Advanced Nanoformulations

Theranostic Nanosystems, Volume 3

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Advanced nanoformulations for theranostics: current status and challenges

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1.1 Introduction

Theranostic is described as a platform that combines the modalities of diagnostic imaging as well as therapy and hence, increases the precision and effectiveness of a particular treatment (Kim, Kwak, Kim, Yoon, & Kwon, 2019; Tade & Patil, 2020). The concept of theranostics was introduced by John Funkhouser way back in 2002 (Jeelani et al., 2014). Since then, this innovative platform has helped to overcome the gap between biodistribution as well as the specificity of therapeutic agents and imaging molecules. Theranostics comprise a single delivery vector, which can deliver therapeutic and diagnostic agents at the same dose in the desired cellular environment (Filippi, Chiaravalloti, Schillaci, Cianni, & Bagni, 2020; Jeelani et al., 2014; Vahidfar, Aghanejad, Ahmadzadehfar, Farzanehfar, & Eppard, 2021).

Before starting the treatment of a particular disease, it is essential to understand the cellular phenotypes and tissue heterogeneity. Each disease exhibits certain features, which may be intelligently used to execute payload delivery at the intended site. Tumor tissues, for example, possess several unique traits including acidic pH, hypoxia, and higher enzymatic activities. Therefore a formulation chemist may prefer the use of complementary innovations such as pH-responsive materials or redox-sensitive polymers to ensure the delivery of drugs or diagnostics within the tumor microenvironment (Uthaman, Huh, & Park, 2018). The objective of theranostics is to image as well as monitor the diseased tissues, drug release kinetics, and therapeutic efficacy, which ultimately exert the perfect control on patient therapy (Jeelani et al., 2014). Customizing medicines, rather than implementing a generalized approach, can push the field of nanomedicines toward an era of advanced therapeutics and personalized treatments (Kim, Lee, & Chen, 2013; Mura & Couvreur, 2012).

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