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EC PHARMACOLOGY AND TOXICOLOGY

Review Article

Application of Nanoparticles for Nano Medicine

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Received: January 09, 2020; **Published:** February 28, 2020

Abstract

Firstly, the idea of using nanotechnology in medicine was developed from a creative imagination which based on that small machine men can be designed and after entering these machines into the human body they are used to perform molecular restorations at the cellular level. Also, in this research we introduce common nanoparticles, fullerenes, nano micelles solid lipid nanoparticles, metal nanoparticles, polymeric nanoparticles, dendrimers, nano shells, quantum dots, nano liposomes. In this research, the features of particles and know structures and applicable in drug delivery are mentioned. The purpose of this research is to introduce the application of nanoparticles for Nano medicine for excellence in nano medicine development.

Keywords: *Nanoparticles; Dendrimers; Solid Lipid Nanoparticles; Nano Shells*

Introduction

This idea was first stated into Derxler manuscripts in 1986 and it was emphasized in the Freitas papers in the years 1990 - 2000 [1,2] the first scientist who worked on this topic during world war 11 was Richard Feynman [3,4]. Richard Feynman was the first scientist who worked on this topic during world war 11 [5].

He posed his renowned theory that is there is plenty of room at the bottom and he believed that small machines could be used to make smaller tools and be continued to minimize dimensions and reach the atomic dimensions. Feynman won the Nobel prize by expressing his theory in 1959. He said about the availability of various kinds of machines and molecular tools in different (several) dimensions in the future, in fact, he became the founder (institutor) of the science of nanotechnology in medicine.

Feynman's first theory was about designing a molecular nanomachine that was able to perform heart surgery. The final goal of this branch of science is to control all atoms and molecules to produce computer chips and other devices which they are smaller than current instruments. In the manufacture of nano-size medical devices in addition to more control over diseases treatment the economical benefits of treatment are also increasing and according to this fact improving quality the of life and increasing lifetime will be possible during this chapter several particles structures tools than are used in medical nanotechnology and their usage will be discussed.

Fullerenes: Fullerenes are conjugated carbonate skeleton structures that are in the form of spherical structures that are in the form of spherical structures these structures are prepared by some methods such as these methods include [6,7].

Graphite evaporation through resistive heating combustion of simple hydrocarbons by fuel-rich flames, ultraviolet laser radiation [8,9].

Fullerene refers to the whole set of the word empty (hollow) carbon molecules which have pentagonal of hexagonal structure [10,11]. The number of carbon atoms in this molecule is changeable. The most famous and most stable fullerene structure contains 60 carbon atoms (Fullerene c60).

Spherical fullerenes are sometimes culled Bucky ball are very resistant from a physical point of view which can withstand very high pressure so that to withstand very high pressure so that they return to their original shape after sustaining 3000 atmosphere of pressure. Interactions between bucky balls molecules are done by very weak forces (Van der Waals force). These forces are similar to the forces which hold the graphite layers. According to this event Bucky balls like graphite has an in lubricating ability although these molecules are very small for many usages because of their adherence to gaps. The several shells bucky balls than which called Nano-onion are bigger and they can be used our lubricant [13].

Based on fullerenes materials have important uses in photonic components. Fullerenes show a wide range of optical properties when exposed to light and they may be used for telecommunication purposes on liner optical properties can be upgraded (enhanced) by increasing one or more metal atoms outside or inside the fullerene cage. Fullerenes are also useful in destroying free radicals that affect living tissue.

Therefore, it is recommended to use them in cosmetics to protect the skin the fullerene c600 has medical properties fullerenes are used for antiviral bacterial anti-cancer antioxidant and anti-cell death. Carbon nanotubes are salver shaped plates made of self–assembling of atoms that made of organic or inorganic compounds. Undoubtedly the well-known nanotube structures are carbon nanotubes which carry 100 times more tensile strength than steel and they have a higher thermal conductivity than most known materials and show electrical conductivity similar to copper carbon nanotubes are formed by [14].

In fact, a carbon nanotube is a thin and long cylinder of graphite consisting of one or more layers of carbon atoms arranged in a hexagonal grid which (that) each layer adjoining its next layer with a weak (van der Waals connection link) If you take one of the graphite plates are on one side you have made carbon nanotube.

Second comparison of the atomic structure of a carbon nanotube with graphite. In the comparison of them, graphite and carbon nanotubes atoms have sp2 hybridization and the hexagons are on the plates while diamonds carbon atoms have sp3 hybridization and are connected by very strong covalent bonds in three-dimensional space. The way the graphite is rolled creates several kinds of nanotubes. There are 3 main types of carbon tubes.

Their models are Armchair model which graphite plates become pipes in width (chiral angle: 30), zig zag model that graphite plates become pipes in end long and Chirality model that graphite plates become pipes in diagonal and it is the average between the other than models and in this model, the angel is changeable between o to 30. The nanotube has a large internal volume and the large outer surface which are easy to able functionalization. Although these talks have potential properties in treatment the body s reaction to these toxic structures is unknown. Much research is currently being done on their toxicity and biocompatibility but carbon nanotubes through the oxidative pathways lead to cell death (cause the cell death) [15,16].

Nanoliposomes: Liposome are concentric systems encapsulated by two phospholipids which formed by simple design of the structure of the liposome [17]. Nanoliposomes are those nanosized liposomes that are divided into two main groups based on the size and number of the twofold layers. According to the size and number of the fold layers nanoliposomes divided into 2 groups.

Multilamellar vesicles: They have been formed of several phospholipid layers as each layer being separated by an aqueous space. These liposomes are not mutual in size and the will have a diameter of about 1000 - 100 nm.

Unilamellar vesicles: They have been made of a single phospholipid layer. According to their sizes, they are divided into two groups: single layer and small vesicles with a diameter of about 100 nm. And single layer and large and large vesicles with a diameter greater than 100 nm. Amphiphilic specifications of nanoliposomes and some features such as ease of surface modification and good biocompatibility have caused that they have been used to increase the half time of proteins peptides in the body. Drug molecules are encapsulated based on their physicochemical properties either in aqueous space or into lipid bilayer lattices and by sticking the nanoliposomes to cell membrane they are transferred into the cell [18,19].

Nano micelles: The micelles like as liposomes are systems which are formed by the hydrolysis of phospholipid molecules but unlike liposome are composed of a single layer. Nano micelles is those micellar systems that their size is about nanometer. And because of drug transfer, they have been taken into consideration the uppermost feature of these systems is their rapid penetration into the body generally if the molecular thickness is not too hight micelles can be formed by hydrolysis of Amphiphilic molecules. Besides the usual micelles that are used for curing hydrophobic drug as the design of reverse micelles allows the transport of hydrophilic drugs. These micelles are formed by placing the hydrophile parts of amphiphilic polymers in the oil phaser and they are effective for transporting protein molecules.

Solid lipid nanoparticles (SLN): Solid lipid nanoparticles are lipid carriers with the colloidal base that their size is less than a micrometer and was first designed in 1990 for therapeutic use to replace liposome liposomes and emulsion. Solid lipid nanoparticles are structurally between nano emulsions and nanosuspensions in that their central part is solid lipid and there is a layer of surfactant around the lipid. As a result, these nanoparticles are lipid Nano suspensions or solid internal phase nano emulsion which are less toxic than polymers and ceramic nanoparticles generally solid liposomes which is due to the features of the central part of these particles which are solid at room and body temperature. Because of the existence of large amounts of surfactant in the place of synthesis these gatherings are stabilized [20-22]. SLN's condition controllable pharmacokinetic agents and can be synthesized in 3 forms; These nanoparticles through high-pressure homogenization [23,24]. Using microemulsions and other similar methods can be available Factors which are effective on drug release from these nanoparticles include drug location in the particles the temperature used in particles processing the type of lipid and the amount of surfactant used in the combination of these particles have been used for oral and respiratory drug delivery [25].

Metal nanoparticles

Gold nano particles: During the time gold nano-particles are gold metal particles that have had interesting usage in medicine and pharmacy [26]. There are several different strategies for mailing metallic colloidal suspensions first the method of using the liquid-liquid phase was described by faraday in 1857 [27]. He revived water-soluble gold salt by phosphorus in carbon disulphide and achieved a ruby-coloured suspension containing gold particles. The above method was replaced by Burst-Schiffrin Thus. displacement of aqueous solvent thorough existence of Toluen in the Aqueous two phase system which contains gold salt by using Tetraoctylammonium bromide accomplished as the phase transition agent and then chemical resuscitation was performed with the presence of Dodecanethiol in aqueous Sodium borohydride water solution. Many gold nanoparticles with biomolecular coating were synthesized for biological uses common example for this is the identification of polynucleotides by connecting Oligonucleotides to the surface of these particles by attaching particles such as DNA to gold nanoparticles colloidal solution changes from red to blue and the hereby a sensitive way be available for the detection of such biomolecules [28,29].

Silver nano-particles: Silver is a material that has always been regarded as an antibacterial throughout human life as it has been used in silver containers to store water and milk and in the wars, it was used for wound healing. Nowadays its usage has increased dramatically for examples NASA in using it to clean space please shut the air. According to recent experiments, silver nanoparticles kill more than 650 types of germs bacteria and viruses. One of the uses of silver nanoparticles in medicine is its usage in the treatment of eye infections [30,31]. Also, silver sulfadiazine has been used to treatment of burn injuries 10 nm-sized - 1 silver nanoparticles are capable of sticking to the 120 k Da glycoprotein (120 gp) present on the surface of 1-HIV as they inhibit the attachments of the virus to the host cells [32].

Polymeric nanoparticles: Polymeric nanoparticles are biocompatible and biodegradable and are used as a bath gadget for drug delivery. Also, they have good potential for surface amendment through chemical factors and are suitable for connection and many therapeutic agents Polymeric nanoparticles can also be used in gene therapy. Not only these polymeric coatings protect drugs or genetic factors against demolition but also through the possibility of controlled release of these agents be possible [33,34]. Polymers which are used in medicine nano particles can be Polylactic acid (PLA) polyglycolic acid (PGA) polyacrylic 8 glycolic acid copolymer (PLGA) poly alkyl cyanoacrylate (PACA) polymethyl methacrylate (PMMA) poly butyl cyano acrylamide (PBCA) chitosan gelation and other biodegradable polymers. The surface of such nano particles can be used for targeted medication by correcting specific chemical factors (agents) and these particles are just allowed to enter the target cellular. In the treatment of chronic diseases because of the biodegradability properties of polymeric particles, they get more attention than inorganic particles. [35,36].

Dendrimers: Dendrimers or tree-like are nano-sized branched molecules that are used as an intelligent therapeutic tools. For example through changing the structure of these molecules and strengthen them against cancer cells these interpreters, molecules can be used to the demolition of cancer cell.

By targeting these dendrimers against specific proteins in the body they can be possible to identify different illnesses or by empowering these dendrimers against virus-infected cells and parasitic infections they can be able to destroy these cells [37].

Dendrimers are large polymeric-based molecules which include monomeric or oligomeric units features like the cavity inside a Dendrimers the shrub-like mood of it ease of preparation improvement of Dendrimers structure and the ability to control the particle size provide great potential for the use of these nanoparticles in medication. Dendrimers usually have a symmetrical structure furthermore is a central protected area with a surface that is capable of chemical functionalization. By making the necessary changes to the branching rate and level of Dendrimers it is possible to confine other molecules inside this structure For example, when the terminal groups of this structure are functionalized with hydrophilic groups (like carboxylic acids) the water-soluble dendrimers are designed (are created) which have to potential to carry a considerable amount of hydrophobic molecules inside their potential [38].

Dendrimers molecules need more improvement in the fields of biocompatibility cytotoxicity and distribution of bioavailability for use as medicinal curriers in the body.

Nano shells: Nano shells are flat shells that are used for medication. Gold nano shells are one of the well-known nano-shell structures gold nano particles consist of two major parts: A dielectric core is covered by a very thin layer of gold colloid. Changing the size of the core and the outer colloidal layer changes the optical properties of the nanoparticles. Depending on their structure nano shell exhibit specific electrical resistance against the laser light. The structure of gold nanoparticles can be such that absorb or disperse a particular wavelength 2 gold nanoparticles with the same size core and with 15 nm difference in the thickness of the gold sell can (they) have 2 different absorptions and emission wavelength. Thicker shell (20 nm) propagates in the visible area(region) and the thinner shell (crust) (5 nm) propagates near their area. In the near to IR region cell masses and blood cells absorb a very little amount of this wavelength and as a result laser light passes through the body without damaging the internal cell tissues [39]. The difference in the wavelength of the nano shells is due to the different thickness of the outer layer After designing a specific anti-cancer system that is targeted against specific cells and injected into the body these nanoparticles accumulate near the cancer cells and laser light is applied with the rays. These nano shells (like a polymeric shell) that enclose an anti-cancer drug are specifically capable of absorbing irradiation and by melting the polymer they release the drug which is accumulated at the desired location [39,40].

This tools also can be used to treat diabetes insulin hormone which is surrounded by nano shell is injected beneath the skin of the patients body then by the laser irradiation on the surface of the patients skin the bores begin to secrete insulin every hormone therefore through this way we can get insulin every hour (time) of the day. These tools can stay on the patient's body for month's whit out any problem.

Quantum dots: Quantum dots are luminous dots that have high potential in imaging biological systems.

The main components of this structure are the core and shell as well as a cover (coating). The coating is used for some cases such as improvement of biocompatibility eliminates the toxic properties of the structure provides greater stability and increasing quantum efficiency at room temperature the material of the cover that is used may be different; One of the well-known covers is polyethylene glycol (PEG) which is effective in both improving biocompatibility and enhancing the stability of these particles in biological systems. The diameter of quantum dots is a few (several) nano meters to several micrometer and they are classified as semiconductor materials. These nanoparticles are often composed of fifth sixth and seventh elemental groups.

The quantum dots have valance and conduction band which are separated from by reactor vacuity with distinct energy that this is energy called (bend gap). In the non-excited mood, the electrons fill all the surfaces of the valence band while the surface of the conduction band is vacant. When a ray of energy is emitters to these particles in the form of laser if the energy level is greater than the energy distance it will absorb photons and will progress from valence band to the conduction band. Thus some electronic holes are forms (created) in the valence band which the consequence of that is continuous and uniform propagation by quantum dos. The emission from these particles is called excited fluorescence and it is observed as a regular and low amplitude emission. This excited fluorescence depends on the size of the quantum dot Nano crystals. As in larger particles, the emitted light tend to lower energy (red light) and in smaller light particles it tends to higher energies (blue light). According to studies of different groups, there is a linear relationship between the size of the particle and their energy distance. When the physical dimensions of the particle become smaller the wavelength of emitted light, for example, fluorescence emission by cadmium Nano crystals with a size of 2.5 nm and 5.5 nm is 500 nm and 620 nm.

Thus by charging the size of quantum dots or through a single excited wavelength radiation different fluorescence emission can be achieved. In distinguishable fluorescence emission from cadmium, selenide quantum dots is observed which coated with sulfuric acid and is stimulated by ultraviolet radiation so from left to right the highest emission is 443 nm and the least emission is 655 nm.

A quantum dot of 4.2 nm has an energy distance of about 2 eV and emits orange while this particle has an energy radix of 0.9 nm at about 7.2 eV and emits blue. With the charge in the genus of semiconductor material the emission wavelength also varies. As an example of point input and in as quantum dots are emitted around the infrared while the case and ZnSe quantum dots usually emit blue light near the UV.

It has been estimated that CdSe quantum dots are about 20 items lighter and 100 items more stable than common minerals such as ramin defects in the surface of the nanocrystals can trap the electrons thereby interfere with the spectrum of the resulting emission. To resolve this problem creating a surface, cover can destroy the defective parts and improve the Fluorescence quantum efficiency. Created cover can be used to improve optical properties. Quantum dots can usually be coated with a thin layer of a material with a high energy spacing and this can increase the fluorescence significantly. For example through increasing the in coverages from first to the second layer the quantum efficiency of CdSe fluorescence increases from 5% to 50%. Quantum dots are becoming an effective tool for tracking the movements of individual molecules in the living system the use of quantum dots is effective in the following.

Conclusion

This purpose aims to introduce common nanoparticles and nanostructures applicable in the medical field Fullerenes, Nano micelles Solid lipid nanoparticles, Metal nanoparticles, Polymeric nanoparticles, Dendrimers, Nano shells, Quantum dots Nano liposomes which makes it possible to use them in various medical fields such as, identify a diagnosis and manufacture of smart medicines as well as different sensors. Application of nanoparticles for Nano medicine Research related to introducing the different type of nanoparticles for the development of new advanced processes and equipment in Nano Medicine.

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