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Bi-functionalized clay nanotubes for anti-cancer therapy

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Systemic toxicity is an undesired consequence of most chemotherapeutic drugs. Multifunctional nanoparticles with combined diagnostic and therapeutic functions show great promise towards personalized nanomedicine. Halloysite clay Nanotubes (HNTs) have shown potential as a drug delivery vehicle and its surface can be modified and tailored as a targeted drug delivery system. In this short report, we modified the HNT surface by covalently bonding Folic Acid (FA) and Fluorescein Isothiocyanate (FITC). The modification of HNTs with folic acid imparts the potential to target tumor cells selectively. The addition of FITC offers a method for quantifying the effectiveness of the FA tagged HNTs ability to target tumor cells. We documented cell uptake of our bi-functionalized HNT (bHNT) through phase contrast and epi-fluorescent microscopy. bHNTs showed no signs of cytotoxicity up to a concentration of 150 μg/mL. The increase in cell death with increased bHNT concentration may be due to induced cytotoxicity resulting from intracellular bHNT accumulation that disrupts cellular function leading to cell death. With HNTs recognized as having the ability to serve as both a nanocontainer and nanocarrier, we envision our construct as a potential modular platform for potential use in cancer therapeutics. The HNT interior can be loaded with a variety of anti-cancer drugs (or other chemotherapeutics) and serve as a death cargo designed to kill cancer cells while providing feedback imaging data on drug efficacy. The surface of the HNT can be modified with gold or silver nanoparticles and used in photothermal therapy by converting light to heat inside tumors. Our HNT-based drug delivery system has the potential to provide localized and targeted therapies that limit or reduce side effects, reduce patient costs and length of hospital stays and improve quality of life. However, further research is needed to validate the potential of this new chemotherapeutic drug delivery system.

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