Nanotechnology: Future for cancer

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PASS

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Research into Nanotechnology of cancer is vague, and few individuals know about what is being researched and taking place in this field. We propose to explain current treatments, research, prevention and diagnostic tools regarding nanotechnology and its progression for the future within the oncology field. We chose cancer as our research paper due to it being a major widespread disease – and its substantially large mortality rate. Cancer affects many individuals and families annually therefore we believe we should illuminate what is being done. The future for cancer patients looks brighter credited to the research being done by nanotechnologists. We believe nanotechnology could be the future to treating cancer patients. We will be exploring nanotechnology and how it could make an impact on cancers in the body. Nanotechnology is not noticed globally; through out this research paper we will give the reader the chance to understand nanotechnology in detail.

Nanotechnology is the engineering of functional systems at the molecular scale [1]. The name is derived from the Greek word 'Nano' – meaning dwarf. A nano-meter is a billionth of a meter; this is approximately the 1/80,000 of the diameter of a single human hair or 100,000 times the thickness of an average A4 sheet of paper. As you can imagine – this is TINY!

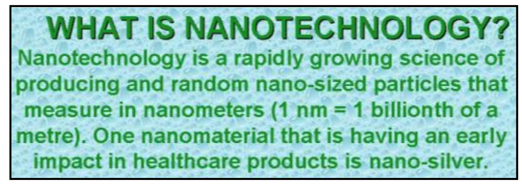

Figure 1 – what is nanotechnology?

Nanotechnology concerning oncology and cancer; with advances in nanotechnology – oncologists will be able to give patients routine health checks, resulting cancers to be preventative rather than curative. Nanotechnology could be what changes the future of cancer patients. Currently scientists would like to find out a way to detect cancer via the molecular change of the body – rather than wait for the cancer to reach a stage where the individual has encountered physical changes. With current and future developments in nanotechnology - this can be made possible. Nanotechnology devices have the potential to fundamentally improve cancer therapy for to dramatically increase the number of highly effective therapeutic agents.

The devices should be presented with the capability of containing large doses of chemotherapeutic agents or therapeutic genes into malignant cells while sparing healthy cells, which would greatly reduce or eliminate the often unpleasant side effects that accompany many current cancer therapies. Research shows some nanoscale devices can target cancer cells. Despite the immense progress scientists have made relating to cancer, most cases are still diagnosed after the development stage has metastasized. Dr. David Cathcart is one of many researches working on 'the Trojan horse concept' where they affix molecules and attachments allowing the side effects of chemo-therapy to decrease. This is very effective to allow the doctors to treat the patients and try to remove the cancer cells without putting their patients in uncomfortable conditions and still endeavouring to help them [2]. With the focus on searching for multifunctional devices, one goal is to create and characterize platform technologies that can be mixed and matched with new targeting agents that will come from large-scale proteomics programs already in action and therapeutics both old and new. Accomplishing this goal, however, will require that engineers and biologists work hand in hand to combine their resources in the fight against cancer.

NanoTechnology can provide great hope for medicine. It can offer exciting possibilities. Nanotechnology in medicine involves the application of nanoparticles currently under development, in the body. As well as longer range research that involves the use of manufactured nano-robots to make repairs at the cellular level (sometimes referred to as nanomedicine). Nanotechnology within cancer is already proving to work, as CytImmune has published preliminary results on the chemo nano technology being trialled show a positive outcome. http://www.cytimmune.com/go.cfm?do=Page.View&pid=19 –Its shows a clear correlation within the results, that the nano seems to help get rid of the tumour and helps reduce its solidity.

The use of nanotechnology in cancer treatment offers some exciting possibilities for the future. The possibility includes destroying cancer tumours with minimal damage to healthy tissue and organs, as well as detecting & eliminating cancer cells before they can form any tumours. A treatment suggested involves chemotherapy that delivers a tumour-killing agent called tumour necrosis factor alpha (TNF) to cancer tumours. TNF is attached to a gold nanoparticle along with Thiol-derivatized polyethylene glycol (PEG-THIOL), which hides the TNF bearing nanoparticle from the immune system. [3] This allows the nanoparticle to flow through the blood stream without being attacked by any blood cells. I believe that this will provide great hope for those who have cancer, because it seems in today's society other treatments seem to attack the healthy parts of the body, for example the chemo being used now attacks, hair growing cells, reduces movement of the body, and allows rigidity within the cancer patient, and not actually tackling the problem, whilst this nano technology could actually kill the cancer whilst not harming any other part of the body. For the future, this treatment could save the grief of family and friends of the cancer sufferer, although the manufacturing of this therapy will alone be expensive; so this could be an economic factor. This could put governments in debt.

Another nano technology therapy is to get rid off cancer tumours using nanoparticles called 'AuroShell'. [4] The 'AuroShell' nanoparticles constantly go around the cancer patient's bloodstream, exiting where the blood vessels are leaking at the affected area of where the cancerous tumour lies. Once the nanoparticles get to the tumour the 'AuroShell' nanoparticles are used to concentrate the heat from infrared light to destroy cancer cells with minimal damage to surrounding healthy cells. This therapy could also offer great hope, as it uses radiation to kill the cancer; however this is similar to today's treatments for cancer, and may not be the best solution. As radiation may not affect cancer, but could give off side effects and attack other cells within the body. Infrared radiation is strong type of radiation, and is not healthy. It is also not a natural resource, it is man made. This could be unhealthy for the patient, and could be economically wise a let down. As it will cost the government a great deal.

Targeted heat therapy is also being developed to destroy breast cancer tumours. This involves antibodies which are very attracted to proteins being produced in one of the types of breast cancer cell getting attached to the nanotubes, causing the nanotubes to accumulate at the tumour. Infrared light from a laser is absorbed by the nanotubes and produces heat that incinerates the tumour. The tumour will die, this is another great therapy. However this method could result in harming the patients other cells, as this radiation is strong, and could have the potential to damage or increase the cancer.

Nanoparticles containing drug molecules called interlukins are attached to immune cells (T-cells). This is so that when the T-cells reach the tumour the nanoparticles release the drug molecules into the tumour, which cause the T-cells to reproduce. If enough T-cells are reproduced in the cancer tumour the cancer can be destroyed, it will over power the strength of the tumour to reproduce, and eventually it will die. This method has been tested on laboratory mice with very good results. This method shows to be the most promising. It shows a correlation, that the more T cells within the tumour, the quicker the tumour dies, and the more likely the tumour will die. I believe that this method could be a future antidote to those who have tumours; because it has shown to be trustworthy and seems to work, providing there are no side-effects.

Already, research has shown that nanoscale delivery devices, such as silica-coated micelles, ceramic nanoparticles, and cross-linked liposomes, can be targeted to cancer cells. This is done by attaching monoclonal antibodies or cell-surface receptors that bind specifically to molecules found on the surfaces of cancer cells, such as the high-affinity folate receptor and luteinizing hormone releasing hormone (LH-RH), or molecules unique to endothelial cells that become co-opted by malignant cells. Once they reach their target, the nano-particles are rapidly taken into cells. As efforts in proteomics and genomics uncover other molecules unique to cancer cells, targeted nanoparticles could become the method of choice for delivering anticancer drugs directly to tumor cells and their supporting endothelial cells. Eventually, it should be possible to mix and match anticancer drugs with any one of a number of nanotechnology-based delivery vehicles and targeting agents, giving researchers the opportunity to fine-tune therapeutic properties without needing to discover new bioactive molecules [5]. This citation shows that research proves that nanotechnology allows cancer cells to be targeted by a number of nano-particles and cross-linked liposome's, by attaching molecules on the surface of cells, and due to the attachments being tiny can transport into cells easily.

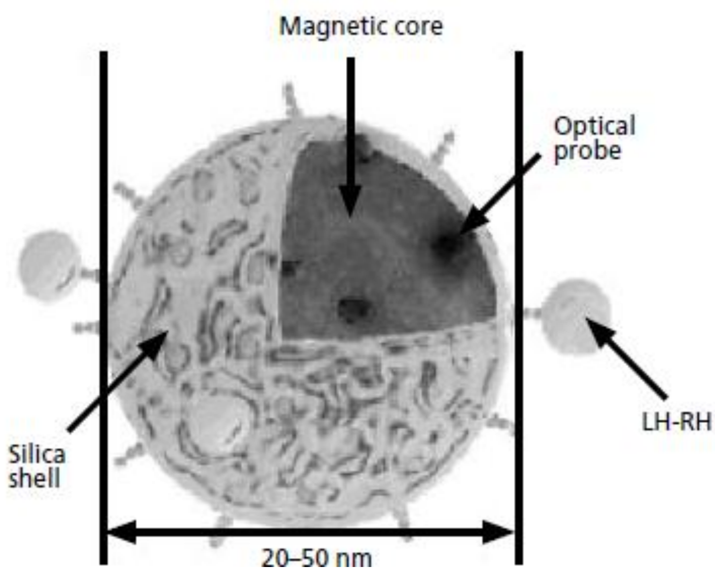

Figure 2 shows the multifunctional nanoparticles can be targets to cancer using the receptors 'LH-RH' liglands.

Current efforts are focused on constructing "smart" nanostructures that will in the end be capable of detecting malignant cells within the body, in their specific locations in the body and killing the cells.

The effective ideology motivating these current efforts is - the ability to multifunction. A good example from the biological world is a virus capsule, made from a limited set of proteins, each with a specific chemical functionality, that comes together to create a multifunctional nanodelivery vehicle for genetic material. While such work with naturally existing nanostructures is promising, chemists and engineers have already made substantial progress turning synthetic materials into multifunctional nanodevices. Dendrimers, 1- to 10-nanometer spherical polymers of uniform molecular weight made from branched monomers, are proving particularly adept at providing multifunctional modularity. In one elegant demonstration, investigators attached folate—which targets the high-affinity folate receptor found on some malignant cells, the indicator fluorescein, and either of the anticancer drugs methotrexate or paclitaxel to a single dendrimer. Both in vitro and in vivo experiments showed that this nanodevice delivered its therapeutic payload specifically to folate receptor-positive cells while simultaneously labeling these cells for fluorescent detection. Subsequent work, in which a fluorescent indicator of cell death was, linked to the dendrimer, provided evidence that the therapeutic compound was not only delivered to its target cell but also produced the desired effect. For example, silica-coated lipid micelles containing LH-RH as a targeting agent have been used to deliver iron oxide particles to LH-RH receptor- positive cancer cells. Once these so-called devices have been taken up by the target cell, they can not only be imaged using MRI, but can also be turned into molecular-scale thermal scalpels: applying a rapidly oscillating magnetic field causes the entrapped Fe2O3 molecules to become hot enough to kill the cell. The critical factor operating here is that nanoparticles can entrap 10,000 or more Fe2O3 molecules, providing both enhanced sensitivity for detection and enough thermal mass to destroy the cell. [6]

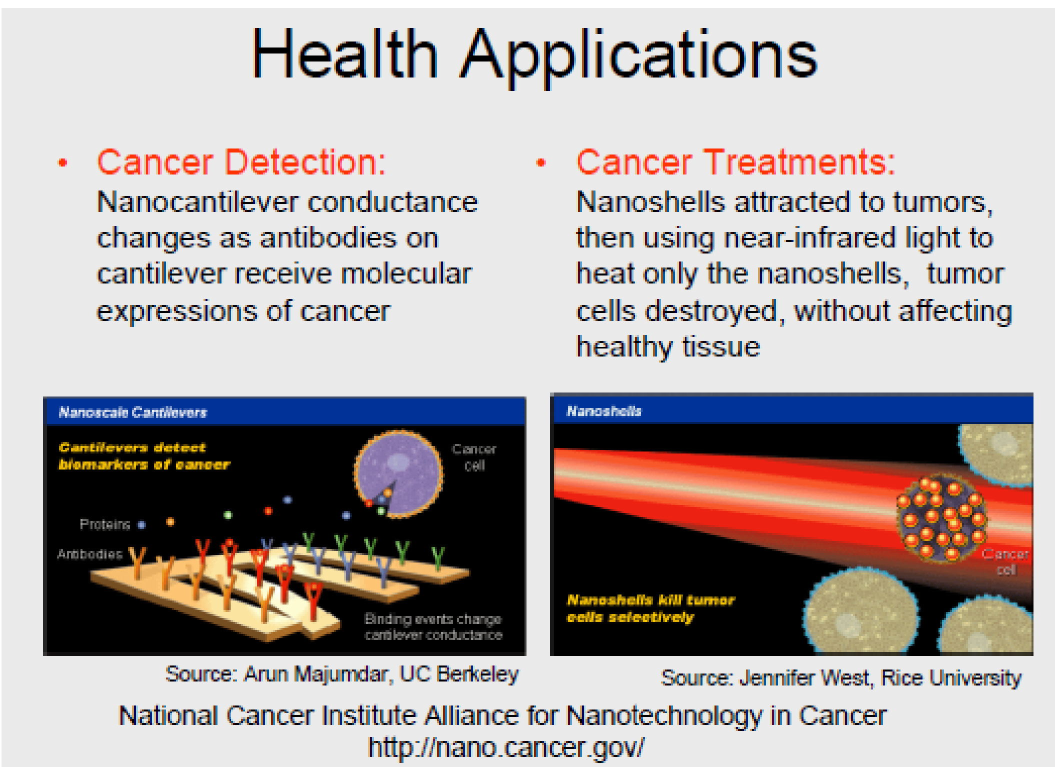

Figure 3 – clearly shows the cancer treatments and detectors, with the aid of nanotechnology.

Issues which could be raised within nanotechnology include economic issues, such as expenses to manufacture the technology, creation, and production could risk putting the country in debt. Nanotechnology might increase dramatically the life expectancy of human beings through diagnostic or treatment nano-machines, improved drugs, or DNA repair. This is often seen as a purely positive outcome. However, a sudden increase in the life expectancy of a large number of people will likely mean that the carrying capacity of cities, countries, and perhaps even the entire world will be exhausted in supporting currently living persons. *This would mean that new births would have to be controlled.* Further, longer productive lifespan mean that key power positions in government, academia, and corporations will not be turning over in their normal manner. As a result, we need to consider the effects on society of a slower turnover of power to the next generation. There could also be more ethical issues raised, as people may disagree to the idea that technology will begin to run everything, like God. To those who are religious, science and technology seems to be taking over the act of God, and disobeying Gods rules, so this may cause a division within society.

Overall, nanotechnology is the future for medicine. Nanotechnology is initiative within science and technology. However it does have several ethical, social, and economic implications that may affect its conclusive popularity within society. Some people may refuse treatment by nano technology because they believe it could be dangerous, as it is not really a treatment which has been fully explored, nor commercialised nowadays. Countries may refuse to pay for such an economically dangerous treatment, it could jeopardise the countries finance as its expenses will be ridiculous, because it will require expensive material and new scientific technology. However saying all that, nanotechnology can replace all current treatments for medical complications such as the topic that has been discussed, Cancer. Nanotechnology has the capability of removing cancer, which is what is wanted and needed in today’s society. We need a treatment to not temporarily fix the problem, but to completely solve it - to completely cure a cancer patient from the disease. Nanotechnology has that capability of using powerful radiation, and powerful substances that will immediately kill the harmful tumour. Also this treatment will potentially attack the tumour and kill it without actually harming other cells within the patient. It is a direct treatment, something that we lack in today’s medical world.

The future holds new ideas, and new initiatives for medicine. With new technology it is easy for Nanotechnology to be replaced by more imaginative ideas. These ideas will have less ethical, social and economic implications in society. Possible treatments that may be used in the future could be a conventional chemotherapy, which won’t harm the patient, and won’t put the patient through the pain and suffering they go through to attempt to remove the cancer. Or possible Long term chronic treatment, which can be injected or made into a tablet. The growing knowledge of cancer, and biological methods, could mean that in the next decade a scientific break through could be emerging. New treatments could be produced and manufactured before nanotechnology is scientifically proven, and globally approved of.

We all want cancer to be beaten because it is a disease which takes away our loved ones. Surely we want a treatment that whilst healing the patient will not harm them. The current chemotherapy treatment harms the patient in many ways. Therefore, surely if nanotechnology can provide a future or hope for any cancer patient, then it deserves the chance to be recognised by people globally, by scientific journals, and by university researchers. This medication deserves a chance to prove it could give hope to a sufferer. Nanotechnology could be the final cure to cancer - surely it deserves to be researched more and globalised

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