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Round table on epidemiology and control of fox rabies

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ABSTRACT

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The current epizootic of rabies in Europe has as its main host the fox. Oral vaccination of the fox population has proven to be particularly effective. It is clear that the major components for a successful vaccination programme are a potent and stable vaccine, and an effective baiting system; the latter should attract the target animal but no non-target species. Recently, vaccines of increased stability have been generated; amongst these is a vaccinia recombinant virus which expresses rabies virus glycoprotein. Consequently, both attenuated live virus vaccines and a recombinant vaccine are available for routine field vaccination of the fox population.

INTRODUCTION

It is considered that the fox is the main host responsible for the transmission of rabies in the current epizootic in Europe. Information on the epidemiology of the disease is of prime importance for a control programme to be successful (Wandeler et al., 1988). There are certain salient points concerning the epidemiology of fox rabies in Europe which should be considered with respect to any control programme:

— the fox is currently the main host for rabies virus, and there is no indication of another rabies virus reservoir of the same importance;
— the incidence of rabies cases is directly related to the fox density;
— the rabies virus circulating in European fox population is antigenically homogeneous;

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— the transmission of rabies is mainly by biting
— most of the foxes with rabies virus antigen in their brain also had infectious virus in the salivary gland;
— during the short period of virus excretion by a rabid fox, the virus has to be transmitted to enough susceptible foxes in order to maintain the infectious chain.
— rabies virus antigens are good immunogens and confer protection if applied in the correct manner.

The round-table session concentrated on presentations concerning the control of fox rabies; epidemiological discussions were not included due to time restrictions.

One aspect of the control which was dealt with in some detail was the potential for vaccination. A number of vaccines are available, and reports on their applicability and relative efficacy were presented.

CONTROL

Theoretically, it should be possible to eliminate rabies, either by a drastic reduction in the fox population or by mass immunization of foxes. Attempts have been made in several countries to control the fox population, but it was not possible to achieve a level of reduction which would abrogate the transmission of the virus. Consequently, it was considered that mass vaccination of foxes should hold more promise (Wandeler, 1988), particularly in view of the success achieved in controlling the disease in dogs by parenteral vaccination. However, the following special requirements for fox vaccination had to be respected: (1) the vaccine must be safe and potent for field application; (2) the vaccine delivery system must permit mass immunization of foxes.

The Swiss Rabies Centre started its first field trial for vaccination of foxes against rabies in an Alpine valley in 1978. Oral immunization was pursued, using chicken heads as baits, and a cloned SAD vaccine strain. Several previous innocuity and potency tests had demonstrated both safety and efficacy of the material employed. By 1982, rabies had been eliminated from large areas within the Swiss Alps by this vaccination programme. Extension of the programme to other areas during 1982–1991 has resulted in the disappearance of rabies from the country, except for those areas bordering endemic zones in France, where no vaccination was performed.

Other European countries also commenced similar vaccination strategies; Germany in 1983, Italy in 1984, Belgium, Luxembourg and France in 1986, followed by Czechoslovakia and Yugoslavia. When vaccination was applied according to the specified protocol, all of the above countries reported reductions in the incidence of rabies cases within the vaccinated areas.

RABIES VACCINES AVAILABLE (reviewed by Wandeler, 1991)

It is widely accepted that the SAD strains of rabies virus which have been used for fox vaccination have had some residual pathogenicity for certain rodents. However, this has apparently no biological significance for vaccination of wildlife in Europe. Nevertheless, less pathogenic strains of the virus such as SAG have been produced, and it would be desirable if such reagents could be efficaciously applied (Leblois et al., 1988).

In addition to the safety aspect of attenuated live rabies virus vaccines, there is the question of vaccine stability. With respect to conventional vaccines, this was sufficient for the successful mass immunization of foxes. In parallel, a recombinant vaccinia virus expressing rabies virus glycoprotein was engineered (Kieny et al., 1984). Field trials in Belgium demonstrated that this recombinant vaccine was both safe and potent (Brochier et al., 1991). In France, two vaccines are being tried; the vaccine using SAG_1 avirulent rabies virus variant, and the V-RG recombinant virus vaccine (Blancou et al., 1986). Both have proved to be effective, not only in laboratory tests but also under field conditions.

VACCINE STABILITY AND TARGETING

The recombinant vaccinia virus expressing the rabies virus glycoprotein was found to be the most stable; the virus titre in baits remained high during a 1-month period of storage at 20°C. It induced antibody titres in the fox which remained stable for at least 18 months, and in a study area reduced the incidence of rabies in cattle to zero following three vaccination campaigns in foxes (Brochier et al., 1991).

The recombinant vaccine was shown to be safe for the target species. It replicates to a low level and at restricted sites in target animals such as foxes, and no pathogenicity problems have been observed in laboratory animals.

Nevertheless, there is one question which arises concerning targeting. It is necessary that the baiting system is correctly chosen in order that the vaccine reaches the desired target and no residual material is left. In fact this is the situation that has been found with the chicken head baits; within 1 month of seeding an area, all baits had been taken; the rate of removal was particularly rapid when foxes were feeding in the area. Analyses have shown that the Swiss vaccine /bait (chicken head) system was attractive for foxes but not for other animals.

The main target for the rabies vaccine is the fox, but in Europe there are other potential reservoirs of the virus, particularly the bat. Only preliminary experiments have been performed with this host, wherein the recombinant virus was shown to be safe for *Myotis daubentonii* when given by the oral route. In the United States, where skunks and raccoons are the main reser-

voirs for rabies, it has been noted that attenuated vaccines can be pathogenic (for the skunk) or ineffective (in the raccoon); the recombinant vaccinia virus vaccine for rabies was shown to be immunogenic in both skunks and raccoons.

CONCLUSIONS

The fox is currently the main reservoir in Europe for rabies virus. Oral vaccination of the fox population has been particularly effective in a large number of European countries for the control of rabies in these animals. Whether such methods could be applied to other species such as bats is still under study. What is clearly essential for such work to be productive is both a potent vaccine and an appropriate baiting system (a baiting system which attracts the target species only, is rapidly assimilated by that species, and leaves no residual baits after a short period of time). The vaccine must be stable and retain potency during the baiting period. The risk to non-target species of residual vaccine being left in the environment is minimal if the baiting system is efficient, i.e. that the baits are rapidly taken by the target species.

Recent developments have generated vaccines with increased stability. One particular vaccine which is receiving attention is the vaccinia recombinant virus which expresses rabies virus glycoprotein. Other potential virus vectors for rabies virus immunogenic proteins are under study. In this context, human and canine adenoviruses are possibly the best candidates at the moment. Nevertheless, the latter may not prove such a good candidate for the immunization of dogs, many of which have been vaccinated against canine adenovirus. Moreover, if a vector virus is circulating in an endemic form, there is the risk that recombinant events might occur between the endemic strain and the vector vaccine. Furthermore, other viruses to be used as recombinant vectors of the rabies virus immunogenic protein(s) may not have the same characteristics of replication as those observed with the vaccinia virus. Excessive replication and excretion of the vector virus into the animal would be most undesirable.

For the moment, it can be concluded that the current modified live virus vaccines against rabies (SAD, SAG_1), have a proven efficacy and safety for foxes. On the basis of more recent evidence, the vaccinia recombinant vaccine is also effective. In both types of vaccine we have the stable and potent vaccines required for the control of fox rabies.

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