Epidemiology and control of raccoon rabies: an update

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Summary: The raccoon has lately become an important rabies vector in the mid-Atlantic region of the United States. Following epidemiological studies and antigenic characterisation of raccoon rabies virus, oral immunisation trials were conducted in the laboratory. The results have been encouraging. A vaccinia-rabies glycoprotein recombinant virus was shown to be efficacious, and a limited field trial of the vaccine is planned.

KEYWORDS: Disease control - Epidemiology - Genetic recombination - Oral vaccination - Rabies - Raccoon - USA - Viral diseases.

1. Within North America, the raccoon (Procyon lotor) was a significant rabies vector only in the south-eastern USA prior to 1977. At that time, translocation of incubating raccoons into the mid-Atlantic region began a new rabies outbreak that by 1988 had encompassed the areas of West Virginia, Virginia, Maryland, the district of Columbia, Pennsylvania and Delaware. The use of panels of anti-nucleocapsid and anti-glycoprotein monoclonal antibodies allowed the antigenic characterisation of raccoon rabies virus “spillover” into a wide variety of other animals, including skunks, red and grey foxes, opossums, woodchucks, companion animals, livestock and horses.

2. The laboratory and field data generated from European vaccination trials was the basis for an attempt at oral immunisation of raccoons in the laboratory with SAD virus. Raccoons sedated and given $10^7$ PFU of SAD-19 *per os* developed virus-neutralising antibodies and were protected against a lethal peripheral street rabies virus challenge. Encouraged by these preliminary results, raccoons were fed the Tübingen bait with SAD vaccine but, unfortunately, only 30-50% protection was observed at challenge.

3. Vaccinia-rabies glycoprotein recombinant virus (V-RG) vaccine was developed during 1983, as a potential alternative vaccine for raccoons. This V-RG vaccine elicited high titres of rabies virus-neutralising antibodies (VNA) and protection from rabies challenge when inoculated parenterally into laboratory animals. Moreover, the efficacy of V-RG by the oral route was soon demonstrated for laboratory rodents (during 1984) and for raccoons shortly thereafter. Further laboratory research with V-RG within baits fed to raccoons showed excellent short and long-term protection from peripheral street rabies virus challenge. In addition, the examination of cerebrospinal fluid (CSF) from captive raccoons receiving V-RG vaccine was shown by cellular and rabies VNA analysis to be identical to the CSF of free-ranging raccoons, and

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significantly unlike the obvious encephalitic profile of clinically rabid raccoons. This CSF analysis does not support the concept of potential neurotropism by V-RG in experimental hosts. Moreover, experimental studies of the pathogenesis of V-RG vaccine have shown an attenuation of the recombinant vaccine over its vaccinia parent virus via the inactivation of the thymidine kinase gene. The V-RG vaccine could only be recovered in low titres within 48 hours of oral infusion of raccoons in the tonsils and regional (i.e. sub-mandibular) lymph nodes, attesting to its transient and limited replication, despite its obvious efficacy. The safety of V-RG has also been demonstrated for pregnant and lactating raccoons and their kits, suggesting passive protection for animals less than approximately three months of age, with active immunisation thereafter.

4. Theoretical concern has been expressed about the possibility of recombination between raccoon pox virus and V-RG. This will depend in part upon the prevalence of natural raccoon pox virus and the probability for simultaneous infection with V-RG vaccine virus. Thus far, we have no serological evidence of raccoon pox activity among Pennsylvania or barrier island raccoon populations, making the probability for this event rather low.

Considering the safety and efficacy of V-RG vaccine for a diversity of mammalian species, we have begun preliminary site selection for a limited field trial of V-RG vaccine in the USA. Several Atlantic barrier islands have been selected for background study, involving factors such as relative density movements, foraging patterns, denning characteristics and bait preferences of raccoons.