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A Review on Implantable Drug Delivery System

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Abstract: *Implantable drug delivery system are being developed to release a drug to the bloodstream continuously as well as free patient from being hospitalized to receive intravenous infusion or frequent injectuion. one technique is implantation of a pellet in the subcutaneous tissue so the pellet may be release by erosion. Drug are also diffused through silicon rubber capsule but only polyacrylamide is able to release large molecule. Contraceptive ring containing large molecules.*

Keywords: Implants, Polymers in implants, Approaches, Classification of implants, Methods, Release mechanism, Evaluation of Implant

I. INTRODUCTION

Most of the drugs about 90% are given through the oral route of drug administration but the oral route of drug administration drug delivery of the drugs the unpredictable plasma concentration in the human body, some drugs also get degraded in the acidic pH of the stomach, some drugs irritate of the gastrointestinal tract and these drugs also show first order and also the first-pass metabolism of the drug takes place that leads to the reduce drug concentration in the blood Because the oral route of drug administration having disadvantages and difficulties also thus to overcome these problems like several drugs cannot be administered through the oralroute of administration it may be due to the degradation of the drug either at acidic or alkaline pH also and may also be degraded by the gastric juice or gastric enzymes [1] The design of ophthalmic drug delivery systems is a unique challenge that is restricted by the anatomical position of the eye as well as the functional physiology of the eye tissues.
body, retina, and choroid. Historically, the bulk of ophthalmic research focused on drug delivery to the The eye is a relatively isolated organ divided into an anterior and posterior segment with numerous avascular structures. In this regard,the efficacy of topical drug delivery via eye-drops is only limited to the treatment of anterior segment eye diseases.[2]

IDEAL REQUIREMENT

The ideal requirements of an implantable device are-
Exhibit zero order or modulated drug release kinetics for constant delivery rate to minimise adverse effects.

- The dosing frequency shall be minimised for enhancing patient adherence and must fully discharge the medication during duration of therapy.
- Safe, stable and effective with good mechanical strength

IMPLANTABLE POLYMERIC SYSTEM CLASSIFICATION

1. Passive Polymeric Implantable

They are simple, singular and uniform devices, mainly contains simple drug loaded in biocompatible matrix. They do not have any mobile part or technique and depend on passive diffusion for releaseof drug load.

A. Non-Biodegradable Polymeric Implant Systems

The most common commercial forms are matrix-controlled or polymeric system and membrane enclosed reservoir. Polymers like polyurethanes, polyacrylates, silicones or heteropolymers like polyethylene vinyl acetate (PEVA) are widely used. In the matrix-controlled organisation, a medicament is uniformly distributed across the base. Gradual dispersion of embedded medicament gives sustained release from delivery system.

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B. Biodegradable Polymeric Implant Systems

These systems offer advantages over non bio-degradable ones and hence are more popular. Polymeric substances such as polycaprolactone (PCL), polylactic acid (PLA), or polylactic-coglycolic acid (PLGA) are typically used for formulation[3]

Table 1: Examples of biodegradable polymer

CLASS	EXAMPLE
POLYPEPTIDES	SOYA PROTEIN,ZINC, SILK
POLYSCAEEIDES	CELLULOSE,STARCH
POLYESTER	POLYLACTIC ACID
LIPIDS	SURFACTANTS ANDWAXES

II. IMPLANT PUMP

Various drugs need exterior source to control amount and expulsion which is not achieved by biodegradable or nonbiodegradable systems except in magnetically modulated devices. The presence of sophisticated microsystems havemade easy in designing pumps as little adequate that it can be implanted hypodermally to deliver drugs.

Types of implant pumps:

1 Infusion pumps

Infusion pumps distribute the stored medicament inside the body with the help fluorinated hydrocarbon as energy source. They were earlier used in delivering insulin to diabetic

2.Osmotic pumps

Osmotic pumps are extensively prevalent of all implant types. These devices involve medication confined in a selectively permeable membrane that permits an inward movement of aqueous fluids in the device by simple osmosis. The built hydrostatic pressure forces invariable expulsion

3 Peristaltic pumps

Peristaltic pumps work by external source of power mainly by batteries and consist of cylindrically rotating apparatus. An exterior source modulates the flow of drug from it. This class of pumps are made of a rubber membrane of silicone and their duration of use

ADVANTAGES

- Targeted action.
- Helpful in delivery of drugs exhibiting short in vivo halflives.
- Improved Patient compliance.
- Reduced wastage of the drug.
- Improved efficiency

DISADVANTAGE

- Interactions between host and implant .
- Insertion of big size implants requires surgical interventions which can be unpleasant.
- Treatment cannot be abruptly stopped

BENEFITS

- Improved drug delivery
- Compliance
- Potential for controlled release

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LIMITATION

- Chances of toxicity
- Painful.
- Dose tapering is not easy in case of need.
- Need for surgery to insert the device

Other atypical implantable drug delivery systems

1 Micro-/nano- abricated implantable drug delivery system

A number of implantable drug delivery devices based on microfabrication or nano-fabrication technologies are being developed. In one system under development by MicroCHIPS, microliter-sized reservoirs are etched into a silicon wafer and filled withdrug or multiple drugs.

2. Ceramic drug delivery system

IDDS based on ceramics, also known as ceramic drug delivery systems (CDDS), are classified as atypical implantable systems . These systems have been used to deliver a variety of drugs and more than five different forms of ceramics are in use today including inorganic bone meal, aluminum calcium phosphorous oxides, hydroxyapatite, tricalcium phosphate, and ceramic–metal hybridsamic drug delivery system

3. Insertable drug delivery systems

Drug delivery systems can be placed or "inserted" into a number of body sites. Local therapy can be achieved (e.g., delivery of drugs into the eye via ocular inserts) or systemic therapy can be achieved (e.g., via release of the drug and transport across a permeable biological surface into the bloodstream). A number of sites or routes have been utilized for therapy including ocular, transurethral, vaginal and intrauterine

4. Vaginal and intrauterine

Site specific delivery to the female reproductive tract has been pursued for treatment of diseases and disorders and also for contraception.One of the first systems developed for contraception was theProgestasert® (ALZA Corporation). This T-shaped device was inserted into the uterus. The body of the system consisted of a rate-controllin cylindrical PEVA reservoir containing progesterone dispersed in siliconeoil. The arms of the "T" were also constructed of PEVA. The drug was released by diffusion over the period of one year[4]

Ocular disease

Numerous different implantable systems have been estimated to deliver sustained ocular delivery. Thesecomprise membrane-controlled devices, implantable systems and implantable silicone devices. Ocular insert (ocusert)having pilocarpine base and alginic acid in a drug reservoir surrounded by a release-rate controlling ethylene-vinyl acetate membrane is an example of the membrane-controlled system

III. CONTRACEPTION

Norplant a sub-dermal implant for long-lastingtransport of the contraceptive agent tlevonorgestrel recently been approved for marketing by the FDA.The device consists of six silicone membrane capsuleseach having about 36 mg of levonorgestrel. Thecapsules are placedsub-dermally on the inside of the upper arm or the forearm in a fan-shaped patternthrough a trocar from a single trocar entry point. Clinically, Norplant users have a net pregnancy rate ofbelow 1.5 in 100 women at 4 years. At the end of 4years 42 % of the women continued with the technique representing acceptability comparable withother techniques. Other polymer-based systems under study for contraception contain vaginal rings usually composed of silicon rubber used for 3 to 76 monthsoften with a re removal period of one week monthly to allow for menstruation; the progestasert an ethylenevinyl acetate copolymer intrauterine drugreleasing device.

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IV. CONCLUSION

Recently Implantable drug delivery is one of the technology sectors that often overlooked in the development of new drug delivery by the formulation, research and development in many pharmaceuticals. Implanted drug delivery technologies have ability to reduce the frequency of patient driven dosing and to deliver the compound in targeted manner. Many product utilizing implant delivery technologies are being utilized for many therapeutics applications such as, dental, ophthalmic, oncological disease. As with any implanted material, issues of biocompatibility need to be investigated, such as the formation of a fibrous capsule around the implant and, in the case of erosion-based devices, the possible toxicity or immunogenicity of the by-products of polymer degradation

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