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Magnetic Particle Imaging Method for In Vivo Drug Release Monitoring

Researchers at Stanford have developed an in vivo drug release monitoring method using magnetic particle imaging (MPI). In vivo drug release monitoring is beneficial to doctors as it provides information to guide drug dosing and helps reduce therapeutic side effects. Imaging approaches to in vivo drug release monitoring are ideal as they provide spatial information for drug distribution. As such, imaging methods have been developed for this purpose, but they are not optimal as they have low tissue penetration depth or difficulty accurately quantifying the drug release rate. Thus, new imaging-based methods are needed. To help meet this need the inventors have developed this method of using MPI for in vivo drug release monitoring. MPI is a new, non-invasive imaging method that uses superparamagnetic nanoparticles (SPNs) as tracers. It provides large imaging depth and linearly quantifiable signals. For this method, the inventors have developed a composite nanoparticle with a superparamagnetic core and a shell layer that can be loaded with therapeutic drugs. Thus, the nanocomposite can serve as both a drug delivery system and a quantitative MPI tracer. The drug release process is monitored by tracking the continuous changes in MPI signal over time as the nanocomposite disassembles. This technology provides a better, more effective method for in vivo drug release monitoring.

Stage of research
Using a mouse breast cancer model, the inventors have shown that their in vivo drug release monitoring method has great promise and are continuing to develop and characterize the nanomaterials with respect to their magnetic response.
Proof of principle in vitro, in cell culture, and in living animals.

Applications

- In vivo drug release monitoring

- Drug delivery for localized diseases

Advantages

- Allows quantitative imaging of the kinetics of drug release at the disease site
  - Maximize efficacy- allows physicians to adjust the drug doses to keep them in the therapeutic window
  - Allows physicians to anticipate potential side effects
- Method can be translated to other therapeutics
- Magnetic Particle Imaging:
  - Has no limitation to the imaging depth
  - Retains linearly quantifiable signal for determining drug release
  - Contrast is only from the tracer therefore intrinsic structures cannot interfere with signal

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