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Perspective

Over View on Current Solutions, Challenges and Future Prospects of Atopic Dermatitis: Nanotechnology

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INTRODUCTION

Atopic dermatitis is a chronic, recurrent, non-contiguous, exudative eczema/dermatitis that is caused by a disruption of the stratum corneum barrier and is a complicated, multi-factorial disorder. This causes a disruption in skin function as well as an increase in trans-epidermal water loss, which leads to dehydration, as well as a cascade of inflammatory processes defined by the synthesis and release of cytokines, chemokines, and interleukins. These and other molecules, such as tumour necrosis factor-alpha (TNF-) and interferon-alpha (IFN-), stimulate lipogenesis by activating lipids that are important not just for the skin barrier but also for conveying biochemical signals, which raises inflammation and infection risk. Alterations in the apoptotic cascades are also seen in atopic dermatitis. Furthermore, an overabundance of elastase in neutrophils from the peripheral circulation causes an imbalance in the quantities of the proteolytic enzyme and its endogenous inhibitors, causing elastic fibre organisation to be disrupted. To summarise, atopic dermatitis has traditionally been thought to be a T helper type 2 lymphocyte-mediated disease, but recent advances in basic science have revealed that other immune actors, such as T helper type 17 lymphocytes and T helper type 22 lymphocytes, as well as eosinophils and mast cells that degranulate and contribute to the inflammatory microenvironment, may play a critical role.

DESCRIPTION

Patients with atopic dermatitis complain of dryness, erythema, scaling, and fissuring on a clinical level. Atopic dermatitis can strike at any stage in life, but its beginning and progression should be considered in the context of the "atopic march," a series of events that begin on the skin and primarily affect the respiratory system. Atopic dermatitis is being treated with cyclosporine A, topical calcineurin inhibitors, and corticosteroids. Atopic dermatitis has only just begun to benefit from targeted therapy, thanks to the introduction of dupilumab, an anti-IL4/13 biologic that can effectively treat individuals who are resistant to systemic medications. In tandem with the revolution in atopic dermatitis therapy and care, doctors have begun to distinguish and better investigate late-onset atopic dermatitis, which is generally more pleomorphic and less recognised, and hence requires a more precise differential diagnosis. In terms of prognosis, co-morbidity burden, and contraindications to traditional systemic treatments or even targeted therapy, each patient is unique.

Taking these factors into account, nanotechnologies can pave the way for personalized atopic dermatitis treatment and maintenance, in which medication delivery, controlled release, dose, and skin permeation/retention all play important roles. The working group was multi-disciplinary, with two dermatology experts, a research methodology expert, and a biophysics and nanotechnology expert. The "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" standards were followed. Studies conducted on animals for veterinary purposes, which are outside the scope of this analysis, were excluded from the literature search approach used in this systematic review.

If any review articles existed, they were scanned to increase the chances of finding possibly relevant publications, but they were not included in this study. Extensive, iterative cross-referencing was carried out, with each eligible study's list of references being checked until no new studies could be located. Additional information is provided in the form of a diagram. Nanoparticles and nanocarriers appear to have the best rheological qualities, antibacterial properties, and skin-restoration abilities. Silver and silver-lipid nanoparticles, as well as poly nanoparticles, appear to be beneficial in the treatment and care of atopic dermatitis patients. Pandey and colleagues created betamethasone valerate-loaded chitosan nanoparticles with hyaluronic acid decorations. For the treatment of atopic dermatitis, drug diffusion and penetration efficiency profiles proved to be excellent and promising. Rosado and colleagues used a modified solvent displacement approach to make hydrocortisone-loaded polynanoparticles with good physical-chemical characteristics. The efficacy of cyclosporine A loaded solid lipid nanoparticles produced by thermal homogenization was studied by Kim and colleagues. In murine models, the product showed a 2-fold increase in skin penetration and a reduction in the synthesis and release of IL-4 and IL-5 by T helper type 2 (TH2) cells. In a murine model, Kang and coauthors compared the efficiency of

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thermo sensitive, solid lipid nanoparticles loaded with tacrolimus to that of 0.1 percent TCR-SLNs were found to be effective at delivering tacrolimus to the deepest layers of the skin.

CONCLUSION

Singh and Pole used a high-pressure homogenization process to make tacrolimus-loaded lipid nanoparticles. In comparison to the reference ointment, statistically significant improvements in drug controlled release and skin permeation profiles were discovered. Zhuo and colleagues designed and tested hyaluronic acid-decorated tacrolimus-loaded nanoparticles in vitro. The kinetics of drug release, permeability, and effectiveness were all found to be satisfactory. Marto and colleagues investigated the feasibility of topically administering a new synthetic human neutrophil elastase inhibitor using a starch-based nanoparticulate technology, demonstrating good penetration and retention properties. MD and colleagues created an ad hoc nano-encapsulated delivery system for atopic dermatitis using chitosan nanoparticles with betamethsone valerate. The entrapment efficiency and loading capacity of the formulation were both satisfactory.

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