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A review/survey paper on Nanobots in Medical Applications for cancer cures

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Abstract

A review or survey on Nanobots in Medical Applications is presented in this paper. Nanorobotics is the science and technology of designing and manufacturing nanoscale machines, especially robotic machines. Nanorobots would constitute any "smart" structure capable of actuation, sensing, signaling, information processing, intelligence, manipulation and swarm behavior at nano scale (10-9m). More specifically, nanorobotics (as opposed to micro robotics) refers to the nanotechnology engineering discipline of designing and building nanorobots with devices ranging in size from 0.1 to 10 micrometers and constructed of nanoscale or molecular components. The first useful applications of nanomachines is in nanomedicine. The biological machines are used to identify and destroy cancer cells. The work given here is a project that is taken up as a part of the curriculum completed by electronics and communication engineering post-graduate student in the second year of the electronics & communication engineering department at Dayananda Sagar College of Engineering in Bangalore.

Keywords : Nanorobot, Medicine, Intelligence.

1. Nanomedicine Introduction

Nanomedicine's nanorobots are so tiny that they can easily traverse the human body. Scientists report the exterior of a nanorobot will likely be constructed of carbon atoms in a diamondoid structure because of its inert properties and strength. Super-smooth surfaces will lessen the likelihood of triggering the body's immune system, allowing the nanorobots to go about their business unimpeded. Nanorobots can offer a number of advantages in drug delivery over present methods. Potential uses for nanorobotics in medicine include early diagnosis and targeted drug-deli very for cancer, biomedical instrumentation, surgery, pharmacokinetics, monitoring of diabetes and health care. Fig. 1 & 2 gives the nanorobots inside blood vessels [1].

Fig. 1 : Nanorobots inside blood vessel

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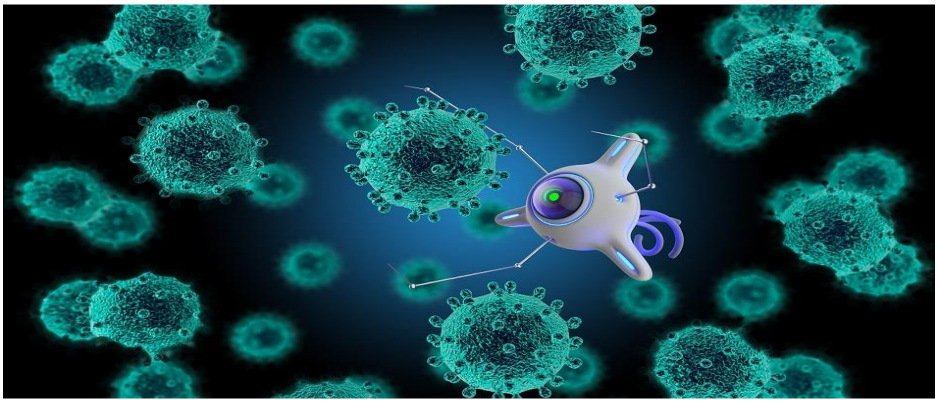

Fig. 2 : Nanorobots inside blood vessel

2. Medical Nanotechnology

In medical nanotechnology it is expected to employ nanorobots injected into the patient to perform work at a cellular level. Such nanorobots intended for use in medicine should be non-replicating, as replication would needlessly increase device complexity, reduce reliability, and interfere with the medical mission [2]. Nanotechnology provides a wide range of new technologies for developing customized means to optimize the delivery of pharmaceutical drugs. Today, harmful side effects of treatments such as chemotherapy are commonly a result of drug delivery methods that don't pinpoint their intended target cells accurately [18]. However, have been able to attach special RNA strands, measuring nearly 10 nm in diameter, to nanoparticles, filling them with a chemotherapy drug. These RNA strands are attracted to cancer cells. When the nanoparticle encounters a cancer cell, it adheres to it, and releases the drug into the cancer cell. This directed method of drug delivery has great potential for treating cancer patients while avoiding negative effects (commonly associated with improper drug delivery) [3].

3. Application of Nanorobots

Another useful application of nanorobots is assisting in the repair of tissue cells alongside white blood cells [17]. Recruiting inflammatory cells or white blood cells (which include neutrophil granulocytes, lymphocytes, monocytes, and mast cells) to the affected area is the first response of tissues to injury. Because of their small size, nanorobots could attach themselves to the surface of recruited white cells, to squeeze their way out through the walls of blood vessels and arrive at the injury site, where they can assist in the tissue repair process. Certain substances could possibly be used to accelerate the recovery [4].

4. Objectives of Nano-Robotics in medical Field [5]

- To help monitor the patient’s body continuously and be able detect cancer and other diseases at early stages.
- To destroy cancerous cells without affecting the healthy cells.
- To reduce the time of recovery for people fighting against cancer and other diseases.
- To carry and deliver large amounts of anti-cancer drugs into cancerous cells without harming healthy cells, and thus reducing the side effects related to current therapies.
- To repair tissues, clean blood vessels and airways, transform our physiological capabilities, and even potentially counteract the aging process.

5. Methodology [6]

- First finding out the method of entry into the body for the nanorobot.
- Finding means of propulsion for the nanorobot Finding means of maintaining a fixed position while operating.
- Finding how to control of the device.

- Finding the appropriate power source to nanorobot.
- Finding means of locating substances to be eliminated by the nanorobot.
- Finding means of doing the elimination the substance from the body.
- At last, continuously monitoring the body and giving feedback.

6. Designing of Nanorobots for medical application [7]

In this paper according to the author Hariharan, there are three main considerations need to focused on designing a nanorobot to move through the body: navigation, power and how the nanorobot will move through blood vessels [15]. Ultrasonic signals are used for directing the nanorobots to the cancerous cells. These ultrasonic waves are detected by ultrasonic sensors. Nanorobots can also be fitted with a small miniature camera assuming the nanorobot isn't designed to float passively through the bloodstream, it will need a means of propulsion to get around the body [16]. Because it may have to travel against the flow of blood, the propulsion system has to be relatively strong for its size. Another important thing need to consider is the safety of the patient, the system must be able to move the nanorobot around without causing damage to the host [8].

7. Locomotion & Propellors

There are a number of means available for active propulsion of our device. The very first Feynman prize in Nanotechnology was awarded to William McLellan for building an electric motor that fit within a cube 1/64th of an inch on a side [14]. This is probably smaller than we would need for our preliminary microrobot. One or several of these motors could be used to power propellers that would push (or pull) the microrobot through the bloodstream. We would want to use a shrouded blade design so as to avoid damage to the surrounding tissues (and to the propellers) during the inevitable collisions [9]. In this scenario, we are using some sort of vibrating cilia (similar to those of a paramecium) to propel the device [13]. A variation of this method would be to use a fin-shaped appendage. While this may have its attractions at the molecular level of operation, an electric motor/propeller combination would be more practical at the scale we are talking about [10].

8. Electromagnetic pump

This is a device with no moving parts that takes conductive fluid in at the front end and propels it out the back, in a manner similar to a ramjet, although with no minimum speed. It uses magnetic fields to do this. It would require high field strengths, which would be practical with high-capacity conductors. At the scale we are talking about, room (or body) temperature ceramic superconductors are practical, making this a possibility [11].

9. Jet Pump

Here, we use a pump (with moving parts) to propel blood plasma in one direction, imparting thrust in the opposite direction. This can either be done with mechanical pumps, or by means of steam propulsion, using jets of vaporized water/blood plasma [12].

10. Conclusion

In this paper, we have presented a brief review of the nanorobots that were being used in the biomedical engineering or curing of the deadliest disease in the world, that is cancer. Biological systems are an existing proof of molecular nanotechnology. Rather than keep our eyes fixed on the far future, let us start now by creating some actual working devices that will allow us to cure some of the deadliest ailments known, as well as advance our capabilities directly, rather than as the side effects of other technologies.

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