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RAGHULKUMAR. S
Angel College of Engineering and Technology,Tirupur, rahulkumarckt@gmail.com

SATHISH KUMAR . R
Angel College of Engineering and Technology,Tirupur, csesathish25@gmail.com

RAJKUMAR. K
Angel College of Engineering and Technology,Tirupur, rajkumar1893@gmail.com

MOTHILAL. G
Angel College of Engineering and Technology,Tirupur, mothi.acet@gmail.com

NANOROBOTICS IN CANCER TREATMENT

RAGHULKUMAR.S[1], SATHISH KUMAR .R[2], RAJKUMAR.K[3] & MOTHILAL.G[4]

[1,2,3,4&5]Angel College of Engineering and Technology,Tirupur
Email:rahulkumarckt@gmail.com, csesathish25@gmail.com, rajkumar1893@gmail.com,mothi.acet@gmail.com

Abstract-Disease and ill health are caused largely by damage at the molecular and Cellular level. Today's surgical tools are, at this scale, large and crude. From the Viewpoint of a cell, even a fine scalpel is a blunt instrument more suited to tear and injure than heal and cure, where in real-time the organ most affected is heart. The present method of treatment-bypass surgery or angioplasty is outdated in this Nan world. Our work shows any viral respiratory infection could be diagnosed with the help of quantum dot system in an efficient manner. Finally, this paper clearly pictures the solutions for human illness using the "Nanotechnology" which will be driver for the future technologies of today's "shrinking world.

INTRODUCTION

Nanotechnology is a broad term that can describe any science and technology where structures of the order of a nanometer play a critical role, and as result encompasses many different areas including: electronics, magnetism, biotechnology, materials science, medicine and health care, environmental science, and textiles. Nanotechnology is an emerging technology today and it promises revolutions to be brought out in almost every field or branch. Three factors which define nanotechnology are smaller size, new properties and integration of technology into materials and devices. In this paper we have made an effort to bring out the various ways in which nanotechnology can enhance the human health…

This paper discusses …

- ✓ In removing heart blocks using Nan robots.
- ✓ In killing cancerous cells.
- ✓ Detecting RSV(Respiratory Syncytical Virus) using quantum dot.
- ✓ Detecting and breaking prions.

REMOVING HEART BLOCKS

Heart block is a condition describing a failure in the conduction of electrical impulses from the natural pace maker (senatorial node) through the heart, which can lead to slowing of the pumping action. Angiogram and Angioplasty are the adopted methods to locate and remove the heart block. The procedures for both are as follows:

ANGIOGRAM

Here a small tube with a catheter at its end is inserted into the blood vessel. The catheter injects a radioactive fluid into the blood stream. By monitoring the flow of the fluid with the help of continuous X-Ray, we can locate the block .ANGIOPLASTY

- Here, the end of the catheter has a deflated balloon.
- Once the block is located, the balloon is positioned under it and inflated.
- As the balloon gets inflated, it crushes the block, which eventually burns and is carried away by the blood stream.
- A one-way inflatable metal cylinder is placed covering the region of block, to prevent recursions.

NANOROBOTS

- Nano robots are Nano devices of size of about 3 to 5 micrometers.
- Individual parts may be of 1 to 100 nm in size.
- Mainly made of carbon and given a protective coating of diamond, as diamond is the most inert and tough material.

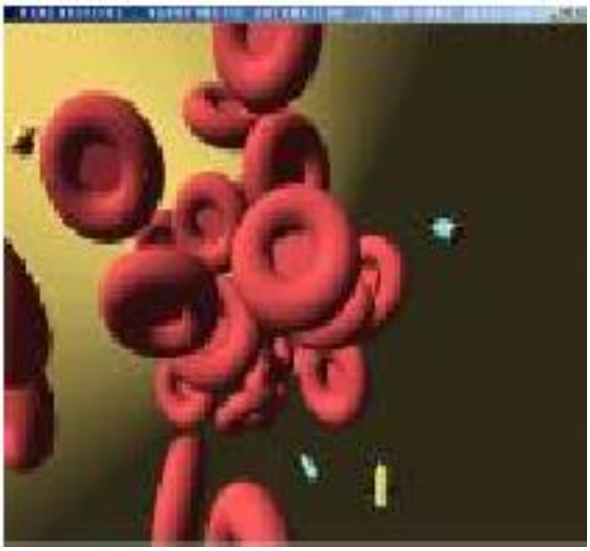

Fig.1: ***Size of Nan robots when compared to that of red blood cells***

ROBOTS EMPLOYED

Nan robots with Nan sensors to locate the block.
Nan robots with Nan lasers to remove the block.

SENSORS EMPLOYED

- ✓ PRESSURE SENSORS
- ✓ ACOUSTIC SENSORS
- ✓ CHEMO SENSORS

- ✓ SMART SENSORS

THE ACTUAL PROCESS

- The three types of Nan robots are suspended in a liquid matrix and injected into the blood stream.
- Immediately the acoustic sensors get activated and navigate their way up the blood stream.
- These robots use the simple principle of Doppler effect.

➢ **SMART SENSORS**

- These sensors on activation form a closed ad-hoc network of all the robots present in the blood.
- All the data from the other sensors are processed by these sensors.
- All the control signals for the various operations will be sent by these smart sensors.

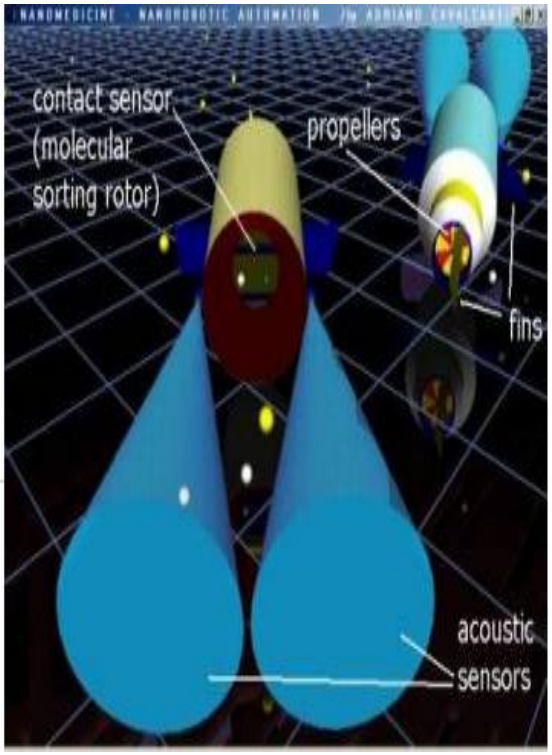

Fig .2 Sensor robots that navigate the other robots through the blood stream

PRESSURE SENSORS

- These sensors scan the blood vessels for variations in blood pressure.
- The output of the sensors is our first confirmation.
- This step is necessary because regions of heart blocks will have increased pressure of the flowing blood.
- The data collected is sent to the smart sensors

CHEMO SENSORS

- These sensors give us the second confirmation.
- These sensors scan the region they traverse, for the chemical composition of the surrounding blood vessel.
- This will help to differentiate between normal blood vessels and cholesterols.
- The data collected will be sent to the smart sensors.

NANOLASERS

- These laser robots on activation, based on the information flow, burn down the block.
- These robots can be powered by the body itself, by means of the kinetic energy of the flowing blood.
- Since the operation is on a Nan scale the outcome is very accurate.
- There is no damage to the surrounding healthy tissues.

MOLECULAR SYNTHESIS

- The Nan robots equipped with "molecular synthesizers" perform the last leg of the operation.
- These synthesizers take the required substances from the blood or surrounding tissues and prepare fresh flawless cells.
- These cells are used to replace the burnt ones in order to prevent recurrences of the block.

ADVANTAGES

- Process is very fast.
- Process is less painful.
- Technologically advanced and reliable.
- No exposure to harmful X-rays as in the case of An

DISADVANTAGES

- Nan robots, the technology as such, may not be affordable.
- The technology may take several years to be implemented practically.
- Sometimes the Nan robots may go out of human control.

KILLING CANCER CELLS

Device of size range ~0.1 microns to kill cancer cells would have a small computer, several binding sites to determine the concentration of specific molecules, and a supply of some poison which could be selectively released and was able to kill a cell identified as cancerous. The device (Nan bots) injected into human body using Nan probes would circulate freely throughout the body, and would periodically sample for the occupation of binding sites. Today's monoclonal antibodies are able to bind to only a single type of protein or other antigen, and are not effective against most cancers. The cancer-killing device suggested here could incorporate a dozen different binding sites and so could monitor the concentrations of a dozen different

types of molecules. When the computer finds a "cancerous" profile, it encounters it by releasing the poison

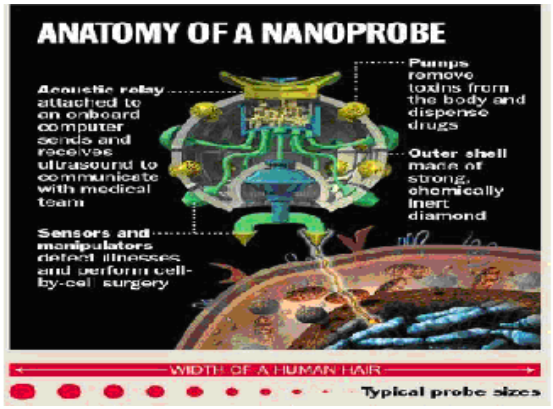

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Fig .3 ***Anatomy of Nan probes***

The cancer killer could thus determine that it was located in (say) the big toe. If the objective was to kill a colon cancer, the cancer killer in the big toe would not release its poison. Very precise control over location of the cancer killer's activities could thus be achieved.

Fig .4 "Driller, peeper, stingers engages in a delicate surgical operation to remove cancer tumor. Detecting and breaking Prions:

Prion is the acronym for "pertinacious infective particles". Stanley Prusiner has described Prion proteins (PrP) in 1982,who was awarded Nobel prize in 1997.PrP is a normal protein of 253 amino acids, found in leukocytes and nerve cells. Is gene is located on the short arm of chromosome number 20.It exists as a sialoglycoprotein anchored on the cell surface. PrP molecules can undergo a change in structural conformation. The altered molecule is resistant to heat and proteolytic enzymes. The abnormal protein is called PrPsc . "sc" stands for scrape , the disease in which it was first isolated. Thus, prions are normal proteins with correct primary structure, but with abnormal tertiary structure. The PrP is in alpha helical form, but PrPsc is in beta pleated sheets.

A normal gene makes the normal PrP protein. Disease is produced when the gene is mutated or if an abnormal PrPsc is injected or ingested. The "Seeding Model" explains that the infectious prion induces the nearby normal protein molecules to unfold to abnormal form. It is similar to the conversion of the good "Dr.Jekyll" to the criminal "Mr.Hyde"(same person with two personalities, described in the famous novel).Those abnormal proteins now convert further normal proteins into abnormal varieties, producing a "chain reaction" that generates new infectious materials."Phosphorylation-dephosphorylation" is another proposed mechanism to produce abnormal protein.

The lysosomal enzymes could break down the normal PrP ; but PrPsc cannot be digested. Hence the prions are accumulated inside the cells, and eventually the cell dies. One part of prion protein can cause apoptosis(programmed cell death),which also leads to loss of cells. As a group, they are also called transmissible spongiform encephalopathy's (TSE), because the brain becomes riddled with small holes like a sponge. Neurons degenerate, protein deposits may accumulate as plaques and glial cells grow larger. Clinically, rapidly progressive dementia sets in with neurological defects and ataxia. All the prion diseases are slowly progressing, but eventually become fatal.

Prions are responsible for Mad Cow disease and similar human diseases. It is unclear how many other problems may be caused by the accumulation of other non-digestible chemicals.

What is clear is that diamond nanobot (Diamonded) could make short work of breaking up a prion, or any other chemical that the body couldn't deal with on its own. Nan bots could go from cell to cell like a housecleaning service, absorbing and breaking down a variety of undesired chemicals.

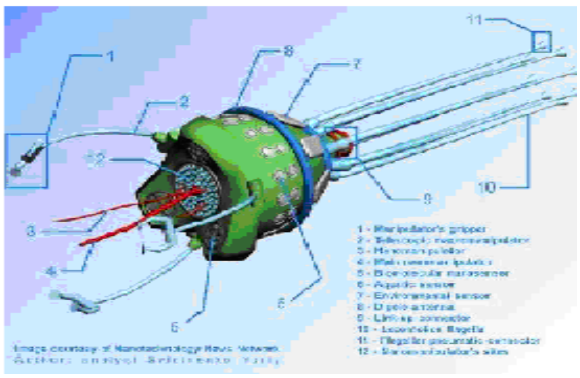


Fig.5 ***Components of diamondoid***

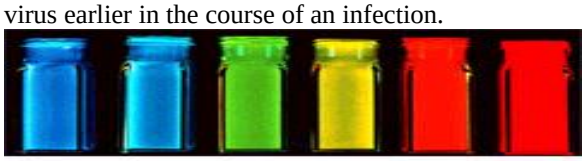
Diamonded can easily navigate through the blood stream. It consists of manipulator subsystem, anchor and locomotion subsystem, sensor and CPU subsystem, transport subsystem. Manipulator subsystem consists of manipulator's gripper, telescopic micromanipulator, Nan manipulator, main Nan manipulator, Nan manipulator's site. Anchor and locomotion subsystem consist of dipole antenna, link-up connector, locomotion flagella, flagella pneumatic connector. Sensor and CPU subsystem consist of bimolecular Nan sensor, equisetic sensor, and environmental sensor. Transport subsystem storage device which store the molecules required for synthesizing new molecules. Transport subsystem transports the molecules from the storage device to the manipulator.

Manipulator attached to the prion, breaks the prion and sends the signal to the computer after which new molecules are synthesized instead of an old molecule.

Respiratory syncytial virus (RSV)

Respiratory syncytial virus (RSV) is a common pathogen responsible for upper respiratory illness among children and the elderly. Current methods of detecting the virus can take from two to six days, postponing effective treatment.

The new, high-tech method uses multi-colored, microscopic fluorescent beads, called quantum dots, which bind to molecular structures that are unique to the virus's coat and the cells that it infects. It is interesting to see that not only can a quantum dot system detect the presence of particles of the respiratory syncytial virus (RSV) in a matter of hours, but it is also more sensitive, allowing it to detect the virus earlier in the course of an infection.



One of the advantages of quantum dots is that slightly changing the size of the individual beads causes them to glow in different colors. The six glass vials are filled with different-sized quantum dots floating in a clear liquid.

When an RSV virus infects lung cells, it leaves part of its coat on the cell's surface. Quantum dots have been linked to antibodies keyed to structures unique to RSV's coat. As a result, when quantum dots come in contact with either viral particles or infected cells they stick to their surface.

The researchers' next step will be to develop a quantum dot cocktail capable of simultaneously detecting the presence of at least five major respiratory viruses: influenza A and B, Para influenza and metapneumo virus, in addition to RSV. The colored quantum dots are attached to different "linker" molecules that bind to different RSV surface structures. "It's not much of a jump from two to five". Quantum dots are available in a dozen different colors, and antibodies specific to the other four respiratory viruses have been identified and can be used as linker molecules. Such a test would be able to diagnose more than 90 percent of all the cases of viral respiratory infection...

CONCLUSION

Nanotechnology with all it challenges and opportunities is an unavoidable part of our future. The possibilities with nanotechnology are immense and numerous. The Researchers are filled with optimism and products based on this technology are beginning to make their mark. The extent to which nanotechnology will impact our lives only depends on the limits of human ingenuinity. It can right be said that nanotechnology is slowly but steadily ushering in the next industrial revolution.

"***Nanotechnology*** *– one word, many technologies….."*

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