Nanorobots In Medical Field And Health

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Abstract- *Nanorobotics is an emerging field of nanotechnology which deals with design and construction of devices at an atomic , molecular or cellular level. These hypothetical nanorobots will be extremely small and would transverse inside the human blood. As these nanorobots would have special sensors to detect the target molecules, it can be programmed to diagnosis and treat various vital diseases. The nanorobots such as respirocytes, microbivores and clottocytes are been designed to act as artificial substitutes of blood. The respirocytes are intend designed to mimic all the important functions of red blood cells and also used in treatment of anaemia, heart attack, lung diseases etc where as the clottocyte mimics the natural process of hemostasis and microbivore follows the process of phagocytosis to destroy the blood borne pathogens. This paper will look at how the recent advancements in nanorobotics that have led to the designing and development of these nanorobots which will act as the most efficient blood substitutes.*

Keywords- Nanorobots , Hemostasis , Target molecules , Clottocyte , Phagocytosis , Respirocytes

I. INTRODUCTION

Nanobots are robots that are microscopic in nature, measured largely on the scale of nanometers. They are currently in the research and development phase, but on realization they are expected to do specific tasks at the atomic, molecular and cellular level and help in bringing about many breakthroughs, especially in medical science. Nanobots are also known as nanomachines, nanorobots, nanomites, nanites or nanoids.

A nanobot is an extremely small robot that operates on a microscopic scale. Originally spoken of in science fiction circles, there has been an increased focus on it in biological and robotics research. The term nanorobot was created by combining the terms robot and nanometer. Other common names for robots of this size include nanobots, nanomites, and nanites with sizes ranging from 0.01 to 0.1 micrometers. Currently, most nanobot research is being done in the medical and military fields. The more the technology develops, the greater the number of potential uses that arise. An alternative development for nanorobots is the interactions that a robot can accomplish on the nanoscale resolution with no restriction on the overall size of the robot.

The birth of nanotechnology is often associated with the talk given by Nobel Prize winner Richard Feynman entitled “There’s Plenty of Room at the Bottom”. The Nanotechnology has been defined as a description of enormous number of technical applications. Nanotechnology has been defined as a description of activities at a level of atoms and molecules that have applications in the real world. Nanotechnology comprises technological developments on a nanometer scale usually on the order of 0.1 to 100nm. Thus, Nanorobots are the nano devices that will be used for the purpose of maintaining and protecting the human body against pathogens.

II. IMPORTANCE OF NANOROBOTS FOR HEALTH

1) BLOOD CLOTS : Blood clots can cause complications ranging from muscle death to a stroke. Nanorobots could travel to a clot and break it up. This application is the one of the most dangerous uses of nanorobots. The robot must be able to remove the blockage without losing small pieces in bloodstream.

2) TREATING ASTERIOSCLEROSIS : Asteriosclerosis refers to a condition where plaque builds along the walls of arteries. Nanorobots could conceivably treat the condition by cutting away the plague, which would then enter the bloodstream.

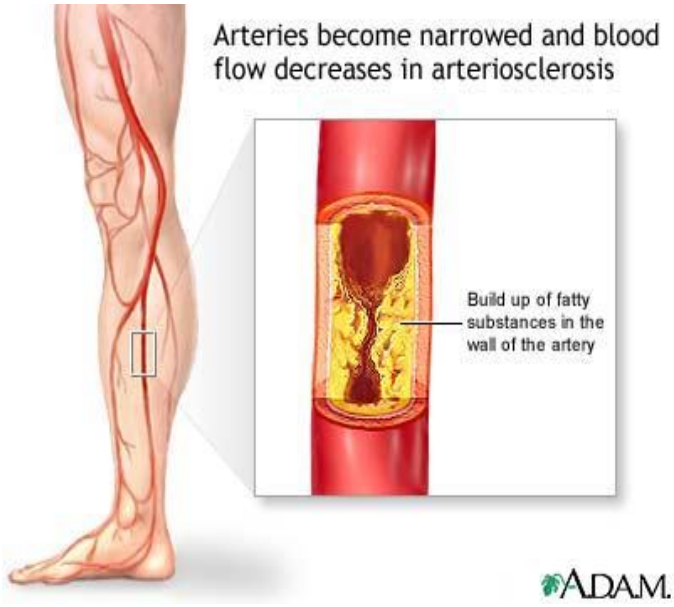
3) BREAKING UP BLOOD CLOTS : Bloodclots can cause complications ranging from muscle death to a stroke. The robot must be able to remove the blockage without losing small pieces in the bloodstream, which could then travel elsewhere in the body and cause many problems. The robot must also be small enough so that it doesn’t block the flow of blood itself.

4) FIGHTING CANCER : Doctors hope to use nanorobots to treat cancer patients. The robots could either attack tumors directly using lasers, microwaves or ultrasonic signals or they could be a part of chemotherapy treatment, delivering medication directly to the cancer site. Doctors believe that by

delivering small but precise doses of medication to the patient, side effects will be minimized without a loss in the medication's effectiveness.

5) HELPING THE BODY CLOT : One particular kind of nanobot is clottocyte or artificial platelet. The clottocyte contains a small mesh net that dissolves into a stick membrane upon contact with blood plasma. According to Robert A. Freitas, the man who designed the clottocyte, clotting could be up to 1000 times faster than the body's natural clotting mechanism. Doctors could use clottocytes to treat hemophiliacs or patients with serious open wounds.

6) PARASITE REMOVAL : Nanorobots could wage micro-war on bacteria and small parasitic organisms inside a patient. It might take several nanorobots working together to destroy all the parasites.



III. NANOTECHNOLOGY IN MEDICINE FIELD

For centuries, man has searched for miracle cures to end suffering caused by disease and injury. Many researchers believe nanotechnology applications in medicine may be mankind's first "giant sleep" towards this goal. According to Robert A. Frietas nanomedicine is

1)The comprehensive monitoring , control, construction, repair, defense and improvement of all human biological systems, working from the molecular level, using engineered nano devices and nanostructures.
2) The science and technology if diagnosing, treating , and preventing disease and traumatic injury of relieving pain and of preserving and improving human health using molecular tools and molecular knowledge of the human body.
3) The employment of the molecular machine systems to address medical problems using molecules knowledge to maintain and improve human health at the molecular scale.
Nanotechnology in healthcare is not only has the potential to change medical science dramatically and as a part of beneficial nanotechnology in developing countries , but to open a new field of human enhancements that is poised to add a profound and complex set of ethical questions for health care professionals.

For instance, there is a fine line between medical and non medical uses of non technology for diagnostic, therapeutic and preventive purposes (e.g. non medical implants in soldiers). The question of whether nanotechnology should be used to make intentional changes in or to the body when the

changes is not medically necessary is just one hot topic in a long list of concerns.

IV. NANOMEDICINE THERAPY

In terms of therapy, the most significant impact of nanomedicine is expected to be realized in drug delivery and regenerative medicine. Nanoparticles enable physicians to target drugs at the source of the disease, which increases efficiency and minimizes side effects. They also offer new possibilities for the controlled release of therapeutic substances. Nanoparticles are also used to stimulate the body's innate repair mechanisms. A major focus of this research is artificial activation and control of adult stem cells. Peptide amphiphiles that support cell growth to treat spinal cord injury; magnetic nanoparticles and enzyme-sensitive nanoparticle coatings that target brain tumors; smart nanoparticle probes for intracellular drug delivery and gene expression imaging, and quantum dots that detect and human breast cancer biomarkers are just a few of the advance researchers have alreadymade.

Nanomedicine is the medical application of nanotechnology, it ranges from the medical applications of nanomaterials to nano electronic biosensors, and applications of molecular, it is reversing and improving the human health by using molecular tools and molecular knowledge of the human body. Nanomedicine involves the use of nanoparticles in the surgical and medical treatment of patients, and it is used for the treatment of diseases in living organism.

Nanotechnology involves manipulating properties and structures at the nano scale. It often involves dimensions that are just tiny fractions of the width of a human hair.

Nanotechnology has been used in the early diagnosis of atherosclerosis, or the buildup of plaque in arteries and gold nanoparticles can be used to detect early stage Alzheimer's disease.

V. ABOUT MEDICAL NANOBOTS

Nanotechnology involves manipulating properties and structures at the nano scale often involving dimensions that are just tiny fractions of width of a human hair. Nanotechnology medical developments over the coming years will have a wide variety of uses and could potentially save a great number of lives. Nanotechnology is already moving from being used in passive structures to active structures through more targeted drug therapies. These predictions for the future have great significance not only by encouraging nanotechnology research and development but also in determining a means of oversight. Adrianocavalcanti is the inventor as well as founder of nanobots.

ABOUT ECOLI BACTERIA: It is a rod shaped bacteria which is commonly found in warm blooded animals. It is an infection caused by contaminated food or water. It plays a vital role in current biological engineering. Some of them are harmless but some produce toxins that can cause many infections.

VI. ADVANTAGES OF NANOBOTS

Nanotechnology can also benefit energy sector. The development of more effective energy-producing, energy-absorbing and energy storage products in smaller and more efficient devices is possible with this technology. Such items like batteries, fuel cells and solar cells can be built smaller but can be made to be more effective with this technology.

Another industry that can benefit from nanotechnology is the manufacturing sector that will need materials like nano tubes, aerogels, nano particles, and other similar items to produce their products with. These materials are often stronger, more durable and lighter than those that are not produced with the help of nanotechnology.

In the medical world, nanotechnology is also seen as a boon since these can help with creating what is called "smart drug". These help cure people faster and without the side effects that other traditional drugs have. You will also find that the research of nanotechnology in medicine is now focusing on areas like tissue regeneration, bone repair, immunity and even cures for such ailments like cancer, diabetes and other life threatening diseases.

MANUFACTURING ADVANTAGES

Nanotechnology is already making new materials available that could revolutionize many areas of manufacturing. For example, nano tubes and nano particles which are tubes and particles only a few atoms across and aerogels materials composed of very light and strong materials with remarkable insulating properties, could pave the way for new techniques and superior products. In addition, robots that are only a few nanometers in length, called nanobots and nanofactories could help construct novel materials and objects.

ENERGY ADVANTAGES

Nanotechnology may transform the ways in which we obtain and use energy. In particular, its likely that nanotechnology will make solar power more economical by

reducing the cost of constructing solar panels and related equipment. Energy storage devices will become more efficient as a result. Nanotechnology will also open up new methods of generating and storing energy.

ADVANTAGES IN ELECTRONICS AND COMPUTING

The field of electronics is set to be revolutionized by nanotechnology. Quantum dots, for example, are tiny light producing cells that could be used for illumination or for purposes such as display screens. Silicon chips can already contain millions of components but the technology is reaching its limit at a certain point, circuits become so small that if a molecule is out of place the circuit won't work properly. Nanotechnology will allow circuits to be constructed very accurately on an atomic level.

MEDICAL ADVANTAGES

Nanotechnology has the potential to bring major advances in medicine. Nanobots could be sent into a patient's arteries to clear away blockages. Surgeries could become much faster and more accurate. Injuries could be repaired cell by cell. It may even become possible to heal genetic conditions by fixing the damaged genes. Nanotechnology could also be used to refine drug production, tailoring drugs at a molecular level to make them more effective and reduce side effects.

ENVIRONMENTAL EFFECTS

Some of the more extravagant negative future scenarios have been debunked by experts in nanotechnology. For example: the so called "gray goo" scenario, where self replicating nanobots consume everything around them to make copies of themselves, was once widely discussed but is no longer considered to be a credible threat. It is possible, however, that there will be some negative effects on the environment as potential new toxins and pollutants may be created by nanotechnology.

VII. DISADVANTAGES OF NANOBOTS

1) The disadvantage of this science and its development is the possible loss of jobs in the traditional framing and manufacturing industry.
2) The development of nanotechnology can also bring about the crash of certain markets due to the lowering of the value of oil and diamonds due to the possibility of developing alternative sources of energy that are more efficient. This can also mean that since people can now develop products at the molecular level, diamonds will also lose its value since it can now be a mass produced.
3) Atomic weapons can now be more accessible and made to be more powerful and more destructive. These can also become more accessible with nanotechnology.
4) Since these particles are very small, problems can actually arise from the inhalation of these minute particles, much like the problems a person gets from inhaling minute asbestos particles.
5) Presently, nanotechnology is very expensive and developing as it can cost you a lot of money. It is also pretty difficult to manufacture which is probably why products made with nanotechnology are more expensive.

VIII. APPLICATIONS OF NANOBOTS

NANOROBOTICS IN SURGERY

Surgical nanorobots are introduced into the human body through vascular systems and other cavities. Surgical nanorobots act as semi autonomous on site surgeon inside the human body and are programmed or directed by a human surgeon. This programmed surgical nanorobot performs various functions like searching for pathogens and then diagnosis and correction of lesions by nano manipulation synchronized by an on – board computer while conserving and contacting with the supervisory surgeon through coded ultrasound signals.

DIAGNOSIS AND TESTING

Medical nanorobots are used for the purpose of diagnosis, testing and monitoring of microorganisms, tissues and cells in the blood stream. These nanorobots are capable of noting down the record and report some vital signs such as temperature, pressure and immune system's parameters of different parts of the human body continuously.

NANOROBOTICS IN GENE THERAPY

Nanorobots are also applicable in treating genetic diseases, by relating the molecular structures of DNA and proteins in the cell. The modifications and irregularities in the DNA and protein sequences are then corrected. The chromosomal replacement therapy is very efficient compared to the cell repair. An assembled repair vessel is inbuilt in the human body to perform the maintenance of genetics by floating inside the nucleus of a cell.

Nanodentistry is one of the topmost applications as nanorobots help in different processes involved in dentistry. These nanorobots are helpful in desensitizing tooth, oral

anesthesia, straightening of irregular set of teeth and improvement of the teeth durability, major tooth repairs and improvement of appearance of teeth.

Nanorobots can also be used as ancillary devices for processing different chemical reactions in the affected organs. These robots are also useful for monitoring and controlling the glucose levels in diabetic patients.

IX. VARIOUS IMPACTS OF NANOROBOTS IN MEDICAL FIELD

VARIOUS APPROACHES TO DEVELOP NANOBOTS INCLUDE:

1. DNA – directed assembly using part of DNA for assembling which works on the self assembly principle of complementary base pairing and has application in the DNA based rotary motors.
2. Protein – directed assembly as seen in genetically engineered chaperon proteins that help in the assembly of gold particles and semiconductor quantum dots into arrays in the self directed assembly as seen in the self assembled monolayers, self assembled Nano scale range. Ratchet action protein based molecular motors have also found much application in biology.
3. Microbes and virus directed assembly, which includes various bacteria that are incorporated into microelectrochemical systems (MEMS) and helps in acting as living motors, pumps etc. Viral capsid shells have also found application in acting as scaffolds for the assembly of the nanoparticles such as quantum dots.

X. WAYS OF TRACKING AND CONTROLLING NANOBOTS IN THE BODIES:

1) Tracking and controlling nanobots include such means us: Ultrasound, MMR/MRI, Radioactive dye, x-rays using special chemicals, spectroscope, TV cameras.
2) Nanobots are going to play a very important role in the future especially in the medical field. They can even start a revolution in medicine. However, there are some disadvantages which accompany the use of nanorobots. The complexity of the design and manufacture accompanied by high cost , is a major drawback for the wide application of nanorobots. The other disadvantages are the possible anti-social applications that accompany every new discovery in science.
3) In spite of the drawbacks, the application of molecular nanotechnology may help in the development of therapeutics for different fatal diseases in the future, thus creating a revolution in healthcare and prolongation of life.

XI. CONCLUSION

Yet, the theoretical and applied research to turn them into reality is progressing rapidly. Nanotechnology will change dentistry, health care and human life more profoundly than many development of the past. As with all technologies , nanotechnology carries a significant potential for misuse and abuse on a scale and scope never seen before. However, they also have potential to bring about significant benefits, such as improved health, better use of natural resources and reduced environmental pollution. These truly days are the days of miracle and wonder.

Current work is focused on the recent developments particularly of nanoparticles and nano tubes for the periodontal management, the materials developed from such as the hollow nano spheres, core shell structures, nanocomposites and nanomembrane will play a growing vital role in materials development for the dental industry.

REFERENCES

[1] https://www.sciencedaily.com/terms/nanorobotics.htm
[2] https://electronics.howstuffworks.com/nanorobot6.htm
[3] https://www.journals.elsevier.com/artificial-intelligence/most-downloaded-articles
[4] http://triotree.com/blog/nanorobots-introduction-and-its-medical-applications/
[5] http://www.irjcs.com/volumes/vol4/iss10/03.OCCS10083.pdf
[6] https://www.express.co.uk/news/science/967564/Nanotechnology-medicine-nanobots-research-fight-disease-superbug-bacteria-pathogens