Applications Of Nanomaterials In Improving The Traditional Diagnostic Approach

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ABSTRACT

The broad art of uses of nanomaterials or nanoparticles and nanodevices that are used in medical healthcare to diagnose and cure a variety of diseases has recently developed as a result of recent advancements in pharmaceutical research.So, in this review article, we will discuss the various art of nanomaterials that are used in various forms to develop various nano-devices and nano technologies that are widely used in medical applications, such as cantilevers, which are highly stable devices that are integrated into highly sensitive disease markers in diagnostic detectors and display reliable performance for a long time. These nanoparticles are also employed in the creation of various dosage forms that are used to eithercure or diagnose diseases. These nanotechnologies are frequently used as sophisticated tools or gadgets in the early identification of cancer and atherosclerosis in the human body, where subsequent therapy such as nano-surgery may be used to cure them. These are well-known superior materials that are necessary for many fields due to their nano size.

Keywords:-Atherosclerosis, Medical applications, Nanomaterials, Nanotechnologies, Nanodevices

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1.0 INTRODUCTION OF NANOMATERIALS

The recent development in pharmaceutical science develops the different art of applications of nanomaterials or nanoparticles and nano-devices that are applied in medical healthcare to diagnose varieties of diseases and treat them very well. So this review article going to describe the different art of nanomaterials that are used in different forms to develop varietiesof nano-devices and nano technologies that are widely applied in the medical applications such as cantilevers which is a highly stable device that is integrated into highly sensitive disease marker in the diagnostic detectors and display reliable performance for a long period of time.

A Bioaffinity developments have made it possible to develop personalised NP medications for tumor therapy, integrated nanodevices for early cancer diagnosis and treatment, and NP probes for molecular and cellular imaging. With the help of these developments, it may be possible to identify and treat patients' molecular profiles of genetic and protein biomarkers and give them with customised medicines. These nanomaterials are also used in the development of different dosage forms that are either used to treat the disease of mark them or detection. These nanotechnologies are widely preferred to use as sophisticated tool or devices in detection of cancer and atherosclerosis at their early stage in human body and further treatment such as nanosurgery can be performed to cure them. Due to their nano size these are well known superior materials and indispensable in many areas.

NANOTECHNOLOGY BASED APPROACH USED IN THE TREATMENT OF DISEASES

Nanotechnology used for Cardiovascular Disease (CVDs)

Cardiovascular diseases (CVDs) are the leading cause of death. In 2019, 18.6 million people worldwide passed away from cardiovascular disease (S. S. Virani, A. Alonso, 2021). Changes in the normal functioning of the heart and its supporting structures frequently cause heart disease and its accompanying conditions, such as atherosclerosis, arrhythmia, coronary heart disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis, and pulmonary embolism.

The main cause of this reported distress is a inactive lifestyle with little to no physical workout, which has been shown as the key contributor to CVD in humans (J. W. Rhee and J. C. Wu, 2013). Designer nanoparticles with targeting ligands have been developed for plaque and heart-targeted medication delivery as a means of preventing CVD. These nanocarriers transport drugs to a specific therapeutic spot without harming normal tissue. Instability, poor bioavailability, poor solubility, poor absorption, and negative side effects are barriers to conventional, systemic medication administration that are intended to be removed using nanotechnology-based methods (W. Jiang and H. Liu, 2016).

Understanding and utilising modern technologies will create a secure and reliable platform for the controlled, targeted distribution of actives that will reduces the incidence of lipid disorders and other diseases (H. Liu and T. J. Webster, 2007). The limitations associated with employing conventional biomaterials were overcome using nanomaterials (O. Pagliarosi, V. Picchio,2020). Need for a Nano-cardi ovascular Targeting Approach. Addition ally, combining new technologies with nanotechnology will alter the way CVDs are treated. Numerous researchers had created nanomaterials that resembled the extracellular matrix and sped up the healing process (N. Kapil, Y. H. Datta, 2017).

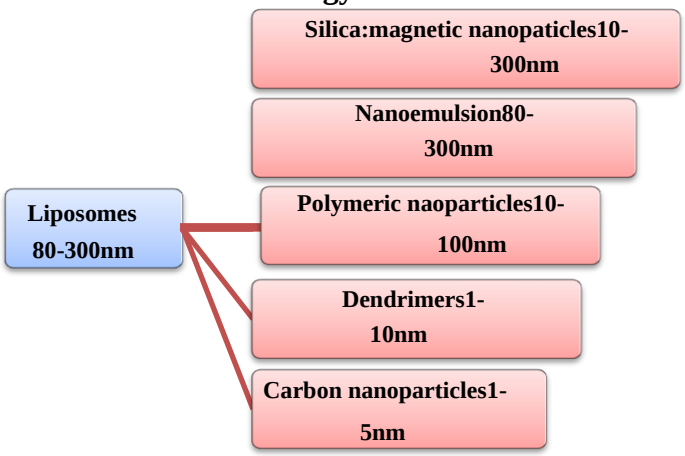
The main goals of contemporary CVD therapy are to restore regular blood flow and to prevent recurrent cardiovascular shocks. Treatment with statins lowers atherosclerotic plaque growth and thickness, as well as its effects on exterior elastic membranes, fibrous and dense calcium volumes (S. C. Johnston, J. D. Easton, 2018). First-line antiplatelet drugs for the prevention of cardiovascular disease include aspirin and clopidogrel, which work to reduce clot formation and platelet aggregation (S. C. Johnston, J. D. Easton, 2018).

According to reports, people who received both clopidogrel and aspirin after having a small ischemic stroke saw a lower risk of significant ischemic events than those who only received aspirin (K. Raj and S. Malini,

2018). Additionally, it has been discovered that ethidium bromide is displaced from its DNA binding site when it binds to the calf thymus DNA signal that indicatedclopidogrel bisulfate (D. A. Tonetti, B. T. Jankowitz, 2020). Additionally, aspirin reduces the availability of clopidogrel bisulfate in basic medium due to its reduced acidity (P. Stano, S. Bufali, 2004).

Antiplatelet therapy has to be improved because of its numerous unfavourable side effects and limited patient compliance (B. Alotaibi, E. Tousson, 2021). Additionally; some patients' antiplatelet medication reactions are subpar, which negatively affects their long-term prognosis. People who respond poorly to clopidogrel after an acute myocardial infarction are more likely to experience subsequent cardiovascular events. This result is in line with earlier research (N. K. Egilmez, Y. Iwanuma, 1996). This shows the promise for nano-medicine and the necessity for technological advancements.

Nanotechnology Based Devices



Liposomes

For the targeted delivery of medications to distant organs, liposomes are the unilamellar or multilamellar lipid membrane carries both hydrophilic and lipophilic medicines. The vesicle's spherical form closely matches the cell membrane in structure. Liposomes reduce the toxicity that results from entrapment and are biocompatible and biodegradable (Jabir NR, Tabrez S, 2004). Thin-film hydration was used to create the liposomes utilising DSPC (di-stearoylphosphatidylcholine), DSPG (di-stearoylphosphatidylglycerol), and cholesterol (Gao XH, Cui YY, 2004). In mice, the liposome formulation demonstrated a 50% reduces cytotoxicity and death rate. Additionally, the liposomes reduced the number of inflammatory neutrophils and inflammatory monocyte infiltration in the heart while increasing angiogenesis (Soutschek J, Akinc A, 2004).

Nanoparticles

Smaller sizes and the ability to surface functionalize with new side chains define NP Their reduced size provides a significant surface area for binding and interaction (Morrissey DV, Lockridge JA, 2005). Since, the NPs may be made both hydrophilic and hydrophobic, they can easily pass through tight junctions. The cardiac magnetic resonance that aids in the diagnosis of atherosclerosis can be improved by targeting macrophage scavenger receptors with NPs conjugated with d-block and f-block components (Matsumura Y, 2004). The Ehrlich ascites carcinoma cardiac toxicity can also be treated by entrapping natural medicines like curcumin inside the NPs (Flynn MA, Casey DG, 2004).The amount of tumor cells decreased and the amount of ascites fluid's apoptotic cells significantly increased after the administration of NPs. The cardiac indicators were also reduced by the therapy (Flynn MA, Casey DG, 2004).

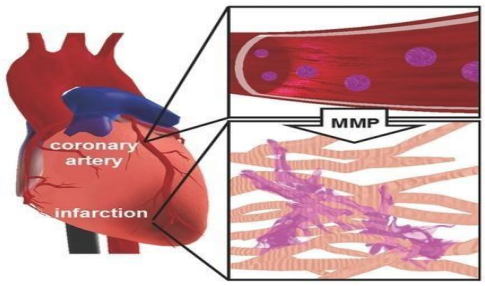


Figure.1.0. Application of nanoparticles intravenously at the site of acute myocardialinfarction using targeting method

In a rat model of an acute myocardial infarction, it is explained how to retain intravenously delivered nanoparticles at the location of the infarction. By acting on enzyme-responsive peptide-polymer amphip-hiles, matrix metalloproteinase (MMP-2 and MMP-9), which are up-regulated in heart tissue after myocardial infarction, induce them to morphological shift from spherical discrete materials to network-like assemblies (Verma UN, Surabhi RM, 2008).

Nanofibers

The term "nanofibers" refers to fibres with a diameter between 1 and 1000. The nanofibers are used for regenerating and engineering heart tissue. For the purpose of regenerative engineering and the therapy of dilated cardiomyopathy, many researchers combined nanofibers with drug elution and implanted cells (De Jonge J, Holtrop M, 2006). Using PLGA-based nano-fiber scaffolds, the human inducible pluripotent stem cell-derived cardiomyocytes (hiPSC-CMs) were cultivated on the cardiac patch (Wilson DS, Dalmasso G, 2010).

Another study that was resistant to arrhythmogenesis and supported the use of PLGA in seeding ventricular cardiomyocytes produced from embryonic stem cells did so as well (Fonseca C, Simoes S, 2002). Wu et al. developed a anisotropic 3D cellular cardiac structure for tissue regeneration. Polycaprolactone, silk fibroin, and carbon nanotubes are the primary components of nanofiber yarn (Koziara JM, Whisman TR, 2006). The yarn assisted in the maturation of the cardiomyocyte. The three dimensions of the hydrogel provided a context (Koziara JM, Whisman TR, 2000).

Dendrimers

The word "dendrimer," which appropriately describes the structure of these frequently branching molecules, comes from the Greek word "Dendron," which means "tree" (Crampton and Simanek 2007). Dendrimers are special because of their multibranched, three-dimensional design, low polydispersity, and excellent functioning (Sherje et al. 2018). Dendrimers provide a number of obvious advantages over other nanotechnologies when used as non-viral vectors for medicinal purposes due to their great solubility, enhanced stability, lower immunogenicity, and capacity to assist the actual transport of therapeutic molecules, DNA, and RNAs, they are supercilious to other viral and non-viral analogues. (Mendes et al 2017).

Due to the large number of branches at their surface, dendrimers frequently have highly charged exteriors; this can frequently result in either a highly cationic or highly anionic nature and, if not properly addressed, can cause toxicity difficulties (Jain et al. 2010).In order to tackle CVD, researchers have turned to gene therapy.

As a result, researchers have researched methods to employ cationic liposomes and other nanocarriers to control the up regulation of inflammatory genes as well as techniques to deliver genetic material to the targeted areas more efficiently. Polyanionic DNA is transported to cells by both dendrimers and cationic liposomes (Bhadra D, Bhadra S, 2003) A G5 dendrimer with an ethylenediamine core was used to study gene shift in mouse cardiac grafts. G5 dendrimer expression increased 1000-fold in myocytes and graft filtering cells after seven to 28 days of X-Gal labelling. Dendrimers have been shown to improve plasmid survival (Bhardwaj

A, Misuriya A, 2014).

Nanotechnology in diagnostic and therapeutic for Gastrointestinal Disorders Nano-tools for Diagnostics Applications Nanowires applications

Biological and chemical species can be detected directly electrically using devices based on nanowires (Ramalho, et al.2016). As a particle flow through microfluidic channels, nanowires sensors detect molecular structures, relaying the information to a signal analyser (Wei, H et al.2017). Researchers can use such systems to detect altered genes associated with the disease and pinpoint the location of these changes (Duli ´nska-Litewka et al.2019). A silicon nanowire (SiNW) biosensor array was developed by Zheng etal. for the simultaneous detection of many cancer markers on a single flexible detection substrate. Using SiNW biosensors functionalized with three matching antibodies, three cancer indicators were identified in real time: prostate-specific antigen, carcinoembryonic antigen, and mucin-1. Several distinct biomarkers may be examined simultaneously with excellent sensitivity, which could make cancer early detection even simpler. This study described how aligned ZnO nanowire arrays were made using the vapour-solid method.

Cantilevers applications

The quantitative analysis of specific molecules at low concentrations is made possible by a nano-cantilever. Fast and sensitive detection is provided by cantilever arrays, which are made of microscopic flexible beams that resemble diving boards. Real-time analysis of the cantilevers' physical characteristics reveals changes brought on by binding events (Kim S.J, Lewis 2016). By fusing an affinity reagent with a surface-immobilized on it to a biomarker protein or nucleic acid (through hybridization), the deflection and resonance frequency of a Nano-cantilevermay be finely modulated (Iyer S.R, S Stain, 2016).

For instance, a cancer cell's released molecular products can be selectively bound to by an antibody-coated cantilever. Modern communication tools can be used in conjunction with this detection. (E.g. smart phones) It offers a personalised, real-time diagnosis based on blood indicators for an illness. Patients will therefore have the unique capacity to access their own amount of inflammation in real time.

Quantum Dots applications

Quantum dots (QDs) are semiconductor Nanocrystals that are easily manufactured and have unique features that fall in between those of discrete molecules and those of bulk semiconductors (Kumar, s et al.2016) QDs have size between 2 and 10 nm. They exhibit size dependent fluorescence characteristics and quantized energy levels (Hobson, N.J et al.2019) Quantum dots fluorescent characteristics make them excellent for imaging and cancer targeted applications. Due to theirincreased permeability and retention at the site of a tumor , semiconductor nanoparticle can build up at a target site (Shari, S et al.2015) .In axenograft model using a human prostate cancer cell line in naked mice, the target accumulation of quantum dots was experimentally proven in- vivo(Wang, Z.J et al.2019)

Table.1.0 Examplesofapplicationofnanotechnologyingastroenterology

Sr.No.	Characteristics and Potentialities	Example of Application in GI (Target, Aim of Study)
1.	**Loaded molecule control release**	Apo B siRNA that has been chemically modified is Administered intravenously and is reduced in the liver and jejunum to lower total cholesterol (Vigneron and Bankson 2019).
2.	**Gene delivery applications**	Hepatitis B virus Si RNA administered intravenously reduces the amount of HBVDNA in the liver. (Geraghty and keshari 2017)
3.	**Low toxicity and antigenicity**	Micelles containing paclitaxel and poly aspartate (block polyethylene glycol) are being developed to treat colon cancer (Cho and keshari 2017).
4.	**Loaded molecule control release**	Targeting the peritoneal cavity to prevent tumor Development and inflammation (Malik and pundir 2019)
5.	**Gene delivery applications**	Hepatocyte growth factor (Zhang and Salameh 2017)is encapsulated and administered intravenously to treat liver cirrhosis.
6.	**Low toxicity and antigenicity**	Intravascular infusion of bcl2siRNA-loaded RNAi to suppress the development of liver metastases. (Cho and Keshari 2017)

7.	**No control release**	Hemagglutinin-presenting virosomes bind to and Fuse with cells that are being targeted in order to deliver iRNA. (Kostarelos and bianco 2009)
8.	**Gene delivery applications**	Reduction of DSS-induced colitis with intra-rectal Injection of DNA that inhibits colon inflammation. (Keren and zedra 2020)
9.	**Loadedmolecule control release**	Oraladmini stration of TNF-siRNA-loaded Thioketal NPs in the colonic tissue of mice with colitis caused by DSS. (welsher and sherlock2009)
10.	**Gene delivery applications**	Oral administration of insulin-loaded zirconium phosphate nanoparticles. (Garg and sung 2009)

Nanoparticles role in detection & treatment of Lung Cancer

Lung cancer is catch all phrase for a group of diverse diseases that account for 18.4%of all cancer diagnoses are cancer, and approximately 70% of patients had advanced disease at the time of diagnosis: include a physical examination, a medical history review, and imaging procedures such as x-rays, computed tomography (CT), bone scans, MRIs PET Scans and combination PET- CT Scans.(Kurhanewicz J et al.2019) We shall talk about the possible applications of nanoparticles for the treatment of lung cancer throughout the review.(Garg, B, Sung, C.H,2015)

Table.2.0. finalize lung cancer clinical trials using nanoparticles. In August 2020, a thorough search on ClinicalTrials.gov was conducted "for & nanoparticles and lung cancer" These were examined and chosen in accordance with the state of the research**.**

Clinical trials gov Identifier NCT no.)	Study Type	Description	Primary outcome	Planned enrollment (n)	Recruitment Status
NCT01792479	Phase-II	A phase II investigation to ascertain the security and effectiveness of BIND 014 (docetaxel nanoparticles for injectable suspension) as second-line treatment for Patients with NSCLC.	Objective response rate	64	Completed
CT02283320	Phase-II	In patients with NSCLC or v-Ki- ras 2 Kirsten rat sarcoma viral oncogene homolog mutation who have progressed following treatment with one prior platinum-containing chemotherapy regimen, BIND014(docetaxel nanoparticles for injectable solution) is being evaluated.	Disease control rate	69	Completed
CT0055346 2*	PhaseII	In this Phase II trial, the effectiveness of radiation treatment, erlotinib, and a carboplatin and paclitaxel albumin- stabilized nanoparticle formulation is being investigated in patients with Stage III NSCLC who are not candidates for surgical resection.	Overall survival at12 months	78	Completed
CT0072961	Phase-II	This Phase II trial is evaluating the efficacy of co-administration of carboplatin and paclitaxel albumin-stabilized nanoparticle formulation for thetreatment of patients with Stage IIIB, Stage IV, or recurrent NSCLC.	Overall response rate	63	Completed
CT00077246	PhaseI-II	ABI-007 is being tested in a Phase I/II trial to determine its side effects, optimal dosage, and effectiveness in treating stage IV NSCLC patients.	Maximum tolerated dose and dose-limiting toxicity of ABI-007 Objective target lesion response	64	Completed
CT0138076 9*	PhaseII	This research compares patients with advanced NSCLC who received CRLX101 to those who received the best supportive care to determine whether group of patients had a higher median overall	Overall survival	157	Completed

APPLICATIONS OF NANOMATERIALS AND DEVICES

Drug Delivery System

Nano materials are colloidal particles composed of environment-friendly polymer and their dimensions ranges between 10-1,000 nm. Pharmacologically active substance can be immersed on the surface of colloidal particles, embedded in polymer or liquefy in the polymer matrix (Nurunnabi et al.2014). Liposomes are an example of dds (Cai, X, Zhu, 2019). DDs improve physicochemical properties of the drug such as partition coefficient, solubility, pharmacokinetics, biodistribution, and efficacy of drug (Kwiatkowski G et al, 2017). Nanomaterials as it may be utilized for target specific drug delivery at the site of disorder to increase absorption of insoluble drugs (Dong, Y.C,2019),drug target to a particular site and bioavailability of drug also enhance.Several anticancer drugs have been successfully formulated using nanotechnology paclitaxel, doxorubicin, dexamethasone, 5-fluorouracil (Yousaf, T,2018).Dexamethasone bind to receptors and the drug receptors complexes are subsequently transport to cell nucleus, which leads to the appearance of specific genes so that easily control cell multiplication (Hemond, C.C,2018).

Nanomaterials in Drug Delivery System obtain FDA approval

Table.3.0. Nanomaterials in drug delivery system obtain FDA approved

Drug or therapeutic agent (tradename)	Indication	Reference
Liposomal amphotericin B (Ambisome, Ablecet, Amphoteric)	Fungal infections, Leishmaniasis	Alder-Moore (1994)
PEG-adenosine deaminase (Pegademase)	Severe combined immunodeficiency disease	Bory et al. (1991)
PEG-stabilized liposomal doxorubicin(Doxil, Evacet)	Kaposi's sarcoma, refractory ovarian cancer	Muggia and Hamilton (2001),Northfelt et al.(1996)
liposomal cytosine arabinoside(DepoCyt)	Lymphomatous meningitis, neoplastic meningitis	Glantz et al. (1999a), Glantz et al. (1999b)
Interleukin 2-diptheria toxin fusion protein (Denileikin Diffitox)	Cutaneous T -cell lymphoma	Olsen et al. (2001)
Liposomal verteporfin (Visudyne)	Wet macular degeneration	Bressler (2001)
PEG-interferon α-b(Pegasys)	Hepatitis c	Gule et al.(2000)
PEG-granulocyte colony-stimulating factor(Neulasta)	Chemotherapy associated neutropenia	Siena et al.(2003)
Protein bound paclitaxel (Abraxane)	Metastatic breast cancer	Nyman et al.(2005)
PEG L- asparaginase (Oncaspar)	Acute lymphocytic leukemia	Rosen et al.(2003)
PEG aptanib (Macugen)	Wet macular Degenration	Lee et al.(2005a,b)
Pemetrexed (Alimta)	Malignant pleural mesothelioma	Ceresoli et al.(2006)

Application in Surgery

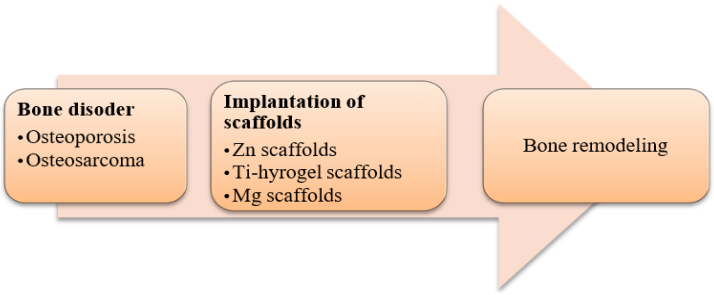
Maxillofacial Surgery using Nanomaterials

Nanomaterials have the potential to

revolutionise the fields of oral surgery and dentistry through the use of nanorobots, nanomaterials, and biotechnology. (Behzadi, A.H, 2019) Nanorobots have a diameter of 0.5-3m and are made up of components ranging in size from 1-100 nm. They can perform precise procedures at the cellular and molecular level(Dong, Y.C,2019). To enable oral and maxillofacial surgeons keep up with the cutting-edge field of nanotechnology and nanosurgery, maxillofacial surgeons need to put in more effort, and supportive groups or societies need to provide more resources in the field of research.(Silvestri, A,2016).

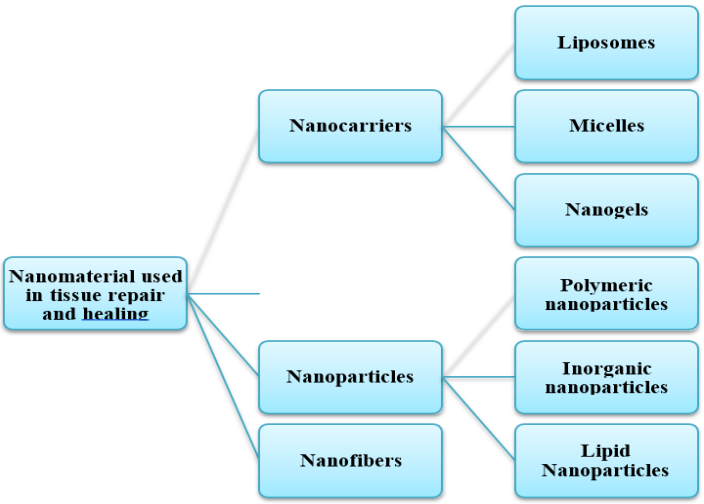
Bone Regeneration Therapy

Biomaterials are widely involved in regenerative therapy and tissue engineering in bone.Bone diseases such as osteoporosis, osteosarcoma and bone loss require bone regeneration therapy. Nanotechnology are utilised for bone regeneration and detection of bone disorders. Nanomaterials (nanoliposomes, gold nanoparticles) loaded in scaffold and subsequently implant into the defected site. Drug released from the nanomaterials. Inorganic nanomaterials silica and metal-based materials, calcium phosphorus having great mechanical propertiesfor bone defect repairing.(Nakagawa, T,2016)



Soft Tissue Repair & Healing

Wound and burn care are two sector of health care that are benefited by advances in nanotechnology. (Santos, B.S,2019) Wound dressing made using nanotechnology can be able to significantly improve tissue repair. Nanoparticles can be made from various materials using methods. Nanoparticles are a promising tool in the field of tissue engineering. Nanomaterial have potential to promote cell homeostasis. Nanomaterial properties involve in soft tissue repair and regeneration cell adhesion, ability to respond to external stimuli, promote cell proliferation.(Siegel R,2017)



Application in Pro Imaging

Proimaging has stepped forward significantly in current decades and allows us to exactly acquire anatomical data through unique modalities (Siegel R,2014). Nanomaterials play a enormous element in proimaging,as mentioned below :

Magnetic Resonance Imaging (MRI)

MRI is a non-invasive imaging approach that can offer comprehensive and multiparametric information (Duncan R,2005). The introduction of magnetic resonance imaging in the revolutionized modern clinical imaging technology. It is rapidly becoming one of the most useful tools for diagnosis and monitoring of disease (Jabir NR, Anwar K,2017). Approximately 17 million MRIs were performed in the US in 2015. Contrast agent improves visualization and performs a crucial role in MRI. Ideally contrast agent administered and excreted from the body without causing any side effects. However, most of the contrast agent currently exhibit adverse effects such as liver toxicity, gado liniumde position. Technical advance- ment in the field of nanomaterials has shown the possibility of using them as contrast agents in MRI and decreasing number of side effects.

Currently SPIO are used as MRI contrast agent .Targeting ligands that binds to particular cancer biomarkers such as proteins, peptides, antibodies attach with nanoparticle for site specific targeting for example MG ,CK19 (Breast cancer biomarker) if bind to SPIO provide targeted retention of SPIO in cancer cells results in detection of cancer by MRI.(Nguyen KT,2011)

Computed Tomography (CT) Scan

CT uses an x-ray source and set of detectors to create an image .It has been extensively utilized in medical imaging and produce image with high resolution Nanoparticles having more advantages in comparison to CT contrast agent like prolonged blood-pool residence periods, the potential for cell tracking and ability to be used for targeted imaging (Shim MS, Lee HT,2002)It can find out internal bleeding, blood clots, tumor cells, spinal and brain injury without using any kind of invasive approach .Gold nanoparticles widely used as contrast agent for computed tomography. (Patri AK et al.2002)

Positron Emission Tomography (PET)

Positron emission tomography (PET) used for clinical diagnosis of various diseases.(Cloninger MJ,2002)It contains positron-emitting isotopes which administered into the body and the gamma radiation produced by that isotope is recorded to determine the exact location of a physiological process.(Choi Y, Thomas T, 2005) Silicon nanoparticles, gold nanoparticles used as contrast agent for positron emission tomography (PET).Given that it combines high-resolution anatomic data produced from CT with quantitative PET imaging, PET- computed tomography (CT) is the ideal modality choice for this application.(Chen C, Cheng YC,2005) Fluorochromes were added to the nanoparticles utilised in this work to make it easier to validate the placement of the agent using optical imaging methods.(Shim MS, Lee HT,2002)

Table.4.0. Application of nanomaterials in the proimaging techniques

Proimaging Technique	Type of nanoparticles
Magnetic resonanceimaging (MRI)	Magnetic nanoparticles
Computer tomography	Inorganic nanoparticles(gold nanoparticles, quantum dots, superparamagnetic iron oxide nanoparticles,)
Positron emission tomography	Silicon nanoparticles, gold nanoparticles

4.0. CONCLUSION

Nanotechnologies are being actively developed to create diagnostic and therapeutic devices. nanoparticle range in size from 1-100nm and can be used to exhibit certain properties at the cellular atomic and molecular level. Nanoparticle-based drugs have limitless potential as new application

continue to be developed for the detection, imaging and treatment of cardiovascular disease, gastrointestinal disorder, lung cancer. Many nanomaterials are still in the pre-clinical stages, it is important to study bio-distribution of nanomaterial. By using nanomaterials as a contrast agent in different diagnosis technique such as gold nanoparticles used as contrast agent in positron emission tomography reduced side effects caused by traditional contrast agent for example side effects of gadolinium are nephrogenic systemic fibrosis. Nanoparticles can attach to biomolecules allow detection of disease biomarkers in lab sample at very early stage. Nanoparticles increasingly used in diagnosis of various cardiovascular diseases like atherosclerosis, arrhythmia, coronary heart disease, gastrointestinal disorder nanowires used for detection of altered genes associated with disorder cancer, brain disorders (biosensors used in diagnosis of Parkinson disease).

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ABBREVIATIONS

CardiovascularDisease(CVDs), Nanoparticles (NPs), Positron emission tomography (PET), Computed tomography (CT Scan), Drug delivery system(DDs), Quantum dots (QDs), Magnetic resonance imaging (MRI), human inducible pluripotent stem cell-derived cardiomyocytes (hiPSC-CMs), Silicon nanowire (SiNW), Superparamagnetic iron oxide nanoparticles (SPIO), Deoxyribose nucleic acid (DNA), di-stearoyl phosphatidylcholine (DSPC), di-stearoyl phosphatidylglycerol (DSPG) Metalloproteinase (MMP), Polylactic-co-glycolic (PLGA), Small interfering ribonucleic acid (siRNA), Zinc oxide(ZnO), Tumor necrosis factor-alpha small interfering RNA(TNF-αsiRNA), Non-small cell lung cancer(NSCLC), Polyethylene glycol (PEG), Cytokeratin 19(CK-19), Myasthenia gravis(MG), Dextran sodium sulphate (DSS-induced colitis), Hepatitis B virus(HBV), Gastrointestinal (GI).

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