Nanomedicine & Biotherapeutic Discovery

Extended Abstract

Anticancer theranostic approaches for in vitro and in vivo drug delivery

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Abstract

The last decade has seen significant advances in anti-cancer drug delivery approaches, although many challenges including availability of limited nano- and bio-materials, uptake and release of drugs from the endosomes, targeting of drugs to the desired diseased cells or tissues, and the lack of translatable models to study drug delivery. To address these challenges we have developed and tested a number of novel drug delivery approaches. To this end, we first developed a near infrared (NIR) triggered drug delivery platform based on the chitosan-modified chemically reduced graphene oxide (CRGO) incorporated into a thermosensitive nanogel (CGN). CGN exhibited an NIR-induced thermal effect similar to that of CRGO, reversible thermo-responsive characteristics at 37-42°C and high doxorubicin hydrochloride (DOX) loading capacity (48 wt%). The DOX loaded nanogel released DOX faster at 42 °C than at 37 °C. Second, since combining chemotherapy with gene therapy has been one of the most promising strategies for the treatment of cancer, we developed a chitosan functionalized magnetic graphene (CMG) nanoparticle platform for simultaneous gene/ drug and SPIO delivery to tumor. The results of these studies indicated that CMGs provide a robust and safe theranostic platform, which integrates targeted delivery of both gene medicine and chemotherapeutic drug(s) and enhanced MR imaging of tumors. Further, since gadolinium (Gd) contrast agents that are predominantly used for T1 MR imaging, have high toxicity and potential side effects including nephrogenic systemic fibrosis, we developed an alternative T1 contrast agents, such as Mn for lung imaging. Here we report on the design and synthesis of multifunctional lipid-micellar nanoparticles (LMNs) containing Mn oxide (M-LMNs) for MRI that can also be used for DNA and drug delivery. Finally, we have developed an in vitro model of tumoroid culture platform for testing drug delivery to tumors that closely mimics in vivo tumors. Taken together these advances are expected to lead to better anticancer drug delivery against cancers. Current diagnostic ways need to be dilated to produce beforehand detection capabilities, and normal chemotherapy strategies to cancer remedy are restrained through lack of specificity and general toxicity. This analysis highlights advances in technology that have allowed the event of multifunctional platforms for many cancers detection, therapy, and observation. Nanomaterials is used as MRI, optical imaging, and photoacoustic imaging distinction agents. once used as drug carriers, nanoformulations will extend growth message to therapeutic dealers and ending in elevated treatment consequences by mistreatment prolonging circulation times, defensive entrapped capsules from degradation, and improving growth uptake through the EPR impact additionally as receptor-mediated endocytosis. Multiple therapeutic marketers like therapy, antiangiogenic, or cistron medical aid retailers is at the same time delivered by nanocarriers to growth websites to beautify the effectiveness of medical aid. in addition, imaging and medical aid dealers is co-delivered to furnish seamless integration of medicine, remedy and follow-up, and exceptional therapeutic modalities like therapy and physiological condition is coadministered to require gain of synergistic effects. Liposomes, steel nanoparticles, polymeric nanoparticles, dendrimers, carbon nanotubes, and quantum dots are samples of nanoformulations that can be used as multifunctional systems for cancer theranostics. Nanomedicine approaches in cancer have tremendous potential for clinically translatable advances that may completely have an effect on the common diagnostic and therapeutic method, and ending in stronger better of lifestyles for cancer patients. However, a concerted scientific effort is all the same integral to utterly discover long risks, effects, and precautions for safe human use. Liposomes are concentric, closed bilayer membranes of water insoluble polar lipids that may be accustomed encapsulate biomolecules and tablets for focused delivery whereas protective their bioactivity. Liposomal DOX has been investigated clinically for carcinoma, female internal reproductive organ cancer, AIDS-related

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Kaposi's malignant neoplastic disease, head/neck cancer, and intelligence tumors. A approach to beat these limitations by means of decorating the surface of the nanoparticles with targeted on moieties like tiny ligands, antibodies, or biomarkers that may direct the delivery automotive toward precise molecular aims that are overexpressed through growth cells. Targeted particles will then be internalized with the help of growth cells by means that of receptor-mediated endocytosis/phagocytosis, leading to extended concentrations in growth tissue. Although antibodies is directly conjugated to capsules except the utilization of a vehicle, scientific trials have highlighted the difficulties of applying this approach, on the complete because of potential loss of bioactivity upon conjugation, steric hindrance, and immunogenicity of the antibodies once employed in their full type. In contrast, conjugating antibodies to the ground of a shipping vehicle will not interfere with the bioactivity or traits of the entrapped drug, and will not lead to loss of affinity of the protein for the target, that makes nanocarriers associate degree fantastic platform for the advance of nice targeted therapies. The purposes of antibodies in focused treatment choices have evolved toward the advantageous use of monoclonal antibodies (mAbs), particularly creating an endeavor to avoid or cut back immunogenicity by using mistreatment designed mythical monster or humanized varieties to maximise the probabilities of winning medical translation.

This work is partly presented at 17th International Conference and Exhibition on Nanomedicine & Nanotechnology in Healthcare November 23-24, 2017 | Melbourne, Australia.

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