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An Overview of Myeloid Leukosis in Meat-type Chickens

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Myeloid Leukosis (ML) is caused by a retrovirus, first isolated from meat-type chickens in the United Kingdom by Dr. L N. Payne and his colleagues in the late 1980's. The virus has been classified as a subgroup J Avian Leukosis Virus (ALV-J), which appears to be a recombinant of an exogenous avian leukosis virus (ALV) with an envelope (env) gene possibly originating from an endogenous (subgroup E) ALV. ALV-J can infect cell cultures from other avian species, but not mammalian cells. No strains of genetically resistant meat-type chickens have been found to date. Commercial Leghorn chickens appear to be resistant to tumor development, but they may be susceptible to infection.

An important economic impact of ALV-J in adult chickens involves high mortality associated with tumors of the myelocytic cell lineage. Clinical infection may result in lower fertility (due to male depletion), and a reduced number of hatching eggs and chicks per housed hen (because of the high mortality in the breeder females, which may reach an overall high of 6% per month or higher at its peak). Tumors of various kinds may be found in up to 60-70% of the dead birds in severely affected adult flocks, myelocytomas being the most common type of tumor. Gross microscopic findings should always be confirmed through virus isolation and identification. Work is in progress to assess the impact of ALV-J infection in broilers. Preliminary clinical observations suggest that broilers stemming from breeder flocks with high virus shedding rates may experience uniformity problems, paleness, abnormal feathering, and higher late overall mortality (>5 weeks of age), usually associated with respiratory disease, but many broiler flocks originating from infected breeder flocks may exhibit an inadequate performance. Myelocytic and erythrocytic leukemias are commonly found in affected adult birds. All these effects together may amount to poor economic performance in broilers and breeders, but further work is needed to clearly assess the role of ALV-J infection in breeder and broiler performance. At the pedigree level, eradication programs may force primary breeders to reduce their genetic selection pressure, so that infected birds can be eliminated from pedigree stock.

Most tumors associated with ALV-J infection are expressed as myeloblastomas or myelocytomas, which are usually expressed beginning at 17 weeks of age. Variations in the clinical and pathological picture of field cases may depend on various factors including: age of infection, genetic composition of the breed or breed cross, concomitant infections with immunosuppressive agents, and multiple predisposing or complicating environmental and management factors. Tumor expression and virus shedding appear to be higher during the first few weeks of egg production, but they remain present throughout the life of the flock. Cases of very acute ML with high mortality could be the result of infection with acutely transforming strains of ALV-J that may activate and incorporate host cellular oncogenes in their own genome.

ALV-J is transmitted both vertically (congenital infection of the egg albumen and the chick embryo), and horizontally (through close contact with infected chicks or fomites. Horizontal transmission is a major challenge for primary breeders, because it occurs extremely quickly during the first few weeks of age, before the infected individuals can actually be identified by conventional diagnostic methods. ALV-J behaves as an exogenous virus, and can be controlled through strategies designed to control other exogenous viruses. However, its ability to quickly spread horizontally is much more efficient than it is for other sub-groups of ALV. In addition, it appears that there is some antigenic and molecular diversity within ALV-J field strains isolated in Europe and North America, which would make less universal the application of some of the newly developed diagnostic tests.

ALV-J seems to be widespread now in commercial meat-type chickens. ML has been diagnosed in the field in several countries through the identification of gross lesions, although relatively few cases have been confirmed through virus isolation and characterization.

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Major challenges that the poultry industry will have to face in the coming years include:

1. ALV-J appears to be genetically unstable, meaning that diagnostic tests (current or to be developed) probably will not have a universal application, and that there is a potential for the appearance of new strains within subgroup J, or even new subgroups of ALV as a result of virus recombination. Still, there might be some potential for the development of recombinant and/or killed vaccines.

2. Few laboratories have the capability or the interest needed for applied research on ALV-J. Since ALV-J is a novel problem for industry, the body of scientists required for the generation of basic information is still extremely small. Although some productive applied research has been done by the primary breeders, its high cost and technical difficulty must be complemented by the efforts of independent laboratories. It is not realistic to expect primary breeders to solve the problem by themselves within a short period of time, while not enough knowledge, tools and economic resources are available.

3. Chicken embryo fibroblasts that are permissive only to exogenous viruses (C/E cells) are essential for doing proper work with ALV-J. Such cells are not produced commercially, and there is a need to expand the existing flocks, and to make their eggs commercially available in order to support industry needs. The SPF industry could contribute by producing SPF eggs of such genetic stock.

4. There are no commercially developed diagnostic tools specific for ALV-J. Examples of systems desirable for effective eradication are:
   (a) an antibody test specific for ALV-J
   (b) sensitive genetic probes
   (c) a specific antigen-capture ELISA test
   (d) rapid diagnostic tests that would allow for timely elimination of infected stock before the virus spreads horizontally or vertically
   (e) diagnostic tests that account for the antigenic diversity suspected to occur among field isolates
   (f) tools to differentiate endogenous from exogenous viruses.

5. There is an urgent need for a clear and objective understanding of the real usefulness application, and limitations of commercially available diagnostic tools developed for ALV virus or antibody detection.

6. Research of the epidemiology aspects of ALV-J infection is clearly very limited. Possible interactions of ALV-J with other poultry field or vaccine viruses must be investigated, or at least assessed in their economic and clinical impact.

7. Basic knowledge of the biology of ALV-J as related to ordinary poultry management practices would also provide valuable insight for effective control in the field. The broiler industry needs to understand the complicating and promoting factors that exacerbate the expression of ALV-J infection in broiler breeders and broilers in the field, and in this subject the primary breeders could provide some insight. It must be underlined that even when ALV-J has been controlled or eradicated from breeding stock, birds will still be susceptible to reinfection.

There are very clear indications that there has been substantial progress achieved already by the primary breeders in controlling ALV-J infection in pedigree stock. Still, ALV-J is expected to be a major challenge for the poultry industry as a whole for the coming years. Many questions remain unanswered about ALV-J at the epidemiological and molecular levels.

Managing Populations at Risk of Infection with ALV Subgroup J

courtesy of
Primary Breeder
Veterinary Roundtable

Under field conditions it appears that a number of disease and management factors can influence the impact of ALV-J infections in broiler breeders. Most infections with this virus have little or no impact on the general health and productivity of the flock. However, tumor development in affected birds results in a gradual deterioration of their condition and their eventual culling and death. Whether ALV-J infection influences egg production is not known. The following disease prevention and management techniques can reduce the risk of tumor development losses whether dealing with vertical or horizontal ALV-J infections:

Disease Challenges

1. Marek's disease virus (MDV). Myeloid leukosis is more frequent in birds where control of MDV has failed due to early exposure to field challenge and/or challenge with highly virulent and immunosuppressive pathotypes of MDV (i.e. vvMDV+). This situation can be improved by the use of more effective vaccine strains or vaccine combinations, along with farm hygiene and disinfection.

2. Reticuloendotheliosis virus (REV). A similar interaction with REV can lead to higher tumor incidence. Freedom of REV is particularly important in quality assurance of live vaccines propagated in chick embryos or cell cultures.

3. Other immunosuppressive agents. Various agents can compromise the birds' ability to mount adequate immune responses in the face of ALV-J challenge. Reovirus, infectious bursal disease (IBD), chicken anemia virus (CAV) and mycotoxins are the most common. Again, improvements can be made by:
   (a) improving maternal immunity
   (b) reducing or delaying field challenge through biosecurity practices
   (c) appropriate and timely vaccination
   (d) ensuring and maintaining feed quality.

The importance of farm hygiene and disinfection is a recurrent issue. As it was stated earlier, several agents alone or in combination can cause early damage of the immune system and lead to the increased susceptibility and severity of ALV-J infections. Placing day-old breeders in contaminated houses (i.e. built-up litter) will ensure challenge to a wide range of poultry pathogens including ALV-J.

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Management Practices

1. Separation of populations. Separate rearing of males and females until mating or transfer to the hen house is advisable. If this is not possible, then males and females should be reared separately until at least 6 weeks of age.
   This will reduce the stress of competition between the sexes and decrease the potential for horizontal transmission of the virus.

2. It is also known that ALV's can be transmitted through contaminated needles. Thus, during vaccination procedures needles should be replaced between males and females while they are being reared separately. This is also important while taking blood samples for health monitoring procedures.

3. Body weight and nutrition. Following recommended body weight profiles and nutritional levels will ensure uniform growth and adequate development of the immune system. The first 6 weeks of age are critical to maximize the birds' ability to cope with ALV-J and other disease challenges.

4. Stocking density and feeder space. Stress is an important cause of immunosuppression, reduced performance and increased susceptibility to disease. Appropriate access to water and nutrients is essential to reduce stress and support adequate growth and development, livability, reproduction, hatchability and health of young offspring.

5. Male/female ratios. Excessive male/female ratios can be stressful for both sexes. The occurrence of aggression and stress increases in a flock when the males and females have to compete for limited feeder space. The males, usually the dominant birds, if frustrated and hungry become highly abusive of their subordinates. Furthermore, the hormonal effects associated with sexual maturity can exacerbate aggressive behavior in flocks with too many males. Prompt action to control male numbers reduces this type of stress.

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