Protective measures against rabies by vaccination of domestic animals

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Summary: As the ultimate goal of any protective measure against rabies is the prevention of the disease in humans, the vaccination of animals should serve to interrupt the transmission cycle of the virus.

After presenting the general characteristics of rabies vaccines, particular types are reviewed. These include traditional vaccines prepared from virus grown in vivo, more recent vaccines prepared from virus adapted to cell culture systems, and "new generation" vaccines prepared by means of molecular biology and genetic engineering techniques (avirulent mutants of rabies virus, subunit vaccines, vaccinia-recombinant virus containing the rabies glycoprotein gene, genome-free vaccines, vaccines produced by chemical synthesis of peptide sequences and anti-idiotypic antibodies).

Vaccination procedures are briefly reviewed. Good quality vaccines can confer immunity lasting up to three years.

KEYWORDS: Disease control - Domestic animals - Public health - Rabies - Vaccination - Vaccines - Viral diseases.

1. The ultimate goal of any protective measure against rabies is the prevention of the disease in humans. Such measures vary according to the epidemiological situations and socio-economic conditions of different countries, but all have the following objectives:

- to interrupt the transmission cycle within the wildlife population;
- to interrupt the transmission cycle between wildlife and domestic animals;
- to prevent transmission from wildlife to domestic animals and then to humans, and from wildlife directly to humans;
- to protect professional categories at risk by pre-exposure treatment.

2. General characteristics of the vaccines. Protection from rabies has been demonstrated to be related to several interdependent host effector mechanisms: virus neutralising antibodies induced by glycoprotein (G) T-cells, stimulated by both G and nucleocapsid proteins, interferon, etc.

It must be emphasised that rabies vaccination of animals is always pre-exposure (except in particular conditions on pre-immunised animals, as antigenic recall). The objective of immunisation is not merely the onset, but also the quality and duration, of immunity.

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3. Recent developments in rabies vaccine research have introduced a new classification: traditional vaccines and "new generation vaccines".

Traditional vaccines are those prepared from virus grown in vivo; new generation vaccines are those prepared from virus adapted to cell culture systems.

In vivo production of rabies vaccine can be achieved either from virus grown in neural tissues of adult animals (mice, rabbits, sheep, etc.) or, preferably, from suckling animals, and partially or totally inactivated virus strains (derived from the original Pasteur virus) or in embryonated eggs (Flury LEP-HEP, Kelev strains).

In vitro vaccines are produced from fixed virus strains (Pasteur-derived strains, Flury strains, SAD or SAD-derived strains, such as the ERA and Vnukovo strains) previously adapted in vivo and then grown in different cell culture systems. These viruses can be used either in the live or, as is more frequently done, in the inactivated form.

New generation of rabies vaccines

Avirulent mutants of rabies virus have been tested in live and inactivated forms of vaccine. Rabies virus glycoprotein-subunit vaccines have been successfully developed and tested.

Furthermore, a vaccinia-recombinant virus containing the rabies glycoprotein gene, has been shown to induce the production of substantial amounts of rabies glycoprotein which in turn gives rise to a rapid production of virus neutralising antibodies and to protection from severe challenge with large doses of street rabies virus in rabbits, mice, raccoons, skunks, foxes and cattle.

Other approaches currently utilise modern molecular biology and genetic engineering techniques to develop Adenovirus and Baculovirus-based systems to produce genome-free vaccines (including only the immunogenic components).

Chemical synthesis of short peptides, reproducing specific amino acid sequences of the glycoprotein, and encapsulated within lipidic vesicles (liposomes), acting both as a delivery system and an adjuvant, has also been tried with encouraging results.

Rabies anti-idiotypic antibodies have elicited specific antibody response (a booster with inactivated vaccine protected against challenge).

4. Vaccination procedures: Rabies vaccines are usually administered to domestic animals parenterally, and normally, unless otherwise specified, by the intramuscular route. The latter is also the only route that can be used when administering live modified virus vaccines. It must be noted that oral administration (with live modified virus vaccine) has been successfully tried recently in Tunisia, in dogs, using vaccine baits. The presence of maternal antibodies can inhibit the immune response to vaccination. Good quality vaccines can confer immunity lasting up to three years. Booster vaccination can be administered upon exposure to previously immunised animals.