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Novel Drug Delivery Approach in Cancer Therapy

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Review Article

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ABSTRACT

Novel Drug Delivery Systems (NDDS) have numerous points of interest, which comprise better therapy by increasing the efficacy and duration of drug activity, improved patient compliance through reduced dosing frequency. It provides appropriate routes of administration and enhanced targeting for a particular site to anticipate hurtful reactions. The Different types of advanced drug delivery approach like polymeric Nano capsules, nanoparticles, liposomes, nanoemulsion, microsphere, microcapsules, hydrogels has been expressed utilizing bioactive and plant extracts. NDDS have significant advantages over conventional therapy for cancer treatment, which include improved solubility and bioavailability, low toxicity, maximum therapeutic effect, sustained and controlled drug delivery, improvement of stability and batter security from physical and biochemical degradation. This article covers the basic information and different types of Novel Drug Delivery Systems.

INTRODUCTION

Cancer is one of the major public health causes in the world. Cancer therapy still remains great challenges [1,3]. Because of the great potential application of NDDS in cancer therapy we are enabled the development of novel therapeutic and diagnostic strategies [4-6].

The particular technique by which drug is conveyed can have an impressive result on its adequacy. A few medications have an ideal focus range which maximum advantage is derived, and above or below concentration of drug from this range can be harmful or didn't produce therapeutic benefit [7,8].

Advanced drug delivery carriers should fulfill mainly two conditions. Firstly, delivery should be rate specific. Secondly, it should be site-specific. Conventional dosage forms can't meet any of these. NDDS can be divided into classes. 1) Sustained release drug delivery system. 2) Controlled release drug delivery system [9-11]. Drug delivery system is designed to produce delayed therapeutic effect over a prolonged period of time [8]. The principle objective of treatment is to accomplish consistent state blood level that is powerful and non-lethal for an extended period of time.

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Advantages:

1) Improved patient convenience and compliance due to less frequent drug administration 2) Increase safety margin 3) Maximum utilization of drug 4) less frequency of dosing etc.
2) Disadvantages:
3) Decreased systemic availability 2) Poor in-vivo, in-vitro correlation 3) Possibility of dose dumping etc.

4) Controlled drug delivery follows delivery of the drug at a predetermined rate, for locally or systemically. Controlled release is splendidly zero order drug release.

5) Reduced dose concentration and dosing frequency 3) Reduced GI toxicity 4) Better patient acceptance.

Disadvantages:

1) Dose dumping
2) Reduce potential for precise dose measurement
3) Need of extra patient instruction
4) Stability problem.

Oral, parenteral, Transdermal and Inhalation route of administration are defined as most preferable route of administration [12-14]. NDDS strategies for local medication like nanoparticles, microspheres, polymeric micelles, liposomes, and hydrogel systems for targeting and controlled release have been examined with biodegradable and non-biodegradable polymers, comprising polyether's, polyesters, polysaccharides, poly amino-acids and proteins. These polymers are mostly utilized in cancer therapy for parenteral drug delivery system [8]. These polymers are actively known for their reduced harmful reactions and enhanced carcinostatic pharmaceutical impacts.

DIFFERENT DRUG DELIVERY SYSTEM

LIPOPROTEIN

In any ideal drug delivery system, an acceptable amount of active therapeutic drug must be assimilated and transported to the site of activity at the favorable time and rate [15].
Lipoprotein as a medication system for malignancy therapy, Lipoprotein can be utilized as a Targeted drug delivery system in malignancy therapy which helps to improve therapeutic index of anticancer agents, either by expanding the concentration of medication in tumor cells or by diminishing the interaction in normal host tissues [16,17].

Low density lipoprotein is potential transporter for chemotherapeutic mediators. They are utilized for targeted delivery of anticancer because several types of malignant cells display higher level of receptor mediated uptake of low density lipoprotein [8]. For clinical malignancy therapy liposomes and phospholipid vesicles, have been known as a potential drug delivery system [18-20]. This system protecting healthy cells from toxic effect and keep their concentration in susceptible tissues for example in patient kidneys and their liver [21-25].

NANOPARTICLE

Nanoparticles are in the solid state and are either amorphous or crystalline in nature with size range (from 10 to 200 nm) [26,27]. It secures drug against chemical and enzymatic dilapidation [28-30]. Biodegradable polymeric nanoparticles have few applications in the controlled release of therapeutic medications in targeting specific tissue or organs as carriers in gene therapy [31].
Nanomaterial classified as Nanotubes, Nanowires, Nano shells, Quantum dots, Nano pores, Gold nanoparticles [32-35].

NANOEMULSION

Nano emulsions can be characterized as oil-in-water (o/w) emulsions with mean droplet size from 50 to 200 nm and the particles can exist as both water-in-oil and oil-in water forms, where the core of the particle is whichever water or oil [8,36-40]. Nano-emulsions like microemulsion may have high optical transparency and kinetic constancy [41-44].

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MICROCAPSULES

Numerous anticancer agents (such as paclitaxel, PCT; camptothecin, CPT; and certain porphyrins like meso tetraphenylporphine, TPP, utilized as a part of photodynamic treatment, PDT) with stumpy aqueous solubility affect their application and makes direct parenteral administration more complicated [45-47]. Novel drug delivery strategies based on the drug carrier systems approaches have been advised to overwhelmed their reduced solubility, little stability, and dangerous symptoms [8,48]. PEG diacyllipids conjugates have attracted much consideration towards their easily controlled properties and great pharmacological features [49-52].

MICROEMULSION

Microemulsion are defined as liquid scatterings of water and oil that are prepared thermodynamically stable formulation which is homogenous, transparent or translucent in nature by the addition of relatively huge concentration of a surfactant and a surfactant [10,53]. Microemulsion droplets diameter having range of 10-100 nm and have been extensively considered for targeted drug delivery system to the brain [54,55-57]. It is a cost effective strategy and enhances the bioavailability of the poorly dissolvable medications [58-60].

MICROSPHERES

Microsphere technology is the newest development in cancer chemotherapy. Microsphere is solid porous particles with diameters 1 - 100 μm [8,61]. It can focus on their medication load by physical trapping in blood veins known as chemoembolization and sustain therapeutic agent action through controlled release. Biodegradable microspheres are used for direct delivery of drugs to organ(s) by lodging therapeutic drug in the end organ vessels [62-65]. Its effect depends on the size and mode of administration of the microsphere either intravenous or intra-arterial [66-68].

DENDRIMERS

Dendrimers are highly branched-three-dimensional, monodisperse molecules with highly controlled structures [8]. Its monodispersed, encapsulation ability, water solubility and huge number of peripheral functional groups, make them perfect candidates for assessment as medication delivery system [69-71]. Recently, Dendrimers used as drug delivery system for anticancer drugs in variety of cancer therapies [72-78].

Mainly there are three methods used for drug delivery through Dendrimers (a) attachment of drug to periphery of the Dendrimers through covalent bond to form Dendrimers pro-drugs, (b) the drug is synchronized to the outer functional groups through ionic interactions, or (c) host-guest supramolecular assembly [79-83].

HYDROGELS

Hydrogels are three-dimensional networks of water-swollen polymers [7-9,39,55]. It usually comprises crosslinked hydrophilic polymers which cross-linked either through covalent bonds or composed by physical intramolecular and intermolecular attractions that swell readily without dissolving in aqueous solution [84-88]. Because of hydrogel unique ability to swell under biological conditions makes them an ideal class of materials for biomedical applications, for example drug delivery and tissue engineering [89-96]. Hydrogels are highly hydrophilic in nature due to the presence of some hydrophilic moieties such as carboxyl, amide, amino, and hydroxyl groups [97-100].

CONCLUSION

Novel drug delivery systems will present an opportunity for formulation researchers to overcome many challenges associated with the conventional systems. Cancer chemotherapy has been renowned as exceptional areas of need for advanced drug therapy. Lipoproteins, nanoparticles, Microspheres etc. as advanced drug delivery systems have become an attractive field of new research and measured excellent candidates with great potential in the area of novel drug delivery systems.

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