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Nanotechnology: In the field of Medicine

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Abstract: At least one dimension of nanotechnology involves the study of particles within the size range of 1 to 100 nanometers. In the field of science, technology, and research, it covers a broad range of disciplines. It is basically the process of dealing with small objects. By using physical, chemical, and biological synthesis methods, nanomaterial can be created either bottom up or top down. There are many applications for nanotechnology in both the medical and technological fields. An introduction to nanotechnology is presented in this article, as well as perspectives on how this technology can be used for medical diagnosis, for drug delivery, and for imaging.

Keywords: Nanotechnology, medicine, diagnosis.

INTRODCTION

Scientists and engineers define nanotechnology as the science and engineering involved in the design, synthesis, characterization, and application of materials and devices whose smallest functional organization is at least one billionth of a meter in size or nanometer-scale. Nanometers are one billionth of a meter (10–9 m or 10–7 cm), one hundred thousand times smaller than human hairs, one thousand times smaller than red blood cells, and half the size of DNA [1]. When we consider individual molecules and the interactions between groups of molecules as part of the bulk macroscopic properties of a material or device, molecular structure becomes significant, since it has a bearing on both the fundamental structural features as well as the macroscopic chemical and physical properties [2]. The field of nanotechnology has found many applications in fields like electronics, physics, chemistry, and engineering over the years. Its applications in biomedical and pharmaceutical fields have not yet been fully explored. In the present article, we discuss some of these applications.

ADVANTAGE OF NANO SIZE AND MECHANISM IN RELATION TO MEDICINE

A multidisciplinary field, nanotechnology combines basic sciences and applied fields such as physics, molecular biology, and bioengineering. In pharmaceutics, size reduction represents a fundamental process for improving drug efficacy. It has a number of advantages, including 1. Increasing surface area, 2.Enhancing solubility, 3.Increasing rate of dissolution and oral bioavailability, 4. Rapid onset of action, 5. Less amount of pharmaceutical dosage is required. This new generation of materials and devices can be designed to interact with a high degree of functional specificity, enabling a degree of interaction between technology and biological systems that has never been possible before [3]. By manipulating drugs and other ingredients on the nanometer scale, fundamental properties and bioactivity of materials can be changed. These tools can allow control of various characteristics of drugs or agents such as [4]. :

a. changes in solubility retention time and blood pools.

b. controlled release for short or long duration.

c. Controlled releases triggered by the environment or shipping targeted by a very specific site.

APPLICATIONS OF NANOMATERIALS IN MEDICINE

In comparison with most biological molecules and structures, nanomaterials are similar in size. Because of this, nanomaterials have a wide range of potential applications in biomedical research. In this hybrid field, we use terms like biomedical nanotechnology, nanobiotechnology, and nanomedicine. So, nanomaterials have been incorporated into biology to create diagnostic devices, contrast agents, analytical tools, and drug delivery vehicles. As an extension of lab-on-a-chip technology, nanotechnology-on-a-chip brings yet another dimension. Molecular, structural or microorganism labels can be created by using magnetic nanoparticles incorporated into an antibody [5]. An easy way to detect genetic sequence in a sample is to tag gold nanoparticles with short segments of DNA. In polymeric micro beads, different-sized quantum dots have been embedded for optical coding of biological assays. Strings of nucleotides can be directly converted into electronic signatures using nanopore technology [6].

a) Disease detection and diagnosis

Bio-labeled nanoparticles are used to diagnose and treat cancer, and this is one of the most well known areas of nanoscience based on nanomaterials. Nanotechnology is very active in this field. Before doctors can use nanoparticles widely for cancer treatment, more work needs to be done. It is crucial to detect cancer at an early stage in order to improve cancer treatment. To detect and diagnose cancer currently, physical touch or imaging expertise are used to detect changes in cells and tissues [5]. The scientists want to be able to identify the earliest molecular changes long before any physical examination or imaging can be useful [7]. For scientists to detect cancer at an early stage, molecular changes must be able to be detected even if only a small percentage of cells exhibit them. Nanostructures may be able to penetrate and analyze single cells, thus meeting this need. Nanotechnology tools can be used to improve healthcare. Cells and tissue taken from the patient are not physically altered during testing. In practice, clinicians often have limited access to the samples they use to screen for cancer.

In recent years, molecular imaging has become an increasingly powerful tool for visualizing molecular events associated with an underlying disease, sometimes before its downstream manifestation. A unique aspect of the combination of nanotechnology and molecular imaging is that it provides a flexible platform to design nanoprobes that enhance the sensitivity, specificity, and signaling properties of various biomarkers in human diseases [8]. MRI contrast enhancement probes can be fabricated using simple magnetic nanoparticles. As a result, these magnetic nanoparticles could be used to add fluorescence tags, radionuclides, and other molecules for multimodal imaging, gene delivery, and cellular transport. By using magneto-resonance imaging (MRI) and hybrid nanoparticles with adenoviruses, we are able to detect target cells optically and monitor gene delivery and expression of green fluorescent proteins [9].

b) Site specific drug delivery

By reducing the costs associated with public health due to reduced drug consumption and treatment expenditures, targeted and personalized medicines reduce the costs to society overall. The biggest diameter of animal cells is between 10000 and 20000 nanometers. Nanoscale devices (less than 100 nanometers) can make contact with DNA and proteins in cells and organelles. The development of nanotechnology may enable the detection of disease in a very small quantity of cells or tissues [10]. Using active delivery to lung cells in tuberculosis chemotherapy was reported to improve bioavailability, reduce dosage frequency, and overcome nonadherence problems [11]. The application of nanotechnology is also opening up new possibilities in the delivery of implantable systems that are often more effective than injectable drugs because they exhibit first-order kinetics [5]. As a delivery system for drugs, nanotechnology has demonstrated its effectiveness in reducing side effects [12].

CONCLSION

With nanoengineered tools, nanotechnology offers new tools, opportunities, and scope which are expected to have a substantial impact on the diagnosis, prognosis, and treatment of diseases. The nanotechnology industry is an integral part of disease prevention efforts because it offers innovative tools to understand the cell and determine whether a cell is normal or abnormal. The field could provide insight into the underlying mechanisms of disease. The following are some of the advantages of nanotechnology:

a. Model nanomaterial identification, definition, and characterization.

b. Designing toxicological tests.

c. Measurement and monitoring of exposure levels.

d. Evaluation of environmental impacts.

e Designing biocompatible hybrid systems.

We still lack the necessary data and guidelines regarding the safe application of nanotechnology based devices and materials. The situation warrants attention as there are several confounding issues yet to be resolved.

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