Mass deployable self-administered DNA vaccines by Microneedle Arrays

Antonis Stylianou[1], James E. Dixon[1], Maria Marlow[1], Janet M. Daly[1], Faz Choudhury[2]

[1]School of Pharmacy, Division of Regenerative Medicine and Cellular Therapies, Biodiscovery Institute, University of Nottingham, Nottingham, United Kingdom

[2]Nemaura Pharma Ltd, 5 Oakwood Dr, Advanced Technology Innovation Centre (ATIC), Loughborough, LE11 3QF, UK

Background:

In recent years, Microneedle Array Patches (MAPs) have been proposed as an alternative method for administering a wide range of therapeutics, including next-generation vaccines such as DNA vaccines, via the dermal route. These patches consist of tiny (≤1 mm), minimally invasive micro-projections that form an array of microneedles (MNs), that penetrate the outermost layer of the epidermis, the stratum corneum, to deliver the therapeutics into the epidermis or dermis layers. At the same time, they are short enough not to reach pain receptors and thus pain sensation can be avoided. Despite their potential, the development and mass production of MAPs for vaccine delivery face challenges such as dosage uniformity and scalability, that ultimately hinder their widespread adoption.

Methods:

To address these challenges, this project focuses on developing innovative methodologies to load DNA vaccines on dissolvable polymeric MAPs with higher efficiency. For their fabrication, the synthetic polymer polyvinyl alcohol (PVA) was utilised due to its biocompatibility, water solubility, mechanical strength, and cost-effectiveness. Our approaches aim to offer cost advantages, through scaling up manufacturing processes, while achieving high dosage loading and uniformity of the DNA vaccine across the needle layer of the MAPs.

Results:

The findings from preliminary experiments demonstrate significant progress in enhancing DNA loading efficiency and consistency within MAPs, paving the way for large-scale production of DNA-loaded MAPs.

Conclusions:

Therefore, these innovations hold promise for revolutionising transdermal DNA vaccine delivery through dissolving MAPs, as they provide a potential solution for rapid, painless, and cost-effective vaccine fabrication, distribution and administration.