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### Letter to Editor

#### Cancer Nanotechnology--- A Panacea

Dr. Vicky V. Mody<sup>†</sup> and Hardik R. Mody<sup>‡</sup>

<sup>†</sup>Assistant Professor of Medicinal Chemistry, Department of Pharmaceutical Sciences, Appalachian College of Pharmacy, Oakwood, Virginia, USA

<sup>‡</sup>Dr. LH Hiranandani College of Pharmacy, Mumbai University, Ulhasnagar, India

*Sir*

Nanotechnology is the manufacturing of the minuscule gears in the range of nanometers. Even though the term is new, its history dates back to the year 1959 when Richard P. Feynman, a physicist at Caltech said, "There is plenty of room at the bottom", suggesting to decrease the particle size of the molecule to use it at its full throttle.<sup>1</sup> His intriguing talk on this new subject led to the advent of a new field "Nanotechnology". Since then myriad work has been done to develop nanoparticles which range in size of 100nm or less to enable its use in medicine, electronics, and energy production. To have a better viewpoint, a nanometer is 1/50,000 times of the width of an average human hair. Moreover, the maximum height of a DNA strand is approximately three times a nanometer. Likewise, a variety of biological processes occur at nanometer scales. Thus it is easy to conclude that human body is fabricated of framework of natural nanoclusters such as genes and cells. Consequently, in order to communicate with these natural nanoclusters, a moiety with dimensions on a nanometric scale has to be developed. As a result, nanoparticles can offer some unique advantages in the field of biotechnology. Hence, it is no wonder that nanotechnology has been used around the world for copious medical applications such as imaging and targeting of diseases.

Among all the diseases, cancer is the key area of medical nanotechnology research due to the defects in its morphology formed during the process of angiogenesis. Angiogenesis represents the ability to form new blood vessels and is a critical step in tumor development. It is during this process the tumor establishes an independent blood supply, consequently facilitating tumor

growth. These newly formed tumor vessels are usually abnormal in form and their architecture is defined by leaky endothelial cells with wide fenestrations. Fortunately, these leaky membranes can be used to our advantage to deliver certain sized molecules which can accumulate in tumor tissue enabling its diagnosis and therapy. This enhanced permeability of the molecules of certain sizes in the tumor cells as opposed to normal tissue is defined as Enhanced Permeability and Retention (EPR) effect.<sup>2</sup>

Most commonly, the therapeutic agents used to target tumor cells range in particle sizes between 10-500nm. Moreover, due to leaky constitution of neovasculature in malignant tumors, smaller sized nanoparticles may easily penetrate the leaky endothelial cells in a non-specific way through gaps into the tumor interstitial space. Once these nano sized particles are positioned onto the tumor cells they can be used to communicate with biomolecule in a fashion or way that can be decoded and designated to various biochemical and physiochemical properties of these cells.<sup>3</sup> This type of non specific targeting achieved by modulating the physical properties (for e.g. size) of the nanoparticles is termed as the passive targeting. However, in an effort to utilize nanoparticles at their maximum potential, it is important that these nanoparticulated systems should be stable, biocompatible, and selectively directed to specific sites in the body after systemic administration. Hence, specific tissue targeting systems are designed to recognize part or certain receptors on the tissues such as cancer. This can be achieved by conjugating the nanoparticle with a ligand or a small peptide chain which has a selective binding activity to the specified receptors only on the tumor cells as opposed to the normal cells. This type of specific targeting achieved by modulating the

chemical properties of the nanoparticles is termed as the active targeting.

Nonetheless, the overall goal of the cancer nanotechnology is to target the tumor cells via passive or active targeting with high specificity so as to incorporate higher payloads at the targeted site. This resulted in the development of various nanocarriers such as polymeric nanoparticles, carbon nanotubes, liposomes, solid lipid nanoparticles, magnetic nanoparticles, nanoshells, nanocapsules, and dendrimers for targeting tumor sites to enable its molecular imaging.<sup>4</sup> Moreover, these nanocarriers can be further modified by conjugating them to various monoclonal antibodies or tumor specific ligands for more precise active targeting of the tumors.<sup>4</sup> Once targeted (active or passive), these nanocarriers can be designed in a way to facilitate them to act as imaging probes.<sup>4,5</sup> Hence, these so called "molecular imaging probes" can provide valuable information about the tumor advancement, staging of the tumor and its metastasis. In addition, it can also be used to differentiate abnormalities in various body structures and organs to determine the extent of disease, and evaluate the effectiveness of treatment rendered.

Thus, I would like to conclude that cancer nanotechnology enables the visualization of the cellular function and the follow-up of the molecular process in living organisms at a

nanoscale. This will assist not only in the diagnosis of the cancer's early stage, but also to assess the efficacy of treatment provided, leading to the decrease in the death rate of the patients around the world, who are affected with this dreadful disease.

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**Dr. Vicky V. Mody**  
**Assistant Professor of Medicinal Chemistry**  
**Department of Pharmaceutical Sciences**  
**Appalachian College of Pharmacy**  
**1060 Dragon Road, Oakwood**  
**Virginia, USA 24614**  
**Email: [vmody@acpharm.org](mailto:vmody@acpharm.org)**