Multi-Functional Cancer Drug Delivery Nanodevice for Precision Medicine

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Technology description

The Need

The majority of human cancers remain incurable, in many cases this is due to innate or developed multi-drug resistance (MDR). Current therapeutics used in treatment are inadequate in light of such resistance, and more robust approaches must be found to circumvent these responses and deliver therapeutics in sufficient concentrations to be practical. Recent research using DNA nanoparticles containing chemotherapeutic agents to bypass MDR and penetrate the cell has shown promise. However, current nanoparticle systems are only able to deliver certain chemotherapeutics, and have their own drawbacks such as dose limitations and unpredictable or slow drug release.

The Technology

This novel therapeutic approach takes advantage of improvements in structural DNA nanotechnology to create a DNA nanostructure to act as a customizable delivery vehicle for anthracyclines, or similar chemotherapeutics, in cancer cells exhibiting MDR. The technology allows for acustomizablemulti-functional cancer drug delivery platform that incorporates interchangeable i) small molecule chemotherapeutics ii) therapeutic oligonucleotides, and iii) targeting moieties on a single DNA-based nanostructure to specifically target and destroy tumor cells, while leaving healthy tissue unharmed. The folded DNA nanoparticle was shown to deliver sufficient dosages of daunorubicin to be clinically relevant in a human Acute Myeloid Leukemia multi-drug resistant cell line. Combined with its fast self-assembly and stability in physiological conditions, this DNA nanostructure could be implemented to deliver a wide-range of chemotherapeutic agents and/or nucleic acids in a targetable manner to drug-resistant cancers that survive conventional treatment.
Using the scaffolded DNA origami molecular self-assembly process, a manufactured DNA nanostructure can be created that circumvents MDR1/MRP-1 protein efflux pump-mediated multi-drug resistance in cancer cells to deliver clinically significant concentrations of chemotherapeutics.

Application area

Precision medicine through antibody-antigen binding

Cancer treatment
Customizable Drug delivery platform
Pharmaceuticals

Advantages

Rapid self-assembly of stable DNA origami nanostructures
Carrier for small molecule drugs
Able to deliver daunorubicin in clinically relevant doses
Fine control of molecular placement for multi-functional modular devices (e.g. simultaneous, co-localized distribution) of therapeutic oligonulceotides and targeting molecules against a specific tumor antigen
Biocompatible

Institution

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