WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Targeted Drug Delivery System

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ABSTRACT

Targeted drug delivery system (DDS) means to selectively transport drugs to targeted tissues, organs, and cells through a variety of drugs carrier. It is usually designed to improve the pharmacological and therapeutic properties of conventional drugs and to overcome problems such as limited solubility, drug aggregation, poor bio distribution and lack of selectivity, controlling drug release carrier and to reduce normal tissue damage. With the characteristics of nontoxic and biodegradable, it can increase the retention of drug in lesion site and the permeability, improve the concentration of the drug in lesion site. at present, there are some kinds of DDS using at test phase, such as slow controlled release drug delivery system, targeted drug delivery systems, transdermal drug delivery system, adhesion dosing system and so on. This paper makes a review for DDS.

What is Targeted Drug Delivery System?

Targeted drug delivery, sometimes called ***Smart drug delivery***, is a method of delivering medication to a patient in a manner that increases the concentration of the medication in some parts of the body relative to others. Targeted drug delivery systems have been developed to optimize regenerative techniques.(Unsoy and Gunduz, 2018)

A novel way of drug delivery to increase drug concentration at the affected region of body. Selectively and preferentially delivers the therapeutic agents to the target site, safer and more effective mode of drug delivery. Drug targeting is achieved by the means of novel carrier system or surface modification with targeting moieties (Kumari et al., 2016)

The goal of a targeted drug delivery system

1. To prolong drug release
2. Localize action
3. Protected drug interaction with the diseased tissue.

The conventional drug delivery system is the absorption of the drug across a biological membrane, whereas the targeted release system releases the drug in a dosage form

Advantages

- Reduction in the frequency of the dosages taken by the patient
- Having a more uniform effect of the drug
- Reduction of drug side-effects
- Reduced fluctuation in circulating drug levels.
- Improves the bioavailability (at target site) and therapeutic efficacy
- A smaller dose is sufficient to produce the desired therapeutic effect

Disadvantage of the system

- High cost, which makes productivity more difficult.

- Reduced ability to adjust the dosages.
- Rapid clearance of targeted systems.
- Immune reactions against intravenous administered carrier systems.
- Insufficient localization of targeted systems into tumor cels.
- Diffusion and redistribution of released drugs.
- Requires highly sophisticated technology for the formulation.
- Requires skill for manufacturing storage, administration.
- Drug deposition at the target site may produce toxicity symptoms.

Ideal Properties of Targeted Drug Delivery System

- Chemically inert and non-immunogenic.
- Physically and chemically stable.
- Specifically deliver the drug to the targeted site.
- Controlled release at predetermine rate.
- Biodegradable and biocompatible.
- The formulation should be easy, cost effective and reproducible.
- Encapsulation with Nano carrier should not affect the therapeutic efficacy of drug.

Challenges of Targeted Drug Delivery

- On Sometimes the drug-carrier system induces immune reactions
- The Insufficient localize action on targeted system.
- The preparation of targeted system requires more sophisticated
- Well skilled professionals are suitable for development Of TDDS.

Targeted drug delivery systems

It has been developed to optimize regenerative techniques. The system is based on a method that delivers a certain amount of a therapeutic agent for a prolonged period of time to a targeted diseased area within the body. This helps maintain the required plasma and tissue drug levels in the body, thereby preventing any damage to the healthy tissue via the drug. The drug delivery system is highlyintegrated and requires various disciplines, such as chemists, biologists, and engineers, to join forces to optimize this system.

Targeting Methods/ Drug Targeting Strategies

- **Passive Targeting**
- **Inverse Targeting**
- **Active Targeting**
- **Dual Targeting**

Fig. 1 Targeting strategies

This ability for nanoparticles to concentrate in areas of solely diseased tissue is accomplished through either one or both means of targeting: passive or active.

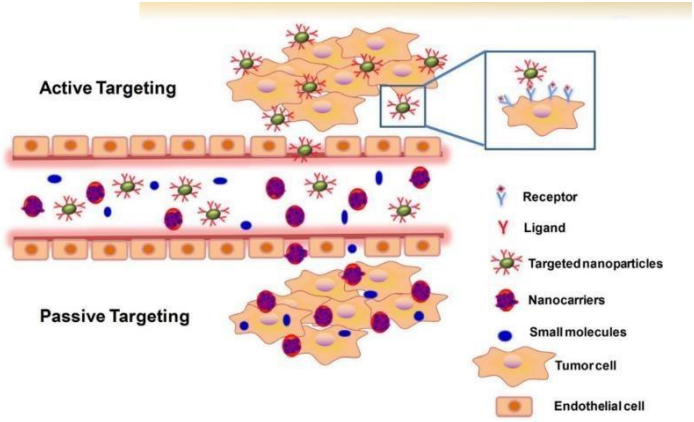


Fig.2 Active and Passive Targeting

Active Targeting

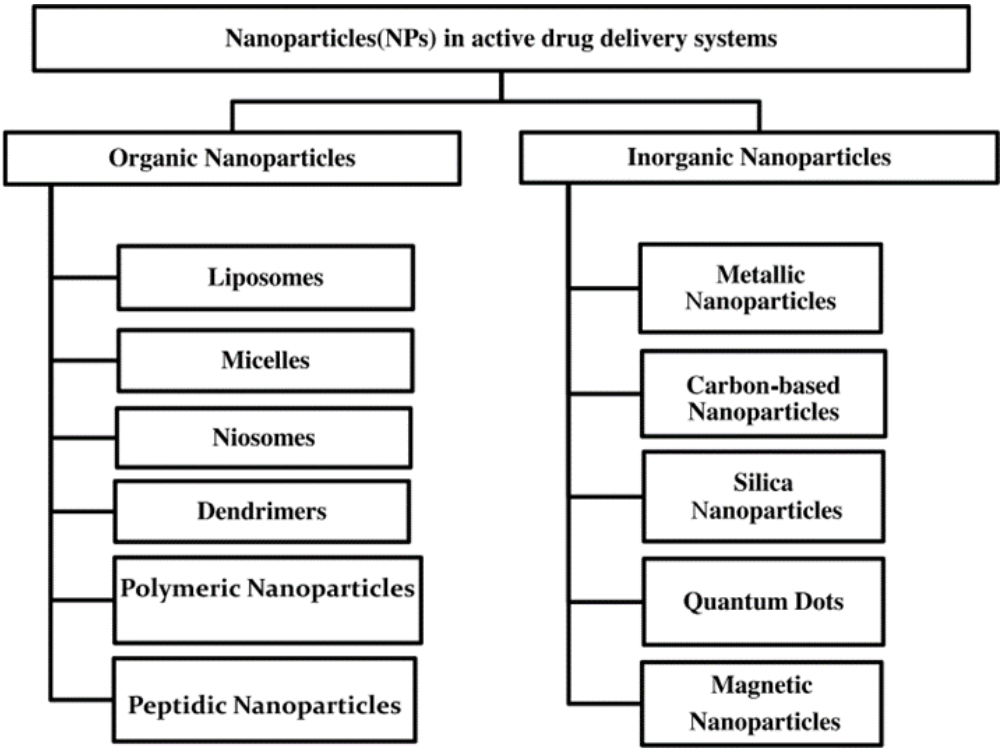
Active targeting of drug-loaded nanoparticles enhances the effects of passive targeting to make the nanoparticle more specific to a target site. There are several ways that active targeting can be achived. One way to actively target solely diseased tissue in the body is to know the nature of a receptor on the cell for which the drug will be targeted. Researchers can then utilize cell-specific ligands that will allow the nanoparticle to bind specifically to the cell that has the complementary receptor. This form of active targeting was found to be successful when utilizing transferrin as the cell-specific ligand.

Furthermore, a nanoparticle could possess the capability to be activated by a trigger that is specific to the target site, such as utilizing materials that are pH responsive. Most of the body has a consistent, neutral pH. However, some areas of the body are naturally more acidic than others, and, thus, nanoparticles can take advantage of this ability by releasing the drug when it encounters a specific pH. Another specific triggering mechanism is based on the redox potential. One of the side effects of tumors is hypoxia, which alters the redox potential in the vicinity of the tumor. By modifying the redox potential that triggers the payload release the vesicles can be selective to different types of tumors.

Fig. 3 Types of active Targeting

Inverse Targeting

- Avoid passive uptake of carriers by RES system
- Saturation and suppression of RES and defense mechanism
- Suitable to target non-RES organs



1. Liposomes

The most common vehicle currently used for targeted drug delivery is the liposome. Liposomes arenon-toxic, non-hemolytic, and non-immunogenic even upon repeated injections; they are biocompatible and biodegradable and can be designed to avoid clearance mechanisms (reticuloendothelial system (RES), renal clearance, chemical or enzymatic inactivation, etc.) Lipid- based, ligand-coated nanocarriers can store their payload in the hydrophobic shell or the hydrophilic interior depending on the nature of the drug/contrast agent being carried.

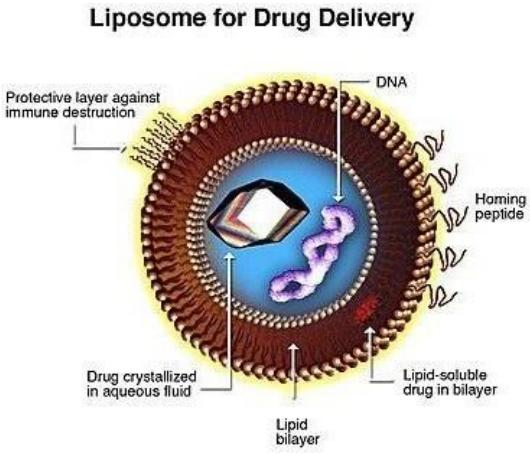


Fig.4 Liposome as Targeting Vehicle

To combat this, polyethylene glycol (PEG) can be added to the surface of the liposomes. Increasing the mole percent of PEG on the surface of the liposomes by 4-10% significantly increased circulation time in vivo from 200 to 1000 minutes.

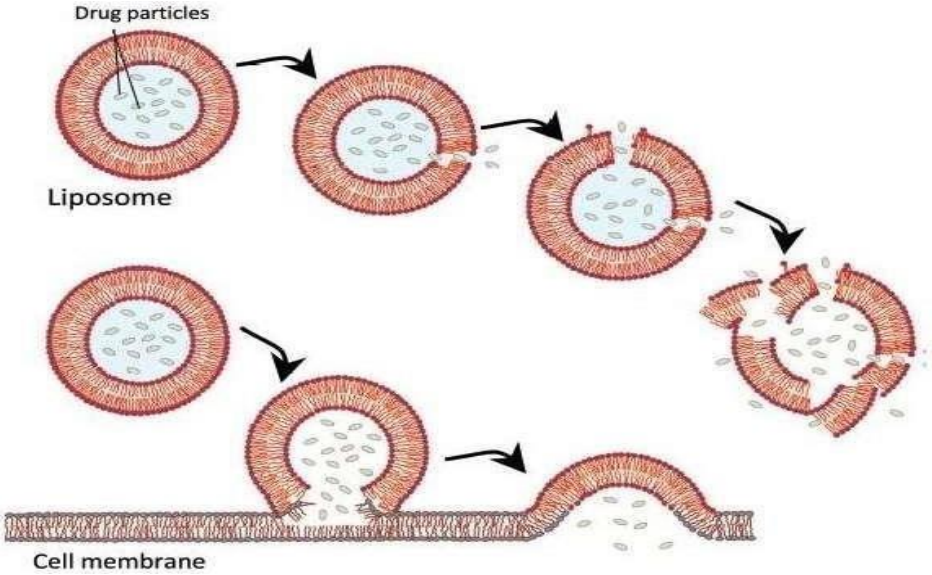


Fig.5 Illustration of Drug delivery through liposomes

2. Micelles and dendrimers

Another type of drug delivery vehicle used is polymeric micelles. They are prepared from certain amphiphilic co-polymers consisting of both hydrophilic and hydrophobic monomer units. They can be used to carry drugs that have poor solubility. This method offers little in the terms of size control or function malleability. Techniques that utilize reactive polymers along with a hydrophobic additive to produce a larger micelle that create a range of sizes have been developed.

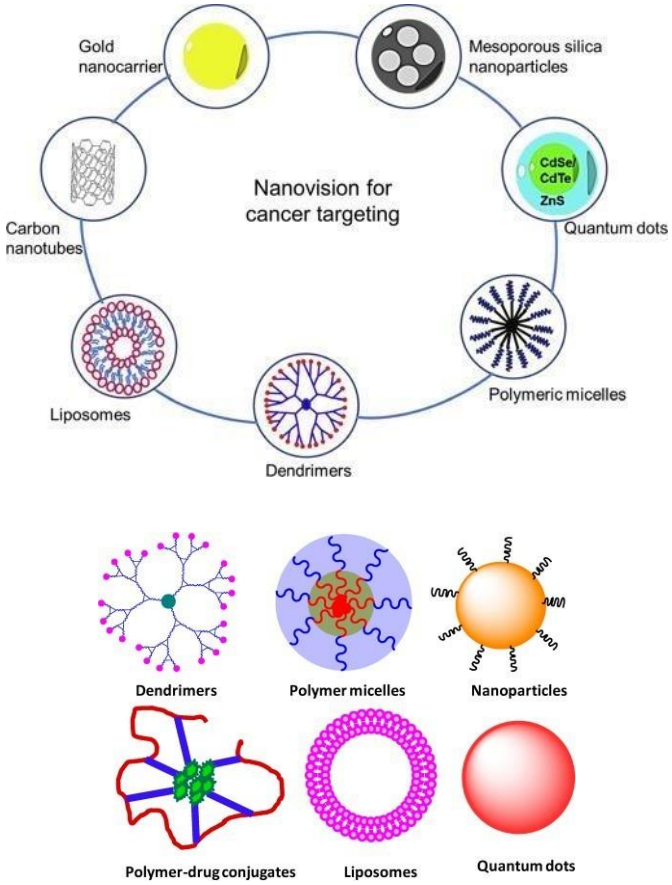


Fig.6 Nanocarrier used in drug targeting

Niosome

The surfactant molecules tend to orient themselves in such a way that the hydrophilic ends of the non-ionic surfactant point outwards, while the hydrophobic ends face eachother to form the bilayer. Controlled release drug products are often formulated to permit the establishment and maintenance of any concentration at target site for longer intervals of time.

Onesuch technique of drug targeting is niosomes. Niosomes are microscopic lamellar structures formed on admixture of a nonionic surfactant, cholesterol and diethyl ether with subsequent hydration in

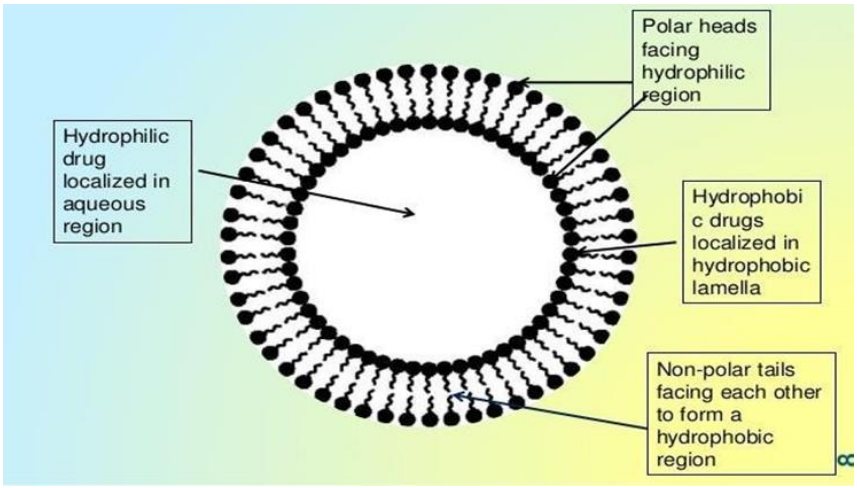


Fig.7 Structure of niosomes

Niosome drug delivery has been studied using variousmethods of administration including intramuscular, intravenous, peroral, and transdermal.

CONCLUSION

Target drug delivery system reduces the side effects and toxicity. The Dose of the drug reduces by targeting organ. It avoids the degradation of drug (first pass metabolism).

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