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Nanorobots – Th Future of Medicine

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Abstract: **Nanoscale devices are able to perform better with reduced time researches in nanotechnology brought newer approaches in the field of medicine. This context focuses on the components of the nanorobots and the employment of nanorobots for removing the heart blocks, cancer treatment and many more health care applications in more effective and accurate manner. Current diagnostic measures include painful processes like the angiogram. The treatment for the block is also extremely dangerous, time consumin g and painful. Angioplasty, although having the higher success rate, is old fashioned. Today's technology promises a lot more than the insertion of a thin tube into the blood vessels. This context focuses the brief study on nanorobots and its benefits, the current process of diagnostics and therapy. Later t he idea of curing these heart blocks, cancer tumours and brain aneurysm using nanorobots is discussed in a theoretical and imaginative a pproach.**

I. INTRODUCTION

Nanorobotics is an emerging technology field creating machines or robots which components are at or near the scale of a nanometre (10−9 meters). More specifically, nanorobotics (as opposed to microbotics) refers to the nanotechnology engineering discipline of designing and building nanorobots, with devices ranging in size from 0.1-10 micrometres and constructed of nano scale or molecular components. The terms nanobot, nanoid, nanite, nanomachine or nanomite have also been used to describe such devices currently under research and development.

Nanorobots are of special interest to researchers in the medical industry. This has given rise to the field of nanomedicine. It has been suggested that a fleet of nanorobots might serve as antibodies or antiviral agents in patients with compromised immune systems, or in diseases that do not respond to more conventional measures. There are numerous other potential medical applications, including repair of damaged tissue, unblocking of arteries affected by plaques, and perhaps the construction of complete replacement body organs.

A major advantage of nanorobots is thought to be their durability. In theory, they can remain operational for years, decades, or centuries. Nanoscale systems can also operate much faster than their larger counterparts because displacements are smaller; this allows mechanical and electrical events to occur in less time at a given speed.

Fig 1: Example of nanorobot

II. NANOROBOTS AND KEY COMPONENTS

Nanorobots are of special interest to researchers in the medical industry. This has given rise to the field of nanomedicine. It has been suggested that a fleet of nanorobots might serve as antibodies or antiviral agents in patients with compromised immune systems, or in diseases that do not respond to more conventional measures. There are numerous other potential medical applications, including repair of damaged tissue, unblocking of arteries affected by plaques, and perhaps the construction of complete replacement body organs.

KEY COMPONENTS OF NANOROBOTS

In order for the nanorobot to function as desired, the following are key components and design attributes that should be considered:

1. Size and shape
2. Sensors
3. Means of mobility/propulsion
4. Power generation
5. Data storage
6. Telemetry and transmission
7. Control and navigation

Size and Shape

The size and shape will depend on the intended function and operating environment of the nanorobot. The "near wellbore prospector" may be much different from "deep wellbore prospector" in size and shape. The first generation reservoir nanorobots may be a simple spherical ball like shape. Latter designs may be shaped like bacteria or other "crawlies" to enhance movement within different pore systems. A major design criterion is the minimum size.

Sensors

For the nanorobot to fulfill some of its functions, it must be capable of sensing different borehole and reservoirparameters. Thus, it should be capable of sensing reservoir fluid type,

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reservoir temperature, formation pressure, basic petrophysical properties, fluid analysis, trajectory and position, etc. One or two sensors may suffice for the early prototypes. That will be several steps ahead of current smart tracers. The latter design may incorporate more of the desired sensors.

Means of Mobility/Propulsion

This is quite an important design consideration for the reservoir nanorobot. Early prototypes can be simple "ball like" robots without self-propulsion mechanisms. They may simply be injected into the reservoir with normal injection water and are allowed to navigate their paths through the reservoir following the natural path created by the injection water or the oil flowing naturally to the producers.

Power Generation

Another major requirement is power for the device. The intelligent nanobot will need power to perform its assigned operations and tasks. At the nano-scale, the power needed is probably low, probably tens to hundreds of pico-watts to even micro-watts, depending on the functions. Potential means of generating power for the nanobot are:

1. Power from fluid flow or counter-current motion.
2. Power derived from the reservoir temperature.
3. Power from friction with rock fabrics.

Data Acquisition and Storage

Data acquisition and storage are other key components for the nanorobot to fulfill some of its functions. Early prototypes with single or few data storage memory will be a step change. Quantum computing may help in the future nano-sized data storage.

Telemetry and Data Transmission

This will be a tough design function to be incorporated into these tiny wonders. Although recent findings by UC Irvine researchers, Zettl et al. and Burke who unveiled a working radio built from carbon nanotubes that are only a few atoms across, show some possibilities of transmitting data at nano-scale.

Control and Navigation System

Another desirable feature is the ability to control the bots from the surface.

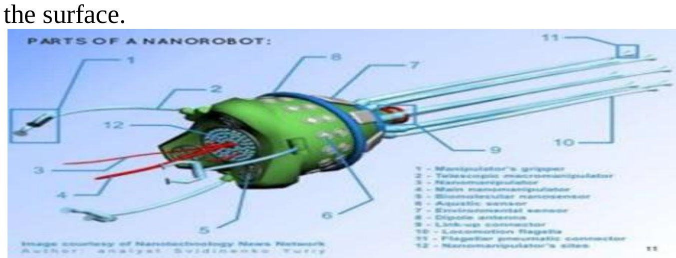

Fig 2: Elements of Nanorobot

III. NANOROBOTS – THE FUTURE OF MEDICINE

The health care industry of today is focusing on developing minimally invasive techniques for diagnosis, as well as treatment of ailments. The most promising development in this field involves marriage of the latest nanomaterial science and robotics technology with biological knowledge: Nanorobotics. This context will deal with the latest development in this field as well as the promising future it offers, mainly focusing on health care, though this is a nanoscopic fraction of the scope of this technology.

BENEFITS OF NANOROBOTS

Nanorobots are the most useful objects that humans have invented.

1) They are capable to rebuild the tissue molecules in order to close an open wound.

2) They also have the capability to rebuild the walls of ruptured veins and arteries.

3) Nanobots find their way to the heart by travelling through your blood stream and perform important surgeries like heart molecular surgery without causing any discomfort to you.

4) Nanorobots play a very vital role in the field of medicine by providing an easy and a controlled way of operating.

Scientists are also of the opinion that nanorobots will help in brain research, cancer research and finding remedies for difficult ailments like AIDS, leukaemia and other major diseases. Nanorobots can indeed be the ray of light for those suffering from such major ailments. Cancer patients have to undergo this painful treatment called as chemotherapy which also has many side-effects. However, with the invention of nanorobots, the cancer patients will no longer be required to undergo such painful process, instead just take a small prick, let the nanorobot enter the blood stream and do the needful.

The nanorobots are efficient and make sure that they eliminate every infected cell without touching the good cells of your body .Which is why nanorobots are becoming a very promising source of operating people in the future.

ADVANTAGES OF NANOROBOTS OVER CONVENTIONAL MEDICAL TECHNIQUES

We Homo sapiens (advanced humans) have always been fascinated with our own anatomy. Techniques to diagnose body ailments as well as to "repair" them have been developed long ago. Ancient Indian texts describe surgery being practiced as early as 600 BC (time variable in various texts) by the great surgeon Sushruta. Humanity has progressed quite a lot since then , in terms of safety and reliability of the procedure. Also techniques such as endoscopy have been

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developed to give a better understanding of the vitals as well as aid diagnosis. But as we all know, all technology inevitably has to be phased out sometime. And as historically procedures have developed to overcome the drawbacks of their predecessors, nanorobotics will aim to overcome the following drawbacks of today's medical technology:

1. Incisions harm tissue layers which take time to heal.
2. Painful anaesthesia can be used to limit the pain to a great extent, yet it is only for a short time.
3. Delicate surgeries such as eye surgery still do not have 100% success rate.
4. In any of the invasive techniques , the patient's life is totally in the hands of the operator/ surgeon/ physician. It is risky, as one mistake could spell disaster.

Conventional techniques of investigation and diagnosis used for over the last few centuries are thus, soon going to fall behind as the technological age advances. Also a lot of these procedures will soon become robotically controlled , as quite a few already have. Robot assisted surgery is already in successful use, as we can see from the Da Vinci surgical robot. Scientists and researchers however are working on a more robust, reliable and bio-compatible approach. Instead of curing from the outside, they plan to defend the body from the inside. That is where medical nanorobotics comes in. The major advantages this technology provides are:

1. Minimal or no tissue trauma.
2. Considerably less recovery time.
3. Less post-treatment care required.
4. Continuous monitoring and diagnosis from the inside.
5. Rapid response to a sudden change.

Also, treatment can be started before the medical condition escalates. Some added features of nanobots would also enable us to do the following:

1. Store and process previous data, identify patterns and hence, help to predict onset of an ailment.
2. Guide nanobots externally or as per programmed, targeting specific locations.
3. Deliver payloads such as drugs, or healthy cells to the specific site.
4. Disassemble and get excreted after completion of task, if required.

An added advantage is that these nanobots will navigate through natural biological pathways, hence we could liken them to customized (and often more durable) body cells, manufactured externally.

There are two possible approaches to building nanobots. One relies on molecular assembly i.e. assembling the nanobot from basic molecules, piece by piece. We could term this as a "bottom-up " approach. The other approach, which we will refer to as the "top-down" approach deals with using current technologies, such as Micro Electro Mechanical Systems (MEMS) and scaling them down further to nano level. In the following sections, we will see the opportunities as well as limitations of both these approaches.

IV. NANOROBOTS FOR BRAIN ANEURYSM

The nanorobots for brain aneurysm prognosis, they are using computational nanotechnology for medical device proto typing, this consists of three main equipments:

1] Prototyping
2] The manufacturing approach and
3] Inside-body transduction

It is the computational nanotechnology provides a key tool for the fast and effective development of nano robots, and that is supports of investigation to address major aspects on medical instrumentation and device prototyping. A similar approach was taken by industry to build racing cars, airplanes, submarines, ICs and medical devices. The bio molecules are too small to be detected reliably: instead the robot relies on chemical nano biosensor contact to detect them. Brain aneurysms are taken for modelling the study of nano robots sensing and interaction within the deformed blood vessel. Intracranial concentrations of NOS are small and some false positives can even occur due to some positive functions of N-oxide with semi carbazone (pNOS). The nano robots must detect protein over expression and the setup for sensing and control activation can be modified for different values, we treat any nano robots not responding while within the workspace as if they did not detect any signal, so they flow with the fluid as it leaves the workspace. If the nano robot's electrochemical sensor detects NOS in low quantities or inside normal gradient it generates a weak signal lower than 50 nA. When activated, the nano robots' sensors also indicate their respective Position at the moment that they detected a high NOS protein Concentration providing useful information about the vessel bulb location and dimensions. To illustrate the proposed approach, the nanorobots must search for protein over expression signals in order to recognize initial stages of aneurysm. An advanced nano mechatromics simulator, using a three- dimensional task-based environment, is implemented to

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provide an effective tool for device prototyping and medical instrumentation analysis. Thus, based on clinical data and nanobioelectronics, the proposed model offers details about how a nanorobot should help with the early detection of cerebral aneurysm.

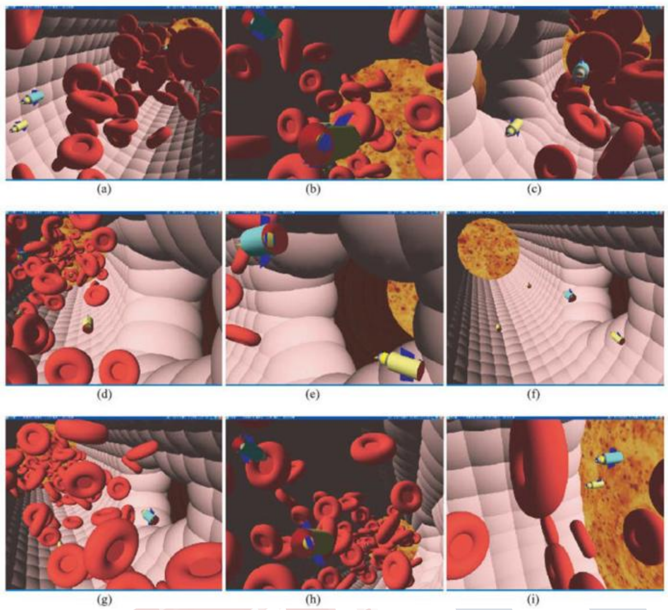

Fig 3: Working of nanorobot on brain aneurysm

Nanorobots used to detect brain aneurysm: (a) the nanorobots enter the vessel and flow with the bloodstream (b) the nanorobots are moving through the vessel with the fluid (c) the aneurysm saccular bulb begins to become visible at the vessel wall (d) nanorobots move closer to the vessel deformation (e) mixed with the plasma, NOS (nitric oxide synthase) signals can be detected as the chemical gradient changes, denoting proteomic overexpression (f) the same workspace viewed without red cells (g) the nanobiosensor is activated as the nanorobots move closer to the aneurysm, emitting RF signals sent to the cell phone (h) as the nanorobots keep flowing, the chemical signals become weaker, deactivating the nanorobot transmission (i) red cells and nanorobots flow with the bloodstream until they leave the vessel.

V. NANOROBOTS IN HEART SURGERY

Heart blockings are occurring more and more. The most common methods of surgery for heart attacks are By-Pass surgery and Angio Plaster. But these methods are risky and bring several side-effects with them. Surgery with nanorobots is safer and the surgeon doesn't even have to touch the patient. Nanorobots as a heart surgeon could replace the mentioned, current surgeries and thus manage the same result without the side effects. The procedure would consist of locating and serving the block. After locating the blockade, nanolasers could be used to tackle the block after getting confirmation by the practitioners.

Nanorobots equipped with nanolasers which is used to serve the block after confirmation in order to prevent the recurrence of the block. Then molecular synthesis is carried out (i.e.) nanorobots fills the burnt gap with fresh flawless cells synthesized by the robots themselves. This process is known as molecular synthesis.

THE ACTUAL PROCESS:

A Sensor robot navigates other robots through the blood stream and following process is achieved:

- The nanorobots needed for the process are suspended in a liquid matrix and injected into blood vessels of the patient.
- Acoustic sensors get activated soon and begin navigating the army of robots through the blood stream to the pericardium.
- Simultaneously, the smart sensors present in the sensor robots, get activated and form a closed ad-hoc network connecting all the robots.
- This is very essential in order to guide all the nanorobots to the desired location.

OPERATION STARTS:

- The pressure sensors mounted on the sensor robots, scan the blood vessels for variation in the blood pressure.
- This will act as the first confirmation.
- This scanning for pressure variations is necessary in the region of the block, there will be a constriction of blood vessel and hence a rise in the blood pressure compared to that existing in the nearby areas.
- These sensors will generate a report of the potential areas of heart block, based on the pressure mapping of the blood vessels.

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OPERATION PROCEEDS:

- The second confirmation comes from chemo sensors.
- These sensors scan the region and they traverse for the chemical composition of the cholesterols. The sensors differentiate the cholesterol compounds accumulated on the walls of the blood vessels from the actual composition of the tissues of the blood vessels.
- In this way the block can be identified accurately.
- All these information are transmitted through the ad-hoc network formed by all the smart sensors and can be constantly viewed by the doctors monitoring the entire process.
- After successful location of the block the second type
- of nanorobots those equipped with nanolasers comes into picture.
- These laser robots on activation based on the information flow through the network, effectively burn down the block

OPERATION SUCCEEDS:

- The final leg of the operation is the responsibility of the molecular synthesizers.
- These nanorobots, take the required biochemical substances from the blood or surrounding tissues, and they synthesize the cells of the blood vessels in order to seal the area of the block.
- These cells are placed in the affected region.
- And as a result, we have a whole new region of blood vessel that is completely free from the threat of another block.

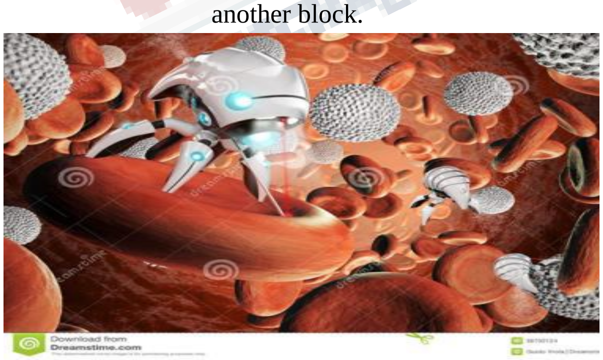

Fig 4: Nanorobot surgery

VI. NANOROBOTS IN CANCER TREATMENT

Cancer can be successfully treated with current stages of medical technologies and therapy tools with the help of the nanorobotics. Determine the decisive factor to chances for a patient with cancer to survive is: how earlier it was diagnosed; another important aspect to achieve a successful treatment for patients is the development of efficient targeted drug delivery to decrease the side effects from chemotherapy. Considering the properties of nano robots to navigate as blood borne devices, they can help on such extremely important aspects of cancer therapy. Nanorobots with embedded chemical biosensors can be used to perform detection of tumour cells in early stages of development inside the patient's body. Integrated nano sensors can be utilized for such a task in order to find intensity of E-cadherin signals. Therefore a hardware architecture based on nano bioelectronics is described for the application of nanorobots for cancer therapy.

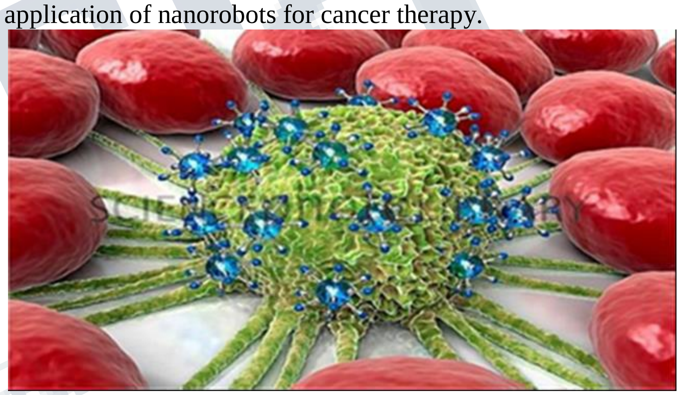

Fig 5: Nanorobot targeting tumour site

The scientists have genetically modified salmonella bacteria that are drawn to tumours by chemicals secreted by cancers cells. The bacteria carry microscopic robots, about 3 micrometres in size that automatically release capsules filled with drugs when the bacteria reach the tumour. By delivering drugs directly to the tumour, the nanorobot, which the team named bacteriobot, attacks the tumour while leaving healthy cells alone, sparing the patient from the side effects of chemotherapy. Bactiriobot can only detect tumour forming cancers, such as breast cancers and colorectal, but the nanorobot will eventually be able to treat other cancers as well. A decisive factor to determine the chances for a patient with cancer to survive is: how earlier it was diagnosed; what means, if possible, a cancer should be detected at least before the metastasis has began. Another important aspect to achieve a successful treatment for patients is the development of efficient targeted drug delivery to decrease the side effects from chemotherapy. Considering the properties of nanorobots

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to navigate as blood borne devices, they can help on such extremely important aspects of cancer therapy.

VII. ADVANTAGES AND DISADANTAGES

ADVANTAGES:

- The nanorobots do not generate any harmful activity as they work only in specific site as told by the physician.
- Rapid elimination of diseases.
- Nanorobots might also reproduce copies of themselves to replace worn out unit, a process called self-replication.
- The major advantage of nanorobot is the durability which in theory is thought be for about decades and centuries.

DISADVANTAGES:

- The nanorobot should be very accurate otherwise harmful events may occur.
- The initial design cost is very high.
- The design of this robot is very complicated.
- Hard to interface, customize and design.

Ⅷ. FUTURE WORK

The minute scale of the nanobots and their proven accuracy will hopefully one day make surgical procedures and medical treatments safer for the patient and more effective at targeting problems at the source. The cancer-targeting nanobots, with their ability to bypass healthy cells, leaving them untouched and unaffected, could help reduce some of the more painful and debilitating side effects of current cancer treatments. The surgical nanobots may only be in trials for eye surgery at the moment, but that same guided technology could be used in variety of delicate procedures thanks to their small size limiting excess damage to surrounding tissue.

Fig 6: Nanorobots being used in foetal surgery (concept)

So much treatment and surgery involves working from the outside in, but these nanobots allow work to begin from the inside, right at the source. As researchers strive to make surgical nanobots small and smaller, the uses for these machines within the human body seem potentially endless.

IX. CONCLUSION

It is a proposed idea that can be made practical by the existing engineering technology. The Nanorobot to be designed must be bio-compatible. The size of the nanorobot should not be more than 3 micron so as, not to block any capillary. The nanorobot should resist the corrosive environment of the blood vessels. The nano particles that are attached to the nanorobot should be held tightly and must be durable.

With the application to healthcare, nanotechnology is indeed quite the exciting and revolutionary technique in the pursuit of quality healthcare. Nanomedicine endeavors to improve human health utilizing molecular tools and nano particles. The technology and the applicability of it to the human body is still at preliminary stages.

REFERENCES

1. Ghosh, A.; Fischer, P. (2009). "Controlled Propulsion of Artificial Magnetic Nanostructured Propellers".
2. Sierra, D. P.; Weir, N. A.; Jones, J. F. (2005). "A review of research in the field of nanorobotics".
3. Vaughn JR (2006). "Over the Horizon: Potential Impact of Emerging Trends in Information and Communication Technology on Disability Policy and Practice".
4. Tarakanov, A. O.; Goncharova, L. B.; Tarakanov Y. A. (2009). "Carbon nanotubes towards medicinal biochips”.
5. Ignatyev, M. B. (2010). "Necessary and sufficient conditions of nanorobot synthesis”.