International Journal of Pharmaceutical Science Invention
ISSN (Online): 2319-6718, ISSN (Print): 2319- 670X
www.ijpsi.org Volume 12 Issue 4 ǁ Jul. –Aug. 2023 ǁ PP. 56-67

Nanotechnology in Pharmacy

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Abstract: *Now a days, with increasing population the demand for health care facilities has increased rapidly. As this demand will keep on increasing without doubt, there is a great need to introduce and develop pharmaceutical industry with new technologies. This review includes information about nanotechnology used in the field of pharmacy and their application in pharmaceutical industries. The word 'nano' is a Latin word, which means 'dwarf'. Use of material at nanoscale is included in nanotechnology. Nano size is basically 10-9 of a particular unit. Therefore, adding similar values to size reduction, nanotechnology can help in improving stability, bioavailability, enhancing release, reducing toxicity and provide better formulation opportunities for drug. This review aims at enhancing knowledge about applications, scope and opportunities with future aspects of nanotechnology in the field of pharmaceuticals.*

Keywords: *Pharmaceutical industry, Pharmacy, Size reduction, Bioavailability.*

Date of Submission: 08-08-2023 Date of acceptance: 23-08-2023

I. INTRODUCTION

The word 'nanotechnology' was coined by Tokyo science university professor Norio Taniguchi, in 1974, and since then it is been used. Basic definitionof nanotechnology includes – any technology whichdeals at nanoscale is called nanotechnology. Nano size refers to 10^{-9} of a particular unit thus nanometeris 10^{-9} of a meter. Nanotechnology is a multidisciplinary field covering areas like electronics, molecular biology, biophysics, physics,engineering, medical and pharmaceuticals [1]. This study includes controlling of atom in an atomic or molecular scale. The properties of material/particle at nanoscale are different than that of macro scale, and this nano scale particles are called as nanoparticles [2]. Nanoparticles are of 10-1000 nm range as particulate dispersions or solid particles. Inrelation to pharmaceuticals; nanoparticles,nanospheres, or nano capsules can be obtained depending on its method of preparation. The drug can be dissolved, trapped, encapsulated or attached to a matrix of nanoparticles. Less expensive and much quicker treatments can be developed by use of nanotechnology in pharmaceutical field. Precise drug delivery can be achieved with the help of nanotechnology. Therefore, nanotechnology is playing an important role in development of pharmaceuticalfield [3].

II. Scope and Opportunities

Pharmaceutical nanotechnology is mostinnovative and so highly specialized field that in near future it will bring revolution in pharmaceutical industry. It is safe to assume that in next 10 years market will be flooded with nanotechnology devisedmedicine. Nanotechnology that helps in drug delivery can be used as substitute to traditional dosage forms. This technology is not only helpful indetecting microorganisms and viruses related with infection, but also helps in detection of antigens responsible for causing diseases like, cancer, diabetes Miletus and neurodegenerative diseases [4].

The scope of pharmaceutical nanotechnology is verywide and some of them are listed below-

1. Tissue engineering
2. Nano medicines
3. Nano robots
4. Biosensors
5. Biomarkers
6. Intelligent tools for delivery of drugs.
7. Image enhancement device
8. Bioactive surfaces
9. Implant technology
10. Tools for and diagnostics
11. Artificial RBC

… and so on. [1]

III. Types of nanotechnology used inpharmaceutical fields

Generally, two types of nanotechnologies are used in pharmaceutical, which includes nano devices and nano materials. Nano devices helps in delivery of certain therapeutic and diagnostic agents, they can in useful in formulation of nanomaterials used in advanced diagnostics and biosensors, molecular machines and medical nanorobots that can help in diagnosis and treatment of microbials and in the development of physiological function. Controlled drug delivery and smart medicine could be achievedby means of nano devices. Molecular medicine by genomics, proteomics, artificial microbial robots. Nanodevices are miniature devices in the nanoscaleand some of which include nano and microelectromechanical systems (NEMS/ MEMS), microfluidic, and microarrays (different kind of biological assay e.g., DNA, protein, cell, and antibody). Examples include biosensors anddetectors to detect trace quantities of bacteria, airborne pathogens, biological hazards, and disease signatures and some intelligent machines [5].

Nano materials are biomaterials that we can assume to use in dental or orthopedic implants or as support system for tissue engineered products. They are manufactured, modified and coated to enhance the biocompatibility by favoring the interaction of living cells with the biomaterial. These materials can be sub classified into nanocrystalline and nano structedmaterials. Nanocrystalline can substitute the lessperforming bulk materials. Nano materials are responsible for functioning of nano tools like quantum dots, carbon nanotools, dendrimers, etc. [5]

IV. Different nano systems used inpharmacy

4.1 Carbon nanotubes

As name indicates carbon nanotubes are made up byrolling graphene into cylindrical form [6]. Carbon nanotubes consist of tube with diameter of nanoscale. Depending upon length, thickness, number of tubes rolled up and type of helicity, carbon nanotubes have many structures. Carbon nanotubes can be classified as single walled carbon nanotube (SWCTs) and multi walled carbon nanotube (MWCTs), on the basis of number of tubes coiled to form tube [7]. They have greater capacity to absorb molecules. Main applications of Carbon Nanotubes in pharmacy and medicine consists of drug, biomolecule, gene delivery to cells or organs, tissue regeneration, and biosensor diagnostics and analysis, along with applications like drug targeting to cancerous cell, for tissue generation, can act as bone substituent, for DNA delivery, for preservation of drugs which are easily oxidized, etc. [8]

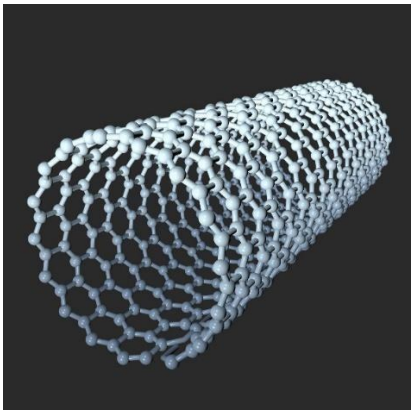

Fig 1. Structure of Carbon Nanotubes

4.2 Ceramic Nanoparticles

Applications at many frontiers of modern materials science like drug delivery system can be obtained by using inorganic (ceramic) particles with trapped biomolecule. Ceramic nanoparticles have the advantages of easy preparation with desired size, shape and porosity, and no effect on swelling or porosity without pH change [9].

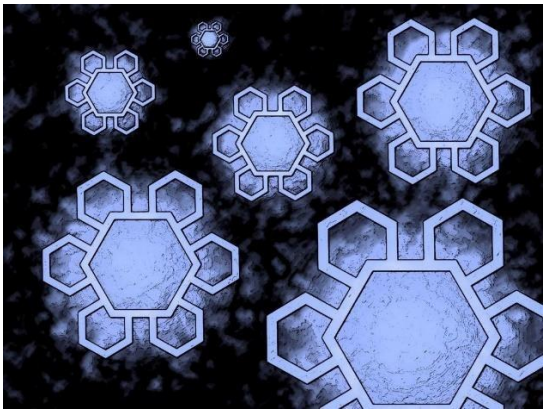

Fig 2. Structure of Ceramic Nanoparticles

4.3 Dendrimers

Dendrimers are highly branched, treelike structures and having different compartments of chemical polymer. They are nanosized macromolecules and are extensively used for drug delivery system. A single dendrimer may hold a molecule recognizing the cell death signals, a therapeutic agent destroying certain cells, and a molecule recognizing cancer cells. They have mono dispersity and well recognized chemical structures as compared to traditional polymer nano vehicle. Due to specific structure, drugs can be loaded in dendrimer structure by either covalent conjugation or electrostatic adsorption this is one of the most appreciable advantage of dendrimers [10]. It consists of huge void space in which drug molecules can be entrapped which helps in improvement in solubility of drug molecule. Dendrimer contain three different regions: core, branches, and surface. They have suitable properties for delivery of bioactive ranging from drugs, vaccines, metal, and genesto desired sites [11].

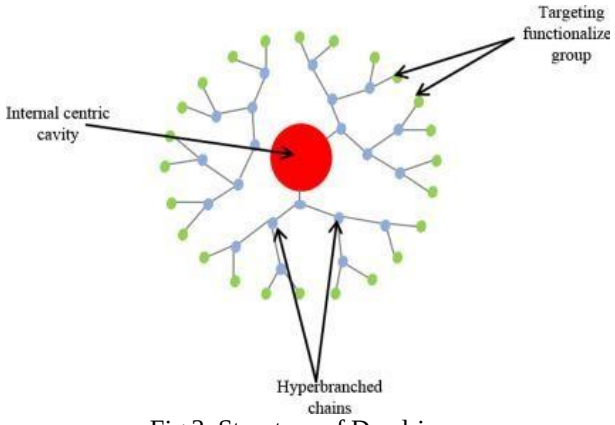

Fig 3. Structure of Dendrimer

4.4 Fullerenes

Any molecule in the form of a hollow sphere, ellipsoid or tubular structure composed entirely of carbon is said to be a fullerene, commonly referred to as "Buckyballs" – named after Buckminster Fuller who designed geodesic physical structures and buildings based on this geometry. A Buckyball was first found in soot developed from a laboratory experiment. Fullerenes are similar to carbon nanotubes in that their molecular framework is entirely composed of an extensive p-conjugated carbon skeleton. They are typically synthesized by poorly understood empirical methods; for instance, the vaporization of graphite by resistive heating yields grunge from which fullerenes can be isolated chromatographically. Fullerenes can very efficiently bind and inactivate radicals that play a crucial role in the development of diseases of the central nervous system (e.g. Parkinson, Alzheimer) andcardiovascular diseases. [11]

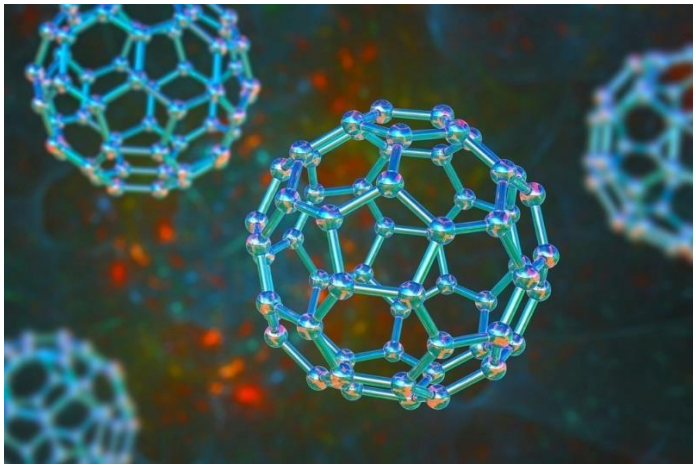

Fig 4. Structure of Fullerenes

4.5 Metallic nanoparticles

Nanoparticles of various metals have been discovered along with silver and gold nanoparticles, which are of prime importance for biomedical use, a large number of ligands have been linked to nanoparticles such as sugar, peptides, proteins and DNA. They have been used for active delivery of bioactive, drug discovery, bioassays, detection, imaging and many other applications due to surface functionalization ability, as an alternative to quantum-dots [12].

Fig 5. Structure of Metallic Nanoparticle

4.6 Magnetic Nanoparticles

These are powerful and efficient medical diagnostic devices. Techniques for magnetic immunoassay were established in which the main field is produced by the magnetically labelled target that was detected directly with a sensitive magnetometer. Superparamagnetic nanoparticles as contrast agents are used in magnetic resonance imaging. Polymer such as dextran is used for coating the magnetic nanoparticle. These magnetic nanoparticles can be used to get precise and accurate drug delivery at the site of action [13].

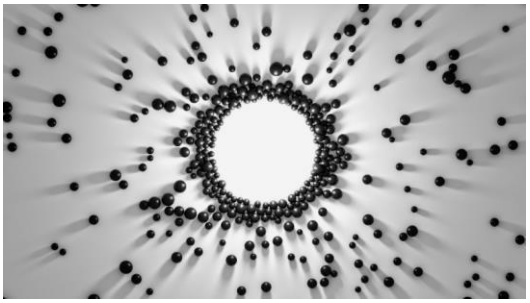

Fig 6. Structure of Metallic Nanoparticle

4.7 Nanocomposite

The word composite indicates any material made up of two or more different material, and the word nanocomposite indicates that among these materials any one material is in nano range. Properties of all the material from which it is made is found in that particular nanocomposite material. Nanocomposite consist of one or more discontinuous phase dispersed through continuous phase. The continuousphase is called as matrix while discontinuous phase is called as reinforcing material. Nanocomposites have several advantages like uniform distribution of active component in matrix, sustain release of active ingredient, reduced frequency of administration andincrease in stability [14].

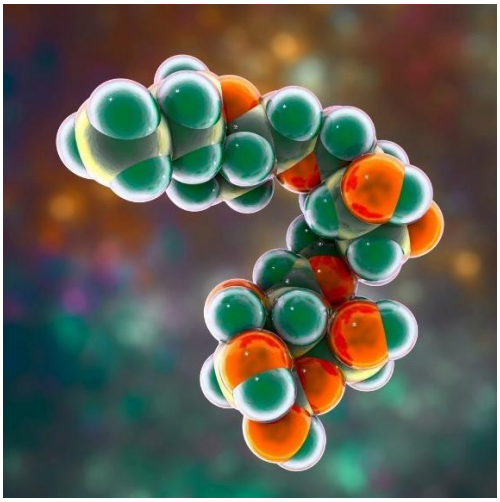

Fig 7. Structure of Metallic Nanoparticle

4.8 Nanopores

Nanopores are nanometer scale holes formed naturally by proteins or cells, for instance to allow ions to pass between nerve cells. Single nanopores form the basis for nerve activity. Similarly sized holes can also be made artificially. Materials with defined pore-sizes in the nanometer range are of special interest for a broad range of industrial application because of their outstanding properties with regard to thermal insulation, controllable material separation and release and their applicability as templates or fillers for chemistry and catalysis. An example of nanopores material is aerogel, which is produced by sol-gel chemistry [8].

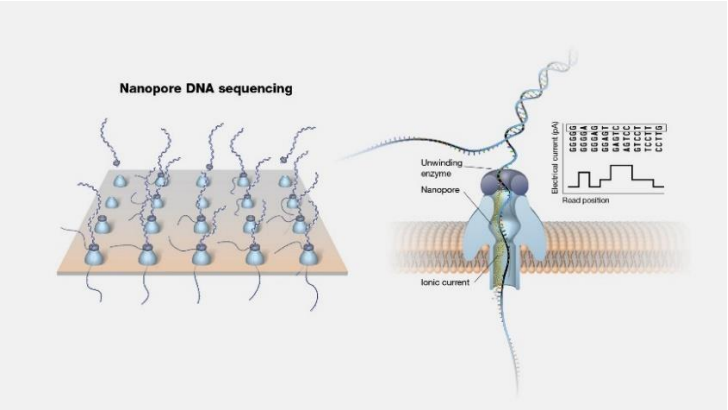

Fig 8. Structure of Nanopores

4.9 Nano shells

Metal nano shells are a new class of nanoparticles with highly tunable optical properties. Metal nano shells consist of a dielectric core nanoparticle such as silica surrounded by an ultrathin metal shell, often composed of gold for biomedical applications. The most significant applications of nano shells include biomedical imaging, therapeutic applications, fluorescence enhancement of weak molecular emitters, surface-enhanced Raman spectroscopy, and surface-enhanced infrared absorption spectroscopy. NS (Nano Shells) that absorb near- infrared light which can easily penetrate severalcentimeters of human tissues are most effective nano shells [8].

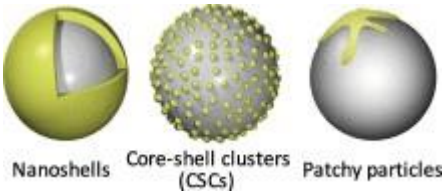

Fig 9. Structure of Nano Shell

4.10 Nanowires

Nanowires are conductive or semi-conductive particles with a few dozen nm crystalline structure and a high ratio of length / diameter. Nanowires are one-dimensional nanostructures that have a large length to diameter aspect ratios and they exhibit unique mechanical, electrical, thermal, and optical properties. Depending on the properties of nanowires such as geometry and material type, they can be produced by top-down or bottom-up methods. The responses of the nanowire to an electromagnetic field generated by a separate devicecan be used to control the release of a preloaded drug. This system eliminates tubes and wires required by other implantable devices that can lead to infection and other complications [8].

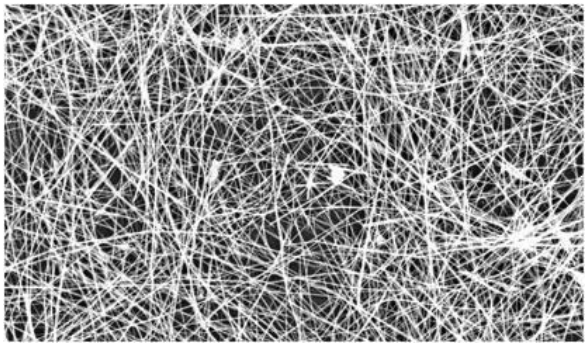

Fig 10. Structure of Nanowires

4.11 Polymeric Micelles

Polymeric micelles are nanoscopic core/shell structures formed by amphiphilic block copolymers. In physiological solution, polymeric micelles have improved thermodynamic stability, as shown by their low critical micellar concentration, which makes polymeric micelles stable and prevents their rapid in vivo dissociation. Drugs incorporated into polymeric micelle can accumulate in tumors to a greater degree than free drugs and show decreased distribution in non-targeted areas. Their inherent and modifiable properties of polymeric micelles make them particularly well suited for drug delivery purposes [15].

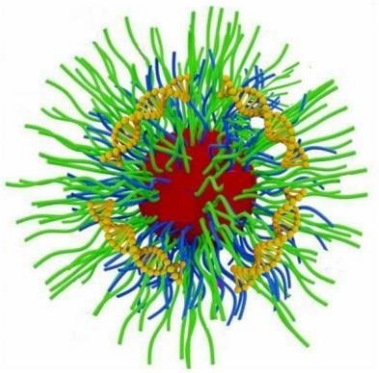

Fig 11. Structure of Polymeric micelles

4.12 Polymeric Nanoparticles

Polymeric nanoparticles (NPs) are particles within the size range from 1 to 1000 nm and can be loaded with active compounds entrapped within or surface-adsorbed onto the polymeric core. The drug is dissolved, absorbed, attached or encapsulated in the matrix of nanoparticles. [19] Nanoparticles, nanospheres or nano capsules may be obtained withvarious properties and release characteristics for encapsulated therapeutic agent, depending on the preparation method. Two main properties of polymeric nanoparticles enable them preferable for drug delivery, firstly because of their small size, firstnanoparticles can pass into smaller capillaries and are

taken up by cells, enabling efficient accumulation of drugs at the target sites. Secondly, the use of biodegradable materials for the preparation of nanoparticles permits the continued release of drugs within the target site for days or even weeks [16].

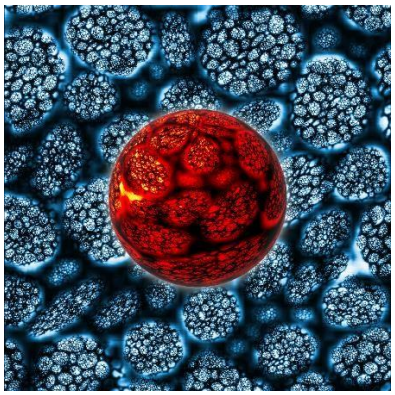

Fig 12. Structure of Polymeric Nanoparticle

4.13 Polyplexes

Polyplexes (PPs) are Interpol electrolyte complexes which are spontaneously formed through the electrostatic condensation between nucleic acid and a cationic polymer. These are assemblies, which form spontaneously between nucleic acids and polycations or cationic liposomes (or polycations conjugated to targeting ligands or hydrophilicpolymers), and are used in transfection protocols. They act by protecting nucleic acids from enzymaticdegradation and enable cargo release to tumor sites [17].

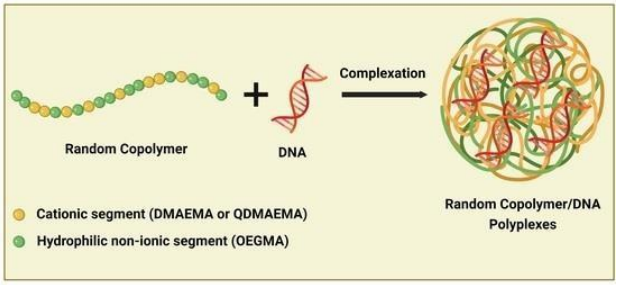

Fig 13. Structure of Polyplexes

4.14 Quantum Dots

Quantum dots (QDs) are semiconducting materials that have a semiconductor core (CdSe), coated with a shell (e.g., ZnS) to improve its optical properties, and a cap that helps improving solubility in aqueousbuffers. Size of quantum dots ranges from 10-100A^0in radius which gives them unique physical characteristics. Quantum dots can be used for labelling of cells and in cancer treatment as therapeutic tool. Quantum-dots have a major impact on some of the important development in medical areas like diagnostic tools (magnetic resonance imaging, MRI), in vitro and in vivo detection and analysis of biomolecules etc. With many pros there are certain cons of quantum dots like, the presence of heavy metals in QDs such as cadmium, a well- established human toxicant and carcinogen, presents potential hazards especially for future medical usage, where quantum dots are intentionally inserted into the body [18].

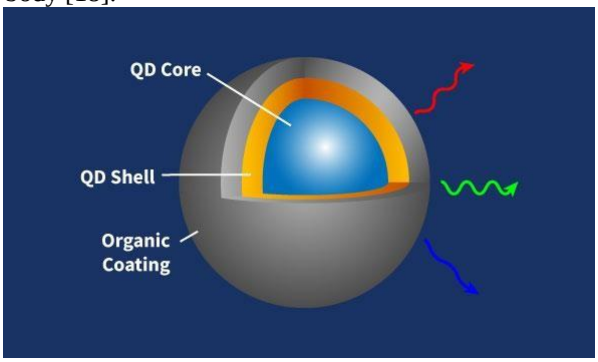

Fig 14. Structure of Quantum Dots

4.15 Solid Lipid Nanoparticles

Solid lipid nanoparticles (SLNs) primarily consist offatty acids or mono-, di-, or triglycerides. Such lipid matrices remain in the solid state at normal body temperature. The highly lipophilic nature of SLNs renders these particles to facilitate BBB transport. They are colloidal sub-micron carriers (50-1,000 nm) consisting of physiological lipid, distributed in water, or in aqueous surfactant. To address the drawbacks of liquid oil droplets, liquid lipid was replaced by a solid lipid, which gradually became solid lipid nanoparticles [19].

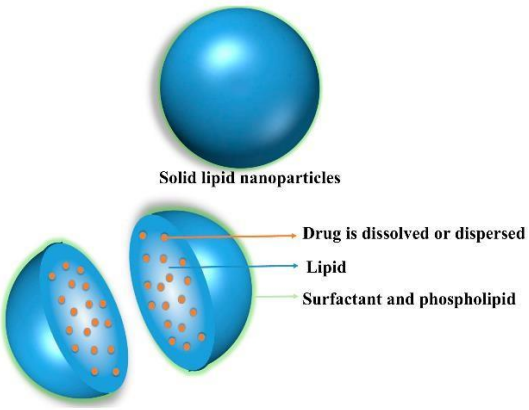

Fig 15. Structure of Solid Lipid Nanoparticles

V. Applications of Nanotechnology

5.1 Artificial organs and implants

Nanotechnology can be actually implemented in development of artificial cells, tissues and organs. Defective functioning cells and organs can be replaced by the use of artificial cells, particularly related to metabolic functions, is being actively investigated. [20]

5.2 Bone Disease

Nanotechnology has ability to do wonders in the fields of orthopedics and Orth odontology. During the procedure of dental implants, use of nanotubes in improves the ability to load the nanotubes with anti-inflammatory drugs that can be applied directly to the implant region. Silver nanoparticles have gained ever greater interest in orthopedics due to their antimicrobial properties. They are used as bone cement in tumor prostheses, wound implants and as well [22]. Calcium-phosphate dependent NP is used without toxicity to bone tissues in drug delivery for bone diseases [23].

5.3 Biochemical Sensors

A measuring device consisting of a sample with a sensitive biological recognition feature, or a bioreceptor, a part of a physicochemical detector, and a transducer between to amplify and transmit these signals in a measurable form is referred as biochemical sensors [24]. Specific pathological proteins and physiological-biochemical markers associated with disease or impaired body metabolism can be assessed by this device. Catalysisis one of the most important functions of nanoparticles, especially with noble metalnanoparticles that have a high catalytic activity for many chemical reactions. Glucose nano sensors areused in diabetics to measure the glucose levels. Triglyceride nano sensors are of great use in the detection of hyperlipidemia. Free optical biosensors based on gold colloids are essential for qualitative and quantitative determination of biomolecular interactions and recent advances in the developmentof gold colloid-based localized surface plasmon resonance (LSPR) biosensors and their applications in immunogens, nucleic acid detection and toxin quantification have added great value to this technology. For polynucleotide or protein detection, oligonucleotide-capped gold nanoparticles have also been documented using various methods of detection / characterization such as atomic forcemicroscopy, gel electrophoresis, Raman spectroscopy, and surface plasmon resonance imaging [25].

5.4 Cardiovascular Diseases

There is the potential for a modern nano-therapeuticapproach to enhance the safety and effectiveness of thrombolytic drugs. It requires the mechanical activation by high-fluid shear strains inside blood vessels to selectively target drugs to vascular hindrance locations. In vitro and in vivo readings have shown that this technique can be usedcompetently to lyse clots by means of a substantiallylesser thrombolytic drug quantity than its requirement when supplied in a soluble preparation. The prime example of this is seen in application of dendrimers. Dendrimers are circular nanoparticles developed for a number of diseases that have been used as a way of administering medicinal agents. A team of researchers created a technique for attaching dendrimers to

tissue plasminogen activator (tPA) tocreate a drug delivery system that would require lower doses with reduced side effects. The results showed that during the course of a varying proportion of dilutions, this drug delivery system developed an advanced concentration of tPA dendrimer complex [22].

5.5 Central nerve system diseases

Nano particles are eligible to pass blood brain barrier and therefore it can be used to administer medicine for treating Alzheimer's disease, brain tumors, inborn metabolic disorders such as lysosomal storage disease, aging and infectious diseases etc. Nano particles has a high affinity and is able to distribute drugs directly through BBB. Most therapeutic particles cannot move through BBB,BBB can only move through a small class of drugs or molecules with high lipid solubility and low molecular mass [23].

5.6 Cancer detection and targeting

It has been a difficult and challenging task for formulator to detect and target cancer cells or tissue. Cancerous tissues or cells that are very difficult to target specific cells or organs; as a result, many normal cells are killed in the process. Quantum dots (QD) are also well established in the literature in the mapping of lymph nodes, which is an important technique for mapping cancer during surgery, and in vivo cancer imaging using semiconductor. The regular tumor cell drug delivery has some side effects nephrotoxicity, neurotoxicity, cardiotoxicity, and multiple drug resistance (MDR) decreases concentration of the drug at the target place, low accumulation. NP dependent drug delivery system isused to solve these problems. The tumor sites are developing new blood vessels to rapidly provide oxygen and nutrients. These newly developed vesicles are defective and have leaky vasculature which allows diffusion of NP. The demand for energy is increasing, and glycolysis occurs. Ultimately generated acidic environment and thebenefit of pH uses for drug release [23].

5.7 Drug discovery

Pharmaceutical nanotechnology plays a key role in drug discovery, which depends on a greater understanding of the drug action process and biomarker recognition associated with clinical disease. Nanotechnology helps to find and verify thetarget by recognizing the protein that is present on the surface of the cell or target. Pharmaceutical Nanotechnology helps in identification and validation of target by identifying the protein present on the surface or target surface. Nanotech will enhance drug delivery process, through miniaturization, automation, aped and reliability of assays. Single walled nanotubes are successfully used to identify surface protein of pathogen. Quantum dots- track individual glycine receptors and to analyze their dynamics in the neuronal membrane of living cells, for periods ranging from milliseconds to minutes. Gold nano particles, nanobodies (smallest, available, intact antigen- antibody fragments) produced by ablynx are some commonly used nanomaterials in diagnosis [26]

5.8 Diabetes

NP containing matrix-attached insulin has been developed. The enzymes are attached to NP when blood glucose levels rise, enzymes induce the release of insulin and can eventually control the level of blood glucose for many days [27].

5.9 Implantable delivery systems

Nanoparticles can serve as delivery mechanisms dueto their nano size, operated by approximately zero order kinetics, otherwise they can cause toxicitycompared to I.V. Liposomes, ectosomes and transferosomes are the carriers. SLN is given to animals intravenously, pharmacokinetic trials of SLN-incorporated doxorubicin showed higher bloodlevels after i. v. injection in rat relative to commercial drug solution. A rat injection. As far asbody distribution is concerned, SLN was found to cause higher concentrations of drugs in the lung, spleen and brain, while the solution led to a greater distribution in the liver and kidneys. For SLN, parenteral application is a very broad field. For commercial purposes, subcutaneous injection of a drug loaded with SLN can be used, e.g., erythropoietin (EPO), interferon-β. Intraperitoneal and also intra-articular are other routes. Because of the application region, intraperitoneal application of the drug-loaded SLN will prolong the release. Furthermore, compared to injecting drug micro particles, incorporation of the drug into SLN may decrease irritancy [28].

5.10 Inhibition of neointimalhyperplasia

Neointimal hyperplasia is the proliferation and migration of vascular smooth muscle cells in the tunica intima, leading to arterial wall thickening andreduction in space of arterial lumen. Neointimalhyperplasia is the main cause of restenosis followingpercutaneous coronary procedures such as stenting or angioplasty. As Nitric Oxide (NO) prevents neointimal hyperplasia, and Diazeniumdiolates are a class of NO donors which, when placed in an aqueous condition, release NO spontaneously. The nanofiber gels were used to formulate these diazeniumdiolates [29].

5.11 Brain Targeting

Blood Brain Barrier (BBB) plays an important role in targeting of drugs to the brain. As it creates a firm blockade between brain and molecules entering into blood. Thus, it prevents entry of potential toxic chemicals into brain, but this also prevents entry of desired drug molecules into brain. By using nanotechnology this hurdle can be removed, as nanopharmaceuticals can penetrate inside the brain alongwith drug [23].

5.12 Gene Therapy

Various genetic disorders like tumors, cystic fibrosis and hemophilia can be treated by using Gene therapy. Delivery of gene at desired site is still a herculean task. Some genetic materials are unstable in nature. They get easily destroyed by biological environment and genetic material fails to cross various biological membranes. For conventional delivery of genes viral vectors are used. But major problem associated with viral vectors is that they may induce immunological response. This problem can be overcome by using non-viral vectors such as liposomes, nanoparticles, nanocarriers, etc. genetic material can be encapsulated inside the carriers. PLA and PLGA nanoparticles can be effectively used for delivery of plasmid DNA. Chitosan, gelatin, poly-1-lysine and silica nanoparticles are used in gene therapy [30].

5.13 Nanotechnology in pharmaceuticalaerosols

As we know, some drugs are very poor candidates for the production of aerosols, but by the means of nanotechnological principles and its application to prepare nanosuspensions for drugs that are insoluble in both aqueous and oily media, improved pharmacokinetics has resulted in improved bioavailability of aerosol-administered drugs. In addition, the production of bio adhesive nanoparticles helped to increase the drug's mucosal residence time with increased drug absorption and subsequently increasedbioavailability [31].

5.14 Nano based drug delivery tools

These are polymeric nanoparticles, liposome, dendrimer, polymeric micelles, polymer-drug conjugates, antibody- drug conjugates, which are classified as:

A. Sustained and controlled delivery system,
B. Stimuli sensitive delivery system,
C. Functional system for delivery of bioactive,
D. Multifunctional system for combined delivery oftherapeutics, biosensing and diagnostic. E. Site specific targeting (intracellular, cellular, tissue). Nanomedicine and nano delivery systems are arelatively new but rapidly developing sciencewhere materials in the nanoscale range areemployed to serve as means of diagnostic tools or todeliver therapeutic agents to specific targeted sitesin a controlled manner [32].

5.15 Nanomaterials for tissueengineering

Nanotechnology offered numerous smart materials that are used for tissue repair and replacement, implant coatings, tissue regeneration scaffolds, structural implant materials, bone repair etc. It can be used for tissue replacement, generation of tissues, as surgical aids and in bone repair. Cells are surrounded by Extra Cellular Matrix (ECM). ECM is natural nanofiber structure surrounding cell. ECM also helps in activity of various biological factors. Successful generation of engineered biomaterial canbe used as replacement of ECM which can be utilized for regeneration of tissues. Tissue engineering of bones also require complexformation of cell types such as osteoblasts, osteoclasts and osteocytes. This complex environment can be created by application of carbonnanotubes. Multiwalled carbon nanotubes has been proven to produce bone repair. Also, carbonnanotubes can be utilized for cardiac tissue engineering [1].

VI. Future aspect of nanotechnology inpharmaceutical industry

In the medical world, nanotechnology is seen as a boon since these have a lot of potential to bring a revolution in the field of medical and medicinalscience. Nanotechnology, if used with properknowledge and righteous mission can help to serve society and help us fight from those diseases that wethink as lethal today. It also posses' potential to change or, we can say, upgrade drug delivery to nextlevel. We would be able to deliver drug directly on the site of action, resulting in production of quicker desirable action of drug. Diseases like cancer can be detected earlier and even killed by using nanotech, this will do wonders in saving life. In the future, a world where medical nanodevices are routinely implanted or even injected into the bloodstream to monitor wellness and to automatically participate in the repair of systems that deviate from established norms could be imagined. These nanobots could be personalized by tailoring them to patient genotype and phenotype to optimize intervention at the earliest stage in the course of disease expression. To date, cancer treatments are performed on the basis ofclinical and pathologic staging that is determined using morphologic diagnostic tools,

such as conventional radiological and histopathological examinations. However, even patients suffering from cancers of the same cellular type and clinical stage respond to the same conventional treatment modalities differently and, ultimately, with variations in survival rate. This implies that cancer-associated events are unique in each patient in the development of nanotherapeutic and imaging approaches to cancer detection and treatment, it is imperative to have a better understanding of the basic principles involved in designing and applying nanoparticles for diagnosis, treatment, or the combination of imaging and therapeutics in different clinical situations [33; 34].

VII. Conclusion

The world around us is changing, people are changing, somethings are changing for better while others are not going as they were planned. But it is our aim to seek development. We belong to different fields, some of us may be engineers, doctors, pharmacists, psychologist, etc. but at the end we all have to come together, work together, coordinate with each other, serve mankind and lead humanity towards a better future. Nanotechnology

is one of those things which can bring us closer towards a bright future. The success of a new developed pharmaceutical formulation is related to the fact that it is able to deliver the active substance to the target organ at therapeutically relevant levels, with negligible discomfort and side effects, increasing the patient compliance to the therapeutics. Regarding this respect, the route of administration is of major relevance. Topical administration of active substances offers several attractions compared to traditional routes. Applications of nanotechnology are not limited for treatment, diagnosis, monitoring, and control of biological systems has recently been referred to as "nanomedicine" by the National Institutes of Health. Research into the rational delivery and targeting of pharmaceutical, therapeutic, and diagnostic agents is at the forefront of projects in nanomedicine. These involve the identification of precise targets (cells and receptors) related to specific clinical conditions and choice of the appropriate nanocarriers to achieve the required responses while minimizing the side effects. Mononuclear phagocytes, dendritic cells, endothelial cells, and cancers (tumor cells, as well as tumor neo vasculature) are key targets. The quality of life can be enhanced by proper, intentional use of this nanotechnology. Pharmaceutical nanotechnology has emerged as a field with immense potential as a carrier for the spatial and temporal delivery of bio actives and diagnostics and offers intelligent materials for tissue engineering purposes. It provides new technologies, possibilities and scope, which through its nano-engineered technologies are expected to have a great effect on many areas of illness, diagnostics, prognosis and illness care. Pharmaceutical nanotechnology offers opportunities for improving materials, medical devices and helping to develop new technologies where existing and more traditional technologies may meet their limits.

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