

NANOBOTS AND ITS APPLICATION IN MEDICAL AND ENGINEER FIELD

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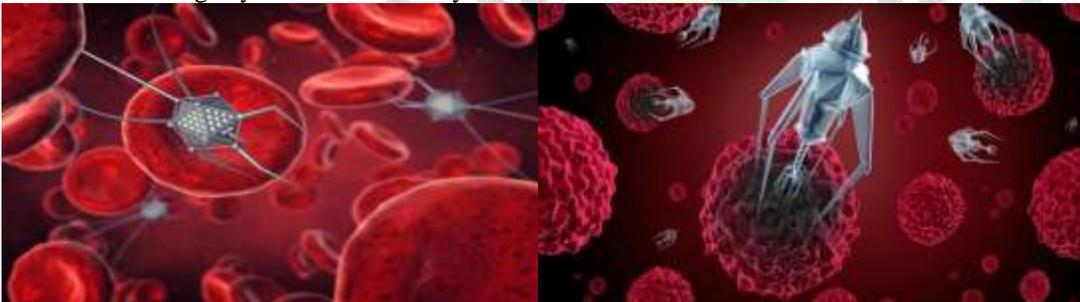
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Abstract: The paper comprises of the use of nanobots in the Engineering and medical field in order to cure many diseases and to diagnose the same. Here I am doing a theoretical survey of nanobots for the treatment of various diseases like cancer and its applications in the field of haematology, biohazard defence and in aviation sector . I have made the report as the combination of medicine, engineering and the nanobots. The combination of the both medicine and the nanobots will bring new solution for the uncured diseases. Nanobots will serve as an effective medicine in future. The use of nanobots is considered to be the most efficacious specialist on a small scale. With the development in the nanotechnology it may even capable of building Respirocytes (Artificial red blood cells) which are having a capability of carrying both the oxygen molecules and carbon dioxide molecules[1]. Respirocytes which can be considered as nanorobots, microscopic gadgets which are planned to work on the molecular level. Respirocytes gives a hope of being used as a substitute for the platelets in the case of emergency. Additionally respirocytes will put an effect in the cure of coronary illness. The day is not far when we will be using the nanobots inside our body for the cure of diseases. Amongst the all the most effective is its use for the deadly disease cancer. Nanobots will serve the purpose of carrying and delivering the anti-cancer medicines into cancerous cell without causing any harm to any other cells[2]. In the nearby future nanobots will be used for many purposes like replacement of therapies ,repair tissues and in-turn will reduce the side effects of the same. The work presented in this report is a brief review of the applications of the nanorobots and main focus will be on their use for the treatment of cancer. In the field of engineering it will be very much helpful in space exploration and in the drone technology.

Index Terms – Nanobots, Cancer Treatment, Medical nanorobotics, Nanomedicine, Biohazard

1.INTRODUCTION

A nanobot can be defined as an mini robot that has been designed artificially in-order to travel freely inside the human body and link with particular cell at molecular level. The figure illustrates the schematic representation of a nanorobot that can reach the cancer causing cell without causing any harm to the healthy cells.



Nanobots to be used for the human body must be glazed with safer agents which will depend up of their application. The outer shell which is the most important part as it has to be in directly contact with the inner parts of the body an is able to release different non-toxic chemicals at a microscopic level[3]. Nanobots in the future will be able to identify different types of cells that is whether the cell is damaged, healthy, what the parent organ is, and mostly all the information about the particular cell, and with the help of some sensors , various cells would be recognized and easily targeted for the rapid action. A 1cm^3 chemical injection coming from nanobots could be able to reach to the specific cell at least 0.5 cm^3 of chemical agent, and with respect to this the sensor would test the levels of the particular chemical to protect against any accidental overdose[4]

Cancer is a most deadly and serious disease in the current world. For the treatment of the same disease many traditional clinical methods comprising of surgery, chemotherapy and radiotherapy are widely used. Although there has been many developments in the field of medical health but the deadly disease like cancer has still remained the challenging disease for not having the fully cure and has now become as the most prominent cause of the death through-out the world and sums up a total of 14% of all the deaths[5]. In the last few years the death rate has marginable increased due to the diseases like cancer. Medical surgeons in the present day used chemotherapies and radiotherapies to get rid of the solid tumours from the human body. However, due to use of chemotherapeutic agents for treatment can cause damage to both cancerous and the healthy cells and due to this the actual dosage gets reduced as it splits between the normal and cancer cells[6]. The most commonly used drugs that is doxorubicin and paclitaxel shows anticancer activity by injecting programmed death of cells that then quickly divides. This in-turn can lead to the death of the healthy cells that are able to divide fast in the usual conditions.

With the development in the nanotechnology it has introduced the use of the microscopic robots called as nanobots which would be used for the treatment of the deadly disease like cancer. Nanobots will be playing an important role in the in cancer therapy as they can be used efficiently for drug delivery. With the help of nanobots Diagnosis of cancerous cell can be easily done during the period of initial stages by making use of particular bio-sensors



II. MAIN OBJECTIVE OF NANO-ROBOTICS IN MEDICAL FIELDS

- Nanobots plays an very important role in monitoring patients body thoroughly and helps in detecting the deadly diseases like cancer.
- Helps in destroying the cancer cells without affecting the normal cells.
- Reduces the time of recovery for people fighting against cancer and other deadly diseases.
- Transportation of huge amount of anti-cancer drugs into the cancer cells without putting any damage to the normal cells and in-turn deduces the side effects related to the same
- To repair tissues, clean blood vessels and airways, transform our physiological capabilities, and even potentially counteract the aging process

These objectives related to the work can only be attained with the help of following steps :

- Firstly we need to figure out the entrance in the body for the nanobot
- Secondly we need to find the propulsive device for the nanobot
- Finding means of maintaining a fixed position while operating
- Need to find how to operate the device
- A power house for the nanobot
- Finding means of locating substances to be eliminated by the nanorobot
- Finding means of doing the elimination the substance from the body
- At last we need to see continuously monitoring the body and giving feedback.

III. ADVANTAGES OF THE MODERN TECHNOLOGY EMPLOYED

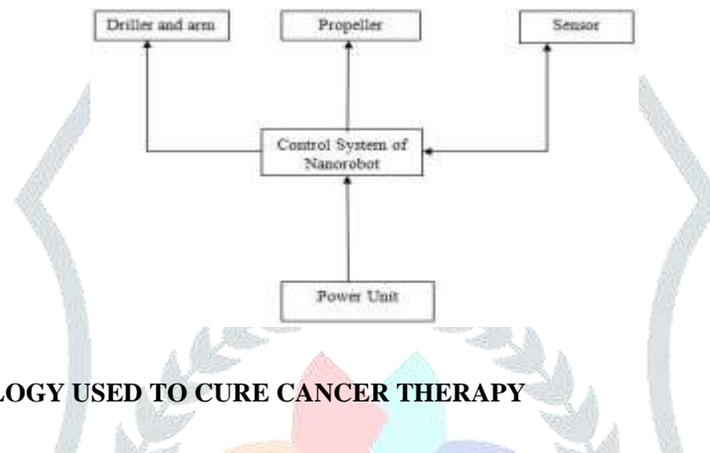
We can get deep knowledge about the complexity of human body and brain with the aid of nanorobots. The progress will moreover assist in carrying out pain free surgeries and the surgeries not involving an invasive medical procedure. The most complex surgeries can be carried out easily. Due to the advanced microscopic features they can go through the brain cells to bring out detailed account of information which is needful for more studies[7]. This nanotechnology program will play a very important role in benefit of scientists in the modern era.

The specialty about nanobots is that they are about 25 times smaller than the width of human hair and are made from a combination of natural red blood cells, platelet membranes and artificial gold wire, hence are not visible by naked eyes which makes it easier to insert in human body[8]. With the advancement of this technology there will be a time when diseases will get way too easier, as even quoted by many great scientists. According to the facts, half of the human population is suffering from this dreadful disease and there is no specific treatment available to cure it. The traditional method for curing cancer is chemotherapy that is usually described as “CARPET BOMBING OF THE BODY”, in many cases it kills the cancerous cells but it also has side effects of killing regular cells which makes patient’s extremely sick and susceptible to other conditions but the programmable nano particles that attack cancerous cells directly without damaging other tissues could mean a revolution in cancer treatment which is more like a Tomahawk precision missile[9]. It might be costly initially but with the passage of time its cost will get reduced.

IV. Design

As per as the design of nanobot is considered it need to be designed with higher accuracy as it has to target the damaged cell. The architect of the nanobot should be well designed as it has to move through liquid environment. In order to navigate through the blood nanobots must follow smooth trajectory and should not affect the healthy cells or to the normal cells. After reaching and detecting the cancer cells the nanobot arm need to target the same cell. A nanobot must be provided with a processing unit system "brain" so that it gain high accuracy. In addition to this the processing unit system must have the miniature [10]

Due to the inherent property of the Carbon nanotubes they can be used for making the outer body of the nanobots. The property of the nanobots of absorbing the infrared radiations can let them pass through the human cells without causing any damage .The nanobots are wrinkled around by the ultrasonic sensors in order to avoid any collision in between the two. In order to target the cancerous cells folate receptor will be used. These receptors are mainly expressed in lungs, kidney brain tumors and now can be used for the cancer. With the help of folate a patient can get a better treatment .Flagella is used as a supportive system for navigation purpose inside the blood stream. Flagella motor is used for the generation of power in order to make sure that it can drive the helical flagella. Flagella motor guides the nanobots about the accurate location. Velocity $25 \mu\text{m/s}$ and $1/s$ direction reversals is given by the particular motor The size range of assembled nanobot is about 0.5μ to 0.8μ and the capillary size was found to be approximately $5-10 \mu\text{m}$ in diameter.[11] For the nanorobot to navigate through blood vessels, it should of size within the range of capillary size.



V. THE MODERN TECHNOLOGY USED TO CURE CANCER THERAPY

Nanotechnology involves the use of therapeutic agents that deliver their toxin to a target cell in a controlled, time-released manner. Through the use of nanorobots, chemical agents could be transported and delivered to specific cells, in the same way as syringes are used in medicine to directly inject drugs into the patient's bloodstream[13]. Nanorobots or nano killers could be used to locate and repair damaged cells and tissues. They could help with the detection and treatment of cancerous masses (tumours) and could also locate the site most affected. They could prove helpful in monitoring the post operation statuses of the tumours and could also be used to monitor the degree of success or failure of the treatment given. Nanorobots have the potential to find out the exact number of active cancerous cells as well as those cells that are treated or inactivated. Respirocytes carry out the identification of cancerous masses, allowing the nano killer to treat them using chemotherapy drugs that are targeted and delivered in small amounts to the exact site of damage.

Apart from the early detection and treatment of cells affected by cancer, nanotechnology through its precision and efficacy can serve to protect a patient from the potential side effects of the chemotherapy drugs.

Through the use of nanotechnology in medicine, glucose levels can be monitored, cancerous tissue can be both located as well as destroyed through non-invasive devices. It is speculated that these devices would be vibrating, ciliated, nanorobots with inbuilt cancer sensors[14]. Their special gold coatings would allow them to attach to and treat dangerous cells, internally.

With regard to designing a nanorobot, there are three main considerations on focus:

Navigation, power and the movement of nanorobots through the blood stream. In order to direct a nanorobot to specific cancerous cells, ultrasonic signals emitted by the nanorobot can be used. These signals could then be easily tracked using ultrasonic sensors. Another possible way is to fit nanorobots with miniature cameras. Another important consideration about the design is to find a means of propulsion for the nanorobot to get around the body without being hindered by the direction of the blood flow. Since it might have to travel against the blood flow, a nanorobot demands a strong propulsion system that may overcome the limitation of its size. Another consideration concerns the safety of the patient; the nanorobot must be able to carry out an input without causing any harm to the host[15].

For the movement of a nanorobot, we can mimic a Paramecium that uses its tail-like limbs called cilia for its locomotion. By creating a sort of vibrating in the cilia, the paramecium can get itself to swim in any direction. We can alternatively, equip a nanorobot with flagella. Flagella are similar to cilia however they differ in length and are generally longer than cilia. Like cilia, micro-organisms use flagella to propel in any desired direction. Nanorobots could also be created as an imitation of jet airplanes where blood plasma can be used to push the nanorobot into propulsion. For providing a nanorobot with power, we could use the body heat of the patient, however there would arise a need to manage the temperature because of the fluctuations it undergoes.

Power generation can be a result of Seebeck effect which occurs when two metal conductors (each made of a different metal) are joined at two points kept at two different temperatures. The metal conductors generate voltage when the junctures are at different temperatures, i.e, they behave as a thermocouple[16]. Since, body temperatures rise and fall, it is difficult to rely on temperature gradients within the body. This makes it highly unlikely for nanorobots to use body heat as a power source.

Nanobots: Applications in the Field of Haematology

In the field of haematology nanobots play a very important role as they can be used in the blood streams. This ranges from developing artificial methods of transporting oxygen in the body after major trauma to forming improved clotting capabilities in the event of a dangerous haemorrhage. Respirocytes which can be considered as nanorobots, microscopic gadgets which are planned to work on the molecular level. Respirocytes gives a hope of being used as a substitute for the platelets in the case of emergency. Additionally respirocytes will put an effect in the cure of coronary illness. Also present day research suggest the respirocytes have tendency to transport 200 times more respiratory gas molecules that the natural RBC of the same quantity. Moreover, clottocytes a type of nanobot can be used in as an artificial platelets for halting bleeds. Clottocytes is a master copy of the natural platelet which is having a tendency to build up a resistor by making a fibre like mesh in order to stop bleed. Clottocytes has an ability of being thousand times more efficient than a same number of natural platelets[17].

Nanobots: Applications for Biohazard Defence

Nanorobots having its multiple applications and can be used for biohazard defence which includes the quick action to epidemic disease. Nanobots which are having protein based biosensors would have capability of transmitting real-time information in those locations where public infrastructure is fixed and laboratory analysis is not available[18]. This is particularly applicable for biomedical monitoring of areas devastated by epidemic disease as well as in remote or war torn countries during humanitarian missions. Nanobots has its beautiful application as it can deduce contamination and can provide thriving screening for quarantine[19]. During the period of influenza epidemic, growing concentration of alpha-NAGA enzyme would be used as a bench mark for the infection caused by influenza. The growing volume could activate the nanobot which sends electromagnetic back propagated signals to portable technology such as a mobile phone. The data could be the retransmitted through telecommunication system providing information on the location of the infected person, increasing the speed of contamination quarantine.

Nanobots: Applications in space missions

Development in nanomaterials oblige nanobots play a very important role in the space missions such as nanobots can be used in satellites in order to lightweight solar sails and cable for space elevator attainable. The cost of reaching and travelling in space can be depleted by purposefully minimizing the desirable amount of rocket fuel. The field where nanotechnology made considerable beneficence is radiation shielding. NASA allege that the threats of subjections to space radiations are the most essential factor restricting human's capacities to indulge in long haul space missions. The radiations that human experience in space are comparatively distinct than that of earth's surface. When astronauts leave the protective magnetic field and aerosphere they become susceptible to ionizing radiation in the form of charged atomic particles travelling close to the speed of light. Highly charged, highly-energetic HZA particles jeopardize humans in space. A long term subjection to this radiation can cause DNA damage and cancer. In order to shield their human cargo spacecraft shall require special shields comprising materials that consists lighter elements such as hydrogen, boron, lithium. Nevertheless, extra shielding attains significant amount in form of extra weight, more fuel and upsurge flight cost.

A team of young researchers from N-E University are putting their work forward which comprises of using of nanobots in space. They have also given the idea of "spider web" which will be made of hairline tubes. These tubes will be having multiple sensors which will be giving certain measurements like tempature[20].

VI. CONCLUSION

The paper provides a brief review of the nanobots which will be used in the field of biomedical engineering and for providing a proper cure of the deadly diseases in the entire world. By staying on the old conventional methods for curing the deadly diseases that hardly provides the proper cure it is better to shift to the new technology that is using the nanobots for the cure of the same. The day is not that far when the cure for deadly disease using nanobots will not be just a paper review but will be helping in serving the cure of the patients practically. In addition to this nanobots will be used for space exploration and in the drone technology as it will be helpful in making them stronger and lighter. Moreover nanobots can protect the humans from cosmic radiations.

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