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Distribution of Genes and Drugs

Pranam Chilkoti*

Department of Biomedical Sciences, University of Oxford, Oxford, UK

Abstract

Nanomaterials are at the leading edge of the rapidly developing field of nanotechnology. Their unique size-dependent properties make these materials superior and indispensable in many areas of human activity. This brief review tries to summarise the most recent developments in the field of applied nanomaterials, in particular their application in biology and medicine, and discusses their commercialisation prospects.

Keywords: Nanotechnology • Nanomaterials • Nanoparticles

Introduction

For the treatment of brain illnesses, nanotechnology has opened up a whole new universe of possibilities. Nanosystems can encapsulate, transport, and administer a wide range of therapeutic substances, including medicines and nucleic acids. Nanoparticles can also be manufactured to include photosensitizers or act as photothermal conversion agents in phototherapy on their own. Nano-delivery agents can also improve the efficacy of contrast agents, allowing for better brain imaging and diagnosis. The blood–brain barrier, on the other hand, makes effective nano-delivery to the brain difficult (BBB). Advances in understanding natural transport channels through the BBB have led to the possibility of using receptor-mediated transcytosis as a method of nanoparticle absorption. As a targeted ligand, the oligopeptide Angiopep-2, which has a high BBB transcytosis potential, has been used. Angiopep-2 has been functionalized on a variety of organic and inorganic nanostructures to route medicinal and diagnostic substances to the brain. These have showed considerable promise not just in the treatment and diagnosis of brain cancer, but also in the treatment of brain damage, stroke, epilepsy, Parkinson's disease, and Alzheimer's disease. This review focuses on studies using Angiopep-2-modified nanoparticles for the treatment and diagnostics of brain diseases done between 2010 and 2021 [1].

"BBB-crossing nanotechnology is predicted to have a transformative influence on traditional brain cancer management," Tang and colleagues. Angiopep-2-mediated transport techniques are becoming increasingly significant in this area. Most Angiopep-2-functionalized nanomedicines are currently being used to treat brain tumours, particularly glioblastoma, which is very aggressive and resistant to current treatment.

Description

Angiopep-2 alteration has the advantage of being able to penetrate both the BBB and the blood-tumor barrier (BTB). There is minimal comparative data on the performance of Angiopep-2 vs. other cell-penetrating peptides that we are aware of. Co-modification of NP with Angiopep-2 and other cell-penetrating peptides has been demonstrated to improve NP function. Functionalization of the chemotherapeutic drug PAPTP with either Angiopep-2 or the TAT48-61 peptide, on the other hand, allowed equivalent transport to the brain in mice [2].

The as-functionalized nanosystems have also shown promise in the delivery of drugs to treat other brain illnesses, such as fungal infections, epilepsy, stroke, brain injury, Parkinson's disease, and Alzheimer's disease, in the last five years. In a Caenorhabditis elegans model of Alzheimer's disease, gold nanorods functionalized with Angiopep-2 and the D1 peptide, which identifies hazardous clumps of -amyloid, exhibited effectiveness [3].

Angiopep-2-decorated nanostructures have been used to deliver a wide range of medicinal and diagnostic substances within the time period evaluated for this review. Chemical substances, nucleic acids such as DNA, siRNA, and miRNA, photosensitizers, and contrast agents are among them. Angiopep-2-modified nanoparticles can also be used in immunotherapy. Angiopep-2 and IP10-EGFRvIIIscFv fusion protein-modified NPs can recruit activated CD8+ T lymphocytes to glioblastoma cells, according to Wang and colleagues [4].

While the use of Angiopep-2-modified NPs in phototherapy is well known, Sonodynamic Therapy (SDT), a unique physical technique of eliminating brain cancer cells based on ultrasound stimulation, has recently been published. Qu and his colleagues created "all-in-one" nanosensitizer platform by combining the sonoactive chlorin e6 and an autophagy inhibitor, hydroxychloroquine, in Angiopep-2-modified liposomes to promote apoptosis and inhibit mitophagy with glioma cells at the same time [1,3].

Angiopep-2 NPs, like those in the previous study, are responsive to dual- and multimodal treatment integration. Angiopep-2 nanosystems can also be made to respond to stimuli in order to deliver their therapeutic cargo in a regulated and continuous manner. Furthermore, their potential in theranostics has recently been recognised. There is a growing corpus of in vivo data to support the development of multifunctional Angiopep-2-modified nanomedicines, which is encouraging. Overall, there is a pressing need to bring BBB-crossing nanotherapeutics' in vitro and in vivo successes to the clinic [5].

Conclusion

As it stands now, the majority of commercial nanoparticle applications in medicine are geared towards drug delivery. In biosciences, nanoparticles are replacing organic dyes in the applications that require high photo-stability as well as high multiplexing capabilities. There are some developments in directing and remotely controlling the functions of nano-probes, for example driving magnetic nanoparticles to the tumour and then making them either to release the drug load or just heating them in order to destroy the surrounding tissue. The major trend in further development of nanomaterials is to make them multifunctional and controllable by external signals or by local environment thus essentially turning them into nano-devices.

***Address for Correspondence:** Pranam Chilkoti, Department of Biomedical Sciences, University of Oxford, Oxford, UK, E-mail: chilkoti568@gmail.com*

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Conflict of Interest

None.

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