Recent Progress on Transfection by using Nanotechnology Nanomedicines

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Abstract:
Nanotechnology offers great advancements to medicine. There is still a lot to be learned about the human body and nanotechnology offers a lot of help. It helps for Target Drug Delivery Systems (TDDS) and also get therapeutic response and against cancer cells or tumors. Designing of nano-medicines helps to create less toxicity and double effect with combination of drug and or alone. Nano-medicines are nano-materials which interact with biological molecules at nano scale. Two forms of nano-medicine that have already been tested in mice and awaiting human trials. Firstly use of gold nanoshells to help diagnose and cure cancer and liposome delivery system and drug detoxification successfully.

Keywords: Properties, Nano materials, Drug Delivery System (DDS), Nano-medicines and nanotechnology, Application

Introduction: Nanotechnology is the study of extremely small structures, having size of 0.1 to 100 nm. “nano” is a Greek word which means “dwarf”. Treatment of individual atoms, molecules, or compounds into structures to produce materials and devices with special properties. Nanomedicine is the medical application of nanotechnology. nanomedicine ranges from the medical applications of nanomaterials and biological devices, to nanoelectronic biosensors, and even possible future applications of molecular nanotechnology such as biological machines1-4.

Properties of Nano Particles: Nanoparticles have discrete diverse properties due to their small size e.g. Electrical conductance Chemical reactivity Magnetism Optical effects Physical strength. Nano medicine is a relatively new field of science and technology. By interacting with biological molecules at nano scale, nanotechnology5 broadens the field of research and application. Interactions of nano devices with bio molecules can be understood both in the extracellular
medium and inside the human cells. Operation at nano scale allows exploitation of physical properties different from those observed at micro scale such as the volume/surface ratio. Two forms of nano medicine that have already been tested in mice and are awaiting human trials; use of gold nano shells (Figure 1) to help diagnose and cure cancer, and the use of liposome as vaccine adjuvants and as vehicles for drug transport. Similarly, drug detoxification is also another application for nano medicine which has been used successfully in rats. Medical technologies can make use of smaller devices are less invasive and can possibly be implanted inside the body, and their biochemical reaction times are much shorter. As compared to typical drug delivery nano devices are faster and more sensitive.

Nanomedicine

Figure 1: Nanoshell gold particle detection and treatment of disease

Figure 2: Nanoparticles for effective detection and treatment of disease

Nano Materials: Nano materials have increased surface area and nano scale effects playing a contributing role in advancement of drug and gene delivery, biomedical imaging and diagnostic biosensors. Nano materials have unique physicochemical and biological properties as compared to their larger counterparts. Nanotechnology playing peculiar role in diagnosis, treatment and prevention of varying types of cancer and neurodegenerative disorders. Nano particles have a special property of high surface area to volume ratio, which allows various functional groups to get attached to a nano particle and thus bind to certain tumor cells. Furthermore, the 10 to 100 nm small size of nanoparticles (see figure 2), allows them to preferentially accumulate at tumor sites as tumors lack an effective lymphatic drainage system. Multifunctional nano particles can be manufactured that would detect, image, and then treat a tumor in future cancer treatment.

Drug Delivery System (Dds) Of Nano Particles: Drug Delivery Nano particles are used for site specific drug delivery. In this technique the required drug dose is used and side-effects are lowered
significantly as the active agent is deposited in the morbid region only. This highly selective approach can reduce costs and pain to the patients. Thus variety of nano particles such as dendrimers, and nano porous materials find applications. Micelles obtained from block co-polymers, are used for drug encapsulation. They transport small drug molecules to the desired location 15-17. Nano materials have increased surface area and nano scale effects, hence used as a promising tool for the advancement of drug and gene delivery, biomedical imaging and diagnostic biosensors. Nano materials have unique physicochemical and biological properties as compared to their larger counterparts. The properties of nano materials can greatly influence their interactions with bio molecules and cells, due to their peculiar size, shape, chemical composition, surface structure, charge, solubility and agglomeration. For example, nano particles can be used to produce exceptional images of tumor sites; single walled carbon nano tubes, have been used as high-efficiency delivery transporters for biomolecules into cells. There is a very bright future to nano technology 18, by its merging with other technologies and the subsequent emergence of complex and innovative hybrid technologies. Biology-based technologies are intertwined with nanotechnology. nanotechnology is already used to manipulate genetic material, and nano materials are already being built using biological components. The ability of nanotechnology to engineer matter at the smallest scale is revolutionizing areas such as information technology cognitive science22 and biotechnology and is leading to new and interlinking these and other fields. By further research in nanotechnology, it can be useful for every aspect of human life. Medicine, regenerative medicine, stem cell research and nutraceuticals are among the leading sectors that will be modified by nanotechnology innovations.[18-22]

4.1 WHY NANOMEDINE [23-28] : nanotechnology offers great advancements to medicine. there is still a lot to be learned about the human body and nanotechnology offers a lot of help such as prevention and control early detection imaging and diagnostics and multifunctional therapeutics (figure 3).
Figure 3: Nanomedicine

Classification of Nanomedicines 29-32: Pharmaceutical nano-system pharmaceutical nanotechnology is divided in two basic types of nano tools viz. 1) nano materials (figure 4). 2) nano devices. Nano pharmaceuticals Nano pharmaceuticals can be used to detect diseases at much earlier stages and the diagnostic applications could build upon conventional procedures using nanoparticles. Nano pharmaceuticals are an emerging field where the sizes of the drug particle or a therapeutic delivery system work at the nanoscale. Novel Delivering the appropriate dose of a particular active agent to specific disease site still remains difficult in the pharmaceutical industry which known as liposome delivery system (Figure 5). Nano pharmaceuticals have enormous potential in addressing this failure of traditional therapeutics which offers site-specific targeting of active agents. That results in reduction of side effects of lethal dose.

Figure 4: carbon nanotube and liposome delivery system
Factors Affecting Drug Delivery Nano technology based drug delivery is based upon three facts:

i) Efficient encapsulation of the drugs.

ii) Successful delivery of said drugs to the targeted region of the body.

iii) Successful release of that drug there.

NANOTECHNOLOGY 33-35: Nanotechnology in health and medicine Nano-medicine is an application of nanotechnology which works in the field of health and medicine. With the help of nanomedicine early detection and prevention, improved diagnosis, proper treatment and follow-up of diseases is possible. Certain nano scale particles are used as tags and labels, biological applications can be performed quickly, the testing has become more sensitive and more flexible. Gene sequencing has become more efficient with the invention of nano devices like gold nanoparticles, these gold particles when tagged with short segments of DNA can be used for detection of genetic sequence in a sample. Tissue Engineering Damaged tissue can be reproduced or repaired. These so called artificially stimulated cells are used in Tissue engineering, which might revolutionize the transplantation of organs or artificial implants. Stem cell Magnetic nanoparticles (MNPs) have been successfully used to isolate and group stem cells. Quantum dots have been used for molecular imaging and tracing of stem cells, for delivery of gene or drugs into stem cells, nano materials such as carbon nanotubes, fluorescent CNTs and fluorescent MNPs have been used. Unique nanostructures were designed for controllable regulation of proliferation and differentiation of stem cells is done by designed unique nano structures.

Applications 24-32: one of the most promising applications of nanotechnology is in the field of medicine. Indeed, a whole new field of “nanomedicine” is emerging. Nanomedicine has been defined as the monitoring, repair, construction and control of human biological systems at the
molecular level using engineered nanodevices and nanostructures. It can also be regarded as another implementation of nanotechnology in the field of medical science and diagnostics. (See figure 6).

Figure 6: Applications and research targets of nanomedicine.

Conclusion: Nanotechnology will radically change the way we diagnose, treat and prevent cancer. Nanomedicine for cancer has the ability to improve health care dramatically. Current research is mostly in diagnostic tools, although there are many other application of nanomaterials in medicine. There are still lots of advances needed to improve Nano-medicines. Applications of nanoparticles in drug delivery, protein and peptide delivery, cancer are explained. Applications of various nano systems in cancer therapy such as carbon nanotube, dendrimers, nano crystal, nanowire, nano shells etc. are given. The advancement in nano technology helps in the treatment of neurodegenerative disorders such as Parkinson’s disease and Alzheimer’s disease. Applications of nanotechnology in tuberculosis treatment, the clinical application of nanotechnology in operative dentistry, in ophthalmology, in surgery, visualization, tissue engineering, antibiotic resistance, immune response are discussed in this article. Nano pharmaceuticals can be used to detect diseases at much earlier stages.

References:


19. Robert Freitas, supra note 29, at 26 (quoting Smalley in testimony before a congressional sub committee about the promise of nanotechnology).


