IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

NANOROBOTICS IN MEDICAL SCIENCES

A.LAVANYA [1], J SWAPNA SUVARNA *, P.TEJASWINI, D.DHANALAKSHMI, S.HAZIMUNNISA [2], Dr. M.KISHORE BABU [3]

1.Associate professor, Department of Pharmaceutics, Krishna Teja pharmacy college, Chadalawada nagar, Renigunta road, Tirupati. India

2.Students of Bachelor of pharmacy, Krishna Teja pharmacy college, Chadalawada Nagar, Renigunta road, Tirupati. Andhra Pradesh -517501, India.

3. Principal of Krishna Teja pharmacy college, Chadalawada nagar, Renigunta road, Tirupati. India

ABSTRACT:

Nanorobotics are the carriers of novel drug delivery system. Nanorobotics is the study of robotics at nanometer scale including robots that are nano in size. The word nano originates from the Greek word which means “dwarf”. These are the devices that are used for protecting or treatment against the pathogens in humans. Nanorobots size varying in between 0.1-10micrometer.It can be visualised in the 3D. Nanomedicines offers the prospect of powerful new tools for treatment of human diseases. It offers the number of advantages in the Drug delivery system. Carbon is the principal element in the Nanorobots other than carbon nitrogen, sulphur, oxygen, hydrogen, fluorine are used in the nanoscale gears. There are three types of Nanorobots: helices, nanorods and DNA Nanorobots. Nanorobots help to expand the life span. The various components in Nanorobot include power supply, fuel buffer tank, sensors, motors, manipulators, onboard computers, pumps, pressure tanks, and structural support. Nanorobots are used in the treatment of cancer, multi surgeries, diabetic monitoring etc. It is the quicker treatment and cheaper. It is already a multibillion dollar business.

KEYWORDS:

Nanorobotics, Dwarf, Nanobots, Nanoids, Nanites, Nanomites, Respirocytenanorobots, Microbivorsum nanorobots, Nanomedicines.

INTRODUCTION:

Nanorobotics are advanced technology in medicine used for diagnose, treatment of diseases. Nanorobotics are the devices used for the identification of disease inside the body. It is the technology of creating machines or robots close to the microscopic scale of a nanometer. These devices are ranging from 0.1-10 micrometer. These are made up of molecular components. It is a pretending concept.

The word nano originates from the Greek word “dwarf”. The concept of nanotechnology was first elaborated in 1959 by RICHARD FEYNMAN. He was a Nobel Prize winner. He won the prize in preparation for a Lecture titled “There’s plenty of room at the bottom”. Finally he ended that lecture concluding “this is a development which I think cannot be avoided”. The term nanotechnology was coined by a student at a Tokyo science University in 1974.[4]

Nanotechnological is the study, design, creation, synthesis manipulation and application of materials, devices, and systems at the nanometer scale (one meter consists of 1 billion nanometers). Nanotechnology can best be defined as a description of activities at the level of atoms and molecules that have applications in the real world. A nanometer is a billionth of a meter, that is, about 1/80,000 th of the diameter of a human hair, or 10 times the diameter of a hydrogen atom.[4,19] Nanotechnological is a part of applied science those theme is to control the matter on atomic and molecular scale. It is becoming increasingly important in fields like engineering, agriculture, construction, microelectronics and health care to mention a few. The application of nanotechnological in the field of health care has come under great attention in recent times. There are many treatments today that take a lot of time and are also very expensive. Using micro-technology, quicker and much cheaper treatments can be developed.

Fig: NANOROBOTS IN BLOOD CELLS

Nanorobots are expected to work at atomic, molecular and cellular levels to perform tasks in both medical and industrial fields. According to nanorobotic theory, "nanorobots are microscopic in size, it would probably be necessary for very large numbers of them to work together to perform microscopic and macroscopic tasks".

Advances in the areas of robotics, nanostructuring medicine, bioinformatics, and computers can lead to the development of nanorobot drug delivery systems. Some examples of nanorobots are respirocytenanorobots, microbivorsum nanorobots, surgical nanorobots and cellular repair nanorobots. Nanorobots will be used for maintaining and protecting the human body against pathogens. They will have a diameter of about 0.5 – 3 micrometers and will be considered out of parts with dimensions in the range of 1-100 nm. The main element used by nanorobots is carbon because of its inertness and strength in the form of diamond and fullerene. Nanorobots have exterior passive diamond coating especially to avoid attack by the host immune system. They are invisible to our naked eye, which make them hard to manipulate and work with.

Nanorobots presented works that summarize distinct aspects of some techniques required to achieve successful integrated system design and 3D simulation visualization in real time. The names for the hypothetical devices of nanorobots are nanobots, nanoids, nanites, or nanomites.

TYPES OF NANOROBOTS

Pharmacyte: It is a medical nanorobot having a size of 1-2 µm able to carry up to 1 µm 3 a given drug in the tanks. They are controlled using mechanical systems for sorting pumps.

Diagnosis and Imaging: They have microchips that are overlaid with human molecules. The chip is projected to send an electrical signal when the molecules detect a disease.

Respirocyte: It is an Artificial Oxygen Carrier nanorobot which is about an artificial red blood cell. The power is obtained by endogenous serum glucose.

Microbivores: It is an oblate spheroidal device for nanomedical applications with 3.4 µm in diameter along its major axis and 2.0 µm in diameter along its minor axis.

The microbivore consists of 4 fundamental components:

i. An array of reversible binding sites.

ii. An array of telescoping grapples.

iii. A morcellation chamber.

Clottocytes: This is a type of nanorobot, with a unique biological capability: "instant" haemostasis using clottocytes, or artificial mechanical platelets. It is known that platelets are roughly spheroidal nucleus-free blood cells measuring approximately 2 µm in diameter.

Chromallocyte: The Chromallocyte would replace entire chromosomes in individual cells thus reversing the effects of genetic disease and other accumulated damage to our genes, preventing aging.

 # the overview outlines three main types of nanorobots

Helices: A number of Robots with screw – like helix tails for movement have been developed, often resembling bacterial flagella or other biological entities. Most of them are rather to be categorised as micro-sized robots, including the above mentioned MagnetoSperm and the MOFBOTS.

Nanorods: The nanods typically consists of cylindrical rods with different metal segments, although different shapes are also used for the same purpose. A particular notable example from a medical point of view is the 250 nm wide and 1800 nm long rod with gold – nickel – gold segments developed by GarciaGradilla et al.

DNA Nanorobots: DNA nanorobots consist of deoxyribonucleic acid molecules, thus using DNA as construction material for nano-sized devices. Sometimes, they are based on DNA origami, where DNA molecules are folded to create patterns and shapes.

WORKING OF NANOROBOT:

Nanorobots will be able to treat a host of diseases and conditions. While their size means they can only carry very small payloads of medicine or equipment, many doctors and engineers believe the precise application of these tools will be more effective than more traditional methods. For example, a doctor might deliver a powerful antibiotic to a patient through a syringe to help his immune system. The antibiotic becomes diluted while it travels through the patient's bloodstream, causing only some of it to make it to the point of infection. However, a nanorobot – or team of nanorobots – could travel to the point of infection directly and deliver a small dose of medication. The patient would potentially suffer fewer side effects from the medication.

NANOROBOT NAVIGATION:

There are three main considerations scientists need to focus on when looking at nanorobots moving through the body: navigation, power and how the nanorobot will move through blood vessels. Most options can be divided into one of two categories: external systems and onboard systems.

External navigation systems might use a variety of different methods to pilot the nanorobot to the right location. One of these methods is to use ultrasonic signals to detect the nanorobot's location and direct it to the right destination.

Doctors would beam ultrasonic signals into the patient's body. The signals would either pass through the body, reflect back to the source of the signals, or both. The nanorobots could emit pulses of ultrasonic signals, which doctors could use with special equipment with ultrasonic sensors. Doctors could keep track of the nanorobots location and maneuver it to the right part of the patient's body. Doctors might also track nanorobots by injecting a radioactive dye into the patient's bloodstream. They would then use a fluoroscope or similar device to detect the radioactive dye as it moves through the circulatory system. Complex three-dimensional images would indicate where the nanorobot is located. Alternatively, the nanorobot could emit the radioactive dye, creating a pathway behind it as it moves through the body. Other methods of detecting the nanorobot include using x-rays, radio waves, microwaves or heat. Right now, our technology using these methods on nano-sized objects is limited, so it's much more likely that future systems will rely more on other methods.

Onboard systems, or Internal sensors, might also play a large role in navigation. A nanorobot with chemical sensors could detect and follow the trial of specific chemicals to reach the right location. A spectroscopic sensor would allow the nanorobot to take samples of surrounding tissue, analyze them and follow a path of the right combination of chemicals.

COMPONENTS OF NANOROBOTS:

1. **PAYLOAD**: A small dose of drug or medicine is stored in this void section. The nanorobots could travel through the bloodstream and deliver the drug to the infection or injury site.
2. **POWER SUPPLY**: supplier of energy for the device operation and function.
3. **SWIMMING TAIL**: Because nanaorobots travel against the blood flow in the body, they will require a means of propulsion to enter the body.
4. **MICROCAMERA**: A miniature camera could be included in the nanorobot. When manually navigating through the body, the operator can steer the nanorobo**t.**
5. **LASERS**: These lasers could burn harmful materials like arterial plaque, blood clots, or cancer cells.
6. **ULTRASONIC SIGNAL GENERATORS**: These generators are used when the nanorobots target and destroy kidney stones.
7. **SENSORS**: Sensors are one of the most important parts in nanobots. Mechanical, thermal, optical, magnetic, chemical and biological sensors have been tested in nanobots applications. Any sensor that uses a nanoscale phenomenon for its operation is classified as a nanosensor. On the organic part, biosensors utilize biological reactions for detecting target analytes, and considering the need to accomplish the target treatments goals of nanobots in medicine, this type of sensors are the most evident devices to explore in the field of nanorobotics.

METHODS OF PREPARATION / MANUFACTURING APPROACHES

BIOCHIP: The joint use of nanoelectronics, photolithography, and new biomaterials provides a possible approach to manufacturing nanorobots for common medical uses, such as surgical instrumentation, diagnosis, and drug delivery.

NUBOTS: A nucleic acid robot (nubot) is an organic molecular machine at the nanoscale. DNA structure can provide means to assemble 2D and 3D nanomechanical devices. DNA based machines can be activated using small molecules, proteins and other molecules of DNA. Biological circuit gates based on DNA materials have been engineered as molecular machines to allow in-vitro drug delivery for targeted health problems.

POSITIONAL NANOASSEMBLY: Nanofactory Collaboration, founded by Robert Freitas and Ralph Merkle in 2000 and involving 23 researchers from 10 organizations and 4 countries, focuses on developing a practical research agenda specifically aimed at developing positionally-controlled diamond mechanosynthesis and a diamondoid nanofactory that would have the capability of building diamondoid medical nanorobots.

BIOHYBRIDS: The emerging field of bio-hybrid systems combines biological and synthetic structural elements for biomedical or robotic applications. The constituting elements of bio-nanoelectromechanical systems (BioNEMS) are of nanoscale size, for example DNA, proteins or nanostructured mechanical parts. Thiolene e-beams resist allow the direct writing of nanoscale features, followed by the functionalization of the natively reactive resist surface with biomolecules. Other approaches use a biodegradable material attached to magnetic particles that allow them to be guided around the body.

BACTERIA-BASED: This approach proposes the use of biological microorganisms, like the bacterium *Escherichia coli* and *Salmonella typhimurium*. Thus the model uses a flagellum for propulsion purposes. Electromagnetic fields normally control the motion of this kind of biological integrated device. Chemists at the University of Nebraska have created a humidity gauge by fusing a bacterium to a silicon computer chip.

VIRUS-BASED: Retroviruses can be retrained to attach to cells and replace DNA. They go through a process called reverse transcription to deliver genetic packaging in a vector. Usually, these devices are Pol – Gag genes of the virus for the Capsid and Delivery system. This process is called retroviral gene therapy, having the ability to re-engineer cellular DNA by usage of viral vectors. This approach has appeared in the form of retroviral, adenoviral, and lentiviral gene delivery systems. These gene therapy vectors have been used in cats to send genes into the genetically modified organism (GMO), causing it to display the trait.

NANOROBOT APPLICATIONS:

1. 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 surgeons 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 the supervisory surgeon through coded ultrasound signals.

2. NANOROBOTICS IN GENE THERAPY:

Nanorobots are also applicable in treating genetic diseases, by relating the molecular structures of DNA and proteins in the cell.

3. NANOROBOTICS IN ONCOLOGY:

The current stages of medical technologies and therapy tools are used for the successful treatment of cancer. The important aspect to achieve a successful treatment is based on the improvement of efficient drug delivery to decrease the side-effects from the chemotherapy.

4. NANOROBOTICS IN DENTAL:

Nanodentistry is one of the topmost applications as nanorobots help in different processes involved in dentistry. These nanorobots are helpful in desensitizing teeth, oral anesthesia, straightening of irregular set of teeth and improvement of the teeth's durability, major tooth repairs and improvement of the appearance of teeth, etc.

5. NANOROBOTS IN KIDNEY DISEASE:

Nanorobots are used to break the kidney stones with the help of ultrasonic shocks. Kidney stones are painful and large stones doesn't pass out in urine. Sometimes doctors can break these stones by ultrasonic frequency but these are not always effective. Nanorobots break up these kidney stones by using a small laser and these smaller pieces are passing out the urine outside the body.

6. NANOROBOTS IN SKIN DISEASES:

To cure skin diseases, a cream containing nanorobots may be used. It could remove the right amount of dead skin, remove excess oils, add missing oils, apply the right amount of natural moisturizing compounds and even achieve the elusive goal of 'deep pore cleaning ' by actually reaching down into pores and cleaning them out.

7. NANOROBOTS IN 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 one of the most dangerous uses for nanorobots the robot must be able to remove the blockage without losing small pieces in the bloodstream, which many doctors and engineers believe the precise application of these tools will be more effective treatment method.

8. NANOROBOTS IN NERVE REGENERATION:

The application of nanorobots is in the treatment of injured nerves. Scientists are working on it, and in the near future it will be an effective tool to cure spinal injuries, neurons etc.

CONCLUSION:

From the above topic we conclude that NANOROBOTICS is one of the emerging fields in science and technology. Nanorobotics are the advanced technologies used in the treatment of various types of diseases. Nanorobots are typically devices constructed of nanoscale or molecular components. Nanorobot is not only the safest but also faster and better technique to remove the plaque deposited on the internal walls of arteries. This is also an efficient method to remove these hard plaques without any surgical procedure involved. In future several advanced technologies should be made from these nanorobotics.

REFERENCE:

1] Deepa R Parmar, Julee P Soni, Dhrubo Jyoti sen, Apexa Patel; Nanorobotics in advances in pharmaceutical sciences; 10 June 2010; ISSN: 0975-9344;ijddr.com

2] Apeksha P Avakale, Shubham M Sanap; A Review on Application of Nanotechnology in pharmaceuticals; 24 september,2021;e-ISSN: 2320-1215,e-ISSN: 2322-0112.

3] Yamaan saadeh B.S.Dinesh Vyas M.D.; Nanorobotic application in medicine: current proposals and designs; 8 September, 2015; Am J Robot surg.2014 Jun; 1(1):4-11.

4] Sarath kumar S, Beena P Nasin, Elessy Abraham; Nanorobots a future device for diagnosis and treatment: 5 August, 2018; ISSN: 2277-7105; 10.15436/2377-1313.18.1

5] Sakshi Sethi M, Nanorobotic Technology in the Medical Industry.2015; IJEECS 4(5): 46-50.

6] Abhilash m. :International journal of Pharma and Biosciences 1(1): 1-10.

7] Nandkishor K., Swapnil P., Rajeswar K; et al Review on application of nanorobotic in health care 2014; 3(5): 472-480.

8] M.Sivasankar, RB Durairaj; Brief review on nanorobots in Biomedical applications 27 February, 2012; ISSN: 2168-9695; 1000101.2.27.

9] Fisher B, Biological Research in the evolution of cancer surgery 2008; 68(24): 10007-10020; 10.1158/0008-5472.

10] Ved Prakash Upadhyay, Mayank Sonawat; A Review on nanorobots in medicine, 2017; ISSN: 2454-1907; IJETMR: 4.12.2017

11] Sorna Mugi Viswanathan, Anitha S, Revanth rajan; Nanobots in Medical field: A Critical overview; 11 December, 2019; ISSN: 2278-0181; IJERTV8ISI20023.

12] Rajat Singh, Pankaj kumar, Lokesh Chaudhary; Nanorobotics: A novel and conceptual techniques for drug delivery system and its applications in pharmaceuticals; 25 July, 2021; ISSN: 2277-7105; singh et al. vol 10 issue 10, 2021.

13] Aggarwal M, Kumar S; The use of nanorobotics in the treatment therapy of cancer and its future aspects; 20 September, 2022; 10.7759/cureus.29366.

14] Aruntapan Dash, Preetam chandan; Nanorobotics - A Review; December, 2013; AICTE Sponsored National Conference on Modern trends.

15] Dr. V. Sujatha, Dr. Malathi Suresh, Dr. S. Mahalaxmi; Nanorobotics-a futuristic approach; January 2011; 86-90; 10.12691/bse-2-2-3.

16] C.B.P.Devi, P.Harika and K.Vijay; Nanorobotics: Futuristic Approach in Medicine; 1 May 2021; ISSN: 2548-2558; 10.13040/IJPSR.0975-8232.12 (5).2548-58.

17] Feynman R.P.; There is plenty of room at the bottom Engineering and science; February, 1966; ISSN: 0013-7812; 23(5) PP 22-36

18] Nanorobotics wikipedia - free encyclopedia

19] Shiva kumar H.D, Ramakumar ishwar naik, S.B. Halesh; Nanorobots scope in the medical field; 6 June, 2021.

20] Sudakar J, Shweta M Nirmanik; Nanorobotics in medical field; 6 July, 2022; ISSN: 2321-9635; IJRASET45385.

21] Richard Arvidsson, Steffen Foss Hansen; Environmental and health risks of nanorobots: an early review 27 August, 2020; ISSN: 2875-2886; 10.1039/D0EN00570.

22] Nanorobots wikipedia, en.m.wikipedia.org.

23] Awadesh Arya, Lalit kumar,Deepa B Pokharia, Kamlakar Tripati; Applications of nanotechnology in diabetes; 25 october,2008 ; Digest journal of nanomaterials and biostructures volume 3, no. 4 December 2008, p.221-225.

24] Sujayita Mazumder, Gopa Roy Biswas; Applications of nanorobotics in medical techniques; 2020; ISSN: 0975-8232, 2320-5148; IPSR, 2020; VOLUME.11(7) 3150-3159

25]Jonathan Strickland; How nanorobots will work; www.electronics.howstuffworks.com/nanorobot.htm

26] Saiana. M; https://electricalfundablog.com/nanorobots-component-application/

27] Editorial; 9 January, 2022

https://roboticsbiz.com/nanorobots-key-components-and-substructures/?amp=1

28] Apoorva Manjunath, Vijay Kishore; The Promising Future in Medicine: Nanorobots; 25 May, 2014; Biomedical science and engineering, 2014 2(2), pp 42-47; 10.12691/bse-2-2-3.

29] https://en.m.wikipedia.org/wiki/Nanorobotics.

30] April2013; https://www.elprocus.com/nanorobots-and-its-application-in-medicine/

31] Dr. Mehra P, Dr.Nabhi K.A. Nanorobotics. ; The Changing Face of Dentistry". March 2016; ISSN: 2319-7064; IJSR 5(3), 192-197.

32] Prabhjot Kaur, Loveleenpreetkaur and MU. Khan. ; Nanoparticles as a Novel Drug Delivery system: A Review; ISSN: 2231-2781; IJRPC [International Journal of Research in Pharmacy and Chemistry]; 756-761.

33] Abhilash M; Nanorobots; 2010; International Journal of Pharma and Biosciences; V1 (1) 1-10.

34] Yendry Regina corrales urena, Stephanie Vargas chacon; Nanorobots development and future; 23 May, 2017; e-ISSN: 2573-2838; 2017; 2(5):146-151.