Infectious Bronchitis (IB) in poultry

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Introduction

Infectious Bronchitis Virus (IB or IBV) is an acute, highly contagious viral respiratory disease of chickens characterised by tracheal rales, coughing, and sneezing. It is a disease of major economic importance worldwide because it is associated with production losses in the form of poor weight gain and feed conversion, which result from mixed infections, including airsacculitis. It also results in decreased egg production, egg quality declines, as well as abattoir condemnations. It primarily affects domestic chickens (Gallus gallus), but it can also infect other Galliformes like pheasants and partridges.

Control through immunisation is complicated by the highly transmissible nature of the IB virus as well as the occurrence of multiple serotypes. IB has no public health significance.

Production inefficiency losses are usually of greater concern than mortalities, although in broilers, the mortality rate due to IB could be economically significant. Mortalities in broilers from IB usually peak in the last 2 weeks of life. Some nephropathogenic strains may cause mortalities up to 30% and lead to significant abattoir condemnations.

Aetiology and epidemiology

IBV is an avian gammacoronavirus (SARS-CoV-2 is a coronavirus that belongs to the beta coronavirus genus) that only causes disease in chickens, although the virus has also been found in pheasants and peafowl, which may be subclinically infected. The virus has a worldwide distribution, and many antigenic types can cocirculate in a given region. This often complicates IB vaccination programs. Some IBV types are widespread, whereas others are regional.

Infected poultry shed IBV in respiratory discharge as well as faeces, and it can be spread by aerosol, ingestion of contaminated feed and water, and contact with contaminated equipment and clothing. Poultry that are naturally infected and/or those vaccinated with live IBV vaccines may shed virus intermittently for up to 20 weeks after infection. The incubation period is generally short at only 24–48 hours, with the peak in excretion of virus from the respiratory tract lasting 3–5 days after infection.

The severity of the disease and the body systems involved are affected by:

- Strain of the virus
- Age, breed, immune status, and diet of the chicken
- Environmental conditions – esp. ammonia and CO2 levels and cold stress.

Coinfection with diseases such as *Mycoplasma gallisepticum*, *M. synoviae*, *Escherichia coli*, and/or *Avibacterium paragallinarum* (Infectious Coryza) or any other respiratory pathogen can exacerbate disease.

Clinical and postmortem findings

Due to the high transmissibility of IBV, affected flocks often have up to 100% morbidity rate. Symptoms include coughing, sneezing and tracheal rales. Conjunctivitis and dyspnea may be seen, and sometimes facial swelling, particularly with concurrent bacterial infection of the sinuses.

Birds often appear depressed and may huddle under the heat source. Feed consumption and weight gain are reduced with a resultant increase in feed conversion ratios. Infection with nephropathogenic strains can cause initial respiratory signs, then later depression, ruffled feathers, wet droppings, greater water intake, and death. The resultant wet litter often leads to increased abattoir condemnations from lesions such as breast blisters, hock burns and footpad dermatitis.

In layers, egg production may drop by as much as 70%, and eggs are often misshapen, with thin, soft, wrinkled, rough, and/or pale shells, and can be smaller and have watery albumen. Egg production and egg quality can return to normal, but this may take up to 8 weeks. In most outbreaks, mortality is approximately 5%, although mortality rates can be as high as 60% when the disease is complicated by concurrent bacterial infection or when nephropathogenic strains induce interstitial nephritis in chicks.

In breeders/layers that are well vaccinated, IBV is often only associated with egg production losses and abnormalities, and not associated with clinical signs. Infection of chicks may cause permanent damage to the oviduct, resulting in layers or breeders that never reach normal levels of production, so-called false layer syndrome. This results in the so-called penguin stance/gait.

In the respiratory tract, the trachea, sinuses, and nasal passages may contain serous, catarrhal, or caseous exudates, and the air sacs a foamy exudate, progressing to cloudy thickening. If complicated by infection with *E. coli*, there may be caseous airsacculitis, perihepatitis and pericarditis.

Birds infected when very young may have cystic oviducts, whereas those infected while in lay have an oviduct of reduced weight and length and regression of the ovaries. Infection with nephropathogenic strains results in swollen, pale kidneys, with the tubules and ureters distended with urates; in birds with urolithiasis, the ureters may be distended with urates and contain uroliths, and the kidneys may be atrophied.

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Figure 1: Respiratory lesions (tracheitis) associated with IBV infection

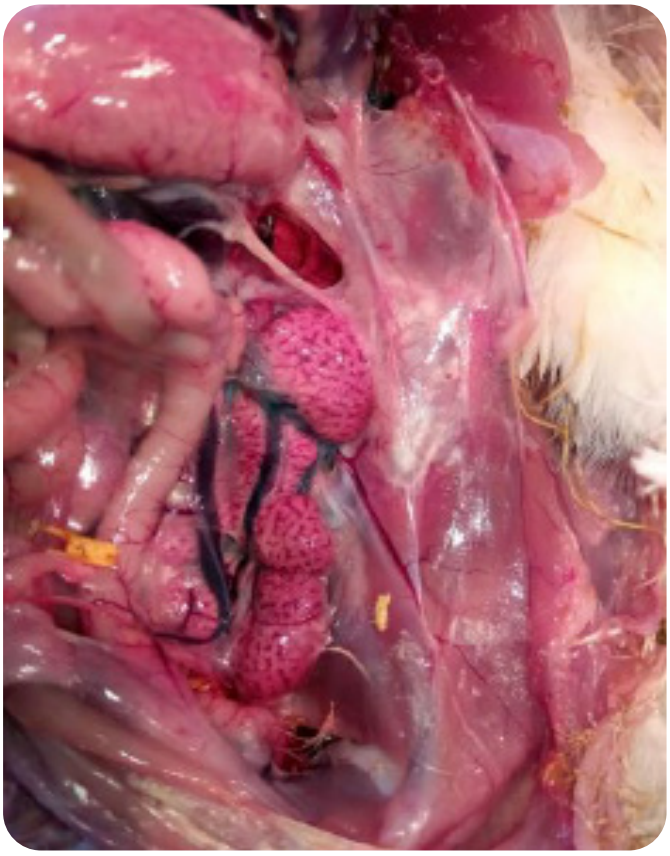

Figure 3: Nephritis in a broiler chicken after Variant 2 IBV infection

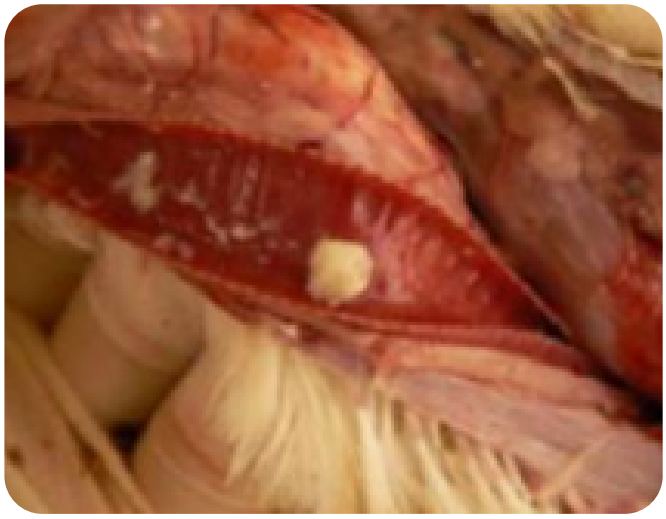

Figure 2: Tracheal plug

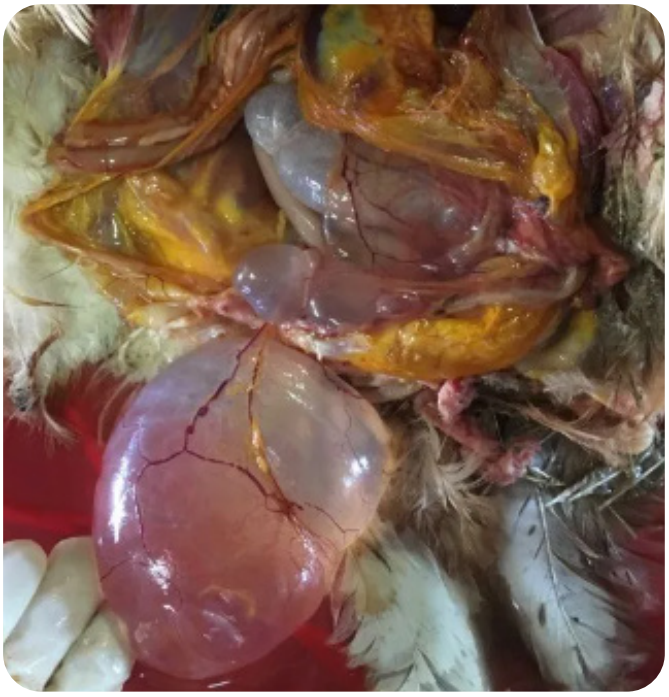

Figure 4: Oviduct cyst in a broiler breeder hen

Differential diagnoses

Newcastle Disease, mycoplasmosis, infectious laryngotracheitis, low pathogenicity avian influenza, infectious coryza

Sampling

When to Sample:

- The critical time for isolation or identification of pathogens is 3-5 days post-infection in the upper respiratory tract. Virus titers fall quickly below detection levels post 2 weeks.
- Broilers: Best time appears to be between 16 and 20 days of age
- Layers/Breeders: Often infections occur around peak production (27 – 31 weeks), so this would be the best time, but if symptoms are seen at other ages, samples can be taken at those time points as well.

What samples to take:

- Blood
- Cloacal swabs, choana swabs
- Trachea, caecal tonsils and kidney tissue samples
- Take samples from "healthy-looking" birds.
- Take samples from at least 10 birds per house.

Transport to the lab:

- As soon as possible, in an ice pack, or frozen (-20 ^{0}C).
- If it is not possible to send organs/swabs, the samples can be smeared onto FTA cards, and these can be sent to the relevant lab as well for typing.

Diagnosis

A presumptive diagnosis can be made by clinical signs and clinical history. Confirmation is generally needed due to the large number of diseases that show similar symptoms. Serology can be used for diagnosis if an elevation in antibody titers can be demonstrated. Thus, two samples are needed, one at the beginning of the disease and a second sample 10 days later. Identification of serotype is recommended, especially if vaccinated animals develop the disease.

Diagnosis is broadly based on the detection of rising antibody titers by ELISA or HI testing and virus detection and typing using RT-PCR and sequencing. Because clinical and PM signs are often non-specific, it is important to rule out other diseases / pathogens such as Newcastle disease virus, avian metapneumovirus, infectious laryngotracheitis virus, mycoplasmas, *A. paragallinarum*, and *Ornithobacterium rhinotracheale*. This may also diagnose coinfections.

Definitive diagnosis is generally based on virus detection and identification. Virus can be isolated by inoculation of homogenates of tracheal, cecal tonsil, and/or kidney tissue into 9- to 11-day-old SPF chicken embryos, with growth of IBV indicated by embryo stunting and curling and by deposition of urates in the mesonephros, with variable mortality.

Alternatively, IBV may be isolated in tracheal organ cultures, with growth of the virus indicated by cessation of cilial motility. Several blind passages of the virus may be necessary for isolation of some field strains. Diagnosis is commonly achieved using reverse transcriptase PCR assays to detect viral RNA in nucleic acid extracts of tracheal, cecal tonsil, or kidney tissue.

It is crucial to type IB viruses to diagnose outbreaks that are caused by serotypes that are distinct from those of the vaccines used in a flock and to determine an IBV vaccination program.

Serotypes have been identified using sera from SPF chickens inoculated with known serotypes in virus neutralisation tests. However, because this is expensive and time-consuming, it is not readily available. The S1 region of the spike glycoprotein can be used to determine the genetic type of the virus, which correlates with the virus serotype. RT-PCR products derived from this region can be analysed by nucleotide sequencing, and then the amino acid sequence compared to sequences in a gene bank to determine its relatedness to known strains.

Molecular diagnosis of IBV on clinical samples is becoming more and more common, and serology is used less frequently.

For molecular testing, it's important to know exactly what type of test and kit your lab uses and what its capabilities are. Also, know whether they can distinguish between field and vaccine strains.

While virus isolation gives you a virus to work with, PCR only gives you a sequence, but it is faster and more cost-effective.

Control

Attenuated live and killed vaccines are used to control the disease, but little or no cross-reactivity between types requires the correct vaccine type to be applied.

No medication alters the course of IBV infection, although antimicrobial therapy may reduce mortalities caused by complicating bacterial infections. In cold weather, increasing the ambient temperature may reduce mortalities, and reducing the protein concentrations in feed and providing electrolytes in drinking water may assist in outbreaks caused by nephropathogenic strains.

The live-attenuated vaccines used for immunisation may produce mild respiratory signs. These vaccines are initially given to 1- to 14-day-old chicks by spray, drinking water, or eye drop, and birds are commonly revaccinated approximately 2 weeks after the initial vaccination. Revaccination with a different serotype can induce broader protection, in what is known as the "protectotype" principle.

Attenuated or adjuvanted inactivated vaccines can be used in breeders and layers to prevent egg production losses as well as to pass protective maternal antibodies to progeny.

There are many distinct types of IBV, and new or variant types, which are not fully controlled by existing vaccines, are identified relatively frequently. Variant viruses historically arise from mutations accumulating over time as the virus replicates (genetic drift). However, recombination can occur in coronaviruses and may result in unique viruses that may or may not cause disease.

Selection of vaccines should be based on knowledge of the most prevalent virus type(s) in the area. The correlation between IBV type and protection is imperfect, and selection of the most appropriate vaccine, or combination of vaccines, may require experimental assessment *in vivo*.

The most used live vaccines worldwide contain derivatives of the Massachusetts strain (Ma5 and H120). In addition, there are several different IBV vaccine types licensed for use in various countries, as well as live and killed autogenous vaccines specific to the variant virus in the region.

Sources

1. https://www.msdvetmanual.com/poultry/infectious-bronchitis/infectious-bronchitis-in-poultry
2. Diseases of Poultry. Swayne, D et al. 14th Edition. 2019

MULTIPLE-CHOICE QUESTIONS

QUESTION 1

Which statement is true?

a) IBV is a disease of chickens only
b) IBV only affects the respiratory tract
c) IBV is caused by a Coronavirus
d) IBV is a zoonosis
e) c and d

QUESTION 2

Which statement is true?

a) IBV is a notifiable disease
b) There are no vaccines available against IBV
c) Coccidiosis is a DD for IBV
d) IBV infection may lead to false-layer syndrome
e) None of the above

QUESTION 3

Which statement is true?

a) The incubation period for IBV is only 24-48 hours
b) IBV spreads vertically through the egg to the chick
c) IBV is a zoonosis
d) None of the above
e) a, b and c

QUESTION 4

Which is not a symptom of IBV in poultry?

a) Coughing
b) Stargazing
c) Sneezing
d) Tracheal rales
e) Conjunctivitis

QUESTION 5

Which test is not used to diagnose IBV?

a) *Serology - HI*
b) Serology - ELISA
c) MRI scan
d) PCR
e) Virus isolation from embryonated SPF eggs

QUESTION 6

Which statement is true regarding vaccination against IBV?

a) All IBV vaccines are inactivated (killed) vaccines
b) IBV vaccination is commonly done through the wing-web route
c) H120 and MA5 are known as Massachusetts-type vaccine derivatives
d) None of the above
e) All of the above

QUESTION 7

Which statement is true regarding sampling for IBV?

a) Sample from at least 3 birds per house
b) Only sample from dead birds
c) Feather samples are crucial for the detection of the virus
d) All of the above
e) None of the above

QUESTION 8

When advising a small-scale farmer on IBV prevention and control, which applies?

a) Source chicks/birds from a reliable source with known vaccination history
b) Vaccinate birds with IBV vaccines, based on prevalent IBV strains in the area
c) Follow good biosecurity protocols to limit the introduction and spread of IBV and other disease
d) All of the above
e) None of the above

QUESTION 9

Which statement is true:

a) Coronaviruses have a high rate of mutation
b) Coronaviruses have spike proteins on their surfaces
c) Coronaviruses are naked (non-enveloped)
d) a and b
e) a,b and c

QUESTION 10

Which of these diseases of poultry are notifiable?

a) Newcastle Disease
b) IBV
c) Low path Avian Influenza (LPAI)
d) High path Avian Influenza (HPAI)
e) a, c and d.

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