TOPICAL DRUG DELIVERY SYSTEM

AIM

To study about the Topical Drug Delivery System.

INTRODUCTION

Topical drug delivery can be defined as application of drug via skin to directly treat or cure the skin disorder. Skin is one of the most readily accessible organs on human body for topical administration and is main route of topical delivery system. Drug can penetrate deeper in to skin and hence give better absorption.[21]

Over the last decades the treatment of illness have been accomplished by administrating herbal drugs to human body via various routes namely oral, sublingual, rectal, parental, topical, inhalation and etc. according to the global burden disease are considered the fourth leading cause of nonfatal disease burden with dermatitis being the highest contributor and cellulitis contributing the least in global burden of the skin diseases.[22]

Herbal therapy for skin disorders has been used for thousands of years herbal medication that shows a scientific evidence for clinical efficacy as well as the more common herbs found to be useful in the treatment of dermatological disorders. Herbal therapy has increased in popularity in the past to decades among patient seeking alternative treatment to conventional allopathic medicine. Dosage forms for topical application are intended to produce the required therapeutic action at specific targets in the skin with the least probable adverse effects.

For any topical formulation the onset, rate and extent of therapeutic response depend on the efficiency of sequential process: release of the active substance from the dosage form penetration/diffusion of the drug through the stratum corneum (SC), and other skin layers, before prodrug the pharmacological effects.

DEFINITION

Topical drug delivery system is defined as the application of a drug containing formulation to the skin or mucous membrane, to treat specific cutaneous disorder (e.g. acne) or cutaneous manifestations of a generalized disease (e.g. psoriasis), with the intent of containing the pharmacological effect of the drug only to the surface or within the layers of skin or mucous membrane.

CLASSIFICATION OF TOPICAL DRUG DELIVERY SYSTEM

1. Includes two types of Topical Drug Delivery System:
    - External-that are spread or dispersed on the cutaneous surface covering the affected area.
    - Internal-that are applied to the mucous membrane of eye (conjunctiva), ear, oropharyngeal cavity, nasal cavity, vagina or anorectal region for local activity.
2. Classification Based on physical state:
    - Solid: Powder, Aerosol, Plaster
    - Liquid: Lotion, Liniment, solution, Emulsion, Suspension, Aerosol
    - Semisolid: Ointment, Cream, Gel, Jelly, Suppository
    - Miscellaneous: Transdermal drug delivery system, Tapes and Gauzes, Rubbing alcohols, Liquid cleanser and Topical aerosol.

ADVANTAGES

- Using d/o/w emulsion, hydrophobic medicine can be easily integrated into gels.
- There will be no intensive sonication.
- Stay away from first-pass metabolism.
- More focused on a single location.
- Stay away from foods that are incompatible with your gastrointestinal system.
- Increasing the patient's willingness to comply.
- Self-medication is possible.

- Ensuring that a medicine with a short biological halflife and a restricted therapeutic window is used.
- The ability to easily stop taking medication.
- Provide medicine distribution that is a specific to the patient' needs.
- Simple to make and inexpensive to prepare.
- Increased loading capacity
- Release is regulated.
- Convenient and simple to use. [5]

DISADVANTAGES

- Excessive irritability of the skin.
- The risk of an allergic response.
- Some drugs have a low permeability through the skin.
- Large particle drugs are difficult to absorb via the skin.
- Contact dermatitis causes skin inflammation.
- The occurrence of a bubble during emulgel formulation.[11]

STRUCTURE OF THE SKIN

The skin is a large multilayered organ in the body. The skin and its derivatives (Hair, Nails, Sweat glands and oil glands) make up the integumentary system. It acts as a barrier between outside and inside environment. The skin serves as a hedge against physical, chemical, attack. The skin act as thermostat in maintain body temperature, securities the body from irruption by microorganism, protects against ultra-violet shafts, and play a part in the regulation of blood pressure.[23]

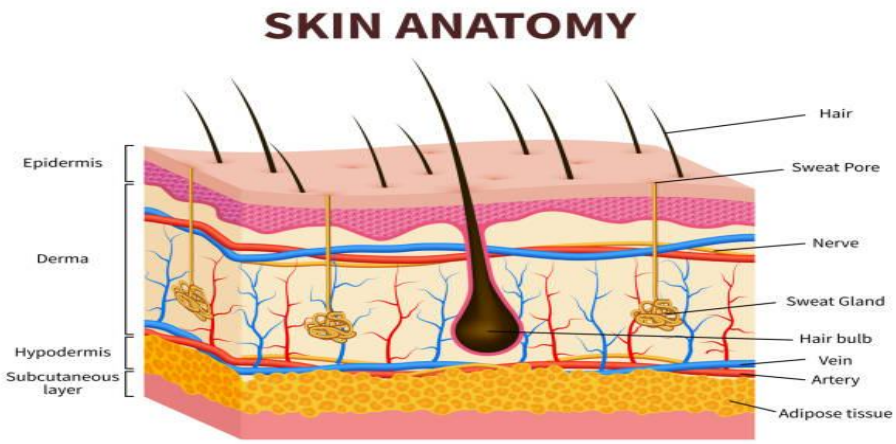

Figure:1 (structure of the skin)

LAYERS OF THE SKIN

❖ EPIDERMIS

The epidermis is the thin, external subcaste of the skin that is visible to the eye works to give production for the body the epidermis subcaste provides a hedge to infection from environmental pathogens and regulate the quantum of water released from the body in to the atmosphere through epidermal water loss. Epidermis contain cell that produce color and cover vulnerable system.

The absence of blood vessels is the epidermis most distinguishing feature.The capillaries of the dermis give nutrient.

The layers of the epidermis include the stratum basale (the deepest portion of the epidermis), stratum spinosum, stratum granulosum, stratum lucidum, stratum corneum (the most superficial position of the epidermis).[17]

❖ DERMIS

The next layer of the dermis skin is a thick layer of fibrous and elastic tissue that gives it flexibility and strength. This layer is primarily composed of collagen, elastin, fibrillin. The dermis contains nerve endings, sweat glands, oil glands, hair follicles, and blood vessels. The dermis is a vascularized collagen-rich connective tissue that contains mucopolysaccharides (also known as ground material).[13]

❖ **HYPODERMIS**

The hypodermis is the deepest layer of the skin. It is the layer that connects the body's underlying tissues, such as muscle and bone, to the skin. Although they are coated in the epidermis, sweat glands, sebaceous glands, and hair follicles all have their origin in the dermis. On this skin's surface, sweat glands release a dilute salt solution. The skin is cooled by the evaporation of the mild salt solution, which is important for body and skin temperature regulation. Sweat glands are present all over the body. [13]

❖ **SKIN ACCESSORIES**

Sweat gland produces sweat of pH 4-6.8 and absorption medicines, secretes proteins, lipids and antibodies. Its function is to control heat.

❖ **HAIR FOLLICLES**

They have sebaceous glands which produces sebum and includes glycerides, cholesterol and squalene.[19]

DRUG TRANSPORT ACROSS THE SKIN

Topical administration also includes transdermal operation, where the substance is administered onto the skin but is absorbed into body to attain systemic distribution. Similar specifics are generally hydrophobic chemicals, similar as steroid hormone. Topicals specifics are specifics applied onto the body to treat colorful affections. Almost generally, a topical medicine delivery system is applied to the skin, where the drug either treats only they area of operation are is absorbed Into the blood stream through the dermis.

The crucial purpose of topical medicine delivery system is to enhance the skin permeability and to retain in the dermis. These motes are absorbed into the skin through "pores" or opening of the hair follicles and sebaceous glands that restricts medicine immersion. These are three possible pathways for epidermal penetration of active composites.

These are appendageal (intracellular) penetration through the hair follicles or via the sebaceous and / or sweat glands, and transcellular (intracellular) saturation through the corneocytes and intracellular lipid matrix.[18]

SKIN PENETRATION

Skin penetration is the primary challenge to deliver the bioactive agents into the skin that follows Fick's first law of diffusion, which states they transfer rate of solutes as they function of the concentration of the various ingredients, the size of the surface area to be treated and the permeability of the skin. Percutaneous absorption is inversely proportional to molecular weight, which affects the diffusion coefficient. Further, permeability can also be affected by some of the factors such as moisturizing, drying or occluding affects of the excipients used in the formulation, which in turn modifies the drug release at the treatment site.

$$J=-D.\{dc/dx\}$$

Where,

J = Flux

D = Diffusion coefficient of the drug

dc/dx = Concentration gradient

According to Kalia and guy, drug transport in the skin process involving several steps:

a) Drug dissolution and release of the drug from the formulation;

b) Drug partitioning into the stratum corneum;

c) Drug diffusion across the stratum corneum, mainly by intracellular lipids;

d) Drug partitioning from the stratum corneum into viable epidermis layers into the dermis,

f) Drug absorption by capillary vessels, which achieves systemic circulation.[16]

FACTORS AFFECTING TOPICAL ABSORBTION OF DRUGS

Physiological and physiochemical consideration are taken into account for drug absorption in topical areas.

PHYSIOLOGICAL FACTORS

1. Thickness of skin.
2. Lipid content.
3. Density of hair follicles.
4. Density of sweat glands.
5. pH of the skin.
6. Blood flow.
7. Skin hydration.
8. Inflammation of skin.

PHYSIOCHEMICAL FACTORS

1. Partition coefficient.
2. Molecular weight.
3. Degree of ionization.
4. Effects of vehicles.[20]

FACTORS TO BE CONSIDERED WHILE CHOOSING A TOPICAL PRESENTATION:

1. Potential of enragement or sensitization in general, ointments and creams with water and oils are less irritating whereas gels irritate. If you have an allergy to preservatives or emulsifiers, ointments are not for you.
2. The type of preparation should correspond to the type of lesions.
3. Match the kind of preparation to the location. (For examples, for hairy places, a gel or lotion).[23]

EVALUATING THE PENETRATION OF DRUGS INTO THE SKIN

The evaluation of penetration of drugs into the skin is important in development of topical formulations because the excepted effect is targeted to the superficial layers of the skin. The concentration of drug in the skin layers can be determined by in vitro and in vivo assays.

CLASSIFICATION OF METHODS

I. In vitro technique
   - ❖ Franz diffusion cell

II. In vivo techniques
   a. Ex vivo
      - ❖ Tape stripping technique
      - ❖ Franz diffusion cell
   b. In-vivo
      - ❖ Skin biopsy
      - ❖ Suction Blister
      - ❖ Micro dialysis
   c. Others
      - ❖ Confocal laser microscopy

IN VITRO TECHNIQUES

❖ FRANZ DIFFUSION CELL

The diffusion cell apparatus is used to measure in vitro release of drugs from creams, ointments, oil and gels. Diffusion is the random movement of molecule across the concentration gradient, from high concentration to low concentration. In vitro diffusion is the passive diffusion of a solution molecular species from a donor chamber through membrane into a “receptor fluid” present in the recipient compartment.[9]

WORKING

The working of diffusion cell apparatus or Franz cell based on in vitro diffusion it consists of two chamber a donor compartment and a receptor compartment separated by a membrane. The product to be tested in introduced through the donor compartment (the top chamber). The bottom chamber or the receptor compartment contains fluid from which samples to be analyzed are extracted at regular intervals. The samples collected determines the amount of active that permeates through the membrane at point time.

The cell temperature constantly remains at 37^0C. The receptor compartment of a diffusion cell or Franz cell has a fixed volume, and it allows the stirring of both receptor and donor chamber.

MEMBRANES TYPES

Various type of membranes can be used for diffusion experiments.

- Human membranes
- Animal membranes
- Synthetic or polymeric membrane
- Human skin equivalents

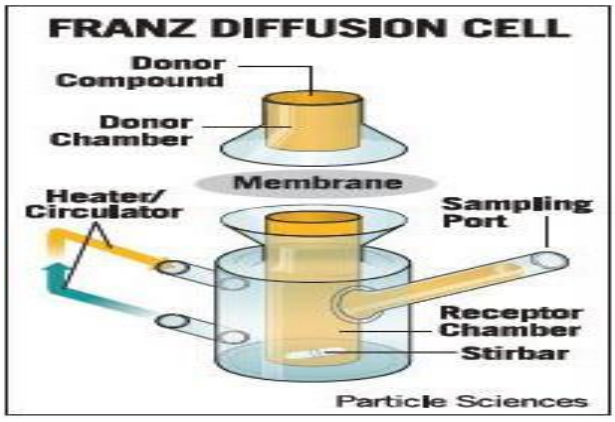

Figure:2 (Franz diffusion cell model)

Diffusion cell apparatus is used for in vitro release testing (IVRT), pre-formulation characterization of semi-solid dosage form, evaluation of permeation of drug through biofilms and artificial membrane permeability assay. [8]

ADVANTAGES

- It is use as gold standard for DPK (Digital product key) evaluation
- No continuous sample collecting is required as it can be automated
- Requires low amount of drug required for analysis

DISADVANTAGES

- Different types of cells are required depending on the type of formulation release kinetics
- Use of instrument requires practice as it is not user-friendly

IN VIVO TECHNIQUES

EX VIVO

❖ TAPE STRIPPING TECHNIQUE

The tape stripping procedure is a suitable minimal invasive tool to study, e.g. the penetration and dermato-pharmacokinetics of topically applied substances. In the present study, this procedure was used to remove the stratum corneum (SC) completely and to study the penetration of the UVA (Long wavelength ultraviolet) filter substance butyl methoxydibenzoylmethane after application in two different vehicles.[9]

METHOD

The amount of corneocytes removed by each tape strip from the flexor forearm of human volunteers was determined via their pseudo-absorption. In a second part, the penetration profiles of a UVA filter substance applied in two different vehicles were determined following the developed standard protocol using the tape stripping procedure in combination with UVspectroscopy.[23]

ADVANTAGES

- This method is simple, inexpensive, efficient, quick, and relatively non-invasive approach to assess the quality and efficacy of drugs, excipients, cosmetics in the skin following the topical dermatological application.
- In general, the variation in the tape stripping method is considerable as the number of tape strips used in removing the stratum corneum varies with the type of tape, pressure applied during application, and force in removal.
- It is stand-alone technique thus mainly helpful to assess the local bioavailability of drugs whose target site is the stratum corneum itself.

DISADVANTAGES

- Velocity of removing this tape can be varied which leads to error in the evaluation data.
- The major disadvantage is with the detection of material by using this method which includes interference with chemical absorbing in the wavelength range of coenocytes absorbance at wavelength 430 nm.

IN VIVO TECHNIQUE

By 2013, the EU dedicated itself to removing animal testing for cosmetics, thereby giving greater prominence to human in vivo studies, particularly those that can be performed non-invasively. Hence, various imaging techniques like confocal microscopy, tomography, fluorescence studies received much attention by the research scientist.

❖ SKIN BIOPSY METHOD

Skin biopsy technique is generally differentiated according to the area used for the biopsy sample like if it is the level of the dermis (shave biopsy) or through to the sub-cutis (punch biopsy). These methods are invasive and generally performed under local anesthesia. Skin biopsy has not attracted very much attention as routine approach for tissue sampling and analysis of post-drug application in transdermal delivery system. Despite of many attempts to reduce the tissue trauma, this method is not remotely acceptable and its use in the foreseeable future will be restricted to animal and in vitro studies.

SHAVE BIOPSY TEST

During a shave biopsy, a tool like a razor is used to scrap the surface of the skin. The goal is to remove irregular tissue to send to the lab. Stitches usually aren't needed after this procedure.

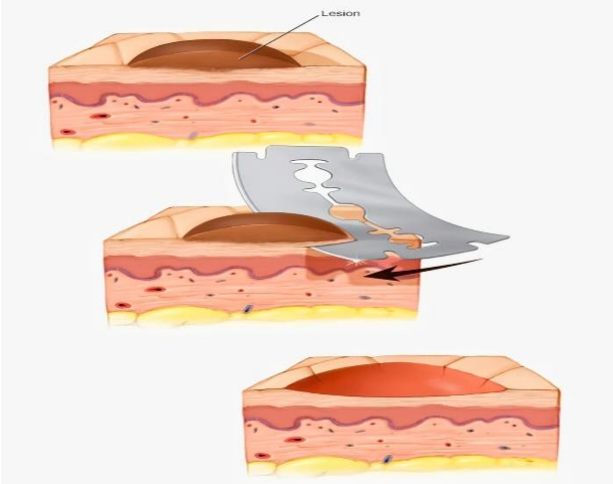

Figure:3 (Shave biopsy)

PUNCH BIOPSY TEST

During a punch biopsy, a round-tipped cutting tool is used to remove deeper layers of skin for testing. Depending on the size, stitches may be needed to close the wound.

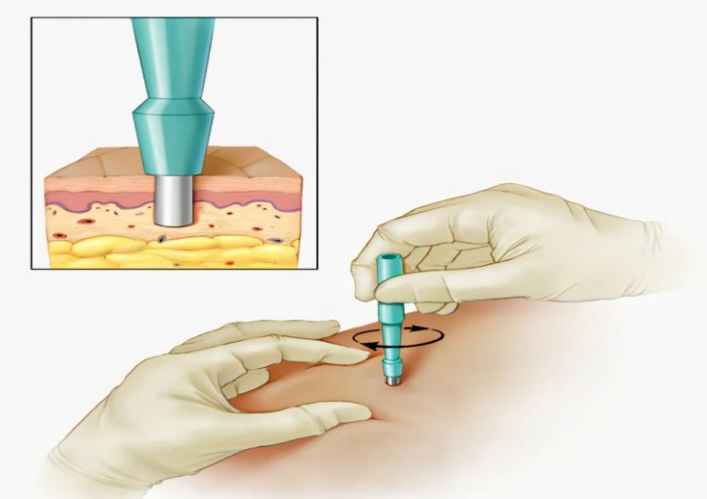

Figure:4 (Punch biopsy)

EXCISIONAL BIOPSY TEST

During the excisional biopsy, a scalpel is used to cut out a lump or an area of irregular skin and some surrounding healthy skin. As a rule, stitches are needed to close the wound.

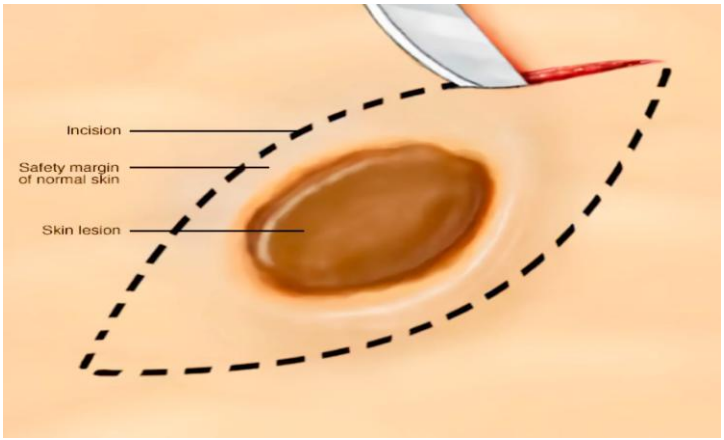

Figure:5 (Excisional biopsy)

ADVANTAGES

- This method offers a snapshot of drug disposition in the different skin layers.

DISADVANTAGES

- It is not adopted as standard procedure due to its invasive nature.
- Tissue sample obtained from this method is almost 1mm size and almost invisible.

❖ **SUCTION BLISTER**

Suction blistering is a technique used in dermatology to treat chronic wounds, such as non-healing leg ulcers. When a wound is not healing properly, an autologous skin graft is the best option, to prevent rejection of the tissue. Since autologous transplantation cannot always be performed, a substitute has to be used,such as cultured skin. However, this technique is costly and time-consuming. Other uses of suction blister are to provide transplantation donor tissue for vitiligo research in the pharmaceutical and cosmetics research field.[8]

METHOD

During suction blistering, the lamina lucida of skin is cleaved from the underlying layers. This separates the epidermis from the dermis. With the use of small vaccum pumps, little fluid-filled blisters are created, typically on the abdomen. Blisters are usually formed within 2 to 3 hours.

A well- recognized instrument, the negative pressure instrument, from electronic diversities, Finkburg MD, US, is used with heated chambers to produce various-sized suction blister with less time and improved success. The blisters are then cut, emptied and the loose skin is transferred side by side to the non-healing wound. Subsequently, the donor-site is treated with antiseptic drugs and covered with bandages. The acceptor-site is treated with non-adherent bandages, to prevent the skin graft from sticking to the bandages.[1,14]

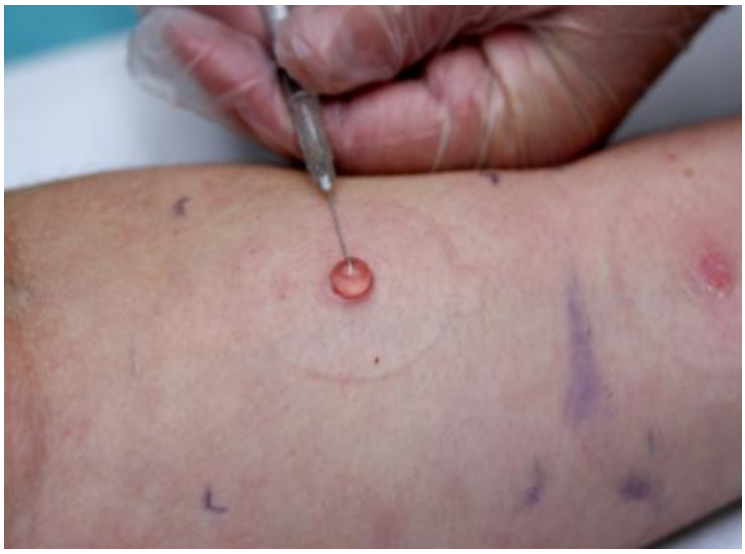

Figure:6 (Suction blister)

ADVANTAGES

- Method is easy to perform
- Low chance of rejection of results obtained from this method

DISADVANTAGES

- Too invasive a technique for practical and routine application

❖ MICRODIALYSIS

Microdialysis is a minimally invasive technique for the chronological study of metabolic, biochemical, and pharmacological events in living tissues. During the last two decades, microdialysis has become well established method for continuously sampling substances within the extracellular fluid compartment of various tissues outside the central nervous system, including subcutaneous adipose tissue, dermis, muscle, and other organs.[7]

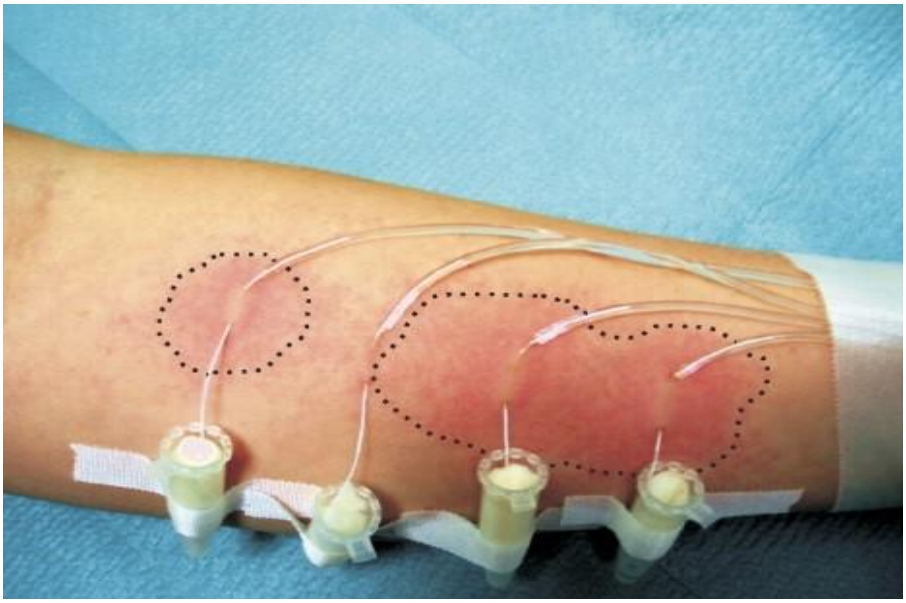

Figure:7 (Microdialysis)

The Microdialysis technique is minimally invasive and requires the insertion of a small microdialysis catheter into the tissue of interest. The microdialysis catheter consists of a semi-permeable membrane that is continuously perfused with the physiological solution. This physiological solution is called a 'perfusate', and then becomes a 'dialysate' once it has filtered through the membrane. The direction of the analysate flow is determined by the respective concentration gradient and allows the usage of microdialysis probes as sampling (Retrodialysis) as well as tools for the delivery of investigated molecules or medication.

The solution leaving the probe (dialysate) is collected at certain time intervals for analysis. 'Retrodialysis' occurs when diffusible compounds are added to the perfusate, and can diffuse from the catheter into the tissue of interest, exerting their effects.

The design of microdialysis probes is divided into two basic categories: linear and concentric. The linear style probe is a membrane embedded within a length of small diameter tubing. It is usually used for tissue implants such as those in the subcutis, dermis, adipose tissue or muscle. Concentric probes have a membrane located at the distal end of a supporting cannula.

They are most often used for accessing the extracellular fluid of the brain . This avoids unnecessary invasiveness at this site as this probe has only one insertion point, and no exit point.

Sample analysis is a critical step in microdialysis and various methods exist. These include enzyme-linked immunosorbent assays, radioimmunoassays and high performance liquid chromatography. Other approaches include microsphere-based protein micro-assays, electron spin resonance, immunoaffinity capillary electrophoresis, capillary electrochromatography or mass spectrometry-based proteomics.[2,10]

ADVANTAGES

- This method can give very detailed chronological pharmacokinetic data, and simultaneously several sampling sites can be considered in the same volunteer.
- The semipermeable membrane used prevents cells, cellular debris, and proteins from entering into the dialysate. This due to the lack of protein in the dialysate, a sample clean-up prior to analysis is not needed and enzymatic degradation is not a concern.
- Insertion of the probe to particular location of the selected tissue helps in evaluation of extracellular concentration gradients due to transporter activity or other factors, such as perfusion differences. Thus, it is been suggested as the most appropriate technique to be used for tissue distribution studies.

DISADVANTAGS

- Use of micro dialysis probe may can alter tissue morphology resulting in disturbed microcirculation, rate of metabolism, or integrity of physiological barriers.
- Need of sensitive analytical method to detect small concentrations of analyte.

OTHER TECHNIQUES

❖ CONFOCAL LASER SCANNING MICROSCOPY (CLSM)

Confocal laser scanning microscopy is widely used for checking spatial drug distribution of the principle drug inside the tissue by using fluorescence phenomenon.

The technique works on the principle of point illumination and detection which is the ability to differentiate between the light originating from different planes of the specimen. The confocal microscope can image thick samples with high resolution have enabled their use in studying skin penetration of various molecules and delivery systems.

CLSM is useful in analyzing localization of different nanoparticles, lipid microparticles, noisome, liposomes etc in specific skin tissue samples. Various studies have been carried out using CLSM to understand the transport of hydrophilic and hydrophobic drugs into the skin using these drug carriers that is niosomes, liposomes, nanoparticles etc. Technique has been applied in vivo and in vitro for studying the skin structure without physically cutting tissue or to assess the effects of physical and chemical enhancers on skin permeability.

ADVANTAGES

- Non-invasive technique and clear high defined images obtained from microscope help in assessing drug penetration into skin
- High-resolution images with depth sensitivity can be obtained by using CLSM

DISADVANTAGES

- Qualitative analysis is possible with this technique, not quantitative.
- Images are also limited to determined points of the skin at determined times, and the images do not represent the dynamic process of skin permeation for prolonged times.
- Limited fluorescence markers are available for these studies.

NOVEL TOPICAL DRUG DELIVERY SYSTEM

Novel drug delivery system (NDDS) is an expression mainly associated with the the formulation of new pharmaceutical forms which have optimized characteristics such as smaller Particle size, higher permeability parameters, and selective site targeting.

AEROSOL FOAMS

The aerosol foams gained the increasingly popular type of topical formulation for a variety of skin condition including acne vulgaris the vehicle base of the foam can have consistency like liquid or semisolid which shares equal physiochemical characteristics of conventional carrier vehicle like gels, lotion and creams but it main desirable properties such as moisturizing quicker drying effects or high bioavailability of drug. The aerosol base is dispensed through a gas pressurized can that discharges the foam. The product characterized like thickness, viscosity, texture, bubble size density persistence stable nature and spread ability are determined by the type of formulation and the dispensing container that are needs. The foams may be preferred for application on large hairy surface (e.g. chest and back) or on the face as cleansers, because they are easier to apply.

LIPOSOMES

The liposomes are artificially prepared vesicles made of lipid bilayer which are frequently used as vehicles in pharmaceuticals and cosmetics for drug delivery in controlled manner to particular areas of skin or its layers. Liposomes are spherical vesicles whose membrane consist of amphiphilic lipids this lipid that are hydrophilic on one side and lipophilic on the other side i.e. dual characteristics which enclose an occurs core, same as to the bilayer membrane of living cells. Because liposomes offer an amphiphilic environment, they may encapsulate hydrophilic substances in their aqueous core and lipophilic substances in their lipid bilayer. This unique dual release capability enables the delivery of 2 types of substances once they are applied on the skin; each differs in its effects on skin permeability, which may enhance the desired therapeutic benefit.

NANOEMULSION

Nano emulsions are class of emulsions which may be water-in-oil or oil-in-water type of formulations that are identified and characterized by the dispersion of very small-sized droplets when mixed. The major requirement of nano emulsion unique thermodynamic conditions without the nano emulsions will not formedspontaneously, as the require unique thermodynamic conditions, specialized manufacturing process, and specific surfactants that can stabilized nano droplets. Nano emulsions are suitable for the transport of the lipophilic compounds into the skin and therefore, they may be an ideal vehicle for use in acne to increase the penetration of the active compounds inside the lipophilic environment of the pilosebaceous unit. In addition nano emulsion particulates will not clog the pores and they can produce additional therapeutic effects such as increased skin hydration and viscoelasticity.

MICROSPONGES

It is a unique technology for the controlled release of topical agents and consists of microporous beads typical 10-25 microns in diameter loaded with active agent. When applied to the skin the MDS releases its active ingredients on a time mode and also in response to other stimuli like rubbing, temperature, pH, etc. MDS(Microsponges delivery system) technology is being used in cosmetics, over- the -counter skin care, sunscreens and prescription products. These are biological inert particles that are made of synthetic polymers with the capacity to store a volume of an active agent up to their own weight. Furthermore, the particles serve to protect the entrapped active compound from physical environmental degradation. The micro sponge technology can be utilized in a variety of formulations, but is more frequently manufactured as gels. Once applied on the skin, micro sponges slowly release the active agents.

EMULSIFIER- FREE FORMULATIONS

Emulsifier-free formulations are also a growing area of development for dermatologic and cosmetic products. The emulsifier-free formulations which are easy to process and suitable for O/W and W/O emulsions they offer a melting texture with non-tacky skin feel and ease of distribution. Most skin care products are emulsion i.e. mixture of 2 or more materials that are not miscible with each other; as such, according to second law of thermodynamics, they are inherently unstable. As a result, they require the addition of surfactants agents are applied on the skin, they tend to emulsify and remove the natural lipids of the epidermis. Consequently, the pharmaceutical industry has been developing surfactant free emulsions as alternative to conventional formulations by using stabilizers, such as polymeric emulsifier of solid particles, in order to yield sufficiently stable products with a cosmetically pleasant appearance.

EXCIPENTS USED IN THE NOVEL DRUG TECHNOLOGY

POLYMERS

The polymers have played the milestone functioning in designing the topical formulations. The polymers are large molecule consisting of repeating structural units, or monomer that are connected by covalent chemical bonds. These compounds serve as the building blocks of natural like paper and amber, biological like proteins and nucleic acid, synthetic polymers are found in the nearly every industry, and their versatility has given rise to technological advancements within the pharmaceutical sector that address a variety of medical needs. For example, dermatology, there are new acrylic acid polymers that turn into a gel in the presence of water by trapping water by trapping water into microcells. Inside these aqueous microcells, hydrophilic compounds may be dispersed in suspension. The result is a stable gel-like formulation that is easy to use and release the active compound once they are applied on the skin. Moreover, these polymer-based gels can be mixed with other excipients, such as moisturizers and emollients, to provide additional clinical benefits. Recently introduced anti-acne formulations that combine clindamycin 1% with benzoyl peroxide 5% (Duac, stiefel laboratories; BenzaClin, Dermik) utilize this novel polymer-based gel technology that exhibits efficacy and excellent tolerability. Following is the on of the polymer type used in topical formulations has wide applications in the designing the advance formulation for skin delivery.

DENDRIMER

Dendrimer have found recent application in novel topical and transdermal delivery system, providing benefits such as improved drug solubilization, controlled release, and drug polymer conjugates like prodrugs. The viscosity generation number property of a dendrimer solution allows for ease of handling of highly concentrated dendrimer formulations for these applications.

Dendrimers have been shown to be useful as transdermal and topical drug delivery system for nonsteroidal anti-inflammatory drugs (NSAIDs), antiviral, antimicrobial, anticancer, or antihypertensive drugs. PAMAM(Polyamidoamine) dendrimers have been studied as carrier transdermal system for the model NSAIDs ketoprofen and diflunisal. It was found that the PAMAM dendrimer- drug formulations showed increased transdermal drug delivery compared with in mice showed prolonged pharmacodynamic responses and 2.73- fold higher bioavailability over 24 h for certain dendrimer containing drug solution.

CONCLUSION

The current review concludes the topical drug administration is a relatively new approach. We can easily access different medications into the skin by using topical formulation as a result of the many approaches utilized to improve absorption through the skin membrane. The topical drug delivery system is primarily utilized in the treatment of skin conditions. It has several advantages including ease of application, non-invasive process and higher patient compliance. There are reduced side effect and toxicity to other organs compared to systemic medication.

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