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REVIEW ARTICLE

Impact of Nano medicines and nanotechnology for cell repair of human body

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ABSTRACT

Cells of humans are capable for restoration damages as well as swap deceased body cell. Nanotechnology, has ability to figure complicated molecules, to behave as machine, along with its utility, to measure dimensions onto nano scale. Molecules acting as devices, regulated via computers, having lesser size than human cells. Nanoparticle, and nano medicines, with their provisions have been potential therapeutic presentations, concerning nano vaccinology. There have been certain achievements in this regard, controlling 'superbugs' progression, like drug resistant bacteria. Nano antibiotics, regarding such prospective, created with the help of combined forms of nano particles with antibiotics, comprising greater compatibility and affinity. Our target is to make variety of nano machines for repair of human cells.

Keywords: Antibacterial, Drug delivery system, Metal oxide nanoparticles, Nanobots Nanomedicine.

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INTRODUCTION

Recently, repair of heart tissues is dealt through amputation of limbs, resulting massive blood losses, damaging lot of cells. Nerve, and blood vessel could be merged surgically, by use of numerous devices as well as tools. As for as drug therapy, is concerned, drug particles, such as morphine links receptor with in brain, affecting nerve impulse causing pain signals. However, drug delivery processes like this are random, due to random motion of drug fragments (Christopher *et al.,*1988).

Nanomedicines are being generated via nanoparticles for wellbeing of mankind (Medina *et al.,* 2007). Nanoparticles play vital roles, regarding medicines, because of usage in therapies and diagnostic purposes, as well as biomaterials in bio-imaging fields (Surendiran *et al.,* 2009). Metal fragments having antimicrobial actions are evaluated, regulating various infections (Goodman *et al*., 2004; Schaller *et al*., 2004). Silver nano molecules are utilized, proving to be antimicrobial agent, like killing of bacteria to release respiratory blockage (Pedro *et al.,* 2018). Nano fragment connects with bacterial membranes electrostatically, causing disintegration. Exact procedure of toxic behavior of nanomolecules is yet hidden (Thill *et al.,* 2006). Poisonousness can be enhanced because of free radical formation , through addition of nano molecules, having oxidation stress (Nel *et al.,* 2009).

Antibodies are being utilized against enzymes as well as proteins, to cut and splice DNA. Bacteria and viruses are being used to deliver drugs for drug therapy. Current target is assembly of nanomachines for cell repair, via editing. Repairing tools show analogy withcytoskeleton, enzymes, as well as antibodies, regulating disassembly, with regard to cell structure as well as healing processes (Drexler, 1985). Having look on, transfer of virus and WBCs, cell repairing machinery, follow same procedure among cells. Their programming can be done, for opening as well as closing of cell membrane (Eric *et al.,* 1985). First RBC constructed artificially, has been just polyHb, that has to carry oxygen alone. Now, that has been using in routine, Russia and South Africa, clinically. Recent RBCs function completely i.e., 3, containing polyHb catalase, carbonic anhydrase, and super oxide dismutase. Poly Hb fibrinogens, that are oxygen carriers,function like platelets (Chang, 2012). Respirocytes, comprising size of 1 μm, are another RBCs' model, artificially constructed, having oxygen carrying capacity, efficiently (Freitas, 1998). Microbivore has been artificially constructed WBC's model (Freitis, 2005). Through nanotechnology, nanocarriers could be synthesized forming vaccine and cell marker (Kukowska *et al.,* 2005).

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Nanoparticles

Nanoparticles are being engineered to target diseased cells, then they are used for direct treatment of all those diseased cells. This technique of nanotechnology minimizes the damage to healthy cells and helps us for earlier disease detection.

Nanotechnology in medicine application

Diagnostic techniques

- *Biosensors*

Living beings' responses could be converted via biosensor, as noticeable signal. Their task is done to bind through bio-receptor. In addition, it aids connection of antibodies and antigens, detecting responses, with catalysis of enzymes, for detection of DNA. Their increased concentrations could assist during PCR. Biosensor can be used for Alzheimer's patients, as biomarkers (Georganopouchlou *et al.,* 2005).

- *Working Principle of a nanobot to repair cell*

Nano robots can be called nanobots or nanite. Its size has beencalculated in nanometer. Due to their small size, they are just like viruses and bacteria. Nanobotis supported with different devices,such as, camera to monitor body system, nano chemicals to clean infection and nano laser, nano gloss (Shalini, 2014).

- *Nanobots for tissue repair*

It is need of time, to have tool, directing to targeted fine tissue, not possibly done through surgeries. So with the help of nanotechnology, we are able to construct certain devices and nano machines to repair cells and tissues. Molecular machines can detect damage in particular sequence of amino acids of specific protein and able to target position and type of complex molecules of cell as well as able to detect DNA damage at particular site (Katrina and Felix, 2010).

Scientists have designed a medical nanobot that could repair human body tissues. It works on three basic functions. First is use of nano laser for removing infected cells along with bacteria and viruses. Second is cleaning of damaged part by nano chemicals to remove all spores and third is cell repair.

- *Working of nanolaser in nanobots*

First of all, nanobots within patients recognize impaired tissues and after thatgo towards infected part, subsequently, injured area is removed by nano laser. Such infected tissue could be detached with the help of nano chemical, behaving like WBC. Nanobots must have been multi programmed. After some time, nanobot is programmed to be ejected, surpassing maximum limit (Mitra, 2017).

- *Nanotubes*

Antibodies, linked to carbon nanotube have been used within chip, detecting cancer through blood, at the Worcester Polytechnic Institute. This method can be adopted as lab test, simply for detection of early cancer that could provide early detection of cancer cells in blood.

- *Nanorod*

Nanorods are used, detecting early kidney damages. It involves gold nanorod, to function by attaching to protein type, released through impaired kidney. Due to accumulation of protein on nanorods, there is change in color. Design of this test is quick as well as inexpensive.

Applications of nanomaterials in medicine

Nanomaterials and its different mechanisms as shown in Table 1

Antibacterial activity by nanoparticles

Silver nanoparticles

Silver is used against bacterial infection such as, infections via catheter and dentistry, as well as burns as, $AgNO_3$, metallic Ag and Ag sulfadiazine (Dibrov *et al.,* 2002).

Gold nanoparticles

Gold is usedto coat carbon tubes, as nano molecules, increasing targeted effects, for bacterial detection via increased flow cytometry sensitivity. Chosan, having coat of gold nano fragments with ampicillin, in combination,is found to increase antimicrobial effects to two folds (Chamundeeswari *et al*., 2010). Gold nano fragment technique has been used by Lincolin University scientists, UK (Mitra, 2018).

Zinc oxide

ZnO nano molecules, having antibacterial effects on *E-coli*, which spoil food can be used for food preservation (Liu *et al.,* 2009, Roselli *et al.,* 2003).

Titanium dioxide

Due to its photo catalytic feature, by producing free radical TiO_2, has antibacterial effect (Choi *et al.,* 2007). TiO_2 distort bacterial function (Maness *et al.,* 1999).

NO

It has role against microbes, as immunity is increased during infections (Martinez *et al.,* 2009). NO gas can inhibit resistant *Staphylococcus aureus* (Hetrick *et al.,* 2008).

Aluminium

Aluminium oxide in greater concentrations disrupts bacterial cell walls (Sadiq *et al.,* 2009), inhibiting growing *S. aureus* and *Pseudomonas aeruginosa* (Buckley *et al.,* 2008).

Copper

Copper ions, which are major constituents of microbes' enzymes, could distort amino acid synthesis in greater concentrations, through ROS generation, that impose toxicity, with regard to microbes (Esteban-Tejeda *et al*., 2009).

Nanomedicines for antibiotic resistant bacteria

Houston University researchers have been developing nanoparticle's technology for killing *Enterococci* bacteria which being vancomycin resilient. By applying gold nano fragments and laser light of infrared, reduction VRE growth to 16 folds is found (Wang *et al.,* 2018).

Table 1: Nanomaterials and its different mechanisms

Nanomaterials	*Mechanism of actions*	*References*
Chitosan	Increased permeability, rupture of membrane, chelation of trace metals, enzyme inactivation	(Kumar *et al.,* 2012)
Silver nanoparticle	Release of Ag+ ions, disruption of cell membrane, DNA damage, electron transport	(Dibro *et al.,* 2002)
Zinc oxide nanoparticles	Intracellular accumulation of nanoparticles, cell membrane damage, hydrogen peroxide production, Zn^{2+} ions release	(Liu *et al.,* 2009; Roselli *et al.,* 2003)
Titanium dioxide nanoparticles	Production of reactive oxygen species (ROS), damage of cell wall and membrane	(Choi *et al.,* 2007; Maness *et al.,* 1999)
Gold nanoparticles	Interaction with cell membrane, strong electrostatic attraction	(Chamundeeswari *et al.,* 2010; Mitra, 2018)
Fullerenes	Cell membrane destruction, activity of infiltrating neutrophil enhancing	(Amora *et al.,* 2018)
Carbon nanotubes	Cell membrane damage by ROS, oxidation of cell membrane proteins and lipids	(Amora *et al.,* 2018)
Nitric oxide releasing NPs, Al, Cu ions	Inhibit microbes and product of ROS	(Hetrick *et al.,* 2008)
Nano emulsion	Disruption of membrane and spore coat	(Amora *et al.,* 2018)
Dendimers	Play role in drug delivery	(Kukowska *et al.,* 2005)
Ferrofluids (iron oxide)	Imaging MRI	(Amos and Torrance, 2010)
Quantum Dots	Imaging and playing role *in-vitro* diagnostics	(Wang *et al.,* 2005)
Chromallocyte	Chromosome replacement therapies	(Robert and Freitas, 2007)

Quantum dots

University's researchers investigated quantum dot to treat infection, due to antibiotic resilience. Such tools are being worked within molecular imaging. Because of non-toxicity of quantum dots, probe is connected with it for detection of cancer (Wang *et al.,* 2005). Super paramagnetic iron oxide and dextran are used frequently during liver MRI (Karunaratne, 2007).

Wound treatments by nano medicines

Nano generator Wisconsin University's researchers demonstrating bandage, that poses electric pulses, onto wound, by electricity, generated via nano generator.

Polymer nanoparticles

In trauma patients, internal bleeding results in heavy blood loss. Chase Western Reserve University's researchers have worked uponplatelets, synthetically constructed, via polymer nanoparticles which in turn minimized bleeding.

Cell repair by nanomachine

Nanorobotsis to specific impaired parts that use during normal healing, by use of programmed vectors to the gene.

Chromallocyte

Chromallocytes are models, used for repairing cell as well as chromosome. Such nanorobots are vital for chromosome replacement therapies. Methodology is to extract original chromatin, then artificially constructed, healthy chromatin, due to its mobility, is injected that go through capillaries' bed to target organ as well as tissue (Robert and Freitas, 2007).

Neuronal unit

Dendrimer

Dendrimers are molecules, having sphericalshape and branched inner core. Numerous receptors could link such branched core, making it probe. This is best to attach anti-cancer drug known as, methotrexate as well as folic acid, targeting cancer cell, by using fluorescent object (Kukowska *et al.,* 2005).

Working principle of nanomachines

Richard Smalley,in 1996 got Nobel Prize, to work on, Buckminster fullerenes. Their molecules, bonded into Bucky balls are found to be carbon allotropes, sizedin nanometer. In nanoscale Carbon is involved into nanotube formation, in nanoscale due to having significant features. Such nanotubes, are proving, medically important, in the form of buckminsterfullerene, measured in nanoscale, which are hollow as well as steady, using to deliver drugs. These carbon tubes could mark cancer cell, having little drug dosefor protection of body, concerning adversatives of drugs.

Iron containing nanoparticle

Regarding medicines, fate of stem cells can be determined by stem cell as well as nano techniques. So, purposely, stem cell is labeled via iron nano fragment, carrying targeted site through magnets, placing out of body (Amos and Torrance, 2010).

Nanotechnology in drug delivery

Nanocarrier

Nanocarrier is submicron, small in size having various nano carrier kinds, as nanowire, dendrimer, nanotube, nanosphere, liposome, nanocapsule, and nanosuspension, on basis of pharmacokinetics (Koo *et al.,* 2005). As nanosphere is concerned , there has been uniformity to distribute drugs while for nanocapsules, drugs are liquefied in aqueous solution or oils. These are proved to be biodegradable, withgreat absorption as well as long lasting influences, having lesser adversities.

Nanovesicle

North Carolina State University's scientists have developed, delivering method toward cardiac stem cell for impaired heart. Nano vesicle to stem cell and directs injured area, by making stem cell more efficient for delivery.

Nanomedicine companies

Nanomedicines are prepared by different companies, commercially. For example, nanomedicine, is constructed for delivery of gold fragments towards cancer area. Other is, Blue willow, a nanoemulsion type, delivering nasal area, in case of flu and cold viruses, could be advantageous for skin, fighting against bacteria.

CD bio-particles

Core drug constituents have been CD bio-particles, acting like transferring factual. Nanocage is included as well that has C-base, usingin research as well as commercial applications. Nano devices are analyzed as well as characterized with encapsulated C-based nanomaterials, constructing to see size, type, distribution, and functional group types. These nanomaterials like fullerenes, graphenes, nanodiamonds, and carbon nanotubes are nanomaterials, with their different derivatives which are carbon based have versatile electronic, mechanical, thermal, and optical properties. They have contributed a lot in fields of in nanomedicines.

Carbon based nanocage

Nanocages, like graphene, carbon nanotubes, and fuellerenes are carbon based and they have major role in nanoscience these days. These nanocages contain mesopore arrays having large surface areas which is cage like and they have pores, that is much advanced than previously used mesoporous materials like CMK-3. Their properties of biochemical and electrical interactions with biomolecules enable themperfect in biomedical field and applications in a diverse range for example drug delivery and biosensors. Moreover, their surface modification along with different functional groups (carboxylic acid, epoxy, and hydroxyl) enhance their properties. These of carbon nanocages, due their stability in aqueous solution and their interactions with living cells and tissues, are biologically safe. So it has become one of the popular practical applications biomedical field.

Carbon nanotube

Carbon nanotubes (CNTs) are the collection of carbon atoms arranged in form of sheets. The diameter ranges between 1-20nm.They are meant to deliver proteins and DNA. Carbon nanotubes are structured in a sheet of graphite which has thickness of just one atom and it is rolled like a tube having diameter ranged one nanometer. It has very unique properties based on the mechanism and type of rolling of nanotubes. Working is based on the number and the arrangement of graphene layers organized in the cylinders and tubes. There are different types of carbon nanotubes such as (SWCNTs) are single walled and (MWCNTs) are multi walled. If CNTs has poor dispensability, it is proved to be one of the major barriers for their nanomedicinal use. Different attempts in research has made different strategies for improvement of biocompatibility of CNTs by surface modification of different nanomaterials and has also adopted the unique methods for the degradation of CNTs by enzymes. Various kinds of polymers, metals, and several biological materials have been using to graft to carboxylated CNTs surfaces. CNTs with DOX, which is a model drug, have been studying extensively as drug carrier. Drugs are either loaded into carbon nanotubes by way of non-covalent interactions, for example, π-π stacking. But covalent binding is also being used for hydrophilic drugs. Their unique spectroscopic characteristics, which include Raman scattering as well as photoluminescence, can give us important sources for tracking and detecting then imaging several dangerous diseases. They could also help to monitor *the vivo* therapy and pharmaco dynamical behavior with efficient drug delivery.

Graphene

Graphene is another important nano material for drug delivery. It is made up of single layers of atoms of sp^2 hybridized C atoms that are much studied due to its unique mechanical as well as electrical properties. Graphene which has a poly-aromatic structure having ultra large surface area, and it is available for binding drug molecules through p–p stacking and to solubilize them for drug delivery applications. They can act as potential vehicles for drug delivery if they are loaded sufficiently with high drug and are very suitable *in case of vivo* drug distribution. Then help in achievement of release profiles. Recently, various nanocarriers such as graphene oxide (GO) is getting significant importance for delivery of anticancer drugs and imaging because of their high drug loading ability and efficient delivery capacity. Their surface area is measured specifically, approximately 2600 m^2 g^{-1}, that is much more than the double of most nanomaterials. Furthermore, unlike pristine graphene, GO has got high water dispensability as well as endows negative surface charge, that is PH dependent to exhibit high colloidal stability.

Fullerene

Fullerenes, especially C_{60}, have received widespread attention as drug and gene delivery vehicles. Fullerene that is stable like cage, provide enough place to encapsulate ions, atoms, and molecules. It allows the construction of molecular or particulate entities, where one or more functional groups are covalently attached to the fullerene cage surface in a geometrically controlled manner. It is applied totarget drug delivery through biological membrane as well as receptor ligandto agonize / antagonize cellular as well as enzymatic process. Fullerene could accumulate to vesicle known as fuller some, acting like multivalent drug delivering vehicle, containing likelihood to target.

Nanodiamond

It is sp3 C- nanoparticles, comprising of crystal domains that contain diamonded-like topology as well as diameter greater than that of 1-2 nm, however lesser than that of 20 nm. NDs are nanocrystals that consist of tetrahedral bonded carbon atoms in the form of a three-dimensional cubic lattice. So, it divulges diamond's features as well as carbon shells, having onion shape with functional group coatsover surfaces. Nano-diamond could certainly be functionalized through numerous ligands, using as stage to conjugate diverse, chemicals, drugs and molecules.

Nanomedicines in cancer therapy

Aptamers artificially synthesized peptide domains are used to recognize and bind to targets. Vascular endothelial growth factor has been using as signal protein to treat different kind of cancer and arthritis (Karunaratne, 2007). Use of tropic fibrils can shrink the tumor. Process is fibril attach to insulated conductor, e.g., doped poly acetylene which is used for communications in electro chemical processes (Runsewe, 2019).

Chemotherapy

Proteomic technology on nanoscale can detect cancer more efficiently rather than biopsies (Karunaratne, 2007). There are effective methods to target nanoparticles carrying therapeutic drugs directly to diseased cells. For example scientists are MIT have demonstrated increased levels of drugs delivery to tumors by using two types of nanoparticles. First nanoparticle's category finds tumor while, other one, containing drugs for therapy, homes inside upon signals,produced via first one. Two researcher groups have been focused on the best shape of nanoparticle to use for delivering drugs to cancer tumors.

Nanomedicine in tissue engineering

Nanotechnology is being applied in construction of artificial organs and cells (Kubik *et al.,* 2005). Electro spinning is used to produce nanofibers (Chew *et al.,* 2006).

Nanodisk

One research group has found that a disk shaped nanoparticle (nanodisk) will stick to the surface of a tumor longer than a spherical shaped nanoparticle, providing more efficient transfer of therapeutic drugs to the tumor. Moreover, it has been examined that nanoparticle in rod shapes, is highly effectual to deliver chemotherapy drug for breast cancer as compared to spherical shaped.

Cancer radiation therapy

Researchers are investigating the use of bismuth nanoparticles to concentrate radiation used in radiation therapy to treat cancer tumors. Early investigations have indicated increased radiation's dosage through bismuth nanoparticle toward cancer, as 90%. Use of radioactive gold with nano molecules, to attach with substance, attracted towards prostate cancer is proved to be greatly effective in radiation treatment. Researchers believe that this method will help to concentrate the radioactive nanoparticles at the cancer tumors, allowing treatment of the tumors with minimal damage to healthy tissue.

Cancer heat therapy

It is a therapy for drug delivery to tumor with heat, via gold nano rods attached with DNA strand, acting as scaffold to hold nano rod as well as therapeutic drugs. These gold nano rods turn to heat energy, by absorbing infrared radiations, when illuminated to tumor, thus releasing chemotherapeutic drug and destroying cancer, subsequently. Targeted heat therapy has been of significant use in case of breast cancer. Following the process, antibodies have been appealed towards specific protein, generated in breast cancerous cells, within connected nanotubes, at tumor. Infrared radiation through laser beam is captivated via nanotube, producing heat which burns tumors.

Nanotechnology to heart disease

Cardiovascular disorders can be diagnosed by nanopolymers by the process of imaging. Nanoparticles can help to treat all kinds of lesions in case of implantation of stent by binding to

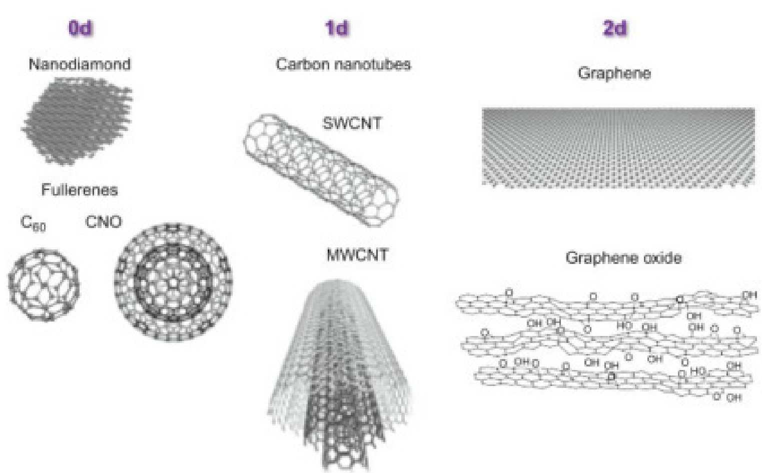

Figure 1: Members of the carbon-based nanocage family (D'Amora, *et al*., 2018)

target sites (Lanza *et al.,* 2006). Scientists are trying to develop such nanoparticles that can disassemble and dissolve arterial plaque and thrombus. It is based on the principle that that two sulfide bonds bind to form disulfide bridge and interact with ionic attractions to form tertiary structure of protein. So a programmed cell should understand all mechanism of restoration of proteins and enzymes (Katrina and Felis, 2010). Scientists of North Carolina State University have been delivering cardiac stem cell into impaired heart by a unique method, for attachment of nanovesicles which have been inclined towards injured area to stem cell for increasing stem cells' delivery quantity. Scientists of Georgia University have worked on nano molecules which have been together synthetic HDL, with MRI opposing agent that is iron oxide. The researchers are now conducting animal studies to determine how well the artificial HDL treats arterial plaque.

Treatment of malaria

As a result of malaria, RBCs are damaged. So they can be repaired by nano devices to target RBC as hydrogen per oxide is not much so use of glucose could be restored via chemotaxis (Katrina and Felis, 2010).

Nanodiamonds for eye treatment

Drug with nanodiamonds has been embedded in contact lenses for treatment of glaucoma. Drug particles have been liberated through nanodiamond that is having close contact with tears, and carrying continuous dose than that of eye drops.

Pancreatic cancer nanomedicine

Scientists worked on RNA profiling and sample analysis of patients of pancreatic cancer. Now they invented nanoparticle which can target genes to tumor (Mitra, 2018).

Fluorescent nanomedicine for cancer

This technique destroys all remaining malignant cells which cannot be excised by surgery. They are injected coated with dye intravenously or inside the peritoneum (Mitra, 2018).

Nanomedicine for nerve cell regeneration

Mauris N De Silva have used magnetic nanoparticles for regrowth of axons in case of an injury (Mitra, 2018). Attempts are made to construct nanofibers for repairing damaged neurons by transport of nutrients into axoplasms. Experiment of implantation of nerve fiber was done on mice having spinal cord injury but after treatment that paralyzed mice could able to walk (Katrina and Felis, 2010).

Nanotechnology for peripheral nerve regeneration

Any damage in peripheral nerves, it can lead to permanent loss. For this purpose, different techniques have been adopted by researchers to repair these injuries by construction of synthetic nano nerve fibers scaffolds (Biazar *et al.,* 2010). Progress has been made in this regard by using substances like polyglycolic acid, polylactic acid and poly hydroxy butyrate. It can easily be absorbed as it is biodegradable. So it is suitable for the process of regeneration of peripheral nerves (Sinis *et al.,* 2009). Moreover, Polysialic acid is found to be more biocompatible and can be readily reabsorbed because it is vital to make communications between two hemispheres of brain (Kiyotani *et al.,* 1996).

Nano carriers for dental treatment

Researchers are improving dental implants by adding nanotubes to the surface of the implant material, by loading nanotube along with anti inflammatory drug, which could be placed around area of implantation directly. Additionally, it is indicated that bone adherence with titanium dioxide nanotube is comparatively greater rather than conventional method of surface titanium implantation.

Nano particles for diabetes treatment

Scientists are developing nano molecules which free insulin during higher level of glucose, comprising of both insulinas well as dissolved enzyme. So, insulin releases when enzymes dissolve. Laboratory tests have evaluated capability of nanomolecules, controlling sugar level in blood for many days.

Nanocapsules

Moreover, an advanced process is to liberate insulin using spongy matrix, containing insulin and enzymes of nano capsules. When the glucose level rises the nano capsules release hydrogen ions, which bind to the fibers making up the matrix. Hydrogen ions help in making fibers, with positive charge, which repelone another as well as create opening within matrix by that insulin releases.

Nanoparticles for autoimmune diseases

The processes, tackling autoimmune disorders are in use of nano molecules for delivery of antigen in case of specific disorder to blood. Antigen resets immunity, while stoppage of WBCs from attack of healthy cell. It is evaluated inside lab over mice by disorder, having similarity to the multiple sclerosis and got positive result.

Nanoparticles for neurologic disorders

Scientists have developed nano molecules, delivering drug through brain barriers and tackling neurologic abnormalities.

Mesoporous nanoparticles

A method being developed to fight aging uses mesoporous nanoparticles with a coating that releases the contents of the nanoparticle when an enzyme found in aging cells is present.

Liposomes for skin treatment

Creams for skin, using stem cell derived help in preventing skin aging, encapsulated within liposomes nano molecules, merging skin cell membranes and allowing protein delivery.

Nanoparticles for lung damage

Researchers developed a nanoparticle that can slip through mucus coating surfaces such as lung tissue. This ability to penetrate the mucus coating should provide the capability to coat lung tissue with therapeutic drugs.Medical implants made of porous plastic, coated with carbon nanotubes. Drug linked with nanotube is freed to blood, as any fluctuation in blood send signal.

Polymeric nanoparticles production

Polymers are either natural or synthetic made of macromolecules, having multiples of monomers. Polymeric materials are such nanoparticles, that can cause modifications and have the ability of reabsorption in the living body. Because of their enhancing characteristics, for example, biocompatibility, easy preparation and design, various structures and advanced techniques have been adopted with bio-mimetic characters, and specifically, they have therapeutic ability to deliver different drugs directly into the target sites of action with high efficacy. They have been focused more in the past two decades because of their multifunctional qualities in nanotechnology for delivery system of drugs. They contain macromolecular nanomaterials and are therapeutic agents which can be used as adjuvant in formation of vaccines or carriers of drugs. In this process, the main ingredient is dissolved, then entrapped, encapsulated, after that it is either chemically attached or absorption is carried out. In recent research, delivery of drugs is done through polymeric nanoparticles. Due to its properties such as a nanocarriers, drugs are protected by polymeric nanoparticles *in-vitro* as well as *in-vivo* degradations. It releases the drugs specifically at target sites and are controlled. It also causes the drugs to be targeted to increase the effects of drug remedial results and decrease the adverse effects. There are different delivery systems. Nano-carriers related to polymeric group and have enormous properties like easy to manufacture, cheap, biocompatible, water soluble, non toxic, biodegradable and non-immunogenic. Interaction of the drugs is prevented through polymeric nanocarriers along with macromolecules like proteins. This may sequester the ingredients which are active and can stop to reach at the action site. This system based on polymeric materials has more cost-effectiveness and it is easier to produce on large scales than liposomes and has more stable profiles. Occurrence of harmful effects, reactions of drugs and decreased toxicity and good drug utilization can be taken into account by use of this type of carrier. Chitosan, poly(methyl methacrylate), polyhydroxy alkanoates, poly-(lactic-co-glycolic acid) There are typical kinds of polymers which have been using widely in all drug delivery systems such as chitosan, poly hydroxyl alkanoates, poly methyl methacrylate and poly lactic- co-glycolic acid. They reflect high potential indifferent therapeutic and diagnostics applications.

Chitosan

Chitosan is the most popular hydrophilic polymers that is natural and widely used. It has approached to significant study to applications of drug delivery due to its antibacterial, biocompatible characteristics. In the chitosan action, amino group play role and act as reactive site for the attachment of new groups to produce versatile derivatives which differ physically and chemically with the use of favorable reaction conditions at mild rate. These amino groups are responsible for other features of chitosan, for example, nature of cations, drug release control, muco-adhesion, and permeation enhancement. There are unique formulations of materials of chitosan like microspheres, tablets, nano fibers that have been explored applications of drug delivery and used as versatile therapeutic agents.

Nanocarriers

Poly(Methyl Methacrylate) (PMMA)

PMMA, that is not biodegradable homopolymer belonging to synthetic methyl methacrylate monomer, has been frequently used biomedical substances to deliver drugs, having less cost, ability to scale up examination and easily availability, especially its biocompatibility. Kinetics of dischargefollows generally biphasic route, containing incomplete drug discharge, linked with hydrophobic polymers as well as less porosity. PMMA on basis of nano carriers, with latent biomedical solicitation involves its utility like vaccine adjuvant as well as drug carriers, for example, antioxidant, antibiotics, anti-inflammatory as well as antineoplastic through various administration pathways.

Polyhydroxyalkanoates (PHA)

PHAs are the polyesters of various hydroxyalkanoate monomers accumulating as energy / carbon storage materials by granular inclusions in the cytoplasm of various bacterial cells, usually under unbalanced growth conditions. Combined tunable features by chain lengthsas well as branching controls, co-monomer compositions, biocompatibility, biodegradability, and thermoplastic features help making PHA potential candidate substance to deliver drugs.

Poly-(Lactic-co-glycolic Acid) (PLGA)

PLGA, that is the copolymer of poly lactic acid and poly glycolic acid, has been abundantly explored biodegradable polymer with regard to biomedical application. PLGA's accessibility commercially, promising degradation physiologically, likelihood of tuning surfaces as well as physiochemical qualities, sustainable drug discharge, have proved PLGA as exciting polymeric drug carriers in many clinical applications. PLGA goes through hydrolytic degradation inside aqueous solution because, ester linkage with polymer backbone undergo random hydrolysis. Then reduced forms, fragment soluble in water, undergo hydrolysis into lactic and glycolic acid degrades producing energy, carbon dioxide as well as water through regular metabolic paths of the body. Different types of polymer-based nanoparticles. Drugs can be loaded in the polymeric nanocapsules / nanospheres by entrapment or absorption (Kumar *et al.,* 2012).

Biocapsules

NASA's work on "biocapsules" like implant, keeping astronauts safe, from adversative radiations. Such implants could be beneficial, to produce insulin for diabetics, via drug deliveryas well as for cancer patient through chemotherapy.

CONCLUSION

Nanotechnology, nanomedicines and nano devices has become very popular because of its benefits and advantages in medical biology. It has played major role to combat antibiotic resistant bacteria and introduced advanced techniques for diagnosis and cancer therapy. Different pharmaceutical companies and scientists have targets to construct nano machines and nano robots to repair and engineer cell and tissues. For this purpose, some researchers of different universities have achieved great success in this field and they are applying these devices and techniques for treatment of patients. But this manufacturing and research is complicated, time consuming and need very high cost.

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