Composite nanodevices for the imaging and therapy of cancer

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Although modern drugs can very effectively address one or two of the needs of an ideal medicine, they are simply not complex enough. Complexity of the devices is unavoidable to deliver the required number of actions. Only nanoscale medical devices will be able to provide the level of complexity ideally needed. Functional nanodevices (FND) are assembled from various parts that carry out the desired functions (targeting moieties, contrast materials, apoptosis detectors, therapeutic molecules and so on) and a platform to assemble and hold together all the primary components. The platform of our composite nanodevices (CND) consist of poly(amidoamine) (PAMAM) dendrimer templates that can be made in discrete sizes, with multiple surface functionalities, and regulated surface charges. These targeted nanodevices deliver anticancer drugs to specific organs and tissues. Other components consist of inorganic material(s), such as gold or silver metal clusters that are topologically trapped in the organic dendrimer matrix without having covalent bonds between the components. For several years we have pioneered composite nanodevices and their interactions with complex biological systems in an attempt to understand the characteristics that govern their biodistribution in mouse tumor model systems. The aim is to determine principles that may be applied in the future to predict key characteristics of nanodevices. We have also pioneered the development an angiogenic tumor microvascular targeted composite nanodevice, partly designed based on the nanodevice biodistribution data above, and we will discuss the experiments to greatly improve tumor nanomolecular imaging.

Similar CNDs are also being developed for novel forms of radiation therapy, both nanobrachytherapy and a nano-systemic targeted radiation therapy (NanoSTaRT), and photomechanical therapy, which procedures will be briefly described.