A Review on Various Iontophoretic Drug Delivery System

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Abstract- *The delivery of drug into systemic circulation through skin with help of electric current. It gives controlled release of drug in to the blood through skin. It avoids first pass metabolism however,the skin nature provides greatest challenge for the successful delivery of drug molecule by utilization of iontophoresis concepts. This system utilizes electric current as a driving force for permeating of ionic and non- ionic medications.Several medications have received FDA approval for iontophoretic technique in recent years. This method is becoming more popular since it has higher compliance rates, non-invasive medication delivery that causes less side effects, and sustained drug release. Additionally, programmed delivery and bolus delivery systems have made it possible to alter the medicine dosage and dosing schedule based on the needs of the patient.*

Keywords- Drug delivery, translational research, transdermal therapeutic system, iontophoresis

I. INTRODUCTION

Iontophoresis a term widely used abroad, expresses the carrying of ions from one point to another, but it is not one that comes readily to the English reader.Ionisation is a term which has for long been associated with destructive processes and in consequence is unlikely to convey the idea of the healingprocess.Iontophoresis is a therapeutic method used by therapists to treat various diseased conditions. It is a type of electrical stimulation due to electric current is used to administer medication into your body through your skin. The basic principle of iontophoresis is ionic charges that are alike will repel one another, while ions that are oppositely charged will be attracted to each other. The drugs that are having positive charged molecules then, the positive current is applied they pushed away the charged molecule (or) repelled this method is used in iontophoresis by physical therapist that push drug into the body through the skin.

HISTORY

It is derived from Greek word"ionto""phoresis"means "TO bear" is the process that allow to increase penetration of ionized molecule across (or)into the body tissue by applying low current. The idea of applying electric current to increase the permeation of electrically charged drug into the body tissue is probably originated by *pivati*in 1740 used to treatment of arthritis in 18th century.In 20th century *Leduc* introduce the term ionto therapy and formulating law regarding this.First reports from *Kratzenstein* (1723–1795) And *Galvani* (1737–1798)

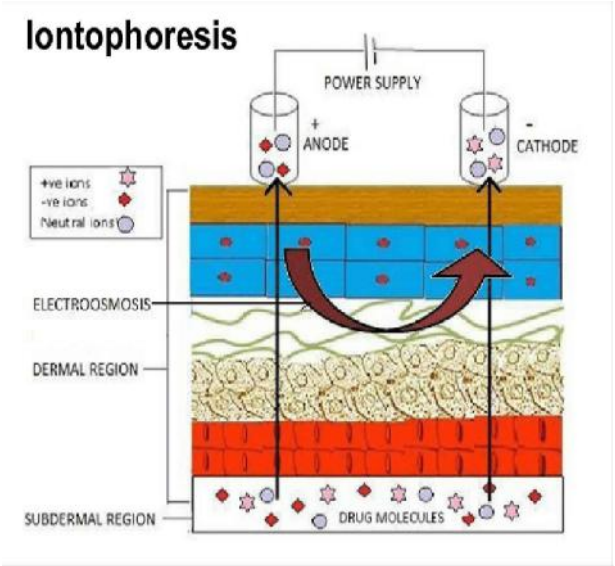
PHARMACOKINETICS

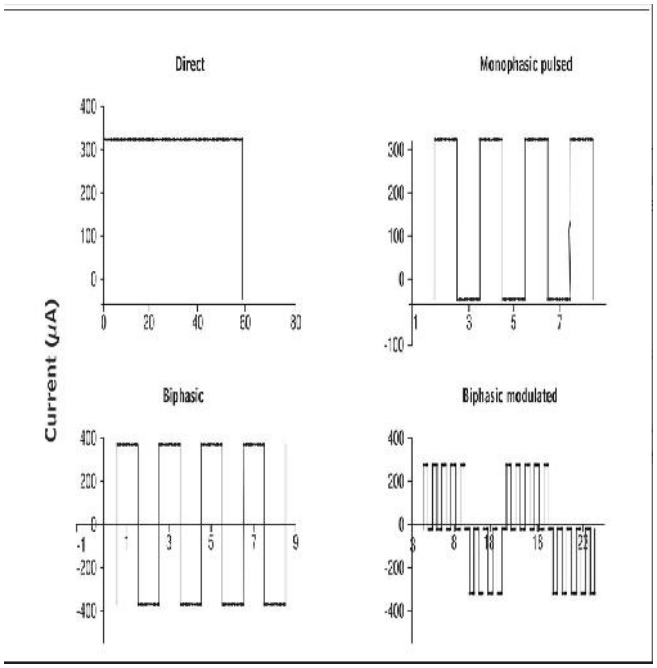
Skin pharmacokinetics is very difficult and complex to predict. Some drugs rapidly cleared from the dermal it's depending on the local blood flow and concentration of the skin and its depends on the property of the molecule. This method is used for both systemic and local effect. Invitro study performed by Franz cells (or) horizontal cells which allow the membrane permeation to the investigate. Invivo study drug administration topically measure of concentration in the blood (or)urine is used to asses systemic bioavailability (or)toxicity.

CURRENT USED FOR THE TREATMENT

There are two types of current are used for the treatment;

1. Direct current
2. Pulsedcurrent





DIRECT CURRENT

Direct current (DC) is an electric current that is one-directional that the flow of current in the same direction. Negative to negative and positive to positive. The continuous flow of charged particle lasting for 1 second (or) more. The twoelectrode anode(+) and cathode(-) when the current moves in same direction, the charge build-up causing a stronger chemical effect on skin tissue. DC iontophoresis is considered as more effective and quick therapeutic results.

PULSED CURRENT

Pulsed current (PC) is also one directional current but the intensity changes in value over the course of treatment. It consider as more comfortable because user can be tolerate higher current. The flow of charge stop for less then 1 second and it occurs individually (or) series. PC iontophoresis is not as effective to patient because it only receive a small portion of treatment at the maximum value.

CURRENT STRENGTH:

Current strength is a linear relationship between the observed fluxes of a 1 sq.cm, consideration of patient comfort the current is limited to 1milliampere (Ma) increasing current results in risk of non-specific vascular reaction(vasodilation). The current should not be applied for more than 3mins because it gives local skin irritation and burns. At a current 0.4-0.5 Ma sq.cm the vascular reaction is initiated after few seconds of iontophoresis with deionized (or) tap water. This effect is due to the current density being high enough to stimulate the sensory nerve ending and leads to release of substance P from C fiber.

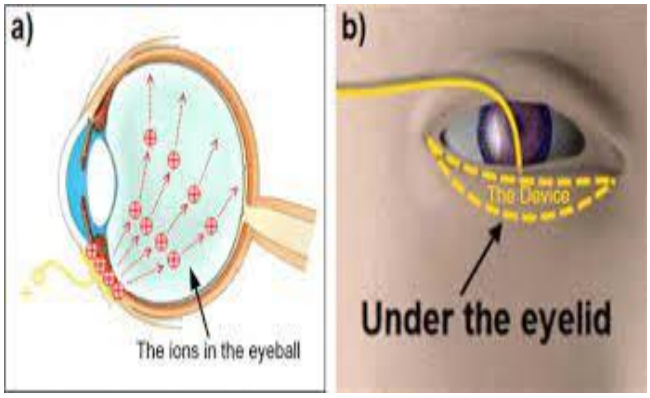
CONTRAINDICATION

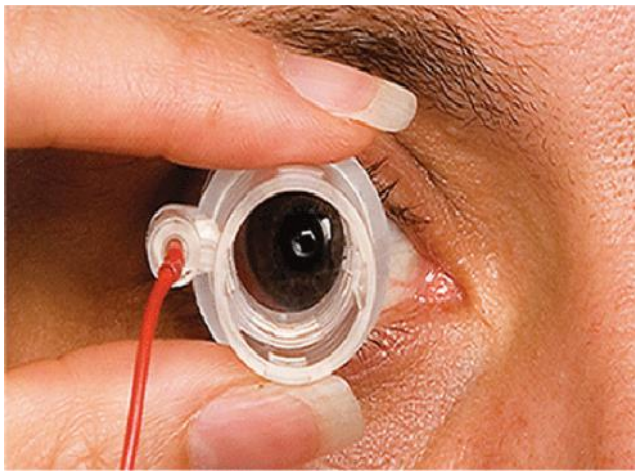
- Patients with the priorhistory of hypersensitivity should avoid iontophoresis.
- Also avoid this procedure near cardiac pacemaker, superficial blood vessel during cardiac arrhythmia.
- There is no any investigation of iontophoresis used in pregnancy time and therefore, it is either should not be used (or) used in the extreme conditions like pregnant have a pace maker, have a joint replacement(sustained metal implant in the current path way) have a cardiac condition(or) epilepsy

OCULAR IONTOPHORESIS

In ocular therapies, drug delivery to the inner eye still poses a serious challenge toreach the fluids within the eyes.Topical treatment is ineffective. whereas systemic restrictions to the drug delivery due, to barriers present between the blood and the retinal fluid. The sub-conjuctival and retrobulbar injections do not result in sufficient drug delivery levels, whereas intravitreal or intracameral delivery directly leads to difficulties with the eyes.The eye Iontophoresis may be a remedy for such issues. The use of ocular iontophoresis was initially studied in By German investigator Wirtz in 1908, transmitted a current of electricity through cotton swabs soaked in electrolyte placed over the world to cure corneal episcleritis, keratitis, and ulcers 6 essentially, in a donor electrode is used in ocular iontophoresis. When another electrode is being inserted in the eye positioned on the body's surface to finish the treatment. This technic is relatively easy and more convenient method safe and give higher concentration of drug on specific ocular site. However, it cause irritation to patient and it’s not harmful to eye.

Iontophoresis has been studied for the delivery of various drugs into the eye. This method can deliver therapeutic concentrations of various ophthalmic drugs, such as antibiotics, corticoids, peptides, and proteinsto both halves of the eye. The drugs are capable of be delivered via transscleral (or)transcorneal iontophoresis. Transscleral Iontophoresis has more advantages compared to transcorneal administration. Because of the larger surface area of the scleral.





The EyeGate II iontophoresis system uses electrochemical repulsion to drive charged drug molecules into the eye.

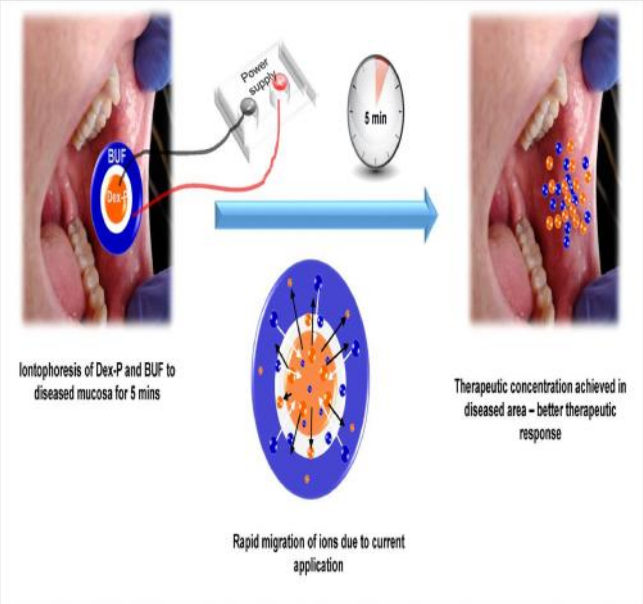
TRANSDERMAL IONTOPHORESIS

Transdermal iontophoresis is the application of an electrical potential across the skin to maintain a constant electric current and improve the delivery of ionised and unionised molecule. It has several advantages, including easier therapy termination, better drug delivery control, improved delivery of polar drugs as well as high molecular weight substances, the benefits of bypassing hepatic metabolism and significantly reducing inter and intra-individual variability, and the ability to be used for systemic or local drug delivery.

BUCCAL IONTOPHORESIS

The purpose of this study was to look the effect of iontophoresis on the mucosal penetration of prilocaine hydrochloride (PCL) and lidocaine hydrochloride (LCL), two commonly used anaesthetic. When combined in the same formulation, they are used as local anaesthetics in dentistry. Semisolid hydrogels containing these drugs alone or in combination were developed. At two different pH (7.0 and

5.8) and demonstrated adequate mechanical and electrical propertiesBuccal administration requires mucoadhesive properties. The distribution coefficients between the mucosa and the formulations (Dm/f) and mucosa permeation in vitro Both PCL and LCL retention. iontophoresis increased the rate of PCL permeation.

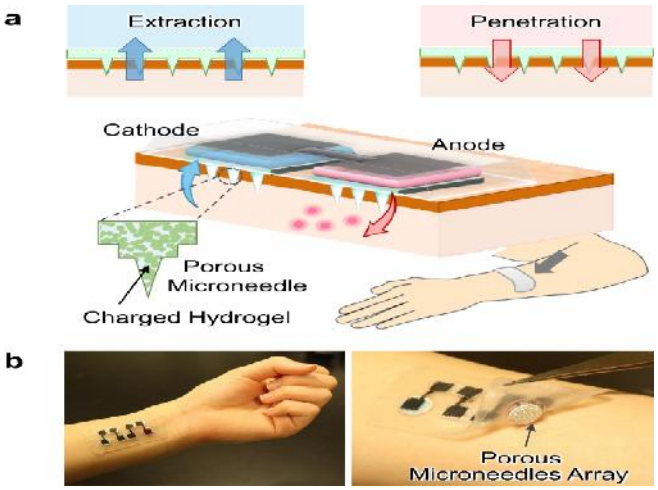


TRANSNASAL IONTOPHORESIS

Transnasal drug delivery allows for direct access to the brain by overstepping the blood-brain barrier. This method relied on a relatively passive process that relied on drug instillation high into the nasal cavity, formulation, and gravity for drug delivery. The current study looked at how an electrical field (transnasal iontophoresis) could be used to actively drive a charged peptide, octreotide, into the rabbit brain. On both sides of nasal cavity a simple electrode with an octreotide reservoir was placed deep into the cavity. A return electrode was attached to the back of the head and a current strength of 3.0 mA was applied for 60 minutes.The experiments resulted to elevated levels of octreotide in brain, with varying results due to electrode and tissue damage during insertion of electrode.

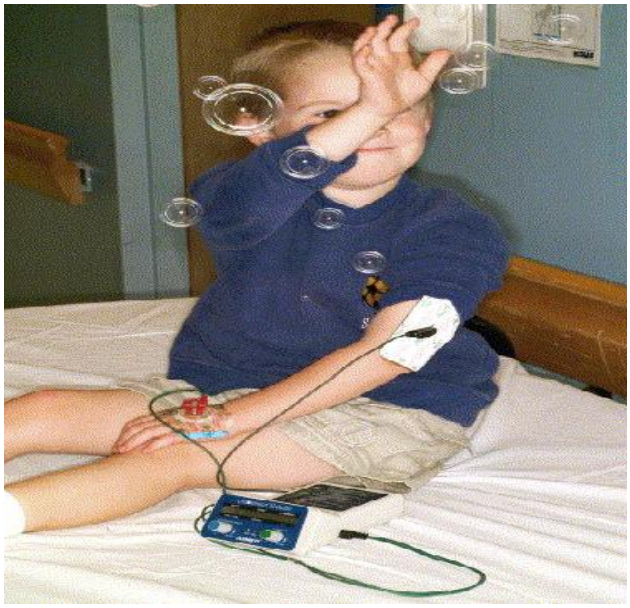
MICRONEEDLE IONTOPHORESIS

Due to low permeation rates transdsermal insulin delivery remains a significant challenge. We describe unilamellar nanovesicles with a membrane thickness of 3-5 nm and an encapsulation efficiency of 89.05 +_ 0.91% that can be driven by iontophoresis to improve transdermal insulin delivery via microneedle-induced skin microchannels. Insulin permeation rates from positive nanovesicles driven by iontophoresis through skins with microneedle-induced microchannels were 713.3 times higher than passive diffusion. In vivo studies show that the blood glucose levels of diabetic rats induced by positive nanovesicles driven by iontophoresis through skins with microneedle-induced microchannels are 33.3% and 28.3% of the initial levels at 4 and 6 h, which are comparable to those induced by subcutaneous insulin injection.This approach offers a new strategy for non-invasive delivery of peptides with large molecular weight using nanovesicle.



CHILDREN

This iontophoresis system appears to offer a safe way to administer lidocaine topical anaesthetic to children without having worry about systemic absorption of the medicament. The results of numerous research on the stratum corneum's ultrastructure following iontophoresis have been published. Increased current densities, on the other hand, led to a number of alterations in the lipid organisation and suggested that the electric field can disturb the intercellular lamellar ordering in the stratum corneum. Low current densities had no effect on the structure of the stratum corneum.In vitro applications of a 0.5 mA/cm2 current for 9 hours and in vivo applications of a 0.25 mA/cm2 current for 3 hours did not significantly alter skin architecture, according to *Fatouros*. Iontophoresis is a safe procedure as far as structural changes in the stratum corneum are concerned. Iontophoresis has been shown to only induce very mild skin erythema and edema.



CLINICAL APPLICATIONS

SKIN CANCER

Skin cancer radiotherapy treatment is complications. Iontophoresis could be used to treat such complications. Chang et al88 studied cisplatin iontophoresis in the treatment of basal and squamous cell carcinomas of the skin and concluded that small lesions would respond best to iontophoresis. Vinblastine subcutaneous administration causes necrosis and phlebitis and is thus not advised. Furthermore, intralesional administration is painful and reduces patient compliance. Smith et al. 89 investigated the use of vinblastine sulphate iontophoresis to treat cutaneous lesions associated with afflicted with Kaposi sarcoma All of the patients' lesions had cleared significantly.

HYPERHIDROSIS

Hyperhidrosis or excessive sweating is most commonly confined to the palms and soles. This frequently begins at puberty and has no definite aetiology. The disease has an unpredictable course and may persist for several years. It is often a cause of social embarrassment and a disability at work, play or studies.It can be cured by iontophoresis treatment by applying electric current on palm of hands.The exact mechanism by which iontophoresis reduces sweating is unknown. The Electric gradient theory proposed that iontophoresis disrupted the normal movement of sweat along the sweat duct, which flows due to an ionic gradient. The second "Plug theory" proposes that sweating is inhibited by mechanical sweat blockage at the stratum corneum level, with the depth and severity of obstruction being dose related. However, both theories have fallacies and no clear conclusion**.**

II. CONCLUSION

Iontophoresis, in comparison to oral route, definitely provides benefits of improved efficacy and/or reduces adverse effect. Transdermal Technology ensures that up to 95% of a supplement is delivered to the cells where it is required. Transdermal delivery has been termed "the delivery system of the future" by doctors all over the world as a fantastic alternative to pills and tablets. The iontophoretic delivery of macromolecules enables a strategy for noninvasive transdermal delivery of peptide-based pharmaceuticals, and it contributes to future advances in recombinant DNA technology. Although iontophoresis appears to be more effective than other techniques, more research and careful application of technology with microelectronic devices are required before it can be used commercially. As a result, iontophoresis could be "a potential emergence to transdermal drug delivery.

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