Future prospects for vaccination of cats and dogs

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Veterinarians in clinical practice are quite familiar with the characteristics of inactivated and modified-live vaccines intended to help protect dogs and cats against bacterial and viral infectious diseases. Indeed, generations of veterinary students have been required to learn the relative advantages and disadvantages of inactivated (*i.e.,* killed) and modified-live (*i.e.,* attenuated) vaccines. Most of the vaccines currently available for use in dogs and cats can be placed into one or other of these two 'conventional' categories, although it is perhaps a little unfair to lump them together and describe them as conventional, since some are relatively sophisticated (*e.g.,* a modified-live, temperature-sensitive mutant virus). Relatively few currently-available canine and feline vaccines are based on recombinant DNA technology. However, it seems likely that—over the next few years—a startling profusion of novel vaccines will be marketed for use in cats and dogs. Most of these will be based on recombinant DNA technology and not all of them will be prophylactic; some will most likely be therapeutic.

Recombinant, attenuated, canarypox virus vectored vaccines against canine distemper, rabies, West Nile virus and feline leukaemia virus (FeLV) are already available on the market. More are sure to follow. Each of these vaccines consists of a live, attenuated canarypox virus that has been genetically engineered to carry one or more genes that encode immunogenic proteins of companion animal pathogens. The 'foreign', inserted genes are expressed to produce immunogenic protein in the recombinant poxvirus. Poxviruses are large DNA viruses, with large genomes, so a substantial amount of foreign genetic material can be inserted into recombinant poxviruses. After these vaccines are administered to mammals, the recombinant canarypox virus is thought not to replicate successfully to completion. However the immunogenic proteins of companion animal pathogens are processed in a manner that closely parallels a natural infection. Unlike 'conventional' modified-live vaccines, canarypox vectored vaccines cannot revert to virulence in the recipient dog or cat, since they are essentially an attenuated avian virus. They are live vaccines and do not need to be adjuvanted. Therefore, it expected that the risk of cats developing injection site sarcomas will be diminished by their use. Transdermal, needle-free delivery of some of these vectored poxvirus vaccines is already being practiced by veterinarians in some countries.

Several other kinds of virus, and indeed bacteria, have been investigated or considered as potential vectors for use in companion animal vaccines. So far, poxviruses have dominated among the licensed veterinary vaccines.

Although the use of vectored vaccines for immunization of dogs and cats is certainly innovative and exciting, there are other interesting and arguably even more radical approaches to vaccination being investigated. For example, the use of 'DNA vaccines' involves the direct introduction of bacterial plasmids (closed circular DNA molecules) that are engineered to encode a 'foreign' immunogenic protein of a companion animal

pathogen (say, a virus). Once 'inoculated' (*e.g.,* by intramuscular injection or 'gene gun'), these plasmids are taken up by cells in the vaccine recipient (*e.g.,* muscle cells) and are expressed, leading to production of the immunogenic protein. This can lead to substantial humoral and cellular immune responses. Some 'naked DNA' candidate vaccines under investigation consist of a mixture of several different plasmids. Some of these plasmids encode genes for immunogenic proteins of the pathogen and others encode immunostimulatory molecules such as interleukins.
Further in the future, it is possible that some bacteriophages—viruses that infect and kill bacteria—may prove useful as vectors for delivery of 'foreign' immunogenic proteins and the DNA that encodes them. Recombinant bacteriophages can be grown up in large quantities and their external protein coats protect the recombinant DNA genome. Bacteriophages are reported to be rapidly taken up by antigen presenting cells (APCs), appearing in Kuppfer cells in the spleen and liver shortly after injection. In some early studies, bacteriophage-based vaccines have been reported to provoke much stronger immune responses than do equivalent naked DNA vaccines, perhaps because bacteriophages protect their enclosed nucleic acid from nuclease attack and target APCs.

Therapeutic, as opposed to prophylactic, vaccines (*e.g.,* directed against various canine and feline malignancies) are likely to appear on the market in the not-too-distant future. Numerous vaccines of this kind are already undergoing clinical trials for use in humans. As our understanding of the role of viruses in the aetiology of companion animal neoplasms grows, it is likely that new vaccines to prevent virally-induced forms of cancer will be introduced. Eventually it may prove possible to develop vaccines for prevention of some malignancies that do not have a viral aetiology.

Further reading

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