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Cell harm seen in lab tests of e-cigarettes

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Adding to growing evidence on the possible health risks of electronic cigarettes, a lab team at the VA San Diego Healthcare System tested two products and found they damaged cells in ways that could lead to cancer. The damage occurred even with nicotine-free versions of the products.

"Our study strongly suggests that electronic cigarettes are not as safe as their marketing makes them appear to the public," wrote the researchers, who published their [findings](#) in the journal *Oral Oncology*.

The U.S. Food and Drug Administration does not regulate e-cigarettes like it does conventional tobacco products. But it has [warned](#) of possible health risks. So far, though, evidence is limited on what exactly e-cigarettes contain and whether those chemicals are safe, particularly in terms of cancer.

"There haven't been many good lab studies on the effects of these products on actual human cells," says Dr. Jessica Wang-Rodriguez, one of the lead researchers on the new study. She is a professor of pathology at the University of California, San Diego, and chief of pathology and laboratory medicine at the San Diego VA. She specializes in studying head and neck cancer.

Vapor-exposed cells more likely to die

Her team created an extract from the vapor of two popular brands of e-cigarettes and used it to treat human cells in Petri dishes. Compared with untreated cells, the treated cells were more likely to show DNA damage and die.

The exposed cells showed several forms of damage, including DNA strand breaks. The familiar double helix that makes up DNA has two long strands of molecules that intertwine. When one or both of these strands break apart and the cellular repair process doesn't work right, the stage is set for cancer.

The affected cells were also more likely to launch into apoptosis and necrosis, which lead to cell death.

In the main part of the experiment, the team used normal epithelial cells, which line organs, glands, and cavities throughout the body, including the mouth and lungs.

Nicotine not the main culprit

The scientists tested two types of each e-cigarette: a nicotine and nicotine-free version. Nicotine is what makes smoking addictive. There is also some evidence it can damage cells. The San Diego team found that the nicotine versions caused worse damage, but even the nicotine-free vapor was enough to alter cells.

"There have been many studies showing that nicotine can damage cells," says Wang-Rodriguez. "But we found that other variables can do damage as well. It's not that the nicotine is completely innocent in the mix, but it looks like the amount of nicotine that the cells are exposed to by e-cigarettes is not sufficient by itself to cause these changes. There must be other components in the e-cigarettes that are doing this damage. So we may be identifying other carcinogenic components that are previously undescribed."

She says her team is now trying to sort out those other substances and their specific effects.

Scientists already know of some troubling chemicals in the products. One is [formaldehyde](#), a known carcinogen. Using the products at a low voltage setting may minimize the production of formaldehyde, research suggests. Another possible culprit is [diacetyl](#), a flavoring agent that has been linked to lung disease. A Harvard study found it in more than three-quarters of flavored e-cigarettes and refill liquids, or "e-juice."

There are nearly 500 brands of e-cigarettes on the market, in more than 7,000 flavors. So scientists have their work cut out for them identifying all the potential problems.

"For now, we were able to at least identify that e-cigarettes on the whole have something to do with increased cell death," says Wang-Rodriguez. "We hope to identify the individual components that are contributing to the effect."

Study did not mimic actual doses

She notes that cells in the lab are not completely comparable to cells within a living person. The cells lines that scientists work with have been "immortalized because of certain cell changes," she says. So it could be that e-cigarette vapor has different effects than those seen in the lab.

Also, her team didn't seek to mimic the actual dose of vapor that an e-cigarette user would get.

"In this particular study, it was similar to someone smoking continuously for hours on end, so it's a higher amount than would normally be delivered," she says. "What we're looking at now is to dose-control these. We want to know at what dose it causes that critical switch-over to where we see the damage."

The overarching question is whether the battery-operated products are really any safer than the conventional tobacco cigarettes they are designed to replace. Wang-Rodriguez doesn't think they are.

"Based on the evidence to date," she says, "I believe they are no better than smoking regular cigarettes."

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