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Generation of robust immunity following DNA vaccine immunization enhanced by intradermal electroporation

Trevor R F Smith
Inovio Pharmaceuticals, USA

In vivo electroporation (EP) is an efficient non-viral method for enhancing DNA vaccine delivery and immunogenicity in animals and humans. Intradermal (i.d.) delivery of DNA vaccines is an attractive strategy due to the immunocompetence of skin tissue. We have previously reported on two minimally invasive i.d. EP devices for delivery of prophylactic DNA vaccines to the skin. The CELLECTRA-3P® device is a minimally invasive device which targets both the dermal and subcutaneous layers of the skin. The device consists of three-needle (3mm in length) electrodes forming a triangle microarray to cover the DNA injection site. This device modality has proven an effective enhancer of DNA deliver in both pre-clinical and clinical settings. The Surface Electroporation Device (SEP) only contacts the surface of the skin and does not penetrate the skin. Due to the shallow nature of the electric field generated by the SEP device, only cells in the epidermal region of the skin are targeted. We show robust GFP expression in these upper layers of skin and a significant influx of lymphocytes following low voltage EP. Robust antibody responses are induced following vaccine delivery via surface EP in a number of animal models including mice, guinea pigs, rabbits and non human primates. Delivery of DNA vaccines encoding influenza virus H5 hemagglutinin (H5HA) and nucleoprotein (NP) of influenza H1N1 enhanced by i.d. electroporation elicited robust and sustained antibody and cellular responses. This data confirms that low voltage EP using the SEP device is capable of efficient delivery of DNA vaccines into the skin while establishing that these parameters are sufficient to elicit both robust and sustainable humoral as well as cellular immune responses without tissue damage. The SEP device functioning at these parameters may have important clinical applications for delivery of prophylactic DNA vaccines against diseases such as HIV, malaria and tuberculosis that require both cellular and humoral immune responses for protection since this device offers a safe, tolerable and most importantly, potent method to administer DNA vaccines.

TSmith@inovio.com