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A REVIEW ON NANOTECHNOLOGY IN DRUG DELIVERY SYSTEMS

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ABSTRACT

Nanotechnology is a current development in science, engineering and technology conducted at the Nano scale up to 1 to 100 nanometers. Mainly this system is based upon nanoparticles, nanocarriers, magnetic nanoparticles. Nanotechnology is use in field of medicine for the treatment, diagnostic, monitoring, genetic engineering and drug delivery therapy. To overcome the difficulties of a gene and drug delivery, nanotechnology has expanded interest in current years. As per this technology have many advantages but also several disadvantages too. It has also great potential to bring benefits in several areas of research and applications. Here we discuss the methods involve in nanotechnology.

KEYWORDS

Nanodrug delivery, Nanoparticles, Nanocarriers and Magnetic nanoparticles.

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INTRODUCTION

The drug delivery means process of administering a pharmaceutical compound to achieve a therapeutic effect on specific site of action in humans or animals without undergoing site like non targeted cell, tissue, organ, etc. The prefix Nano is derived from the Greek word means *dwarf*. Nanotechnology is a current development in science, engineering and technology conducted at the Nano scale up to 1 to 100 nanometers[1]. One nanometer (nm) is equal to 10^{-9} meter. The concepts of nanotechnology were first introduced by physicist Richard Feynman in 1959, at that time many of scientist work on this system inspired by nuclear concept. Nowadays an

enormous of application of this techniques use in medical field like manufacturing, designing of drugs moreover as treating various diseases and used against several tumor types for several decades[2]. This technique is used as targeted delivery system for distributing every size of molecules by altering their pharmacodynamics and pharmacokinetic properties.

Nanomedicine define by European Science Foundation as the science and technology of diagnosing, treating and avoiding disease and disquieting injury of relieving painand of preserving and improving human health, using molecular tools and molecular knowledge of the human body[3].

Advantage of nanotechnology

- Increased bioavailability
- Dose proportionality
- Decreased toxicity
- Increased active agent surface area results in a faster dissolution of the active agent in an aqueous environment, such as the human body.
- Reduction in fed/fasted variability[4].

Disadvantage of nanotechnology

- The manufacturing costs of nanoparticle are high.
- Nanoparticles are difficult to handle in physical form because particle-particle aggregation occurs due their small size and large surface area.
- Solvents are toxic in nature which is used in the preparation process.
- Extensive use of poly (vinyl alcohol) as stabilizer may have toxicity issues.
- This cause immune response and allergic reaction in body[5].

Nanotechnology in drug delivery system mainly based upon the nanoparticles, nanocarriers and magnetic nanoparticle for various purposes.

NANOTECHNOLOGY IN DRUG DELIVERY

Nanoparticles

The chemical and physical properties of nanoparticles make effective drug delivery that have the probable to progress the bioavailability, drug carrying capacity, constancy for the drugs within the body. It consists mainly two types nanoparticles i.e. organic nanoparticle such as liposomes, Nanocrystals, Dendrimers, polymeric nanoparticle and inorganic nanoparticle (Figure No.1)[6].

Liposome

Liposomes are established from such as phosphatidylcholine, phosphatidylglycerol, phosphatidylethanolamine and phosphatidylserine, which have been use in biology, biochemistry, medicine, food and cosmetics. The physical appearance of liposomes is determined by the choice of lipid, their arrangement, method of preparation, size and surface charge. Applications of liposomes contain transdermal drug delivery to progress skin permeation of medication with high mass and poor water solubility[7].

Nanocrystals

Nan crystals are aggregates of molecules which is able to be combined into a crystal from of drug surrounded via a thin coating of surfactant. These crystals are broadly employed in materials research, chemical engineering and in biological imaging, but comparatively less in nanomedicine for drug delivery system[8].

Dendrimers

The name actually derived from Greek word 'Dendron' means Tree. Dendrimers are symmetrical, three dimensional and spherical macromolecules (nearly 5000-500,000g/mol) comprising a relatively dense shell composed of a core, branching sites and terminal groups that usually form a well-defined surface. In recent this are used for various cancer treatments like colon and breast cancer[9,10].

Polymeric nanoparticle

Polymeric nanoparticles are solid colloidal particles with diameter starting from 1 to 1000 nm. It'shires as biomaterials for the explanation that of their favourable characteristics and style, good biocompatibility, a comprehensive structures variability and clear bio imitative characteristics, purposed in human body with excellent efficacy. Many of polymer are use in this like alginate,

albumin, chitosan, gelatin, PLA, PLGA, PGA, POE, PCL, PMLA, PMMA etc[11,12].

Inorganic nanoparticle

Inorganic nanoparticles are non-harmful, hydrophilic (water loving), biocompatible and highly steady compared to organic materials. It protects the drug from degradation and can reduce the frequency of administration and dose of the drug, thereby a significant reduction in the toxicity of drugs and particularly of cancer drugs. Inorganic particles like Gold nanoparticles, Qdots, Super paramagnetic iron oxide nanoparticle, paramagnetic Lanthanide ions etc (Figure No.2)[13].

Nanocarriers

Nanocarriers are basically colloidal particles, broadly used for the transmission of a therapeutic agent[14]. Most of this are useful in targeted drug delivery system as carrying drug at specific site of action on certain organs or tissue. Usually their size ranges from 1-1000nm in diameter. It includes carbon carrier, polymeric micelle, viral carrier, solid-lipid carrier etc (Figure No.3). Nanocarriers is being applied to their potential use in drug delivery, especially in chemotherapy.

Carbon carrier

Carbon nanotube are carbon-carbon connected structure with single or double bonded, compose of benzene rings arrive into a tubular structure. They have nanometric dimensions and fallen into two groups based on their structure i.e. single-walled carbon nanotubes which have one layer of cylinder graphene, diameter about 0.4-2nm, length about 20-100nm and multi-walled carbon nanotube consist multiple concentric graphene layers, diameter about 1.4-100nm, length about from 1 to several μm[15].

Polymeric micelle

Polymeric micelles typically consist of hydrophilic (outer region) as well as hydrophobic (inner region) polymers characterized in an aqueous medium by self-aggregation of polymer chains. Typically, its size less than 50-100nm. For drug delivery, copolymer is use like that poly lactic acid, poly ethylene glycol, poly glycol oxide, poly ε-caprolactone. The most commonly used hydrophilic segment of micelles for drug delivery is poly ethylene glycol, with a molecular weight of 2-15 kDa and hydrophobic segment of micelle as it is. This polymeric micelle use in cancer treatment[16,17].

Viral carrier

Virus particles typically consist of several 100-1000 of protein molecules, which self-assemble to form a hollow frame work packaging the viral nucleic acid. This virus is versatile at the genetic level, for applications as reagents, catalysts, and for chemical reactions. Range is about in sizes from 10nm to over a micron. As per virus originated it consist cowpea chlorotic mottle virus, cowpea mosaic virus, red clover necrotic mosaic virus, MS2, bacteriophage Qβ, M13 bacteriophage etc. Application of nanocarrier are genetically engineered vaccine, target drug delivery, biomedical imaging[18,19].

Solid-Lipid carrier

It mainly classified into two groups like solid-Lipid nanocarrier and Nanostructured lipid carrier. Size range mainly 50-1000nm. Solid lipid particles composed with suitable excipients like triglycerides, monoglycerides and fatty acids and method of preparation commonly used are high pressure homogenization and microemulsification. Solid lipid nanocarriers have great application in drug delivery especially in controlling drug release and targeting to specific organs[20,21].

Magnetic nanoparticles

Magnetic nanoparticles are type of nanoparticle which alternating by use of magnetic field. This are cluster of two component i.e. magnetic metal like iron, nickel, cobalt and chemical component like functional group. They have a core-shell structure, in which core consist of magnetic iron oxide generally magnetite (Fe3O4) or maghemite (gamma-Fe2O3) and the shell is commonly a polymer such as silica, dextran, PVA, or metals to which functional groups can be attached via (Figure No.4)[22]. This method is not use in cancer treatment, but as per its positive feedback it uses for various approaches like:

- Use as magnetic resonance imaging (MRI)

- Hyperthermia agents on tumors treatment, where the magnetic particles are heated selectively on high frequency magnetic field.
- Magnetic vectors can be directed by certain location, so this case use in the targeted drug delivery[23].

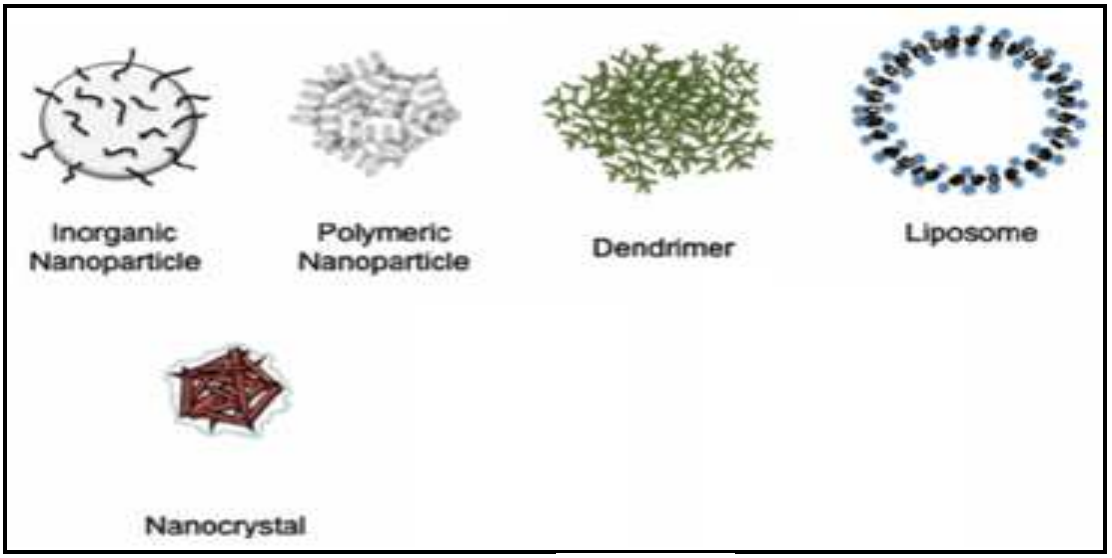

Figure No.1: Nanoparticle

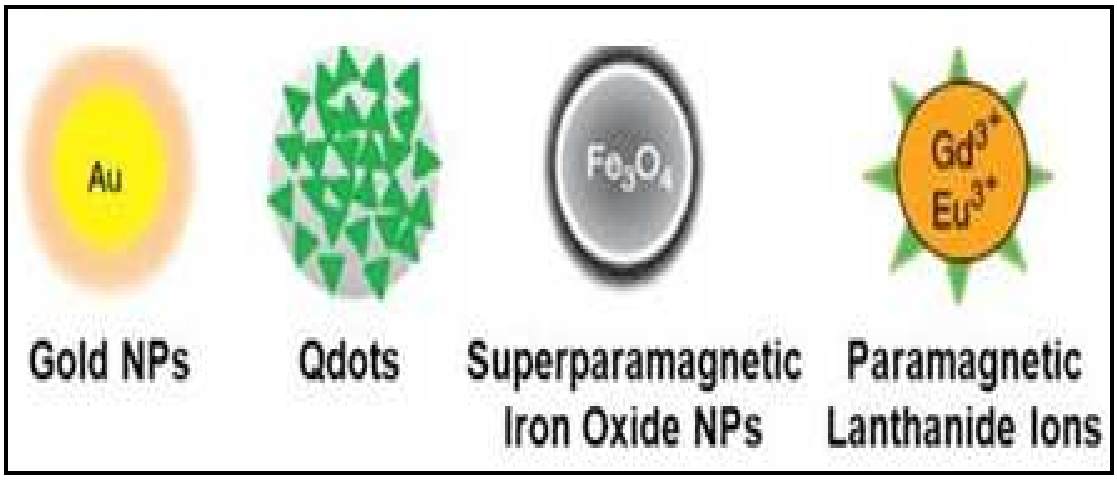

Figure No.2: Inorganic Nanoparticle

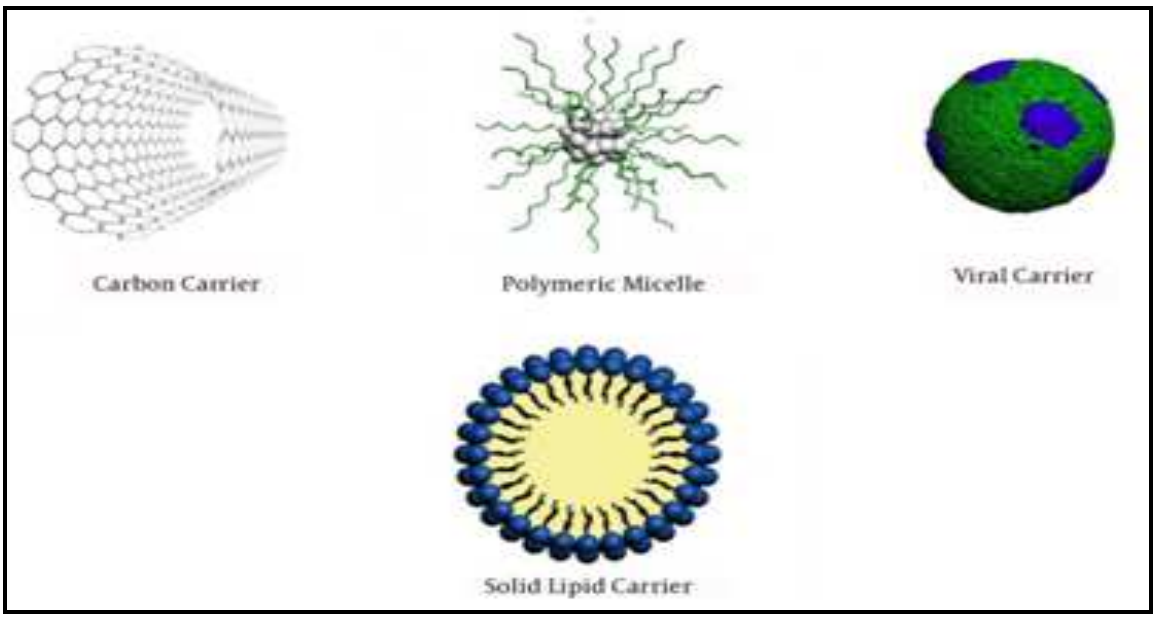

Figure No.3: Nanocarriers

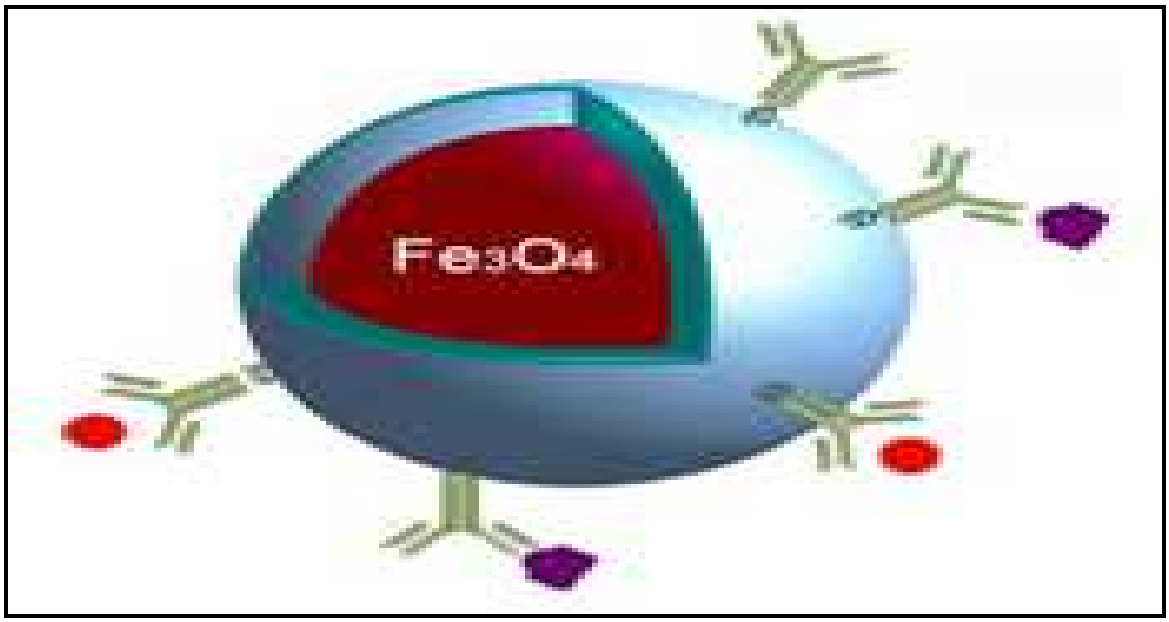

Figure No.4: Magnetic nanoparticle

CONCLUSION

From above study of nanotechnology, we conclude that varieties of nanoparticles, nanocarriers and magnetic nanoparticle are use to improvise the drug delivery system and medical profession. Mostly this is use for targeted organ. It also helps in critical situation or treatment like cancer therapy and skin related problem.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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