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Review Article

A REVIEW ON TRANSDERMAL DRUG DELIVERY SYSTEM

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ABSTRACT

Recently delivery of drugs through the skin is being a challenging area for research because of barrier properties exhibit by the outermost layer of skin stratum corneum. The transdermal drug delivery system has offers significant clinical benefits over other dosage forms. Because transdermal drug delivery offers controlled and predetermined rate of release of the drug into the patient, it able to maintain steady state blood concentration in blood stream. It is essential form of drug delivery due to absolute advantages, Eg: easy pain free administration, save from hepatic first pass metabolism, enhance therapeutic efficiency and also maintain steady plasma level of drug. Transdermal delivery not only provides controlled and constant administration of the drug, but also gives continuous input of drugs with short biological half-lives and also eliminates pulsed entry into systemic circulation, which many times leads to undesirable side effects. Transdermal drug delivery becomes an important tool in medical practice. The skin penetration enhancement technique developed to improve bioavailability of drug, transdermal drug delivery is obvious option. Many no. of drugs formulated into patches. The review article gives overall study of transdermal drug delivery system which contributes to Novel drug delivery system.

KEYWORDS: *Transdermal patch, TDDS, Skin and Permeation enhancers.*

INTRDUCTION

Past few years studies have focused on new technologies in drug delivery. Traditional drug deliveries are replaced by new effective and advanced drug deliveries. Transdermal drug delivery system is one of the most effective and innovative approach to drug delivery system [1, 8]. Transdermal drug delivery system provides controlled continuous delivery of drug through skin to systemic circulation. Transdermal patch is source of delivering the drug through skin, by the difusion process the drug slowly enters the blood stream, through the skin [4, 7].

Transdermal patch contain high dose which adhere on skin for prolong period of time. Transdermal drug delivery system reduces first pass metabolism as well as hepatic metabolism. This type of drug delivery used to treat disorders like angina pectoris, pain smoking cessation and Parkinson's disease.

Merits of TDDS:

1. Transdermal drug delivery system avoids gastrointestinal incompatibilities.
2. Transdermal drug delivery system reduces unwanted side effects which produced by conventional drug delivery.
3. Transdermal drug delivery system maintain drug plasma concentration when it goes to systemic circulation.
4. Transdermal drug delivery system expands duration of action of drug.
5. Transdermal drug delivery system avoids first pass metabolism.
6. Transdermal drug delivery system has been increased therapeutic value of many drugs.
7. Allows effective use of drug with short biological half life.
8. Allow administration of drug with narrow therapeutic window because drug level is maintained within the therapeutic window for prolonged period of time.
9. Reduced inter and intra patient variability.
10. Avoidance of significant presystemic metabolism (degradation in GIT or by the liver) and therefore need lower doses.

Demerits of TDDS:

1. Transdermal drug delivey system produces allergic reactions like rashes.
2 . The barrier function of skin varies individually and site to site.
3. Hydrophillic type of drugs are not suitable in this type of drug delivery system.
4. Adequate solubility of the drug in both lipophillic and aqueous environments,to reach dermal microcirculation and gain access to the systemic circulation.
5. May not be economical.
6. Tolerance inducing compounds are not an intelligent choice for this mode of administration unless an appropriate washout period is programmed between the dosing regimen.
7. The molecular size of drug should be reasonable that it should be absorbed percutaneously [4, 9].

Anatomy and Physiology of Skin:

Human skin is multilayered organ. The human skin is the outer covering of the body. In humans, it is the largest organ of the integumentory system. The skin has up to seven layers of ectodermal tissue and guards the underlying muscles, bones, ligaments and internal organs. Human skin is similar to most of the other mammals skin and human skin is very similar to pig skin. Though nearly all human skin is covered with hair follicles, it can appear hairless. The main function of skin is protection of major internal organs, sensations and it also regulates temperature of body. The surface area of skin about two square meters. The human skin has three distinct layers as given below:

A. Epidermis
B. Dermis
C. Hypodermis

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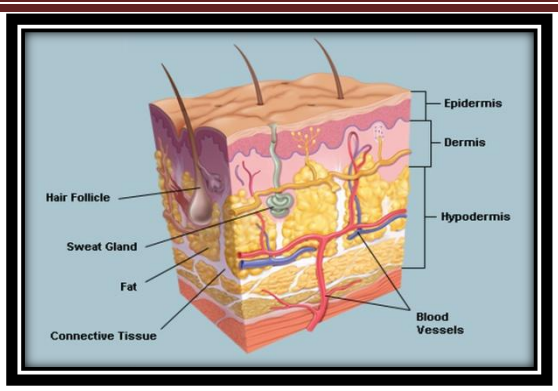

Fig. 1: The skin

A. Epidermis:

Epidermis is composed of stratified and squamous epithelium. Depending on size of cell the thickness of epidermis layer varies. Epidermis contains karatinocytes which produce karatin. They also contain melanocytes which produce melanin pigment that contributes to skin colour.

There are five layers of epidermis as follows:

a. stratum basale
b. spinosum
c. lucidum
d. cornium

B. Dermis:

Dermis is made up of connective tissues, having 3 to 5 mm thickness. It also contain blood vessel and nerves. Dermis is larger layer between Three layers. Dermis supports the epidermis layer of skin. Dermis is divided into papillary and reticular region.

1- Papillary Region = Papillary Region is made up of areolar connective tissues.

2- Reticular Region = Reticular Region is made up of dense irregular coactive tissues.

C. Hypodermis:

Hypodermis is made up of subcutaneous fat tissues. It plays role as fat storage area. Thickness of hypodermis varies according to surface area of body [3, 5, 19].

Components of TDDS:

The components of transdermal drug delivery are as follows

1. Drug
2. Polymer matrix
3. Permeation enhancers

1. Drug:

The drug should be highly selective. Ideal properties of drug are as follows

Ideal properties:

a) The drug should be compatible for hydrophillic and hydrophobic phases.
b) The molecular weight of drug should not be more than 1000 dalton.
c) The drug should have low melting point.
d) The drug must have short half life.
e) The drug should be effective and less irritant

2. Polymer Matrix:

There are two types of polymer matrix:-

a) Natural polymer: Eg, Waxes, Shellac, Zein.
b) Synthetic enhancers: Eg,Siliconer rubber.

3. Permeation enhancers:

The drug or substances which diminish the impermiability of skin know as permeation enhacer. There are various types of permeation enhancers.

a) Solvents: E.g- water, alcohol, alkylmethyl sulfoxide, ethanol, N-methyl
b) Surfactonts: Eg: Dioctyl sulphasuccinate SLS (Sodium louryl suphate).

Defination:

Transdermal drug delivery system is defined as the topically administered medications, which when applied to the skin deliver the drug, through the skin at a predetermined and controlled rate.

A Transdermal patch is defined as medicated adhesive patch which is placed above the skin to deliver a specific does of medication through the skin with a predetermine rate of release to reach into the bloodstream.

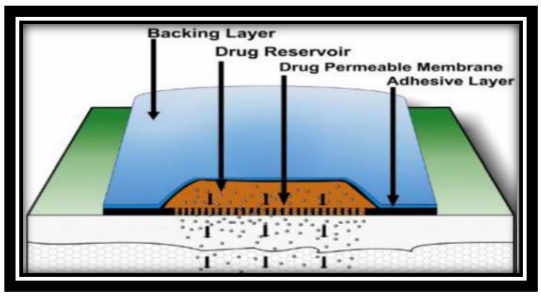

Fig. 2: Transdermal patch showing its different components

Types of Transdermal Patches:

1) Single layer drug in adhesive: In this system drug and excipients is inclusive with skin adhesive which serve as formulation as a single breaking layer. The rate of release of drug through diffusion phenomenon.

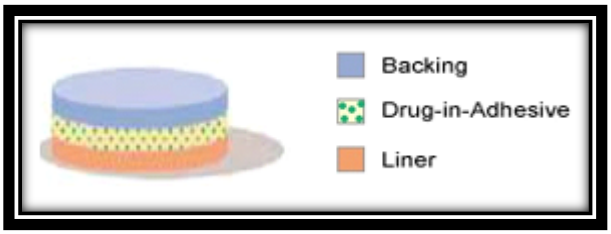

Fig. 3: Single layer drug in adhesive patch and its different components

The rate of release of drug is expressed as:

$$\frac{dQ}{dT} = \frac{Cr}{1/Pm + 1/Pa}$$

Where, Cr = Drug concentration inreservoir compartment
Pa = Permeability coefficient of adhesive layer
Pm = permeability coefficient of rate controlling membrane

2) Multi drug layer in adhesive: In this system drug and expcipients incorporated with adhesive but both layer of adhesive separated by single layer membrane. The released of drug occurred through diffusion phenomenon.

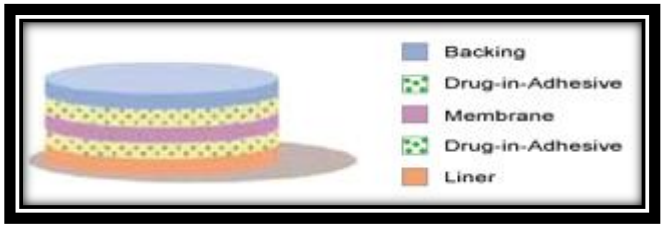

Fig. 4: Multi layer drug in adhesive patch and its different components

The rate of release of drug is governed by following equation:

$$\frac{dQ}{dT} = \frac{Ka/r.Da}{ha} Cr$$

Where; Ka/r = Partition coefficient for the interfacial partitioning of the drug from the reservoir layer to adhesive layer.

3) Drug reservoir in adhesive: In the reservoir system, inclusion of liquid compartment containing drug solution/suspension between baking layer and semipermeable membrane followed by adhesive layer and release liner.

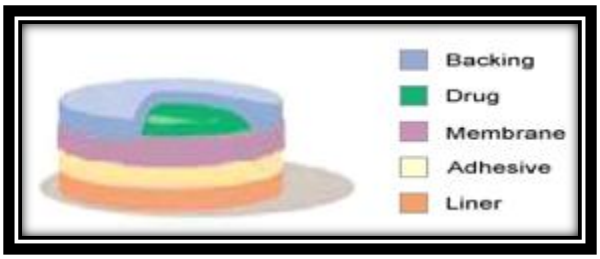

Fig. 5: Drug reservoir in adhesive patch and its different components

The rate of release is governed by following equation,

$$Da = \frac{dQ}{dT} = \frac{Ka}{\frac{r}{ha(t)}} A(\ ha\ )$$

Where, Ha= Adhesive layer thickness;
A= diffusion path thickness.

4) Drug matrix in adhesive: This system is designed by inclusive of semisolid matrix having drug in solution or suspension from which is in direct contact with the release liner.

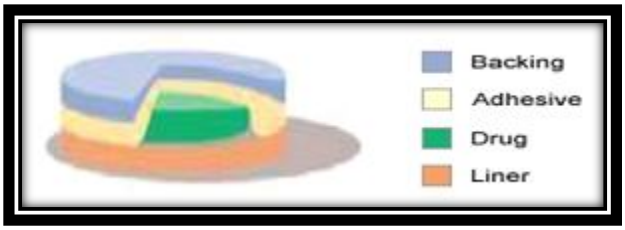

Fig. 6: Single layer drug in adhesive patch with its different components

The rate of release of drug is governed by following equation,

$$\frac{dQ}{dt} = \frac{ACp\ Dp1/2}{2t}$$

Where, A= The initial drug loading dose dispersed in the polymer matrix.
B= Solubility of drug.
C= Difusivity of drug in the polymer [3, 7].

Evaluation of Transdermal Film:

1. Interation studies: The drug and excipient should be compatible each other to produce a stable product thus it is necessary to detect any physical or chemical reations. Thermal analysis is carried out for interation studies.

2. Thickness of patch: Digital micrometer is used to measure the thickness of drug- loaded patch; which determines the average thickness and standard deviation of patch.

3. Drug Uniformity: The patches should be dry at 60"c for 4 hours before testing. Some specific area of patch cut into different pieces and weighed at digital balance. The average weight and standard deviation calculated.

4. Folding indurance: Firstly at the strip of specific area and fold at same place till at breaks. At the same place no. of times strip folds without breaking gives value of folding indurance.

5. Percentage moisture content: The patch should be kept in desiccators which contain fused calcium chloride at room temperature for 24 hours and films reweighted.

$$\%\ \text{Moisture Content-}\left[\frac{Intial\ \ wgt - Final\ \ wgt}{Final\ \ wgt}\right] 100$$

6. Percentage moisture uptake: The patch should be kept in a desiccator which contains saturated solution of potassium chloride to maintain 84 % RH at room temperature for 24 hours and films reweighted.

$$\%\ \text{Moisture Uptake} -\left[\frac{Final\ \ wgt - Intial\ \ wgt}{Intial\ \ wgt}\right] 100$$

7. Drug Content: Some area of patch is dissolved in suitable solvent in a fixed volume. The solution of patch and solvent should filter by filter medium and analyse drug content by UV or HPLC method [10, 20].

Applications:

1. The nicotin patch delivers drug in stady state mechanism used to treat and terminate the tobacco smoking.
2. Nitroglycerine patch is used to treat angina instead of sublingual pills.
3. The patches which contain estrogen are used to treat menopausal and post menopausal osteoporosis.
4. MAOI selegiline in the form of patches is used to treat depressant disorders.
5. Clonidine also used in form of transdermal patch which is antihypertensive drug.
6. Transdermal drug delivery agent Methylphenidate used to treat "Attention Deficit Hyper Activity Disorder ".
7. Two medications Buprenorphine and Fentanyl used for relief from severe pain available in patch form [7, 23].

Limitations:

1. If the dose of drug for transdermal drug delivery is large such that more than 10 to 25mg/day then transdermal drug delivery is difficult.
2. The itching, erythema, local edema type of local irritations may cause by drug or excipients used in the formulations at the site of administration.
3. The clinical need of trandermal product has to examined before developing the transdermal product.
4. The barrier function of skin changes from person to person, site to site and with age.
5. Skin permeability should be high for delivering the drug at the systemic site.
6. Potent drug delivery is restricted in Transdermal drug delivery system.
7. Ionic drug can't be delivered by Transdermal drug delivery system.
8. Some patients occurs Contact Dermatitis at the site of administration [10, 25].

CONCLUSION

Transdermal drug delivery system is alternative way of systemic administration of drug which gives desirable therapeutic effect, sefty and easy to use with low cost. Transdermal drug delivery technologies are becoming one of fastest growing sectors within the pharmaceutical industries. Transdermal patch is source of delivering the

drug through skin. The types of transdermal patches mentioned above have been highly investigated and also tested by clinical trials.

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REFERENCES:

1. Pang Z and Han C. Review on Transdermal Drug Delivery Systems. J Pharm Drug Devel **2014**;2(4):402. doi: 10.15744/2348-9782.1.602
2. Nikhil Sharma, Geta Agarwal, AC. Rana, Zulfiqar Ali Bhat, Dinesh Kumar. A Review: Transdermal Drug Delivery System: A Tool For Novel Drug Delivery System. **2011**;3(3).
3. B. Bhuvana, S. Nagalakshmi, S. Shanmuganathan. A Novel Transdermal Drug Delivery System and Its Applications in Present Scenario. JCPS **2017**;10(4): 15-64.
4. Dipen Patel, Sunita A. Chaudhary, Bhavesh Parmar, Nikunj Bhura. Transdermal Drug Delivery System: A Review. **2012**; 1(4):66.
5. Ashvini S. Kadam, Mukesh P. Ratnaparkhi, Shilpa P. Chaudhary. Transdermal Drug Delivery: An Overview. **2014**; 3(4):1042-1053.
6. Latheeshjlal L, P. Phanitejaswini, Y. Soujanya, U. Swapna, V. Sarika, G. Moulika. Transdermal Drug Delivery Systems: An Overview. Int J PharmTech Res IJPRIF **2011**;3(4):2140-2148.
7. Richa Sachan, Meenakshi Bajpai. Transdermal Drug Delivery System: A Review. **2013**;3(1):748-765.
8. J. Ashok kumar, Nikhila Pullakandam, S. Lakshmana Prabu, V. Gopal. Transdermal Drug Delivery System: An Overview.
9. Abdul Hafeez, Dr. Upendra Jain, Jagpal Singh, Arun Maurya, Lakhan Rana. Recent Advances in Transdermal Drug Delivery System (TDDS): An Overview. J Sci and Innov Res **2013**;2(3): 695-709.
10. Vaibhav Rastogi, Pragya Yadav. Transdermal drug delivery system: An overview Department of Pharmaceutics, College of Pharmacy, IFTM University, Moradabad, Uttar Pradesh, India.
11. Harunusman Patel, Dr. Upendra Patel Daslaniya. Transdermal Drug Delivery system as prominent dosage forms for the highly lipophilic drugs. Int J Pharm Res & Biosci **2012**.
12. Nikhil Sharma, Bharat Parashar, Shalini Sharma, Uday Mahajan. Blooming Pharma Industry with Transdermal Drug Delivery System. Indo Global J Pharm Sci **2012**;2(3):262-278.
13. Saurabh Pandey, Ashutosh Badola, Ganesh Kumar Bhatt and Preeti Kothiyal. An Overview on. Transdermal Drug Delivery System. Int J Pharm Chem Sci.
14. Kamal Gandhi, Anu Dahiya, Monika, Taruna Karla, Khushboo Singh. Transdermal drug delivery-A Review. www.ijrps.pharmascop.org
1. K. Ezhumalai, P. Ilavarasan, R. Murali Mugundhan, U. Sathiyaraj, AN. Rajalakshmi. Transdermal Patches in Novel Drug Delivery System. Int J Pharm Tech **2011**.
15. Hiren J. Patel, Darshan G. Trivedi, Anand K. Bhandari, Dushyant A. Shah. Penetration enhancers for Transdermal Drug Delivery System: A Review. IJPI's J Pharm Cosmetol.
16. PK. Gaur, S. Mishra, S. Purohit, K. Dave. Transdermal Drug Delivery System: AReview. Asian J Pharm Clin Res.
17. Vandana Yadav, Sipia Altaf Bhai M, Mamatha Y, Prashant VV. Transdermal Drug Delivery System: A Technical Writeup. J Pharm & Sci Innov **2012**.
18. J. Ashok Kumar, Nikhila Pullakandam, S. Lakshmana Prabu, V. Gopal. Transdermal Drug Delivery System: An Overview. Int J Pharm Sci Rev Res **2010**;3(2): Article 009.
2. Md. Intakhab Alam, Nawazish Alam, Vikramjit Singh, Md. Sarfaraz Alam, Md. Sajid Ali, Tarique Anwer, Mohammed M. Safhi. Type, Preparation and Evaluation of Transdermal Patch: AReview. World J Pharm Pharm Sci 2(4):2199-2233.
19. Bulletin of Pharmaceutical Research 2013;3(2):78-89.
20. Vishvkarma Prabhakar, Agrawal shivendra, Sharma Ritika, Saurabh Sharma. Transdermal drug delivery system-Review. Int Res J Pharm **2012**.
21. DIJ. Morrow, PA. McCarron, AD. Woolfson and RF. Donnelly. Innovative Strategies for Enhancing Topical and Transdermal Drug Delivery. The Open Drug Deliv J **2007**;1:36-59.
22. Snigdha Bharadwaj, Vipin Kumar Garg, PK. Sharma, Mayank Bansal, Nitin Kumar. Recent advancement in transdermal drug delivery system. Int J Pharma Prof Res **2011**;2(1).
23. Prasanthi D, PK. Lakshmi. Vesicles – Mechanism of transdermal permeation. A review, Asian J Pharm Clin Res **2012**;5(1).

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