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Viral Diseases of the Respiratory System

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ABSTRACT Infectious bronchitis, Newcastle disease, infectious laryngotracheitis, avian influenza, and pneumovirus are the viruses that more frequently affect the respiratory tract of chickens. Because of the tendency to change its antigenic properties, infectious bronchitis is currently the viral disease present in most poultry producing areas of the world. New serotypes and variant strains are reported in several countries. Current commercially available vaccines do not always provide protection against new field isolates. Vaccination programs are constantly adjusted in an attempt to improve

protection against this disease. Infectious laryngotracheitis has appeared in the broiler industry as a serious disease. Improved vaccines are needed to control the disease in broilers. In the U.S., the control of the highly pathogenic forms of avian influenza and the velogenic forms of Newcastle disease have been achieved by eradication. In other countries, effective vaccines have been used to control Newcastle and avian influenza. Avian pneumovirus infection is also an emerging disease of chickens and turkeys.

(*Key words:* infectious bronchitis virus, Newcastle disease virus, infectious laryngotracheitis virus, avian influenza virus, avian pneumovirus)

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INTRODUCTION

Several avian viruses have a predilection for the respiratory tract of chickens: infectious bronchitis virus (IBV), Newcastle disease virus (NDV), infectious laryngotracheitis virus (ILT), avian influenza virus (AIV), and pneumovirus primarily infect the respiratory tract of chickens. Other viruses, such as adenovirus and reovirus, are generally considered to be secondary invaders of the upper respiratory tract of chickens.

Pneumovirus and ILTV have been found in tissues of the respiratory tract, whereas IBV, NDV, and AIV also invade other tissues such as the kidneys and the reproductive system (IBV), the gastrointestinal tract (NDV, IBV, and AIV), and the central nervous system (NDV, AIV).

To control most respiratory viruses, live and inactivated vaccines have been developed and used by the poultry industry for many years. In most cases, live vaccines are prepared with attenuated strains of the respective virus and therefore, these viruses replicate in the tissues of the respiratory tract, inducing a reaction that is known as postvaccination reaction. The degree of this reaction varies from very mild to severe, depending on factors such as degree of attenuation, concentration,

route, and age of administration of the vaccine virus. Severe postvaccination reactions are observed when environmental factors or secondary infections with other microorganisms occur, resulting in what is commonly known as complicated postvaccination or respiratory reactions. The vaccine viruses most frequently involved in these type of reactions are the IBV and NDV viruses, probably because these two viruses are commonly used in vaccination programs throughout the world.

INFECTIOUS BRONCHITIS VIRUS

The Coronavirus IBV constitutes one of the most important viruses in poultry medicine because of its numerous serotypes that have been described (Hopkins, 1974; Johnson and Marquardt, 1975). The Massachusetts (Mass) strain of IBV is considered to be the prototype strain for the group and is the representative of the Mass serotype. Viruses or strains that differ from the Mass strain are known as serotypes, and have been described in numerous countries of the world. Variant strains, or isolates that differ from the common serotypes, have also been described (Gelb *et al.*, 1991). Numerous descriptions of viruses that differ from the common IBV serotypes have appeared in the recent literature. In

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Abbreviation Key: AIV = avian influenza virus; IBV = infectious bronchitis virus; ILTV = infectious laryngotracheitis virus; Mass = Massachusetts; NDV = Newcastle disease virus; TRT = turkey rhinotracheitis.

Australia, two genotypically distinct groups of strains have been described, some of them exhibiting nephropathogenicity (Sapats *et al.*, 1996). In Japan, IBV strains with additional tropism for tissues other than the respiratory tract have been described (Otsuki *et al.*, 1990; Animas *et al.*, 1994). In Hungary, nephrotropic strains were identified as different from the Mass 41 and H52 strains (Tarcha *et al.*, 1990). French workers described the IBV strain PL 84084 as a variant strain (Bonney *et al.*, 1993). Strain 624/I isolated in Italy was described as being distinct from several European and American strains (Capua *et al.*, 1994). Several variant serotypes isolated from commercial layers and broilers were described by Gelb *et al.* (1991) in the U.S. Enterotropic strains of infectious bronchitis virus have also been reported in the U.S. (Karaka *et al.*, 1990; Lucio and Fabricant, 1990), and in England (Ambali and Jones, 1990; Ambali, 1992).

In Great Britain, strain 4/91 is now recognized as serotype 793B, a new group of IBV strains considered to be different from commonly known IBV strains (Gough *et al.*, 1992; Parsons *et al.*, 1992; Adzhar *et al.*, 1995). Neutralizing antibodies against this virus have been found in several countries (Cook *et al.*, 1996). Because the commercially available vaccines did not control the condition in the field (Parsons *et al.*, 1992), a new vaccine prepared with strain 4/91 has been approved for use in Europe.

With the common use of molecular techniques to study avian viral isolates, the possibility of finding differences among isolates is greater than the possibility of finding similarities. Perhaps it is necessary to attempt to establish groups of viruses based on their shared characteristics, with additional work *in vivo* to determine the ability of current vaccines to protect against new viral isolates, as has already been suggested (Avellaneda *et al.*, 1994).

NEWCASTLE DISEASE VIRUS

The NDV situation in the U.S. differs considerably from other parts of the world. Strains of the lentogenic type are commonly isolated from respiratory outbreaks, mainly from broiler flocks that have been vaccinated with lentogenic strains, mainly the B1 strain. Vaccine reactions are common especially when certain environmental factors are present. The number of NDV isolations increase during the cold season, whereas in the summer very few outbreaks caused by lentogenic strains are observed. Velogenic, viscerotropic, or neurotropic strains of Newcastle disease virus have not been isolated from the commercial poultry industry in the U.S. in more than 20 yr.

The NDV situation overseas is quite different. In several countries, the velogenic form of the disease is considered endemic, with outbreaks caused by velogenic, viscerotropic NDV and velogenic, neurotropic strains reported with some frequency. During 1996, outbreaks of the velogenic form of the disease were

reported in the bulletin of the International Office of Epizootics from the following countries: South Africa, Zimbabwe, Uganda, Botswana, Angola, Belgium, Denmark, France, Netherlands, Austria, Russia, Indonesia, Malaysia, Korea, Colombia, and Paraguay. Numerous countries also reported the isolation and identification of NDV strains that have not been classified (O.I.E. Bulletin, 1996). These reports suggest that the velogenic and neurotropic forms of the virus are still present in several countries, and that the vaccination programs established to control the disease in most cases maintain these field viruses under control.

The live vaccines used to control NDV around the world are, with very few exceptions, of the lentogenic type: B1, LaSota, F (Asplin), V4, Ulster and VG/Ga. Mesogenic strain are now very seldom used. The tendency of the poultry industry is to use vaccines of low reactivity, although still providing a high rate of protection. Such vaccines are already on the market, as well as recombinant vaccines.

INFECTIOUS LARYNGOTRACHEITIS

Infectious laryngotracheitis used to be of concern mainly to the layer and breeder industry; however, during the last few years, serious outbreaks of the disease have been seen in broilers. In The U.S. in some broiler producing areas, the disease has been present in the last 3 to 5 yr. To control the condition, vaccines of chicken embryo origin as well as cell culture have been used with limited success. The recommended application route of these vaccines is the intraocular procedure, a method clearly inappropriate for the broiler industry. Several applications via the drinking water have given mixed results in broilers, where postvaccination reactions have been observed as well as a decrease in the production parameters in the vaccinated flocks. When outbreaks are present, new vaccines should be tested for use in broilers. In Japan, a cell-associated vaccine has been developed for injection at 1 d of age (Taneno *et al.*, 1990, 1991; Honda *et al.*, 1994). The authors reported satisfactory results in broilers. At the Poultry Diagnostic and Research Center of the University of Georgia, attempts are being made to develop stable attenuated strains that can be administered to broilers in the drinking water (Villegas *et al.*, 1997). New or improved vaccines are needed.

PNEUMOVIRUS

This group of viruses is now widely distributed in the poultry industry. The disease in turkeys was called turkey rhinotracheitis (TRT), and in some cases, "swollen head syndrome," which is the term used to describe the condition in chickens. Although the name avian rhinotracheitis was proposed, it appears that the name avian pneumovirus infection is most appropriate for both species (Jones, 1996). In chickens, broiler breeders have been more severely affected, with swell-

ing of the infraorbital sinuses being the most common sign or lesion. Torticollis is observed in the late stages of the disease in breeders. This clinical manifestation has not been observed in broilers.

Although in some countries the presence of the disease has been diagnosed based on virus isolation, antibodies have been detected in numerous countries. The virus neutralization and ELISA tests have been used frequently to detect antibodies against this virus.

To control the disease, live and inactivated vaccines have been used in chickens and turkeys. Although in some countries vaccination results have been variable, in the author's experience, the respiratory conditions and declines in production are more easily controlled in vaccinated flocks.

AVIAN INFLUENZA

Sporadic outbreaks of avian influenza were reported in several countries (O. I. E. Bulletin, 1996). In general, the highly pathogenic form of the disease is easily diagnosed mainly because of the high mortality and typical lesions observed. However, the disease caused by the low pathogenic strains is not always easily recognized, and the virus can rapidly spread to other susceptible poultry populations. Also, low pathogenic strains can become highly pathogenic, as it has already been observed in outbreaks in the USA in 1983, and in Mexico in 1994.

The control of avian influenza is based on eliminating the virus by eradicating the disease, or establishing a vaccination program using inactivated vaccines to decrease the rate of virus multiplication in the field, with the final goal of eliminating the virus.

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