Design and development of a transdermal drug delivery system

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Currently the transdermal route has become one of the most successful and innovative focus in drug delivery, with around 40% of the drug candidates being under clinical evaluation related to transdermal or dermal systems. In the development of new transdermal drug delivery devices the main challenge is to obtain controlled, predictable and reproducible release of drugs into the blood stream of the patient. One of the possible techniques used for transdermal delivery is iontophoresis. Based on these principles a device for the active and controlled delivery of biologically active substances and agents has been designed. The solution is a disposable patch comprising a programmable discharge element, iontophoretic electrodes and active substance loaded reservoir. The control method designed for the device achieves more reproducible drug delivery profiles offering smaller inter and intra subject variations.

1. Motivation

From wound healing to immuno-modulation and drug delivery, a large number of therapeutic strategies rely on the application of electric fields and currents to and through the skin with an electronic device comprising skin-contacting electrodes. The main application of such devices is currently transdermal drug delivery [1], which represents an alternative to oral delivery of drugs and is poised to provide an alternative to hypodermic injection too. Currently the transdermal route has become one of the most successful and innovative focus in drug delivery, with around 40% of the drug candidates being under clinical evaluation related to transdermal or dermal systems. In the development of new transdermal drug delivery devices the main challenge is to obtain controlled, predictable and reproducible release of drugs into the blood stream of the patient.

2. Design and development

One of the possible techniques used for transdermal delivery is iontophoresis [2]. It is the application of an electric potential that maintains a constant electric current across the skin and enhances the delivery of ionized as well as unionized moieties [3]. The ion movement in the skin and in a hydrogel is governed by the combined influence of the ionic concentration gradient and the electric field, as defined by the Nernst-Planck equation.

Based on these principles a device for the active and controlled delivery of biologically active substances and agents has been designed. The solution is a disposable patch comprising a programmable discharge element, iontophoretic electrodes and active substance loaded reservoir. The control method designed for the device achieves more reproducible drug delivery profiles offering smaller inter and intra subject variations.

The design of the system has been numerically simulated and the simulation results are in good agreement with the experimental observations [4].

3. Results and conclusions

The proposed solution comprises a device and a methodology for controlled and monitored transdermal delivery of active components, such as drugs, prodrugs, tissue growth factors, nanoparticles, biomedical probes such as biomarkers or allergen probes. The device and method have been tested on battery of over 20 model drugs and biologically active agents including drugs such as analgesic and antipyretic (sodium salicylate), Antiviral drug (Acyclovir) and Anti-inflammatory and inmuno-suppressor (Dexamethasone sodium phosphate), with corresponding “in vitro” test with porcine skin.

References

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