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Immunoglobulins and Visceral Gout in Chickens: An In-Depth Treatment Assessment

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Abstract

The immune system's essential components, immunoglobulins, have been examined in relation to immunological responses. The precise immunomodulatory impact of immunoglobulins on visceral gout remains unclear despite their well-established involvement in immunity. This study clarifies the function immunoglobulins perform in the underappreciated immunomodulatory context of visceral gout in broiler chicks. 150 broiler chicks with clinical indications of visceral gout were split into two categories, Category 1 was the untreated control group and Category 2 had intramuscular injections of immunoglobulin. Mortality rates, body mass and metabolic markers were observed for six weeks. As a result of receiving immunoglobulin treatment, the afflicted chicks' body mass increased, uric acid (UA) and gamma-glutamyl transferase (GGT) levels decreased and mortality was considerably reduced. The results demonstrate immunoglobulin delivery as a potential treatment method that could reduce the severity of visceral gout in broiler chicks.

Keywords: Immunoglobulins, visceral gout, chicks, uric acid, gamma-glutamyl transferase (GGT).

INTRODUCTION

The immune systems of vertebrates, such as chickens, depend on immunoglobulins, or antibodies. Produced by specialist white blood cells known as B lymphocytes, these complex proteins operate as the first line of defense against infections like bacteria, viruses and fungus. Although the immune systems of birds and mammals are similar in primary forms, birds' immune systems differ in specific ways, such as in the types of immunoglobulins they produce (1, 2).

The most common immunoglobulin Y in chickens is called IgY and it functions similarly to immunoglobulin G (IgG) in mammals. Invading pathogens are neutralized and eliminated by IgY, which is present in the bloodstream and gives hens a robust immune system against illnesses (3).

A metabolic disease known as visceral gout affects chickens and it is typified by the accumulation of crystals of urea in the kidneys and other internal organs. The cause of the condition is complex and impacted by environmental, dietary and hereditary factors. One important side effect of visceral gout is kidney failure, which lowers UA excretion and causes crystal formation (4).

Immunoglobulins perform a significant role in the avian immune system's ability to establish successful defenses against infections. The primary antibody class, IgY, is essential for neutralizing and getting the removal of pathogenic pathogens. Through the egg yolk, chickens create and pass on IgY to their progeny, giving freshly hatched chicks passive immunity. The safety of chicks in their early, delicate stages of life depends on the maternal transmission of antibodies (5, 6).

Immunoglobulins work in a variety of ways, such as by neutralizing poisons and infections, triggering complement proteins and activating foreign invaders, making it easier for immune cells to identify and destroy them (7).

A chicken's ability to protect itself against sickness depends on maintaining adequate levels of immunoglobulin. A number of factors, including management techniques, nutrition and genetics influence chick immunoglobulin production. Moreover, to promote the development of specific antibodies against common infections, effective vaccination techniques are crucial (8).

Unbalances in dietary components, especially too much protein and insufficient water, are linked to visceral gout in chickens. Increased synthesis of UA is a result of high-protein diets and kidney stones are made more concentrated when hydrated. Visceral gout manifests clinically as reduced consumption of food, lethargy and enlarged, pale kidneys upon postmortem examination. A vicious cycle of dehydration and increasing gout can result from affected birds displaying increased thirst as the illness worsens (9).

Although immunoglobulins are involved in the immune response, there continues to be an exploration of their role in visceral gout. Gout's immunomodulatory effects, which can affect immune cell activity and antibody generation, should be investigated. Comprehending the complex interactions between the immune system and metabolic conditions such as visceral gout is essential for creating comprehensive strategies for managing poultry health (10).

The study (11) examined the impacts of different dietary fiber and protein compositions on goslings' increase performance, incidence of gout, gut micro-biota and immunological responses in the gut-kidney axis. They aimed to clarify the complex interactions among diet, gut micro-biota along with immune modulation in goslings by investigating the effects of these dietary determinants on the birds' general health and development.

The clinical and molecular features of visceral gout in hens caused by the infectious bronchitis virus Israel variation 2 (IS/1494/06) genotype were analyzed in the research (12). They provided valuable context for the understanding of infectious bronchitis in chickens by providing information on the clinical and molecular features associated with the strain.

The author (13) analyzed an astrovirus linked to gout that infects afflicted chicks and creates disease. The virus was isolated and evolutionary analyses were carried out to reveal details about its genetic structure. They emphasized the significance of transmission between species and provided important information to the understanding of the involvement of astroviruses in avian diseases, particularly those related to gout.

The article (14) examined the impacts of a fermented feed supplement on reducing kidney damage and imbalance of the caecal microbiota that emerged from a diet rich in protein throughout the process of “gosling gout”. They

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focused on the supplement's possible therapeutic benefits in treating these physiological problems in goslings fed a high-protein diet.

The study (15) explored the pathogenic consequences and molecular characteristics of chicken astroviruses. They investigated essential facets of these viruses, highlighting their molecular properties and possible effects on the health of chickens. They provided important information about avian astrovirus infections.

The research (16) examined the natural co-infection of gout-affected goslings with genotypes I and II of the Goose astrovirus. They offered a thorough description of the co-infection and provided the dynamics of interactions between various astrovirus genotypes in afflicted birds. The findings improved knowledge of the Goose astrovirus's pathogenic potential and its relationship to gosling gout.

The author (17) investigated the infectiousness of a strain of Goose Astrovirus 2 that was thought to be responsible for goslings' deadly gout. They examined how the virus affects the birds' health and shed light on the effects of the illness. The results provided important new information about bird diseases, especially those involving astroviruses in geese.

The identification and characterization of an astroviral virus that causes lethal visceral gout in domestic animals were discussed in the article (18). They outlined the essential characteristics of the astrovirus and linked it to severe illness in goslings. The results offered the pathogenicity of the virus in residential bird populations and guided possible countermeasures for the avian health issue.

The study (19) explored into the co-infection of parvovirus and astrovirus in goslings with gout. They examined the coexistence of these viral infections in gout-affected geese. The results provided the potential variables driving the development of gout in geese and improved the understanding of the intricate dynamics of viral interactions in bird populations.

The research (20) examined new isolates of Malaysian chicken astrovirus, describing their molecular composition and evaluating their pathogenic potential. The genetic characteristics of the isolates and their effects on chicks were investigated by them. They provided the diversity and pathogenicity of chicken astroviruses in Malaysia, which was important information for regulating the health of poultry.

A comprehensive analysis of the immune response mechanisms is lacking in the context of immunoglobulins and visceral gout in chickens. This study seeks to enhance comprehension of poultry health by examining the relationship between immunoglobulins and visceral gout in chickens as well as exploring possible connections between the immune system along with the onset of this ailment.

METHOD AND MATERIALS

A total of 150 broiler chicks with clinical signs of visceral gout at five days of age were selected from a commercial poultry farm. These included weakness, droopiness, emaciation, lameness and loss of appetite. The post-mortem examination revealed chalky white deposits on the serosa of several organs. The chicks were split into two categories at random: Category 1 was the untreated control group and on day 5, Category 2 got an intramuscular injection of $0.5\,ml$ $(0.02\,g\,protein)$ of immunoglobulin. The same management conditions applied to both categories. Throughout six weeks, weekly data on mortality and body mass were gathered. Six birds from each category were given blood samples on days 8, 16, 24 and 32. Utilizing an automated biochemical analyzer, the collected serum was tested for overall Protein (g/dl), GGT (U/L) and UA (mg/dl). After three weeks of recovery from visceral gout, about $60\,ml$ of pooled serum was taken from 16 broiler hens to examine immunoglobulin

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precipitation. Utilizing the PEG (Polyethylene glycol) 6000 method, immunoglobulin precipitation was carried out in accordance with recommendations. The overall protein content was measured with an auto-analyzer for antibodies.

RESULT AND DISCUSSION

According to the study, categories 1 and 2 had death rates of 25% and 15%, respectively. When compared to categories 1 and 2, mortality throughout the 9– 15 and 16– 22 days periods were relatively low, suggesting that the passive injection of immunoglobulin decreased the death rate in broiler chicks affected by visceral gout. Renal failure and hydration are the leading causes of mortality linked to visceral gout.

On days 16, 24, 34 and 40, category 2's $mean \pm SE$ of body mass was considerably ($P < .05$) higher than category 1's (Table (1)). Therefore, the average body mass of the visceral gout- impacted broiler chickens treated with antibodies was statistically more significant, suggesting that the passive injection of immunoglobulin increased the body mass of the impacted broiler chickens. The decreased body mass in broiler chickens impacted by visceral gout can be related to reduce weight, dullness and carelessness.

Table (1). Broiler chicks' body mass and biochemical characteristics (Source: Author)

Days	Category 1				Category 2			
	Body mass (g)	Uric Acid (UA) Level (mg/dl)	Overall Protein (g/dl)	GGT Rating (U/L)	Body mass (g)	Uric Acid (UA) Level (mg/dl)	Overall Protein (g/dl)	GGT Rating (U/L)
8	163 ± 5^a	3.61 ± 0.33^a	3.33 ± 0.05^a	8.65 ± 0.07^a	164 ± 4^a	3.59 ± 0.14^a	3.48 ± 0.05^a	8.72 ± 0.06^a
16	396 ± 9^a	7.91 ± 0.20^a	3.52 ± 0.05^a	16.57 ± 0.08^a	411 ± 6^b	6.51 ± 0.21^b	3.65 ± 0.05^b	9.75 ± 50.16^b
24	791 ± 21^a	7.01 ± 21^a	4.38 ± 0.05^a	16.63 ± 0.15^a	911 ± 16^b	5.82 ± 0.16^b	4.72 ± 0.05^b	15.27 ± 0.17^b
32	1001 ± 16^a	6.58 ± 14^a	4.55 ± 0.05^a	16.63 ± 0.10^a	1251 ± 21^b	5.98 ± 0.23^b	5.72 ± 0.05^b	14.45 ± 0.12^b

On day 8, there wasn't any statistical important variation ($P > .05$) in the $mean \pm SE$ of UA level across categories 1 and 2. However, from days 16 to 32, there was a statistically important variation ($P < .05$) in the average UA levels when compared to category 1. This showed that injecting immunoglobulin passively lowered the mean UA level in broiler chicks affected with visceral gout. Due to their uricotelic nature and lack of uricase enzyme, birds with visceral gout experience hyperuricemia when kidney functions are compromised. Although UA itself isn't toxic, precipitated crystals can harm the kidney, heart, lung and intestine tissues in affected birds.

In comparison to categories 1 and 2, total serum protein ratios were greater ($P < .05$) and this increasing tendency was seen on days 8, 16, 24 and 32. Previous researchers observed similar findings. Hydration is a known gout precipitating factor, which could explain the rise in serum protein levels in chicks with visceral gout.

On day 8, the $mean \pm SE$ of the gamma-glutamyl transferase (GGT) level between categories 1 and 2 wasn't significantly different. On days 16, 24 and 32, however, category 2's mean GGT level was ($P < .05$) higher than category 1's. It was shown that the mean GGT level was lower in broiler chicks with visceral gout who received immunoglobulin treatment. Urate deposition occurred in the kidney and liver of gout-affected birds. In visceral gout-affected birds, there was liver congestion and bleeding along with intermittent urate deposition in experimentation-induced liver damaged birds. The GGT level is thought to be an indicator of liver damage.

Due to their ability to attach to complex structures, antibodies against viruses can attach to entire virus proteins, including structural elements of virus components and virus proteins found on the surface of affected cells. T cells are unable to eliminate the infectivity of viral particles found in the bloodstream or surfaces of the mouth, this is the unique ability of antiviral antibodies. T-cell lymphocytes are not involved in the direct neutralization of entire virus components because they are unable to identify intact viral proteins.

Based on the study's findings, it was determined that antibodies given to category 2 could have reduced the impact of gout by inhibiting the viral particles' ability to infect birds. In comparison to category 1 and 2 it had a substantial increase in the amount of total protein in the blood, a statistically important reduction in the average serum GGT concentrations and UA levels, as well as a significant increase in mean body mass due to the disease's reduced severity, which led to a reduction in mortality in broiler chicks. Hence, antibodies have proven to be a beneficial alternative to traditional treatment for visceral gout in broiler chicks.

CONCLUSION

The particular immunomodulatory effects of immunoglobulins in visceral gout need to be clarified despite their well-known function in immunological responses. This study clarified the function that immunoglobulins perform in the underappreciated immunomodulatory context of visceral gout in broiler chicks. 150 broiler chicks with clinical indications of visceral gout were split into two categories, Category 1 was the untreated control group and Category 2 had intramuscular injections of immunoglobulin. The treated chicks showed significant improvements in "body mass, gamma-glutamyl transferase (GGT), uric acid (UA) levels" and mortality rates over six weeks as compared to the control group. According to these results, immunoglobulin treatment could be effective in reducing the severity of visceral gout in broiler chicks and offer a new treatment method for the control of chicken health. There was insufficient knowledge of the precise immunomodulatory impact of immunoglobulins on visceral gout in broiler chicks. Future studies should investigate the best immunoglobulin dosage and delivery strategies to improve the effectiveness of treatment for visceral gout in poultry.

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