WashU

Office of Technology Management

CO-REGISTERED ULTRASOUND AND PHOTOACOUSTIC SYSTEM, SOFTWARE, AND AI MODELS FOR COLORECTAL CANCER IMAGING

Chapman Jr., William "Will Jr", Nie, Haolin "Taylor", Thakur, Sanskar, Zhu, Quing

Dahl, Lisa

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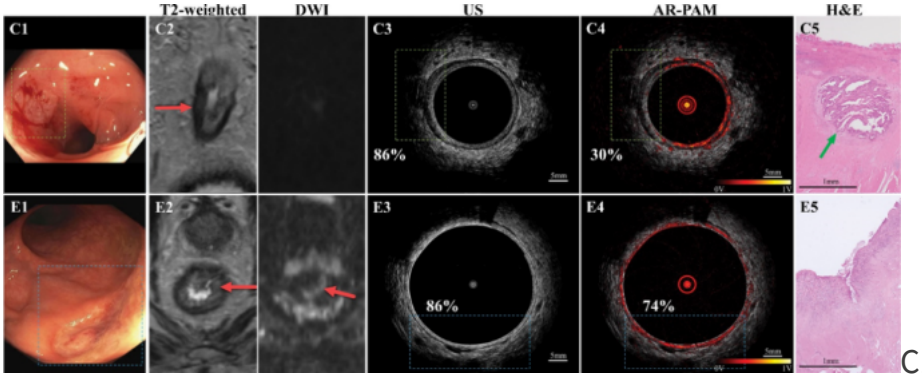
Value Proposition: *Method that utilizes machine learning, photoacoustic microscopy and ultrasound for improving rectal cancer imaging.*

Technology Description

Researchers at Washington University in St. Louis have developed a method for imaging rectal tumors using photoacoustic microscopy, ultrasound model with a machine learning component, and deep learning fusion that can improve diagnostic and predictive accuracy. Current methods for managing rectal cancer have limited resolution and poor capability to differentiate active tumors from post edema and scar.

This method utilizes an ArpamGui Software, an all-in-one software platform to drive the PAM/US system by implementing data acquisition, real-time image reconstruction, imaging parameter optimization, and image annotation during data review to observe the submucosal vasculature. They also trained a convolutional neural network capable of using the imaging data to predict residual tumor presence, with an AUC of 0.98. This imaging system can accurately classify tissue as healthy or tumor even in the presence of heavy scarring, unlike MRIs. By more accurately identifying healthy tissue, the system could reduce the number of unnecessary surgical resections.



C1–C5: Posttreatment endoscopic image shows fibrosis and scarring. T2-weighted and DWI MRI scans look normal, as does the ultrasound image. The PAM image reveals a tumor, confirmed by post-operative H&E stain. E1–E5: T2-weighted and DWI MRI scans show an abnormal signal suggestive of residual tumor. Ultrasound imaging appears normal, as does PAM imaging. Pathologic analysis reveals ulcer and granulation tissue, but no residual cancer.

Stage of Research

The inventors trained the convolutional neural network (CNN) using a sample of 22 patients with adenocarcinoma of the colon or rectum, undergoing primary resection after chemotherapy and radiation. The resected specimens were imaged ex vivo and subsequently analyzed by pathology. The CNN was then tested on data from a group of 10 patients with rectal adenocarcinoma undergoing resection after chemoradiation. These patients were imaged using the PAM/US system in vivo, prior to resection and pathology analysis. The CNN was able to differentiate between tumor and healthy tissue with an AUC of 0.98.

Publications

- Leng X, Uddin KMS, Chapman Jr W, Luo H, Kou S, … Zhu Q. (2021). Assessing rectal cancer treatment response using coregistered endorectal photoacoustic and US imaging paired with deep learning. Radiology, epub202208.

- Miller B. (2021). "Leap forward" in risk management of rectal cancer. The Source, Washington University in St. Louis.

Applications

- Rectal cancer diagnosis

Key Advantages

- Discerns residual tumor from scar tissue better than MRI

- Reduces unnecessary surgeries

Patents
Patent pending

Related Web Links – Quing Zhu Profile; Zhu Lab