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A Review On Transdermal Patch For Asthma

Arati Harne*, Arati Pangole, Diksha Khawse, Gauri Lokhande, Gauri Kharat, Swati Khedekar, Dr.R.H.Kale, Dr.K.R.Biyani

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ABSTRACT

Asthma is a chronic inflammatory airway disorder characterized by recurrent episodes of wheezing, coughing, and breathlessness. Conventional dosage forms such as oral tablets and inhalers, although widely used, often suffer from limitations including poor patient adherence, variable drug deposition, first-pass metabolism, and the requirement of correct inhaler technique. Transdermal drug delivery systems (TDDS) have emerged as a promising non-invasive alternative for sustained drug delivery in chronic respiratory diseases such as asthma.[1,2,3,4]

TDDS offers several advantages including controlled release, improved bioavailability, reduced dosing frequency, avoidance of hepatic first-pass metabolism, and enhanced patient compliance. Various formulation approaches—such as matrix patches, reservoir systems, pressure-sensitive adhesives, and permeation enhancers—have been developed to improve the transdermal transport of bronchodilators and anti-inflammatory agents used in asthma therapy [.2,3,5,7,

KEYWORDS

Asthma; Transdermal Drug Delivery System; Bronchodilator Patch; Reservoir Patch; Matrix Patch;

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Permeation Enhancers; Controlled Release; Chronic Respiratory Disease.

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INTRODUCTION

Transdermal patches for asthma is rooted in the need to overcome the inherent limitations associated with conventional drug delivery routes—particularly oral and inhalational systems—while ensuring sustained and reliable therapeutic outcomes. Asthma is a chronic inflammatory airway disorder that requires long-term, consistent management. Traditional routes of administration frequently suffer from challenges such as poor patient adherence, incorrect inhaler technique, high variability in lung deposition, and extensive first-pass metabolism in orally administered drugs. These issues often lead to suboptimal disease control and increased severity of symptoms. [1,4]

Transdermal drug delivery systems (TDDS) represent an innovative therapeutic ideology that emphasizes non-invasive, controlled, and continuous drug administration through the skin into systemic circulation. The conceptual framework is based on maintaining steady plasma concentrations over extended periods, thereby avoiding the peaks and troughs associated with repeated oral or inhaled doses. This consistent delivery is particularly important for asthma, where stable bronchodilation or anti-inflammatory action can help improve long-term symptom control and reduce episodic exacerbation. [1,2,7]Another foundational aspect of the ideology is patient-centric therapy. Many asthma patients—especially children, elderly individuals, and those with poor motor coordination—struggle with correct inhaler use. Transdermal patches eliminate the need for inhalation technique, thereby reducing dependency on patient effort and skill. This enhances adherence and promotes a more reliable treatment outcome.[4,7]

From a pharmacokinetic perspective, transdermal patches bypass hepatic first-pass metabolism, allowing more predictable bioavailability. The ideology also emphasizes minimizing systemic side effects by providing slow, controlled drug release rather than rapid systemic exposure. The sustained release profile contributes to prolonged therapeutic activity, reduced dosing frequency, and improved convenience—factors that are crucial for chronic disease therapy.[2,3,7]

Additionally, advancements in polymer technology, permeation enhancers, and adhesive systems have strengthened the ideology by enabling efficient transdermal transport of drugs used in asthma therapy. Even drugs with limited skin permeability can be delivered effectively using modern enhancement techniques, reinforcing the practical feasibility of this approach.[3,5,8]

Thus, the ideology of transdermal patches for asthma integrates pharmacological needs, patient-centric considerations, and technological advancements to provide a superior therapeutic alternative. It embodies a shift toward long-acting, non-invasive, and adherence-friendly drug delivery systems that align with modern expectations for chronic disease management.[2,7,9]

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MATERIALS AND METHODS

This review was conducted using a structured and comprehensive literature exploration strategy to assess the ideology, design, evaluation, and clinical relevance of transdermal patches for asthma management. Peer-reviewed articles, guidelines, and scientific reports published between 2000 and 2024 were retrieved from PubMed, ScienceDirect, Google Scholar, and Elsevier using keywords such as transdermal drug delivery system, asthma therapy, transdermal patch technology, permeation enhancers, bronchodilator transdermal delivery, and controlled release systems. Relevant studies were screened based on inclusion criteria that focused on transdermal patch principles, formulation components, evaluation parameters, pharmacokinetics, and applicability to chronic respiratory diseases, while non-English papers, duplicated records, and unrelated delivery systems were excluded. Key information from selected articles was analyzed, compared, and synthesized to develop an integrated understanding of the therapeutic rationale, technological advancements, advantages, limitations, and future prospects of transdermal patches in asthma therapy. The methodology ensured a high-quality, evidence-based narrative review suitable for scientific publication. [1,2,3,4,5,6,8,9]

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RESULTS

2 .TRANSDERMAL PATCH TECHNOLOGY

2.1 Principles of Transdermal Delivery

Transdermal delivery works by transporting drugs across the skin layers—stratum corneum, epidermis, and dermis—into systemic circulation. Permeation can be enhanced by chemical or physical methods.[2,3,5]

2.2 Types of Transdermal Patches

Matrix Patch: Drug dispersed in a polymer matrix.

Reservoir Patch: Drug contained in a liquid/semi-solid compartment.

Drug-in-Adhesive Patch: Drug incorporated directly into the adhesive layer.

Multilayer Patch: Multiple layers for controlled release.[7,8]

2.3 Components of Transdermal Patch

Polymer matrix

Backing layer

Adhesive layer

Release liner

Permeation enhancers

Plasticizers

API (bronchodilator/anti-inflammatory agents) [7,8]

3. EVALUATION OF TRANSDERMAL PATCHES

3.1 Physicochemical Evaluation

Thickness

Weight uniformity

Moisture content

Folding endurance

Surface Ph

Tensile strength [6,7]

3.2 In-vitro Evaluation

Drug content uniformity

In-vitro diffusion study (Franz diffusion cell)

Release kinetics modeling

Skin permeation studies [6]

3.3 In-vivo Evaluation

Pharmacokinetic studies

Irritation/sensitization tests

Bioavailability studies [9]

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DISCUSSION

Transdermal patches provide a novel and patient-friendly approach to asthma management. Unlike inhalers, which require correct technique and coordination, transdermal systems offer continuous systemic delivery without patient effort. This is particularly useful for individuals who struggle with inhalation devices, young children, elderly patients, and those with poor adherence.The controlled drug release provided by TDDS minimizes fluctuations in plasma levels, reducing side effects associated with peak doses. Avoiding first-pass metabolism enhances bioavailability and ensures a predictable therapeutic response. Furthermore, transdermal patches reduce dosing frequency, improving compliance in long-term asthma therapy.
. [2,3,4,5,7,7,8,9]

CONCLUSION

Transdermal patches represent a promising alternative to traditional asthma therapy by offering sustained release, enhanced bioavailability, improved compliance, and reduced systemic side effects. Significant advancements in polymer technology, permeation enhancement, and patch design have expanded the potential for delivering bronchodilators and anti-inflammatory agents transdermally.Despite limitations related to skin permeability and formulation challenges, ongoing research and technological innovation continue to strengthen the feasibility of transdermal systems in asthma management. With further clinical validation, TDDS could become a valuable adjunct or alternative to oral and inhalational therapies, improving long-term control in asthma patients. [1,2,3,5,7,8,9]

ABBREVIATIONS

None

FUNDING

Self-Funded

CONFLICT OF INTERESTS

AUTHOUR DECLARED NO CONFLICT OF INTREST7.REFERENCE

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— Supports advantages, patient compliance, and controlled release ideology.

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— Supports foundational TDDS concepts, polymers, adhesives, and system design.

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— Supports clinical relevance and efficiency of transdermal approaches.

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