

Battery Operated Iontophoresis for Hyperhidrosis and Cardiovascular Drug Delivery System

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Abstract: Excessive amount of sweat by sweat glands is known as Hyperhidrosis. It is categorized into localized and general forms. Initially, iontophoresis uses Direct Current(DC) in the treatment of palmoplantar hyperhidrosis. In the treatment of hyperhidrosis, antichlorogenic drugs are used. The DC used may results in side effects such as pain and burns. In order to reduce side effects, iontophoresis with Alternating Current(AC) was proposed and experiment was performed in patients efficiently. We have proved that it reduces side effects during iontophoresis using AC. In addition, we combined palmoplantar hyperhidrosis with cardiovascular drug delivery system. In this proposed work drugs are penetrated adequately through the skin. Thus by utilizing small amount of current, the cardiovascular drugs are penetrated and helps in delivery of protein and low molecular weight drugs. To reduce shocking effects, the battery operated iontophoresis can be used in future. So, it will be an efficient and highly safest method.

Keywords: Antichlorogenic drugs, Cardiovascular drugs, Battery, Hyperhidrosis.

1. Introduction

Iontophoresis is a process of transdermal drug delivery. Here a basic iontophoresis will be connected to a patient plate where the plates will be placed on a tube. Here the alternative current is given to the patient to treat the hyperhidrosis. Sweat is the production of fluids secreted by sweat glands. And it is also known as perspiration. There are two types of sweat glands they are exocrine gland and Apocrine glands. The maximum sweat rate per day is 10 to 4 litres. And per hour 2 to 4 litres sweat leads to body odour due to the bacterias on the skin. Excessive sweat may produce crack or fungal development on a particular area. And these problems may cause irritation or discomfortness, rashes on the skin [5]. The rashes causes skin allergy.

A sweat caused during the night time is known as nocturnal hyperhidrosis. Hyperhidrosis is due to the over activeness of the body mechanism and 4 to 5 times the sweat than normal. Sweat is usually controlled by the center in the preoptic anterior region of brain hyperhidrosis. Usually sweat is a combination of salt and water. The salts in the sweat include Sodium (Na), minerals (Na, K, Ca, Mg), lactic acid and urea. 4.8% of the

diseases caused due to hyperhidrosis are, heart diseases, Menopause, Spinal cord injuries, lung diseases, stroke, adrenal gland disorders. In case if the sweat is not executed by the skin properly may also cause various diseases like rise in temperature. And it also includes cancer because if there is not proper excretion of sweat stops in the body and may develop into sebaceous cyst and it gets transformed into cancer. Over excretion of sweat from our body is also dangerous to health. An iontophoretic device needs an energy source in addition to the conventional drug delivery [2]. Here a ionto patch is used for delivering the cardiovascular drugs by means of penetrating into the skin .By doing so, we can able to prevent the tissue damage and pain caused during the direct Injection method. In cardiovascular drug delivery an iontopatch is used to deliver drug by giving an alternative current. By which the current penetrates into the skin and reaches the organ instantly.

Some of the most common cardiovascular diseases are coronary artery diseases which includes damage of the heart. In the major blood vessels of the heart and high blood pressure which is a condition in which the force of the blood against the artery walls is too high. Stroke is the damage to the brain to the interruption of its blood supply. The iontophoresis is used in musculoskeletal inflammatory conditions. In this treatment, 4 milligrams per millimetre of dexamethane sodium phosphate combined with 2 cubic centimetres of 4% xyclocine. It was conclude that iontophoresis is an effective mode of delivering ionized anti inflammatory drugs to inflamed tissues.

2. Related works

Iontophoresis works on the principle of electrostatic repulsion of charges. The charged drug gets repelled when the electric current that creates a gradient potential across the tissue of the skin [1]. The palmoplantar hyperhidrosis is treated by the tap water iontophoresis. The ions which enter into the tissues under the stimulation of an electrode, the recombination of the substance is achieved under the active electrode. Transport of charged molecules by the electrolyte solution, the molecules to be delivered using an appropriate electrode polarity.

Higher voltage is used in the electroporation technique where

the range varies from 100-1000 V. The non-invasive monitoring of the level of glucose for diabetics is done by the reverse iontophoresis. The patch type iontophoresis without any current controller uses DC battery. For the ease of operation, the non-invasive sampling techniques is used. The reverse iontophoresis technique is used to monitor the blood glucose level. Adenosine and aminodarone are the drug used for the cardiac arrest. The promising drug delivery system for the charged molecules is done by the ocular iontophoresis. The ocular iontophoretic device is placed under the eyelid during the ion penetration. The ions delivers through a small area of the eyeball. Iontophoresis treatment using electromotive action has the ability to carry different eye tissues. The penetration of the transdermal drug by the application of electric current is done by cataphoresis or electrophoresis [3].

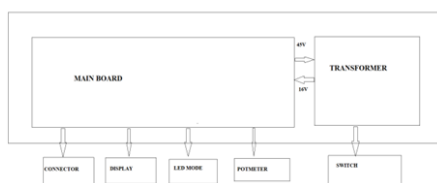


Fig. 1. Block diagram

To improve the ocular bio availability of drug and to release the drug to the anterior and posterior chamber of the eye, the ophthalmic drug delivery system is used. For the use of oxygen delivery, the therapeutic agents with the ultra sound and the micro bubbles were used.

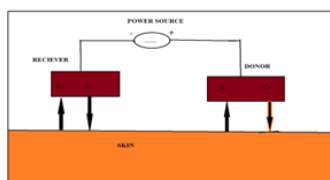


Fig. 2. Illustration of iontophoresis

3. Proposed works

The iontophoresis is initially operated in direct current. It causes electric shock if excessive current density occurs and result in pain. The high current density generates extreme pH, resulting in chemical burn. Ionic form of drug in sufficient concentration for drug delivery is necessary. Using alternating current, the pH can be maintained properly. Ionic form of drug in sufficient concentration is possible. The physical propulsion is possible. The cardiovascular drug delivery iontophoresis is added. The requirement of steady state concentration throughout the treatment is made possible. It is also employed in left ventricular failure and myocardial infraction [4]. Reproducibility of drug flux in passive delivery is established. It results in increase of permeability of skin. It is non-invasive method of propelling high concentration of charged substance repulsive electromotive force. It is painless and sterties. It

minimizes the trauma and risks of infections. Medications delivered directly to the treatment site. It provides option for patients unable to receive injections. Physical propulsion of drug molecules into the deep layers of skin without to be safer alternative. Positive ion will be delivered from the positive electrode and negative ion will be delivered from negative electrode [5]. Electrical energy involves in the movement of ions across stratum corneum. It is done with the help of electrostatic repulsion. For safety purpose, the device is operated in battery. The battery must be rechargeable. The battery used are lithium rechargeable batteries and they are ultra-cell. The battery is usually DC. It is converted into AC using inverted with a range of 12 V to 220V. It is connected to step down transformer.

4. Design methodology

- *DC battery*: The 12V DC battery is used in iontophoresis to make it as a battery operated device. Two parallel batteries are used to make a battery operated device. Full wave rectifier: It is a combination of diodes and capacitor. It converts AC to DC for supplying current to display and LED boards. Voltage regulator: It is used to maintain a constant voltage levels. It includes negative feedback. It regulates one or more DC voltages. It is used for amplification.
- *Counter*: It stores the number of times a particular process to clock signal. It is used for reverse iontophoresis.
- *Transistors and capacitors*: It is used for switching and amplifying the current. The capacitor holds the charge. It is used for power consumption and voltage regulation.
- *Relay*: It allows a minimum amount of current to patients in output. It is used for patient's protection.
- *Inverter*: For the conversion of DC to AC the inverter is used. It gets converted to 12 V DC to 220 V AC.
- *Transformer*: The 220V supply is step down into 45/12 V AC.

5. Challenges in iontophoresis

Factors affecting iontophoretic delivery system are classified into two types and they are operational factors and biological factors. In operational factor there are three sub divisions and they are composition of formulation, physico chemical properties of drug candidate and experimental conditions. The explanation for all the three sub divisions are discussed below: The composition of formulation comprises of concentration of drug solution, pH of donor solution, ionic strength and presence of co-ions. Then the second sub division is physic chemical properties of the drug candidate in that molecular size, charge, polarity, molecular weight, salt form of drug. An in experimental conditions, there will be current density, current

profile, duration of treatment, electrode material, polarity of electrode and current-continuous vs pulse mode are considered.

6. Conclusion

The basic iontophoretic system was established, it has the potential to provide relief to the patients by antichlorogenic drugs. This system promised to overcome the limitations of DC iontophoresis. Electrotherapy stimulation is achieved. It has found in many applications such as diabetics, ocular, DNA etc. It is a promising technology which targets skin surface to create pores for drug administration. This technique is far better than previous iontophoresis techniques. It has reduced hazardous side effects. It provides patient care and on demand delivery without adverse effects. Current leakage must be controlled. Relays were used in circuits rather than analog switches.

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