Immune Mechanism of Foot and Mouth Disease and Treatment of Allergic Reaction to Vaccine

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Abstract: Allergic reactions caused by FMD vaccine are often encountered in the process of FMD immunization. If not treated in time, it can cause the death of immunized animals and economic losses. This paper mainly introduces the immune mechanism of FMD, the mechanism of allergic reaction of vaccine, the clinical symptoms and treatment measures of allergic reaction of FMD vaccine and preventive measures, aim to provide reference for better avoiding the occurrence of allergic reaction of FMD vaccine.

1 INTRODUCTION

Foot-and-mouth disease (FMD) is an acute, febrile, highly contagious zoonosis caused by Foot-and-mouth disease virus (FMDV). The genome of FMDV is a single-stranded positive-sense RNA with a total length of approximately 8,500 nucleotides. There are seven serotypes of FMDV, namely O, A, C, SAT I, SAT II, SAT III and Asia I. More than 80 subtypes, each serotype has different antigenicity and there is no cross-immune protection between the serotypes. Foot-and-mouth disease (FMD) has caused significant economic losses to animal husbandry and is the focus of quarantine and epidemic prevention in various countries around the world. Vaccines, available since the early 1900s, have been the most instrumental method for prevention and control of FMD. However, the allergic reactions caused by vaccines should not be ignored, which may even cause animal death.

2 IMMUNE MECHANISM OF FOOT-AND-MOUTH DISEASE

2.1 Humoral Immunity

The immune response mediated by B cells is called humoral immunity, and humoral immune effect is achieved by B cells through the recognition of antigens, activation, proliferation and finally differentiation into plasma cells and secretion of antibodies. Therefore, antibodies are immune molecules that mediate humoral immune effect.

Antibodies are immune globulins secreted by B lymphocytes after activation and have important anti-infective effects. According to the differences in chemical structure and antigenicity, the antibodies of animals can be divided into five categories, namely IgM, IgG, IgA, IgE and IgD, of which, IgG and IgA have different subclasses. IgM is the largest immunoglobulin molecule and consists of a pentamer of five monomers of the same size as IgG. IgM is the earliest antibody produced by the animal body after the initial antigenic stimulation. Among them, the effect of neutralizing the virus is weak, but the ability to bind complement is strong. IgG is the most important antibody and the most important immunoglobulin in serum, accounting for about 75% of the total immunoglobulin, and is widely distributed in the body. Among all immunoglobulins, IgG has the strongest virus neutralization and can exert immune activities such as antibacterial, antiviral, and neutralizing viruses. IgA is present in mucosal secretions and other secretions, and IgA is also present in the blood, and IgA is associated with local immunity. The site of IgE production, similar to IgA, is produced by plasma cells in the lamina propria of the respiratory and digestive tracts and is present in little amount in the serum. IgE is a cytophilic antibody that readily binds to eosinophils and vascular endothelial cells in skin tissue, mast cells, blood and can mediate type I allergic reactions. IgE also has an important role in

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anti-parasitic, certain fungal infections. The secretion of IgD is rare, and its content in serum is very low, and unstable, and easily degraded. Some researchers believe that IgD is related to immune memory, and some reports suggest that IgD is related to some allergic reactions.

After animals are exposed to FMDV antigen, a specific immune response dominated by humoral immunity is induced and neutralizing antibodies are produced, which mainly destroy FMDV with neutralizing and opsonizing effects.

2.2 Cellular Immunity

The function of anti-FMD infection is mainly related to humoral immunity, but the role of cellular immunity and cytokines produced by immune cells in the immune response to FMD cannot be ignored. At present, the role and mechanism of cellular immunity in FMD immunity are not fully understood, and some progress has been made using synthetic peptides and T cell technology (Alexandersen, 2005). Synthetic peptides containing only B cell epitopes have low immunogenicity, which may be related to MHC (major histocompatibility complex) restriction, and the introduction of Th cell (helper T cell) epitopes can overcome the limitations and induce the production of high levels of protective antibodies. Both natural host pigs and cattle have FMDV serotype-cross-reactive T cells, and this T cell epitope is present on structural proteins VP1 and VP3 (Arztl, 2011). After immunization of pigs with FMDV inactivated antigen, the number of $CD4^+$ and Th cells increased significantly, and lymphocytes with immune memory could be present in the circulatory system for at least 1 year (Ayebazibwe, 2010). In vitro, each structural protein of FMDV can stimulate the proliferation of this cell, of which VP1 and VP3 proteins are more effective, and the proliferative response is dependent on the antigen dose. This shows that Th cells are involved in the immune response to FMDV inactivated antigens.

2.3 Local Immunity

Local immunity is an extension of humoral immunity and is mainly characterized by the production of secretory IgA. Pharyngeal mucosal immunity in FMD is of interest because this site is the site of initial infection with FMDV and long-term virus carriage.

3 MECHANISM OF ALLERGIC REACTION TO VACCINE

Allergic reactions caused by foot-and-mouth disease vaccine are type I allergic reactions. This reaction is a complex process: the allergen enters the animal body for the first time, stimulates the animal body to produce a large amount of allergic antibody IgE, IgE adsorbs on the mast cells of tissues and the basophil surface of blood, so that the animal body is in a sensitized state. When the sensitized body is re-exposed to the same allergen, the allergic principle binds to the IgE antibody attached to the surface of mast cells and basophils, activates the intracellular enzyme system, resulting in the rapid release of various bioactive substances by cellular endocrine granules. For example, histamine, serotonin and anaphylatoxin, these bioactive substances can cause inflammatory reactions, resulting in a series of allergic reaction symptoms such as telangiectasia and increased permeability, mucocutaneous edema, decreased blood pressure and respiratory smooth muscle spasm.

4 CLINICAL SYMPTOMS AND TREATMENT OF ALLERGIC REACTION TO FOOT-AND-MOUTH DISEASE VACCINE

4.1 Mild Allergic Reactions

It is a normal vaccine response and its clinical symptoms are not obvious. Only a few pigs in the vaccinated herd showed mild apathy and loss of appetite (Belsham, 2011). In general, it does not require treatment and resolves spontaneously in 1 to 2 days.

4.2 Moderate Allergic Reactions

It often occurs in groups and appears about 15 minutes after injection of the vaccine. The clinical symptoms were very pronounced and manifested as dyspnea, salivation, vomiting, generalized cyanosis, unsteady standing, and intoxicated gait. Allergic pigs are generally weak and bedridden. A small number of pigs were also seen standing with limbs open and sunk back (Doel, 2003). After the occurrence of the above symptoms, epinephrine hydrochloride or glucocorticoids should be used as

soon as possible for treatment, while paying attention to keeping the environment quiet and providing adequate drinking water.

4.3 Severe Acute Allergic Reactions

It is rare, often occurring within 15 minutes after injection of the vaccine, and severe allergic symptoms occur a few seconds after injection of the vaccine. The main symptoms are: allergic animals suddenly fall to the ground, general weakness; dyspnea, salivation, pale conjunctiva, systemic cyanosis, decreased body temperature; systemic muscle tremor, confusion, ataxia, incontinence, unresponsiveness to various stimuli; severe cases may develop anaphylactic shock, which can cause death if not timely rescued (Ecuru, 2010).

For severe acute allergic reactions, epinephrine injection should be performed immediately for treatment, and some adjuvant therapy can be taken if necessary.

5 PREVENTIVE MEASURES

Establish a reasonable immunization schedule to avoid simultaneous immunization with other vaccines and minimize the occurrence of stress reactions to foot-and-mouth disease vaccines. Before immunization, disinfection and sterilization of devices should be done well, and drugs such as epinephrine or glucocorticoids should be prepared at the same time in order to treat allergic pigs timely. During the immunization, operate in accordance with the specifications strictly, inject according to the dose specified in the instructions, and postpone the immunization for the thin, pregnant animals with a history of allergy. After the completion of vaccine injection, attention should be paid to observation. If allergic reactions occurred, contact the professionals to take treatment measures as soon as possible. In addition, establish immunization archives timely. In case of any death of animals due to allergic reaction, relevant personnel shall be contacted for harmless treatment immediately.

6 CONCLUSION

The globalization of commerce is accelerating the spread of FMDV and presents new requirements on the trade of animals and animal productions. But novel vaccines against FMDV are developed slowly, and only few available novel FMD vaccines have been used in practice. In the development of new vaccines, we should improve the effectiveness while give attention to safety, minimize allergic reactions and reduce the physical discomfort and death of animals caused by vaccination.

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