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An updated overview: Drug carriers used for the targeted delivery system

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***Abstract*---**In this high-tech era, the targeted drug delivery system has various progressions in the delivery of cancerous drugs. In the current review, the main purpose is to address the valuable needs of a targeted drug delivery system in all aspects of the safety and therapeutic delivery of drugs. The main objective is to introduce the drug carriers with their benefits. The targeted drug delivery system is superior to the traditional drug delivery system because they overcome the pros and cons and deliver the dosage form at the targeted site without exhibiting any side effects. The positive benefit of this system is that they reduce the dose dumping and provides the optimized delivery of drugs. The current review article elaborates on the different drug carriers used in the targeted drug delivery system such as liposomes, microspheres, and nanoparticles with their

importance, merits, and demerits. This article mainly concentrates on the applications and some other important facts related to the targeted drug delivery carriers.

***Keywords*---**Chemotherapeutic drugs, Targeted drug delivery system, Conventional drug delivery system, Drug carriers, Site-specific action, Nano-carriers.

Introduction

A targeted drug delivery system shows the advantages over the conventional delivery of drugs in terms of efficacious treatment with improved bioavailability and absorption status. This system works in the interest of the system i.e., the active moiety directly targets the specific tissue without affecting the other body tissues. This novel delivery system gain more attention in today's pharmaceuticals leading the world in all terms of its positive benefits with cost-effective treatment. Prevention, cure, and treatment are the main needs of human mankind and this is fulfilled by the high conversion technique known as the " Targeted drug delivery system".[1-3] Furthermore, this unique technology also controls the absorption, distribution, metabolism, and excretion parameters with improved bioavailability. This modernized and new technology works on the four principle guidelines and these are:

1. Loading of the drug to the specific site.
2. Avoids the first-pass metabolism and degradation of the drug.
3. Transferring the drug to the target site.
4. Release of a drug to the specific site at a predetermined rate.

In drug targeting, the drug is delivered to the capillaries of a specific site, specific cells like in the case of cancerous cells, or the special cells which easily recognize the drug carriers.[4-5]

Need of using the targeted drug delivery system-[6-7]

Conventional formulations exhibit the various drawbacks like:

1. They exhibit lower drug solubility.
2. They possess a lower specificity to the tissue of interest.
3. They exhibit poor solubility and bioavailability characteristics.
4. They possess a narrow therapeutic window with a short half-life.
5. A large amount of drug is bounded in other body tissues.

Good characteristics and features of targeted drug delivery system-[8-9]

1. They are non-toxic, non-allergic, and stable with other body fluid components.
2. They are highly compatible, safe, and stable dosage forms.
3. They deliver the drugs at a specific site with a predetermined release.
4. The procedure of manufacturing is uncomplicated and straightforward.
5. The release rate of drug delivery does not affect the ADME of the drug.
6. No leakage takes place during the transportation of drugs.

Different types of Carriers explored in drug targeting-[10-11]

Various kinds of drug carriers are used for the targeting delivery of drugs and they are listed as:

1. Liposomes which are also known as vesicles of lipids.
2. Niosomes which are known by vesicles of surfactants.
3. Ufasomes which are also called vesicles of unsaturated fatty acids.
4 Pharmacosomes
5. Virosomes
6. Transferosomes
7. Cubosomes
8. Nanobots
9. Nanocrystals
10. Hydrogels
11. Exosomes
12. Quantum dots
13. Gold nanoparticles
14. Dendrimers
15. Microsponges
16. Nanoferrosponges

1. Liposomes

They exhibit a spherical shape and these are mainly formed by two layers of phospholipids. The lipid bilayer consists of an aqueous core that is covered by the neighboring lipid layer. This bilayer enables the liposomes to intermingle both the hydrophilic and lipophilic drugs. They have very high specificity to target the tumor tissues because they give good steady formulations. They are generally formulated by an artificial method by using the phospholipids in the aqueous solutions. Moreover, they are better used in the delivery of biotechnology products and also explored in treating parasitic infections.[12-15]

2. Niosomes

These are the vesicles of non-ionic surfactants which mainly consist of cholesterol and its alternatives. Their spherical structure allows to entrapped the hydrophilic and lipophilic drugs. This technology is one of the innovative and versatile systems which provides sustained release with a low therapeutic index. They act as drug carriers as a diagnostic agent and are also used as penetration enhancers. This new technology provides the potential delivery for various routes of administration.[16-19]

3. Ufasomes

Ufasomes is one of the vesicular drug delivery systems which are composed of unsaturated fatty acids and their ionized species. They are considered a good candidate for the delivery of topical drugs because the outermost layer penetration barrier is overcome by them due to the composition of lipid layers. They are more advantageous over the liposomes in case of stability and they are cost-effective as compared to the liposomes.[20-23]

4. Pharmacosomes

These are known as neutral molecules which consist of both the positive and negative charges. They are mainly complexation of polyphenol with phospholipids.

The word pharmacosomes means drug carrier and their conjugation with lipids gives the result of micelles formation. They have a high level of stability range. Furthermore, in the future, this technology is highly emerging in the case of synthetic and natural active pharmaceutical constituents.[24-25]

5. Virosomes

This technology is a highly emerging novel carrier that can add to vaccines or as vehicles for different synthesis. They are prepared in combination with various agents for instance antigens, drugs, and viral cover proteins. They are mainly explored in the field of immunopotentiating agents.[26-28]

6. Transferosomes

Transferosomes is one of the types of liposomes which generally carries phosphatidylcholine with an edge activator. They exhibit a highly distorted structure with greater penetration power. They have high payload entrapment efficiency. Due to the encapsulation layering, the metabolic degradation of drugs gets to be protected. The transferosomes have various utilizations in the delivery of anti-cancer drugs, analgesics, anti-fungal drugs anesthetics, and corticosteroids.[29-31]

7. Cubosomes

These are made by lipids so they are known as nanostructured lipid carriers. These are highly versatile carriers that mainly plays important role in the treatment of cancer therapy and the drug explored in it are Doxorubicin, Cisplatin, Paclitaxel, Irinotecan, Curcumin, etc. These are made up of liquid crystalline nanoparticles which exhibit a cubic structure that is satisfactory for injection. Tween 80 is used as a stabilizer in it.[32-33]

8. Nanobots

Nanobots is the branch of nanomedicine that is also known as a micro-scale delivery system. They are very small in vision so they can easily traverse the human body. They have a broad range of applications in dentistry, nanoimpression, in the diagnosis of cancer and diabetes. Nowadays, they are also used in gene therapy with improved better therapy.[34-36]

9. Nanocrystals

Nanocrystals are one of the parts of nanotechnology and they exhibit structure like crystals. The main ingredient of the formulation is the drug and no carrier is needed for their formulations. Dispersion of aqueous medium results in the formation of nanosuspension. Nanocrystals improve the saturation solubility rate and dissolution velocity rate of poorly soluble drugs. Nanocrystals are different from nanoparticles in the dimensions because nanocrystals lie in the size range of less than 100nm whereas nanoparticle exhibits the dimensions of less than 1000nm.[37-39]

10. Hydrogels

They exhibit a three-dimensional structure and hydrophilic structure enables them to hold a large amount of aqueous phase. Mechanisms included for the preparation of hydrogel are diffusion-controlled, swelling controlled, and

chemically controlled. It has a broad range of applications in the healing of wounds, tissue engineering studies, and delivery of drugs to the GI tract.[40-41]

11. Exosomes

They exhibit the diameter range of 40-100 nm. Exosomes are bilayer vesicles of lipid. They are utilized in the diagnosis of disease by exhibiting the characteristics of a targeted drug delivery system.[42-44]

12. Quantum dots

Quantum dots are nanocrystalline semiconductor carriers that can mainly be explored in the area of tumor targeting with improved bioavailability of drugs. They are well used for optical applications because they exhibit a high level of extinction value.[45-46]

13. Gold nanoparticles

They exist in the form of protein markers and develop the supersensitive DNA molecule. They are mainly used in the biomedical field with advanced applications in the coverage area of bio-imaging. They are specifically manufactured for the targeting of the specific tissue without any interest in the other organ. Gold nanoparticles are used for the detection of different types of cancerous cells like breast cancer, lung cancer, and prostate cancer.[47-50]

14. Dendrimers

These are generated by using synthetic nano-range particles with a specific diameter. Dendrimers are mainly composed of the central core which is further covered by the different types of polymers. This central core helps to improve the solubility of BCS-class 2 drugs. They are mainly explored in the area of medical imaging, delivery of antineoplastic drugs, and as well as in the therapy of genes.[51-54]

15. Microsponges

Microsponge is a highly patented and cross-linked automation having a sponge-like preserved spherical structure along with a large porous surface. It provides novel and controlled pharmaceutical products. Another term used for microsponge is the "polymeric microspheres" and "solid-phase porous microbeads". They are very small in vision and the particle size ranges from 5 to 300 microns. Apart from it, they provide many benefits over the conventional products, nanocarrier, and microcarrier formulations in terms of stability, safety, bioavailability, and exhibit better drug performance parameters with lesser adverse effects.[55-58]

16. Nanoferrosponges

These are the nano-carriers composed of the ferric ions and they are mainly activated by the help of the magnet. Nanoferrosponges have highly improved penetration power because of the external magnetism due to this the drug directly targets the specific tissue. It is also known as one of the new best approaches to a targeted drug delivery system.[59-61]

Conclusions and prospects

Drug carriers are the forthcoming and highly modern technology that is used in the targeting of specific tissues with lesser adverse reactions. The targeted drug delivery system has more progressions with advantages in the area of all the above-listed drug carriers. These drug carriers provide superior benefits over conventional drug preparations. In the future, these drug carriers provides more benefits with the modification of micro and nanotechnology.

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