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A REVIEW ON NANO TECHNOLOGY

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ABSTRACT:

Nanotechnology has created one of the most dynamic science & technology domains at the confluence of physical sciences, molecular engineering, biology & medicine. It includes better understanding of living systems, synthesis of new drugs and their targeted delivery, Neuromorphic engineering & developing a sustainable environment. The reduction of drug particles into submicron range leads to a significant increase in the dissolution rate & therefore enhances bioavailability. Targeting delivery of drugs to the diseased lesion ns is one of the most important aspects of drug delivery system. Various polymers have been used in the formulation of nanoparticles of drug delivery research to increase therapeutic benefit while minimizing the side effects. This review article presents the most understanding contributions in the field of nanotechnology as drug delivery system.

INTRODUCTION :

- Physicist Richard Feynman ,father of nanotechnology
- Nanotechnology is science, engineering and technology conducted at the nanoscale, which is about 1-100nm.
- The branch of technology that deals with dimensions and tolerances of <100nm, especially the manipulation of individual atoms & molecules.
- Nanoparticles are minimizes/smaller particles with more efficancy.

ADVANTAGES	DISADVANTAGES
1) Promoting renewable energies: Enables new ways to obtain & store energy. It also makes solar panels cheaper & more efficient	1) It threatens the environment: This type of technology could cause negative effects on the environment by generating new toxins & pollutants
2) It extends the limits of electrons: unlike silicon microchips, Nano chips will make it possible to build very precise circuits at an atomic level	2) It has an impact on the job market: the absolute materials and changes in production processes could destroy jobs but this technology could create others
3) It allows a more effectivemedicine: damaged genes can be repaired faster and more precise surgeries can be performed	4) It compromises the safety:properties of this technology facilitate espionage, production of nano weapons & smart bullets

TYPES:

- Descending type: Top-down(bulk to low)
- Ascending type: bottom-up(self-assembly)

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MEDIUM: There are two types of technologies[1] 1) Dry Technology

2) Wet Technology

DRY TECHNOLOGY:

It is used to manufacture structures in coal, silicon, inorganic materials, metals& semi- conductors that do not work with humidity.

WET TECHNOLOGY:

It is based on biological systems present in an aqueous environment –genetic materials ,membranes, enzymes &other cellular components.

APPLICATIONS:

1) Electronics: carbon- nanotubes.
2) Energy: solar panels.
3) Biomedicine: cancer cells.
4) Environment: purification of waste water by nanotubes.
5) Food: Nano biosensors could be used to detect the presence of pathogens.
6) Textile: smart fabrics.

EVERY DAY PRODUCTS USE NANOTECHNOLOGY:

- Sunscreen, clothing, furniture, adhesives, coating for a car paintwork, tennis balls, computers.
- It also includes toothpastes & chapathi.

NANO TECHNOLOGY IN PHARMACY:

- It is the science that deals with the processes that occur at molecular level & Nano length scale size.
- Pharmaceutical nanotechnology provides 2 basic types of Nano-Tools

1.Nano materials:

Ex: Titanium dioxide , silver

2.Nano devices :

Ex:Cam-pill , Digital pill

APPLICATIONS :

- DNA, Water molecules, Virus, Liposomes, Dendrites,Metallic nanoparticles, Polymeric nanoparticles , carbon nanotubes, Quantum dots, Nanofibres Etc.
- Nano-biomaterials: orthopedic , Dental implants, Scaffolds for tissue-engineering products.
- Raw-Nano materials: Drug encapsulation, Bone replacements,
- Prostheses, Artificial mechanical devices-to replace body parts lost in injury & are by birth artificial limbs, facial, prosthetics, neuroprosthetics&implants.
- Biosensors detectors to detect trace qualities of bacteria, airborne pathogens, biological hazards, some intelligent machines like Respirocytes.

General applications include- intracellular targeting, treatment of chemotherapy, Avoidance of multi-drug resistance, Treatment of leprosy, ocular drug delivery, brain drug delivery,DNA delivery, lymph drug delivery, Tissue engineering. Drug discovery.

DRUG DELIVERY SYSTEM:-

NDDS are a class of nanomaterials that have abilities to increase the stability and water solution of drugs, prolong the cycle time, increase the uptake rate of target cells or tissues and reduce enzyme degradation there by improve the safety and effectiveness of drugs

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Nanoparticles are used in drug delivery due to their small size &large surface area, show increase solubility& thus enhances bioavailability ,Additional ability to cross BBB-Blood brain barrier, enter the pulmonary system& be absorbed through the tight junctions of endothelial cells of skin.

Use: NDDS applications occurs through the use of designed nanomaterials as well as forming delivery systems from nano scale molecules such as liposomes, improve the ability to deliver drugs that are poorly water solution provide specific site targeting to reduce drug accumulation within healthy tissue.

Nanoparticles-Examples: Liposomes,alginate ,chitosan, xanthan gum, polymeric micelles, dendrimers , inorganic nanoparticles.

Methods: Delivery vehicles ; Routes of delivery ; Cargo ; Targetingstrategies.
Administration: Swallowing, Inhalation, Absorption-skin, Intravenous.

TYPES OF PHARMACEUTICAL NANOSYSTEM:

CARBON NANOTUBES:

These are hexagonal networks of carbon atoms. Length and diameter of these tubes are 1nm& 1-100nm in length. [2]

These are small macro molecules have unique size & shape

Nanotubes are of two types 1.Single walled nanotubes

2. Multi walled nanotubes

QUANTUM DOTS:

These are semi conducting materials consisting of a semi conductor core coated by a shell to improve optical properties. Their properties originate from their physical size which ranges from 10-100 A^0 in radius detection & analysis of bio molecules in munoassay & DNA hybridisation & in non-viral vectors for gene therapy.

DENDRIMES:

- These are hyper branched tree like structures &have compartmentalized chemical polymer. It contains 3-different regions core, branches, surface.
- The core forms the central part and branches radiates from it forming an internal cavity & sphere of groups.
- These can deliver bioactives like drug, vaccines, materials & genes to desired sites.

POLYMERIC NANOPARTICLES:

These are colloidal carrier 10nm-1µm in size. These nanoparticles provide alternative to above mentioned nanosystems due to inherent property like biocompatibility, Non-immunogenecity, Non-toxicity& biodegradability.

METALLIC NANOPARTICLES:

- Metallic nanoparticles are more favour in the good delivery as carrier for drug& biosensors .Nanoparticles of various metals have been made yet silver &gold.
- Nanoparticles are of prime important for biomedical use , a large number of ligands have been linked to nanoparticles such as sugar, peptide protein & DNA**.**

PREPARATION OF NANOPARTICLES:

Dispersion of preformed polymers by

- Solvent evaporation method.
- Spontaneous emulsification method.
- Salting-out / emulsification diffusion method.
- Production of nanoparticles using super critical technology.

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- Polymerization method.
- Nanoparticles prepare from hydrophilic polymers.

POLYMERIZATION OF MONOMERS:

Nanoparticles can be prepared from a variety of materials such as proteins, polysaccharides &synthetic polymers. The section of matrix materials is dependent on many factors including

- Size of nanoparticles required.
- Inherent properties of drug
- Surface characteristics such as charge & permeability.
- Degree of biodegradability, biocompatibility& toxicity.
- Drug release profile desired.
- Antigenicity of final products.[3]

Nanoparticles have been prepared most frequently by 3 methods

- Dispersion of preformed polymers.
- Polymerization of monomers.
- Ionic gelation or coacervation of hydrophilic polymers.

Dispersion of preformed polymers :

Dispersion of preformed polymers is a common technique used for the preparation of biodegradable nanoparticles from poly lactic acid(PLA) Poly D,L- glycollide (PLG) Poly ld,lactide co-glycollide (PLGA) & Poly cyano acrylate(PCA).

1.Solvent evaporation method :

In this method polymer is dissolved in an organic solvent such as dichloromethane, chloroform or ethyl acetate which is also used as solvent for dissolving the hydrophobic drug.

2. Spontaneous emulsification or solvent diffusion method:

In this method the water miscible solvent along with a small amount of water immiscible organic solvent is used as an oil phase. Due to the spontaneous diffusion of solvent an interfacial turbulence is created between the two phases leading to formation of small particles.

POLYMERIZATION METHOD:

In this method monomers are polymerized to form nanoparticles in an aqueous solution. Drug is introduced either by dissolving it in the polymerization medium or by adsorption onto the nanoparticles after polymerization completed.

COACERVATION OR IONIC GELATION METHOD:[5]

- In this method, positively charged amino group of chitson interacts with negative charged triphosphates to form coacervates with a size in range of nanometer.
- Coacervants are formed as a result of electrostatic interaction between two aqueous phases.

Production of nanoparticles using super critical fluid technology:

Conventional methods such as solvent- extraction, evaporation, solvent diffusion & organic phase separation methods require the use of organic solvents which are hazardous to the environment as well as the physiological systems.

Applications of pharmaceutical nanotools: [4]

1 **.As nanomaterials for tissue engineering**:

Nano technology offered numerous smart materials that are used for tissue repair and replacement, implant coatings, tissue generation, scattolds, structural implant materials, bone repair etc.

2. **Nano based drug delivery tools:**

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These are polymericnano particles, liposome, dendrimer, polymeric micelles, polymer drug conjugates, anti body drug conjugates which can be broadly classified as

a) Sustained and controlled delivery system

b) Stimuli sensitive delivery system

c) Functional system for delivery of bio actives

d) Multifunctional system for combined delivery of therapeutics

e) Site specific targeting

3. a)**Cancer treatment**: nano technology can have a revolutionary impact on cancer diagnosis &therapy

b) **implantable delivery system**: nano technology is opening up new opportunities is implantable delivery systems because of its size, controlled & application zero order level.

c) **site specific drug delivery**: several approaches are now being tested for better site specific delivery using liposomes, polymeric micelle, dendrimes , iron oxide, proteins using manipulation in passive & active update of drug

d) **Gene therapy**: In gene therapy a normal gene is inserted place of an abnormal disease causing gene using a carrier molecule

4.**Biosensor &biolabels**: A number of analytical tools have been developed with application of their smart & potential technology.

A bio sensor is generally defined as measurement of system that consist of probe with a sensitive biological recognition element or bioreceptor, a physiochemical detector component and a transducer in between two amplify & transduce there signals into measurable form

5. **Drug discovery**: Pharmaceutical nano technology is playing crucial role in drug discovery that reply on better understanding of mechanism of the drug action & identification of biomaker associated with specific disease

COMMERCIALLY AVAILABLE NANO PARTICLES:

Melamine nano spheres: plain polymethyl methacylate and biodegradable polylactide nano spheres.

Magnetic plain dextran nano spheres

Gold Nanospheres : gold particels are high quality nanospheres that can be used in the production of diagnostic tests as well as conjugation studies of protiens& antibodies.

Silver Nanospheres: silver nanospheres are high quality nanospheres that can be used in the production of diagnostic tests as well as conjugation studies of protiens&antibodies

Silica Nanospheres: This nano dispense silica particles having a density of 2.0g/cm^8 are easier to dispense & to separate. The silica particles are stable in coater and organic solvents, produced under a new dying method.[6]

CHALLENGES TO PHARMACEUTICAL NANOTECHNOLOGY:

Pharmaceutical nanotechnology has provided refined diagnosis &focused treatment of disease .However some ethical, scientific, social & regulatory issues posing various challenges in practical realization of pharmaceutical nanotechnology. some major health risk associated with such devices includes cytotoxicity, translocation to undesired cells, acute & chronic toxicity. some unknown unpredictable & undefined safety issues , environmental impacts of nanomaterials& non biocompactability.

Future prospects of pharmaceutical Nanotechnology:

Pharmaceutical nanotechnology is an emerging field that could potentially make major impact human health nanomaterials promise torevolutionize the medicine & are increasedsingly used in drug delivery or tissue engineering applications.

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Some of the advantages are:

- Developing toxicity testing protocol.
- Detecting and monitoring exposure level.
- Developing the biocompatible hybrid system.

conflicts:

No conflicts of othets

Conclusion

Pharmaceutical nanotechnology has a profound influence on disease prevention efforts because it offers innovative tools for understanding the cell as well as difference between normal cells and abnormal cells.

Pharmaceutical nanotechnology provides opportunities to improve materials, medical devices and help to develop new technologies where existing and more conventional technologies may reaching their limits.

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