Review Article

RFP Journal of Dermatology
Volume 9 Number 1, January - June 2024

Recent Advance in Transdermal Patch

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How to cite this article:
Sandhiya, N Deepa, Salma R. *et al.* Recent Advance in Transdermal Patch. RFP Jr of Drea 2024;9(1):25–29.

ABSTRACT

Drug administration with transdermal patches is a non-invasive technique. It is an adhesive patch that is intended to penetrate the skin and enter the bloodstream, distributing a precise dosage of medication throughout the body. Compared to other administration methods, transdermal medication delivery is less intrusive, more patient-friendly, and able to avoid first-pass metabolism and the harmful acidic environment of the stomach that arises from oral drug absorption. Transdermal patches have garnered interest and been used for many years to treat a variety of illnesses and ailments. These medications include nitroglycerin, clonidine, nicotine, and fentanyl. This approach has also been investigated recently for the delivery of biologics in several applications. Here, we examine the body of research on the design

Keywords: Transdermal patch; Types; Advance in transdermal patch.

INTRODUCTION

An additional method of administering medications through the skin layer is transdermal drug delivery.[1,2] The medication enters the bloodstream through the epidermis and travels across the body's systems before arriving at the intended location.[3,4] Compared to alternative administration methods, the transdermal medication delivery approach offers a number of advantages. Some examples are the capacity to avoid first-pass metabolism in the liver, the ability to avoid the digestive tract, and the capacity to administer continuous dosages of medications over a prolonged length of time.[5,6] Other methods of administering drugs, such intravenous, may hurt and raise the risk of infection. However, the oral route is ineffective, and it is challenging to regulate the amount when using the inhalation approach. Given its benefits over alternatives, A transdermal patch is a medicated patch that can be applied topically to provide medication at a specified rate directly into the bloodstream via the layers of skin. Actually, the most practical way to administer is via patches. They can be stopped at any time, and the course of treatment can last for several days because they are non-invasive. They have various sizes and are made up of several substances.[7,8] Through diffusion processes, the patch can introduce active substances into the systemic circulation once it is put to the skin. High

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Received on: 28.03.2024

Accepted on: 23.04.2024

concentrations of active ingredients that stay on the skin for a long time can be found in transdermal patches. The nitroglycerin patch was one of the earliest transdermal patches created in 1985. Gale and Berggren created the patch, which makes advantage of a rate controlling ethylene.

DESIGN OF TRANSDERMAL PATCH

A number of variables, including skin permeability, the area and length of the application, and the skin's metabolic activity (i.e., first pass metabolism), influence how well a drug travels through the skin. Actually, each medication has distinct qualities that can influence transdermal delivery. The medication needs to be non-ionic and somewhat lipophilic in order to penetrate the epidermal barrier and achieve sufficient absorption and penetration.[9,10] It is more difficult for molecules bigger than 500 Daltons to get through the stratum corneum, and the drug's therapeutic dose should preferably be less than 10 mg daily.

Components of transdermal patch

The patch's outermost layer, known as the backing layer, shields the inner layers from the elements. Typically, a flexible, waterproof substance like polyethylene or polypropylene is used to create this layer.[11,12] The purpose of the adhesive layer is to adhere and maintain the patch's position on the skin. Usually, it is composed of a skin friendly, hypoallergenic adhesive that is robust. Drugs that are absorbed through the skin are found in the drug layer. It is designed to release the medications gradually and at a steady pace. The rate at which the medications are released from the patch is managed by the rate controlling membrane. Drugs can flow through most semi-permeable membranes because they are made of such materials.

TYPES OF PATCH[13-15]

1. Drug in adhesive system
2. Drug in reservoir system
3. Drug in matrix system
4. Drug in micro reservoir system

Adhesive System Drug

The most basic type of membrane permeability control system is this one. This system's adhesive layer, which holds the many layers together, is drug-containing. The backing and liner are layered with the medication combination.

System of Reservoirs[16]

The medicine is delivered through the microporous rate controlling membrane of this device, which is sandwiched between the backing layer and the drug reservoir. Within the reservoir chamber, the medicine may be disseminated in a solid polymer matrix or exist in the forms of a gel, suspension, or solution.

Drugs in the Matrix System are evenly distributed within hydrophilic or lipophilic polymer matrices. Affixed to drug-containing discs with regulated thickness and surface area is the resultant drug containing polymer.[17]

System of Micro-Reservoirs[18,19]

This system combines a matrix dispersion system with a reservoir. In order to construct thousands of non-leaching tiny drug reservoirs, the drug is prepared here by first suspending drug solids in an aqueous solution of a water soluble liquid polymer and then uniformly dispersing the solution in a lipophilic polymer.

Micro needle

The most basic kind of microneedles are solid ones, which are made up of solid needles that pierce the skin to form microscopic channels. Solid microneedles are frequently employed in cosmetic and medication administration procedures.

Hollow Microneedles: These microneedles can transfer liquids or medications into the skin because of their hollow cores. Hollow microneedles are frequently utilized for interstitial fluid collection and transdermal medication administration.

Coated Microneedles: When a coating on these microneedles penetrates the skin, it dissolves and releases medication or other substances. Transdermal medication delivery frequently makes use of coated microneedles.[20]

Dissolving Microneedles: By using materials that dissolve in the skin, these microneedles enable the regulated release of medications or other substances. Microneedles that dissolve are frequently.

Advancement in transdermal patch

There are just two uses for conventional transdermal patches: medication release and storage.

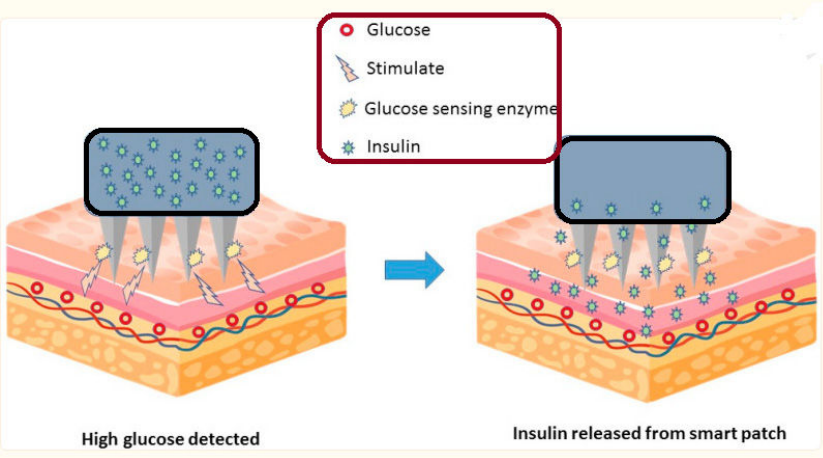
While there are several benefits to this approach, traditional patching has numerous difficulties and disadvantages, such as low release or restricted dosage. Transdermal medication delivery has seen a number of advancements to date.[21,22] Among these include the creation of innovative patches with improved drug penetration and release, increased loading, and precise drug sensing and release capabilities. All things considered, transdermal medication administration is a burgeoning field of study and research, with a plethora of fascinating new advancements to come, as will be covered below.

1. Smart patch

Sensors and other technologies are built into smart patches so that they may monitor patient circumstances and modify medicine delivery as necessary.[23] A team of scientists created a smart patch sensor platform in 2014 that uses microneedles to provide diabetics with continuous, painless intradermal glucose monitoring. This patch works by immobilizing the glucose specific c-enzyme glucose oxidase (GOx) and acting as an electrical mediator for glucose detection using a conducting polymer, such as poly (3,4-ethylenedioxythiophene) (PEDOT).

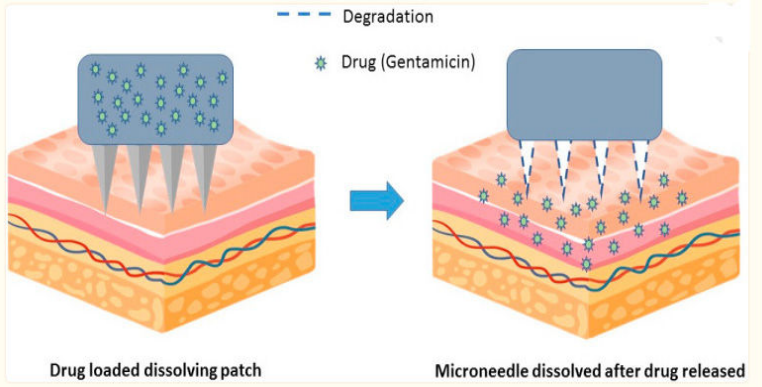
2. Degradable patch

Drugs and vaccinations that are not well absorbed by the body can be delivered with great efficiency using dissolving microneedles (MNs).[24,25] Effective transdermal insulin delivery was accomplished by localizing insulin to the needle using a two-step injection and centrifugation procedure. Insulin from MN patches had a relative pharmacological availability of 95.6% and a relative bioavailability (RBA) of 85.7%. This study shows that compared to



traditional subcutaneous injection, using dissolving patches for insulin delivery results in a satisfactory relative bioavailability (RBA), indicating the usefulness of dissolving patches for the treatment of diabetes.

An additional research team created a hypotensive biodegradable patch for transdermal delivery of sodium thiosulfate (ST) and sodium nitroprusside (SNP). Using centrifugal casting, soluble microneedles containing SNPs and STs were created.



By using this technique, SNPs were delivered onto microneedles in a stable manner and then promptly released into the bloodstream. Antihypertensive microneedle treatment (aH-MN) reduced blood pressure significantly and quickly. It satisfied the clinical standards for controlling blood pressure in cases of hypertension emergency.[26,27] Simultaneous ST treatment successfully reduced negative effects (such as organ damage) brought on by ongoing SNP consumption. An effective and patient friendly biodegradable patch for antihypertensive treatment was demonstrated in this study.

CONCLUSION

With numerous benefits over alternative administration methods, transdermal patch technology is a useful drug delivery technique. Patches can deliver continuous drug dosing for a longer amount of time by avoiding the first-pass metabolism and digestive system. They are frequently used to administer medications for a range of conditions, including hormone replacement therapy, chronic pain, and motion sickness. Transdermal patch technology has advanced significantly in recent years, with the creation of smart, biodegradable/solvent, high-loading/release, and 3D-printed patches among its numerous innovations. Although transdermal patches hold promise as a convenient and efficient drug delivery method for a range of conditions, there are a few obstacles that need to be addressed. These include the potential for self-inflicted toxicity due to incorrect dosing, poor adhesion, low drug penetration, and potential trigger for skin irritation.

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