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Medical uses of nanotechnology

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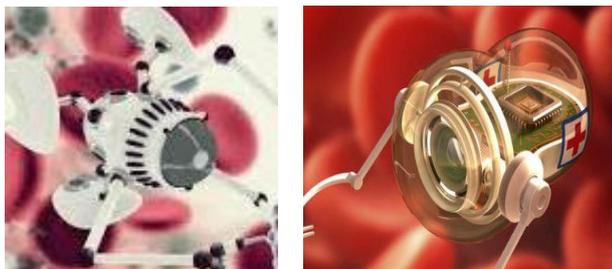
ABSTRACT

NanoRobotics is the technology of creating machines or robots close to the microscopic scale of a nanometer (10⁻⁹ meters). These nano robots play a crucial role in the field of Bio-Medicine, particularly for the treatment of cancer, kidney stones, elimination of defected parts in the DNA structure, and for some other treatments that need utmost support to save human lives. The aim of this article is to outline the potential uses of nanotechnology in medicine.

Keywords— Nanorobotics, Nanometer, Treatment, Human lives

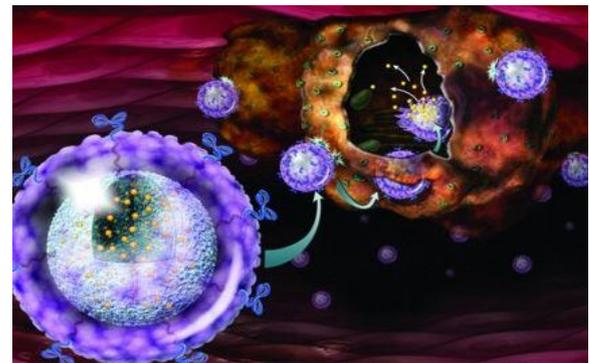
1. INTRODUCTION

Today, there is utmost support is required to save human lives. There are many specialists in a particular field to diagnose human health based problems. It can be grown much wider if it is fully advanced. Technological world has been providing many beneficial inventions that would help people. NanoRobotics is one of the technologies of creating machines or robots. The Nano Robots can be used in different application areas such as medicine. Nanorobots are used for the purpose of maintaining and protecting the human body against pathogens. Nano technology's basic concept relies on using atoms and molecules to build functional structures [1]. In 1959, the physicist Richard Feynman, Nobel Prize winner for Physics in 1965, came up with the brilliant concept of the nano when he said "there is plenty of room at the bottom" during a conference of the American Physical Society [2]. Nanotechnology is a field of science uniting the most recent achievements of chemistry, biology, physics, mechanics and computer science.



2. NANOTECHNOLOGY IN CANCER THERAPY

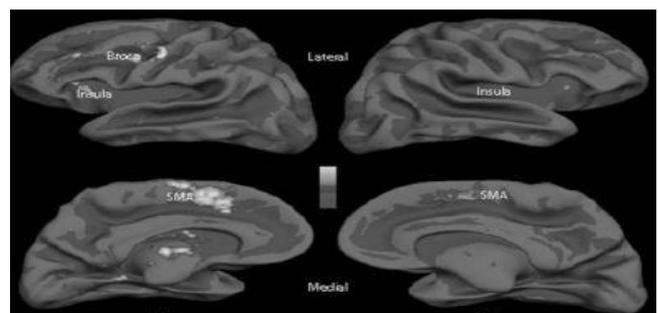
Surgical intervention, radiotherapy and chemotherapy are the currently available ways of treating cancer. It is effective in many cases, but cause severe systematic damage. The usage of nano-compounds is highly limited due to their high cost and lack of appropriate legal regulations.



There are many tools and techniques used in the medical field to treat cancer. The main intention of treating a disease is that it should be efficient. The main technology used for treating cancer is Chemotherapy, which will cause many side effects to the patient. In nanotechnology, with the use of Nano robots and embedded chemical biosensors, one can easily detect the tumour cells in very early stages. Some non-sensor nanorobots can also be used for detecting cancer

3. FUNCTIONAL MAGNETIC RESONANCE IMAGING

One extremely promising technique associated with nuclear magnetic resonance is Functional Magnetic Resonance Imaging (fMRI). This enables scientists to study how the brain works. The excitation of groups of neurons can be observed by the amplification of the resonance signal and the rise in blood flow which is caused by the increase in the metabolism of the neurons. Scientists are therefore able to see how the brain functions. This type of imagery is currently under development.

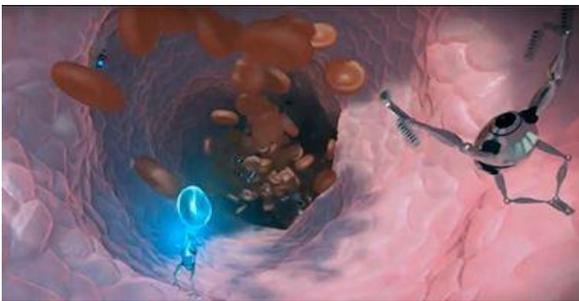


4. OPTIC MICROSCOPY

Optic microscopy has made remarkable progress, in particular in the latest generation of confocal microscopes. 3-D images of the subject matter to be studied are obtained by the scanning of a

laser beam whose absorption only occurs in sites where the frequency of excitation corresponds to twice the frequency of the light used. This property, called two-photon absorption, has two interesting points: first, the matter is transparent for one-photon absorption and, secondly, it only occurs at the focal point of a beam which provides excellent photographic detail. Two-photon laser scanning fluorescence microscopy, which is based on the same principle, is the most sophisticated method of microscopy that uses fluorescent markers.

A new generation of scanning electron microscopes, known as environmental scanning electron microscopes, makes it possible to study specimens without the preparations that are required for traditional electronic microscopy. These microscopes enable scientists to observe in vitro with a resolution of less than a nanometer. The atomic microscope, which is only used in laboratories, is the best microscope used for the analysis of surfaces on a subnanometric scale. Scanners using nuclear magnetic resonance have made extraordinary advances in medical imagery. MRIs continue to improve their resolution by using more intense magnetic fields.



MRI: Magnetic Resonance Imaging

fMRI: Functional Magnetic Resonance Imaging

3-D: Three Dimensional

Units: A nanometer = 10^{-9} meter

5. PROTEINS' MOLECULES WITH EXCEPTIONAL PROPERTIES

The basic component of all living organisms is the cell. Some organisms are made of just one cell (e.g. bacteria), some out of around ten, and others out of several billion including different types of cells. Human beings are made up of 10^{13} to 10^{14} cells. One of the main features is the cell's unique functioning which varies according to the type of cell. The main variation between different kinds of cells is whether they have a nucleus or not. This distinguishes prokaryote and eukaryote organisms. The main functions of a cell consist of a program which possesses all information needed to develop the relevant organism, as well as a system which reads these instructions, and a device which produces the elements required for the development of the cell.

6. ARTIFICIAL EAR

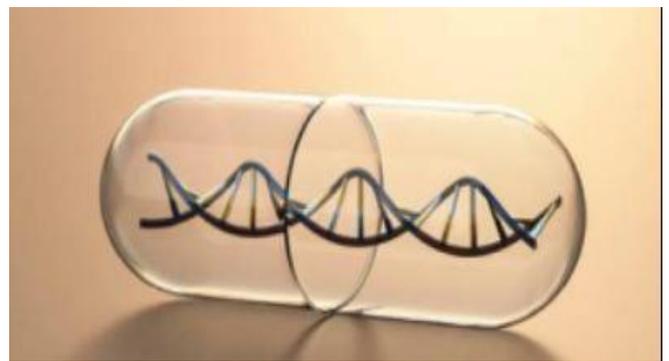
The usage of new technologies is the cochlear implant. This is a surgically implanted electronic device¹⁵ that can help to provide the sense of sound to a person who is profoundly deaf or severely hard of hearing as it replaces the missing or damaged receptor. This device has gone into industrial production and can be implanted at specialized centres. It includes two components: one electronic device, which is implanted into the bone beneath the skin, and a speech processor. The sound is picked up by a microphone and transformed into electric signals by the vocal processor. According to a special code, the vocal processor transforms them into electrical impulses.

These impulses are transmitted through the skin via electromagnetic waves and picked up by the implanted receptor.

The receptor produces a series of electric impulses which, via an electrode fibre, directly stimulate the neurons without using the damaged cells. Once stimulated, the cochlear nerve (also auditory nerve) sends electric impulses to zones of the brain which then interpret them as sound. The entire process, from the sound being picked up by the microphone to the processing of it by the brain, is instantaneous. The patient therefore perfectly understands utterances once the process of auditive rehabilitation and speech therapy is completed.

7. GENE THERAPY

This nanotechnology is highly preferable in treating genetic diseases. If any abnormalities in the cell structure, they are found and corrected then the protein molecules are reattached as a chain once again and changed into its original form.

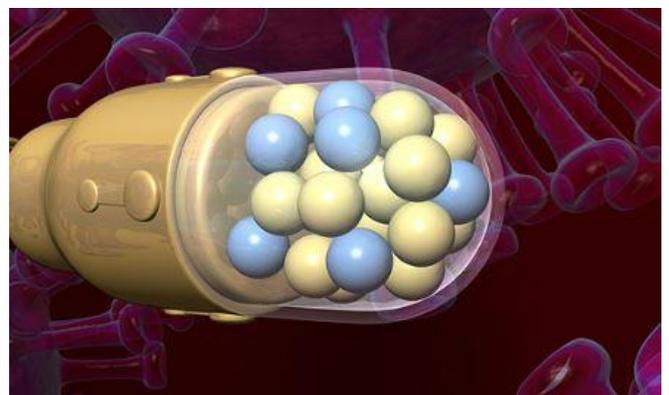


8. SURGERY

The invention of surgical nanorobots which will act as an on-site surgeon. This nanorobot can perform various functions in a human body. It can also contact a higher graded surgeon for supervising or any medical pieces of advice in case of any critical circumstances.

9. DIAGNOSIS AND TESTING

Medical nano-robots are used for testing, diagnosing and monitoring cell tissues and bloodstream. They are capable of noting down the record of observation and can generate a report based on the signs, criteria, parameters, temperature etc. This can be done by nano-robots continuously in a human body.

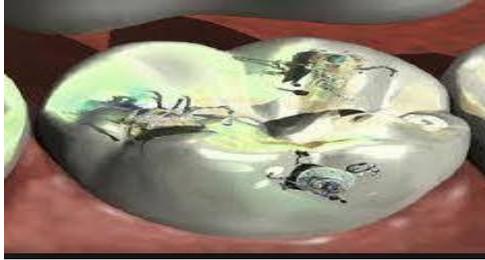


9.1 Neurosurgery

Injury in the spinal cord and nerve damage are the most crucial area in neurosurgery. The nano-robots can be capable of communicating information about vascular changes and make treatments accordingly. It can also provide an option for cerebral screening and can accurately detect the area of fault.

9.2 Dentistry

It is one of the topmost application in nanotechnology. Nanorobots will help different processes that are involved in dentistry. The nano-robots are helpful in desensitizing the tooth, act as oral anaesthesia, for straightening irregular size of teeth, improving tooth durability, in correcting tooth repairs, whitening teeth, changing the appearance of the teeth etc. can be done easily with the help of nano-robots.



9.3 Oncology

With the help of nanorobots, a doctor can easily identify the block in a person's heart. Nanorobots which can also be used for medical surgeries can perform the best surgeries in a human body with all the prior detection techniques and complete the tasks in a more efficient way. Continuous observations and medication injecting will also be taken care of by the nano-robots.

9.4 Removal of kidney stones

Using nano-robots one can detect the stones in human kidney. It can also break that stones into pieces based on the condition. It can also make pre and post diagnostics for a particular patient. And can able to generate a report based on the particulars, temperature, current health condition. This makes doctors the job simpler. Nanorobots plays a very major role in the medical field.

9.5 Treating arteriosclerosis

It is a condition where plaque builds along the arteries. Nanorobots can effectively treat the condition by cutting away the plaque by avoid entering into the bloodstreams.

9.6 Blood clot breakage

Blood clots can cause complications from death to a stroke. But we can easily resolve this with the help of nano-robots. It could travel to a clot and then breaks it up. This application is one of the most dangerous uses for nanorobots because the robot must be able to remove the blockage part without losing small pieces in the bloodstream, which could then travel elsewhere in the body and cause more problems. The robot must also be small enough so that it doesn't block the flow of blood itself.

9.7 Cleaning wounds

Nano robots can remove in cleaning wounds. It can decrease the infection rate. In the cases, where if any conventional

methods are not supporting, one can prefer nano robots that can do the job more quickly. It can move throughout the body and navigates when and where required.



10. FUTURE OF NANOROBOTS

Nano-robots could revolutionize the future especially in the field of medicine. It could make the jobs of doctors simpler that a human being can be cured of simpler heart diseases till cancer with the help of tiny robots as Nano robots which can go inside any part of the human body. It is very smaller compared to other medical instruments.



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