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Editorial

Editorial Note on Gene Vaccination

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EDITORIAL

A DNA vaccine is a type of vaccine that infects the cells of an immunized species with a particular antigen-coding DNA sequence. DNA vaccines operate by injecting a genetically engineered plasmid containing the DNA sequence encoding the antigen(s) for which an immune response is desired, causing the cells to produce the antigen directly, resulting in a defensive immune response. DNA vaccines have theoretical benefits over traditional vaccines, such as the ability to elicit a broader spectrum of immune responses. Several DNA vaccines for veterinary use have been reviewed. In some cases, disease control in animals has been achieved, while in others it has not. In August 2016, no DNA vaccines for human use had been licenced in the United States.

The technique is currently being researched for infectious, bacterial, and parasitic diseases in humans, as well as cancers. In the United States, no DNA vaccines have been licenced for human use. Few laboratory trials have elicited a powerful enough response to defend against disease, and the technique's utility in humans has yet to be proved. A veterinary DNA vaccine to protect horses against West Nile virus has been approved. DNA immunisation is also being looked at as a way to create antivenom serum. DNA immunisation can be used as a platform for the development of monoclonal antibodies. There are several advantages. There is no chance of infection, antigen is presented by both MHC class I and class II molecules, T-cell response is polarised against type 1 or type 2, immune response is based on the antigen of interest, and so on.

When highly active expression vectors are used in DNA vaccines, the immune response is the strongest. These are plasmids with a powerful viral promoter that drive *in vivo* transcription and translation of the gene (or complementary DNA) of interest. Intron A is sometimes added to enhance mRNA stability and, as a result, protein expression. Plasmids also contain a powerful polyadenylation/transcriptional termination signal, such as the polyadenylation sequences of bovine growth hormone or rabbit beta-globulin. Polycistronic vectors (those with multiple genome locations) are often used to express multiple immunogens or an immunogen and an immunostimulatory protein. The plasmid codes for a peptide string of a foreign antigen until it is inserted into the nucleus of the transfected cell. The foreign antigen is shown on the cell's surface along with molecules from the histocompatibility complex groups I and II. The antigen-presenting cell then moves to the lymph nodes and delivers the antigen peptide and costimulatory molecule that the T-cell has signalled, kicking off the immunisation process.

Multiple approaches have been used to incorporate DNA vaccines into animal tissues. In 1999, the two most common methods for delivering DNA in saline were injection with a regular hypodermic needle or delivery with a gene gun. In the intervening years, many other strategies have been documented. Delivery of a gene gun plasmid DNA (pDNA) that has been absorbed onto gold or tungsten microparticles is ballistically accelerated into target cells using compressed helium as an accelerant.

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