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NANOROBOT: A LIFE-SAVING DEVICE FOR THE PHARMACEUTICAL AND MEDICAL INDUSTRIES

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Abstract:
A robot is widely used in a different field because it deals with the layout, manufacture, and control of nanorobots using computers or other sensors. Physics, chemistry, biology, medicine, pharmaceutical sciences, engineering, biotechnology, and health sciences are multidisciplinary fields that require special planning on the part of research and engineering departments. These days the healthcare establishment goals, in addition, to enhance the satisfaction of scientific treatments via growing minimally invasive diagnostic techniques which include helping new advances in nanotechnology. Nanorobot uses in cancer treatment, blood clot removal, atherosclerosis treatment and parasite removal etc.

Keyword: Nanorobot, Nanomedicine, Nanotechnology

Introduction

A robot is widely used in different area because it deals with the arrangement, fabrication, and control of nanorobots using computers or other sensors. This technology is being used to develop machines on the way to replacing people and replicating human actions. This machine-controlled machine (robot) takes the place of manpower in risky producing processes. Nanotechnology is the design, simulation, control, coordination, and manipulation of nanoscale components in a range of 1 to 100 nm.[1] In particular, nanorobots refer to the theoretical field of nanotechnology associated with the design and construction of nanorobots. Nanorobot component sizes range from 0.1 to 10 microns and are constructed of nanoscale or molecular components. Nanobots, nano compounds, nanoparticles or nanowires are used to describe these hypothetical devices. Even large-scale equipment, such as an atomic force microscope, might be designated a nanorobot device if it is designed to complete nano tasks.[2] A concept of modern nanotechnology has been given regarding the innovative and superior materials of nanotechnology, which have left their imprint on science and research. Physics, chemistry, biology, medicine, pharmaceutical sciences, engineering, biotechnology, and health sciences are multidisciplinary fields that require special planning on the part of research and engineering departments. Adriano Cavalcanti is considered a strong proponent of nanodevices. Cavalcanti is a medical nano AI developer who has been integrating as a model of nano biosensors for application in brain haemorrhage, cancer, and diabetes, as well as cardiac and environmental management.[1] Today, the health sector is focusing more on improving the quality of medical treatments by developing minimally invasive diagnostic techniques, including applying recent advances in nanotechnology. Nanorobots diagnose and treat patients using data from molecular biology, mesoscopic chemistry, and mesoscopic physics. Nanorobots are interesting nanodevices for using modern biomedical devices, but they have a few drawbacks.[3] Nanobiotechnology is a subfield of nanotechnology that helps with the concepts and techniques of nanotechnology and applies them in the direction of research and development within the biological sciences and medicinal drugs. Pharmaceuticals and nanoscale mechanical equipment for studying biological systems and cancer diagnostics are examples of nanobiotechnology.[1]

1 What is the Nanorobot?

Nanorobots are hypothetical robots with nanometer-scale dimensions. At the atomic, molecular, and cellular levels, they could conduct clinical and pharmacological research. They have the ability to detect acoustic signals. These nanorobots could be able to carry out the necessary tasks. These nanorobots find out and kill the cell or tissue that is causing the problem.[4]

2 History of Nanorobot

- Richard Feynman coined the word "nanorobot" in 1959, making him the first scientist to use it. According to Richard Feynman's well-known talk, there is plenty of room at the bottom.
- Robert Freitas was the first scientist to investigate nanorobots.
- Norio Taniguchi helped create the term "nanotechnology" in 1974. Nanotechnology, he explained, is "the manipulation and deformation of matter utilising the molecule or atom."
- Dr. Eric Drexler authored many publications on nanoscale and nanodevices in the 1980s.
- 1986: Dr. Eric Drexler develops this concept in his well-known eBook, The Creative Engine.
- 1981: Gerd Binnig and Heinrich Rohrer of IBM Zurich develop the Scanning Tunnelling Microscope (STM), which is used for atomic-level surface imaging and home detection.
- Fullerenes were invented in 1985, and carbon nanotubes were invented in 1991. Carbon nanotubes have high tensile strength, particular electrical characteristics, and high thermal conductivity.
- Atomic Force Microscopy (AFM) is invented in 1991.
- Year 2000: A company and a nano manufacturing facility will collaborate on a research program to build a nano manufacturing unit capable of producing nanorobots for clinical use. Mechanical movement and DNA repair are just two of the activities of this technology.
- In 2002, carbon nanotubes were used in biological and chemical engineering to transport a drug to a specific location within the body.[1,5-6]

3 Ideal Property of Nanorobot

1. Nanorobots can be easily incorporated into human bodies.
2. Nanorobots have a component with a diameter of 1 to 100 nanometers and a size of 0.5 to 3 microns.
3. Nanorobots are smaller than capillaries because the capillary flow is not blocked. A nanorobot can communicate with a doctor or researcher by transmitting a signal at a carrier wave frequency of 1–100 MHz.
4. Because nanorobots are implanted as foreign matter in the human body, they are immune to immune system attacks, implying that the immune system is attacking them.
5. The work (or task) of removing nanorobots from the human body is finished.[7]

4 Structure and Design of Nanorobot

Carbon is the main component of nanorobots because it is stable, solid, and robust and has the shape of a diamond. Other elements used in the production of nanorobots include hydrogen, oxygen, nitrogen, sulphur, silicon, and fluorine. Other elements include:

4.1 Payloads: That is a hollow-shaped portion inside nanorobots. It contains the drug or chemical to treat the infection. The nanorobot detects the target site and releases the medicine from the medicine cavity part and gives pharmacological action. Traditional chemotherapy has less effective action than nanorobots.[8]

4.2 Nanocamera: Nanorobot in an interrupt small camera at the size of a nanometre. The Nanocamera helps to observe and monitor the workings of nanorobots inside the body. It directs nanorobots through the circulatory system to the target organ or cell.[9]

4.3 Electrode: It is used to generate electric current. This electric current destroys the cell without affecting the surrounding cell or tissue.[8]

4.4 Laser: There is a big challenge for scientists to develop a small laser light to attach to nanorobots to kill harmful material but not burn surrounding tissue. A laser causes the destruction of harmful materials like tumour cells, blood clots, plaque in arteries, etc. A laser is directly applied to the target cell and destroys cells, but the surrounding tissue or cells are not destroyed. [8,9]

4.5 Ultrasonic signal generator: Cancer cells and kidney stones are destructive by emitting an ultrasound or microwave signal. There is a rupture of the chemical link between the tumour cell and the cell wall, killing the cell without breaking the cell wall. In traditional cancer chemotherapy, drugs destroy tumour cells. Damaged cells release chemicals that spread throughout the body, causing tumour cells to grow again. On the other hand, these nanorobots have successfully destroyed tumor cells without causing any damage to healthy cells. [8,9]

4.6 Swimming tails and fins: swimming tails are helpful in traveling nanorobots inside the bloodstream against blood flow.[9]

4.7 Probes, Knives and Chisels: This element is used to dissolve bodily blockages such as clots and embolisms. If the little clotting part is a blocked vessel, there is a breakdown of the clotting part and a complete elimination of the clotting part. It had a severe effect on the body .[2,8]

4.8 Power supply in Nano Robot: The nanorobot's primary requirement is that it has to be powerful as many stability analyses on it. Nanorobot in power supply by external sources and internal sources.[10]

4.8.1 External source: Nanobots are based on external energy sources. They are present in the human body in the bloodstream and body temperature.[10]

4.8.2 Internal source: Nanorobots in a rechargeable battery are put to work and perform many functions, but the battery recharges from an internal source.[10]

4.9 Molecular sorting rotor: The Molecular sorting rotor is made of carbon nanotubes. These transport binding molecules and device binding molecules arrive from the solution. Nanotubes with Nanogear are responsible for changing the direction of movement in the body. SWNT is suitable for mechanical movement.[2]

4.10 Sensor: This is an essential component of nanorobots. The sensor has two main objectives on the surface: one is to identify the target site, and the other is to detect a change in the nanorobot's functional properties. Sensors used in nanorobots for pharmaceutical and medical applications include cantilevers and carbon paste electrodes (CPE).[11,12]

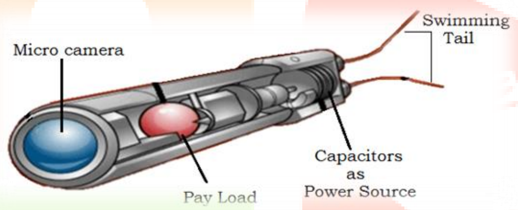

Fig.1 Structure and design of Nanorobot [10]

5 Working principal of Nanorobot: -

Biosensors, antibodies, surface proteins, nanomedicine, fluorescent markers, and other components are used to make nanorobots. Biosensor-equipped nanorobots are injected into the body and exposed to UV radiation or other wave frequencies. The nanorobots' biosensors identify the target spot or cell in the body as a response. Nanorobots in the bloodstream are in charge of detecting the target and releasing the drug. After the nanorobot is finished, remove the target cell layer and do not diffuse it.[2]

While the medicine does not have to travel through multiple pathways in the body, such as the bloodstream, nanorobot-delivered medicines will be much more effective than traditional drugs. Because there are no distinctions between a normal cell and a cancer cell, chemotherapy kills both normal and cancerous cells. While the nanorobots are detecting cancer cells, medications are released to eliminate the cancer cells without harming healthy cells.[13]

6 Type of Nanorobots: -

Nanorobots are used in the pharmaceutical and medical fields in a variety of ways. Pharmacytes, Respirocytes, Microbivores, Clottocytes, Chromalloytes, and Dentifrobots are only a few examples.[2]

6.1 Respirocyte: It's a synthetic red blood cell. It performs the same role as normal RBC in the blood. In anaemia sufferers, a nanorobot can be extremely helpful. A nanorobot is made up of a tank that stores oxygen under high pressure, a sensor that measures how much oxygen is in the blood, and a valve that releases oxygen when the sensor indicates that more is required. RBCs give 236 times more oxygen per unit volume to tissue than respiratory cells. The nanorobots are spherical and have a diameter of one micrometre.[14] It has three types of rotors: one releases stored oxygen as it runs through the body, another removes carbon dioxide from the bloodstream, and the third absorbs glucose from the bloodstream as an energy source.[1]

6.2 Microbivores: Microbivores are WBC that have been created artificially. Microbivores' main job is to eat pathogens that are found in human blood and other parts of the body. It's a 3.4 micron axial diameter oblate spheroidal nanorobot with a minor axial diameter of 2 microns. Microbivores may use up to 200 PW of continuous energy while digesting a restricted throughput of a micrometre of organic material every 30 seconds. When drugs are used to boost natural phagocyte defences, the target microbe may take weeks or months to be removed from the blood vessel. A species-specific reversible binding site allows the microbe to connect to the microbivore's surface. When the pathogen and the microbivore come into touch, the pathogens and the microbivore's surfaces come into close contact, allowing the reversible linkage site to identify the organism and weakly attach. To confirm the determination of the specific microorganisms, a collection of nine antigenic markers that are specific and confirm the strong bind must be used. There might be 20,000 copies of the nine marker units spread among the 275 disk-shaped sections of microbivores. The telescoping robot captures the entrapping bacterium and attaches itself to it, ensuring a complicated connection. The virus may be moved from the binding site to the ingest point by utilising the grapple handoff mechanism. The pathogen is similarly swallowed and crushed into tiny pieces in the morcellation chamber.[9,15]

6.3 Clottocytes: They usually contain a component that facilitates coagulation. The synthetic mechanical platelet or clottocyte may allow full haemostasis in less than 1 second, even in moderately large wounds. This technology responds 100–1000 times faster than the traditional system. Our basic clottocyte is a serum oxyglucose powered circular nanorobot with a foldable fibre mesh with a 4-micron-3 extent and a 2-micron diameter. Under the control of its control computer, the device unfolds its mesh packet inside the immediate site of a broken blood vessel—for example, following a cut through the skin. When soluble thin coatings are put on certain areas of the mesh and exposed to plasma water, they dissolve, disclosing sticky regions in the desired styles. The blood cells attach immediately to the overlapping synthetic networks formed by the large number of active clottocytes, and bleeding is quickly controlled. [9,16,17]

6.4 Pharmacyte: It would be capable of delivering a pharmacological payload of up to 1 m3. It will be physically offloaded utilising molecular sorting pumps installed within the hull and controlled by an onboard computer. The payload can be transported inside the region based on organisational goals. It's a medical nanorobot that can transport up to 1 m3 of a specific medicament inside tanks and has a size of 1-2 m. To assure power and precision in targeting, they are linked to molecular markers or chemotactic sensors.[18]

6.5 Dentifrobots: Dentifrobots are toothpaste-based mouthwashes. These robots are shaped like spiders. Dentifrice nanorobots identify dangerous pathogens and eliminate them without harming healthy cells or tissue. Intelligent nanorobots will identify meal, plaque, and scale particles, which will be removed from the teeth and the plaque statement for elimination. Small Nanorobots are mechanical devices that shut off after being eaten. Nanodental robots are applied to supragingival and subgingival areas using toothpaste. Dentifrobots convert entrapped organic molecules into odourless vapours that are safe to breathe. They do calculus debridement on a regular basis. Dentifrobots can be used for a variety of dental procedures, including preventative, restorative, and curative dentistry. To realign and straighten misaligned teeth, dental nanorobots numb the mouth, sensitise the teeth, and regulate the tissues.[19]

6.6 Chromalloytes: These lozenge-shaped nanorobots are effective gene delivery methods. They might be able to apply chromosomal alternative treatments. With a move-sectional width of 3.28 microns and a length of 5.05 microns, it is 4.18 microns long and 3.28 microns wide. It consumes 50–200 watts in normal operation and up to 1000 watts in bursts during outgoing messaging, the most energy-intensive activity. Chromallocytes can replace whole chromosomes in individual cells, correcting the effects of hereditary illness and other types of accumulated DNA damage while also slowing down the ageing process. A repair machine within a cell will evaluate the problem by analysing the contents and actions of the cell, and then mend the entire cell molecule by molecule and shape by form; repair devices may be capable of repairing the entire cell.[20]

7 Size and Shape of Nanorobots: -

7.1 Nanoids: Nanoids are microscopic machines that may be used to regenerate cells. They study biological systems like bone, tissue, and hair and try to reproduce them. The systems may be activated and managed via very low-frequency radio. They're designed to mend and duplicate in the same way that human cells do, and to act as a living bandage until the tissues can recover. They reproduce by consuming any carbon source that is acceptable as a fuel supply.[21]

7.2 Nanites: Nanite was a type of nanotechnology and a small device. Nanite was made by manipulating atoms and held hundreds of gigabytes of computer memory. The nanite particle size was small enough to enter living cells. A nanostart-up machine that is described as a magnet might alternatively be a mechanical or electromechanical robot with nm-sized dimensions. Nanites are minuscule artificial devices the size of viruses that may be discovered in the air. Which can follow instructions, absorb energy, and reproduce. The Nanites' main aim is to deprive an area or region of power, and the nanomachines came from the Tower and serve because of the world's transmission directives. The Nanites, on the other hand, may be capable of medicinal procedures such as the destruction of cancerous cells in humans, in addition to preserving power.[2]

7.3 Nanospiders: The idea of creating a spider or a robot out of DNA molecules is interesting. They can move, turn right and left, and make items. Molecularly produced robots are DNA walkers with knees that allow them to move freely at a stable interest of around 100 nm every 30 metres – 1 hour. The spider robot was discovered using atomic pressure microscopy. Molecular robots have gotten a lot of attention since they can be designed to detect their environment and react accordingly. According to the Daily Mail, scientists can detect abnormal signals on the surface of cells to assess whether they are cancerous and then release a chemical to eliminate them if required.

7.4 Nanomites: Nanomites are extremely microscopic automaton form extremely measurement inside the high-quality scale of nanometres. Both Joe and Cobra forces use them to stop each other in their never-ending war. Military applications are not the most efficient way to employ these incredible machines, as there are also other applications in the fields of medical and construction.[2]

8 Injection of nanorobots inside the body: -

The nanorobot is inserted into the body by surgery, causing no harm to healthy cells or tissue. Nanorobot administration routes are determined by the nanorobots' size. Nanorobots are smaller than blood vessels because they can block vessels and cause health concerns if they were larger. Because the femoral artery is the biggest artery in the human body, nanorobots are usually implanted there. The purpose of an artery is to send blood to the lower body. The nanorobot detects the target spot and releases the medicine without causing any damage. [2,23]

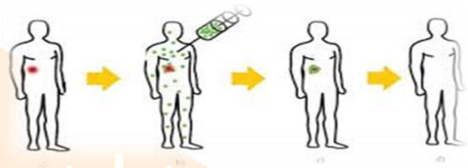

Fig.2 Nanorobot introduced into the body [23]

9 Removal of Nanorobots inside the body: -

The nanorobots attach to a blood artery that is easily visible from the outside and are then surgically removed. Electromagnetic pulses, chemicals, electric shock, and magnetic fields, among other things, are used by nanorobots to kill.

1) Few drugs are destroy microorganisms and the human body immune system to attack them. Similar technology is used to destroy the nanorobots.

2) Nanorobot is damage or deactivates via applied a strong electric powered current or magnetic pulse.

3) The use of a sufficient amount of electricity or magnetic pulses from a nanorobot may kill or hurt it, but it may also contain magnetic field sensitive materials. While living organisms are shocked by electricity, the presence of electrons – the part that harms – follows the trail of resistance to the back of the rock.

4) In many instances, these paths are the nervous and circulatory structures, continuously related networks of relatively more conductive tissue or fluid. Except a nanorobot become immediately within the direction such the prevailing flowed through it, it was no damage in the least. There must also be a potential (voltage) distinction across the current for it to slide. To start with, this type of small system might kill, but weak electromagnetic pulses can cause a small device to breakdown.[24]

10 Application of Nanorobots: -

10.1 Nanorobot in cancer treatment: Improving the supply of drugs to prevent side effects of chemotherapy is critical to providing effective treatment. Traditional chemotherapy in main disadvantage is the drug passes many pathways and dissolve in blood and limit the drug give pharmacology effect with the damage of some healthy cells in the body. Nanorobots with chemical sensors integrated into them can develop to identify tumour cells in the body and release drugs at the tumour cell's site without destroying healthy cells. Treatment can perform with nanorobots equipped with chemical sensors. Specific programmes to detect different cancer biomarkers such as E-cadherin and beta-catenin are use to heal the primary and metastatic phases of cancer. Nanorobot kills tumour cells by laser applied directly in tumour cells with cancer cells are detect and release nanomedicine and remove the cells. A polymer and a protein called transferrin form nanorobots. This protein can detect cancer cells. In nanorobots, chemical sensors determine the target cell and release nano medicine to the target site to deactivate the responsible enzyme. Nanomedicine is the deactivate of ribonucleic reductase. It is a protein-bound to cancer growth made by the inactivate gene. Nanorobots are developing to increase cancer-detecting skills and speed up cancer analysis, as early detection improves cancer survival rates.[2,25,26]

10.2 Nanorobot in the diagnosis and treatment of diabetes: Nanorobots have the potential to enhance medical equipment, pharmaceuticals, and diabetes treatment. To keep their glucose levels under control, diabetic patients should collect tiny blood samples multiple times a day. These treatments are both unpleasant and costly. To avoid problems like these, medical nanorobots use continuous glucose monitoring to keep track of the body's glucose levels. The HSGLT3 gene will be used to test glucose levels in people with hereditary disorders. This protein functions as a glucose sensor and detects it. Nanorobots have been primarily responsible for maintaining the body's extracellular glucose levels. It has a 2-metre range and can move freely throughout the body. An appropriate clinical nanorobotic platform for in-vivo health surveillance is also being developed. The large amount of data captured might subsequently be transferred to the patient's mobile phone inside the clinical nanorobot structure. An alert display of a warning is issued through the smartphone if the glucose level surpasses the target of 130 mg/dl at any moment.[2,27,28]

10.3 Destruction of kidney stone: A kidney stone is a painful condition because calcium stones are not pass-through urine. In many cases, doctor's breakdown stone by using the ultrasonic signal pass. Nanorobots are introduced into the body as well as to detect calcium stones or kidney stones. The ultrasonic generator in the nanorobots generates ultrasonic waves, which break down kidney stones in the urethra. Outside of the body, these breakdown stone eliminate in urine.[29,30]

10.4 Nanorobot in drug delivery: Nanorobot is a delivery drug at a specific target site of the body and reduced the side effect of the drug. Nanomedicine used in drug delivery consists of nanoparticles that could be optimize the bioavailability of the drug.[31]

10.5 Treating arteriosclerosis: The accumulation of fatty material in the walls of the arteries causes arteriosclerosis. Cholesterol, WBC, and other debris collecting in the artery wall is a serious cardiac issue. Arteriosclerosis is caused by a blockage in blood flow in a blood vessel. The breakdown of plaque in artery walls by the nanorobot enhances blood flow in the blood vessel. The nanorobots have a biosensor that can detect plaque and break it down into minute particles.[32]

10.6 Parasite Removal: Parasites never transmit diseases on purpose since they might kill both the organism and the host. Some parasites, like Toxoplasma gondi and Plasmodium spp., can cause disease right away, whereas others depend on their chemicals. Infection in animals can be caused by unsanitary food or water, insect bites, or sexual contact with parasites. Giardia infections can be contracted by drinking contaminated water. Parasites can enter the body through the mouth, pores, or skin. Infection from parasites can be spread through close contact with dogs and cats. Several parasites live on them. A mosquito, a bedding worm, or a flea bite can potentially transmit parasites to their hosts. Parasites are detected by nanorobots, and all nanorobots employ a laser or medication to destroy them.[33,34]

10.7 Nanorobotics in surgery: Nanorobots enter the human body via the circulatory system and other internal cavities. Surgical nanorobots work as semi-autonomous onsite health care providers within the human body, guided or controlled by a human physician. Using an onboard computer nano manipulation guide, a surgical nanorobot programme may search for germs, diagnose and eliminate problems, and communicate with a supervisory healthcare expert by ultrasonic indication. Nanorobots are a simple approach to gaining access to the human body. After gaining access to the cells, a healthcare expert can control nanorobots using a computer. With the advancement of nanotechnology, small instruments for performing surgical procedures have emerged, even on a single smartphone. Nanotechnology in surgery includes surgical blade coatings with nanoparticles, nanoneedles, nano lasers, nanocoat catheters, and nano-shaped implant surfaces.[2]

10.8 Nanorobot in Gout: Gout is a painful joint condition caused by the formation of uric acid crystals in joints such as the knees and ankles. Gout is a condition in which the kidneys lose their capacity to remove waste from the circulation as a result of lipid breakdown. Gout symptoms are reduced when nanorobots disrupt the crystalline structure of joints like the knees and ankles. They are unable to provide long-term relief from the ailment.[35,36]

10.9 Nanorobot in Nanogene therapy: By comparing the molecular systems of DNA and proteins observed inside the cell to specified or desired reference structures, medical nanorobots can quickly cure hereditary diseases. In certain cases, chromosomal replacement therapy is more effective in repairing chromosomes than cytogenetic therapy. An assembler-built repair vessel performs genetic alterations inside the nucleus of a human cell. Stretching the supercoil of DNA between its lower set of robot arms, the nanomachine gently pulls an unfolded strand through the outlet in its prow for examination. In the meantime, the upper hands remove the regulatory proteins from the chain and deposit them in the intake port. The data in the huge nanocomputer's database is compared to the molecular structures of DNA and proteins. Which is kept outside the nucleus and connected to a cellular repair ship through a network. Proteins re-join the DNA chain, which recoils into its original structure. It is capable of cures and therapies that are currently unavailable to even the most advanced physicians. If diseases can be targeted at the molecular level, infections, heart disease, and cancer can be avoided. The majority of human illness is caused by cellular molecular malfunction, and cell function is controlled by gene expression and protein synthesis. Current genetic material is supplemented with fresh genetic material implanted into the cell nucleus. Limit effectiveness and insertion/deletion mutagenesis, in addition to the inflammatory response. Because of an immune response to the viral carrier's antigen, the permanent delivery of a gene via viral carriers has occasionally failed in human patients. Repeated gene clusters, additional gene copies, incomplete trisomies, and bigger polysomies can all cause serious disorders by replicating the ageing process. To try to rectify excessive expression induced by those abnormalities, antisense transcription silencing at the whole-body level is being used. When compared to establishing more practical therapy procedures that do not involve such deep repair, the multigene or entire-chromosome foundation may be a lengthy and costly process.[37,38]

10.10 Breaking blood clot: The cardiovascular system's involvement in blood clotting is complicated. An internal clot or embolism causes a blood vessel to become blocked. A stroke can cause heart muscle or other muscles to be lost. Nanorobots will enter the body and split the membrane with a laser, removing any clots or embolisms. Clottocytes, for example, are a form of nanorobot. When blood plasma comes into contact with a nanorobot, a small mesh net degrades into sticky clottocytes. When blood plasma comes into contact with a nanorobot, a small mesh net melts into an adhesive membrane.[39]

10.11 Cleaning Wounds: If you or your child has been injured, scratched, or burned, it is vital to treat the wound as soon as possible to prevent infection. Foam dressings have the disadvantage of requiring a dressing and are not ideal for wounds with low exudates, dry wounds, or dry scars that heal with exudates. It affects the epidermal layer of the body's new skin. Nanorobots are devices that remove infections, scrapes, and burns from within or outside the body. Because nanorobots rely on exudates to recover, they are ideal for wounds with limited exudate, dry wounds, and dry scars.[40,41]

10.12 Artificial oxygen carrier nanorobot: A Respirocyte is a synthetic RBC. It's a blood-to-spherical 1-micron diamond 1000-atm pressure channel utilising endogenous body fluid glucose as the active pump. A nanorobot made up of 18 billion atoms is perfected in a diamond-encrusted pressure tank that can consume up to 3 billion $O2$ and $CO2$ molecules, deliver 236 times more $O2$ to tissues per unit volume than natural red cells and balance carbonic acidity. A nanorobot made up of 18 billion atoms is perfected in a diamond-encrusted pressure tank that can consume up to 3 billion $O2$ and $CO2$ molecules. After some time, the gases can be released from the tank in a controlled manner by using the same molecular valve. On the devices, a gas concentration sensor is located on the devices. The onboard computer commands the sorting rotors to load the tanks with oxygen and discharge the $CO2$ at the same time the nanorobots pass through the capillaries of the respiratory organs, where $O2$ partial pressure is high and $CO2$ partial pressure is low. The onboard computer sent a signal to the sorting rotors to release $O2$ and take in $CO2$ when the $CO2$ partial pressure was high and the $O2$ partial pressure was low. In the same amount of area, a respirocyte can hold and transport 236 times the amount of gas as a normal red cell. As a therapeutic dose, inject 5 ccs of 50% respirocyte saline solution into the human circulation.[42]

10.13 Nanorobotic Dentifrices (Dentifrobot): Toothpaste is a dentifrice that, when used in conjunction with a toothbrush, helps keep teeth clean. Abrasive, binder, surfactant, and humectant are the main ingredients. A variety of components are also used. The paste's primary aim is to aid in the elimination of debris and plaque, with other advantages such as breath refreshing, and teeth whitening being touted. They can cover all subgingival surfaces when used in mouthwash or toothpaste, decomposing trapped organic debris into harmless, odourless vapours. Smart nanorobots can identify food, plaque, and tartar particles, which are subsequently removed from the teeth and cleaned away. Small Nanorobots are mechanical devices that deactivate when they are eaten.[2,43,44]

Future scope: -

Surgical procedures and various medical devices are currently being used to provide a main therapy that is necessary for the cure of problems in the human body. Nanorobots have the potential to cure any problems within the human body without the need for surgery. Nanorobots offer for more regulated medical therapy as compared to surgical techniques. The use of nanorobots to eliminate cancer cells and other harmful cells in cancer therapy aids in the alteration of medical treatment. Nanorobots disintegrate kidney stones while causing no injury to the surrounding tissue or cells. Medical nanorobots will be used in the field of eye surgery in the future. Nanorobots will make surgical procedures and medical treatments safer for all patients, and they may also aid in the discovery of disease causes.

Conclusion

All of today's technical advances are moving humans closer to creating nanorobots. Nanomachines have the potential to cure all of today's prevalent ailments, reducing a lot of pain and suffering. Nanorobots are still in the early phases of development, but their popularity is growing rapidly. Nanorobots will alter the healthcare system in the future. Recent breakthroughs in nanorobotics offer cause to assume that this technology will be beneficial in the healthcare industry. Nanorobots are employed in surgical procedures because they require minor changes to the surgical method, lowering the risk of complications and side effects. Cancer treatment, kidney stone removal, liver stone removal, and parasite elimination are all possible with them. Nanorobots are more useful in the sphere of research and development.

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