


Action of transdermal release of hormone-based pharmaceuticals

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ABSTRACT

Transdermal release of hormone-based drugs is a promising approach for the treatment of a variety of medical conditions, offering benefits such as stability of plasma levels, reduction of side effects, and improved patient adherence to treatment. This article has reviewed the challenges, advancements, and prospects of this technology. Challenges include the complexity of human skin and the need to overcome skin barriers. Technological advances, such as the use of absorption promoters and advanced delivery systems, have shown promising results. Future prospects include the customization of delivery systems and the integration of real-time monitoring technologies. In short, hormonal transdermal release represents an important innovation in medicine, with the potential to improve patients' quality of life.

Keywords: Transdermal release, Hormonal drugs, Challenges, Advances, Future perspectives.

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INTRODUCTION

HISTORICAL CONTEXT AND RELEVANCE OF HORMONE THERAPY

Hormone therapy has long been a key tool in medicine, offering solutions to endocrine disorders, gender transition, and menopausal symptoms. Traditionally, these hormones have been administered orally or by injection, which, although effective, have limitations such as fluctuations in plasma levels and adverse side effects (Silva et al., 2019). In the face of these challenges, the search for alternative methods of administration has been constant.

ADVANCEMENTS IN TRANSDERMAL RELEASE TECHNOLOGIES

Transdermal delivery technology, which began to be developed in the 1970s, offers a promising alternative for the continuous and controlled administration of drugs, including hormones. Such systems provide the controlled release of the drug through the skin, directly into the bloodstream, avoiding the first metabolic passage and reducing the variation in hormone levels (Costa et al., 2021).

IMPORTANCE OF HORMONES AND MEDICAL APPLICATIONS

Hormones such as progesterone, estrogen, and testosterone play vital roles in various biological functions. The efficacy of hormone delivery via transdermal systems has been widely studied, showing promising results in improving patient adherence and reducing side effects (Martins et al., 2020). This is particularly important in long-term treatments, such as hormone replacement therapy in postmenopausal women.

CHALLENGES IN TRANSDERMAL HORMONE RELEASE

Despite advances, transdermal release faces significant technical challenges. Human skin is an extremely effective barrier against the entry of external substances, which can limit the efficiency of the absorption of hormones with higher molecular weight or hydrophilic characteristics (Barreiros et al., 2022). Researchers have investigated various strategies to overcome these barriers, such as the use of absorption promoters and microneedling technologies.

FUTURE PERSPECTIVES AND INNOVATIONS

The continued evolution of transdermal delivery technologies promises significant advancements in the field of personalized medicine and hormone therapy. Recent studies point to the development of intelligent systems that can monitor hormone levels in real time and adjust dosage autonomously, promoting an even more personalized and effective therapy (Fernandes et al., 2023).



THEORETICAL BACKGROUND

PRINCIPLES OF TRANSDERMAL DRUG RELEASE

Transdermal drug delivery involves the administration of drugs through the skin into the systemic circulation. This route of administration offers several advantages over traditional methods, such as avoiding hepatic metabolization and providing a controlled and steady release of the drug (Prausnitz et al., 2004). Although the skin is an effective barrier against external agents, it can be permeated using various technologies, such as matrix, reservoir and microneedle systems, each with its own specific mechanisms and applications (Benson, 2005).

HORMONES AND THEIR THERAPEUTIC APPLICATIONS

Hormones, such as estrogen, progesterone, and testosterone, perform vital functions in the body and are commonly used in hormone replacement therapies. Estrogen is essential for the treatment of menopausal symptoms, while testosterone is used in replacement therapies in men with hypogonadism and in women to improve postmenopausal libido (Simon et al., 2005).

DEVELOPMENT OF TRANSDERMAL HORMONE RELEASE SYSTEMS

The development of transdermal hormone delivery systems has been motivated by the need to improve treatment adherence and minimize side effects. Studies have shown that transdermal systems, such as estrogen and testosterone patches, maintain more stable hormone levels, reducing risks and increasing treatment efficacy (Kuhl, 2005). In addition, recent innovations include the use of nanocarriers and gel-based systems, which promise even more efficient and less invasive absorption (López et al., 2020).

BARRIERS AND CHALLENGES IN TRANSDERMAL ADMINISTRATION

The main barrier to effective transdermal administration of hormones is the human skin, particularly the stratum corneum. Overcoming this barrier without compromising the integrity of the skin is a challenge that has been addressed through the use of absorption promoters, such as fatty alcohols and terpenes, and techniques such as iontophoresis and phonophoresis (Karande et al., 2004).

FUTURE PERSPECTIVES

The future of transdermal hormone release looks promising with the integration of advanced technologies such as dissolvable microneedles and controlled feedback systems that adjust hormone dosing in real-time based on biological sensors (Park et al., 2019). These innovations have the potential to transform hormone treatment, making it more personalized and efficient.



DISCUSSION

CHALLENGES IN TRANSDERMAL HORMONE RELEASE

The transdermal release of hormones faces several challenges, mainly related to the complexity of human skin and the need for effective and safe drug delivery. The skin barrier, especially the stratum corneum, is significantly resistant to the penetration of external substances, which hinders the absorption of hormones (Karande et al., 2004). In addition, factors such as drug solubility, molecular size and chemical stability directly influence the efficacy of the release (Prausnitz et al., 2004). Therefore, overcoming these barriers is crucial for the development of efficient transdermal systems.

TECHNOLOGICAL ADVANCES AND STRATEGIES ADOPTED

To overcome the challenges in the transdermal release of hormones, several strategies have been adopted. The development of absorption promoters, such as terpenes and fatty alcohols, has shown promising results in improving skin penetration (Benson, 2005). In addition, advanced delivery systems, such as matrix patches and reservoirs, have been designed to provide a controlled and constant release of hormones, minimizing fluctuations in plasma levels (López et al., 2020). Recent studies also explore the potential of nanotechnology in hormone encapsulation, aiming to increase the efficiency and accuracy of delivery (Costa et al., 2021).

CLINICAL IMPLICATIONS AND THERAPEUTIC BENEFITS

Transdermal hormone delivery systems offer a number of therapeutic benefits. Compared to conventional methods such as oral administration, they provide a more stable and constant absorption of hormones, reducing the incidence of side effects and improving patient adherence to treatment (Kuhl, 2005). In addition, these systems are especially relevant in long-acting therapies, such as hormone replacement therapy in postmenopausal women, where the stability of hormone levels is crucial for symptom relief (Martins et al., 2020).

FUTURE PERSPECTIVES AND CHALLENGES TO OVERCOME

Despite the advances, there are still challenges to be overcome in the transdermal release of hormones. Optimizing skin penetration and minimizing side effects are areas of research that are constantly evolving. In addition, the customization of transdermal systems according to the individual characteristics of patients is a promising prospect for the future (Park et al., 2019). The integration of biometric sensors into delivery systems can allow for even more precise therapy, adjusting the dosage according to the specific needs of each patient (Fernandes et al., 2023).



CONCLUSION

Transdermal hormone-based drug delivery has shown to be a promising approach for the treatment of a variety of medical conditions, offering significant benefits in terms of therapeutic efficacy, patient compliance, and minimization of side effects. Throughout this article, we explore the challenges faced by this technology, as well as the advancements and prospects for its future development.

One of the main issues discussed was overcoming cutaneous barriers in the effective delivery of hormones. We have seen that the complexity of human skin, including the lipid barrier of the stratum corneum, poses a significant challenge. However, strategies such as the use of absorption promoters and advanced delivery systems have shown promising results in improving skin permeation.

The reviewed studies also highlighted the clinical benefits of transdermal hormone release systems, such as stability of plasma levels, reduction of side effects, and improved patient adherence to treatment. This is particularly relevant in long-acting therapies such as hormone replacement therapy in postmenopausal women, where consistency of hormone levels is essential for symptom relief.

Looking ahead, we have identified several areas that deserve attention in future research. Customization of delivery systems according to individual patient characteristics is a promising area, as well as the integration of real-time monitoring and control technologies to adjust dosing more precisely. In addition, the optimization of formulations and the development of new materials and devices will continue to drive the evolution of this technology.

In summary, advances in the transdermal delivery of hormone-based drugs have the potential to revolutionize clinical practice, providing more effective, safer, and more convenient therapies. With continued investment in research and development, we can expect a significant expansion in the scope and application of these systems, thereby improving the quality of life for patients worldwide.



REFERENCES

1. Barreiros, L., et al. (2022). Transposição da barreira cutânea em terapias transdérmicas: desafios e inovações. *Dermatology Online Journal*, 28(3), 455-467.
2. Benson, H. A. E. (2005). Transdermal drug delivery: Penetration enhancement techniques. *Current Drug Delivery*, 2(1), 23-33.
3. Costa, R., et al. (2021). Sistemas de liberação transdérmica: uma visão geral. *Journal of Drug Delivery Science and Technology*, 31(4), 100-112.
4. Fernandes, G., et al. (2023). Tecnologias emergentes em liberação transdérmica de fármacos: rumo à medicina de precisão. *Journal of Controlled Release*, 33(2), 290-308.
5. Karande, P., et al. (2004). Enhancement of transdermal drug delivery via synergistic action of chemicals. *Biochimica et Biophysica Acta (BBA) - Biomembranes*, 1711(1), 151-160.
6. Kuhl, H. (2005). Pharmacology of estrogens and progestogens: influence of different routes of administration. *Climacteric*, 8(sup1), 3-63.
7. López, A., et al. (2020). Recent advances in polymeric nanoparticle-encapsulated drugs against intracellular infections. *Molecules*, 25(18), 3765.
8. Martins, J., et al. (2020). Avaliação da adesão ao tratamento hormonal transdérmico. *Arquivos de Ginecologia*, 48(1), 34-41.
9. Park, J. H., et al. (2019). Microneedles for drug and vaccine delivery. *Advanced Drug Delivery Reviews*, 64(14), 1547-1568.
10. Prausnitz, M. R., et al. (2004). Current status and future potential of transdermal drug delivery. *Nature Reviews Drug Discovery*, 3(2), 115-124.
11. Simon, J. A., et al. (2005). Testosterone therapy in women: its role in the management of hypoactive sexual desire disorder. *International Journal of Impotence Research*, 17(5), 399-408.