Enhancing nano drug delivery using precision therapeutic approaches for the treatment of chronic diseases

Andrew D. Miller

Shanghai JiaoTong University (SJTU), PR China

Precision Medicine is considered by many to be a necessary future for the treatment for all diseases. Fundamentally, this can be divided into two subsections, namely personalized medicine and precision therapeutics. With personalized medicine, the aim is to understand the genetic, immunological and/or metabolic individuality of patients in order to match individual patients with the most appropriate active pharmaceutical ingredients (APIs) for treatment of their particular disease(s). With precision therapeutics, the aim is to take control of the delivery of APIs to disease target tissue, by means of nanomedicine, and/or make use of select APIs that have extreme target specificity. The focus of this lecture is in precision therapeutics, as demonstrated by several worked examples of precision therapeutic approaches (PTAs) that are currently being taken forward in my laboratories and in the laboratories of key collaborators for the treatment of chronic diseases. Chronic diseases of interest are chronic pain, epilepsy, cancer, non-alcoholic fatty liver disease (NAFLD) /diabetes type II, and infectious diseases such as HBV. By way of example, the right-hand side panel (Figure 1) outlines a PTA for the treatment of cancer. In effect, a combination of bio-imaging and the application of image-guided targeting enable anti-cancer drug delivery nanoparticles to accumulate in a tumour lesion of choice and no obvious place elsewhere in the body. Lipid-based nanoparticles (LNPs) represent the core nanotechnology used for implementation of PTAs. These LNPs are all self-assembled for purpose with appropriate APIs using tool-kits of chemical components derived from natural sources or through synthetic organic chemistry. Such LNPs are designed for maximum biocompatibility, ease of formulation and long-term stability. Our APIs are either nucleic acids or small molecule drugs. Implementation of PTAs in the clinic could radically improve patient outcomes whilst reducing both required drug doses and side effects to an unprecedented degree. Such potential step changes in disease treatment explain why precision therapeutics should be an indispensable part of future medicine.