

Targeted nanotherapeutics in cancer

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Cancer is not one, but many heterogeneous diseases¹ with complex genetic and epigenetic alterations^{2,3} that annually afflict millions of people worldwide. Despite the progress in understanding the molecular mechanics of cancer,⁴ its treatment has remained essentially unchanged and the death rates almost remain as they were 6 decades ago.^{5,6} In the past, the outstanding failure to deliver effective treatment to patients was a result of the inability to get enough of the right drug to the right place; however, the scenario has started to change substantially with the advent of new “targeted” cancer therapies.^{7–10}

The field of drug delivery is a powerful concept in cancer therapy, which is advancing rapidly. Notably, the emerging new genomic knowledge has revolutionized molecular medicine,¹¹ and targeting with antibody therapeutics^{6,12} and siRNA holds great promise as a potential new class of therapeutics with an ability to treat complex tumor types^{13,14} that have, thus far, been resistant to available therapies. However, the lack of identified molecular biomarkers that could fully explain epigenetic changes and the heritability of complex tumors,¹⁵ making it very difficult for target recognition and treatment,¹⁶ should benefit from vigorous target validation^{17,18} and other efforts^{19–23} to develop new targeted drugs. The goal has to be to hit multiple targets simultaneously, so that the devastating tumor cannot develop resistance. Compelling evidence highlights the potential of advanced nanocarriers^{14,24} as combination multitherapeutic platforms for enhanced efficacy against aggressive cancer cell types.^{20,21,25} These combinations have the potential to significantly eliminate the amount of cytotoxic chemotherapy used, which is still currently the backbone of most oncology treatments.

Personalized nanomedicine has the potential to address one of the biggest problems in cancer therapy: how to get enough of the right combination of therapeutics to the right place, which represents a new paradigm shift in advanced technology; this may prove to be the first cutting-edge field to reflect the new realities of targeted medicine. The hope is that interventions can be tailored to maximize patient benefit with fewer side effects. However, many outstanding challenges remain.

Acknowledgments

I would like to acknowledge Dr Shokat Fatteh (Ohio, USA) and the Avalon Research Committee for their research support.

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Disclosure

The author reports no conflicts of interest in this work.

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