The evolution of Marek's disease and solutions to increase protection

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Currently, Marek's disease (MD) is well under control in most parts of the world. Sporadic outbreaks still occur in certain countries but Marek's disease virus (MDV) isolates of higher virulence than vv+ strains have not been reported. It is uncertain if MDV will continue its evolution towards greater virulence.

The first wave of virus evolution from mild MDV to virulent (vMDV) strains was during the 1950s, and was likely due to the transformation of the industry to highly intensive poultry practices.

Subsequent evolution has been attributed to the introduction of successive generations of MD vaccines. The more recent evolution is likely due to the fact that MD vaccines fail to produce a sterilising immunity, allowing viruses to replicate in and be shed from vaccinated hosts.

MD has been successfully controlled by vaccination since 1970. It is difficult to estimate the total effect of MD vaccination on the poultry industry. Condemnation data from the USDA reveal, at least partially, the remarkable reduction in the incidence of MD after vaccines were introduced.

According to the data provided by the National Agricultural Statistics Service, losses from condemnation of young broiler chickens with MD in the United States decreased from 1.5% in 1970 to 0.003% in 2006, a reduction of over 99%. In countries that were already using CVI988 vaccine, the use of polyvalent vaccines (serotypes 1, 2 and 3), revaccination, improving vaccination techniques, and better control of other immunosuppressive diseases have been the strategies which have taken control of MD.

Evolutionary trend

One of the greatest concerns facing the poultry industry is the evolutionary trend of MDV toward greater virulence.

Unfortunately, the great efficacy of MD vaccines seems to have been accompanied with an increase in MDV virulence.

Both HVT and bivalent vaccines have provided adequate protection for a period of about 10 years. The era of CVI988 vaccines have already exceeded that of HVT or bivalent vaccines. The evolution of MDV has been mainly monitored in the USA. CVI988 vaccine was used without interruption in Europe and other countries since 1972 and no obvious 'vaccine failures' were reported until early 1990s.

At present it is not clear why more virulent pathotypes are able to break vaccine immunity. An increased oncogenic potential might be a reason. However, it is also possible that the severe immunosuppression together with stronger in vivo replication of the highly virulent MDVs could be responsible for the loss of vaccine efficacy.

Disease control

In some European countries, MD has been kept under control with losses kept to a minimum. This has been achieved by adopting all-in all-out methods of production, high standards of husbandry and good sanitation, and biosecurity. Without there being a serious problem with MD, there is unlikely to be greater pressure on vaccine manufacturers to invest in the development of the next generation of MD vaccines or to develop novel strategies to combat MD.

Cell-associated MD vaccines are very labile and there is evidence that they are frequently prepared incorrectly and diluted or administered at a less than protective dose which induces a poor immune response in supposedly 'immunised' chickens. Other unhelpful management practices, such as reuse of the floor litter in the chicken farms or multi-age flocks contribute to an early MDV challenge. In the USA, it is a general practice to house chicks in pens that are not thoroughly cleaned after the previous flock.

Since vaccinated chicks do not develop a good immunity until 7-14 days of age, these chickens are exposed to MDV when they are not completely immunised, which make the vaccine preparation technique and the type of delivering system important factors in the disease control strategy.

Serotype 3 MDV (HVT) strains replicate better in ovo than viruses of other serotypes. However, strain CVI988 has been shown to induce higher protection against challenge during the first three days of life when administered in ovo than when administered at hatch.

In the next five years there is likely to be increasing reliance placed on the serotype 1 CVI988 vaccine to protect against MD in most countries worldwide. The CVI988 vaccine will be used either alone or, in areas where there are severe problems with vv+ strains of MDV, in trivalent combination. In some poultry companies, increased use of revaccination with MD vaccines will be made. However, it should be borne in mind that revaccination is an added production cost in an industry where unit products have a low value and profit margins are very slender. Pressure to reduce the costs of revaccination, as well as a need to provide earlier vaccine protection against MDV, will inevitably mean greater use of in ovo methods for vaccination. It is very likely that recombinant DNA vaccines will be the basis for control of MDV in the future, however there are several limitations such as: limited knowledge of which viral genes are involved with immunity or virulence and what combination of genes must be expressed or deleted to produce an effective vaccine.

Future solutions

Some possible solutions that could be used to help increase protection against the emerging more virulent isolates include:

1Adjuvants and immunomodulators. The use of cytokines and adjuvants such as acemannan with MD vaccine could enhance the innate immune response and induce an earlier maturation of the immune system.

1Alternating vaccines. The use of alternating vaccines strains in successive batches of chickens might diffuse the pressure on the viruses to mutate.

1Genetic resistance. The identification of disease resistance genes in chickens to help selective breeding is a possibility, as well as the development of transgenic chickens that interfere with MDV pathogenicity, may improve disease control. ■

References are available from the author on request