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Cellular functions analyses based on nanorobotics

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Opinion

Abnormal changes in cellular behavior and fate can lead to diseases such as cancer.[1] Even, a single malignant cell can start multistage tumor formation process. Genetical and external factors are the reasons for the tumor genesis. Early diagnosis methods have been developed for detection of cancer risk agents.[2] For this aim, scientists have emphasized to find ways for accurate analysis of biomolecular changes that facilitate efficient therapy of cancer. The knowledge about tumor environment and the progress of the strategies for cancer prevention is necessary for cancer treatments. Many types of cancer could be inhibited by utilization of single-cell monitoring and manipulation. Remote controlling of cells by nanorobotic is a novel idea. This approach could be applied for multimodal purposes such as imaging, diagnosis, and therapy. The controlled release of bioagents and the local treatment are the ultimate goal of this field of research. However, biological environments are the final places for nanorobots. The past studies such as DNA nanomachines, supramolecular nanorobots, and self-powered microrobots, have not been employed *in vivo*.[3-5]

Recently, Miyako group reported a new type of nano transporters that made of a liposome that decorated by a composition of carbon nanohorns (CNHs) and magnetic nanoparticles (MNPs) (Figure 1). This structure permeated into cells by a Neodymium magnet. Nano transporters not only could be moved by the magnetic field but also can be stimulated by NIR laser to control the release of liposome contains at a target place in organisms. This hybrid system has provided opportunities for analyses of biomolecular processes in organisms. As an achievement, enzymatic reaction controlled in the cancerous cells *in vitro* and transgene mice model *in vivo*.[6] β-galactosidase (β-Gal) is an enzyme that often over expressed in primary colorectal, breast, andovarian cancers.[7] The existence of this substance could be monitored by an enzymatic reaction in living cells. So, non-fluorescent fluorescein di-β-D-galactopyranoside (FDG) was loaded inside liposome part of the system.

FDG release from the thermo sensitive hybrid was controlled by NIR-Laser irradiation to the target site. FDG was hydrolyzed by β-Gals that produce fluorescein inside cell as a green fluorescent agent. Also, laser sharp focus could lead to single cell monitoring. Finally, transgenic CG mice over expressing human β-Gal in the whole body were studied. Nanorobots were intravenously injected to mice and accumulated in the blood vessels of mice ear by a magnetic field. FDG was released because of laser irradiation and was hydrolyzed by β-Gal rich environment. So, the green fluorescence was observed, and the reaction monitored *in vivo*.[6]

There are many types of biomarkers such as glutathione transferases.[8] and γ-glutamyltranspeptidase.[9] that can be traced by a similar method. This technology can be applied for innovative transport of various molecules. This system is promising of a new generation of active targeting drug delivery systems and optochemical genetic agents.

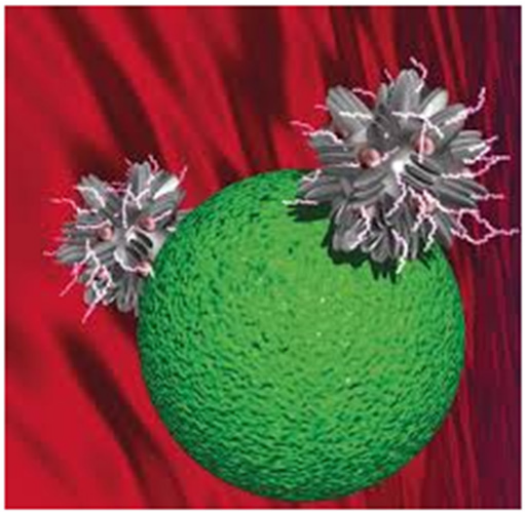

Figure 1 The nano transporter schematic illustration.[6]

Acknowledgments

None.

Conflicts of interest

None.

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