Nanodiamond Drug Delivery

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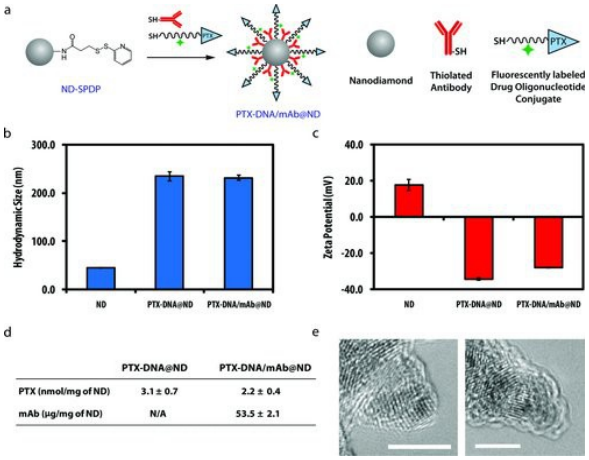
***Abstract*—Nanoparticles have the potential for improved drug delivery because of their many unique properties. Nanodiamonds (or NDs) in particular could vastly improve chemotherapy by reducing the adverse effects of less controlled delivery options and reducing drug resistance in tumors as well.**

I. Introduction

Chemotherapy is a widely used and still dangerous treatment for many types of cancer. Chemotherapy uses chemotherapeutic agents (anti-cancer drugs) to cure, to slow cancer growth, or even to reduce symptoms. Targeted therapy which targets the proteins that are abnormally expressed in cancer cells is often used alongside chemotherapy. [1] Nanoparticle drug delivery hopes to improve the effectively of chemotherapeutic drugs while reducing the adverse effects of the drugs. Also nanodiamonds are being experimented with specifically because of their biocompatibility, functional versatility, and unique surface electrostatics. [2] Nanodiamonds are also useful because of the potential to bypass chemoresistance, have a more controlled delivery, and allow for intracellular tracking. [2]

II. Methods

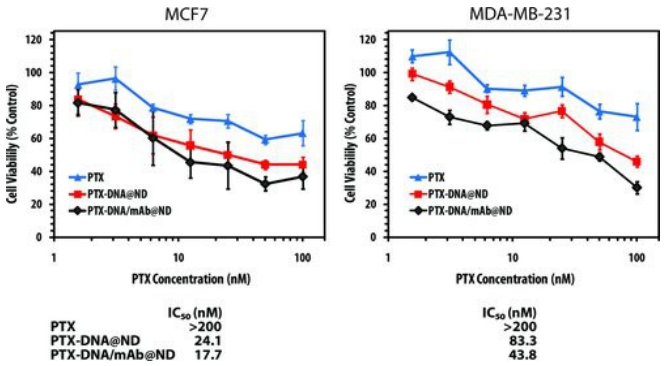
Nanodiamonds were tested for their ability to deliver chemotherapeutic agents to cancer cells. The nanodiamonds drug delivery system was tested on breast cancer cells and its efficacy was compared to that of normal Paclitaxel (PTX). The nanodiamonds as a drug delivery system contained fluorescent drug-oligonucleotide conjugates and monoclonal antibodies (mAbs). The nanodiamonds used for this experiment were between 2 and 8 nm in diameter. [2]



[2] A multicomponent nanodiamond based drug delivery system was tested in vitro in breast cancer cells with contrasting Epidermal Growth Factor Receptor (EGFR) expression. [2] The fluorescent oglinucleotide linkers allowed for observation within the cells through confocal microscopy and flow cytometry. The targeting profiles in cells of abnormal EGFR expression was observed because of the labeled nanoparticles. [2]

III. Results

One of the most important tests was to test the biocompatibility of NDs without any drugs attached. Cell Viability was over 90% with ND concentrations of up to 200 µg/ml. Free PTX was tested and resulted in IC50 values of over 200 nM in MCF7 and MBA-MB-231 cells. The untargeted PTX-DNA@NDs had an IC50 value of 24.1 nM and while the targeted conjugate had an IC50 value of 17.7 nM.



[2]

IV. Discussion

Nanoparticles can be dangerous and useful to medicine because they can do things like cross the blood brain barrier and could potentially be more dangerous than the current chemotherapeutic drugs alone. [3] For this reason there needs to be more research on the effects of nanoparticles on the human body. The results of this experiment show that the nanodiamond is sufficiently biocompatible and also improves the effectiveness of the drugs. The drug concentration on the nanodiamonds was ten times more potent than the free PTX. [2] These results show promise that nanodiamonds will be a useful drug delivery system and could possibly be used in other areas such as imaging and diagnostics. If nanodiamonds prove to be safe and effective to use they could greatly improve chemotherapy treatments and reduce the negative side effects on the rest of the body.

References

[1] "Chemotherapy." *Wikipedia*. Wikipedia Foundation, 19 Sept. 2015. Web. 04 Oct. 2015. <https://en.wikipedia.org/wiki/Chemotherapy>.

[2] Zhang, Xue-Qing et.al. "Multimodal Nanodiamond Drug Delivery Carriers for Selective Targeting, Imaging, and Enhanced Chemotherapeutic Efficacy." *Adv. Mater. Advanced Materials* 23.41 (2011): 4770-775.*Google Scholar*. Web. 29 Sept. 2015.

[3] Jong, De, and Paul JA Borm. "Drug Delivery and Nanoparticles: Applications and Hazards." *International Journal of Nanomedicine IJN*(2008): 133-49. *Pubmed*. Web.