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Confocal Microscopy and Tri-modal Optical Imaging for Breast and Thyroid Cancer Detection

Monday 9 June 2025 15:00 (15 minutes)

Purpose and Hypothesis:
A confocal microscope capable of accurate tissue pathology classification using a WAR tri-modal optical diagnosis system (White-light imaging, Autofluorescence imaging, and Raman spectroscopy) has the potential to improve the specificity and sensitivity to reliably diagnose breast cancer and thyroid cancer. The device will be used to build a database for Raman scattering patterns detected from normal and cancerous breast and thyroid tissue, to classify patient samples. When combined with a needle endoscope, this technology not only has the potential to reduce the false-negative rate of biopsies but also a chance to reduce the amount of unnecessary biopsies and thus the cost of treatment.

Methods:
A confocal microscope that utilizes the WAR tri-modal imaging techniques was designed with three major pathways: (1&2) white light reflectance and autofluorescence imaging via Thorlabs CS895MU CCD camera; (3) Raman collection via the Tornado HyperFlux Pro Raman Spectrometer, using the Thorlabs CLD1010LP laser driver with the LP785-SAV50 785 nm laser diode. Images and spectra are captured ex-vivo.

Results:
WAR tri-modal images were successfully captured from 20+ breast tissue specimens, utilizing white light, autofluorescence, and Raman spectroscopy to differentiate cancerous from non-cancerous regions. Additionally, the first iteration of a machine learning algorithm was created to classify tissue regions as cancerous or non-cancerous. Accuracy is currently being refined by comparing results to pathologist-marked images, with ongoing tests focused on improving classification performance and ensuring alignment with expert diagnoses.

Conclusions:
The integration of confocal microscopy with a tri-modal optical diagnosis system demonstrates the potential for accurate classification of tissue pathology to improve the detection of breast and thyroid cancer. The current confocal microscope requires further optimization and automation before a proper tissue database can be built for breast and thyroid tissue.

Keyword-1

Raman Spectroscopy

Keyword-2

Breast Cancer

Keyword-3

Biomdedical Imaging

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