Washington University in St. Louis
Office of Technology Management

MACHINE LEARNING PAIRED WITH PHOTOACOUSTIC MICROSCOPY AND ULTRASOUND FOR IMPROVED RECTAL CANCER IMAGING

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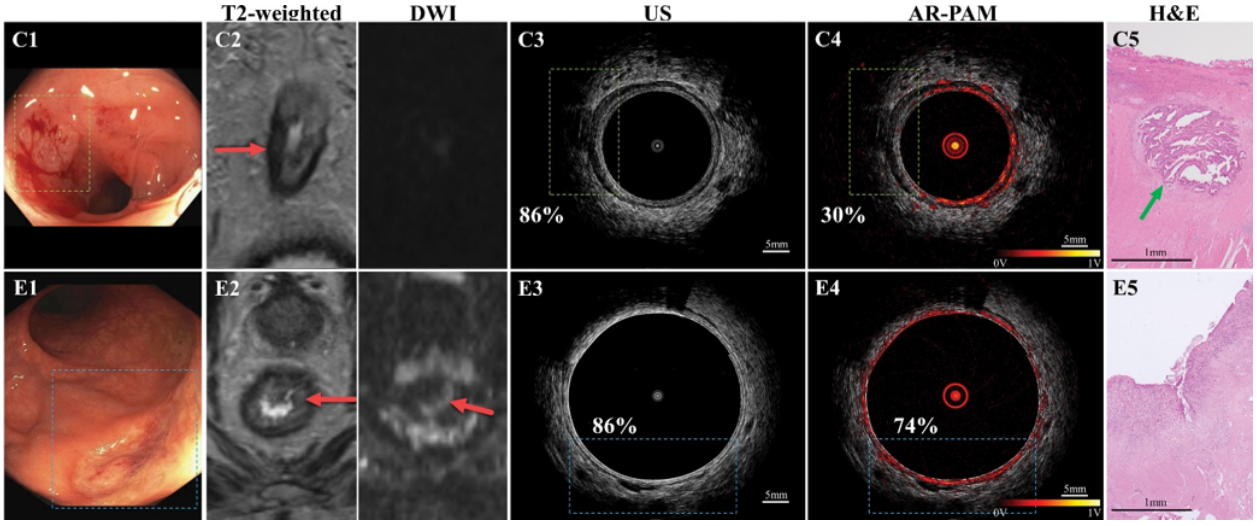
Technology Description:

Researchers led by Quing Zhu at Washington University have developed a method for imaging rectal tumors using photoacoustic microscopy and ultrasound with a machine learning component. This method is better able to differentiate residual cancer from healthy tissue following chemotherapy and radiation.

The inventors have developed an endorectal probe to enable photoacoustic microscopy coregistered with ultrasound (PAM/US) 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 is able to 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:

- Imaging of rectal cancer in patients following chemotherapy and radiation

Key Advantages:

- More effectively differentiates residual cancer from healthy tissue following chemoradiation
    - Discerns residual tumor from scar tissue better than MRI
    - Reduces unnecessary surgeries

Patents: Pending

Related Web Links: Zhu Profile & Lab; Chapman Profile; Mutch Profile