Transdermal Delivery Of Lidocaine HCl Using A Combination of Chemical Enhancement And Iontophoresis

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Objective: This study was aimed to investigate the in vitro transdermal delivery of a model drug lidocaine hydrochloride (Lidocaine HCl) using a combination approach of chemical and iontophoretic enhancement.

Introduction: Iontophoresis provides a non-invasive method for delivery of a wide variety of agents at therapeutically significant levels due to its enhancement effects on skin permeation. When used transdermally, it shares the benefits associated with transdermal drug administration, primarily the circumvention of the hepatic first pass effects and the harsh environment present in the gastrointestinal tract. Patient compliance is significantly improved due to infrequent dosing, and the treatment can be terminated when desired. This technique also enables a great degree of programmability as therapy can be monitored and tailored at pre-programmed rates that may be custom to the patient’s condition. The limitations of iontophoresis technique are the potential for irritation and pain on application of the electric current.

Experimental Methods: Dermatomed porcine skin from posterior side of pigs was immersed in deionized water at 0.5 ºC. Skin was mounted on Franz cells. 2.5% Lidocaine HCl gel prepared using sodium carboxymethyl cellulose as a carrier was applied to the skin to be treated. Dodecyl-2-(N,N-dimethylamino) propionate (DDAIP) HCl was chosen as the chemical enhancer to pre-treat the skin for 0.5 hr. to its non-toxic character.

Results and Discussions: The synergistic effect of iontophoresis and chemical enhancer DDAIP HCl was only achieved at a high current density of 0.47 mA/cm². In this in vitro drug permeation study, compared to passive permeation (no current and chemical enhancer treatment) of 2.5% Lidocaine HCl gel, 2.5% DDAIP HCl solution pretreatment for 0.5 hr and 0.47 mA/cm² iontophoretic treatment increased the permeation of lidocaine by 4 and 60 fold, respectively. However, their combination increased the permeation of lidocaine by more than 90 fold.

Conclusions: Chemical enhancer DDAIP HCl and iontophoresis demonstrated their synergistic effect of enhancing the permeation of Lidocaine HCl through porcine skin, but only at a higher current density of 0.47 mA/cm². No synergistic enhancement effects were observed at lower current densities of 0.16 and 0.31 mA/cm².

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References: