

Nanobots the new nemesis of cancer biology essay



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The term nanotechnology will be one which would be widely used in the near future. It is in the leading position in comparison to futuristic nanotechnologies e. g., surgical nanomachines in terms of extensive research, application and products in pipeline. Nanotechnology is popularly known as the science of small or scientifically can be described as the technology to develop materials and structures of the size range from 1 to 100 nanometres. It will have tremendous applications in the field of medicine especially for cancer treatment

Oncologists, physicians who study, diagnose, and treat cancerous tumours, of every nook and corner of the world has been relentlessly researching for methods for the early detection of cancer and precious localization of cancer therapeutics with minimal adverse effects to healthy tissues. Research in nanotechnology has shown promising possibilities for achieving this goal

Chemotherapy is one of the most common cancer treatments used. It is a process that makes use of cytotoxic chemicals to exterminate cancerous cells. The chemicals may either be injected or taken orally. Chemotherapy may also be administered by rubbing it on the patient's body.

But chemotherapy actually is a harsh form of cancer treatment that kills not only the target malignant cancerous cells, but also many good non-target tissues as well. In some cases it has been guessed that chemotherapy does more harm than good.

The patients even if they recover from the cancer disease and avoid death through chemotherapy, they still will be affected by the harsh side effects of it. Some of those side effects may be more harmful and painful than the

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cancer they had before. But equally effective remedies have not yet been found.

Nanobots are expected to change that. It will provide better ways which makes the treatment safer. By joining multidisciplinary engineering inventions in nanotechnology, an opportunity for development of enhanced, miniaturized and low cost diagnostic/imaging instruments and treatment machines has opened. The future possibility of tackling “ pain- the bitter side of cancer therapy”, through nanotechnology would be considered one of the biggest breakthroughs.

How are nanobots made and what are they made off

Development of nanobots is a rather complicated process. Scientists have made significant progress in this field, but have not deployed a nanobot which is entirely mechanical. Most of the developed nanobots at present are partly or mostly biological in nature. Nanobots are adapted machine version of bacteria. They are designed in such manner so that they can function on the same way as that of both bacteria and common viruses in order to interact with and repel them from the human system. The best way to create a nanobot is to use another nanobot. But the problem lies in getting started.

An ideal material for the construction of nanobots has not yet been found. But expert scientists believe that silicon may be that ideal material, because of its traditional use for delicate electronic devices. Microscopic silicon components called transducers have so far been successfully built into nanobot legs. Selection of an ideal fuel for its working is also a problem faced by the scientists since most of the commonly used fuel units like solar cell or <https://assignbuster.com/nanobots-the-new-nemesis-of-cancer-biology-essay/>

batteries cannot be shrunk to nanoscale. However, nuclear technology may provide answer for this. Researchers consider of equipping a thin sheet of radioactive material as fuel. As the radioactive atoms decay and release energy the nanobot would be able to utilise this power source. Another nice side effect of this system is its ability to renew automatically. With the constant circulating nuclear energy it would supply, this fuel cell would never need to be replaced. Another method to power up the nanobot is using the patient's own body. Nanobots acquire power directly from the bloodstream. A nanobot attached with electrodes can form a battery using the electrolytes found in the blood or the nanobot could contain some chemicals that would perform some chemical reactions with blood to produce energy.

Structure and working of nanobots

Nanobots are very small that they can easily enter the body and flow along the bloodstream. The exterior of the nanobots are constructed similar to the carbon atom structure in a diamond due to its inert properties and strength. It has super-smooth surfaces which lessens the triggering of the body's immune system, allowing its movement inside the body unaffected. The glucose or sugars present inside the body may cause hindrance for its motion, and hence, the nanobots will have other biochemical or molecular parts depending on its tasks.

There are few items that might be found in a nanobot's toolkit. Those are

Medicine cavity - It is a hollow section inside the nanobot that preserves small doses of chemicals or medicine and could release the medication

directly to the site of infection or injury. Nanobots can also store the
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chemicals used in chemotherapy to treat cancer and can carry it directly to the site. Although the amount of medication is comparatively very low, nanobots can apply it directly to the cancerous tissues more effectively than traditional chemotherapy, which depends on the body's circulatory system to carry the chemicals throughout the patient's body killing the cancerous cells and the same time affecting the other healthy cells of the body harmfully.

Probes, knives and chisels - It is used to remove blockages and plaque.

Nanobot need some device to grab, break down and remove these abnormalities. They may also need some devices to crush clots into very small pieces. If a partial clot gets released and enters the bloodstream, it can cause more problems further down the circulatory system.

Microwave emitters and ultrasonic signal generators - It is used to destroy cancerous cells. The doctors depend on methods that will kill a cell without bursting it. A busted cancerous cell may release chemicals that could cause the cancer to spread further to other portions of the body. Nanobots can break the chemical bonds in the cancerous cell and kill it without breaking the cell wall using fine-tuned microwaves or ultrasonic signals. At the same time, the robot could emit microwaves or ultrasonic signals in order to heat the cancerous cells and destroy it.

Electrodes — Two electrodes extended from the nanobots generate electric current and heat the cell until it dies, thereby killing cancerous cells.

Lasers - By vaporising tissues, small and powerful lasers could remove harmful materials like plaque in arteries, cancerous cells or blood clots.

Scientists are working hard to find a suitable design for the body of the nanobot. It must be fast, aerodynamic and smooth to flow freely along the body and to complete its function. Some believe that a spider-like body would work best, but many nanobot researchers also think that a smaller version of the centipede might be best. They hope that by equipping the nanobot with several sets of fast-moving legs and keeping its body low to the ground, they can create a quick, efficient machine that would also be suitably shaped for introduction into human blood vessels to perform its functions.

Nanobots will possess at least the fundamental two-way communication, respond to audio signals and will be able to receive power or re-programming instructions from an external source via sound waves. A network of special stationary nanobots will be positioned throughout the body. These nanobots logs into each active nanobots as it passes and will report results, allowing the interface to keep track of all the nanobots present in the body. Using this, a doctor can not only monitor the patient's progress but also can change the instructions for the nanobots to enter into another stage of the healing. When the tasks are completed, it can be flushed out from the body.

Nanobots can be programmed to perform different jobs around the body, and one of them will be to locate and destroy cancerous cells. There will be different nanobots to do different jobs to help kill the cancer, for example, one will inject toxins, while the other cuts out the tumour carefully without damaging healthy cells around it. Another robot will be able to send video footage of this happening to the surgeon treating the patient.

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Advantages of the technology

The different advantages of the usage of nanobots are

A better method for cancer detection

The most commonly used cancer detection techniques like optical identification of malignant changes, cell growth analysis, specific-ligand receptor labelling or genetic test are inaccurate, lengthy and complicated process, which is impractical for clinical use.

The detection of cancerous cells using nanobots will be simpler and precise than the traditional methods. Nanobots covered with organic-based fluorescent dyes will be bound to the cancerous cells which makes optical detection easier.

A better method for cancer treatment

The popular treatments of cancer at present, like chemotherapy, have many harsh side effects even though it helps in the treatment of cancer. It kills healthy cells present in the body along with the cancerous cells and may cause some side effects or even a more painful disease than cancer in the future. They will not be able to live a normal life even after recovering from it.

Nanobots on the other hand, carry the drugs or tools used to destroy cancer tissues directly to it. It will disperse the drugs directly to the cancerous cells which leave the healthy cells unaffected thus preventing further side effects to a great extent.

Some achievements in nanobotics

Researchers at the École Polytechnique de Montréal, in Canada have created a microscopic device that could offer a new and very effective treatment for cancer. The research team has coupled live bacteria to microscopic polymer beads which can carry cancer-killing drugs to create “nanobots”. The bacteria’s small size and flagella helps them to fit in and flow through the smallest blood vessels in the human body.

A research team of a Californian institute-Pasadena, injected nanobots into a patient’s bloodstream. It was able to enter into the cancer tumour, deliver double-stranded small interfering RNAs (siRNAs), and turn off cancer genes.

Reasons that slow down the use of nanobots at present

Scientists do face challenges and are concerned of making nanobot tools effective and safe. For instance, creating a very small laser powerful enough to destroy cancerous cells is a great challenge, but it’s more difficult to design it so that the nanobot doesn’t harm the healthy tissues surrounding the cancerous cells. Even though many scientific teams have developed nanobots that are small enough to enter into the bloodstream, it’s only the tip of the iceberg. They have to do more experiments and researches to make nanobots a real medical application.

Another problem is with the quantity of toxin which goes into each capsule. This is because too much of the toxin at any one point can damage the body, therefore the process has to be spread out over a longer period of time, using lots of small doses.

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Nanobot consist of a transporting mechanism, an internal processor and a fuel unit. Creating a fuel unit at nano-scale is very difficult with current technology.

Another problem in constructing nanobot is selection of material out of which it is made of and breaking it down small enough. The properties or behaviour of metals at large-scale and nano-scale might be different.

Another factor that slows down its entry to the medical field is the high cost for the research, development and experiments.

Some other applications of nanobots in the field of medicine

Applications of nanobots in the field of medicine are practically unlimited.

Some of the applications are

Treating arteriosclerosis: Arteriosclerosis refers to an abnormality where plaque builds up along the walls of arteries, thereby hindering the normal flow of blood through it. Nanorobots can treat this condition by physically chipping away the plaque along artery walls which would then enter the bloodstream and gets removed from the body.

Breaking up blood clots: Nanorobots could travel to blood clots which can cause complications ranging from muscle death to a stroke and break it up. This application can be one of the most dangerous uses of nanorobots, if the robot could not remove the blockage without losing even small pieces into the bloodstream. Small pieces, if entered into the bloodstream could then travel elsewhere into the body and cause more severe problems. The size of

the robot also must be small enough so that it doesn't block the flow of blood itself through the arteries.

Fighting cancer: Doctors are hopeful to use nanorobots either to attack tumours directly using lasers, microwaves or ultrasonic signals or as a part of a chemotherapy treatment, wherein medication can be delivered directly to the cancer site to treat the patient. According to doctors by delivering small but precise doses of medication to the patient, the side effects of the medicine will be minimized without a bit of loss in the effectiveness of the same.

AIDS treatment: It can act as synthetic immune system of the AIDS affected patient which would help him to survive the disease. It could function as replacement helper-T cells in a weakened immune system

Helping the body clot: Another particular kind of nanorobots named clottocyte is an artificial platelet, which carries a small mesh that dissolves into a sticky membrane upon contact with blood plasma. Robert A. Freitas, Jr., the scientist who designed the clottocyte, claims that clotting done by clottocyte could be up to 1, 000 times faster than the natural clotting mechanism of the body. Doctors can use clottocytes to treat haemophiliacs or patients with serious open wounds also.

Parasite Removal: Several nanorobots working together could directly release drugs on bacteria and small parasitic organisms inside a patient's body and kill them all.

Gout: One of the major functions of the kidney is to remove waste from the breakdown of fats from the bloodstream. The inability of kidney to perform this task develops the condition called Gout which causes waste to crystallize at points near joints like the knees and ankles. A nanorobot, though wouldn't be able to reverse the condition permanently, could break up the crystalline structures at the joints and provide relief from the intense pain at the joints, as a result of gout.

Breaking up kidney stones: Kidney stones vary in size and are intensively painful to get removed normally as the size increases. Though doctors can break up comparatively large kidney stones using ultrasonic frequencies to get it removed normally, it is not always effective. A nanorobot could break up these stones using a small laser as well as can carry small ultrasonic signal generators to deliver frequencies directly to the kidney stones.

Cleaning wounds: Nanorobots could help to remove dead remains from wounds and thereby decreasing the chances of infection. They can be used very effectively in cases of puncture wounds, where conventional methods of treatment are difficult.

Conclusion

Nanotechnology has become an emerging tool which helps to find solutions for several questions of different fields. It has provided the hope from preparing cure for many incurable and deadly diseases of the present. But still more researches and improvements are required, before actually applying it.

The investments and resources required for the research, development and performance trials for nanobots are considerably large. Hence the sponsoring agencies, both private and government, should provide more investments and resources which make these nanotechnology inventions (like nanobots) more cost-effective and easily available for patients all across the world and of all economic classes. It will open a new horizon in the field of medicine especially for the study and treatment of cancer.

Health departments in association with governments should form policies that support the usage of nanomaterials and prevent the use of treatments which are harmful and has harsh side effects, like chemotherapy, for cancer.

The future holds lot of promises as nanotechnology has the potential to provide cancer therapy by challenging the problems like high treatment costs and undesirable side-effects.

Glossary

Therapeutics: The branch that deals specifically with the treatment of disease and the art and science of healing

Diagnosis: Indicating the nature of a disease

Nanoparticle: A particle of something with dimensions in the nanometre range

Aerodynamics: The science which treats of the air and other gaseous bodies under the action of force, and of their mechanical effects

Haemophilia: A tendency to uncontrolled bleeding

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