NANOTECHNOLOGY IN MEDICINE

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Abstract: *Nanotechnology, the manipulation of matter at the atomic and molecular scale to create materials with remarkably varied and new properties, is a rapidly expanding area of research with huge potential in many sectors, ranging from healthcare to construction and electronics. In medicine, it promises to revolutionize drug delivery, gene therapy, diagnostics, and many areas of research, development and clinical application. This article does not attempt to cover the whole field, but offers, by means of some examples, a few insights into how nanotechnology has the potential to change medicine, both in the research lab and clinically, while touching on some of the challenges and concerns that it raises.*

Key words: *Nanomedicine, Drug Delivery, Nano machines, Smart pharmaceuticals, Aging postponement*

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INTRODUCTION

The term “molecular nanotechnology “has been coined to mean the technology of highly versatile and inexpensive molecular fabrication, molecular manipulation and molecular level manufacturing. It has potential applications in many sectors including consumer products, health care, transportation, energy and agriculture.

NANOMEDICINE, also defined Nanotechnology in medicine involves applications of nanoparticles currently under development, 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). . The use of nanotechnology in medicine offers some exciting possibilities. Some techniques are only imagined, while others are at various stages of testing, or actually being used today.Whatever you call it, the use of nanotechnology in the field of medicine could revolutionize the way we detect and treat damage to the human body and disease in the future, and many techniques only imagined a few years ago are making remarkable progress towards becoming realities Nanomedicine as the use of nanotechnologies in medicine, supports a strong research and emerging industrial healthcare sector in world. Based on excellent academic research and innovative ideas, nanomedicine has the potential to answer today’s challenges such as the ageing population, targeted drug delivery, cellular surgeries.

APPLICATIONS OF NANOTECHNOLOGY

Today’s nanotechnology harnesses current progress in chemistry ,physics, material sciences and biotechnology to create novel materials that have unique properties. Some of these materials have already found their ways into consumer products , such as sun screens ,face washes and stain resistant paints. Others are being intensively researched for solutions to humanity’s greatest problems like diseases, clean energy, clean water ,etc.

The use of nanotechnology is rapidly growing in medicine and has generated significant interest at developing roadmap for productive nanosystems, in which a path is sought from today’s nanotechnology to advanced future systems so as to develop useful materials, devices and complex systems such as molecular tools. The products of advanced nanotechnology that will become available in coming decades promise even more revolutionary applications.

NANOTECHNOLOGY CHALLENGES

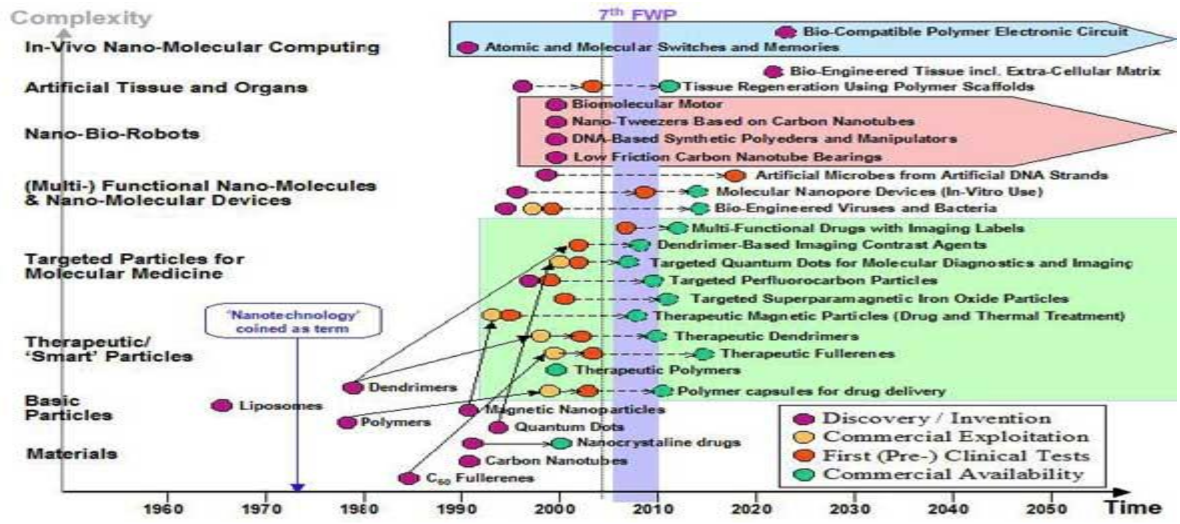
There is various nanotechnology Challenges in which current and advanced nanotechnology is providing hope for solving various challenges facing humanity.

- Providing renewable clean energy
- Supplying clean water globally
- Improving health and longevity
- Healing and preserving the environment
- Maximizing productivity of agriculture
- Making information technology available to all
- Enabling space development

NANOTECHNOLOGY IN MEDICINE

The use of nanotechnology (i.e., the manipulation and control of nanoscale objects) is rapidly growing in medicine and has generated significant interest over the past few years. It has led to important innovations in vaccinology and molecular imaging; immunology, development of optimally designed therapeutic agents etc. There is increasing optimism that nanotechnology, as applied to medicine, will bring significant advances in the diagnosis and treatment of disease. Anticipated applications in medicine include drug delivery, both in vitro and in vivo diagnostics, production of improved biocompatible materials etc. Engineered nanoparticles are an important tool to realize a number of these applications. These nanoparticles (NPs) are attractive for medical purposes due to their important and unique features, such as their surface to mass ratio that is much larger than that of other particles, their quantum properties and their ability to absorb and carry other compounds. NPs have a relatively large (functional) surface which is able to bind, adsorb and carry other compounds such as drugs, probes and proteins.

The diagram below indicates what has already been achieved and what the future prospects for nanomedicine are.



Source: Philips Medical Systems (7th FWP refers to the European Union's Seventh Framework Program)

Some of the nanotechnological applications in medicine are discussed below.

Nanotechnology outside the tissues

One approach to nanomedicine would make use of microscopic mobile devices built using molecular-manufacturing equipment. Development will start with the simpler applications that can work without entering living tissues.

Skin problems can be overcome by cream packed with nanomachines that could do better and more selective job of cleaning than any product can today. It could remove the right amount of dead skin , remove excess oils, add missing oils, apply the right amounts of natural moisturizing compounds, and even achieve the elusive goal of "deep pore cleaning" by actually reaching down to the pores and cleaning them out.

Today daily dental care is an endless cycle of brushing and flossing, of losing ground to tooth decay and gum disease as slowly as possible. A mouthwash full of smart nanomachines could do all that brushing and flossing do and more, and with far less effort,making it more likely to be used. As short-lifetime medical nanodevices they could be built to last only a few minutes in the body before falling apart into materials of sort found in foods (such as fiber). With this sort of daily dental care from an early age, tooth decay and gum disease would likely never arise.

Nanotechnology within Tissues

Nanodevices or nanomachines can perform variety of functions within tissues. Some of them are listed below.

- Identification and elimination of invaders such as Bacteria ,virus ,Protozoa, parasites and worms
- Herding cells that can stimulate and guide the body's own construction and repair mechanism to restore healthy tissues.
- Medical procedures involving delicate surgery on individual cells by using nanoscale tools
- Use of nano surgery machines to defeat viruses by DNA repair.
- Use of molecular medicines to combat metabolic problems like absence of enzymes, biochemicals

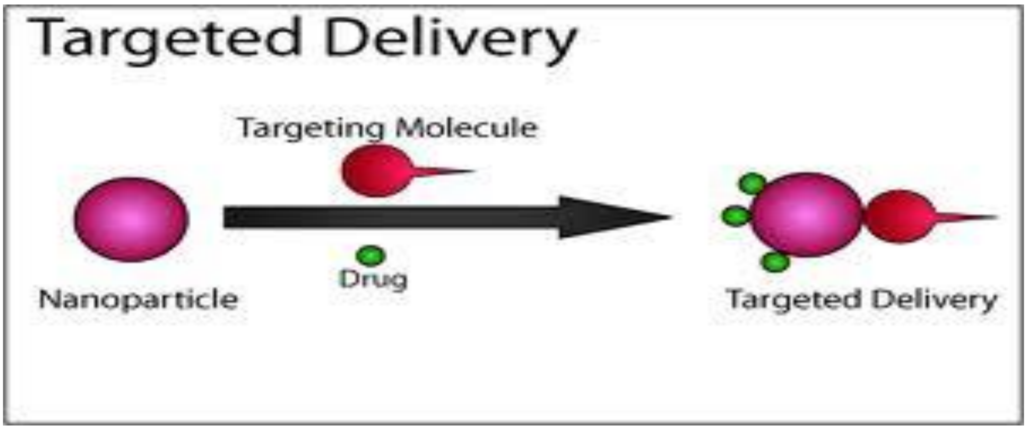
Targeted Drug Delivery

One application of nanotechnology in medicine currently being developed involves employing nanoparticles to deliver drugs, heat, light or other substances to specific types of cells (such as cancer cells). Particles are engineered so that they are attracted to diseased cells, which allow direct treatment of those cells. This technique reduces damage to healthy cells in the body and allows for earlier detection of disease.

The primary goals for research in drug delivery include:

- More specific drug targeting and delivery.
- Reduction in toxicity while maintaining therapeutic effects.
- Greater safety and biocompatibility.
- Faster development of new safe medicines.

Accurate targeting of the drug can now be achieved, using specially designed drug-carrying nanoparticles. This also means that much smaller quantities of a drug are necessary, reducing toxicity to the body. The drug is then activated only at the disease site (such as a tumour) by light or other means, and the progress of the cure can also be monitored using advanced imaging techniques



"Smart Pharmaceuticals"

Today's drug is essentially a single molecule with an often sophisticated but always limited repertoire. Tomorrow's "smart pharmaceuticals" could be essentially programmable nano - machines with a range of "sensory", "decision making", and "effectors" capabilities. They might avoid side effects and allergic reactions, becoming active only upon reaching their final destination and attaining almost complete specificity of action. They might check for over dosage before becoming active, thus preventing accidental or intentional poisoning. They might have not one chemical action but could target an invading organisms or malignant cells through a series of chemical reactions that guarantee the death of the target. Despite the vast increase in complexity over present-day drugs, such agents can be expected to be totally "pure" and predictable in their behavior. Moreover these pharmaceuticals would be more safe and efficient than the presently used drugs.

Postponement of ageing

The deterioration that comes with aging is increasingly recognized as a form of disease, one that weakens the body and makes it susceptible to a host of other diseases. Aging results from internal malfunctions in the molecular machinery of the body, and a medical condition with so many different complicated symptoms. The postponement of aging is likely to follow a trajectory similar to most technologies for which there is widespread enthusiasm; after an indeterminate period in pursuit of initial breakthrough, improvements in the technological aspects like cost, convenience and efficacy will occur rapidly.

Nanotechnology is unlikely, to be sufficiently mature to contribute appreciably to the very first rejuvenation therapies, because purely biotechnological solutions to the major type of age-related damage are well advanced and will reach the clinic before nanotechnology can catch up. However, nanotechnology seems likely to play a major role in the more sophisticated interventions that will be required to maintain youthfulness, once life spans on the order of two or three times natural ones are achieved. Repair of nuclear mutations, cleavage of protein/protein crosslink and destruction of aggregated intracellular material are three major categories of therapy those can be achieved to a large extent by foreseeable nano- biotechnology, to postpone ageing and hence improve longevity.

CONCLUSION

Clearly the world of health care technology will be substantially different in 2050 from that of today. Resent nanotechnology research is making tremendous progress in the medical field. Some of the nanotechnology applications in the arena will be inexpensive and rapid diagnostics, new methods of drug delivery, and faster development of new drugs. Some long term and even more powerful nanotechnology solutions will repair DNA and cellular damage and customize drug therapy. It can be hoped that molecular nanotechnology in addition to create these dramatic changes will also be one of the technologies that help the practitioner of 2050 stay abreast of and manage these development.

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