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Nanorobotics in Cancer Theropy

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Abstract: *Nanorobotics is the technology of creating machines or robots at or close to the scale of a nanometre (10-9 metres), machines Constructed at the molecular level (nanomachines) may be used to cure the human body of its various ills. Traditionally nanotechnology dealt with design, synthesis and Application of materials along with devices at the nanometer scale. The application of nanotechnology in the field of health care and drug Delivery has come under great attention in recent times. Nanomaterials have a large surface area to Volume ratio and their physicochemical properties, such as Friction and interaction with other molecules, are distinct From equivalent materials at a larger scale. The most com-Mon use of nanotechnology in medicine has been in the Areas of developing novel therapeutic and imaging modal-Ities that have the potential to outperform the current state of The art in these areas. We will focus on the application of Nanotechnology to the development of smart drug delivery vehicles for cancer therapeutic applications. The most Common examples of these nanoscale delivery vehicles include polymeric nan Particles, dendrimers, nanoshells, liposomes, nucleic acid-Based nanoparticles, magnetic nanoparticles, and virus Nanoparticles. The following four types of nanorobotic systems have been developed and studied so far (a) large size nanomanipulators with nanoscale manipulation capability; (b) proicin- and DNA- hused bionanorobotic systems) Magnetically guided nano robotic system and d) bacterial based Nanorobotic etc. It can be used in many other applications.*

Keywords: Nanorobotics.

I. INTRODUCTION

1.1 What is Nanorobotics?

Nanorobots are nanodevices that are used to protect or treat pathogens in humans. It is a small device that is designed to perform a specific task, or sometimes tasks, with nanoscale precision of 1-100 nm. They are ex-Pecked to work at the atomic, molecular, and cellular levels to accomplish tasks in both the medical and industrial fields (2). According to nanorobotics theory, “nanorobots are microscopic in size, it would likely require very large numbers of them to work together to perform microscopic and macroscopic tasks (3). Nanorobots will be used to maintain and protect the human body from pathogens. Nanorobots are about 0.5 to 3 microns in diameter and will be made of parts with dimensions ranging from 1 to 100 nanometers. (1)

There are two main types of nanorobotics, i.e. organic and inorganic nanorobots are by far the most studied. Organic nanorobots, also known as bio-nanorobots, are created by combining viral and bacterial DNA cells (4). This type of nanorobots is less harmful to the organism. Diamond structures, synthetic proteins and other materials are used to make inorganic nanobots, which are more dangerous than organic nanobots (4). To overcome this toxicity hurdle, the researchers devised a method involving encapsulating the robot, reducing its chance of being destroyed by the body’s self-defense mechanism (5,6).

Nanotechnology when used with biology or medicine is referred to as nanobiotechnology . This technology should be used very carefully because the lives of human beings are involved. When used correctly, it can be very effective in providing treatment with minimal side effects (7). Nanomedicine , an offshoot of nanotechnology, refers to highly specific medical intervention at the molecular level to treat disease or repair damaged tissues such as bone, muscle or nerve(8).

A nanometer is one billionth of a meter, too small to be seen with an ordinary laboratory microscope. At this scale of about 100 nanometers or less, biological molecules and structures inside living cells function. Nanotechnology involves the creation and use of materials and devices at the molecular and atomic level(7,8). Research in nanotechnology began

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with discoveries of new physical and chemical properties of various metallic or carbon-based materials that appear only for nanometer-sized structures (7).

Nanorobotics is a field that requires a collaborative effort between physicists, chemists, biologists, computer scientists, engineers, and other specialists to work on these common areas (7).

1.2 History of Nanorobotes

It's an old method, but there are many types of innovations today that Nobel Laureate Richard Smalley did in the 1980s. Smalley has a vision of carbon nanotubes discovered by Sumio Iijima, which he envisions as the next super interconnect for ultra-small electronics(10). The term nanotechnology has evolved to mean the manipulation of elements to create unique and hopefully useful structures(9)

- **On December 29, 1959:** carbon nanotubes, discovered by Sumio Iijima, envisioned as the next super-interconnect for ultra-small electronics. The term nanotechnology has evolved to mean the manipulation of elements to create unique and hopefully useful structures.(9,10)
- **In 1974:** Professor Norio Taniguchi defines nanotechnology as "the processing, separation, consolidation and deformation of materials by atom/molecule(10).
- **In 1980:** In 1980 Dr. Eric Drexler publishes several scientific papers promoting nanoscale marvels and bias(9).
- **1986:** The Coming period of Nanotechnology by Dr. Eric Drexler . He envisaged nanorobots as tone-replicating. The first book on nanotechnology(9,10).

1.3 Views for Nanorobotics

Researchers or scientists/engineers have ideas about what nanorobots will look like, what they will do, how they can be used, and how they will be made.

Gregory Fahy and George M. Whitesides hold these two opposing views. Fahyperceives that nanorobots, especially used in the human body, will have a size of 0.3 to 0.5 microns. They are made of nanodevices with a size of 1 to 100 nanometers(11). The material composition of the nanorobot will be carbon in the form of diamond/fullerene nanocomposites due to the strength and chemical inertness of these forms.

The nanorobot will have a passive diamond coating so that its smoothness causes less reaction to the human immune system. Energy for the robot will metabolize local glucose and oxygen to power externally supplied acoustic energy. The robots will have on-board computers that can perform around 1,000 calculations per second(11).

The nanorobots will have chemotactic sensors that sense the target substance the robot was built for, such as cancer cells. To complement other areas of robotics with communication and coordination, Fahy states that communicating information to nanorobots is done using broadcast-type acoustic signaling. Coordination with nanorobotics is done using a navigation network installed in the body that provides precise positioning. This also allows people to track the device(11).

Removal of the nanorobots will be done either by human excretory channels or active scavengers. From another point of view, George M. Whiteside's view of a nanorobot is based on mimicking a biological organism, cells or bacteria. He states that nanoscale machines already exist in the forms of living cells(11). The basic components of a living cell, such as deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and proteins, form functioning devices such as the mechanical parts of modern robots.

DNA stores information for production and operation much like a central processing unit (CPU). The type of RNA (messenger RNA or mRNA) is the transcription of information stored in DNA. Proteins Build everything in the cell. DNA, RNA, proteins, nucleic acids, and other molecules are all molecular catalysts that cause chemical reactions within or among themselves to construct sensors, structural elements, pumps, motors, lipids that self-assemble to form a flexible layer surrounding the cell. , components for self-replication, mitochondria for energy source and much more.

Adenosine triphosphate (ATP) molecules are produced in mitochondria, cell organelles, and move through the cell by diffusion. Propelled by flagellar motors, flagella-like structures, some bacteria use ATP through decomposition to cause changes in the shape of molecules, armatures, to turn a protein shaft for propulsion(11).

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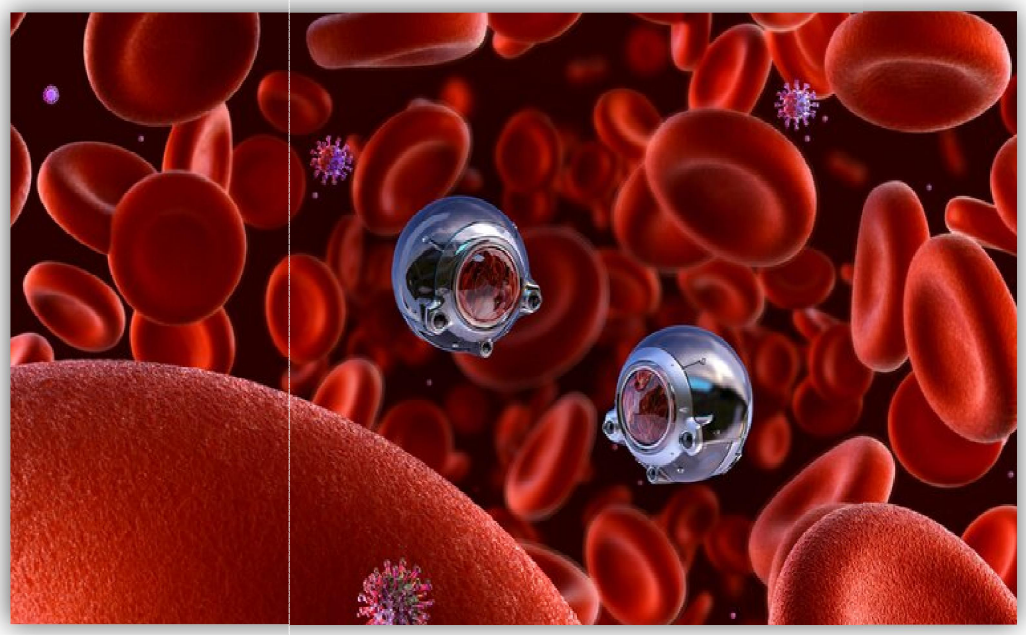
Scientists now use these ATP particles for rotational motion in the development of motors or energy sources discussed in Section 2.3. Whitesides states that "Given the many limitations in the construction and operation of nanomachines, it seems that new systems for building them could end up looking similar to ancient systems in biology.

1.4 Types of Nanorobotic System

It is a fractional concept of swarops of nanorobots in blood vessels.

A. Nanomipulators

The first norobotic systems weren't "nano" at all(12). Instead, they were large manipulator-like structures that had nanopositioning capability. The robotics community was not the first to engage in the field of nanomanipulation, but was preceded and inspired by the work of their colleagues in physics and chemistry, who used scanning probe microscopes (SPMs) such as scanning tunneling microscopes (STMs) and atomic force microscopes (AFMs) to nanomanipulation of atoms and molecules 1231 The first example of nanomanipulation of atoms(12).



B. BioNanorobotics (DNA and Protein-Based Nanorobotic Systems)

In the same period that nanorobotic manipulators were developed and studied. A second type of nanorobotic system, the BioNanorobotics system, emerged and grew independently of the first. The term bionanrobotics, first introduced in 2003 (13,14) , refers to all nanorobotic systems that include nanocomponents that are based on biological elements such as proteins and DNA . Bionanorobotic systems differ from medical nanorobots in that, although bionanorobotic systems contain components based on biological elements, they may not be used in medical applications. Bionanorobotics is a subset of the more general field of molecular machines and machine components, which has grown rapidly in recent decades(15).

The main goal in the field of bionanorobotics is the use of various biological elements whose function at the cellular level creates movement, force or signal as nanorobotic components(12). These components perform their pre-programmed biological function in response to specific physico-chemical stimuli, but in an artificial environment. In this way, proteins and DNA could function as motors, mechanical links, transduction elements or sensors.

If all these different components were put together in the right ratio and orientation, they would create multi-degree-of-freedom nanorobotic devices capable of applying forces and manipulating objects in the nanoscale world (11).

The benefits of using natural machine components is that they are highly efficient and reliable. Just as conventional macrorobotic systems are used to generate forces and movements to accomplish specific tasks, bionanorobots can be

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used to manipulate nano-objects, assemble and manufacture other machines or products; perform maintenance, repairs and inspection activities.

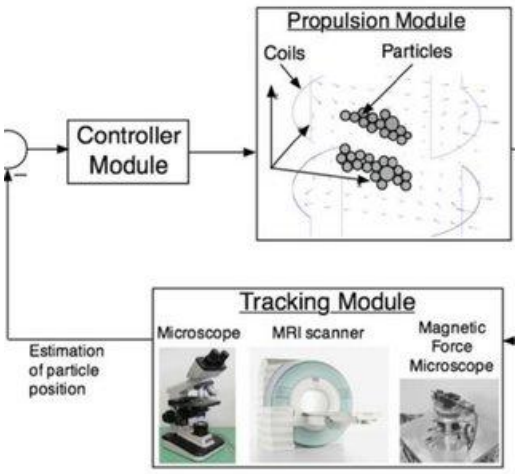
One such bionanorobot concept, with its "sense" made of helical peptides and its body using carbon nanotubes, while the propulsion unit is a biomolecular motor.

In this picture, biological elements will be used to make a robotic system(12).Vision of a bionanorobotic organism ;Carbon nanotubes from the main body; peptide limbs can be used to move and manipulate objects; a head-mounted biomolecular motor can propel the device in a variety of environments.

C. Magnetically Guided NanoRobotic Systems

The third type of nanorobotic system developed so far is much simpler than the previous two types, but is closer to the concept of a nanoscale robotic system, as shown in the sense that its dimensions are nanoscale and composed of artificial nanocomponents.

This manorobot is essentially a simple nanoparticle containing a ferromagnetic material. The obvious question is, of course, "How can a nanoparticle be considered a nanoboron?" The answer to this is that all the components and functions that make up a robotic system have been moved outside of the robot's design. Activation and propulsion could be achieved using an external magnetic field and its gradients, which could apply a six-degree-of-freedom magnetic force to the nanoparticles. Sensing and tracking the movement of nanoparticles can be done using external imaging methods such as microscopes or magnetic resonance imaging (MRI) scanners (11).



General concept of a closed-loop system for driving and guiding magnetically driven nanoparticles using persistent magnetic fields and imaging data.

D. Bacterial-Based Nanorobotics Bacterial-Based Nanorobotics

A fourth type of nanorobotic system that exists today is based on the way bacteria move in a fluid environment (16). It is a "biomimetic" type of nanorobot because it uses systems or concepts developed by nature, it is also a very "unusual type of nanorobot from an engineering perspective. Bacteria-based norobotic systems and some of their venions could also be considered (depending on their manufacturing technique and activation) as either a bionanorobotic system or a magnetically controlled nanorobotic system, as discussed above. Et. However, due to the uniqueness of their design, control and guidance, we consider them an independent type of robotic system.

The first approach attempts to exploit the biological engineering that already exists in living bacteria, and in particular their ability to drive through their flagellar motors

An artificial bacterial merekomen developed at ETH Zurich. By assigning the speed of rotation and the action of an external magnetic field, the speed and auction of the movement of the belie immers can be regulated in a controlled manner.

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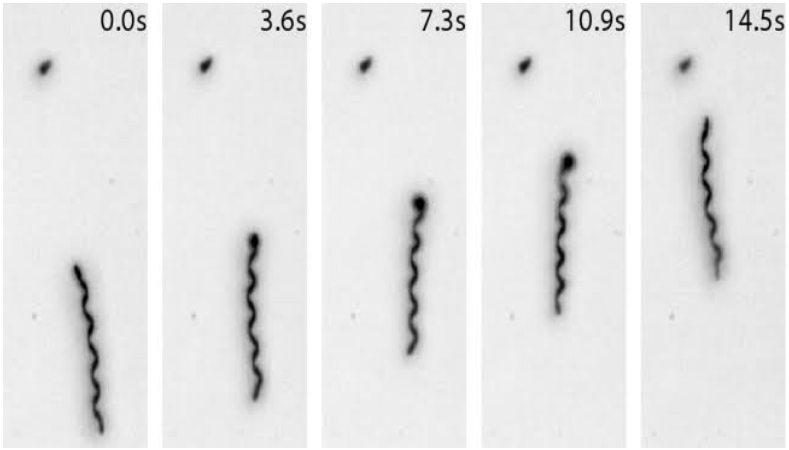
A special type of bacteria called magnetatic bacteria (MTB) offers more possibilities for manipulating objects at the micro- and nanoscale. MTB are bacteria that have magnetic nanoparticles on their membrane. A direct consequence of this is that their main functional characteristic is magnetotaxis, i.e. they orient themselves along the lines of force of the earth's geomagnetic field(17). Using naturally deposited MTB magnetic nanoparticles, it has been demonstrated that well-controlled micro-object unipulation can be performed. MTB, once the external magnetic field 10 is applied it generates a torque to control the MTB steering(18,19).

There are two different approaches to developing bacteria-based nanorobotic systems. The first approach uses living bacteria to serve as a nanorobotic system that will move in a fluid environment and manipulate objects within it. A second approach is the development of hilly artificial bacteria-like nanorobots that are propelled using an external magnetic field.



A second approach in the development of hackteria-based nanorobotic systems is biomimetic. Le, the goal is to create completely artificial nanoswimmers by copying nature's design from bacteria. Inspired by sperm movement, Dreyfus et al(20). developed a microswimmer consisting of a thin paramagnetic Blumenta attached to a blood cell. By applying an oscillating magnetic field, the swimmer drove the cell by continuously deforming the filament in a manner somewhat similar to a eukaryotic flagellum(21).

Recent examples of an artificial flagellum in the form of a nanocoil that has been driven using a rotating magnetic field have been proposed by Brad Nelson's group. An autoscrolling production technique for the production of helical swimmers comparable to E. coli capable of swimming in both water and paraffin oil was also recently performed by the same group(11).

Clearly, there is much to be done in this area of nanorobotics. Most of the work that has been done so far is still in the preliminary stage(11). The analytical systems that have been developed are nowhere near ready for use in a real-world application.

E. Nanorobotes used in Future for various treatment

If the above ideas become a reality in the foreseeable future, every branch of medicine should benefit. Frankly, nanorobotics is so vast that a single article cannot cover it all. Attention is therefore limited here only to its revolutionary impact on the field of medicine.

Central Nervous System (CNS): Nanobots can be used also to treat CNS cancer. Sometimes they could act as implants themselves, replacing damaged neurons in some patients. Nanobots will also be able to perform neural and brain surgeries with high success rates. It would also prevent a necessity today: drilling a hole in the skull to gain access to the brain.

Nanobots can also be used to help people suffering from motor neuron diseases as well as paralysis. Once injected into a patient, they can localize to specific locations in the brain and pick up impulses that would normally reach the body's motor neurons. These impulses can be used to drive external prosthetics, such as a robotic arm. So it would help a lot of people to overcome their handicaps.

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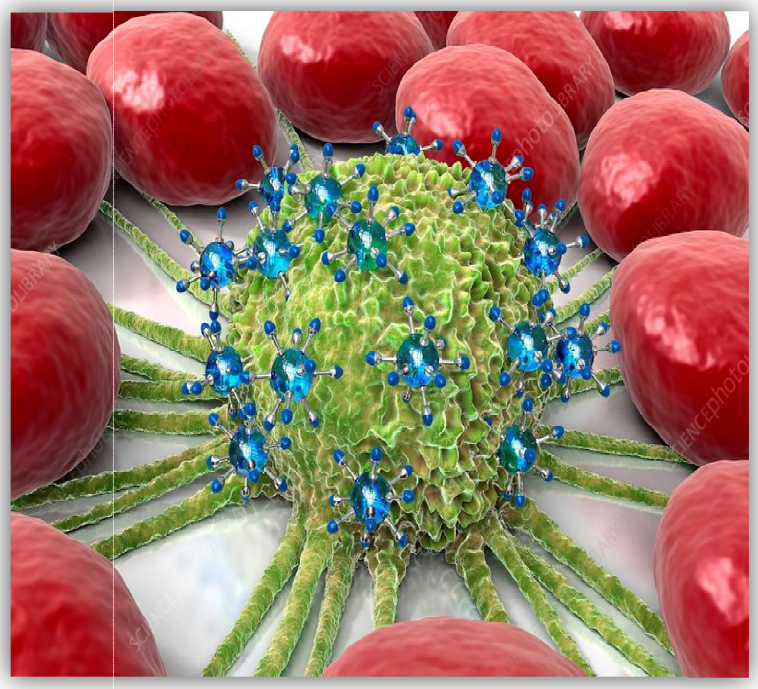
Cancer treatment: This is probably the main reason for the development of nanorobotics. The supply of cancer drugs is difficult to control today. Chemotherapy damages healthy tissue in addition to cancerous tissue. We cannot prevent the adverse effects of chemotherapy on other parts of our body. Nanorobotics will change all that. Nanobots could be used to deliver drugs specifically only to the tumor, avoiding the peripheral impact of the drug.

One of the many methods to achieve this is as follows

Primary nanobots are sent into the target tissue (the tumor) to inflame it. This is partly a machine gun approach; a lot of bots go to waste. However, only the tumor is inflamed and not any other tissue in the entire body. Now a second wave of robots is sent to target the inflamed tissue. This wave of robots contains an actual chemotherapy drug. It releases its payload, i.e. the drug, only after sensing the tissue. So we have high action, no peripheral impact.

Body surveillance: Continuous monitoring of vital signs and wireless transmission could be possible with nanobots, leading to a quantum leap in diagnostics. This would also help in quick response in the event of a sudden change in vital signs or could warn of a potential risk such as high blood glucose in diabetics. Also, multifunctional shoes can turn into stents, say to open a blockage in an artery. The robot itself can be used as a tool to remove unwanted materials such as blockages in the circulatory system. Nanobots could be used in large quantities inside the body to sense and repair anomalies/abnormalities. Current macroscopic robots are programmed and tested using so-called “swarm intelligence”, in which they share the information available to each of them, combine them together and make collective decisions. Such behavior is also seen in ant colonies; They communicate using chemicals and behave as one large organism, often referred to as a “superorganism”. Using a swarm intelligence strategy, intra-corporeal nanobots could help create a single strong defense shield against pathogens and toxins . It would also help prevent delicate operations: vital functions from being pushed beyond medically defined limits Surgical procedures such as those of the eye are still successfully performed today by only a few experienced surgeons. These delicate operations involve enormous risk and require a steady hand and a strong constitution. It may soon be possible to take the human element of risk out of this equation.

Microsurgery of the eye as well as surgery of the retina and surrounding membranes could soon be performed using nanobots. Additionally, instead of injecting directly into the eye, Nanobots could be injected elsewhere in the body and guided into the eye to deliver medication when needed. Similarly, other demanding operations will benefit from advances in nanorobotics. Fetal surgery, risky even today due to high infant or maternal mortality, could soon have a 100% success rate as nanobots can provide better access to the desired area and cause minimal trauma.



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II. BREAST CANCER

2.1 Epidemiology of Breast Cancer

Breast cancer is the most common cancer in women and the second most common cause of cancer-related death among women worldwide. About 2.3 million women were diagnosed with breast cancer and the number of deaths caused by this disease was 685,000 women in 2020. Breast cancer prevention and control strategies must be a high priority in different populations. In addition, it is essential to raise awareness of early detection and risk factors in developing countries(23).

2.2 Nanoparticles in Diagnosis of Breast Cancer

Common diagnostic methods for breast cancer are clinical examinations accompanied by imaging. A pathological examination is then used to confirm the results of the diagnosis. Clinical examinations include palpation of the breast and lymph nodes, assessment of metastases, and the history of the individual and their family. Imaging includes ultrasound and mammography of the lymph nodes and breast. Pathological examination should report HER2, grade and histological type, and estrogen receptor (ER). ER expression level in breast cancer is associated with endocrine therapy benefit. Overexpression of HER2 protein shows benefit from trastuzumab , a monoclonal antibody(24).

Recently, various studies of new contrast agents have been investigated, which lead to non-invasive and reliable detection of breast cancer(25). The development of nanostructured contrast agents that are target specific has improved sensitivity for various imaging modalities such as positron emission tomography (PET), computed tomography (CT) and MRI. In MRI, magnetic iron oxide nanoparticles can enhance T2-weighted negative contrast of target tissues. Surface engineering of magnetic iron oxide nanoparticles with specific tumor markers can create flexible platforms for site-specific tumor localization and MRI imaging of early breast cancer. Tissue immunochemistry is one of the standard methods for determining hormone receptor or HER2 expression, which has limitations such as signal degradation and background noise.

Diagnostic approaches based on nanotechnology are being developed and developed as a suitable tool for cancer detection and diagnosis. Nanoparticles have rapidly expanded to image tumors, show cancer biomolecules or biomarkers, and target drug delivery. Nanotechnology has been used in various medical examinations and tests, such as the use of AuNPs in pregnancy tests. For cancer detection, nanoparticles are used to capture cancer biomarkers (22).

A cancer biomarker Is a biological moleculeand it can be measured in apkins, fluids or blood. It shows the actuality of cancer in the body. It can be nucleic acids, carbohydrates or proteins. Beforehand opinion of cancer can be performed by the dimension of the position of a specific cancer biomarker situations, thus, it help covering and netting of remedy effectiveness. Many barriers limit the use of biomarkers, such as heterogeneity in abundance and low concentrations of biomarkers in body fluids. Biosensor-based nanotechnology can increase the sensitivity of clinical diagnosis compared to traditional approaches. Early detection can therefore be more accurate (22). Nanotechnology offers high sensitivity and selectivity and allows measuring different targets simultaneously. On the other hand, the use of nanoparticles leads to an increase in the surface-to-volume ratio, and therefore biosensors become more sensitive to special bimolecular diagnostics. Three common nanoparticle probes are Polymer Dots (PDs), AuNPs, and quantum dots that can be used and used in cancer diagnosis.

Quantum dots, which are fluorescent nanoparticles , can bind to different antibodies and target specific proteins. The resulting spectrum of quantum dots, which are conjugated to different proteins, is determined simultaneously by spectroscopy. The fluorescence emission of these conjugated nanoparticles is related to protein expression(22). Light fluorescence of quantum dots identifies targets at low concentrations in cancer cells and increases sensitivity. The application of multiple quantum dots results in the detection of target molecules with high sensitivity. The best way to conjugate quantum dots with peptides and antibodies is the application of biotin and streptavidin as adapter molecules. Direct conjugates of quantum particles retain high affinity and minimize non-specific binding. A quantum dot-based assay method was developed to detect and measure Erb-B2 receptor tyrosine kinase 2 (ERBB2), progesterone, and ER in cultured breast cancer cells. These quantum dots conjugate directly to antibodies of these three proteins. Quantum particles are available in different emission spectra and different sizes and can simultaneously identify multiple proteins in a small tumor sample.

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In the study, six proteins were simultaneously identified in breast cancer using direct antibody conjugates of quantum particles on paraffin-embedded tumor samples. Fluorescence in situ hybridization (FISH) is a standard approach used to detect gene amplification or matrix RNA distribution using a fluorescent-labeled DNA or fluorescent-labeled RNA probe, but with certain limitations(22). Nanotechnology overcomes these problems in FISH.Quantum dots that are conjugated are applied as fluorescent tags with oligonucleotide probes and produce stable and bright fluorescent signals. As a result, using quantum dots and conjugates, it is possible to quantify multiple proteins simultaneously on a small cancer sample or on a single piece of tumor, and the final treatment strategy is based on these results.The use of aptamers conjugated to a quantum dot, fluorophore, or other materials such as gadolinium is useful for MRI. The advantage of using tamers for imaging is that they are non-toxic because oligonucleotides are naturally present in the human body. Aptamers have high specificity for their purposes and are rapidly released into the bloodstream. The use of these molecules can increase the validity of the results of clinical or research analyses(22).

2.3 Nanoparticles in Breast Cancer Treatment

Targeted therapy for special receptors has become an important approach to breast cancer treatment, and clinical outcomes have improved compared to the old treatment approach. How nanoparticles can diffuse and affect the target site is the most important issue in using such nanoparticles for cancer detection and treatment. One of the main problems of chemotherapy is multidrug resistance (MDR). Some types of nanoparticles have demonstrated the ability to control MDR. To improve the treatment of breast cancer, nanotechnology has been used to design effective drug delivery systems. The carrier should be manufactured on an industrial scale and must be non-toxic. In addition, an important feature of nano drug is maximum tumor specificity, which should be noted to improve the delivery of active drug to cancer cells and avoid side effects (26). To balance the medicine lozenge, the quantum of
medicine motes loaded in the carrier should be optimized(27). Applicable nanoparticle size is essential, as nanocarriers larger than 100 nm are fluently detected and removed. There has been expansive exploration into the use of nanoparticles that can cover healthy towel and have murderous goods on cancer cells. For illustration, liposomal anthracycline has been applied to treat all grades of breast cancer, but its use is limited due to its poisonous effect on the heart.

This combination with trastuzumab, which is a monoclonal antibody against ERBB2, has a better effect (29). Liposomes containing doxorubicin and a PEGylated liposome (PEGLip) have been reported for use in the treatment of metastatic breast cancer(28). Preclinical studies have shown that paclitaxel in albumin-encapsulated nanoparticles has better penetration power than conventional paclitaxel. Targeted administration of Tamoxifen occurs in all stages of breast cancer. Tamoxifen is a nonsteroidal anti-estrogen drug that is highly hydrophobic. The use of nanoparticles with this Drug increases its permeability to tumor tissue. Its toxic effects on healthy non-cancerous tissue cells are also less. Antibody-conjugated nanoparticles can be used to simultaneously detect multiple molecular targets in small tumor fragments.Due to the side effects of anticancer drugs, it also seems essential to use safe drug delivery systems with biocompatibility, including solid lipid nanoparticles and liposomes, which deliver the drug to the target tissue with high specificity. The basis of this method is to get a sufficient amount of the drug to the tumor site for a specified period of time and reduce the harmful effects of the drug on other organs.Solid lipid nanoparticles are a complex system with unique advantages and disadvantages that distinguish it from other colloidal systems. Further studies using nuclear MRI are needed to elucidate the mechanism of drug delivery using this system(22). A type of drug delivery system that is widely used is albumin-bound (Nab) nanoparticle technology, which uses albumin to transport and bind hydrophobic molecules.In addition, albumin can intervene Nab endothelial transcytosis and identify the albondin(gp60) glycoprotein receptor. Some of the medicine delivery systems that have been substantially studied include protein-grounded nanoparticles and dendrimers grounded on essence and polymer nanoparticles. Using the depressions in their structure, they can be conjugated and filled with medicines. The liposome can be applied as a carrier for the administration of medicines and nutrients.Some methods of biological membrane disruption, such as sonication, can be used to prepare liposomes(22). Due to their structure, liposomes are compatible with the structure of the lipid bilayer. In liposome design, surface ligands can be used to bind to unhealthy tissue.

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III. BRAIN CANCER

3.1 Introduction

Any disturbance in the anatomical structure of the brain and abnormal growth of cells in an uncontrolled manner leads to disruption of the normal functional abilities of the brain(30). Abnormal growth of mass cells can be static and metastatic, leading to the development of benign and malignant cancers(31). Brain tumors are associated with increased intracranial pressure, headaches, vomiting, altered consciousness, and seizures. Additionally, brain tumors can be further elaborated and classified according to their growth and location in the respective brain cells. The most common site for brain tumor invasion is brain glial cells(37). Glial cells of the brain can be further classified into 4 grades according to WHO guidelines (grade l to grade lV).

3.2 Nano materials for the Treatment of brain cancer :

A. Liposomes

Liposomes are spherical vesicles that consist of both biodegradable natural or synthetic phospholipid bilayers and aqueous compartments. These nanospheres form spontaneously due to the amphiphilic nature of phospholipids(32). They can fuse with tumor cells and enter the extracellular matrix by endocytosis, where they release drugs. Liposomes can use passive or active mechanisms for tumor targeting. Although active tumor targeting is not necessarily more efficient compared to passive targeting, it is advantageous to target micrometastases, vasculature and blood tumor. The liposome surface can also be functionalized by incorporating a large number of macromolecules, including antibodies, peptides, aptamer polymers or polysaccharides, to further improve blood circulation duration and brain-targeted drug delivery. Liposome size has a significant effect on their blood half-life; Liposome nanostructures of smaller size (up to 100 nm) easily penetrate tumors, while large-sized liposomes show a shorter half-life due to their better recognition by the phagocytic system(33). In recent years, liposomes have been widely used as nanocarriers in the treatment of various cancers and neurological disorders(37).

B. Nano-Micelles

Micelles are an exciting class of amphiphilic spherical nanostructures that are formed by the self-aggregation of amphiphilic molecules in water above a certain critical concentration (the so-called critical micelle concentration). Micelles have both hydrophilic and hydrophobic regions.The shell of the micelles is surrounded by a hydrophilic region of molecules, while the hydrophobic region forms the cores where lipophilic bioactive substances are trapped(34). These are promising nanocarriers with a considerably high capacity for loading chemotherapeutics that are formulated to target site-specific ovarian cancer. Micelles (with a size range of 10–100 nm) facilitate significant penetrability and endocytosis of ovarian cancer cells and reduce non-specific targeting of normal cells.Unlike other drug carriers, nanomicelles are endowed with a set of unique properties, such as kinetic and thermodynamic stability, improved biocompatibility, sustained plasma circulation, perforation into inflamed tissues and tumors, and the ability to incorporate large amounts of hydrophobic chemotherapeutics. Thanks to their dynamic structure(34). Among nanocarriers, micelles have attracted significant attention in recent years as carriers for targeted drug delivery to treat brain cancer(37). Due to their nano-size, they are not easily recognized and removed by the phagocytic system, and their hydrophilic shells show increased permeability and retention effect, which speculated the mechanism of docetaxel-loaded bioadhesive micelles for brain tumor therapy. The nanotherapeutic approach improved the transport of the docetaxel-encapsulated micelle system into C6 glioma cells, confirming the efficacy of the newly designed bioadhesive micelles for brain cancer therapy.

In recent years, dual-targeting therapeutic nanomedicines have also been developed for brain treatment. Dual-targeting theragnostic liposomes can effectively target the brain tumor and the blood-brain barrier and enhance therapeutic efficacy through a synergistic effect without damaging normal cells (37).

C. Dendrimers

Dendrimers are a class of well-ordered nanoscale hyper-branched polymers. In this case, drug molecules can be attached to surface groups or encapsulated inside the inner cavity of dendrimers. Due to the presence of a large number

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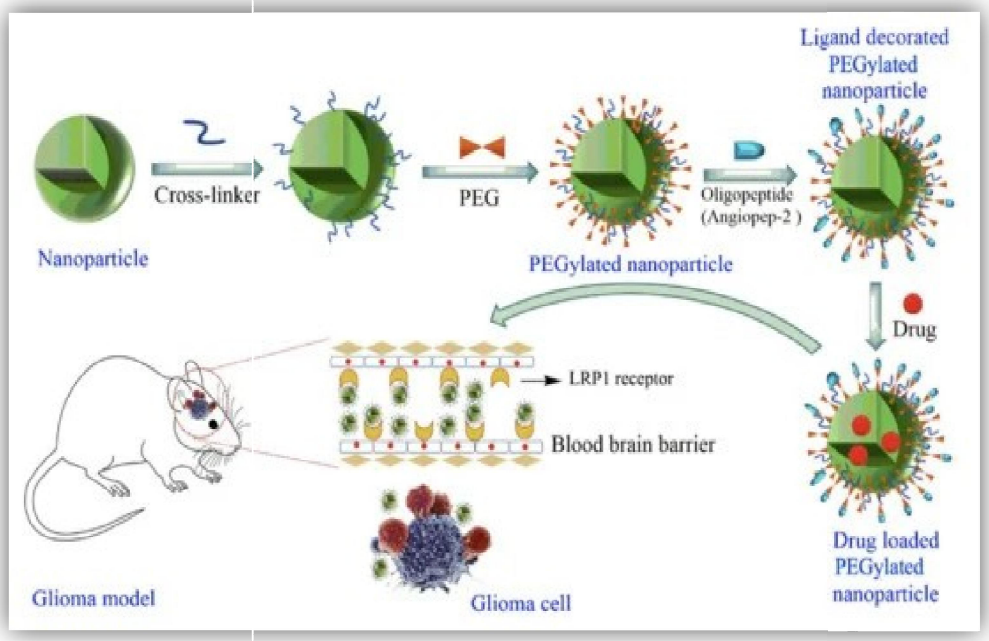
of functional groups on the dendrimer surface, various therapeutic molecules and drugs can be effectively tailored by conjugation.



Schematic representation of polyethylene glycol (PEGylated) blood circulation enhancing nanoparticles decorated with ligand (angio-peptide 2), an oligopeptide that has affinity for the low-density lipoprotein receptor-related protein 1 (LRP1) receptor on brain endothelial cells, enabling targeted drug delivery through blood-brain barrier in glioma(37).

D. Carbon Nanotubes and Carbon Dots

Carbon nanotubes (CNTs) are cylindrical nanostructures. These are special mechanical, electronic and surface properties. According to requirements, these new nanocarriers can be functionalized with polymers, carbohydrates, peptides and organic molecules and mainly applied in cancer treatment and tumor cell targeting (35). Harsha et al. (2018) [111] designed and fabricated mangiferin-conjugated PEG-linked CNTs, and the resulting phytochemical nanotube bioconjugates were investigated for protein loading capacity, cytocompatibility, and drug release in vitro using U-87 cell lines. At tumor cell pH, analysis of drug release indicated a spatiotemporal pattern. A significant reduction (1.28-fold) in IC50 values indicates strong antitumor activity, and the safety of the drug was confirmed by the hemolytic assay.

Carbon dots are a new member of carbon nanostructures(37). These zero nanocarriers are biocompatible, non-toxic, spherical and ultra-small particles less than 10 nm in size. C-dots overcome the problem of minimal observability and traceability of conventional drug carriers. In particular, fluorescent carbon dots (CDs) have received special attention as drug nanocarriers due to their low cytotoxicity, modified functions, and maximum cargo carrying capacity.

E. Gold and Silver NPs

Gold NPs (AuNPs) represent a fascinating system with novel attributes for various therapeutic applications. AuNPs also have a number of advanced features, including monodispersity, tunable core size, easy fabrication, low toxicity, surface plasmon absorption, large surface area, binding capacity. To various biomolecules and light-scattering and diagnostic properties (37). Therapeutic molecules are attached to the AuNPs by covalent bonds or electrostatic interactions.

3.3 Nanomaterials for the Diagnosis and Biosensing of Brain Cancer

Some of the previously available techniques for visualization and diagnosis of brain tumors and cancer are optical imaging, photoacoustic (PA) imaging, computed tomography (CT), positron emission tomography (PET), and fluorescence (FL) imaging techniques. Magnetic resonance (MR) imaging can be used preoperatively to determine the boundaries of cancerous tissues and/or intraoperatively to define the contour of the tumor during surgery with the

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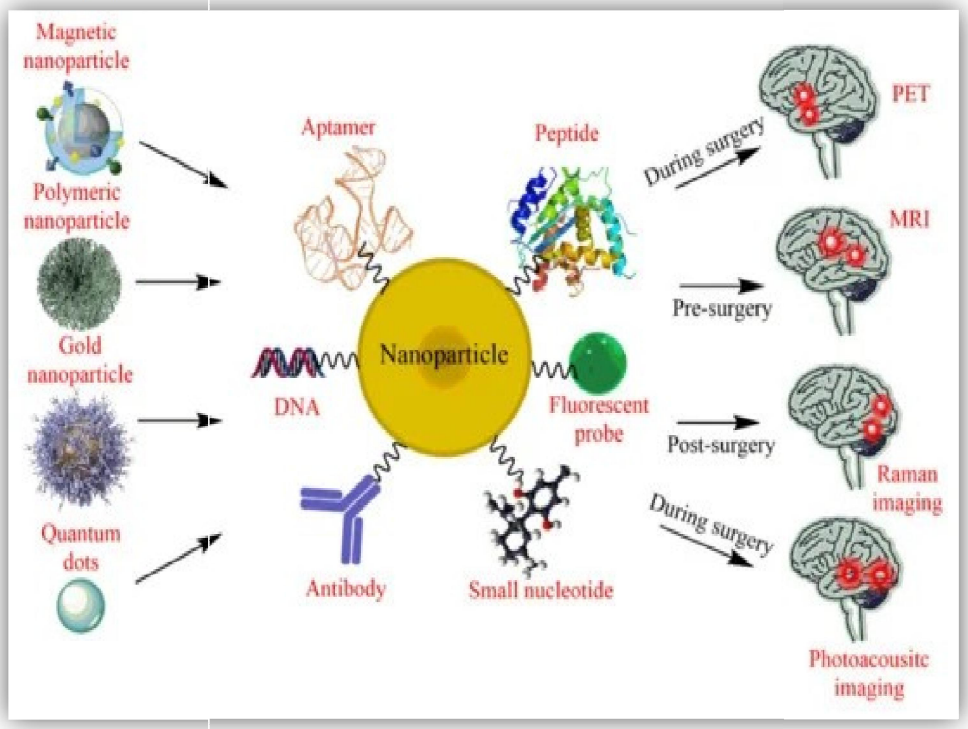
simultaneous administration of gadolinium (Gd) chelates. However, Gd has a short half-life and requires frequent administration to maintain blood levels for effective scanning, which may not be rational. Spectroscopy and thermal imaging are other invasive techniques for obtaining data on brain cancer and tumor tissues. Neurophotonic technologies such as Raman spectroscopy, optical coherence tomography, fluorescence spectroscopy, and thermal imaging are other invasive techniques for obtaining data on brain cancer and tumor tissues(36). Nanomaterial-based imaging technology for better diagnosis and surgery.



IV. SKIN CANCER

4.1 Nanoparticles in Skin Cancer

Skin cancer has emerged as the ffth most commonly reported cancer in the world, causing a burden on global health And the economy. The enormously rising environmental changes, industrialization, and genetic modifcation have Further exacerbated skin cancer statistics(38). Current treatment modalities such as surgery, radiotherapy, conventional Chemotherapy, targeted therapy, and immunotherapy are facing several issues related to cost, toxicity, and bioavail□Ability thereby leading to declined anti-skin cancer therapeutic efcacy and poor patient compliance. In the context Of overcoming this limitation, several nanotechnological advancements have been witnessed so far(38). Among various Nanomaterials, nanoparticles have endowed exorbitant advantages by acting as both therapeutic agents and drug Carriers for the remarkable treatment of skin cancer. The small size and large surface area to volume ratio of nanopar□Ticles escalate the skin tumor uptake through their leaky vasculature resulting in enhanced therapeutic efcacy. In This context, the present review provides up to date information about diferent types and pathology of skin cancer, Followed by their current treatment modalities and associated drawbacks. Furthermore, it meticulously discusses the Role of numerous inorganic, polymer, and lipid-based nanoparticles in skin cancer therapy with subsequent description od patent and clinical trials.

4.2 Nanotechnology used in Skin Cancer Treatment

Nanotechnology is an emerging area of science that Involves the manipulation of various materials in the Nanometre range [35, 36]. Nanomaterials have remark-Able potential to improvise the performance of cancer Therapeutics by acting as both drug carriers and thera-Peutic agents.

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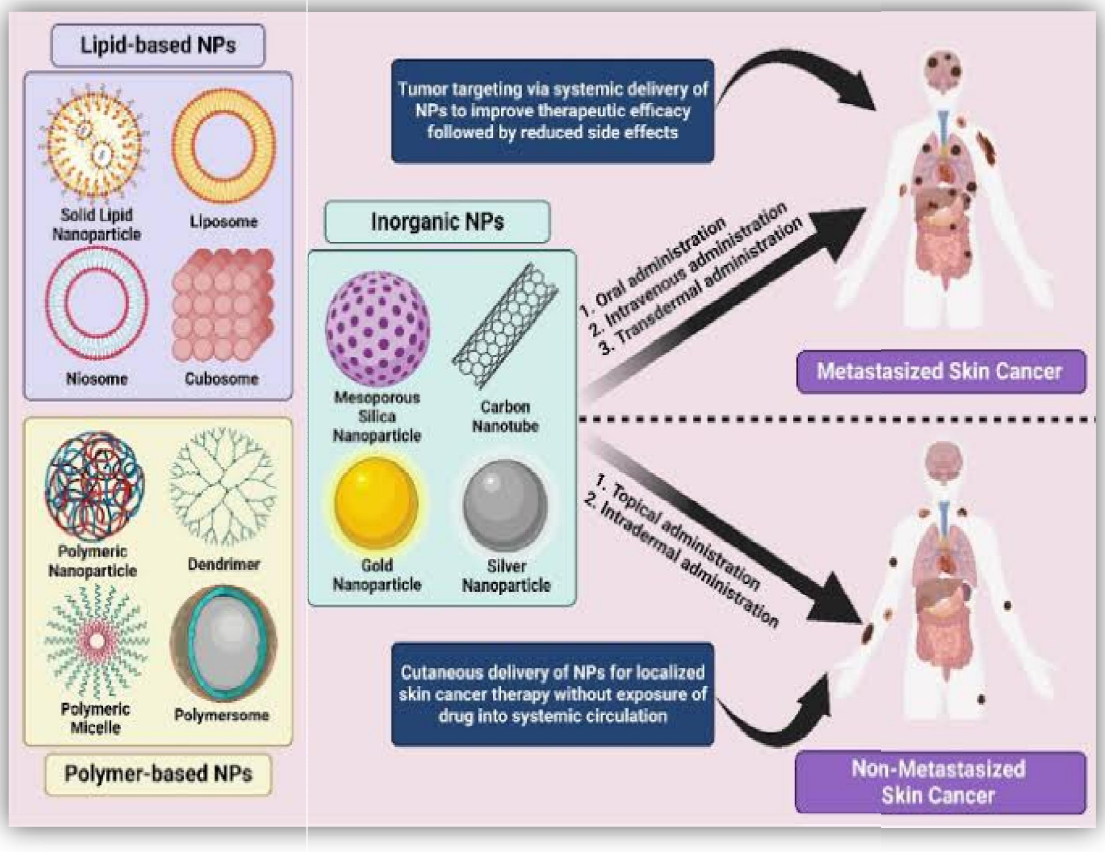
4.3 Inorganic nanoparticles for Skin Cancer Therapy:

NPs are derived from metals, metal oxides, carbon, ceramics, silica, etc. Te unique physicochemical properties of inorganic NPs, including small size, large surface area, bioactivity, biocompatibil-ity, and functionalizing ability, have made them the most appropriate candidates for skin cancer therapy. Scientists have explored that the inorganic NPs possess the intrin-sic therapeutic property, due to which they can execute the cancer cells by themselves. Schematic representation of utilization of nanoparticles in skin cancer(38).



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VI. CONCLUSION

Nanorobots monitoring nutrient concentrations in a three Dimensional workspace is a possible application of nanorobots in Medicine, among other biomedical problems .One interesting Nanorobots application is to assist inflammatory cells (or white Cells) leaving blood vessels to repair injured tissues . Also the Nanorobots could be applied to process specific chemical reactions in The human body as ancillary devices for injured organs.Nanorobots equipped with nanosensors could be developed to Detect glucose demand in diabetes patients .Itcould Also be applied in chemotherapy to combat cancer through Superior chemical dosage administration , and a same Approach could be taken to not able nanorobots to deliver anti-HIV Drugs. Such drug-delivery nanorobots have been termed“pharmacytes” by Freitas .

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