

Vaccines and Vaccination for Veterinary Viral Diseases

Vacunas y vacunación contra enfermedades virales veterinarias

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Abstract:

A large number of infectious diseases in animals and livestock are caused by pathogens of viral origin. This etiology depends largely on quality and welfare standards in animal production, which requires developing highly effective tools to detect, prevent and stop the spread of these mostly infectious diseases dependent on vaccination programs. However, many vaccines are manufactured in a classical way, which is killed or attenuated. Therefore, due to the viral behavior of the disease, it puts the introduction of diseases at risk. Therefore, it is necessary to modernize vaccination processes, using new experimental generation technologies, in the veterinary context the immunity caused by viral pathogens is addressed.

Keywords:

Viruses, vaccines, attenuated vaccine technologies, diseases in animals.

Resumen:

Un gran número de enfermedades infecciosas en animales y en el ganado son causadas por patógenos de origen viral. Esta etología depende en gran medida de los estándares de calidad y bienestar en la producción animal, lo que requiere desarrollar herramientas altamente efectivas para detectar, prevenir y detener la propagación de estas enfermedades mayormente infecciosas dependientes de los programas de vacunación. Sin embargo, muchas vacunas se fabrican de manera clásica, las cuales son muertas o atenuadas. Por lo que debido a la conducta viral de la enfermedad pone en riesgo la introducción de enfermedades. Por lo tanto, es necesario modernizar los procesos de vacunación, utilizando las tecnologías de nueva generación experimental, en el contexto veterinario se aborda la inmunidad provocada desde los patógenos virales.

Palabras Clave:

Virus, vacunas, tecnologías de vacunas atenuadas, enfermedades en animales.

Introduction

Those who have and care for animals know that the main thing in production and care is the health and well-being of the animals. However, animals, like people, are susceptible to a wide range of diseases caused by viruses, bacteria, fungi and parasites. Vaccines are available for many of these diseases, making them preventable or mitigating the long-term losses or consequences of the disease. This is particularly important for those diseases that have complex, limited or non-existent treatment options.

Therefore, disease prevention or minimizing the clinical signs of the disease in the first instance should be prioritized to protect the health and well-being of animals, under the premise of prevention.

One of the greatest transformations in history occurred when humanity moved from a hunter-gatherer lifestyle to an agricultural lifestyle.

For millennia, livestock and companion species (ruminants, pigs, poultry, cats and dogs) were domesticated and bred first for survival (in this sense the word "livestock" has meaning) and then for profit and trade.

Since then, animal husbandry evolved as one of the most important activities for civilization and development. The importance of such activity is obvious since proper management of the use of land and animal resources is always required to avoid malnutrition and hunger in developing countries or in countries where intensive agriculture is essential for subsistence.

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The explosive growth rate of the global human population complicates this picture (particularly in developing countries), so other sources of dietary consumption, such as farmed fish, will be more in demand in the near future. Inevitably, the intensive breeding of animal species leads to the emergence of diseases caused mainly by the spread of infectious pathogens, affecting animal welfare, reducing productivity and, in the worst cases, seriously undermining the economy of nations.

In some cases, livestock or animal pathogens can also cause disease in humans, so it is necessary to implement means to control and eradicate them.

Key Concepts: Vaccines and Vaccination Vaccines have a long and successful history of preventing and controlling disease. The veterinary vaccines available today represent years of innovative research and meet many of the disease threats faced by pets and farm animals today.

Vaccines work by stimulating an immune response in an animal without causing the disease itself. When healthy animals are vaccinated, their own immune system responds to the vaccine and can remember the infectious agent to which the animal is vaccinated. This means, if appropriately vaccinated animals are then exposed to the pathogen against which they have been vaccinated, they can expect a level of protection from disease.

The main types of vaccines available can be categorised as modified-live (attenuated), inactivated and recombinant.

- **Modified-live (attenuated):** a vaccine that contains an intact but weakened pathogen which stimulates an immune response but does not cause clinical disease.
- **Inactivated (killed):** a vaccine that contains a completely inactivated pathogen, which is no longer infectious. These vaccines often contain an adjuvant, which is a compound added to help improve the protective immune response.
- **Recombinant:** a vaccine that is produced using genetic engineering technology and using specific genetic material from a pathogen to produce proteins which will stimulate an immune response when the animal is vaccinated.
- **Toxoid:** a vaccine that is based on inactivated toxins produced by pathogens. These vaccines stimulate immunity and protect the animal against these toxins. Research and innovation has also resulted in the

development of novel and more sophisticated technologies such as marker vaccines.

Typically, when animals are vaccinated they produce an immune response that resembles that of a natural infection. It can then be difficult when testing animals to determine if they have been naturally infected or if they have been vaccinated. An example is the farm animal marker vaccine for Infectious Bovine Rhinotracheitis (IBR) – a highly contagious respiratory disease in cattle.

Irrespective of the type of vaccine used, an animal should be in good health at the time of vaccination – as a properly functioning immune system is needed to stimulate a good immune response and develop an effective level of protection.

Initially a primary vaccination course should be completed and depending on the vaccine type and the species of animal, it may be necessary to follow up with booster vaccinations at intervals based on veterinary advice and the characteristics of the vaccine, to maintain protective immunity throughout the animals' lifetime.

There are no one size fits all when vaccinating animals and vaccination protocols should be tailored, based on veterinary consultation, for individual pets or groups of farm animals. This is because animals are exposed to a range of different risk factors related to their age, lifestyle, prevailing disease threats and travel/movement.

Species	Target Pathogen	Vector	Target Antigen	Type of Vector
Humans	Ebolavirus	Vesicular Stomatitis Virus	Glycoprotein	Pseudotyped
	SARS-CoV-2	Adenovirus	Spike	Gene Transfer
Dogs	Canine Distemper	Canarypox	F and HA	Gene Transfer
Cats	Rabies	Canarypox	Glycoprotein	Gene Transfer
	Feline Leukemia Virus	Canarypox	Env and Gag	Gene Transfer
Ferrets	Canine Distemper	Canarypox	F and HA	Gene Transfer
Wildlife	Rabies	Vaccinia Virus	Glycoprotein	Pseudotyped
Horses	Equine Influenza Virus	Canarypox	HA	Gene Transfer
	West Nile Virus	Canarypox	PreM-Env	Gene Transfer
	West Nile Virus	Yellow Fever Virus	PreM-Env	Pseudotyped
Poultry	Avian Influenza Virus and Fowlpox Virus	Fowlpox	HA (H5) and whole virus	Pseudotyped
	Marek's Disease and Infectious Bursal Disease	Turkey Herpesvirus	Whole virus and IBD VP2	Gene Transfer
	Marek's Disease, Infectious Bursal Disease, and Newcastle's Disease	Turkey Herpesvirus	Whole virus, IBD VP2, and ND F gene	Gene Transfer
	Marek's Disease and Fowl Laryngotracheitis	Turkey Herpesvirus	Whole virus and LT Glycoprotein B	Gene Transfer

Table 1: Overview of select approved viral vector based vaccines for use in humans and animals.

These factors should be discussed with the vet to decide on the most appropriate choice of vaccine and vaccination protocol.

Another important concept in vaccination is that of 'herd immunity'. Herd immunity is the protection offered to a wider community of animals, pets or farm animals, when a sufficiently high proportion of individual animals are vaccinated, reducing the prevalence of disease and numbers of susceptible individuals in an area.

Conclusions

- Vaccination is an effective way to prevent or reduce disease in pets, farm animals and fish.
- Vaccines are available for a range of important bacterial, viral, fungal and parasitic diseases – many of which are difficult or impossible to treat.
- Preventative health measures, such as a robust vaccination strategy can reduce the need for veterinary treatments and improve responsible antibiotic use.
- There is no 'one size fits all' vaccination strategy and consultation with your vet to discuss specific disease risk factors is important to decide on the most appropriate vaccines for animals in your care.
- Although it is not always technically possible to develop an effective vaccine, the animal medicines sector continues to invest and innovate in vaccine technology to support endemic and exotic disease prevention and control. Vaccines are therefore part of a wider range of animal medicines available to prevent or treat disease.

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