Fabrication of two-layer dissolving polymeric microneedle patches for transdermal delivery of insulin in diabetic mice

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Outline

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Abstract

Dissolving microneedle (MN) has been developed to overcome the stratum corneum barrier of skin, which allows the penetration of epidermis and enhance the transdermal delivery of insulin. The aim of this report was to investigate the fabrication of two-layer MN by two step casting method and centrifuging process to localize the drugs in the needles. Furthermore, the ex vivo and in vivo transdermal delivery of drugs-loaded MNs were evaluated. Two-layer dissolving MN made of gelatin and carboxymethyl cellulose (CMC) can penetrate the epidermis and enhance the diffusion depth of low and high molecular weight model drugs (rhodamine 6G and insulin-FITC). Ex vivo studies showed that almost 50% of insulin was released after 1 h and the cumulative permeation reached 80% after 5 h. In addition, the in vivo studies showed the relative pharmacologic availability (RPA) and relative bioavailability (RBA) of insulin from gelatin/CMC MN patches were 95.6% and 85.7%, respectively. Moreover, the ex vivo and in vivo studies of MN made of two different molecular weight of polyvinylpyrrolidone (PVP, 10 and 360 kDa) MN, with 1:3 ratio were investigated. Ex vivo studies revealed that this MN can enhance the permeation efficiency of model drugs, lissamine green B and bovine serum albumin-FITC. The in vivo studies showed the RPA of insulin from PVP MN patches was 108%. The RPA and RBA results showed both insulin-loaded MNs have similar efficiency to hypodermic injection in the regulation of blood glucose. Briefly, both studies demonstrated two-layer dissolving MN patches which achieved efficient transdermal delivery of insulin, can be used as an alternative device to treat diabetes.

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