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Scent of melanoma: New research may lead to early non-invasive detection and diagnosis

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According to new research from the Monell Center and collaborating institutions, odors from human skin cells can be used to identify melanoma, the deadliest form of skin cancer. In addition to detecting a unique odor signature associated with melanoma cells, the researchers also demonstrated that a nanotechnology-based sensor could reliably differentiate melanoma cells from normal skin cells. The findings suggest that non-invasive odor analysis may be a valuable technique in the detection and early diagnosis of human melanoma.

Melanoma is a tumor affecting melanocytes, skin cells that produce the dark pigment that gives skin its color. The disease is responsible for approximately 75 percent of skin cancer deaths, with chances of survival directly related to how early the cancer is detected. Current detection methods most commonly rely on visual inspection of the skin, which is highly dependent on individual self-examination and clinical skill.

The current study took advantage of the fact that human skin produces numerous airborne chemical molecules known as volatile organic compounds, or VOCs, many of which are odorous. "There is a potential wealth of information waiting to be extracted from examination of VOCs associated with various diseases, including cancers, genetic disorders, and viral or bacterial infections," notes George Preti, PhD, an organic chemist at Monell who is one of the paper's senior authors.

In the study, published online ahead of print in the *Journal of Chromatography B*, researchers used sophisticated sampling and

analytical techniques to identify VOCs from melanoma cells at three stages of the disease as well as from normal melanocytes. All the cells were grown in culture.

The researchers used an absorbent device to collect chemical compounds from air in closed containers containing the various types of cells. Then, gas chromatography-mass spectrometry techniques were used to analyze the compounds and identified different profiles of VOCs emitting from melanoma cells relative to normal cells.

Both the types and concentrations of chemicals were affected. Melanoma cells produced certain compounds not detected in VOCs from normal melanocytes and also more or less of other chemicals. Further, the different types of melanoma cells could be distinguished from one another.

Noting that translation of these results into the clinical diagnostic realm would require a reliable and portable sensor device, the researchers went on to examine VOCs from normal melanocytes and melanoma cells using a previously described nano-sensor.

Constructed of nano-sized carbon tubes coated with strands of DNA, the tiny sensors can be bioengineered to recognize a wide variety of targets, including specific odor molecules. The nano-sensor was able to distinguish differences in VOCs from normal and several different types of melanoma cells.

"We are excited to see that the DNA-carbon nanotube vapor sensor concept has potential for use as a diagnostic. Our plan is to move forward with research into skin cancer and other diseases," said A.T. Charlie Johnson, PhD, Professor of Physics at the University of Pennsylvania, who led the development of the olfactory sensor.

Together, the findings provide proof-of-concept regarding the potential of the two analytical techniques to identify and detect biomarkers that distinguish normal melanocytes from different melanoma cell types.

"This study demonstrates the usefulness of examining VOCs from diseases for rapid and noninvasive diagnostic purposes," said Preti. "The methodology should also allow us to differentiate stages of the disease process."

Current studies are focusing on analysis of VOCs from tumor sites of patients diagnosed with primary melanoma.

Provided by Monell Chemical Senses Center