Name(s)
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Project Number
S0617

Project Title
On-Demand Electrically Controlled Drug Release from Resorbable Nanocomposite Films

Abstract

Objectives/Goals
Today, drugs are administered orally or intravenously. Such methods distribute drugs systemically, resulting in low drug efficacy and side effects. To solve this, scientists have been developing nanocarriers that can release drugs at targeted areas in response to stimuli. An exciting research area is nanocarriers that release drug in response to electric stimuli. Current electroresponsive drug release systems use dangerously high voltages (2-20V), are non-resorbable, or use non-FDA approved materials. My project goal was to develop a drug delivery system that uses safe voltages (<1.5V) to trigger drug release and is composed of materials that are FDA-approved and resorbable. I hypothesized that pH-responsive polymers could be used to achieve this goal, as electric stimuli generate pH changes that can be harnessed to trigger drug release. To test my hypothesis, I developed a nanocarrier composed of Eudragit S100 (EGT), a resorbable and FDA-approved polymer with pH-dependent dissolution.

Methods/Materials
I designed and synthesized nanometric films composed of EGT loaded with various drugs and coated them with a protective layer of chitosan. I tested the films' electroresponsive drug release abilities, and investigated my hypothesized drug release mechanism.

Results
Drug release experiments demonstrated that the nanofilm had electroresponsive release capabilities, as drug release was only observed upon voltage. Furthermore, excellent dosage control was observed, as drug release scaled linearly with the magnitude and number of applied stimuli. Finally, the versatility of the film was shown through the release of 4 drug molecules of varying hydrophobicity, pKa, and size.

Conclusions/Discussion
I envision that my nanofilm could be integrated with recently developed radio-powered implants that can wirelessly stimulate electroresponsive drug release inside the body. This drug delivery system would have several benefits for the treatment of chronic diseases, including increased drug efficacy and more precise drug regimens (due to control over the dose and timing of drug delivery). It would also be more convenient and safe, in part due to its resorbability (ability to disintegrate in the body). To the best of my knowledge, this is the first demonstration of an electroresponsive drug delivery system that is sensitive to low voltages and composed of completely FDA-approved, bioresorbable polymers.

Summary Statement
I designed a nanofilm composed of a resorbable polymer that can load drugs and release them on demand upon application of an electrical stimulus. This system would enable physicians to administer drugs in a more targeted, effective manner.

Help Received
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