利用鉺雅鉻雷射來促進與控制藥物經由皮膚的傳遞：對親油性與親水性藥物的比較研究

Transdermal drug delivery enhanced and controlled by erbium:YAG laser: a comparative study of lipophilic and hydrophilic drugs

中文摘要

本篇研究探討了鉺雅鉻雷射對體外藥物經皮吸收及傳遞是否能有明顯的促進效果，並利用兩種分子量相同的藥物，但一個是親油性的 indomethacin，一個是親水性的 nalbuphine 分別來做比較。結果顯示，裸鼠皮膚經過鉺雅鉻雷射的處理後，兩種藥物的經皮吸收都能呈現有意義的增加；對於平常經皮吸收能力較差的親水性 nalbuphine 來說，增加的效果更大，鉺雅鉻雷射的能量與雷射光點的大小在此種控制性的藥物經皮吸收過程中，扮演了很重要的角色；對親水性的藥物而言，藥物穿透能力與雷射的能量呈正比，而親油性的藥物就不一樣了，在較低的雷射能量範圍中，反而是低能量的穿透能力比高能量的穿透能力要好。由於角質層可以被鉺雅鉻雷射部份的汽化剝離（ablation），經由組織切片的觀察，發現用低能量的雷射，就可以改變角質層的屏障功能，卻不會影響到其下表皮與真皮的結構；而在雷射的安全性方面，經由活體的動物實驗，我們也發現到 5 天內雷射作用的部位都回復的很好，尤其是低能量的雷射處理部位都回復到正常的表皮厚度，沒有裸鼠在 5 天動物實驗的過程中有傷口感染或死亡。適當的使用鉺雅鉻雷射可以精確的去除角質層，對促進藥物經皮吸收是一項很好的方法，對親油性或親水性的藥物都有效，鉺雅鉻雷射目前在皮膚科相當普遍而且方便使用，對一些厚角質層或藥物難以穿透的皮膚病灶可以提供進一步的幫助。

英文摘要

The influence of an erbium:YAG laser on the transdermal delivery of drugs across skin was studied in vitro. Indomethacin and nalbuphine, which have the same molecular weight, were selected as model lipophilic and hydrophilic drugs respectively, to compare skin permeation by laser treatment. The results indicate a significant increase in the permeation of indomethacin and nalbuphine across skin pretreated with an erbium:YAG laser. The laser had a greater effect on the permeation of hydrophilic molecules which usually possess low permeability. The laser intensity and its spot size were found to play an important role in controlling transdermal delivery of drugs. Permeation of the hydrophilic drug increased following an increase of laser energy. On the other hand, a different result was observed for the lipophilic drug transported across laser-treated skin. The stratum corneum (SC) layer in skin could be partly ablated by the erbium:YAG laser. The barrier function of the SC may

also be modulated by a lower intensity of the laser without affecting the viability and structure of the epidermis/dermis as determined by histological observations. However, ultrastructural alteration of the epidermis/dermis may be caused by laser treatment. Use of an erbium:YAG laser is a good method for enhancing transdermal absorption of both lipophilic and hydrophilic drugs, because it allows precise control of SC removal, and this ablation of SC can be reversible to the original normal status.