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Nanotechnology a Boon To Drug Delivary System".

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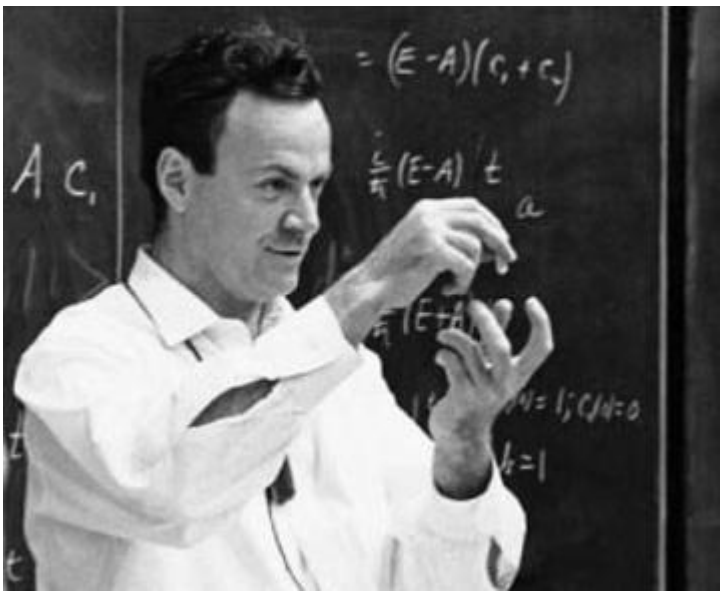
Abstract:- Nanotechnology has entered the realm of drug delivary.Performances of intelligent drug delivery systems are improved to maximize therapeutic activity and to minimize undesirable side effects.Nanoparticles hold tremendous potential as an effective drug delivary.In this review we discussed recent development in Nanotechnology for drug delivary.This review describes the system, carbon nanotubes in drug delivery .To overcome the problems of gene and drug delivery nanotechnology has gained interest in recent years.Nano systems with different compositions and biological properties have been extensively investigated for drug and gene delivery applications. To achieve efficient drug delivery it is important to understand the interaction of Nanomaterials with the biological environment, targeting cell surface receptors, drug release, and multiple drug administration, stability of therapeutic agents and molecular mechanisms of cell signaling involved in pathobiology of the disease under consideration. Brain cancer is one of the most difficult malignancies to detect and treat mainly because of the difficulty in getting imaging and therapeutic agents past the blood-brain barrier and into the brain. The use of nanomaterials is a new approach to control disease progression which is discussed in detail in the present review.

Keywords: *Nanotechnology, drug delivery, carbon nanotube,malignancies,Nanomaterials*.

I. INTRODUCTION

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers.



Physicist Richard Feynman, the father of nanotechnology.

Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering.
The ideas and concepts behind nanoscience and nanotechnology started with a talk entitled "There's Plenty of Room at the Bottom" by physicist Richard Feynman at an American Physical Society meeting at the California Institute of Technology (CalTech) on December 29, 1959, long before the term nanotechnology was used. In his talk, Feynman described a process in which scientists would be able to manipulate and control individual atoms and molecules. Over a decade later, in his explorations of ultraprecision machining, Professor Norio Taniguchi coined the term nanotechnology. It wasn't until 1981, with the development of the scanning tunneling microscope that could "see" individual atoms, that modern nanotechnology gan.
Nanotechnology is increasingly considered to be the technology of the future,
With nanotechnology, scientists are acquiring abilities to understand and manipulate materials at the scale of atoms and molecules, with having the, With nanotechnology, scientists are acquiring abilities to understand following key properties;

- Nanostructures have at least one dimension of about 1–100 nm
- They are designed through methodologies that exhibit fundamental control over the physical and chemical attributes of molecular-scale structures.

Nanotechnology has been utilized in medicine for therapeutic drug delivery and the development of treatments for a variety of diseases and disorders. So, there are very significant advances in these disciplines.
Since emerging in the early 1970s, Controlled drug delivery systems (DDS), which are aimed to deliver drugs at predetermined rates and predefined periods of time, have attracted increasing attention (Qiu and Park, 2001 and Jeong et al., 2002). On the other hand, drug delivery is an emerging field focused on targeting drugs or genes to a desirable group of cells. The goal of this targeted delivery is to transport proper amounts of drugs to the desirable sites (such as tumors, diseased tissues, etc.) while minimizing unwanted side effects of the drugs on other tissues (Tran et al., 2009). Micro- and nano-scale intelligent systems can maximize the efficacy of therapeutic treatments in numerous ways because they have the ability to rapidly detect and respond to disease states directly at the site, sparing physiologically healthy cells and tissues and thereby improving a patient's quality of life. This new class of "intelligent therapeutics" refers to intelligent and responsive delivery systems that are designed to perform various functions like detection, isolation and/or release of therapeutic agents for the treatment of diseased conditions. To meet these requirements, researchers must be able to interface synthetic and hybrid materials with dynamic biological systems on the micro- and nano-length scale. Stimuli responsive biomaterials are very promising carriers for the development of advanced intelligent therapeutics (Moore and Peppas, 2009).

In this review, we discuss the use of nanotechnology for medical applications with focus on its use for drug delivery. Specifically, we discuss about various intelligent drug delivery system Such asInorganic nanoparticles,polymers in drug delivery system,cardon nano tubes in drug delivery system and genetic and gene therapy like Targeting cancer cells with nanoparticles, Targeting angiogenesis with nanoparticles and many others. Use of smart drug delivery systems is a promising approach for developing intelligent therapeutic systems.

II. INORGANIC NANOPARTICLES;

Inorganic nanoparticles can be defined as particles of metal oxide or metallic composition possessing at least one length scale in the nanometer range. These nanostructures exhibit significantly novel and distinct chemical, physical, and biological properties, and functionality due to their nanoscale size, have elicited much interest. The preparation of inorganic nanoparticles offers several challenges. There is not a one-fits-all type of production process for nanoparticles and most procedures will differ considerably between different research institutions and industrial scale laboratories.

The most traditional preparation method for nanoparticle synthesis is the sol–gel route (Brinker and Scherer, 1990)which the preparation of a solution of inorganic precursor, and the control of its particle growth though thermal or pH conditions of the solution. Typical inorganic precursors including metal salts, metal halides, and inorganic alkoxides are synthesized by hydrolysis and condensation reactions into the relevant metal oxide species. The use of mineralizers (acids or bases) allows for control of the rates of hydrolysis and condensation independently, switching from kinetic-based to equilibrium- based particle growth mechanisms, and ultimately allowing for control of the growth speeds of various facets versus others (Lee et al., 2006).
Another method for the preparation of nanoparticles is microemulsion processing. Microemulsions have been used for the production of metallic nanoparticles (Kishida et al., 1995) as well as magnetic and superconductor nanoparticles (Pileni and Fendler, 1998). Microemulsions are produced spontaneously without the need for significant mechanical agitation making it a rather simple technique. The technique is simple and uses inexpensive equipment that results in high yields with homogeneous particle sizes (Vestal and Zhang, 2002). Among, inorganic nanoparticles, we focus on metallic nanoparticles and mesoporous silica nanoparticles.
3. Polymers in drug delivery systems

Engineering polymeric nanostructures such as hyperbranched polymers, dendrimers and polymeric micelles (Xu et al., 2012, Gong et al., 2012a and Gong et al., 2012b) are a growing area of contemporary biomaterials science, due to their unique properties and large potential in drug delivery (Kim et al., 2012, Lim and Simanek, 2012 and Bielawski et al., 2011). For using polymers in drug delivery, a polymer must be biocompatible. Biocompatibility was defined by (Williams (1999)) as the ability of a material to act with an appropriate host response in a specific application. Moreover, biocompatible polymers used in drug delivery are often biodegradable with the formation of non-harmful byproducts, such as non-toxic alcohols, acids and other easily eliminated low molecular weight products. They can indeed contribute to the drug release as a result of their erosion/degradation, in addition to drug diffusion through the polymeric material. Biodegradable polymer (Table 1), in the development of drug delivery systems, must meet very specific requirements such as:

a. Biocompatibility backbone of the polymer and its degradation products.
b. Mechanical strength sufficient to meet the needs of specific applications.
c. Degradability with degradation kinetics matching a biological process such as wound healing.
d. Processibility using available equipment.

e. Solubility in various solvents.
f. Chemical, structural and application versatility.
g. Economically acceptable shelf life.
h. European Medicine Evaluation Agency (EMEA) or Food and Drug Administration (FDA), USA. (Coulembiera et al., 2006).

Table 1.Classification of biodegradable polymers used in drug delivery systems (Coulembiera et al., 2006).

Synthetic biodegradable polymers		Natural biodegradable polymers	
Polyesters	Polyoxalates	Starch	Albumin
Polyorthoesters	Polyiminocarbonates	Hyaluronic acid	Dextran
Polyanhydrides	Polyurethanes	Heparin	Chitosan
Polydioxanones	Polyphosphazenes	Gelatin	–
Poly(a-cyanoacrylates)	–		

Table options

Stimulus-responsive polymers, as 'intelligent', 'smart' or 'environmentally sensitive' polymers, are systems that exhibit large, sharp changes in response to physical stimuli (such as temperature, solvents, or light) or to chemical stimuli (such as reactants, pH, ions in solution, or chemical recognition). Responses differ depending on the stimulus applied and may include changes in shape, volume, mechanical properties, or permeation rates, among other things.

III. CARBON NANOTUBES IN DRUG DELIVERY

Since the discovery of carbon nanotubes (CNTs) in 1991 (Iijima, 1991), CNTs have raised considerable attention due to their excellent mechanical, electrical and surface properties that have made them ideal candidates for a wide range of applications such as structural materials (Guldi et al., 2006 and Goldberger et al., 2006). Recently, its potential application in biotechnology has attracted much interest, as CNTs have been reported to exhibit great advantages in biosensors (Qureshi et al., 2012 and Zhang et al., 2007a), biomedical devices (Li et al., 2011) and drug delivery systems (Karchemski et al., 2012 and Zhang and Olin, 2012) etc.

Pristine, CNTs tend to bundle up and are insoluble in most types of solvents (Tasis et al., 2003) making it difficult to use them in biological systems. Moreover, some CNTs without any functionalization have been shown to be cytotoxic (Colvin, 2003 and Warheit et al., 2004). Therefore, to integrate CNTs into biological systems, CNTs need to be functionalized. Functionalization can make CNTs soluble and improve their biocompatibility properties. Moreover, through functionalization, bioactive agents can be conjugated to CNTs which can serve as a carrier for drugs, antigens and gene delivery (Tran et al., 2009).

. Nanosystems with different compositions and biological properties have been extensively investigated for drug and gene delivery applications [1-5]. An effective approach for achieving efficient drug delivery would be to rationally develop nanosystems based on the understanding of their interactions with the biological environment, target cell population, target cell-surface receptors [6], changes in cell receptors that occur with progression of disease, mechanism and site of drug action, drug retention, multiple drug administration, molecular mechanisms, and pathobiology of the disease under consideration.

In this review I am focusing on Targeting cancer cells with nanoparticles and Targeting angiogenesis with nanoparticles.

5. Cancer

Targeting cancer cells with nanoparticles

Cancer is one of the most challenging diseases today, and brain cancer is one of the most difficult malignancies to detect and treat mainly because of the difficulty in getting imaging and therapeutic agents across the blood-brain barrier and into the brain. Many investigators have found that nanoparticles hold promising for ferrying such agents into the brain [20-22]. Apolipoprotein E was suggested to mediate drug transport across the blood-brain barrier [23]. Loperamide, which does not cross the blood-brain barrier but exerts antinociceptive effects after direct injection into the brain, was loaded into human serum albumin nanoparticles and linked to apolipoprotein E. Mice treated intravenously with this complex induced antinociceptive effects in the tail-flick test. The efficacy of this drug delivery system of course depends upon the recognition of lipoprotein receptors. Kopelman and colleagues designed Probes Encapsulated by Biologically Localized Embedding (PEBBLE) to carry a variety of unique agents on their surface and to perform multiple functions [22]. One target molecule immobilized on the surface could guide the PEBBLE to a tumor. Another agent could be used to help visualize the target using magnetic resonance imaging, while a third agent attached to the PEBBLE could deliver a destructive dose of drug or toxin to nearby cancer cells. All three functions can

be combined in a single tiny polymer sphere to make a potent weapon against cancer. Another anti-cancer drug, doxorubicin, bound to polysorbate-coated nanoparticles is able to cross the intact blood-brain barrier and be released at therapeutic concentrations in the brain [24]. Smart superparamagnetic iron oxide particle conjugates can be used to target and locate brain tumors earlier and more accurately than reported methods [25]. It is known that folic acid combined with polyethylene glycol can further enhance the targeting and intracellular uptake of the nanoparticles. Therefore, nanomaterial holds tremendous potential as a carrier for drugs to target cancer cells.

IV. Targeting angiogenesis with nanoparticles

Robust angiogenesis underlies aggressive growth of tumors. Therefore, one of the mechanisms to inhibit angiogenesis is to starve tumor cells. Angiogenesis is regulated through a complex set of mediators and recent evidence shows that integrin αvβ3 and vascular endothelial growth factors (VEGFs) play important regulator roles. Therefore, selective targeting of αvβ3 integrin and VEGFs is a novel anti-angiogenesis strategy for treating a wide variety of solid tumors. One approach is to coat nanoparticles with peptides that bind specifically to the αvβ3 integrin and the VEGF receptor [26]. The synthetic peptide bearing Arg-Gly-Asp (RGD) sequence is known to specifically bind to the αvβ3 integrin expressed on endothelial cells in the angiogenic blood vessels, which can potentially inhibit the tumor growth and proliferation. Following hydrophobic modifications, glycol chitosan is capable of forming self-aggregated nanotube and has been used as a carrier for the RGD peptide, labeled with fluoresein isothiocyanate (FITC-GRGDS) [27]. These nanotubes loaded with FITC-GRGDS might be useful for monitoring or destroying the angiogenic tissue/blood vessels surrounding the tumor tissue. Our research group has been studying biological responses of RGDSK self-assembling rosette nanotubes (RGDSK-RNT). These rosette nanotubes are a novel class of nanotubes that are biologically inspired and naturally water soluble upon synthesis [28,29]. These nanotubes are formed from guanine-cytosine motif as building blocks. However, one of the novel properties of the RNT is the ability to accept a variety of functional groups at the G/C motif which imparts functional versatility to the nanotubes for specific medical or biological applications. Therefore, the RNTs can be potentially modified to target a variety of therapeutic molecules in vivo to treat cancer and inflammatory diseases.

V. CONCLUSION:

Nanotechnology will assume an essential place in drug delivery and human therapeutics.
Nanotechnology, which is still in its infancy, provides opportunities for physicists, chemists and biochemists
Nanotechnology is an emerging field that is potentially changing the way we treat diseases through drug delivery.Through nanotechnology elaboration match in sophistication and precision of biological structures elaborated by nature.The design and testing of novel methods of controlling the interaction of nanomaterials with the body are some of the current barriers to translating these technologies to therapies. Methods of targeting nanomaterials to specific sites of the body while avoiding capture by organs, such as the liver and spleen, are major challenges that need to be addressed.

It appears that nano drug delivery systems hold great potential to overcome some of the barriers to efficient targeting of cells and molecules in inflammation and cancer. There also is an exciting possibility to overcome problems of drug resistance in target cells and to facilitating movement of drugs across barriers such as those in the brain. The challenge, however, remains the precise characterization of molecular targets and to ensure that these molecules are expressed only in the targeted organs to prevent effects on healthy tissues. Secondly, it is important to understand the fate of the drugs once delivered to the nucleus and other sensitive cells organelles. Furthermore, because nanosystems increase efficiency of drug delivery, the doses may need recalibration. Nevertheless, the future remains exciting and wide open.

Nanoscale structures such as surface topography and patterning could be used to direct cell behavior. The incorporation of these strategies within tissue engineering scaffolds could further enhance their function. As Feynman had predicted, there has been plenty of room at the bottom to modify and enhance existing technologies by controlling material properties at the nanoscale. Therefore, with sufficient time and research, the promise of nanotechnology based medicine may become a reality.Thus we can say in future for research in nanotechnology gates are wide open .The dream through gene therapy curing the genetical diseases like diabeties,hypertension and heamophila can be cured with more precision .

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