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MICROBIVORES – A NANOROBOT

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ABSTRACT

Nanomedicine provides the promise of powerful new technologies to treat human diseases and expand the use of molecular nanotechnology to improve human biological systems. The microbivore is an oblate spheroidal nano medic tool measuring 3.4 microns in diameter along its main axis and 2.0 microns in diameter along its minor axis, consisting of 610 billion correctly arranged structural atoms in a gross geometric volume of 12.1 microns3. Microbivores are up to around 1000 times faster than either natural or antibiotic-assisted biological phagocytic defenses and are ~80 times more effective as phagocytic agents than macrophages in terms of digested volume / sec per unit phagocytic agent number.

INTRODUCTION

The most promising technology of the 21st Century is nanotechnology. Nanotechnology is a collective term that refers to nanometer-sized technical developments, usually 0.1-100 nm. The term 'nanotechnology' usually refers to the size of molecular or nanometer-length research and manufacturing.The word "nano" originates from "dwarf" in Greek. Richard Feynman, a Nobel Prize winning physicist, first developed the idea of nanotechnology in 1959 in a lecture entitled "There is plenty of space at the bottom" He ended the lecture, "this is a trend that I don't think can be stopped."Nanotechnology is the research, design, development, synthesis, manipulation, and application of nanometer-scale materials, tools, and systems (one meter is 1 billion nanometers). Nanotechnology can best be described as a description of atom-and molecular-level activities that have real-world applications.

NANOROBOTS: Nanorobots are the nanodevices which are used in humans to shield or handle pathogens. This is a tiny device designed to perform a specific task or tasks at nanoscale dimensions of 1-100 nm with precision at times. They are expected to work in both medical and industrial fields at the chemical, molecular and cellular levels.Due to its inertness and strength in the fo rm of diamond and fullerene, theprincipal elem ent used by Nanorobots is carbon. Nanorobots have passive diamond coating on the outside pa rticularly to avoid attack by the host immune sy stem. They are invisible to our naked eye, making them difficult to control and to deal with. Techniques such as Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM) are used to create a visual and haptic interface that allows us to experience the molecular structure of these nano-scaled instruments.

Nanorobot Types: Some researchers classify n anorobots according to their applications in dru g delivery and therapy, as mentioned below, Pharmacyte, Respirocytes, and Microbivores

PHARMACYTE: It is a medical nanorobot with a scale of 1-2 μm that can hold up to 1 μm 3 in the tanks a given product. They are managed with the use of mechanical pump sorting systems. They are equipped with molecular markers or chemotactic sensors which ensure complete accuracy of the targeting.The onboard power supply is the glucose and oxygen derived from local environments such as blood, intestinal fluid, and cytosol. They can be extracted or recuperated by centrifuge nanapheresis after the nanorobot has completed tasks.

RESPIROCYTES: It is a nanorobot of the Artificial Oxygen Carrier, about an artificial red blood cell. Endogenous serum glucose gets the strength. This artificial cell is capable of providing tissues 236 times more oxygen per unit volume than RBCs (red blood cells) and producing acidity.

MICROBIVORES:

It is desirable for all cells within a give n tissue or organ that possessed a specific featu re (e.g., all cancer cells or all bacterial cells of a certain type, etc.) to be targetable.This ideal v ehicle would be biocompatible and nearly 100 percent reliable, with all drug molecules delivered exclusively to the targeted target cells and none delivered elsewhere to avoid the unw anted side effects.Let's call this perfect drug delivery vehicle a hypothetical "MICROBIVORE." Microbivores are self-propelled, computer-controlled Nano robotic systems capable of digitally accurate transport; timing and targeted delivery of pharmaceutical agents to different cellular and intracellular destinations within the human body.

Why are we using the microbivores?

Microbivores could be produced as artificial white blood cells or-Nanorobotic phagocytes used to patrol the bloodstream, looking for and digesting harmful pathogens like bacteria, viruses or fungi.During each cycle of nanorobot operation, a target bacterium becomes bound, through species-specific reversible binding sites, to the blood borne microbivore like a fly on flypaper.Regardless of whether a bacterium has developed multiple drug resistance to antibiotics or any other conventional therapy, microbivores will eat it anyway, achieving full clearance of even the most serious bloodborne infections in minutes to hours, rather than weeks to months using current antibiotics, using just a few ccs of nanorobots.Hence microbivores would be up to ~1000 times faster than natural cells, every 2-3 microns in size.

Microbivore Needs: The above analysis indicates that current therapies for many septicemic agents that require large quantities of medicines that can be applied over a long period of time;often only achieve incomplete eradication, or pure arrest of the pathogen for development.A nanorobotic system that can safely provide rapid and complete eradication of bloodborne pathogens using relatively low doses would be welcome in addition to the armamentarium of the doctor.Designed to treat septicemia, microbivores would be a type of medical nanorobots, made up of a diamond arrangement of atoms that attack harmful pathogens with the blood stream. Such nanorobots are estimated to be 100 times faster and 80 times more efficient than the normal phagocytes of the body, and can be applied to a variety of medical practices.The microbivores are made up of four main functional groups, a reversible binding site, grapple telescoping, chamber of morcellation and chamber of digestion. The reversing binding sites use nanorobot ligand receptors to classify a bacteria based on the contents of their cell membrane, or other characteristic materials.When identified, telescopic grapples would move the bacteria or viruses into the morcellation chamber where the pathogen could be cut in for enzymatic digestion into digestible pieces. Harmless waste materials would be released into the bloodstream and through nanapheresis the microbivores would drain out of the blood.

Working with microbivores: The main activity guiding the scale and design of microbivores is the process of digestion of organic substances which is also very close to

digestive foods. The digestive microbivore system has four main components:

1. A number of initially binding reversible binding sites.
2. Trap target microbes; once caught, an arra y of telescoping grapples fo r handling the microbe.
3. A chamber of morcellation in which a micr obe is pounded into a small piece which is easily digested.
   3. A digestion chamber where chemical di gestion of the small pieces takes place.

Here's how the nanorobot operates. During eac h operating cycle, the target bacterium is bound by species specific reversible binding sites to the surface o f microbivores, like a fly on flypaper.Such nanorobots will consist of 4 main components: reversible binding site, grapples for telescoping, chamber for morcellation and chamber for digestion. All microbial pathogens' bacterial membrane contains atleast one distinguishing characteristic unique to the species, whether it is a carbohydrate chain, surface protein, or amino acid.A reversible binding site (for a microbivore to attach more than once to pathogens) on the outside of the microbivore enables the nanorobot to recognise and bind to pathogens. This method of targeted nanomedicine delivery prevents the destruction of useful bacteria, and can be highly costumed, depending on the number of reversible binding sites ligand receptors.Telescopic grapples, attached to the o utside of the microbivores, would also be fitted with binding sites and would help move pathog en towards the ingestion port and into the morc ellation chamber, using diamond (resembling a thick, crystalline diamond or sapphire structure, usually made up of C-H bonds).The morcellate would then be passed to the digestive chamber, a mixture of peptidases and other enzymes would break down the pathogen into amino acids, simple sugars, and mononucleotides that would be released harmlessly back into the bloodstream.Microbivores would be extracted after treatment by means of nanophases, a method in which blood is cycled through an apparatus to extract nanorobots and transfer blood back into the body.

3. CHALLENGES:

- Microbivores are capable of being captured by phagocytic cells because they are foreign particles. This may cause it to undergo phagocytosis. Use of phagocyte engulfment inhibitors should overcome this.
- The flagella bacteria should be carefully internalized. Otherwise the flagella could be left in the blood. These are antigenic flagels and could causeallergic reaction.
- The engineered enzymes in the microbivore may be partly degraded after they may be expelled into the bloodstream. They can display immunogenic, inflammatory, and any other harmful activity after entering bloodstream. The microbivorous enzymes should be designed to enable the natural enzymes present inside the body to digest them.

IDEAL CHARACTERISTICS OF MICROBIVORES:

- 0.5 to 3 microns in size with 1-100 nm parts for each nanorobots.
- Capillary flow will be blocked by microbivores of greater size than the above.
- This protects itself from being attacked by the immune system with a passive external diamond.

ADVANTAGES:

- Application of drug delivery systems for microbivores with increased bioavailability.
- Targeted therapy such as treatment of only malignant cells; · Reach remote areas of human anatomy that cannot be operated at the operating table of the surgeon.
- As drug molecules are carried by microbivores and released where necessary, the advantages of large interfacial areas can be realized during mass transfers.
- The procedure is non-invasive.

- Machine regulated operation with nobs to fine-tune the quantity, frequency, release time; / Better precision.
- Inactive medication in areas where treatment was not needed to mitigate unwanted side effects.
- Limited size-The maximum nanorobot size limit is 3 microns so it can circulate easily in the body without blocking the capillary flow.
- Effective cost (if mass produced) — Batch processing production reduces costs even if the initial development costs are high.
- Less post-treatment care-Therefore less post-treatment care is needed since it is minimally invasive.
- Many microbivores are ~1000 times faster than the normal phagocyte or antibiotic-assisted phagocytic defense mechanism.
- Compared to natural phagocytes, they are about 80 times more effective.
- During the phagocytosis process, natural phagocytes release bioactive compounds. At the other hand, microbivore releases biologically inactive fragments that don't cause an immunogenic response.
- · They can be used in veterinary and military applications aside from their use in humans.
- Our research can be explored for variou s applications, such as food sterilization , biohazard washing, biopolluted drinki ng water treatment and many more

SENSORS:

To complete its tasks the microbivore requires a number of external and internal sensors. External sensors include chemical sensors for up to 10 different molecular species with 100 sensors per molecular species for glucose, oxygen, carbon dioxide, and so forth.It is presumed that each 10 nm = 45 nm = 45 nm chemical concentration sensor with a face area of 450 nm2 discriminates concentration differentials of ~10% and displaces ~105 nm3 internal nanorobot length.Taking chemical sensor energy costs as ~10 zJ / count with ~104 counts / reading, then 10 readings / sec for each of 1000 microbivore sensors gives a maximum sensor power requirement of ~1 pW by a chemical sensor facility which displaces a total of ~0.1 micron3 of device volume and 0.45 micron2 of device surface area.An internal temperature sensor capable of detecting a change in temperature of 0.3 ° C may have a volume of (~46 nm)3 ~ 10-4 micron3; placing ten such sensors near each of the 10 independent backup power plants implies a total volume of ~0.01 micron3 internal temperature sensor.The microbivore architecture contains an additional 0.03 micron3 of unspecified internal sensors, bringing the total for all the sensors to 0.15 micron³.

MICROBIVORE BIOCOMPATIBILITY:

Many additional biocompatibility problems do need to be specifically discussed for microbivores. Firstly, nanorobots larger than ~1 micron in all three physical dimensions could be stuck in the fenestral slits of the splenic sinusoids in the spleen red pulp.A small percentage of blood is forced to circulate in the spleen through a physical barrier requiring passage through slits ranging1-2 microns in width and length of ~6 microns.Microbivores pinned to a faceon slit or stuck edgeon during an attempted passage may detect that they are trapped by measurinspecifi c concentration of blood components and differ ential pressure across their surfaces.The nanorobot then triggers its automated splenofenestral escape procedure, which includes the extension and patterned ciliation of surface grapples before sensor readings show that the slit is complete and that grapple retraction is observed.

APPLICATIONS:

The analysis indicates that current therapies for many septicemic agents still require large amounts of medicines to be administered over long periods of time, often resulting in only partial eradication of the pathogen, or pure growth arrest.A nanorobotic system capable of providing rapid and complete eradication of blood borne pathogens with relatively low doses of devices will be a welcome addition to the clinical armamentarium of the physician.

Treatment of cancer

Brain damage prevention in Neurodegenerativ e Diseases,
Deficiency in hormones:
For Infection Control,
Protect Life after Accidents,
For Blood-associated diseases

FUTURE SCOPE: Microbiviores, which is a nanorobot, have the primary function of killing the microorganisms that cause the disease found in the human blood stream by using digest and discharge protocol.

CONCLUSION:

The nanorobots from the field of nanomedicine can be an revolutionary, compassionate and positive computer technology for patients in the treatment and diagnosis of life-threatening diseases, given the extreme side effects of current therapies such as radiation and chemotherapy. In future, the main medical focus will shift from medical science to medical engineering, where nanorobotic robotics is used.

REFERENCES:

1. https://www.slideshare.net,mobile. Microbivores documentation slide share.
2. Robert. A, Freitas. Jr; Microbivores: Artificial mechanical phagocytes using digest and discharge protocol; volume 14; April 2005.
3. Anil.B, Natuva.D.P.etal Journal of pharmacy research; Artificial WBC(microbivores);Volume 5 (7); 2012.
4. Save N[1]*, Deshpande S[2]; Biochemistry: An Indian Journal; Nanorobot: A prospective outlook and medicine; volume11; issue 2: April 4, 2017.
5. Shabhanashmi.P. S, Naga kani, et al; Journal of chemical and pharmaceutical research; Therapeutic applications of nanorobots, reciprocates and microbivores; volume 8(5); 2016.
6. Moni saha; Nanomedicine- promising tiny machine for the health care in future. A review; 2009.
7. Manjunath. A and Vijay Kishore; The promising future in Medicine-Nanorobots; May 25 ,2014.
8. Sarath kumar.S, Sneha.S, et al; World journal of pharmaceutical research; Nanorobots: A future device for diagnosis and treatment; volume 7, issue 7; March 2018.
9. Yaman saadeh B.S, Dinesh vyas,M.D; Nanorobotic applications in Medicine: Current proposals and designs; September 8 2015.
10. Deepthi.M. S; 2nd International conference and exhibition on pharmaceutical regulatory affairs; Microbivores: Artificial mechanical phagocytes using digest ad discharge protocol; November 2012.
11. Tashnuva Rifat, Md. Shahadat Hossain et al; Bangladesh Pharmaceutical Journal; A Review on Applications of Nanobots in Combating Complex Diseases; volume 22(1); January 2019.
12. Shreya Mishra, Anuja nighut et al; International Journal of technical research and applications; Microbivores; March 2016.
13. Sarath kumar.S[1]*, Beena p. Nasim; JouSarath kumar.S[1]*, Beena p. Nasim; Journal of pharmacy and pharmaceuticals; Nanorobots: A future device for diagnosis and treatment; Published: August 5,2018