

The Research Progress of Targeted Drug Delivery Systems

Jiayin Zhan, Xizi Liang Ting, Junjie Zhu*

School of Chemistry and Chemical Engineering, Nanjing University, Nanjing 210023, China

*Corresponding author e-mail: jjzhu@nju.edu.cn

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.

1. Introduction

DDS is refers to the use of new technology and biological polymer materials technology to delivery gene or drugs to the designated the body parts according to the clinical need time and dose. it can be designed to minimize drug degradation, increase bioavailability, allow targeting to specific cells and reduce the total amount of drug needed, it can be controlled release of drugs to decreasing toxicity and harmful side-effects^[1].the idea of DDS drug research and development is to use the new technology and new materials to improve curative effect, reduce the effect of patients with adverse reaction and easy to use by changing the drug pharmacokinetic model and delivery channels. DDS is the application and development in pharmacy by the modern science and technology, it has become the theme of the modern pharmacy innovation and development.

Targeted drug research began in the 1970s, its main form is for injection, with the development, the current trend of DDS drug research and development is the use of liposome, lipid, protein, fat, microspheres and a biodegradable polymers as drug carrier. Targeted drugs originally is mainly used in cancer treatment, to maximize the efficacy of a drug is of prime importance during the choice of the delivery system. Among the currently available delivery systems, which include liposomes, emulsions, polymeric micelles and micro-particles, carbon nanotubes (CNTs) , and so on. The following we will illustrate the characteristic of all kinds of DDS respectively.



2. Targeted drug delivery system

2.1 Liposomes

Because the design of viral vectors is relatively expensive and might be toxic to normal organs, a variety of Nano vectors have been explored as possible gene therapy vehicles. Liposomes, especially nano-liposomes is primarily lipid bilayer membrane. Phospholipid elimination in the blood is relatively slow, as pharmaceutical package can be released slowly by buried liposomes, which thus effectively prolongs action time of drugs^[2]. Liposomes is safe and non-toxic, targeted modification advantages are more apparent^[3], the newest research about bio reducible lipid nanoparticles obtain good results^[4]. Researchers combining bio reducible lipid (8-O14B) nanoparticles with negatively supercharged Cre recombinase or anionic Cas9: single-guide (sg) RNA complexes drives the electrostatic assembly of nanoparticles that mediate potent pro-teiin delivery and genome editing, in order to across the

Mammalian cell membrane, including escape from endosomes, developing delivery vehicles to transport active protein to their intracellular target site is thus essential to advance protein-based genome editing. Another^[5] research functional targeting epirubicin liposomes for transferring drugs across the blood-brain barrier (BBB) to treat glioblastoma Pro. Zhao^[6] used the lipid-mixing method to make Liposomes were developed in order to treat bacterial infections in cystic fibrosis with regard to the enhanced bactericidal activity of entrapped antibiotics released through their fusion with bacterial membranes.to overcome the acute and growing problem of antibiotic resistance of bacteria to conventional antibiotics which made it imperative to develop new liposome formulations for antibiotics.

2.2 Carbon Materials

Nanoscale carbon materials usually including carbon nanotubes⁹⁷, graphene⁹⁸ / graphene-oxide⁹⁹, and nano diamond Targeting and selectivity during cancer cell destruction has also been reported through molecular surface functionalization of single-walled carbon nanohorns(SWCNTs)both in vitro and in vivo. The use of nanoscale materials has attracted considerable attention. Nanoscale materials have been demonstrated to offer a variety of therapeutic and diagnostic capabilities. It usually has a diameter between 10 nm and 1000 nm. The drug is usually made from natural polymer material and has been fully applied to treatment course of tumor, diabetes and vascular disease. It can effectively extend action time of drug, then effectively improve clinical effect of the drug and minimize toxic and side effects of the drug^[7]. Frequency of use of nano preparation technology can provide better development space for medical use and effectively promote long-term development of nano biotechnology. Compare with other materials, Carbon can be much cheaper, but the chirality and diameter of nanotubes, which severely impact the physical and chemical properties, they are difficult to control^[8].

2.3 Metallic nanomaterials

Metallic nanomaterials including gold and silver nanocrystals, and Nano rods. Have been shown to generate localized hyper thermal heating through the absorption of incident optical radiation and surface Plasmon relaxation to treat the disease. Affected by the size and shape of the particle and are susceptible to drift. One problem with drug delivery is heterogeneity within the tumor due to irregular blood vessel architecture, hindered diffusion from a dense intercellular matrix. Its advantage is low-cost, easily synthesized nanoparticles and the particles are also hown to have a high thermal stability^[9]. PEG-DSPE coating may be related to better absorption, based on the stability and a pharmacokinetic improvement in the blood circulation time. This method will lead to enhanced permeation for nanoparticles to across the vascular endothelium and achieve improved accumulation in the tumor^[10].

2.4. *Semiconducting nanomaterials*

Semiconducting nanomaterials have also received a significant amount of recent attention for hyper thermal theranostics, their structures typically allow for substantial penetration of electromagnetic fields throughout the internal volume of the particle. Yet these materials are often composed of toxic metals. The following research of semiconductors as PTT agents will certainly require the study of biocompatible materials in the future.

2.5. *Iron Oxide Nanocrystals*

The difference between the magnetic particles and their metallic and semiconducting counterparts is the mechanism by which the particle is heated. Briefly, magnetic hyperthermia is achieved by applying external alternating magnetic fields to cause the magnetic particles to heat through hysteresis loss (Néel relaxation) or induced eddy currents^[11]. Nanoscale materials have been demonstrated to offer a variety of therapeutic and diagnostic (theranostic) capabilities.

2.6. *Nano micelles*

Polymeric Nano micelles are formed by amphiphilic polymers with distinct hydrophobic and hydrophilic segments. The polymer self-assemble to form micelles in aqueous solution. The mechanism of drug release from Nano micelles is dependent on the nature and strength of interactions between core-forming polymer and drug molecules, micelle stability^[12].

2.7. *Carbon nanotubes*

Carbon nanotubes (CNT), have recently been studied as novel and versatile drug and gene delivery vehicles. When CNT are suitably functionalized, they can interact with various cell types and are taken up by endocytosis. Some anti-cancer drugs cisplatin, methotrexate, the antifungal compound amphotericin B and doxorubicin have been delivered by Centrist advantage is pro-protecting the cargo from metabolism or degradation, or through targeted delivery that can reduce side effects about the Nano toxicology of the CNT and their potentially damaging effects on the environment^[13]. Shorter multi-walled CNTs (MWCNTs, i.e., 1 μm) have been reported to penetrate the cell membrane more efficiently than the longer CNTs, which can inhibit their uptake by self-arranging into a coiled or bundled shape. Cai et al.^[14] made a theoretical analysis of penetration pathways. They showed that amphiphilic nanotubes can penetrate through artificial lipid bilayers via an endocytosis pathway. Different types of nucleic acids such as micro-RNA (miRNA), small-interfering (siRNA) and plasmid DNA (pDNA) can be bound to CNTs and transferred into mammalian cells. Oral administration of peptides has problems with enzymatic degradation and poor uptake from the gut, but CNTs were proposed to overcome these limitations^[15].

2.8. *Mesoporous silica materials*

Mesoporous silica nanoparticles (MSNPs) is uniformly sized, porous and dispersible nanoparticles using colloidal chemistry and evaporation-induced self-assembly. This kind of material enables the loading of diverse cargos and cargo combinations at levels exceeding those of other common drug delivery carriers such as liposomes or polymer conjugates. This is because non-covalent electrostatic, hydrogen-bonding and van der Waals interactions of the cargo with the MSNP internal surface cause preferential adsorption of cargo to the MSNP^[16], SNPs within reconfigurable supported lipid bilayers to develop new classes of responsive Nano carriers that actively interact with the target cell. It usually requires biocompatibility and low toxicity and can be used to follow bio distribution, cancer cell targeting efficiency, internalization pathways, cytotoxicity, and the progress of therapy. There have been widely differing reports concerning the toxicity of MSNP and amorphous silica in genera¹^[17-18]

3. Conclusion

Because of the curative effect and smaller side effect, the role of targeted drugs will more and more be taken seriously, with the acceleration development of research on mechanism of drug targeting, targeted drug applications continue to expand in more field.

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