

## Topical vaccination

Reference Number: TO 32-00001

### Challenge

Nearly all vaccines to date are administered by injection, a painful procedure, bearing the risk of propagating infections through re-used needles. Moreover, the vaccine is usually injected into immunologically relatively inactive sites such as muscles or subcutaneous tissue. Thus, an excess of vaccine components is required adding to the risks of adverse effects.

Dendritic cells (DCs) are unique antigen processing and presenting cells that efficiently initiate immune responses and induce immunological memory. Therefore, DCs are important targets and mediators of both prophylactic and therapeutic vaccination.

In the skin, the body's largest immune organ, an unbroken network of DCs, Langerhans cells and dermal DCs senses danger and induces immune responses. Ideal vaccines would target antigens directly to these skin cells, best by non-invasive application. Such topical vaccination needs to penetrate the physical barrier of the skin in order to transfer the vaccine components to the target DCs.



[courtesy of Dr. M. Rohde, GBF]  
Dendritic cell in red-orange, interacting with T-cells in fluorescent green.

### Technology

The technology relates to novel topical vaccines. The vaccine is composed of antigen determinants for cytotoxic effector T cells and helper T cells and synthetic analogues of bacterial lipopeptides as adjuvants for reinforcement of the specific immune response. Vaccine components are immobilized on micro- and/or nano-scale SiO<sub>2</sub> support particles. After application to the skin, they are actively transported into the hair follicles, where they are temporarily deposited. Released under the local physiological conditions, the active ingredients diffuse to the target structures, stimulate the cell surface receptors of the DCs and induce targeted T-cellular immune responses.

### Benefits:

- needle-free vaccination avoids pain and circumvents hygienic problems (e.g. contaminated syringes)
- vaccine delivery directly to dendritic cells of the skin

### Commercial Opportunity

The technology is offered for joint development within industry collaboration. In-licensing is also possible. Goal is the development of a novel needle-free vaccine for the prevention or therapy of diseases such as cancer, acute and chronic infections and autoimmune diseases.

### Developmental Status

Preclinical research. Coordinated delivery of the essential vaccine constituents to target DCs and efficient T-cell stimulation were shown *in vitro*. Particle delivery and peptide release were demonstrated in a porcine ear model. Particle delivery was shown in human skin *in situ* and peptide targeting to DCs in human skin *ex vivo*.

### Patent Situation

German patent application DE102011018499A1 filed on April 23, 2011. International patent application WO2012146364A1 filed on April 23, 2012. Patent owner: Charité - Universitätsmedizin Berlin.

### Further Reading

Speiser DE *et al.*, Memory and effector CD8 T-cell responses after nanoparticle vaccination of melanoma patients. *J Immunother* (2010) 33(8), 848-58.

Gregory AE *et al.*, Vaccine delivery using nanoparticles. *Front Cell Infect Microbiol* (2013), doi:10.3389/fcimb.2013.00013.

Baleeiro RB *et al.*, Topical vaccination with functionalized particles targeting dendritic cells. *J Investigative Dermatology* (2013)133, 1933 - 1941.



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