An improved technology platform for the delivery of DNA vaccines

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Technology description

The DNA vaccination market is one of the fastest growing biotechnology areas with the compound annual growth rate from 2008-2014 estimated at nearly 150% for human health. DNA vaccines are comprised of plasmid DNA encoding one or more protein antigens for a specific disease. When DNA vaccines are delivered to the nucleus of the target cell, the desired protein antigen is synthesized in the cytoplasm of the cell. DNA vaccines have a distinct advantage over conventional vaccines because they stimulate many types of immunity such as antibody, T helper cell and cytotoxic T lymphocyte mediated immunity. Where conventional vaccines can only be used for preventative purposes, DNA vaccines can also provide a therapy for those with pre-existing conditions. Furthermore DNA vaccines do not carry a risk of disease spread and production is faster and easier making them cost effective. The biggest stumbling block to the success of DNA vaccines has been in the delivery system. Current delivery systems employed include gene gun and electroporation, neither of which fully address the biological barriers that the DNA has to overcome, especially at an intracellular level.

This project is designed to test a novel technology platform that will revolutionize the current options available for the delivery of DNA vaccination. This technology platform brings together two main components; i) a peptide delivery system, termed RALA, that is able to wrap the DNA into nanoparticles, protect the DNA from degradation, enter cells, disrupt endosomes and deliver the DNA to the nucleus of cells ii) a microneedle patch that will house the nanoparticles within the polymer matrix, painlessly breach the skin’ s stratum corneum barrier and dissolve upon contact with skin interstitial fluid thus releasing the nanoparticles into the skin to the antigen presenting cells.

The model plasmid DNA that we will use in this study encodes for the Human Papilloma Virus E6 and E7 antigens that are responsible for high-grade cervical cancer. Through a series of objectives we will show how effective this unique technology platform is compared to conventional injectable systems. Ultimately, we will create a DNA vaccine for HPV in a transdermal patch which has the major advantage of being more effective than the current system by evoking cellular immunity, pain free, simple to use and low cost. In addition the microneedles are self-disabling, in that they rapidly dissolve, meaning that inappropriate reuse is prevented, needle stick injuries are circumvented and disposal is not problematic. Since the microneedles are a solid state system, as opposed to conventional liquid-based vaccines, stability issues at higher storage temperatures are circumvented and the expensive cold chain is bypassed. We are the only research group worldwide to have this unique combination technology

and, given the track record the School of Pharmacy has in commercialisation of University IP, it is envisaged that the commercial interest in a needle free highly effective vaccine will be significant. In principle, this system could be applied to any vaccination program for humans or veterinary healthcare.

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