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Cancer treatment by nano-diamonds

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Cancer cells have unique properties that can be exploited by nano-particles. Their rapid rate of growth causes them to intake an abnormal amount of nutrients (i.e., folic acid). Nano-particles (NP) can be used to target bio-markers or antigens that are highly specific to cancer cells. The nano-particles are typically between 20-150 nm or roughly 100 times smaller than most human cells. In the nanotechnology methods, certain NP can be designed to absorb preferentially certain wave length of radiation and if they enter in the cancerous cells, they will burn them. Nanotechnology can be used to create therapeutic agents that target specific cells and deliver toxin to kill them. The NP will circulate through the body, detect cancer associated molecular changes, assist with imaging, release a therapeutic agent and then monitor the effectiveness of the intervention.

Diamond nano-particles are now finding new and far-reaching applications in modern biomedical science and biotechnologies. Due to its excellent biocompatibility, nano-diamonds serve as versatile platforms that can be embedded within polymer-based microfilm devices. The nano-diamonds are complexed with a chemotherapeutic, and subsequently enable sustained/slow release of the drug for a minimum of one month, with a significant amount of drug in reserve. This opens up the potential for highly localized drug release as a complementary and potent form of treatment with systemic injection towards the reduction of continuous dosing, and as such, attenuation of the often powerful side effects of chemotherapy.

Nano-diamonds are quite economical, enabling the broad impact of these devices towards a spectrum of physiological disorders e.g. serving as a local chemotherapeutic patch, or as a pericardial device to suppress inflammation after open heart surgery. A substantial amount of drug can be loaded onto clusters of nano-diamonds, which have a high surface area. The nano-diamonds are then put between extremely thin films of parylene, resulting in a device that is minimally invasive.

Nano-diamond patch could be used to treat a localized region where residual cancer cells might remain after a tumor is removed. If a tumor has to be removed from the breast or brain, the device could be implanted in the affected area as part of the same surgery. This approach, which confines drug release to a specific location, could mitigate side effects and complications from other chemotherapy treatments.

Thus, the nano-diamonds can be used to explore a broad range of therapeutic classes, including additional small molecules, proteins, therapeutic antibodies, RNAi, etc.

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Liposomes radiolabeled with Gd-159 as an innovative therapeutic tool against cancer

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PEG-coated pH sensitive and PEG-folate-coated pH sensitive liposomes containing the Gd-DTPA-BMA complex were prepared and radiolabeled by neutron activation. The radiolabeled liposomes presented significant in vitro cytotoxic activity against Ehrlich tumor cells when compared with controls. The biodistribution profile of these liposomes and free (159) Gd-DTPA-BMA were studied in mice bearing a previously-developed solid Ehrlich tumor. The results demonstrated an important uptake of the formulations by the tumor tissue, with a tissue/blood partition coefficient (Kp) 3.88 and 14.16 times higher than that of the free complex for pH-sensitive PEG-coated and PEG-folate-coated liposomes containing the (159)Gd-DTPA-BMA complex, respectively. Both formulations accumulated in the liver and spleen, thereby revealing some difficulty in escaping the action of the MPS cells. The formulation without folate presented a lower renal uptake, which is desirable in patients with chronic renal failure due to the potential risk of nephrogenic systemic fibrosis (NFS). The scintigraphic study revealed that the target/non-target ratio is always greater than three for pH-sensitive PEG-coated liposome formulations and above nine for pH-sensitive PEG-folate-coated liposome formulations. The results obtained in this study demonstrated that the formulations employed can be considered to be a potential alternative for the treatment of cancer, including patients with chronic renal failure.

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