

# A Review on Implantable Drug Delivery System

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## ABSTRACT

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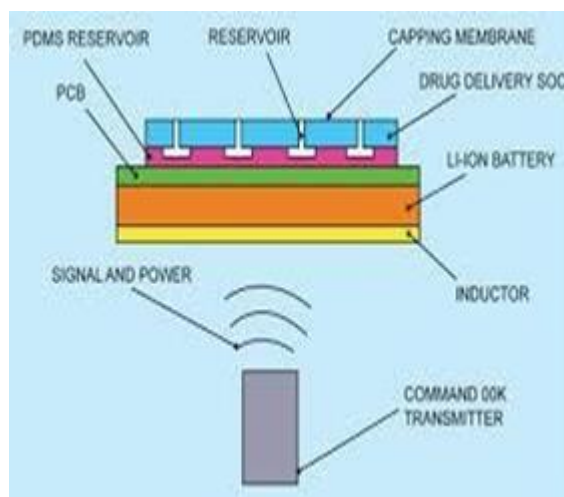
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Recently Implantable drug delivery is one of the technology sector that often overlooked in the development of new drug delivery by the formulation, research & development in any pharmaceuticals. Implant drug delivery technologies have ability to reduce the frequency of patient drive dosing & to deliver the compound in targeted manner.(3) To avoid problems incurred through the utilization of the oral route of drug administration, new dosage forms containing the drug were introduce. Drug delivery system were developed to optimize the therapeutic properties of drug product & render them more safe, effective,& reliable. Implantable drug delivery system are an example of such system available for therapeutic use. The study currently available implantable drug delivery system is the main focus of the review. some of the most recently discovered implants are in the early developmental stages & more rigorous clinical testing is required prior to their use in standard practice.

**Keywords :** Drug delivery, formulation , clinical testing, implant

## I. INTRODUCTION

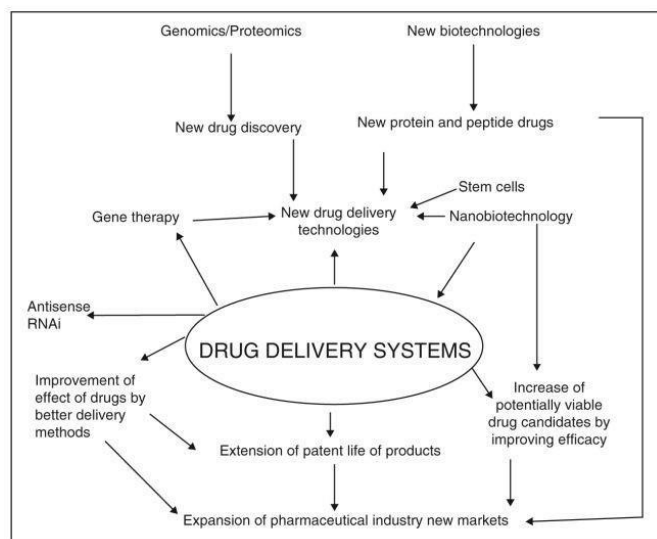
The concept of implantable drug delivery system in modern medicine may be stress to deans by & parks who, in 1938, subcutaneously implanted compress pellets are crystalline estrogen. folk man & long pioneered implantable formulation with drug release pets controlled by a polymeric membrane in the 1960s. They investigated the use of silicon rubber form long term drug delivery at a systemic level. from this early beginning, the potential of this mode of delivery in a overcoming problems associated with oral administration, such as drug bioavailability, stability, toxicity & duration of release, was recognized.(4)



Implant delivery systems have been subsequently designed to reduce the frequently of dosing, prolong duration of action, increased the patient compliance,

and reduce the systematic side effects. implantable drug delivery system are very attractive for a number of classes of drug, particularly those that cannot be delivered via the oral route, are irregularly absorbed via the gastrointestinal tract, or that benefit from site specific dosing. example include steroids, chemotherapeutic, antibiotic, analgesic, and contraceptives & biologics such as insulin or heparin. Implant morphology is typically cylindrical with monolithic device at the millimeter or centimeter scale being most commonly employ in addition to subcutaneous implantation, various other body regions have also successfully served as implantation sites, particularly for delivery to localized tissue such as intravaginal, intravascular, intraocular, intrathecal, intracranial & peritoneal perhaps the most common clinical application to data target cardiac or carotid arteries as site for drug -eluting stents (DES), delivering therapy to intravascular locations.

## II. Protocol of drug delivery system



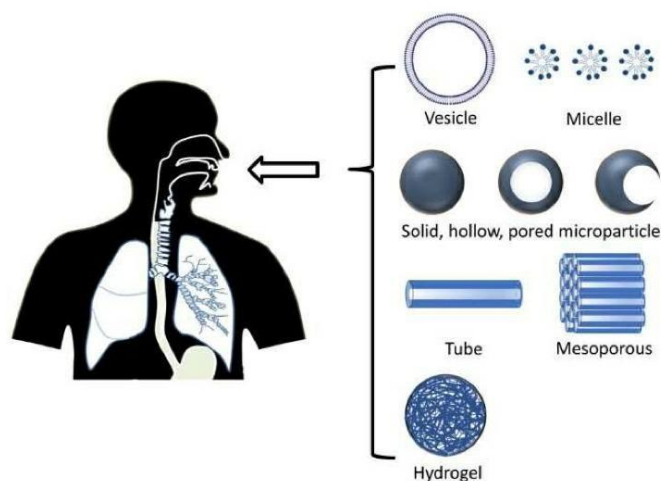
Classification :-

### 1. Oral drug delivery system:-

Orally administered drug must be protected against denaturation in the gastrointestinal tract & should be capable of absorption across the wall of the stomach or the intestine. The rate of the drug absorption &

elimination should ensure the blood levels within the therapeutic range oral controlled release dosage forms can provide efficacy for about 24 hours. The main drawback of oral dosage forms is the long transit time of approximately 12 hours through the gastrointestinal tract (GIT). If drug cannot be administered orally, A parenteral route or implantable route of delivery is an alternative.

### Oral drug delivery system



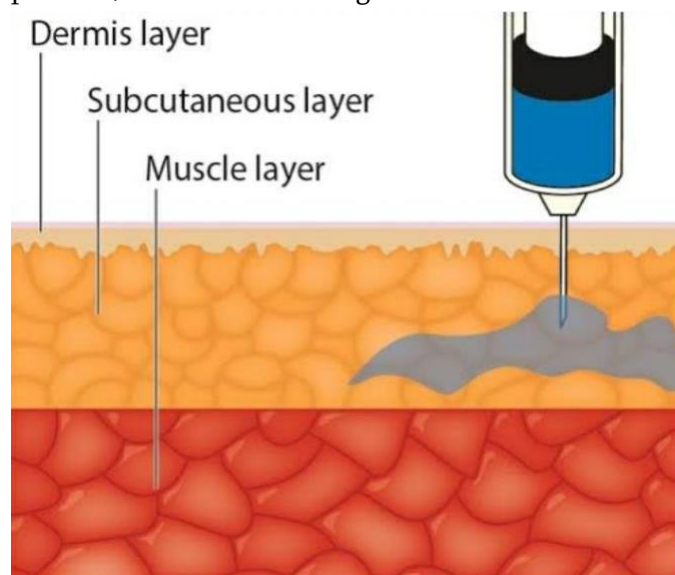
### 2. Intravenous drug delivery system:-

Devoid of aforementioned limitations associated with o IV, drug administration. Implant is a single unit drug that has been designed to deliver a drug moiety at a therapeutically desired rate over a prolonged period of time. Intravenous (IV) delivery is an injection or infusion method of drug administration, which means drugs are sent directly into your vein using a needle or tube. The term "intravenous" actually refers to "into the vein".



### 3. Subcutaneous drug delivery system:-

Subcutaneously or under the skin & the human skin & the human skin is the outer covering of the body. In human, it is the largest organ the integumentary system. The integumentary system helps to maintain a constant body temperature, protects the body & provides sensory information about the surrounding environment. It consists of two main parts: epidermis & dermis. Epidermis is the outermost layer of skin. It is composed of keratinized stratified squamous epithelium. Dermis is the second deeper layer of the skin. It is composed of mainly connective tissue. The function of subcutaneously is the sensation that arises in the skin including touch, pressure, vibration & tickling.



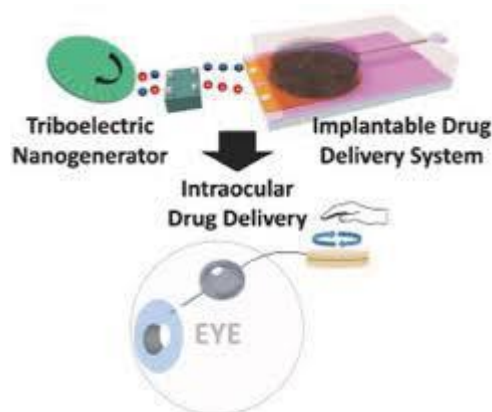
#### ADVANTAGE OF IMPLANTABLE DRUG DELIVERY SYSTEM :-

- 1) Improved efficiency.
- 2) very effective.
- 3) Small dose is sufficient to elicit the action. for e.g progesterone 2-8mg.
- 4) Provide linear delivery for long periods of time, from a few weeks to many months.
- 5) Plasma drug levels are continuously maintained in a therapeutically desirable range.
- 6) Patient compliance may be improved.
- 7) On spot delivery.

8) CONVENIENCE - Effective concentration of drug in the blood can be maintained for long period of time by techniques such as continuous intravenous infusion or repeated injections.

9) IMPROVED DRUG DELIVERY - The drug is distributed locally or in systematic circulation with least interference by metabolic or biological barriers.

10) FLEXIBILITY - In the choice of material, method of MFG degree of drug loading, drug release rate etc. considerable flexibility is possible.



#### DISADVANTAGE OF IMPLANTABLE DRUG DELIVERY SYSTEM :-

1) INVASIVE - To initiate therapy either a minor or a major surgical procedure is required to initiate therapy. appropriate surgical personnel is required for this, & may be time consuming & traumatic. This causes some scar formation at the site of implantation & surgery related complications in a very small number of patients. Uncomfortable feeling for the patient wearing the device.

2) DANGER OF DEVICE FAILURE - There is no associated danger with these treatments that the device may for some reasons fail to work. These again require surgical involvement to correct.

3) TERMINATION - Osmotic pumps & non biodegradable polymeric implants also are surgically removed at the end of therapy.

4) LIMITED TO POTENT DRUGS - In order to minimize patients' discomfort the size of an implant is usually kept small therefore most implants have a limited loading capacity so that frequently only

somewhat potent medicines such as hormones may be appropriate delivery by implantable device.

5) **BIOCOMPATIBILITY ISSUES** - Concerns over body reaction to a foreign substance often increase the issues of biocompatibility & safety of an implant.

6) **POSSIBILITY OF ADVERSE REACTION** - A high concentration of the drug delivery by an implantable device at the implantation site may produce adverse reaction.

7) **COMMERCIAL** - An enormous amount of R&D investment, effort & time is required in the development and an **IDDS** if a new material is purpose to formulated an implant its compatibility.

### III. LIMITATION OF THE IMPLANTABLE DRUG DELIVERY SYSTEM

Possible toxicity

Need for microsurgery to implant the system

Possible pain

Difficulty in shutting of release if necessary

**DRUG RELEASE DEPENDS UPON :-**

Diffusion of drug through the polymer.

Non biodegradable polymers use to prepared dosage form, for e.g, polymethylsiloxane.

Dissolution of the drug, & usage of biodegradable polymer, for e.g polylactic acid & polyglycolic acid.

**IDEAL PROPERTIES OF IMPLANTABLE DRUG DELIVERY SYSTEM :-**

Environmental stable.

Biocompatible.

Sterile.

Biostable.

Improve patient compliance by reducing the frequency of drug administration over the entire period of treatment.

Release the drug in rate controlled manner that leads to enhanced effectiveness & reduction in side effects.

\*Readily retrievable by medical personnel to terminate medication.

Easy to manufacture & relatively inexpensive.

**EVALUATION PARAMETERS FOR IMPLANTES :-**

Uniformity of weight

Diameter of implantes

Procedure of drug content uniformity test

% Swelling index

Drug polymer interaction study

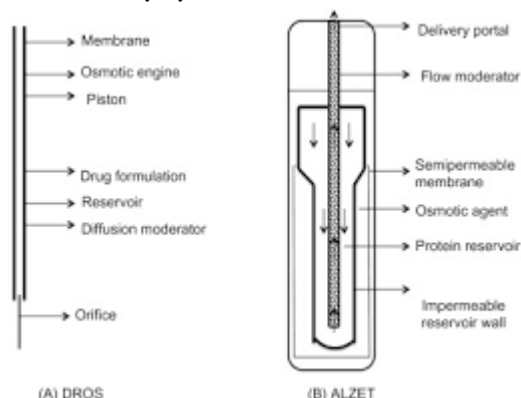
Stability study

In vitro dissolution studies

Non-degradable & biodegradable implant systems :-

Non degradable systems :-

There are several type of nondegradable implantable drug delivery systems available on the marketplace today but the nondegradable matrix systems & reservoir system are the two most common forms. In the polymeric matrix systems the drug is dispersed homogenously inside the matrix material slow diffusion of the drug through the polymeric matrix material provides sustained release of the drug from the delivery system.



**Biodegradable systems :-**

Biodegradable systems have gained much popularity over nondegradable delivery system. The major advantages of biodegradable system include the fact that the inert polymer used for the fabrication of the delivery system are eventually absorbed or excreted

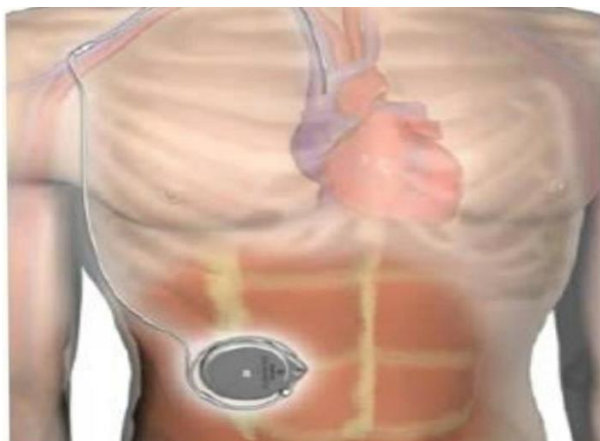


by the body. This alleviates the need for surgical removal of the implant after the conclusion of therapy thereby increasing patient acceptance & compliance.

APPROCHES :-

#### IMPLANTABLE PUMP SYSTEM :

Many different drugs require external control of delivery rate & volume. such control cannot be obtained when using biodegradable or non-biodegradable delivery systems with the exception of the magnetic-type delivery systems. pump systems have been used to provide the control needed in these situation. recently, due to the availability of advanced micro technology, it has been possible to create pump systems small enough to implant, subcutaneously, for drug delivery. this allows the patient to maintain the control of drug release without the need for an external pump system. in recent advanced, insulin implantable pump systems have been invented & used for the control of type- 1 diabetes



#### INFUSION PUMP :-

Infusion pumps are implantable mechanical systems that utilize a fluorocarbon propellant to administer the drug. in vivo such pumps were initially developed for the administration of insulin to diabetics patient. Infusaid was one of the first commercially available pumps for this use.



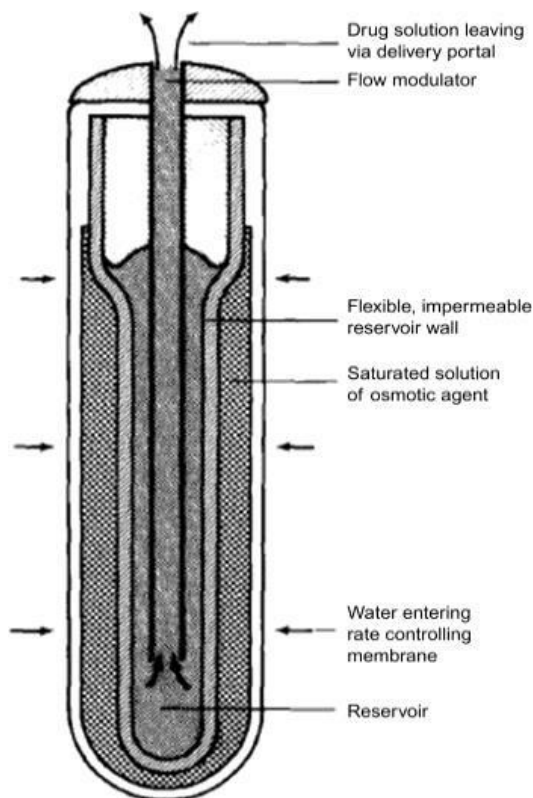
#### PERISTALTIC PUMP :-

Peristaltic pump consist of rotary solenoid driven systems that run via an external power source which is usually a battery. Peristaltic systems like the infusion p[ump system are filled through a silicon rubber septum & can be used for several year depending on the life span. The advantage of this type of system is that the rate of drug administration can be controlled by an external remote control system.



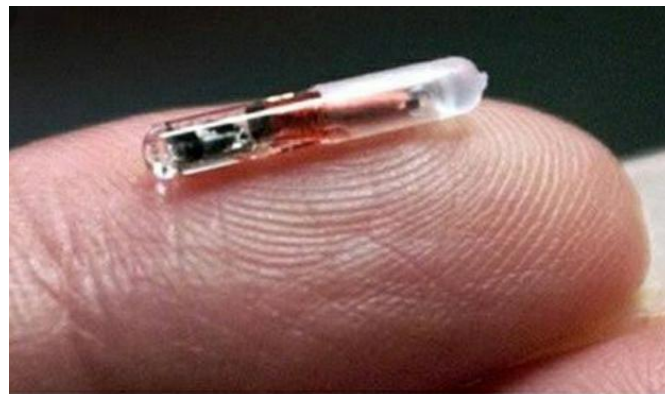
#### OSMOTIC PUMPS :-

Osmotic pumps have proven to be the most popular type of implantable drug delivery system. The osmotic pump also known or oros or the gastrointestinal therapeutic system, was first described by Theeuwes & Yum & released for use by alza corporation. this pump consist of a drug reservoir surrounded by a semi permeable membrane. The surrounded membrane allows a steady influx of water & biological fluid into the reservoir through the process of osmosis.



#### IV. IMPLANTABLE RODS

Implantable rods are prepared with the help of different type of biodegradable & non biodegradable polymers the implantable rod release the drug in a control manner.



#### V. CONCLUSION

#### POSITIVE DISPLACEMENT PUMPS :-

Positive displacement pumps have been developed to provide continual insulin delivery in diabetic patients. Most of these systems utilized piezoelectric disk bender affixed to flexible tubing. Such pumps are made by first exposing the disks to certain voltages so that they form a spherical surface. The bellow type system is then connected to a drug reservoir via a three-way solenoid driven valve in the pump open or close depending on the direction of pulse.



A research work & novel technique is currently being conducted in the area of implantable drug delivery system. However, much work is still needed in the areas of biodegradable & biocompatible materials, the kinetic of drug release, & further development of current systems before many of these formulations can be used. In the future, researchers remain hopeful that many of these systems can be developed with ideal zero-order release kinetic profiles *in vivo*, over a long period of time, allowing for extended use in chronically ill patients.

#### VI. REFERENCES

- [1]. Mohammad zaki AJ, Satish k. Patil, Dheeraj T. Baviskar, Dinesh k. Jain Department of pharmaceutical, Institute of pharmaceuticals education, Bordi, Shirpur, Dhule (MS) - 425428
- [2]. Rajor N., Patel M, Bhaskar VH Department of Pharmaceutics, M. P. Patel College of Pharmacy, Kheda, Nootan pharmacy college, S.P. Sankar Vidhyadhan, Gujarat India.

- [3]. Himanshu K. Solanki, Jalaram H.Thakkar , Girish K.Jani Deparment of Pharmaceutics, SSR college of pharmacy, Sayli- silvassa Road, Sayli, UT of D & NH-396230
- [4]. Sindhu v. Bhavya s, Suresh Kumar P, Jeyabaskaran M, Praveenkumar T, SD. Yasmin Sulthana department of Pharmaceutics, Browns collage of pharmacy, Khammam, Telangana, India.
- [5]. Deepa K. Ingawale , Satish K. Mandlik - Nirali Prakashan of Human Anatomy & Physiology -1
- [6]. Anoop Kumar, & Jonathan Pillai - Implantable Drug Delivery System An Overview.
- [7]. A. R. & G. H. Patel Institute of Pharmacy Slide Shear Paresh K Bharodiya & Dr. Ajay B. Solanki Department of Pharmaceutics.
- [8]. ChienYie W; Novel Drug Delivery Systems,Marcel Dekker Inc.;1992, 2nd Ed, 269.
- [9]. Vyas SP and KharRoop K; Controlled Drug Delivery Concepts and Advances, VallabhPrakashan (Delhi);2008, 1st Ed, 450-459.

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