New method to test breast lesions could better detect cancer, save money by reducing repeat biopsies

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A newly developed, single-step Raman spectroscopy algorithm has the potential to simultaneously detect microcalcifications and enable diagnosis of the associated breast lesions with high precision, according to data published in *Cancer Research*, a journal of the American Association for Cancer Research.

"Nearly 1.6 million breast biopsies are performed and roughly 250,000 new breast cancers are diagnosed in the Unites States each year," said Ishan Barman, Ph.D., postdoctoral fellow at the Massachusetts Institute of Technology in Cambridge and the study's lead author. "If 200,000 repeat biopsies were avoided, even by a conservative estimate, the U.S. health care system could save $1 billion per year."

X-ray mammography is currently the only accepted routine screening method for early detection of breast cancer, but it cannot accurately distinguish whether microcalcifications (microscopic areas of calcium accumulation) are associated with benign or malignant breast lesions, according to Barman. Most patients, therefore, undergo core needle biopsy to determine if the microcalcifications are associated with malignancy, but the technique fails to retrieve microcalcifications in about 15 to 25 percent of patients. This results in nondiagnostic or false-negative biopsies, requiring the patient to undergo repeat, often surgical biopsy.

According to the researchers, the newly developed algorithm exhibited positive and negative predictive values of 100 percent and 96 percent, respectively, for the diagnosis of breast cancer with or without microcalcifications. The algorithm also showed an overall accuracy of 82 percent for classification of the samples into normal, benign or malignant lesions.

"There is an unmet clinical need for a tool that could minimize the number of X-rays and biopsy procedures. This tool could shorten procedure time; reduce patient anxiety, distress and discomfort; and prevent complications such as bleeding into the biopsy site after multiple biopsy passes," said Barman. "Our study demonstrates the potential of Raman spectroscopy to simultaneously detect microcalcifications and diagnose associated lesions with a high degree of accuracy, providing real-time feedback to radiologists during the biopsy procedures."

The researchers used a portable clinical Raman spectroscopy system to obtain Raman spectra from breast tissue biopsy specimens of 33 women. They collected Raman spectra from 146 tissue sites within the samples, including 50 normal tissue sites, 77 lesions with microcalcifications and 19 lesions without microcalcifications. Notably, they acquired all spectra within 30 minutes of sample removal.

Barman and colleagues fitted the obtained spectra into a model that identifies the different type and texture of various components of the breast tissue. They then developed a single-step Raman algorithm to distinguish normal breast tissue, breast cancer with and without microcalcifications, and other benign breast lesions including fibrocystic change and fibroadenoma.

In addition, the majority of breast cancers diagnosed using the one-step Raman algorithm were ductal carcinoma in situ, the most common lesion associated with microcalcifications, which is a challenge to diagnose

using existing methods, according to Barman.

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