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The use of Light and Nanomedicines in Treating Cancer and Increasing Lifespan

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Abstract

This paper focuses on the current need to work on the cancer treatment using Photodynamic therapy (PDT) that uses special drugs, called *photosensitizing agents*, along with light to kill cancer cells. The use of nanotechnology in cancer treatment offers some exciting possibilities, including the possibility of destroying cancer tumors with minimal damage to healthy tissue and organs, as well as the detection and elimination of cancer cells before they form tumors**.**

Keywords – PDT, DNA,FDA,ALA,EST

INTRODUCTION

PDT may also be called *photoradiation therapy*, *phototherapy*, or *photochemotherapy*.PDT can be used in people with certain types of cancer to help them live longer and improve their quality of life.PDT is also used to treat pre-cancers of the skin, and is being tested against pre-cancers in the mouth and other places.Nanotechnology, a new, novel focus of research evolved from the convergence and coalescence of many diverse scientific disciplines and as a general term for the creation, manipulation, and application of structures in the nanometer size range.The ultimate goals of Nano medicine is to create medically useful Nano devices that can function inside the body.

It is envisioned that Nano devices will be hybrids of biologic molecules and synthetic polymers that can enter cells and the organelles to interact directly with DNA and proteins.Nano devices such as quantum dots, nanowires, nanotubes, Nano cantilevers, and Nano pores, Nano shells and nanoparticles are the most promising applications for various cancer treatments

LITERATURE REVIEW

Nanoparticle research is currently an area of intense scientific research, due to a wide variety of potential applications in biomedical, optical, and electronic fields. The word “Nano” is a greek word synonymous to dwarf meaning extremely small. Nanoparticles are of great scientific interest as they are effectively a bridge between bulk materials and atomic or molecular structures. The properties of materials change as their size approaches the nanoscale. Nanomaterials often show unique and considerable change in physical, chemical and biological properties compared to their macro scaled counterparts. For bulk materials larger than one micrometer, the percentage of atoms at the surface is minuscule relative to the total number of atoms of the material

The greatest immediate impact of nanotechnologies in cancer therapy is in drug delivery. The therapeutic index of nearly all drugs currently being used can be improved if they are more efficiently delivered to their biological targets through appropriate application of nanotechnologies[1]. Some drugs that have previously failed clinical trials might also be re examined using Nano technological approaches. A number of obstacles may be overcome with various novel applications of Nano drug delivery.

For example, many drugs are not very soluble, making it difficult to administer therapeutic doses. These compounds[2] can be "solubilized" by formulating them into crystalline Nano suspensions that are stabilized by surfactants, or by combining them with organic or lipid nanoparticles[2] that keep them in circulation for longer periods .

If an efficacious compound has a short half-life in the circulation, its stability can be increased tremendously by encasing it within nanosized[2] liposomes as a drug carrier. In the case of central nervous system cancers, many drugs have difficulty in crossing the blood–brain barrier to attack the tumor. Drug-loaded nanoparticles are able to penetrate this barrier, and have been shown to greatly increase therapeutic concentrations of anticancer drugs in brain tumors

PHOTODYNAMIC THERAPY (PDT):-

PDT using porfimer sodium

Porfimer sodium[3] (Photofrin) is given through a vein (IV). It travels through the bloodstream and is absorbed by both normal and cancer cells all over the body. The normal cells get rid of most of the porfimer sodium over a couple of days. But a lot of the drug stays in the cancer cells, with less in normal cells.
Porfimer sodium alone does not destroy cancer cells. It must be activated or "turned on" with light. This is done about 2 or 3 days after the drug is given. (This gives normal cells a chance to get rid of the drug.) The doctor directs a laser light at the area of cancer cells using a very thin fiber-optic glass strand.

PDT using aminolevulinic acid (ALA)

Aminolevulinic acid (Levulan Kerastick) is a solution that's put right on the spots (called *lesions*) of actinic keratosis. Unlike porfimer sodium[3], it does not reach other parts of the body. This means the lesions are sensitive to the light but the rest of the body is not.

The drug is left on the affected skin for about 14 to 18 hours, usually until the next day. At that time your doctor will expose the area being treated to a blue light for about 15 minutes. During the light therapy[3] you and the doctor will wear protective eyewear. You may feel stinging or burning once the area is exposed to the blue light, but it should go away within a day or so. The treated area may get red and scale and crust for up to 4 weeks before healing. If a lesion does not completely go away after treatment, it can be treated again 8 weeks later.

PDT using methyl ester of ALA

Methyl ester of ALA (Metvixia cream) is used very much like aminolevulinic acid. It's a cream that's put on the skin of the face or scalp to treat actinic keratosis lesions. The doctor will likely first scrape the area with

a small, sharp blade. The lesions[2] where the cream is applied will become sensitive to light, but the rest of the body will not. (This drug does not reach other parts of the body.) The cream should not be left on the skin for more than 4 hours.
The cream is applied and covered with a bandage. About 3 hours later the doctor will take off the bandage, wash off the cream, and expose the area to a red light source for 5 to 20 minutes. During the light therapy you and the doctor will wear protective goggles. You may feel stinging or burning when light reaches the area. Two treatment sessions are usually done 7 days apart. The treated area may turn red, blister, scale, and crust for up to 10 days before healing. The doctor will look at the lesion about 3 months after the last treatment to see whether it worked.

CANCER NANOMEDICINE ON THE MARKET

This section is focused on the cancer nanomedicines that are in clinical trials for any cancer indications and have not been approved by FDA or other regulatory bodies for commercial production.
Therapeutic Nanomedicine in Clinical Trials. Even with development challenges, a few first-generation nanoparticle therapeutics, such as Doxil and Abraxane, have already obtained recognition in the clinical cancer research community. Considerable research and

clinical trials are now being invested in qualifying nanoparticles as "platforms" for various drugs. A large number of preclinical nanoparticle delivery systems have been developed with potential for cancer detection and therapy. The European Science and Technology Observatory (ESTO) conducted a global survey in 2006 and identified that over 150 companies are developing nanoscale therapeutics. As indicated by this blossoming research area, the synthesis and formulation possibilities for nanoparticles are almost endless considering the ability to incorporate various chemical and biology entities that provide both imaging and therapeutic capabilities. However, this multimodality approach combined with the ability to control and target the delivery of a therapeutic agent requires a sophisticated engineering of nanoparticles. For example, multiple factors affect the pharmacokinetic behavior of nanoparticles, but the surface charge, size, nanoparticle shape, and stealth properties are among the most critical. Researchers have exploited these properties at the benchtop for introduction into various preclinical models for the optimization of the stability and delivery characteristics of the nanoparticle. More significantly, this research work has now also led into the introduction of nanoparticle candidates into the clinical and commercial market.

RESULTS AND DISCUSSIONS

Studies have shown that PDT can work as well as surgery or radiation therapy in treating certain kinds of cancers and pre-cancers. It has some advantages, such as:

- It has no long-term side effects when used properly.
- It's less invasive than surgery.
- It usually takes only a short time and is most often done as an outpatient.
- It can be targeted very precisely.
- Unlike radiation, PDT can be repeated many times at the same site if needed.
- There's usually little or no scarring after the site heals.
- It often costs less than other cancer treatments.

Medicinal and structural chemists have been creating and manipulating nanometer and sub nanometer sized components of drugs for decades, and will continue to do so into the foreseeable future. The difference is that they will now be joined by a wide variety of scientists from a number of disciplines normally not involved in drug research

CONCLUSIONS

If the incidence of deaths from cancer had dropped as much as heart disease, cancer would be approaching the status of a rare disease. Instead, overall cancer mortality has changed little during the last decade, while

deaths from heart disease have plummeted almost by half. Although cancer may be more complex than cardiovascular disease, it is not inconceivable that lifestyle changes (smoking cessation) and new drugs developed from Nano technological and other medical advances could create the same laudable statistic for cancer as heart disease in the next decade.Studies are also being done to try to make PDT work better and have fewer side effects. Scientists are looking at things like using ointments containing ferrous or cobalt ions and using hydrogen peroxide on the treated area to improve PDT outcomes

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