% and 40% of viral proteins, respectively [4.18], in contrast to VP1 (3%) and VP4 (6%). However, the exact amount of VP4 in the purified VIBB particles is not known. VP4 is a minor non-structural protein that is formed in infected cells of a 2-type with the same floating density as mature virions and therefore it can be combined with virus particles in a cesium chloride gradient [19].

VP1 protein is a viral RNA-dependent RNA polymerase (RdRp), present in the virus particle as a free polypeptide or a genome-linked protein [20,21]. VP2 is a hydrophobic glycosylated protein that is the main protein of the viral capsid. It forms trimers that have a crystalline structure and are the main elements of the viral envelope [10]. VP2 as a protective antigen, has antigenic sites responsible for the induction of neutralizing and type-specific antibodies. The VP2 structure revealed a hydrophobic highly variable domain (206–350) with hydrophilic sites at the ends located on the surface of the virion. Altering the sequence of amino acid residues of hydrophilic sites (shift - replacing several amino acid residues or drifting - replacing 1-2 amino acid residues) may cause a change in antigenic properties. So, as a result of antigenic shift, the second serotype of VIBB

appeared, and as a result of antigenic drift, variant strains of the 1st serotype appeared [6]. VP3 - is an internal capsid protein and has group-specific properties, is involved in the formation of a viral particle [22]. The VP4 protein as a viral-encoded protease by the unusual catalytic dyad Ser-Lys [23,24] is involved in the cleavage of the viral polyprotein (VR234, 108 kD) with the formation of VP2, VP3 and VP4 itself. VP5 - performs a regulatory function, is involved in the release of the virus from the cell and its dissemination [25], and also has an anti-apoptotic effect in the early stages of infection [26,27,28]. VP5 does not interfere with viral replication in vivo, but prevents the development of pathological changes in the bursa, which indicates its role in the pathogenesis of the disease [28].

Installed 2 serotypes of IBB virus. Strains within serotypes have significant antigenic differences. The first serotype of the IBD virus is isolated from chickens, the 2nd serotype is found in chickens, turkeys, and also ducks [4,18]. Serotype 1 has 6 subtypes, which are conventionally called "variant strains" [6]. Currently, serotype 1 strains based on restriction mapping and sequencing have been divided into genetic groups. A high degree of sequence homology was established in the coding region of segment B between pathogenic serotype 1 and non-pathogenic serotype 2, unlike segment A. However, in both genome segments, the coding regions are flanked by short 5 'and 3' disjoint regions (from 79 to 111 nucleotides in length) [four]. The secondary structure of the 3'-untranslated region is crucial for virus replication [29].

The molecular basis of VIBB pathogenicity is not fully understood. However, it was found that segment A is the genetic basis of the tropism of VIBB serotype 1 [30]. Boot H.J. Studies et all. [31] showed that the genetically modified chimeric virus expressing the VP2 vvIBDV gene in the genetic context of the classical serotype 1 virus does not possess the properties of a highly virulent phenotype. This fact suggests that the VP2 protein is not the only determining factor of virulence [32,33,34].

In chickens younger than 3 weeks of age, VIBB causes severe bursa damage, which is accompanied by a depletion of B cells expressing surface IgM, thereby affecting antibody responses [18,35]. It has been established that when chicks are infected at a day old, a decrease in the number of B-cells expressing IgM in the spleen and peripheral lymphocytes has been observed. At the same time, no effect on circulating $CD4^+$ and $CD8^+$ T cells was revealed [35].

VIBB infects and replicates in B-lymphocytes, as well as in macrophages [18,35,36,37]. Studies using the methods of RT-PCR and immunohistochemistry showed that for 3-5 days after infection, the number of macrophages in the bursa increased significantly. Viral RNA and proteins in macrophages were detected from 1 to 7 days after infection. In addition, the level of anti-inflammatory cytokines, such as IL-6, IL-1β, IL-18, increased in the bursa and spleen, and the level of anti-inflammatory cytokine TGF-β4 decreased [36,37].

Serotype 1 viruses can cause acute immunosuppression (mostly in chickens infected up to 3 weeks of age), accompanied by a weak antibody response and increased sensitivity to various pathogens [35]. Serotype 2 viruses do not have immunosuppressive properties [4]. Immunization of poultry with a vaccine containing VIBB 2 serotype does not protect against the 1 st serotype of the virus. It is impossible to establish the degree of protection from the 2nd serotype when using a vaccine against the 1st serotype, due to the absence of virulent viruses of the 2nd serotype [38].

After an IBB reboot in the serum of chickens, neutralizing and precipitating antibodies are detected. The virus does not agglutinate the red blood cells of chickens, horses, cattle, sheep, goats, pigs, guinea pigs, rabbits, rats and humans [1].

The virus is cultivated in SPF chicken embryos (CE) and in SPF chickens. In infected embryos, the virus is more accumulated in the yolk sac and, to a lesser extent, in the allantoicfluid. The death of chicken embryos after infection occurs at 3-8 days after infection. The dead CEs reveal edema of the abdominal cavity, hemorrhages, and necrosis on the body, necrosis, and hemorrhages in the liver, kidneys, and pulmonary hyperemia. On the chorioalantoic membrane (HAO), there are no visible lesions. In some cases, there may be a small hemorrhage. There may also be hyperemia and necrosis of the kidneys, "pale heart" [5]. When infected with variant strains of the IBB virus, the death of embryos is not high. Splenomegaly and hepatic necrosis are observed in affected embryos [6].

The IBD virus can be cultured in chick, turkey, and duck embryo cell cultures, mammalian cell lines derived from rabbit kidney cells (RK-13), Vero cells, and green monkey kidney cells (BGM-70) [4,6]. Cultivation of the IBD virus in cell cultures is accompanied by a cytopathic effect [5].

Strains of IBD virus is divided into highly virulent, slightly virulent (moderate) and apathogenic. Highly virulent strains of the IBD virus cause an acute form of the disease with a mortality of up to 30% or more. Infection, induced by weakly virulent virus strains, proceeds with erased clinical and pathoanatomical signs with lethality up to 5%. Apathogenic strains cause inaparantnuyu form of the disease, similar toperebolevaniyu after using a number of live vaccines against IBD. When infected with weakly virulent and pathogenic strains of the IBB virus, a post-infectious immunity is formed that is similar to the post-vaccination [5]. The IBB virus has interferonogenic and oncolytic properties [6].

The Gamborough disease virus is very resistant in the external environment. In the litter of birds, feed, water, the virus does not lose its infectivity more than 56 days, on the equipment of poultry farms - more than 122 days. When heated to 60 ° C, it remains infectious for 90 minutes, at + 4 ° C - more than 3 months, and at -20 ° C - more than 6 months. The virus is resistant to freezing and thawing. When heated to 56 ° C, the virus is not inactivated for 24 hours. At 37 ° C, the virus titer is reduced by 1.2 lg after 10 days. At pH 2.0, the virus retains pathogenic properties for 60 minutes, at pH 7.3 for 30 minutes. Iodine preparations inactivate the virus in 2 minutes, 0.5% solution of chloramine - in 10 minutes, 20% chloroform - in 10 minutes, 1% solution of phenol, cresol, formalin - within 60 minutes, 0.5% formalin solution - in 6 hours, 20% solution of ether - within 18 hours [1,8]. BG virus is sensitive to ultraviolet and optical radiation, actinomycin, trypsin, 5-iodine-2-deoxyuridine. 2% solution of chloramine (with 16-24% of active chlorine), disinfectants vircon, dezinpol [1] are considered to be rather effective against BG virus. The virus is inactivated at pH 12 [5].

The main target organ for VIBB is a fabric bag. The virus also persists in other organs containing lymphoid tissue. So after infection, the virus is localized in the fabric bag for 12 days, in the spleen - 10 days, in the thymus and kidneys - 8 days, in the liver - 7 days, in the lungs - 6 days, in the blood - 4 days [1]. The maximum period for virus isolation from the body is 14 days [1.39]. Cells and fabric fabricfabric bags are capable of recovery. The duration of the recovery process depends on the age of the infection and the virulence of the strain [40.41].

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