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Iontophoresis: Rediscovering the transdermal drug delivery system

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Currently, the pharmaceutical research is focused on the development of improved drug delivery routes for the existing drugs. In this context, Transdermal Drug Delivery System (TDDS) has generated a lot of interest. In the last decade, 40% of the drug delivery candidates under clinical evaluation globally belonged to the transdermal category. Statistics reveal a market of $ 31.6 billion for TDDS products in the year 2015 and expected to increase up to $ 91.57 billion in the year 2025. One of the inherent advantages of TDDS is the ability to include the wide array of compounds- having either analgesic or anti-inflammatory actions—applied directly into the target area. TDDS have an edge over injectable and oral routes by enhancing patient compliance and bypassing the first-pass metabolism respectively. Iontophoresis (IOP) is one of the most popularly preferred TDDS, which uses electric potential to enhance the drug delivery through the biological membrane. In most of the clinical studies conducted using iontophoresis as well as commercially available iontophoresis system uses continuous Direct Current (DC) IOP for delivery of lidocaine Hydrochloride (HCL) on subjects. However continuous DC IOP had few side effects like electrical burns or erythema on the skin due to electrode polarization. Some studies suggested Alternating Current (AC) IOP is better than DC IOP to overcome electrode polarization. However, the driving force of AC IOP was less as compared to DC IOP to permeate lidocaine HCL drug across skin due to the presence of the negative cycle. Therefore, a current delivering technique has to optimized such as to minimize the electrode polarization and increase the driving force. In our present work, instead of using AC IOP, we have modulated a continuous DC by introducing an on-period (90 s) and off- period (30 s). During off-period, no drug ions will be pulled back as there will be no negative polarity in the modulated waveform. Also during off-period, the skin becomes depolarized and returns to its initial condition decreasing the chances of burning or erythema. Our experimental system successfully demonstrated that modulated IOP enhanced the lidocaine HCL permeation across the human skin at par with continuous DC IOP. Compared to the passive group, the flux of lidocaine HCl with an application of modulated and continuous IOP was about six-fold and ten-fold higher respectively. At 2.5% lidocaine HCL concentration, the time taken by modulated and continuous IOP to achieve therapeutic level was approximately 10 mins. At 5% lidocaine HCL, the therapeutic effect was achieved at approximately 5 min after applying iontophoresis waveform. This study suggests that modulated IOP with "on-off period" can be a promising alternative method that can be used in clinical settings apart from continuous DC IOP.

Biography

Roopa Manjunatha received her PhD degree from Indian Institute of Science, Bengaluru, in the area of Biomedical Instrumentation in 2014; she received M.E degree with the specialization in Instrumentation and Control from Birla Institute of Technology, Mesra, Ranchi in 2008. She worked as a Post-doctoral fellow in the Centre of Biomedical Engineering, Indian Institute of Technology- Delhi. She is the co-founder of LifePhy Pvt. Ltd, a medtech start-up with a vision and mission of providing an technology support for Indian health care system. Her PhD work has been reported by media because of its novelty and usefulness. She has published many research articles in peer-reviewed journals and conference proceedings. She has been serving as a member of reviewer panel for reputed conference proceeding like IEEE-Sensors. Her research interests are mainly focused in the area of biomedical sensors, medical devices, transdermal drug delivery systems especially using iontophoresis & sonophoresis techniques.

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