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Drug delivery to skin by nanotechnology-based drug delivery systems

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To overcome the sophisticated cutaneous barrier is one of the main issues of drug delivery to the skin. The stratum corneum can block microorganisms, particulate materials, and bulky molecules. In skin inflammatory diseases, where the stratum corneum is impaired, penetration of drugs is hindered by the component of the viable skin layers such as the tight junctions in the stratum granulosum. Even if the epidermis is missing, like in case of wounds, collage bundles in the dermis delay the penetration and diffusion of drugs. Nanotechnology-based delivery systems like thermoresponsive polyglycerol-based nanogels (tNGs) or nanowires have been shown to be valuable tools for selective and sustained release of drugs to skin. Recently, we used tNG to deliver tacrolimus (TAC), a high molecular weight poorly penetrating skin drug. We compared the particle-based formulation with the commercial formulation (Protopic 0.1%) using breast and abdominal *ex vivo* skin. Different methods for skin barrier disruption were used in order to investigate tNG skin penetration and drug release in skin with compromised barrier. The amount of penetrated TAC was measured in skin extracts by liquid chromatography–mass spectroscopy/mass spectroscopy (LC–MS/MS), whereas effects on skin inflammatory mediators (IL-6 and IL-8) were detected by means of ELISA. In another study we used polylactic-co-glycolic acid (PLGA) particles, as well as PVP-based nanofibers to deliver the antimicrobial drug ciprofloxacin to a wound model based on *ex vivo* human skin. The results showed that nanocarriers help to deliver drugs across the stratum corneum to the target skin regions. Different drug delivery profiles could be achieved depending on the delivery system. We conclude that nanotechnology offers promising alternatives to conventional drug formulations.

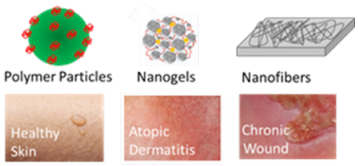

Fig. 1 Nanotechnology-based drug delivery system can be used to improve drug delivery to skin

Recent Publications

1. Graf C, et al. (2018) Shape-dependent dissolution and cellular uptake of silver nanoparticles. Langmuir 34(4):1506-1519.
2. Rancan F, et al. (2017) Drug delivery across intact and disrupted skin barrier: Identification of cell populations interacting with penetrated thermo-responsive nanogels. Eur. J. Pharm. Biopharm. 116:4-11.
3. Schulz R, et al. (2017) Data-based modeling of drug penetration relates human skin barrier function to the interplay of diffusivity and free-energy profiles. Proc. Natl. Acad. Sci. USA. 114(14):3631-3636.
4. Rancan F, Afraz Z, et al. (2017) Topically applied virus-like particles containing HIV-1 Pr55(gag) protein reach skin antigen-presenting cells after mild skin barrier disruption. J Control. Release 268:296-304.
5. Schaudinn C, et al. (2017) Development, standardization and testing of a bacterial wound infection model based on *ex vivo* human skin. PLoS One 12(11):e0186946.

Biography

Fiorenza Rancan is an Associated Scientist at the Clinical Research Center for Hair and Skin Science at the Charité University of Berlin Charité – Universitätsmedizin Berlin, Germany. Her expertise lays in dermal and transdermal drug delivery. She is interested in the interactions between nanocarriers and skin barrier components as well as skin immune cells. Her main research fields are dermatotherapy, transcutaneous vaccination, and chronic wounds with biofilm infections. She investigated several biodegradable particles (e.g. poly-lactic acid and virus-like particles) for transcutaneous vaccine delivery, explored the use of stimuli-responsive nanogels for the treatment of skin inflammatory conditions as well as delivery systems for the treatment of wound infections. She works on *ex vivo* human skin and skin organ culture to develop models for healthy and inflammatory skin as well as wound infections.

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