# Raman spectroscopy poised to make thyroid cancer diagnosis less invasive

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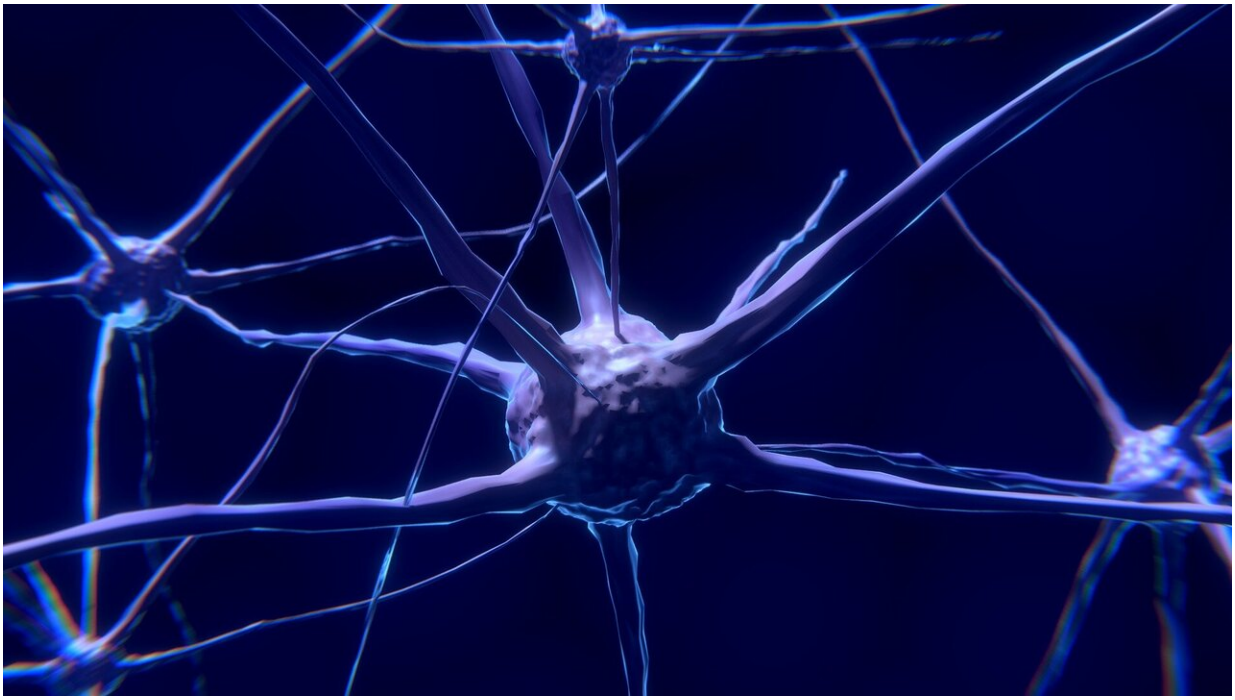

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Researchers have demonstrated that an optical technique known as Raman spectroscopy can be used to differentiate between benign and cancerous thyroid cells. The new study shows Raman spectroscopy's potential as a tool to improve the diagnosis of thyroid cancer, which is the ninth most common cancer with more than 50,000 new cases diagnosed in the United States each year.

"Our encouraging results show that Raman spectroscopy could be developed into a new optical modality that can help avoid invasive procedures used to diagnose thyroid cancer by providing biochemical information that isn't currently accessible," said James W. Chan from the University of California, Davis, U.S.A. "This could have a major impact in the field of pathology and could lead to new ways to diagnose other diseases."

In The Optical Society (OSA) journal *Biomedical Optics Express*, a multidisciplinary team led by Chan; Michael J. Campbell, University of California, Davis, U.S.A.; and Eric C. Huang, University of Washington, Seattle, U.S.A., report that their Raman spectroscopy approach can distinguish between healthy and cancerous human thyroid cells with 97 percent accuracy.

"We are the first, to our knowledge, to use human clinical thyroid cells to show that Raman spectroscopy can identify cancer subtypes at the single cell level," said Chan. "However, we will need to increase both the number of cells and number of patients studied to confirm the accuracy of the Raman technique."

## Improving cell-based diagnosis

A lump—or nodule—in the neck is a common symptom of thyroid cancer. However, most thyroid nodules aren't cancerous. Ultrasound-guided fine needle aspiration biopsies are typically used to check for cancer by inserting a thin needle into the nodule to obtain cells that are prepared on a microscope slide, stained and analyzed by a pathologist.

For about 15 to 30 percent of cases, the pathologist cannot determine whether cells acquired from the biopsy are benign or malignant. For these cases, a surgical procedure known as a thyroidectomy is required to remove tissue, which provides more information for a more accurate

diagnosis.

The researchers turned to Raman spectroscopy as a possible solution because it is a non-invasive technique that requires no sample preparation or staining to determine subtle differences in the molecular composition of complex samples such as cells.

"We would like to use Raman spectroscopy to improve the pathologist's analysis of the cells obtained with fine needle aspiration to reduce the number of thyroidectomies necessary," said Chan. "This would both minimize surgical complications and reduce health care costs."

## Biochemical information from an entire cell

For the new study, the researchers used a line-scan Raman microscope that allowed them to rapidly acquire Raman signals from an entire cell volume. This allowed them to more accurately capture the chemical composition of entire cells compared to other approaches that acquire a Raman spectrum from only part of a cell's volume. Multivariate statistical methods and classification methods were then used to analyze the Raman data and classify the cells in an objective, unbiased manner.

The researchers applied this Raman spectroscopy approach to individual cells isolated from 10 patient thyroid nodules diagnosed as benign or cancerous. The data analysis identified unique spectral differences that could distinguish cancerous cells from benign with 97 percent diagnostic accuracy. They also showed that other subtypes could be identified by their spectral differences.

"These preliminary results are exciting because they involve single cells from human clinical samples, but more work will need to be done to take this from a research project to final clinical use," said Chan.

In addition to testing it on more cells and patients, the researchers also need to apply the technique to cells obtained with a fine needle aspiration and test it on samples for which the pathologist can't determine if the cells are benign or cancerous. They also want to develop an automated prototype system that can perform the Raman measurements and analysis with minimal human intervention.

**More information:** Marcos A. S. de Oliveira et al, Hyperspectral Raman microscopy can accurately differentiate single cells of different human thyroid nodules, *Biomedical Optics Express* (2019). DOI: 10.1364/BOE.10.004411

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