Mesoporous Silica Nanoparticle Based siRNA/Drug Delivery System

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OTHER INFORMATION

KEYWORDS

Nanoparticle, MSNP, siRNA, mesoporous silica nanoparticles, anticancer, drug-resistance

CATEGORIZED AS

- **Nanotechnology**
  - NanoBio

RELATED CASES

2011-017-0

SUMMARY

UCLA inventors have developed a novel delivery platform using mesoporous silica nanoparticles (MSNP) that has the ability to deliver both nucleic acids and drugs concurrently. Using this system, clinicians would be able to deliver drugs and nucleic acids that modify the expression of a series of drug resistant genes that may neutralize the effect of a co-delivered drug.

BACKGROUND

Owing to its unique structure and ease with which their surface can be functionalized, mesoporous silica nanoparticles constitute a multi-functional platform that can be used for nucleic acid delivery and/or small molecule (e.g. anti-cancer drugs) delivery for therapeutic purposes. This unique functionality allows for MSNPs to be used for a number of applications that are not possible with conventional delivery vectors.

INNOVATION

UCLA researchers have developed a novel delivery system using mesoporous silica nanoparticles coated with specific chemical groups. Utilizing this coating, researchers were able to load siRNAs and nucleic acids onto the nanoparticles. This binding was shown to be stable for cellular nucleic acid delivery and was also shown to protect the nucleic acids from degradation by nucleases. When taken up into cancer cells, siRNA species of various kinds could be released from the particles and were capable of knocking down specific gene expression. Since the polymer coating leaves the pores of the nanoparticle accessible, MSNP can also be functionalized to act as a delivery system for a number of drugs and other small molecules that can be CO-delivered with siRNAs to achieve unique synergistic therapeutic effects. Example applications of this bi-functional nanocarrier include sensitization of drug resistant cancer cells to a drug, through co-delivery of siRNAs capable of knocking down the expression of multi-drug resistant pump proteins with the drug on interest. In the fight against cancer the ability to mitigate the effects of drug resistance would go a long way towards reducing mortality from a host of diseases including cancer.

APPLICATIONS

In addition to representing a novel means to deliver siRNAs, this invention may lead to a new class of nanotherapeutics that are capable of delivering drugs in combination with nucleic acids capable of modifying the expression of a series of drug-resistant genes.

ADVANTAGES

- MSNPs constitute an efficient multifunctional platform with unique advantages in cargo delivery (e.g. DNA/siRNA, small molecule), targeting, controlled release, and bio-imaging.
- Advantages of using MSNP to deliver siRNA and anticancer drugs include the following:
  - Mesoporous silica nanoparticles have minimal cytotoxicity, they are used extensively as food additives; MSNPs are biologically inert when injected intravenously at high dose in rodents and are also biologically degradable.
  - Low cost and ease of large-scale production.
  - Easy to modify physicochemical characteristics (e.g. particle size, surface charge, hydrophilicity) and simple purification procedures (centrifugation).
  - Improved ability to deliver poorly water-soluble drugs by making use of phase transition trapping in the pores.
  - MSNPs are capable of delivering large macromolecule drugs (siRNA/plasmid DNA) to intracellular sites of action.
  - MSNPs allow for CO-delivery of two or more drugs or therapeutic modality for combination therapy.
  - Versatile functionalization methods (organo-silanes) allow ligand (e.g. folate, transferrin) conjugation for targeted delivery of drugs in a cell- or tissue-specific manner.
  - Visualization of sites of drug delivery by combining therapeutic agents with imaging modalities such as iron oxide nanoparticles for MRI or probes for fluorescent imaging

STATE OF DEVELOPMENT

This technology is currently in the experimental stage

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,343,903	07/09/2019	2011-017

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