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Review on transdermal drug delivery system

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Abstract

The transdermal drug delivery system offers the best way of drug delivery through the skin compared to the oral route of administration by overcoming side effects. Drug delivery is done through the adhesion of transdermal patches to the skin surface. Novel application techniques have been employed for better therapeutic response for the various drug in the treatment of several diseases using a dermal route of administration. This is the best non-invasive method of drug delivery by reducing the frequency of administration to achieve complete action of drug with maximum benefits to patients. These patches are formulated using various permeation enhancers that are compatible with skins surface. The dermal route of delivery is best suited for therapy to patients for certain diseases.

Keywords: Transdermal Patches, Best Therapeutic Response, Maximum Benefits to Patients.

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Introduction

Skin is used as portal of drug delivery due to its large surface and systemic accesses through circulatory and lymphatic networks the non invasive nature of drug delivery [3]. The drugs enters into through three pathways by hair follicles, sebaceous, and through sweat ducts Transdermal drugs are medications which are used for managing various diseases such as rheumatoid arthritis , diabetes mellitus, hypertension, psychiatry disorder, neurological disorders etc through dermal route of administration ,these drugs exhibits action through penetration into the skin surface moves into in to the stratum corneum layer by evolution of drug into blood circulation showing its therapeutic action [4,7,16,19]. There have been recent advancements in delivery of drugs through transdermal route by application novel technologies these include micro needles – small painless needles have ability to deliver

compounds that have high molecular weight [2,5,13]. Matrix type patches containing different drug formulations were prepared for showing of maximum drug release at control rate [10]. Hypodermic needles new form of micro needles which the drug enters directly into systemic circulation, the nano lipid carrier mediated delivery is optimized for sustain release of drugs having better therapeutic efficacy [19].

Need For Transdermal Patches

Transdermal drug delivery is the delivery of medicament through the dermal route of administration by over coming to the first-pass metabolism, gastrointestinal complications, oral incompatibilities of various drugs [2,6]. This route of administration of drugs shows better plasma concentration with enhanced bioavailability compared to other formulations containing same medicament. The patches having more than one medicament are very useful for managing different disease states of the patient with minimal medication prescription, thereby achieving best outcomes with patient care-oriented therapy [1,3,9] The major side effects such as Lacto-acidosis, drug toxicities can be reduced through using of transdermal patches [5]. This is patient-friendly as it is easy to use if any of the situations and even care takes can also administer to

patients in case patient is having neurological and psychological diseases [7,9,14,16,29]. The transdermal system is a less painful route of administration, minimally invasive technique, ensuring better patient comfort for drug administration and increased to a great extent due to novel inventions and recent developments.

Fig :1 The comparison of topical cream hypodermic needle, micro needle patch and transdermal patch [35,37,38].

The drug delivery by various transdermal systems is depicted as above topical creams spreads on skin surface area only upto 10-20 percent of total drug component in cream penetrated into the skin. In case of transdermal patches, drug has to pass through stratum corneum barrier thus is exhibiting low bioavailability [33,35]. The Adding of permeation enhancers to transdermal patches can improve drug permeation to a limited extent. Hypodermic needles go deep into dermis where pain receptors are present ensuring 90-100% delivery of loaded drug, but this is a painful having poor patient acceptability [2,4,34]. Microneedle patches bypasses stratum corneum barrier delivering drug directly into epidermis or upper dermis layer that ensures delivery of 100% of loaded drug at site of administration without any pain.

Anatomy Of Skin Layers

Fig:2. Mechanism of drug delivery by micro needle device [33,34]

The above picture depicts about skin layers along with its circulatory system.

This can be briefly described as the following:

- The stratum corneum is the outer layer of the skin (epidermis). It serves as the primary barrier between the body and the environment, made up of layers of very resilient and specialized skin cells and keratin [6]
- The epidermis, the outer most layer of skin, provides a waterproof barrier and creates our skin tone.
- The dermis is located below the epidermis, contains tough connective tissue, hair follicles, and sweat glands [22].
- The deeper subcutaneous tissue (hypodermis) is made of fat and connective tissue [22]

Advantages

- Drugs having shorter duration of action and exhibiting high first-pass metabolism and low bioavailability has been formulated as transdermal patches [16]
- Drugs exhibiting gastrointestinal complications when given by oral route are formulated in the form of transdermal patches [26]
- The frequency of administration can be decreased by using sustain and control release patches [14].
- The drugs of different molecular weights and different physical properties also can be delivered [14].
- The release of drug depended on the lipophilicity of matrix moderately lipophilic show the best release by diffusion mechanism.
- This is also used to achieve long-term therapy for patients ensuring their safety by providing better patient compliance and showing maximum benefits [19].
- The drug toxicities due to accumulation and adverse effects can be minimized or avoided through transdermal patches [11].
- Constant plasma drug levels can be maintained and convenient for usage for the patient.

Disadvantages

- Improper usage due to lack of knowledge resulting harm or treatment failure.
- Administration errors are observed while application of patches to skin surface [33].
- Lethal problems such as Accidental overdoses [11].
- Inappropriate in-storage disposable patches [9].

- There may occur skin irritation and allergic reactions at site of application.

Advancement In Transdermal Drug Delivery System

A break through in transdermal drug delivery system was seen in previous generations only focused on the areas for maximising the better utility of drug delivery system [14,16]. The recent growth in the area found to be personalized in medicine requires a new generation of the drug delivery [14,18]. Which aimed at controlled release and feed back induced transdermal drug release [20]. Novel material design and device fabrication bought advancement in variable devices for biomedical applications, giving a new opportunity in personalised health care.

Fig:3 (a) schematic illustration of device transdermal drug delivery for patients.

(b) the wearable device system monitoring of vital signs [32]

Mechanism of iontophoresis [16,32]

Iontophoresis promotes the movement of ions across the membrane under the influence of a small externally applied potential difference (less than 0.5 mA/cm²), which has been proven to enhance skin penetration and increase release rate of several drugs with poor absorption/permeation profiles

Utilisation of medication by overcoming errors through following process

Fig:4. The Transdermal patches best practice administration process .

The process should be followed constantly without disturbing the cycle to achieve required outcome. The proper care should be taken while using patches at site of application on skin [9].

Conclusion

The transdermal route of drug delivery through transdermal patch formulation is the most optimized way for offering a great efficacious drug response to patients ensuring a vivid way of drug therapy. The exact treatment for the disease can be done even if a patient is non-cooperative to drug therapy. Addiction habits to certain narcotic substances can be minimized and further usage is best prevented. This review illustrates the current improvements and developments in transdermal research to achieve better diabetes management. The treatment for diabetic patients is best suited than compared to the oral route, by reducing patient's stress regarding disease and medications helping to provoke probable outcome. Active transport methods of drug delivery by using external devices have more extensively increased, because of efficiently delivering of drugs and macromolecules by the transdermal delivery system. However, the ability of the technologies for effectively delivering of drugs is partially balanced by their dependence on electronic controlled devices that works on energy sources, thereby limiting their price and utility in the drug delivery system.(all)

Authors acknowledgment

All are equally contributed

Conflict of interest

No Conflict of Interest

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