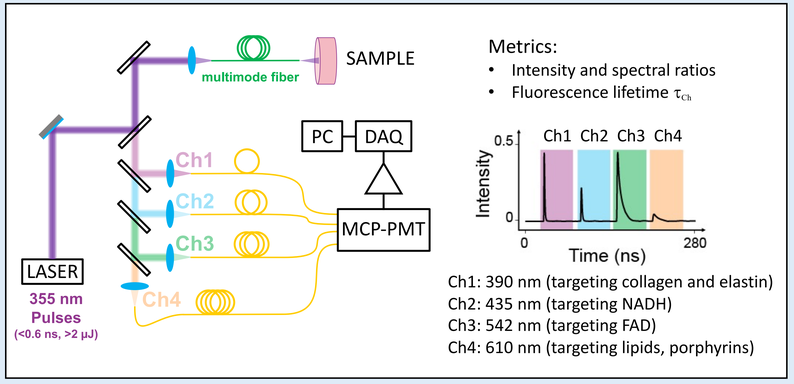
Proof of Concept for the Application of Fluorescence Lifetime Imaging (FLIm) In Colorectal Surgery

Fluorescent guided surgery (FGS) value has been demonstrated in multiple procedures to aid precision surgery and perfusion assessment. However, there are limitations in current platforms and fluorophores. To address the limitations, we developed an assessment technique using near-UV light that stimulates tissue autofluorescence- Fluorescence Lifetime Imaging (FLIm). FLIm detects the dynamic spectral and temporal changes in tissue fluorescence resulting from metabolic and compositional changes under pathological conditions. Specific benefits include label-free interrogation of tissue and the ability to measure tissue spectral and lifetime properties in real-time with a sterilizable optical fiber probe. FLIm has discriminated between normal and malignant, fibrosed, and inflammatory tissue in animal models, and proven to be a sensitive tool for discrimination of malignant and normal tissue in solid brain and head/neck tumors in human studies. There has been no application in gastrointestinal (GI) disease to date.

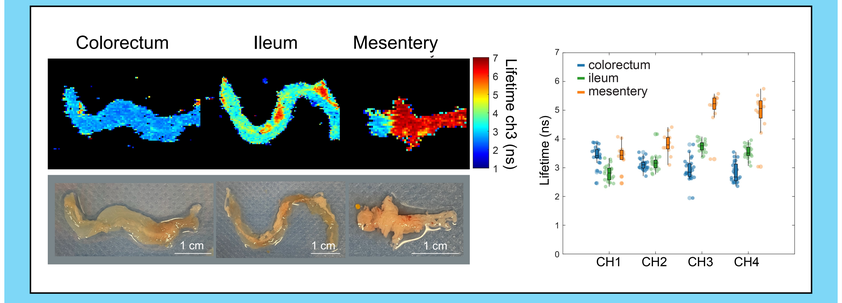
METHODS

The colorectum, ileum, and mesentery of 12 mice (6 male and 6 female) were imaged with FLIm. Images were acquired by raster-scanning an optical fiber probe (400 µm diameter) with a 3D scanning stage and multispectral 4-channel detection system across the visible spectrum. Channels were tuned to capture fluorescence from structural proteins, cellular metabolic co-factors, lipids, and porphyrins.



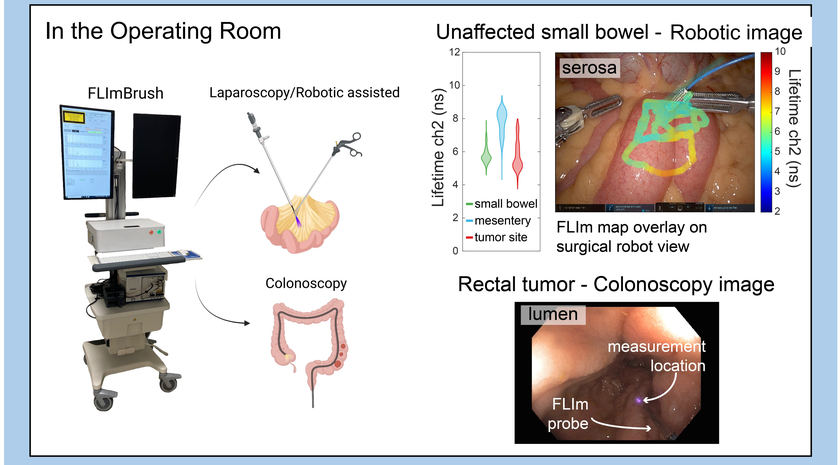
RESULTS

- Colorectal, ileal, and mesentery tissue exhibited distinct fluorescence lifetime signals in a spectrally dependent manner.
- Colon and ileum samples presented a mid-section with longer lifetimes than the proximal and distal ends, likely due to different arrangements in connective tissue.
- Mesentery had distinct areas with lifetime corresponding to simple mesenteric, lymphovascular tissue, and interstitial fat.
- Signal patterns were consistent across gender and reproducible.



OUTLOOK

FLIm was successfully adapted to GI tissue in the mouse model. Preliminary human data was successfully acquired integrating a clinical FLIm system (FLImBrush) with multiple surgical and imaging approaches including laparoscopy, robotics, and colonoscopy. Current results show lifetime differences in healthy GI tissues analogous to mice model, and distinct values for tumor tissue.



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