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JSM Nanotechnology & Nanomedicine

Editorial

Nanotechnology and its role in advancing Medicine

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Submitted: 11 September 2013

Accepted: 12 October 2013

Published: 14 October 2013

Nanotechnology a word stemmed from Greek origin means the dwarf. In the modern science, a nanometer means one billionth of a meter of something. The science of nanotechnology is therefore the ability to manipulate these tiny particles. Nanotechnology is increasingly employed to explore the unseen avenues of medical sciences. There are many types of nanoparticles that are used in medicine and other fields, gold particels, Dendrimers, Perfluorocarbon, Nanotube, Iron oxide and FeCo are just few types that are used in this field and will lead to personalized medicine and early target therapy [1]. This editorial will address just few of the different uses of Nanotechnology in Medicine;

Combatting bacterial growth by using nano-silver particles for delivery of the drug inside the cell where the bacteria is hiding as in case of *Tuberculosis*, *Brucella* and other intracellular parasites is of prime importance. Silver nanoparticles coupled to chitalic, a modified chitosan (polysaccharide) were used effectively to combat both gram negative and positive bacteria [2]. Similarly, chitin/silver nanoparticles composites were used to combat both Gram positive and Gram negative especially during wound healing after major surgeries [3]. The enhanced antibacterial effect of silver nanoparticles might be attributed to their stability as colloid which modulate the phosphotyrosine profiles of bacterial proteins leading to their death [4]. In addition, silver itself was found to strongly interact with bacterial genome or thiol groups of vital enzymes leading to their inactivation [5]. These breakthroughs could provide an alternative to the traditional antibiotics where antimicrobial resistance emerge as a problem particularly in wound management after surgeries and in nosocomial infections caused by multidrug resistant *S. aureus* and other pathogens.

Imaging quality enhancement could be accomplished by using nanoparticles before imaging of that organ to target a certain location or to enhance the visualization of a selected biomarker. For instance, the use of near infrared-absorbing gold nanoparticles can significantly enhance image contrast by creating different optical absorption zones leading to the development of stronger photoacoustic wave generation [6] and thus enhancing the whole imaging process. The use of tissue specific antibodies conjugated to gold nanoparticles or certain dyes like luciferase certainly enhance imaging of the targeted tissues. Other example is the use of Fluorodeoxy-gluclsoe imaging by PET for the characterization of diverse disease states [7]. More interestingly is the use of the HDL molecules as carriers for imaging agents such as a radiolabel or gold particles for the atherosclerosis plaque imaging process by CT scan or MRI [8].

Targeted drug delivery and therapy of certain diseases and tumors was always one of the most significant challenges facing the treatment of certain diseases and for the drug to reach certain location such as tumors. The first attempts to use nanotechnology for drug delivery goes back to 1965 where liposomes were used to coat certain drugs so they reach their destination while intact. Drug conjugated to liposomes had short life span while circulating in blood. Polyethylene glycol (PEG) conjugated products exhibited longer life in circulation. Therefore, low MW PEG is normally used to deliver small drug molecules such as oligonucleotides, and siRNA [9] and to increase their circulation and thus bioavailability. Akin et al, [10] have used a fascinating system to deliver certain drugs or genes to the cells using bacteria coated with an antibody that binds to a nanoparticle attached to a drug or a gene. Bacteria are internalized by the affected cell where the cargo is released and exert its effect. Other fascinating approach is the use of tumor-targeted nanoparticles where these particles are guided to the location of the tumor. Once these particles reside there, a thermal energy by laser is applied leading to the destruction of the tumor cells adjacent to the particles. According to Gannon et al [11] direct intratumoral injection of nanotubes followed by immediate radiofrequency field treatment (13.56 MHz) resulted in complete necrosis of VX2 hepatic tumors [12]. Monoclonal antibodies specific to antigenes experessed on the suface of certain malegnancies were uesd as a vehicle for targeted drug (toxin) delivery to the malignant cell where the antibody bind to the cell while the toxin is internalized via receptor mediated endocytosis followed by the reales of the toxin where it exert its effects and kill the cancerous cell [13].

Improving medical diagnosis of bacteria and biomarkers through using antibody-coated nanoparticles to collect dispersed bacteria in large volume of media is just one of the many uses of nanotechnology in the diagnostic medical filed. Colloidal gold particles are used frequently in point of care diagnostics and biosensors for early diagnosis of many diseases or certain developmental stages like pregnancy detection. Indeed colloidal gold particles made a revolution in cutting the time and effort

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in such diagnostic kits enabling physicians to diagnose disease cases or carriers of a certain pathogen within 3-5 minutes.

In Conclusion, nanotechnology, with revealing the unseen and reaching the unreachable, offers unlimited medical and diagnostic applications that will certainly be reflected positively on the welfare of human beings. However, like any other product or tool, there are always arising some concerns as a result of its usage. The exceptional mobility of nanoparticles, their tinny size and their ability to penetrate cell membranes might pose certain health hazards while in use for imaging, drug delivery or combatting certain diseases.

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Cite this article

Jaradat ZW (2013) Nanotechnology and its role in advancing Medicine. JSM Nanotechnol Nanomed 1(2): 1012.