

Personalized Nanotheranotics for Cancer

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According to a cancer statics report, more than 14 million new cancer cases and 8.2 million deaths were reported worldwide in 2012 [1]. Cancer remains a complex and difficult-to-treat disease with heterogeneity of tumor makes it more challenging for chemotherapeutic intervention. Heterogeneity of tumor includes differences among cancer patients of same type and within a same type of tumor. Traditional cancer treatment with “One treatment fits all” or “one dose fits all” philosophy provides lack of specificity to tumor, limited or no therapeutic effects, drug resistance, disease relapse, and severe adverse effects.

Biological sciences are rapidly evolving with tremendous amount of information discovered about normal and diseased biology. An important tool in this area is the evolution of “omics” (genomics, proteomics, epigenomics, transcriptomics, metabolomics and lipidomics) database [2]. Integrative Omics technology has been enabling scientists to discover precise and accurate cancer biomarkers which can be used for predictive, prognostic and/or diagnostic purposes.

Nanomedicines has shown various advantages such as design flexibility, prolonged blood circulation, increased drug accumulation at the target site, increased therapeutic efficacy and at the same time, reduced adverse or toxic effects to healthy cells [3]. Moreover, the surface of the nanoparticles can be modified to attach hydrophilic polymers (e.g. polyethylene glycols), targeting ligands (e.g. peptides, monoclonal antibodies) and diagnostic or imaging agents (e.g. quantum dots, inorganic nanoparticles). Chemotherapy containing nanomedicines are already in the market including Myocet, Doxil and Abraxane. The success of monofunctional nanomedicines enabled us to design more complex, multifunctional nanoscale drug delivery systems advantageous for cancer treatment. The combination of diagnostic and therapeutic nanomedicines into a single, integrated system, better known as nanotheranotics would be an exciting new avenue for effective cancer diagnosis, and treatment. Apart from diagnostic agent, there may be a need to combine small-molecular weight drugs, proteins, nucleic acids or radioactive agents into a single nanoparticle cargo for maximizing therapeutic efficacy [4].

Personalized medicine would be revolutionizing the treatment paradigm in cancer [5-8]. It aims at individualizing therapeutic interventions based on *ex vivo* and *in vivo* profiling, the type, the stage, and the grade of the disease, as well as on the response of a particular patient to a particular treatment [5]. In the first personalization step, nanotheranostic (image-guided nanomedicine) formulations would be tested *ex vivo* in tumor biopsy samples and *in vivo* intervention. The image-guided nanomedicine formulation would be able to provide information on target site accumulation and also off-targeted biodistribution profile. The patients with moderate to high target site accumulation are preselected and the patients are closely followed up by imaging and biomarker assay to determine the treatment response. To fulfill the demands of PM, an efficient multifunctional drug delivery system such as nanomedicine would be a more rational choice. The field of personalized nanotheranostic is still in its infancy with potential opportunities for further research to develop an ultimate, custom-build personalized therapy for individual cancer patients.

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