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BRIEF REVIEW ON NOVEL APPROACHES OF TRANSDERMAL DRUG DELIVERY

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ABSTRACT

Created with out external source, therapeutic transdermal patches, also known as transdermal patches, are an ideal method to deliver drugs throughout the body and skin to treat diseases. Several of the disadvantages of multi-drug administration include the heavy path of administration, the danger of over dose, poor patient compliance and the variation in plasma levels of the drug. Transdermal medication delivery is an innovative approach to systemic drug delivery in which drugs are absorbed into body units over along period of time and in a predetermined manner. This method is more beneficial in reducing the frequency of treatment and eliminating the first-pass metabolism, asitis directly circulating; it is less adverse and easy for the sick elderly to apply for self-treatment when they cannot consume drug.

KEYWORDS: transdermal patches, drugdelivery, absorption, compliance, metabolism.

1. INTRODUCTION

Today, about 74% of drugs are taken orally and are not considered as valuableas the yare expected. Inorder to advance the se features, a transdermal drug delivery system was developed. Asthe pharmaceutical dosage form of the time has been created, the Transdermal Drug Delivery System (TDDS) has been recognized asan important part of anew drug delivery system. Transdermal dosage form s arean affordable alternative to conventional formulas and are increasingly popular for their exclusive benefits. Improved bioavailability, controlled absorption, increased uniform plasma levels, painless and reduced side effects, and the flexibility to terminate the delivery of transdermal drugs bysimply removing patches from

the skin are some potential advantages.[1] Systemsfortransdermal drugdeliveryare Created toprevent such issues. Transdermal patchesarediscrete, self-contained medication patchesthatprovide asimple delivery method forsome skinand bodyproblems[2] oral traditional dosageforms suchastabletsandcapsules, are the most widelyuseddrugdelivery systems, butbothdosageforms facetheproblem of gastric drug/enzymeinstability first from metabolism. Oraltransportationhasmanyotherproblems, suchasunpleasanttaste, smell andcolor. Manyadditionalproblems ariseduringtaking pills, soproblems arise duringtreatment. Sometimes patientsdonot comply. TDDSpatchesare used to release thedrugcontinuously, sothey have anaccuratedurationofeffect, and transdermal patchesarenon-irritatingandnon-invasive techniques. Alternativesto conservative techniques for the systemicadministration of drugsare attractive.[3]

2. Advantages

1. No-invasive delivery: Avoidstheriskofpain, discomfort andinfectionassociated with injectionsandsurgical implants.
2. Controlledrelease: Ensurescontinuousrelease ofdrugstomaintainconsistentplasma levels.
3. Improving bioavailability: Bypassing the metabolismof the first stepand increasing bioavailability.
4. Reduce sideeffects: Minimize systemsideeffectscaused bylocaldelivery.
5. Enhancedpatient compliance: convenient, easy-to-useandself-administered.
6. Targeted delivery: Drugs are delivered directly to affectedareasorsystemic circulation.
7. Flexibility in formulation design: Available invarious formulations (colors, gels, creams).
8. Reduceddosefrequency: Maintainstherapeutic levels with lowerdose frequency.
9. Improving therapeutic results: Improvedefficacy, reduced treatment time.
10. Cost-effective: Reduce health costs by minimizing hospitalization and medical intervention.[4,5]

3. DISADVANTAGES

1. Skinirritationand allergic reactions: TDD Scancause skinirritation, allergic reactionsand allergicreactions.
2. Limitationofpermeability: Thenatural barrier functionofthe skinlimitsthepermeability andabsorptionof drugs.
3. Variablebioavailability: Bioavailability canvarydependingonskinthickness,moistureand otherfactors.

4. Dosageaccuracyandcontrol: It isdifficulttoobtainaprecisedoseandcontrol oftherelease of drugs.
5. Skinsensitivity: Repeated exposure tothesame drugorexcipient maycause skinsensitivity.
6. Interpatientvariability: Variationofskin permeability andmetabolisminindividuals.
7. Drugdegradation: Drugscanbe degradedonthesurfaceoftheskinorwithintheTDDS.
8. Adhesionproblems: Patchadhesion problems canaffectdrug delivery.
9. Limiteddrug candidates: Suitableonlyforlowmolecularweight lipophilic drugs.
10. Regulatorychallenges: stringentregulatory requirements forapproval.[6,7]

4. FORMULATIONAPPROACHES

1. Adhesive Selection: - Considerskincompatibility, attachment andadhesionstrength– Evaluate adhesionviscosity, shearstrengthandstoragemodule
2. Fermentation Formulation - Chooseasuitable polymer(e.g. hydroxyethylcellulose, polyvinylpyrrolidone)– Selectasolvent (e.g. water, ethanol, isopropanol)– Addastabilizer (e.g. antioxidants, preservatives)
3. Drug Incorporation:- Dissolveorsuspenddrugs indispersion– ensureuniform distributionand stability
4. Mixingadhesivedispersion:- Mixadhesiveanddispersion.[8,9]
5. Basiccomponents of TDDS.

1. Active Pharmaceutical Ingredient(API).

- Therapeutic agent(e.g., lidocaine, fentanyl, nicotine).
- Determineseffi cacy andsafetyof TDDS.

2. Adhesive

- Holds TDDSinplaceonskin.
- Types: pressure-sensitiveadhesives(PSAs), acrylic-based, silicone-based.
- Examples: Duro-Tak 87-2516, Bio-PSA 7-4302.

3. Backing Layer

- Impermeable orsemi-permeable material
- Protects API fromenvironmental factors
- Examples: polyester, polyethylene, polyurethane

4. Release Liner

- Protectivefilmremoved beforeapplication

- Examples: polyester, polyethylene

5. Matrix/Reservoir
- Controls API release rate
- Types: matrix, reservoir, hybrid
- Examples: hydroxyethyl cellulose, polyvinylpyrrolidone
6. Permeation Enhancers[10,11]

Skin Anatomy[12]

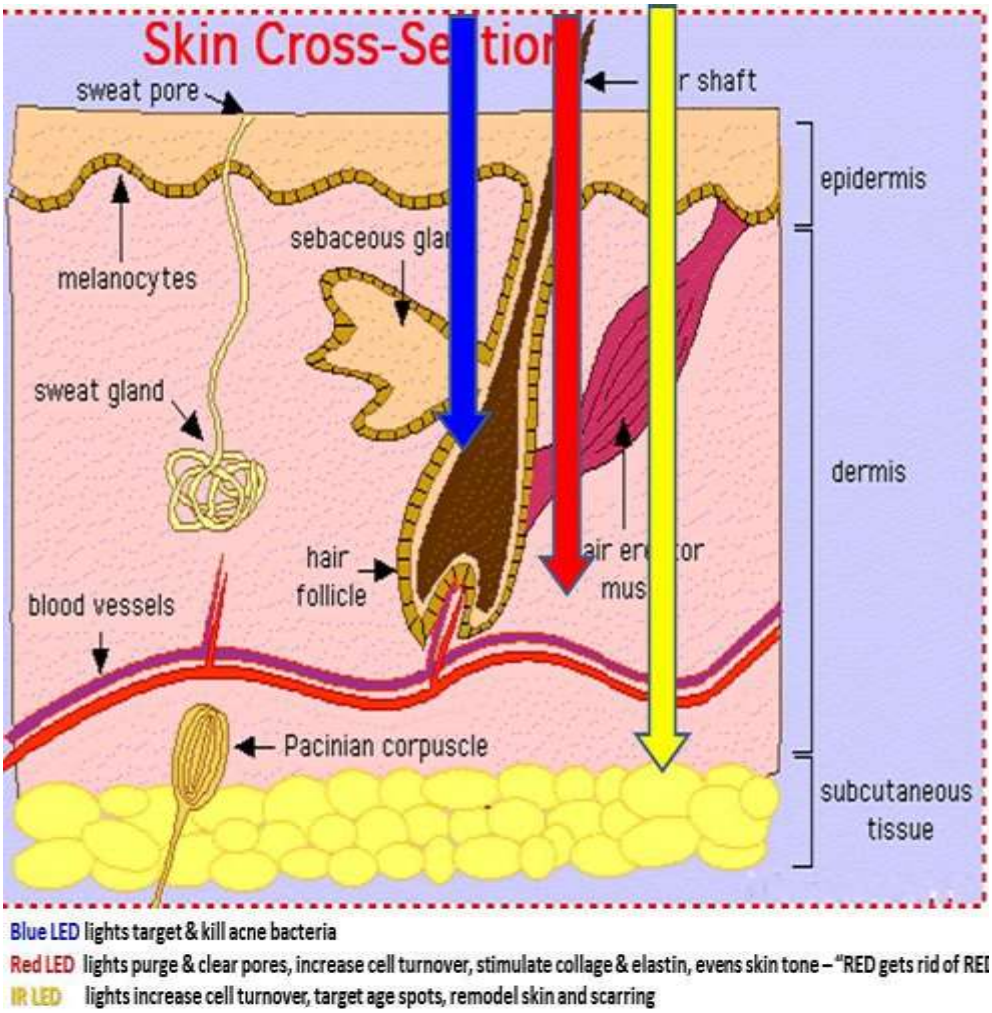

Fig-skincrosssection

Skinanatomyandphysiology

1. Epidermis: Outermost layer, 10-15 µmthick
2. Dermis: Beneathepidermis, 1-2 mm thick
3. Hypodermis: Subcutaneoustissue, 1-2 cmthick Skin Layers Relevantto TDDS:

1. Stratum Corneum (SC): Outermost epidermallayer, 10-15 µmthick

2. Stratum Lucidum: Thin, translucent layerbeneath
3. Stratum Granulosum: Layerbeneathstratum lucidum
4. Stratum Basale: Innermost epidermal layer Skin Barrier Function:

1. Lipid Bilayer: SC' smainbarrier component
2. Corneocytes: Dead cellsin SC, provide mechanicalbarrier
3. Natural Moisturizing Factor(NMF): Hydrates SC, maintainsbarrierfunction Transdermal Absorption Pathways.

1. Inter-cellular Pathway: Through lipidbilayer
2. Trans-cellularPathway: Throughcorneocytes
3. Appendage Pathways: Through thehairfollicles, sweat glands Physiological Factors Affecting TDDS.

1. Skin Temperature: Affectsdrugpermeability
2. Skin Hydration: Affectsdrug solubilityandpermeability
3. Bloodflow: affectstheabsorptionanddistributionofdrugs.
4. pH: Affectsdrug ionizationandpermeability[13,14] factors affecting transdermal permeation.

Physiological Factors

1. Skin Temperature: Affectsdrug permeability andsolubility
2. Skin Hydration: Affectsdrugsolubilityand permeability
3. Blood flow: affectstheabsorptionanddistributionofdrugs.
4. pH: Affectsdrugionizationandpermeability
5. Skin Thickness: Affectsdrugpermeation rate Chemical Factors:

1. Drug Molecular Weight: Affectspermeation rate
2. Drug Lipophilicity: Affectspermeationthrough lipidbilayer
3. Drug Solubility: Affectspermeation rate
4. DrugpKa: Affectsionizationandpermeability
5. PermeationEnhancers: Chemicals thatenhance drugpermeation Formulation Factors:

1. Vehicle (Solvent): Affectsdrug solubilityandpermeability
2. Concentration: Affectsdrug permeation rate
3. pHof Formulation: Affectsdrug ionizationandpermeability
4. Excipients: Affectsdrugstabilityand permeability
5. Formulation Type(e.g., gel, cream, patch): Affectsdrugreleaseandpermeation Environmental Factors.

1. Temperature: Affectsdrugstabilityandpermeability

2. Humidity: Affectsdrugstabilityandpermeability
3. Light: Affectsdrugstability
4. Pressure: Affectsdrugpermeationrate Other Factors:

1. Skin Condition(e.g., healthy, diseased, damaged): Affectsdrugpermeation
2. Age: Affectsskinpermeability
3. Sex: Affectsskinpermeability
4. Ethnicity: Affectsskinpermeability[15,16] Transdermal drug delivery systems (TDDSs) aretherapeuticapplications. Pain Management

1. Fentanyl (Duragesic) forchronic pain
2. Lidocaine (Lidoderm) forlocal anesthesia
3. Buprenorphine(BuTrans) forchronicpain Cardiovascular Diseases

1. Nitroglycerin (Nitro-Dur) foranginapectoris
2. Clonidine (Catapres-TTS) forhypertension Neurological Disorders

1. Nicotine(Nicotrol) forsmoking cessation
2. Rivastigmine (Exelon) forAlzheimer' sdisease
3. Rotigotine(Neupro) for Parkinson' sdisease Hormone Replacement Therapy

1. Estradiol (Estraderm) formenopause symptoms
2. Testosterone (Androderm) forhypogonadism Inflammatory Conditions

1. Methylsalicylate(Salonpas) for topicalpainrelief
2. Diclofenac (Flector) forosteoarthritis Other Applications

1. Scopolamine(Transderm Scop) formotionsickness
2. Oxybutynin(Oxytrol) foroveractive bladder Emerging Applications

1. Insulindeliveryfordiabetes management
2. Cancertreatment usingtransdermal immunotherapy
3. Genetherapyusingtransdermaldelivery[17,18,19]

Following Are The Transdermal Marketed Patches[20]

Productsname	Drug	Manufacturer	Indication
Androderm	Testosterone	TheraTech/GlaxoSmithKline	Hypogonadism (males)
Nitrodisc	Nitroglycerin	Roberts Pharmaceuticals	Anginapectoris
Minitran	Nitroglycerin	3M Pharmaceuticals	Anginapectoris
Deponit	Nitroglycerin	Schwarz-Pharma	Anginapectoris
Climaderm	Estradiol	Ethical holdings/Wyeth-Ayerest	Postmenstrual syndrome
Climara	Estradiol	3M Pharmaceuticals/Berlex Labs	Postmenstrual syndrome
Estraderm	Estradiol	Alza/Norvatis	Postmenstrual syndrome
Fematrix	Estrogen	ethical holdings/Solvay Healthcare	Postmenstrual syndrome

Fempatch	Estradiol	Parke-Davis	Postmenstrual syndrome
Alora	Estradiol	TheraTech/Proctol and Gamble	Postmenstrual syndrome
Prostep	Nicotine	Elan Corp./Lederle Labs	Smoking cessation
Nicoderm	Nicotine	Alza/GlaxoSmithKline	Smoking cessation
Habitraol	Nicotine	Novartis	Smoking cessation
Nuvelle TS	Estrogen/progesterone	Ethical holdings/schering	Hormone replacement therapy
Combipatch	Estradiol/Norethindrone	Noven, Inc./Aventis	Hormone replacement therapy
Orthoevra	Norelgestromin/estradiol	Ortho-McNeil	Birthcontrol
		Pharmaceuticals	
Duragesic	Fentanyl	Alza/Janssen Pharmaceutic	AModerate/severe pain
CatapresTTS	Clonidine	Alza/BoehingerIngelheim	Hypertension

CONCLUSION

Transdermaldrug deliverysystems(TDDS) haverevolutionizedpharmaceutical delivery, offeringanon-invasive, patient-friendlyalternative to traditional routes. Advancesin materials science, nanotechnology, andphysical enhancement methodshave significantly improved skinpermeability anddrug bioavailability.

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