CHAPTER 35

PATHOGENESIS AND PREVENTION OF ASCITES SYNDROME IN BROILERS

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INTRODUCTION

The main consequences of this type of cardiopulmonary failure are systemic arterial hypoxia (deficient arterial oxygen saturation) and pulmonary hypertension and the terms pulmonary hypertension, pulmonary hypertension syndrome, and ascites syndrome are often used interchangeably. Systemic hypertension increases important hematological parameters such as red blood cell count, hemoglobin level, and mean red blood cell count. Pulmonary hypertension increases filling cell (PCV) volume and blood viscosity, resulting in right ventricular (RV)-specific hypertrophy, which is a stress response to elevated pulmonary arterial pressure, and blood relative increases in RV mass as a percentage of PC or ventricular occupancy. Percentage calculation of total mass (TV). The RV:TV ratio for conventional broilers is typically less than 0.25. The main factors contributing to ascites in commercial broilers are early exposure to low temperatures (low-neutral temperatures) and rapid growth to maximize the genetic potential of the broiler through an energy and protein-rich diet. pulmonary hypertension syndrome, broiler ascites, heart failure syndromed and altitude sickness (Liu 2016), it is characterized by increased pulmonary artery pressure, increased pulmonary vascular resistance, right ventricular hypertrophy (HVR), and ascites (Liu 2016). It is a metabolic disease caused by the joint action of multiple pathogenic factors. The main pathological changes of broiler chicken ascites syndrome are accumulation of a large amount of pale yellow serous fluid in the abdominal cavity and pericardial cavity, with the right ventricular thickening and hypertrophy. The disease was first reported in the United States in 1946, and also began to be reported in North America in 1958. Since then, the disease has quickly become a common phenomenon in the chicken industry in high altitude and cold areas, and since 1896, the disease has been reported in many provinces in China(Liu 2016). In the process of livestock and poultry breeding, the disease is most often manifested in groups, and it is most common in 2-3 week old chicks, which shows its incidence rate is as high as 5% or more. The peak of death is more common at 4-8 weeks of age, and the recovery period is still accompanied by death, which can bring huge economic losses to the global breeding industry every year. Therefore, AS is considered to be one of the important factors restricting the rapid development of the chicken industry (Hormozi et al. 2017; Shi et al. 2017; Parveen et al. 2020). Therefore, in view of the huge impact of this disease on the global stockbreeding, this article will discuss this disease from the aspects of the causes of the disease, clinical symptoms, pathological changes, related research results, prevention and control measures, and aims to provide theoretical guidance for the prevention and treatment of ascites syndrome in broilers.

Since ambient temperature, energy level, and growth rate directly affect the metabolism of bases, which in turn affects the oxygen needed by the animal, it can reduce oxygen demand and ascites, reduce the growth rate of chickens by cutting, and create them under thermoneutral conditions.

Contributing Factors for Ascites Syndrome

Genetic Factors

Grow Too Fast

A large number of studies have shown that broiler ascites syndrome mostly occurs in fast-growing broiler strains, such as Avian broiler, AA broiler, Ross broiler, and Sanhuang chicken. In the long-term genetic selection process, the growth rate of broilers is accelerated and the metabolism is vigorous, but their cardiopulmonary function has not been improved synchronously (Hormozi et al. 2017). Therefore, in the process of its metabolism, the consumption of oxygen can easily reach the critical point of cardiopulmonary oxygen supply function, and the body is easily in a state of hypoxia. In addition, the anterior vena cava and pulmonary capillaries of broilers are underdeveloped, which is easy to cause pulmonary vein congestion. Therefore, it is very prone to pulmonary hypertension, right heart failure and even ascites syndrome.

Limited Lung Capacity

Since the lungs of poultry are close to the back of the rib cage, the dorsal side of the lungs is embedded in the sternum ribs, which limits its expansion, and in the long-term breeding process, the ratio of heart, lung and body weight of broilers is getting smaller and smaller. When the blood flow increases, it is restricted by the lungs, and there are few spare capillaries to cope with the increased blood flow. The capillary filling degree is high, and the pulmonary vascular resistance increases, so it is easy to cause pulmonary hypertension.

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Environmental Factor

High Altitude

Ascites syndrome in broilers was first discovered in high altitude areas, and altitude is an important cause of ascites in broilers. In high-altitude areas, the oxygen is thin, the partial pressure of oxygen is low, and the oxygen concentration in the air is low, which leads to the decrease of blood oxygen saturation in the blood of broilers, the increase of red blood cells, and the increase of blood viscosity, which can easily lead to the occurrence of ascites syndrome in broilers.

Poor Ventilation

In the cold spring and winter seasons, some chicken houses use coal stoves for heating and heat preservation, which increases the consumption of oxygen in the chicken houses. In the state of oxygen and harmful gas stimulation, it is easy to cause damage to the lung function, increase the burden on the heart, cause heart failure, and cause lesions to other organs such as the liver, thereby causing ascites.

The Cold Weather

The cold weather can increase body heat production by enhancing metabolism, resulting in increased oxygen demand and compensatory increase in cardiac output in broilers; in addition, cold can also lead to increased hematocrit and blood viscosity, as well as the formation of pulmonary hypertension.

Poor hygiene

If the manure in the chicken house is not cleaned in time, it will ferment and spoil for a long time, increase the concentration of toxic and harmful gases, and increase the probability of broiler chickens suffering from ascites syndrome.

Feed Factor

Feed factors mainly include the following aspects: 1) Broilers eat high-energy, high-protein or pelleted feed, which increases growth rate (Kalmar et al. 2013), boosts the body demand for oxygen and promotes the occurrence of ascites syndrome in broilers (Liu et al. 2017). 2) High levels of sodium ions in feed or drinking water can lead to increased blood volume and increased incidence of ascites syndrome in broilers (Shi et al. 2014). 3) Deficiency of vitamin E or lack of trace elements such as phosphorus and selenium can also cause ascites syndrome in broilers. 4) Excessive daily feed intake or excess nutrition of broilers can cause excessive growth of broilers, relative hypoxia of the body, and increase the incidence of ascites (Hasanpur et al. 2016).

Disease Factor

Respiratory Disease

Early respiratory tract injury caused by hatching factors of respiratory diseases, acute respiratory tract injury caused by virus, damage to lungs and air sacs caused by climate or management conditions, etc., all directly or indirectly affect the oxygen absorption capacity of broilers, causing tissue hypoxia, which in turn leads to blood and blood in broilers. Decreased oxygen saturation induces ascites syndrome in broilers.

Toxic Disease

When broilers eat moldy feed or encounter aflatoxin-contaminated feed, it will cause damage to the heart, lungs, liver and other parenchymal organs, and then the disease will occur (Liu et al. 2017).

Nutritional Metabolic Disease

Broiler chickens suffering from rickets due to early nutritional deficiencies have a narrow thorax and limited space for lung expansion. They cannot fully utilize the function of the lungs when breathing, resulting in hypoxia, which is easy to cause ascites syndrome.

Other Factors

Improper medication or long-term use of sulfonamides can cause liver and kidney damage in broilers (Tisljar et al. 2011; Varmaghany et al. 2015), increase vascular permeability, increase the burden on the heart, and cause ascites syndrome (Hassanzadeh et al. 2008).

Pathogenesis

Many scholars at home and abroad have conducted in-depth exploration and research on the pathogenesis of AS, and a more consistent view is that the occurrence and development of this disease is closely related to the formation of pulmonary hypertension (PH). That is, PH is the main reason for the occurrence and development of AS. The increase of blood flow through the lungs and the increase of pulmonary vascular blood flow resistance are the main factors leading to PH. Hypoxia is the most important trigger for ascites syndrome in broilers, as well as reduced blood capacity in the capillaries of the lungs. Any factor that can increase the body oxygen demand can promote the occurrence of PH. Oxygen is a vital component in the energy metabolism process and is required for thermoregulation, activity, growth and any form of energy use in broilers. Studies have shown that chickens prone to ascites syndrome require more oxygen than chickens not prone to ascites syndrome due to their high metabolic activity and low venous partial pressure of oxygen, and the oxygen partial pressure in arterial blood is higher than that of chickens. There was no significant difference in carbon dioxide partial pressure between the two chickens. Higher partial pressure of carbon dioxide in the venous blood of broilers can increase pulmonary arterial pressure. And studies have shown that the content of carbon dioxide in venous blood is related to genetic background. Elevated carbon dioxide in venous blood in domestic chicks is a predisposing factor for right ventricular hypertrophy and ascites syndrome. Chickens with low FCR have lower metabolic heat production and therefore require less oxygen. Low oxygen requirements and low feed conversion ratios can result in reduced thyroid hormone activity and reduced susceptibility to ascites syndrome, so an imbalance in oxygen demand can result in insufficient oxygen supply (hypoxia). This imbalance may be caused by endogenous and exogenous factors, and the two factors have a synergistic enhancement effect, resulting in additional or even synergistic

effects leading to increased sensitivity to ascites syndrome. In the case of absolute and relative hypoxia, the body's blood oxygen saturation decreases, and the cardiac output compensatory increases. At the same time, in order to increase the oxygen supply to the tissue, the kidney secretes a hormone that stimulates the production of red blood cells and hemoglobin, which promotes the production of red blood cells and hemoglobin. A large number of red blood cells can enhance the oxygen transport capacity of the blood, so that the hematocrit, the number of red blood cells and the value of hemoglobin increase, the specific viscosity of whole blood increases, and the deformability of red blood cells decreases, and all of these are compensatory physiological effects of the body to adapt to hypoxia.

With the increase of PCV and BRV, the cardiac load increases, the right ventricular wall is hypertrophied, and the cardiac chamber volume increases, which leads to right heart failure, chronic hypoxia, and stimulates pulmonary vascular endothelial cells to produce and release mediators such as endothelin and endothelin, etc., which trigger the proliferation of smooth muscle cells, resulting in thickening of the vessel wall and the formation of PH; and further cause excessive right ventricular afterload, and the body further exacerbates the vicious circle of relative hypoxia. With the development of the disease, heart failure, serious obstruction of venous blood return, congestion and swelling of internal organs, increasing venous pressure, and fluid exudation to form ascites.

It has long been found that high dietary salt content can cause ascites syndrome and edema in chickens and turkeys, especially young chickens are more sensitive than adult chickens. Toxic components in poisoning, Na^+ in any source of diet can enhance the toxicity of Na^+, due to low serum osmolarity and underdeveloped kidneys in chicks, it is difficult for them to regulate their own serum Na^+ levels. High sodium causes increased PCV, decreased red blood cell deformability, and increased blood volume, resulting in increased blood viscosity, pulmonary vascular remodeling, and increased pulmonary capillary resistance to blood flow, resulting in PH. The same is true for high cobalt loads, which can affect blood viscosity in broilers and increase the incidence of AS. Studies have shown that the weight ratio of the right ventricle to the whole ventricle is significantly increased in chickens with ascites syndrome. In the occurrence and development of broiler ascites syndrome, pulmonary hypertension precedes right ventricular hypertrophy, and the two promote each other and strengthen together. Many scholars believe that the pathological basis of ascites syndrome is hepatic lymphatic circulation disorder. Increased production and obstruction of hepatic venous return are one of the most important factors for the formation of ascites in broilers. Due to changes in lymphatic circulation, further changes in the venous circulatory system are caused, resulting in ascites syndrome in broilers. The rapid growth rate of modern broilers makes them very sensitive to various stresses in the internal and external environment. The rapid growth of chickens and excessive metabolic heat production may be one of the important reasons for the lesions of the thoracic duct.

Clinical Symptoms

Sick chickens are lethargic, have a loss of appetite, and have disheveled feathers; the abdomen is obviously enlarged and drooping, the skin of the abdomen becomes thinner and brighter, and there is a sense of fluctuation when touched by hand (Luger et al. 2003), and the pale yellow liquid can be drawn out with a syringe; difficult breathing, unwilling to stand, slow movement, and drooping wings. In some chickens, cyanosis of combs and beards can also be seen, accompanied by diarrhea; sick chickens often die 1 to 3 days after the occurrence of ascites, and sometimes the sick chickens suddenly fall to the ground and die, especially when subjected to strong external stimulation and stress.

Pathological Changes

Necropsy revealed a large amount of fluid containing fibrinous translucent jelly in the abdominal cavity, which was clear yellowish brown; pericardial effusion increased, the heart volume increased significantly, the right heart was dilated and hypertrophied, filled with blood, and the myocardium was thinned; severe lung stasis blood, edema, blood-red fluid with small bubbles can be seen after incision; liver edema, blood stasis, hard texture, sometimes brittle and easy to rupture; kidney enlargement, blood stasis, often white urate deposition; intestinal wall thickening, blood stasis, chest muscle, leg muscle blood stasis, and systemic organs are accompanied by different degrees of blood stasis (Hassanzadeh et al. 2004).

Preventive and Therapeutic Measures

Precaution

Selective Cultivation

The chicks hatched from the eggs produced by breeders around 28 weeks of age are relatively small in terms of individuals and organs at 1 day of age, and different breeds of broilers have different susceptibility to ascites syndrome. The varieties with better development of lungs and other organs have a certain role in preventing the occurrence of ascites syndrome (Luger et al. 2001).

Environment

During the breeding process, attention should be paid to the ventilation of the chicken house, so that harmful gases such as carbon dioxide and ammonia and dust can be discharged in time to ensure sufficient oxygen, reduce environmental stimulation, and reduce the load on the heart and lungs; in the cold season, pay attention to heat preservation, reduce the probability of hypothermia-induced ascites syndrome in broilers; control the light time to slow down the growth rate of broilers within 4 weeks (Hasanpur et al. 2016). Try to keep males and females separately to meet different metabolic needs; adjust the stocking density reasonably, clean up excrement in time, establish a strict disinfection and epidemic prevention system, reduce the occurrence of respiratory diseases and other diseases, and reduce stress (Hasanpur et al. 2016).

Feed

Reasonable feeding restriction should be carried out in the early stage and to control the growth rate of broilers, feed low-energy and low-protein diets to reduce oxygen demand; prevent excessive sodium intake, sodium bicarbonate can be

Table1: Drug treatment of ascites syndrome in broilers

Drug classification	Medicine	Dosage	Treatment effect
Diuretics	1% furosemide injection	intraperitoneal injection 0.3ml/time	Symptomatic treatment to relieve
	Hydrochlorothiazide	mix feeding bid 4-5ml/chick	symptoms of chicken flocks
Antibacterials	0.05%penicillin procaine	Injection after aspiration of peritoneal fluid	
	Gentamicin	0.2ml-0.3ml/time	
Hepatoprotective drugs	vitamin C	Drink	
Cardiotonic	10% Sodium coffee	Im 0.3ml/time	
Antidote	Rhubarb Soda Chips	Po 1piece/chick	
Other	urease inhibitor	mix feeding	
	Sodium Selenite.	Ih	

Table 2: Chinese medicine prescription for broiler ascites syndrome (g)

Prescription one		Prescription two		Prescription three	
Drug name	Dose	Drug name	Dose	Drug name	Dose
Atractylode	20	Atractylodes	20	Porcine	20
Mutong	30	Poria	20	Guizhi	20
Porcine	30	Alisma	20	Mulberry bark	30
betel nut	30	pawpaw	20	Alisma	30
Citrus aurantium	30	jujube	20	tangerine peel	30
rhubarb	40	Atsushi	20	psyllium	30
Alisma	40	Muxiang	20	big belly	30
tangerine peel	45	ginger peel	20	Mutong	30
Poria	45	dried ginger	20	Poria	60
Atractylodes	45	Mulberry bark	20	Astragalus	60
Bacteria	45	big belly	20	raisins	60
green leather	45	gentian	40		

used instead of sodium chloride as a sodium source; phosphorus levels should not be too low, and selenium and vitamin E content should be sufficient and vitamin C can also be added to the feed to improve the anti-stress and disease resistance of broilers. Reduce the use of drugs that are harmful to the heart and lungs, and do not feed spoiled and moldy feeds; in addition, adding tanshinone IIA to the feed can effectively prevent the occurrence of ascites syndrome in broilers (Hormozi et al. 2017).

Treatment

Physiotherapy: Use a sterile syringe to extract the peritoneal effusion of sick chickens.

Medical treatment: See Table 1 and 2. Once broiler ascites syndrome occurs, the cure rate is low, and the treatment principles of symptomatic treatment, diuresis and detoxification, liver protection and kidney protection are mainly adopted, and the effect of traditional Chinese medicine treatment is relatively good.

Chicks were vaccinated against Newcastle disease and infectious bronchitis by intranasal instillation at 7 days of age, and a booster immunization was given at 21 days of age to reduce the incidence of ascites caused by respiratory diseases. Bacterial pathogens such as *Escherichia coli*, Mycoplasma, Streptococcus and other bacterial pathogens can be prevented by broad-spectrum antibiotics. It is recommended to use 2.5% cefquinome sulfate injection. Due to the short time to market, the drug resistance rate is extremely low, and the effect is very ideal. Before 15 days of age, intramuscular injection is carried out according to the dosage of 4000 chickens/100ml, and 15 to 30 days old according to the dosage of 2000 chickens/100ml. It can be doubled on this basis. After 30 days of age, due to the risk of drug residue exceeding the standard, it is not recommended to use chemical drugs. Traditional Chinese medicines that clear heat and benefit the lungs can be used for conditioning to prevent drug residues. Montmorillonite was added to the feed at a dose of 0.1% to reduce the damage of mold. For chicken farms with frequent occurrence of this disease, VC can be added to the drinking water according to the actual dosage of the drug at a concentration of 10g/100kg of water, and drink continuously for 3 days to quickly improve the symptoms. For high mortality flocks, an additional 1% linseed oil can be added to the feed to control mortality quickly.

Summary

Broiler chicken ascites syndrome is caused by the interaction of internal and external environmental factors. There is no particularly effective treatment for the disease, focusing on prevention. Therefore, in the breeding process, it is necessary to strengthen feeding management, pay attention to environmental hygiene, reasonably cooperate with the diet, reduce the stress on the flock, and provide an excellent growth environment for the flock.

Research Results

Related Polyclonal Antibody Preparation

The available literature shows that the theoretical circles conduct research from the following aspects. For example, studies have shown that the RPS14 gene (ribosomal protein S14) maintains normal physiological functions *in vivo* by regulating ribosome biosynthesis and translation of essential proteins, so some scholars focused on the preparation of RPS14 polyclonal antibody, and carried out further research on the application of this polyclonal antibody in broiler ascites syndrome, the author aimed to investigate the possible role of RPS14 in chicken ascites syndrome (BAS). They were able to generate polyclonal antibodies against RPS14 and studied the localization and expression of the RPS14 protein in key tissues of various animals. Researchers were able to generate polyclonal antibodies against RPS14 and study the localization

and expression of RPS14 protein in key tissues of various animals (Wideman et al. 1999). In addition, some scholars focus on the role of some important genes in diseases. Some scholars focus on the role of MEOX2 gene in the development of ascites syndrome in broilers. The starting point is that MEOX2, as a transcription factor with important regulatory functions in the proliferation and differentiation of vascular smooth muscle cells and vascular endothelial cells, may inhibit the occurrence of AS by controlling the angiogenic phenotype, which has important research significance (Buys et al. 1999). In this experiment, they used PCR amplification method to obtain MEOX2 gene, used TA cloning technology to obtain pUCm-T-MEOX2 recombinant plasmid, and carried out bioinformatics analysis on it, aiming to provide a reference for the efficient prokaryotic expression of MEOX2 gene and protein purification, and provide a strong basis for the connection with pulmonary hypertension, and provide a reference for the regulation and prevention mechanism of AS.

Peroxisome proliferator-activated receptor alpha (PPARα) plays a key role in regulating metabolic homeostasis, inflammation, cell growth and differentiation, while PPAR (peroxisome proliferator-activated receptor) functions as lipid metabolism and important regulators of glucose metabolism have been extensively studied. To this end, the scholar reported the prokaryotic expression and purification of chicken PPARα protein, and successfully produced polyclonal antibodies against recombinant PPARα protein. PPAR is a member of the nuclear receptor superfamily consisting of PPARα, PPARβ/δ and PPARγ. PPARs regulate many metabolic pathways by activating endogenous ligands (such as fatty acids and their derivatives) or synthetic agonists that bind to regulatory elements of the PPAR response, heterodimerize the retinol X receptor, and control many genes involved in adipogenesis and lipids Metabolism, maintenance of inflammation and metabolic homeostasis. PPARα, the first member of the PPAR family to be discovered, is a transcription factor mainly expressed in energy-consuming tissues such as liver, kidney, heart, muscle and some inflammatory and immune cells, among which PPARα is used to control the core of FS. Numerous experiments have shown that activation of PPARα may enhance the protective effects of fatty liver, inflammation and fibrosis.Some scholars showed that PPARα deletion increases fatty liver and inflammation in PPARα null mice when fed a high-fat diet (McGovern et al. 1999; Luger et al. 2003). This mechanism is based on the physical interaction between the transcription factors PPARα, NF-κB, and AP-1, resulting in the inhibition of their transcriptional activity, thereby reducing the expression of these target genes. Regarding energy metabolism, PPARα is a therapeutic target for energy metabolism disorders. In type 2 diabetes, PPARα agonists are used as oral hypoglycemic agents. Other researchers have also reported severe and persistent hypoglycemia in mice after PPARα was knocked out on an empty stomach. Furthermore, after liver-specific knockout of the PPARα gene, mice developed hepatic lipid accumulation, resulting in fatty liver.

However, the use of prokaryotic expression system to clone and express PPARα protein in the production of chicken polyclonal antibody has not been reported yet. Furthermore, the potential role of PPARα in chicken pathogenesis has been poorly studied. In this study, a large number of PPARα polyclonal antibodies were successfully prepared, and the generated antibodies were used to localize the endogenous PPARα protein to the liver, kidney and hypothalamus. The relationship between PPARα and lipid metabolism has been investigated, leading to future research into the pathogenesis of dyslipidemia.

Judging from the data collected in this subject, many scholars have done a lot of research on the clinical application of polyclonal antibody to broiler ascites syndrome. As to Gu (Gu et al. 2021), she successfully developed RPS14 polyclonal antibody, and verified the efficacy of polyclonal antibody on broiler chicken ascites syndrome in clinical practice, which laid a solid foundation for conquering the disease. As to Huang (Huang et al. 2020), she carried out gene cloning and corresponding biological information analysis of MEOX2, which laid a solid foundation for the preparation of subsequent related antibodies, and then provided a strong basis for the pathological detection of pulmonary artery remodeling and gene drug therapy for broiler ascites syndrome.

Tanshinone IIA

Tanshinone is a kind of traditional Chinese medicine with wide clinical application, belonging to Lamiaceae, and it was first recorded in the classic Chinese medical book "Shen Nong Baicao Jing", and it was called "abandoned horse grass"; in "Compendium of Materia Medica" (Hu et al. 2017). The active substances in Salvia miltiorrhiza are mainly divided into two categories: fat-soluble and water-soluble. The fat-soluble substances are mainly o-quinone-type diterpene quinone compounds, and most of their skeletons have three- or four-membered carbocyclic o-quinone or p-quinone structure. The water-soluble ones mainly include polyphenols, danshensu, protocatechuic aldehydes, acids, etc. TIIA is a diterpene quinone lipid-soluble active ingredient extracted from its roots or stems. After long-term pharmacological and clinical treatment observation and research, it has been proved that TIIA has the functions of scavenging oxygen free radicals, anti-tumor, anti-oxidation, antibacterial and anti-inflammatory, calcium antagonism, improvement of microcirculation, protection of vascular endothelial cells, anti-atherosclerosis, prevention of angina pectoris and myocardial infarction, and anti-cancer pharmacological effects. Especially in the role of cardiovascular system, it has the ability to dilate arteries, increase myocardial contractility, etc., and is a commonly used traditional medicine for clinical treatment of heart disease. Several studies have shown that Tanshinone IIA plays an extremely important role in anti-tumor, anti-oxidation, and protection of the heart. In some studies, scholars took AA broilers as research objects, and explored the risk of ascites syndrome by detecting the production performance of broilers, analyzing the bioinformatics of pulmonary artery gallus transcriptome, pathological changes of various tissues and organs, and measuring blood-related biochemical indicators. The differentially expressed genes of broiler pulmonary artery and the changes of the metabolic pathways involved, monitored the prevention and treatment effect of TIIA on broiler ascites syndrome, and provided a certain basis for further research on the pathogenesis and prevention of broiler ascites syndrome (Wang et al. 2013). In addition, in pulmonary hypertension, mild inflammation often occurs, and mild inflammation is related to polycyclic aromatic hydrocarbons, and infiltrating inflammatory leukocytes are found in the internal organs of polycyclic aromatic hydrocarbons, and some inflammatory cytokines are associated with polycyclic aromatic hydrocarbons, such as IL-6、IL-1β、NF-κB and P38.

Therefore, some scholars used high-salt drinking water to simulate PAHs and evaluated the relationship between tanshinone IIA (TIIA) and PAHs.

The available literature shows that the theoretical circles have mainly carried out related research on the following aspects:1). To study the effect of Tanshinone IIA (TIIA) on pulmonary arterial hypertension (PAH) in broilers. 2) The prevention and treatment effect of TIIA on ascites syndrome in broilers was monitored, which provided a basis for further research on the pathogenesis and prevention and treatment of ascites syndrome in broilers. These studies have achieved excellent results, and laid a solid foundation for the subsequent conquest of broiler chicken ascites syndrome. Scholars also have a very positive attitude towards the clinical application of tanshinone in this disease (Luger et al. 2001; Wang et al. 2011; Tan et al. 2011; Wang et al. 2012).

Pulmonary Artery Remodeling

Ascites syndrome (AS), also known as pulmonary hypertension, is a global metabolic disease. The transformation of pulmonary artery is a key link in the formation and development of AS. The exact relationship of pulmonary artery mRNAs and SNPs in regulating AS progression is unclear. Therefore, the scholars obtained pulmonary artery tissue from pathological sections and pathological anatomical observations of diseased chickens (Yang et al. 2016). SNP, inDel, and mRNA data were analyzed using GATK and ANNOVAR software to examine previously reported SNP loci for 985 genes (437 elevated, 458 elevated). Pathological examination showed that there was a lot of yellow fluid in the abdominal cavity and pericardium in this group, the cardiac index and hematocrit of ascites were significantly changed, and the pulmonary artery was changed and thickened. Heart sections show vacuolar degeneration of myocytes and disintegration of myofibers. In addition, ALDH7A1, IRG1, GGT5, IGSF1, DHX58, USP36, TREML2, SPAG1, CD34 and PLEKHA7 are closely related to the pathogenesis of AS progression to pulmonary artery remodeling. In conclusion, our study further elucidates the molecular mechanism of pulmonary artery remodeling in AS progression (Yang et al. 2016). Recent studies have demonstrated that the impact of pulmonary vascular remodeling on PAH development involves a complex multifactorial process in which endothelin-derived vasoactive molecules, such as endothelin-1, vascular endothelial growth factor, and insulin-like growth factor-II, altered the growth (Hassanpour et al. 2009; Hamal et al. 2012; Rabinovitch et al. 2014). These molecules are increasingly recognized as key elements and potential therapeutic targets for the treatment of PAH. Furthermore, these protein-coding genes contain at least one conserved microRNA-binding site (miRNA) and a large number of unreserved sites; most protein-coding genes are likely to be under the control of miRNAs. However, SNPs of target genes may alter miRNA expression due to altered mRNA levels. Therefore, it has also been suggested that SNPs of disease risk-related miRNA target genes (mRNAs) may play a role through their effects on miRNAs.

This study now provides a unique place to assess whether SNP loci and miRNA target genes affect miRNA expression in PAH broilers, leading to AS. To determine whether specific SNPs alter miRNA expression levels, we used PAH and tissues other than PAH to assess expression differences between genotypes (Yang et al. 2016). However, since SNPs can alter miRNA expression levels in PAH and non-PAH tissues alike, this association does not necessarily lead to the potential risk of PAHs in broiler AS. To determine whether SNPs are associated with PAH through miRNA regulation, we sought to understand the regulatory mechanisms by which miRNAs and SNPs are associated with target genes that alter the pulmonary vasculature remodeling phenotype. Finally, we assessed the SNPs involved in miRNA expression and the potential risk of AS in PAH broilers.

In the process of disease development, the issue of remodeling and thickening of pulmonary arteries has also attracted the attention of scholars at home and abroad. Several researchers have investigated the aberrant expression of microRNAs and mRNAs in pulmonary arterial transformation in ascites syndrome. Previous studies have shown that miRNAs play important roles in the biology of developmental timing, differentiation, cell death, proliferation, and metabolism (Liu et al. 2017). Recently, dysregulation of miRNAs has been shown to be associated with many cardiovascular diseases, including pulmonary hypertension (Zhou et al. 2015). In this study, researchers obtained pulmonary artery tissue from AE chickens and chickens without AE and performed miRNA sequence analysis, miRNA-mRNA association analysis, and pathological examination. Among known and novel miRNAs, 29 miRNAs were found to be significantly differentially expressed, and the regulation of miR-155, miR-23b-3β, miR-146b-5β, and miR146b-3β was closely related to arterial pathogenesis. transformation. in the process of AS. The miRNA-mRNA association analysis showed that these 29 differentially expressed miRNAs regulated 162 differentially expressed target genes. Of these, 20 miRNAs were associated with 18 predicted target genes that appear to be involved in pulmonary artery remodeling, mainly involved in three broad physiological processes: the hypoxia sensing response (HIF1α, NHE1, STAT5 and STAT3), endothelial permeability dysfunction (CD44, TRAF2, CDK2AP1, LZTFL1, JAZF1, PEBP1, LRP1B, RPS14 and THBS2) and inflammation (MEOX2, STAT5, STAT3, IRF8, MAP3K8, IL-1BETA and TNFRSF1B). In this study, the pathological transformation of the pulmonary artery in AS broilers continued. In conclusion, this analysis further elucidates the molecular mechanism of lung remodeling in AS progression (Liu et al. 2017). In addition, some researchers have investigated the issue of abnormal miRNA and mRNA expression during pulmonary artery remodeling in ascites syndrome. They believe that the transformation of the pulmonary artery is a critical step in the development of AS. To further elucidate the molecular mechanism of pulmonary artery remodeling, they obtained pulmonary artery tissues with and without AS from chickens, and performed miRNA sequence analysis, miRNA-mRNA association analysis, and pathological examination. Twenty-nine significantly differentiated miRNAs were found among known and novel miRNAs, of which 18 were up-regulated and 11 were down-regulated. Through GO (Gene Ontology) and KEGG (Kyoto Encyclopedia of Genes and Genomes) analyses, their predicted potential targets included a wide range of functional clusters. The increase of miR-155, miR-23b-3β, miR-146b-5β and miR146b-3β is closely related to the progression of AS in the pathogenesis of lung remodeling.

Conclusions

Although broiler chicken ascites syndrome is a disease that is difficult to overcome and has a huge impact, according to the

research results collected so far, different scholars have studied the disease from different angles and approaches to overcome the disease. Overall, the trend is positive, it's only a matter of time, and the academic community is quite positive about the disease's prospects.

REFERENCES

Buys N et al., 1999. Performance and physiological variables in broiler chicken lines differing in susceptibility to the ascites syndrome: 1. Changes in blood gases as a function of ambient temperature. British Poultry Science 40: 135-139.

Gu Y et al., 2021. Preparation of ribosomal protein S14 polyclonal antibody in broiler pulmonary artery: Its application in broiler ascites syndrome, International journal of biological macromolecules, 193: 328-336.

Hassanpour H et al., 2009. Evaluation of endothelial and inducible nitric oxide synthase genes expression in the heart of broiler chickens with experimental pulmonary hypertension. British Poultry Science 50: 725-732.

Hasanpur K et al., 2016. The suitability of some blood gas and biochemical parameters as diagnostic tools or early indicators of ascites syndrome in broiler sire lines. Journal of Animal Physiology and Animal Nutrition 100(3): 456-463.

Hassanzadeh M et al., 2008. Further evidence for the involvement of anatomical parameters of the cardiopulmonary system in the development of ascites syndrome in broiler chickens. Acta Veterinaria Hungarica 56(1): 71-80.

Hassanzadeh M et al., 2004. Effect of chronic hypoxia during embryonic development on physiological functioning and on hatching and post-hatching parameters related to ascites syndrome in broiler chickens. Avian Pathology 33(6): 558-564.

Hormozi M et al., 2017. The effect of acetylosalicylic acid and berberis on ascites syndrome parameters in broiler chickens. Polish Journal of Veterinary Sciences 20(4): 835-837.

Hu G et al., 2017. Tanshinone IIA protects against pulmonary arterial hypertension in broilers. Poultry Science 96: 1132-1138.

Hamal KR et al., 2012. Immunohistochemical examination of plexiform-like complex vascular lesions in the lungs of broiler chickens selected for susceptibility to idiopathic pulmonary arterial hypertension. Avian Pathology 41: 211-219.

Huang C et al., 2020. Cloning and bioinformatics analysis of MEOX2 gene in broiler pulmonary artery tissue. Chinese Journal of Veterinary Science 40(08): 1528-1535+1570.

Kalmar ID et al., 2013. Broiler ascites syndrome: collateral damage from efficient feed to meat conversion. The Veterinary Journal 197(2): 169-174.

Liu P et al., 2017. Dysregulated expression of microRNAs and mRNAs in pulmonary artery remodeling in ascites syndrome in broiler chickens. Oncotarget 8: 1993-2007.

Liu W, 2016. A Trial Diagnosis of Ascites Syndrome in Broiler Chickens. Pakistan Journal of Biological Sciences 19(8-9): 352-359.

Luger D et al., 2003. Erythropoiesis regulation during the development of ascites syndrome in broiler chickens: a possible role of corticosterone. Journal of Animal Science 81(3): 784-790.

Luger D et al., 2001. Association between weight gain, blood parameters, and thyroid hormones and the development of ascites syndrome in broiler chickens. Poultry Science 80: 965-971.

McGovern RH et al., 1999. Analysis of right ventricular areas to assess the severity of ascites syndrome in broiler chickens. Poultry Science 78(1): 62-65.

Parveen A et al., 2020. Identification and validation of quantitative trait loci for ascites syndrome in broiler chickens using whole genome resequencing. BMC Genetics 21(1): 54.

Rabinovitch M et al., 2014. Inflammation and immunity in the pathogenesis of pulmonary arterial hypertension. Circulation Research 115: 165-175.

Shi S et al., 2017. Combinatory evaluation of transcriptome and metabolome profiles of low temperature-induced resistant ascites syndrome in broiler chickens. Scientific Reports 7(1): 2389.

Shi S et al., 2014. Integrative analysis of transcriptomic and metabolomic profiling of ascites syndrome in broiler chickens induced by low temperature. Molecular BioSystems 10(11): 2984-2993.

Tisljar M et al., 2011. The impact of L-NAME and L-arginine chronic toxicity induced lesions on ascites--pulmonary hypertension syndrome development in broiler chickens. Coll Antropol 35(2): 547-556.

Tan X et al., 2011. Tanshinone IIA protects against cardiac hypertrophy via inhibiting calcineurin/NFATc3 pathway. International Journal of Biological Sciences 7: 383-389.

Varmaghany S et al., 2015. The effects of increasing levels of dietary garlic bulb on growth performance, systolic blood pressure, hematology, and ascites syndrome in broiler chickens. Poultry Science 94(8): 1812-1820.

Wang P et al., 2011. Tanshinone IIA prevents cardiac remodeling through attenuating NAD (P)H oxidase-derived reactive oxygen species production in hypertensive rats. Die Pharmazie 66: 517-524.

Wang Y et al., 2012. Changes of hepatic biochemical parameters and proteomics in broilers with cold-induced ascites. Journal of Animal Science and Biotechnology 3: 41.

Wang L et al., 2013. MicroRNA expression profile of pulmonary artery smooth muscle cells and the effect of let-7d in chronic thromboembolic pulmonary hypertension. Pulmonary Circulation 3(3): 654-664.

Wideman et al., 1999. Broiler breeder survivors of chronic unilateral pulmonary artery occlusion produce progeny resistant to pulmonary hypertension syndrome (ascites) induced by cool temperatures. Poultry Science 78(3): 404-411.

Yang F et al., 2016. Transcriptome Analysis and Gene Identification in the Pulmonary Artery of Broilers with Ascites Syndrome. PloS One 11: e0156045.

Zhou G et al., 2015. MicroRNAs in pulmonary arterial hypertension. American Journal of Respiratory Cell and Molecular Biology 52(2): 139-151.