Targeted Nanomedicine that Interacts with Host Biology

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초 록: Nanotechnology is of great importance to molecular biology and medicine because life processes are maintained by the action of a series of molecular nanomachines in the cell machinery. Recent advances in nanoscale materials that possess emergent physical properties and molecular organization hold great promise to impact human health in the diagnostic and therapeutic arenas. In order to be effective, nanomaterials need to navigate the host biology and traffic to relevant biological structures, such as diseased or pathogenic cells. Moreover, nanoparticles intended for human administration must be designed to interact with, and ideally leverage, a living host environment. Inspired by nature, we use peptides to transfer biological trafficking properties to synthetic nanoparticles to achieve targeted delivery of payloads. In this talk, development of nanoscale materials will be presented with a particular focus on applications to three outstanding health problems: bacterial infection, cancer detection, and traumatic brain injury. A biodegradable nanoparticle carrying a peptide toxin trafficked to the bacterial surface has antimicrobial activity in a pneumonia model. Trafficking of a tumor-homing nanoprobes sensitively detects cancer via a high-contrast time-gated imaging system. A neuron-targeted nanoparticle carrying siRNA traffics to neuronal populations and silences genes in a model of traumatic brain injury. Unique combinations of material properties that can be achieved with nanomaterials provide new opportunities in translational nanomedicine. This framework for constructing nanomaterials that leverage bio-inspired molecules to traffic diagnostic and therapeutic payloads can contribute on better understanding of living systems to solve problems in human health.

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