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SHORT COMMUNICATION

Laser microporation: A promising field in transdermal drug delivery

Mozhdeh Sepaskhah

Molecular Dermatology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

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Correspondence to: Mozhdeh Sepaskhah, Department of Dermatology, Shahid Faghihi Hospital, Zand Avenue, Shiraz 71348 44119, Iran; sepaskhah_m@yahoo.com

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Introduction

Topical therapy is an expanding field not only in dermatology but also in other fields of medicine[1,2]. An expanding list of systemic medications have been applied topically in several dermatologic conditions[1]. Drugs applied topically have the advantage of fewer side effects, and bypassing the first-pass effect. Also, painless drug delivery which is especially encouraging in children, makes transdermal drug delivery even more appealing[3].

However, transdermal dermal drug delivery has limitations, including decreased penetration of larger and water-soluble molecules and poor penetration of agents in areas like nails[4,5]. Researchers have tried to overcome the limitations and enhance percutaneous drug delivery by using different carriers or microporation[6,7].

Microporation

Microporation devices create micron-sized pores or channels in the skin to facilitate the transport of hydrophilic molecules and macromolecules[4]. Microporation has been performed by different mechanisms, including laser ablation, radiofrequency, iontophoresis, mechanical needling, thermal microporation, phonophoresis, electroporation and high pressure gas/powder or liquid[7].

Laser microporation

Laser microporation is among the recently used microporation techniques. Historically, a pulsed argon fluoride excimer laser was first used in 1987 for stratum corneum ablation[8]. Since then, other lasers including Q-switched ruby, Neodymium-doped yttrium aluminium garnet (Nd:YAG) lasers and carbon dioxide (CO_2) lasers were also used for microporation[8].

However, the most widely used lasers for microporation are erbium-doped yttrium aluminium garnet (Er:YAG) lasers which are preferred due to less heating of the surrounding skin. One of the most frequently used laser devices for transdermal drug delivery is a fractional Er:YAG laser named Precise Laser Epidermal System (P.L.E.A.S.E.®, Pantec Biosolutions, Ruggell, Liechtenstein)[9,10].

To date, most of the studies evaluated laser microporation *in vitro* or *in vivo* (animal studies).There are few clinical studies assessing the efficacy of microporation in human[11,12].

Advantages and disadvantages

As noted previously, laser microporation presents many advantages including delivering drugs to the target tissue *i.e.* dermis, decreased dose of drug administered, decreased risk of systemic side effects, penetration of medications in tissues like nail and fibrosing tissues and presenting a relatively painless method[3-5,13].

While laser microporation is considered a promising technique in promoting drug absorption via skin, potential side effects of ablative lasers remain the main limitation. The most common side effects include discomfort, erythema, edema, dyspigmentation, scarring and herpes virus reactivation[14]. Also, possible risk of local and/or systemic side effects due to increased amount and depth of the penetrated medication may be a concern[15].

Conclusion

Laser microporation is a recently investigated, promising technique for improving transdermal drug delivery, although, optimal drug dosing, laser treatment protocol and safety of the technique need to be determined clinically. Therefore, conducting strong randomized controlled clinical trials, especially in assessing laser microporation effect on transdermal drug delivery of dermatological medications in the future, will help to confirm laser microporation as a new method for enhancing drug delivery in clinical practice.

Conflict of interest

The author declares no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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