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Review Article

Review on Avian Corona Virus in Ethiopia

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Abstract

The extremely contagious disease known as Infectious Bronchitis (IB) affects the urogenital and respiratory tracts of chickens. It is brought on by the Infectious Bronchitis Virus (IBV), a member of the Coronaviridae family. Because this virus is infectious, it causes significant economic losses. Mortality, stunted growth, and high condemnation rates in meat type birds are among the economic ramifications for the poultry sector. The performance of both meat type and egg laying birds has also been shown to be impacted by decreasing egg output, lower internal and exterior egg quality, and decreased hatchability in layers and breeders. Furthermore, kidney injury is caused by certain nephro pathogenic strains. Secondary infections have the potential to worsen the illness and raise morbidity and death rates. IBV is a single stranded RNA virus that can change a great deal through genetic recombination and spontaneous mutation, giving rise to new variations. Since the virus was initially identified in 1937, nearly every continent has seen its presence. Furthermore, it is currently recognized that the majority of nations have their own native IBV versions. The rise of variant strains of IB is a major challenge to control, even with the use of currently available live and inactivated vaccinations. This study summarizes the state of IBV research as of right now.

Keywords: Infectious bronchitis; Coronaviridae; RNA virus

Introduction

Ethiopia is predicted to have 56.5 million chickens overall. Despite the large number of chickens, the sector's economic contribution remains out of proportion due to multiple productions, reproduction, and infrastructure limitations. It is well known that the two main causes of death in the country are disease and predators. Newcastle disease caused the greatest percentage of flock deaths overall (57.3%), followed by coccidiosis (9.4%), fowl pox (31.6%), and predator loss (1.7%) [1,2].

Lesions in the reproductive, urogenital, and respiratory organs are the most common sign of infectious bronchitis, an acute, highly contagious viral disease that affects chickens [3]. All ages of hens are susceptible to the illness, but young birds are particularly at risk because resistance increases with age. Following avian influenza, the condition causes significant economic losses in the chicken industry due to poor performance, lower egg output and quality, and mortality that can be severe in the presence of nephropathogenic strains or when secondary infections emerge; it is thought that IBV infection causes the third-highest losses among all livestock diseases [2,4]. IBV was found in other US states after the first serotype was identified in the US in 1931, and a wide range of IBV genotypes and serotypes were reported worldwide [5]. Despite international efforts to control it up to this point, infectious bronchitis remains an issue for the chicken business. This is mostly because to the high mutation rate, rapid generation period, and wide genetic diversity of IBV [6]. The efficiency of natural or vaccine immunity is limited by the continual emergence of genetic diversity and the selection process among IBV variants [2].

One of the main viral infections that endanger chicken productivity in Africa is IBV. 1950 saw the first reports of it in Africa, from birds exhibiting respiratory issues in Egypt. The illness, which is considered an epidemic virus, is the most common viral respiratory infection in chickens on the continent and affects both vaccinated and unprotected poultry birds [7]. Although the prevalence and types of strains of the disease have not been well explored, it is widespread in Ethiopia [8].

Therefore, the main objective of this seminar paper is:

- To highlight about the infectious bronchitis disease in chickens
- To review its clinical managements.
- To describe the prevention and control options to tackle the spread of the disease

The Disease

Avian Infectious Bronchitis (IB) is a contagious disease of birds caused by *Corona virus* and leading to economic loss in chicken operations. The infection was first described in 1931 in

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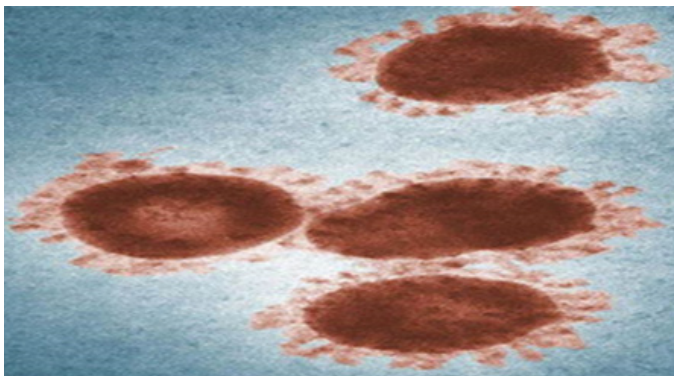

Figure 1: Structure of the avian corona virus source (© Public Health Image Library from the Centres for Disease Control and Prevention CDC).

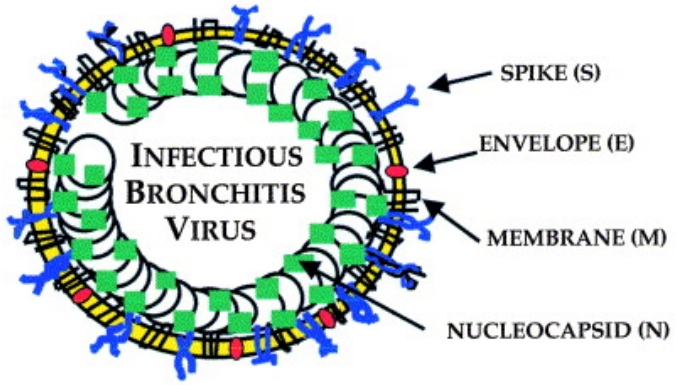

Figure 2: Structural proteins of the virus source (https://doi.org/10.1016/S0145-305X (99)00072-5).

Figure 3: Nasal discharge, wet eyes, swollen sinuses and gasping [32].

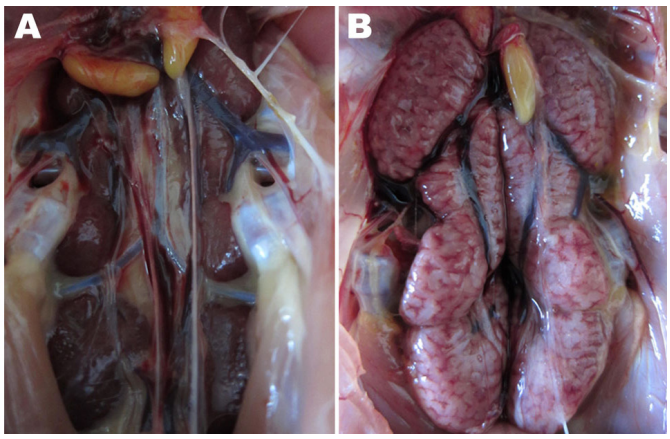

Figure 4: Normal kidneys A versus swollen kidneys B source [15].

the USA as a respiratory disease of chicks. The virus is a corona virus and is prevalent in all countries with an intensive poultry industry. The infection has a significant economic impact; in broilers, production losses are due to poor weight gains, condemnation at processing and mortality. In laying birds, losses are due to suboptimal egg production and downgrading of eggs [9].

Etiology

Infectious bronchitis virus is a corona virus that causes infectious bronchitis affecting domestic chickens. It replicates in respiratory tissues as well as other epithelial tissues such as the kidneys, gonads, and bursa [10]. However, virologists have found it difficult to pinpoint exactly which tissues and animal species these viruses replicate in, as it has been seen that they can bypass host barriers, like in the case of SARS (severe acute respiratory syndrome). Gamma Coronavirus Classical and variant strains Massachusetts serotype (Classical) have a complex construction and consist of an envelope and a nucleocapsid. They are spherical, or kidney-shaped, or pleomorphic. The surface projections are distinctive club-shaped peplomers that evenly cover the surface. The nucleocapsid is cylindrical; 2 nm in diameter. The genome is not segmented and consists of a single molecule of linear positive-sense single-stranded RNA. The viral genome encodes structural proteins and non-structural proteins [1].

The virus is a member of the Coronaviridae family and its 27.6 kb single-stranded positive sense RNA genome has the following genomic arrangement and: fifty untranslated regions 30UTR: 1a/1ab S 3a 3b E M 5a 5b. While the non-structural viral proteins are encoded by two polyproteins, the structural viral proteins include the Membrane (M), small Membrane (E), Nucleoprotein (N), and Spike (S). The spike protein, among others, is the subject of extensive research due to its genetic diversity and biological function [10].

The virus has five structural proteins that are named S, M, N, HE and E. Surface glycoprotein (or spike, S), which S protein is responsible for attachment to cells, hemagglutination and membrane fusion, Integral membrane protein (M) which spans the virus envelope three times, Nucleocapsid protein (N) , Hemagglutinin-Esterase protein (HE), which forms short surface projections, and have receptor binding, hemagglutination and receptor destroying activities and Envelope protein (E), small, envelope-associated protein unlike (-) sense RNA viruses polymerase enzymes are not present in the nucleocapsid [9].

Epidemiology

Transmission

Infectious bronchitis is spread horizontally through direct contact with chickens (between diseased and vulnerable birds) or indirectly (by wild birds, water, and other materials) [11]. Furthermore, it may persist asymptomatically in minute concentrations in the ceacal tonsils of the digestive system for a long time. Protection may not be effective even if immunization has been used for several years [9]. The affected birds shed the virus in respiratory secretion and faeces. The virus spreads rapidly among chickens in a flock through inhalation of virus droplets produced by infected chickens. Infection is also transmitted by aerosols, contaminated feed and water, contact with animals or material. Movement of live birds is considered as a potential source for the introduction of IBV. Affected birds recover within 14 days. However, a small number of chicks may become latently infected with erratic shedding of virus for a prolonged period of time via both faeces and aerosol [10]. There is no carrier state and vertical transmission. No vectors are also involved in the spread. Incubation period is 24 – 48 hours and severity of the disease is influenced by strain of the virus, age of bird, immune status of bird, cold stress and coinfection with other diseases like *Mycoplasma* and *E. coli* [12].

Geographic Distribution

Infectious bronchitis is widely distributed geographically and has been identified in parts of Africa, Asia, Australia, Europe, and the Americas [13-15]. It is one of the most endemic viral respiratory infections of chickens in Africa, where it is widespread in both vaccinated and unvaccinated poultry birds and is regarded as an epidemic virus [16,17]. The most significant IBV variations (793B, 4/91, and CR88) may be found in European nations as well in North Africa, where variants have received less attention, may represent a reservoir for these variant [18]. In fact, the 793B form, which originated in North Africa, has been discovered to have been present in France since 1985 [19]. The IBV variation 793B has been reported in Ethiopia by Hutton *et al*, [20] in 2017 and by Tegegne *et al* [8] in 2020.

Seroprevalence and Associated Risk Factors

The study carried out by Birhan *et al* [21] in northern Ethiopia indicated a seroprevalence of 24.6% and the study by Shiferaw *et al* [22] in Debrezeit, Ethiopia discovered a prevalence of 94.5 %. The study conducted by Tesfaye *et al* [23] and by Yonas *et al* [24] were found 70.6 % and 64.7 % seroprevalence of IB in Hawassa, and Ada'a Districts of Ethiopia, respectively.

The prevalence varied significantly among chickens of different ages. According to the study by [25], young chickens had the higher prevalence than adults. All age groups of chicks are susceptible to IBV; young chicks are more vulnerable than older ones [4]. Additionally, as chickens get older, their resistance to diseases is stronger as well. The prevalence of the disease is higher in exotic breeds than the prevalence of in local breed. This might be due to exotic breeds limited resistance to disease and other environmental stresses [26].

An investigation of the prevalence of IB in chicken farms indicated that intensive farming had higher seroprevalence than its extensive equivalents as indicated in commercial poultry farms in Nigeria by Oyejide, *et al*. [27], in Jordan by Rousson, *et al*. [28] and in Ethiopia by Hutton *et al*. [20]. Higher seroprevalence was found in layers and dual-purpose chickens as compared with broilers [29]. This could be explained by layer and dual-purpose birds spending more time on the farm than other birds, which leads to their re-infection if there is no effective way to manage it [30] and the longer the chickens were exposed to the virus, the higher the seroprevalence of IB became [31].

A higher seroprevalence was obtained in females than in males as indicated study of local chickens in live bird markets in Sokoto State, Nigeria, with a higher prevalence in females than in males. Due to differences in the activity of humoral- and cell-mediated immune responses between the sexes, this may be due to the presence of a less effective immunological response in males than in females [25].

Clinical Signs

The virulence of the virus and the organ or system implicated determines the severity and clinical aspects of IB infection. Although clinical indications of simple infection persist less than seven days and have a mortality rate of 5% to 25%, chronic infection can last for several weeks [19]. Respiratory rales (gurgling and snicking) and ocular discharge are associated with moderate morbidity and low flock mortality. With deformed shells, mature flocks produce fewer eggs [32]. The infection in young chickens is characterised by gasping, coughing and nasal discharge with wet eyes and swollen sinuses. The chicks appear depressed and may huddle near the heat source. Food consumption and weight gain are also reduced. In adult laying flocks, the respiratory symptoms of gasping and coughing are usually followed by a drop in production Pullets in good condition may suffer only a slight drop in production and regain normal production within few weeks. Production of misshapen soft-shelled eggs with inferior internal quality is often observed. Secondary bacterial infection due to *E.coli* complicate the disease scenario and lead increased condemnation of birds [12].

Diagnosis Methods

Although IBV is a virus that causes significant economic losses in poultry, there are no distinct clinical indications of IB. When there are clinical concerns in the field, it is vital to employ methods to identify IBV. IB can be diagnosed in general by identifying the virus (or components of it) or particular antibody reactions. Serological tests involving the Virus Neutralization Test (VNT) and Hemagglutination Inhibition (HI) test for detection and serotyping of Infectious Bronchitis Virus can be used to make various diagnoses. The gold standard test is VNT, while cross-neutralization assays are utilized for variation detection [33]. IgM IgG-specific ELISA is most commonly used in the field for monitoring antibody response because it is more sensitive and simpler. Choosing the proper test for diagnosis and then interpreting the results can be complicated and complex. An immunofluorescence assay or the isolation and identification of the causative virus utilizing egg inoculation or tissue culture techniques can be used to confirm the diagnosis. RT PCR is used to quickly diagnose IB when suitable laboratory resources are available. Retrospective diagnosis is achievable using an ELISA or SN assay to demonstrate a significant increase in circulating antibody in paired acute and recovery-phase samples [32].

Post mortem lesions like airsacculitis excessive mucus in the trachea, haemorrhagic tracheitis, severely congested lungs with exudates, perihepatitis, pericarditis, swollen kidneys and uroliths are also used to diagnose the disease [12].

Treatments

There is no specific treatment for infectious bronchitis as there is no effective treatment for viral diseases. Antibiotics against secondary bacterial pathogens can be provided in the case of mixed infections. In the event of nephropathogenic IB, 72mEq sodium and/or potassium might be given in the drinking water, with one-third in the citrate or bicarbonate salt form. To limit IB losses, extra heat sources, excellent ventilation, preventing overcrowding, and controlled feed consumption can be implemented [33].

Prevention and control

Due to the enormous number of IBV strains and the rapid evolution of new strains, control and management techniques to avoid IBV infection are problematic. However, biosecurity and management measures such as strict isolation, repopulation of single-day chickens after cleaning and disinfecting the room, distinct age groups of birds reared separately, and a vaccination program can be used to prevent IBV from spreading. After each chicken flock, restocking must take place at least 10-14 days apart [34,35]. Vaccines are administered through drinking water, via eye drops, nasal illustration, or aerosol sprays. Despite commercially available live and inactivated vaccinations, monitoring infections is difficult due to considerable variation. When the vaccine is available, the best way to treat IBV is to utilize vaccine strains that are similar to those found in

a particular farm or field. Broilers, as well as breeders and layer pullets, frequently receive activated or live immunizations inactivated oil emulsion vaccines preceded by a live virus vaccine produce persistent antibody response. Strict biosecurity measures and good husbandry practices will minimize the spread of IBV. During outbreaks, the virus should be serotyped and vaccine should be altered. In areas where there is no IB, use of live vaccine should be minimized [33].

Conclusion and Recommendations

Avian infectious bronchitis continues to be a major problem for the global chicken industry. Since the virus is constantly changing, many localized and worldwide variations have been found. However, the previous analysis of the existing data does not suggest additional vaccinations at every turn. Thankfully, a few live vaccines offer wide protection against the majority of genotypes known to cause nephrotropic and respiratory forms of the disease. Including selected strains in inactivated vaccines is a viable substitute. Aside from this, it seems that enhanced management, ongoing active surveillance, and farm biosecurity are all crucial to reducing losses brought on by IBV infections.

Author Statements

Authors' Contributions

Conceptualization, writing-original draft preparation, T.M and O.M, Writing-review and editing, T.M

Competing Interests

The authors declare that there are no conflicts of interest.

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