Ingestible Medical Device for Controlled Drug Delivery to the Small Intestine

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Introduction
- Crohn’s disease affects 5 million people worldwide and approximately 25% of those people will undergo surgery at some point.
- Crohn’s causes inflammation of the gastrointestinal (GI) tract
  a. Ulceration, swelling, and scarring of the intestinal walls
  b. 

Our Device

Goal
To directly target the inflammation within the small intestine, our group has designed an orally administered device which uses a multi-layered pill system and deployable adhesive arms to encourage retarded motion of the device in the small intestine.

Outer Capsule
pH sensitive polymer Eudragit L 100
Degrades at pH > 6
Arms
- Synthesized from PAA,a mucoadhesive polymer
- Released once outer capsule degrades

Inner Capsule
PLGA and the drug (Antibody: Anti-TNF Receptor II)

Proof of Functionality
- Modelling of the drug release from the inner capsule done in MATLAB
- Drug diffusion based on random walk
  - Able to achieve different drug release profiles based on different drug and polymer parameters

Future Work:
Micropillars technology:
Making arms out of a micropatterned surface will further increase the gastro-retentive capabilities of the device. This will keep the device in the small intestine for more time and further increase drug delivery to the inflamed area.

In vivo studies looking at drug release using dog or pig models

Goals:
- Prove dose-dependent effects of the drug loaded in the device
- Establish a timeline for the device moving through the GI tract
- Compare efficacy with pre-existing treatments for Crohn’s

Production

Acknowledgements
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Drink coat gel capsules with eudragit

PLGA and the drug (Antibody: Anti-TNF Receptor II)

Our Device

- The pill is swallowed and goes through the esophagus and stomach
- The pH-sensitive polymer coating of the pill begins degradation upon entry to the small intestine
- The pH-sensitive polymer erodes completely allowing for the release of mucoadhesive arms
- The arms adhere to the walls of the small intestine using micro-molecular interactions
- Stuck in place, the inner capsule dissolves releasing the immunosuppressants coated in nanospheres

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