Theranostic nanoagents: Future of personalized nanomedicine

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18.1 Introduction

18.1.1 Theranostics

The term "theranostics" is defined as the combination of diagnosis and therapy, an emerging field of medicine supposed to embrace huge prospective to cure many complicated diseases (Sumer and Gao, 2008). The basis is due to the fact that for dreadful diseases, like cancers, at the selective stage of disease development the existing therapies and treatments have proved to be effective on a few patient subpopulations. Therefore, merging diagnosis and therapeutics together could provide more individual specific therapeutic protocols which result in enhanced prognosis (Xie et al., 2010a).

With the advent of science and technology; theranostics is fast-growing field that is a combination of nanotechnology with personalized medicines that significantly enhance the efficacy of treatment through target specific delivery of therapy to any targeted tissues. With the enhanced intelligent signals and sensors corresponding to a slight change of any disease at the molecular level can be detected at ease. Theranostic can provide early detection of cancers in patients through a new process of image guided therapy. The most meticulous imaging methods include magnetic resonance imaging (MRI), computed tomography (CT), positron emission tomography (PET), and optical imaging. From these, optical imaging is more appealing as it can give images in real-time with high spatial resolution and the use of nonionizing irradiation (Wang et al., 2014; Believing in Seeing, 2014; Lim et al., 2015; Fu et al., 2017).

Theranostics can be amalgamated to have the best possible delivery properties, low renal clearance, reduced immunogenicity and antigenicity (for example by PEGylating the surface of theranostic nanoparticles), and high capacity for therapeutic agents, which is required to give the restricted concentrations of specific molecular markers expressed on cancer cells.

18.1.2 Nanoagents

Theranostic nanoagent is a carrier with a combination of therapeutic and diagnostic applications. These nanoagents provide a platform for clinicians to monitor the treatment effect of the suffered areas by merging diagnostic and therapeutic approaches in one system (Bardhan et al., 2011).

18.1.3 Nanotheranostics

Nanotheranostics is a superior type of theranostic that involves "nanotechnology" for the diagnosis and therapy of different diseases with poor diagnosis. This comprises a new generation of different kinds of nanocarriers such as polymer conjugates, dendrimers, micelles, liposomes, metal and inorganic nanoparticles (NPs), carbon nanotubes (CNTs) to develop appealing nanomedicine. The idea of nanotheranostics is the prognosis and alleviation of diseases at their probable initial stages of development. To summarize, nanotheranostic is a recent and superior group of nanomedicine that can detect, treat and check diseases at the cellular and molecular level with the use of nanotechnology (Wang et al., 2014).