

Scientists study how asbestos fibers trigger cancer in human cells

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Ohio State University scientists believe they are the first in the world to study the molecular underpinnings of cancer by probing individual bonds between an asbestos fiber and human cells.

Though any clinical application is years away, the researchers hope their findings could aid in drug development efforts targeting illnesses caused by excessive exposure to asbestos, including the deadly cancer called mesothelioma.

The researchers use atomic force microscopy to observe how a single asbestos fiber binds with a specific receptor protein on cell surfaces. They suspect that at least one of the more lethal forms of asbestos triggers a cascade of events inside cells that eventually lead to illness, sometimes decades later.

The conditions most commonly associated with long-term exposure to airborne asbestos are lung cancer; asbestosis, a chronic respiratory disease; and mesothelioma, a cancer that forms in the membrane lining most internal organs of the body, including the lungs.

Eric Taylor, a doctoral candidate in earth sciences at Ohio State and a coauthor of the study, describes atomic force microscopy as "Braille on a molecular level," meaning it allows scientists to feel and observe what's happening on molecular surfaces.

"We're looking at what molecules are involved in the chain of events when the fiber touches the cell. Does the binding occur over minutes, or hours? And what processes are triggered?" said Taylor, who presented the research at the American Geophysical Union meeting in San Francisco.

Asbestos comprises six different minerals that naturally occur in both fragment and fibrous forms. Because of its high durability and heat resistance,

the fibrous form has been used in many manufacturing products since the late 1800s. Though its use is now highly regulated, asbestos is still present in many materials. The U.S. Department of Labor estimates that 1.3 million employees face significant asbestos exposure on the job. Environmental exposure is also possible because asbestos is a naturally occurring mineral in soils and exposed bedrock.

Crocidolite, or blue asbestos, is part of the amphibole group of asbestos minerals, which were banned in most of the Western world by the mid-1980s. Before that, they were used in such products as ceiling tiles and thermal insulation.

Ohio State researchers have focused so far on the crocidolite form of asbestos, but eventually hope to study how all six forms of asbestos interact with certain proteins on cell surfaces. Some forms of asbestos can dissolve in the lungs if they are inhaled, but others are believed to essentially "stick" to cells, especially at high concentrations, and eventually cause lung diseases.

"For the first time, this will give us data on biological activity that should help policymakers determine which forms of asbestos are the most dangerous," said Steven Lower, associate professor of earth sciences at Ohio State and a coauthor on the study.

"The hypothesis we're testing is that binding of cell surface receptors to asbestos fibers triggers a signal event, which initiates the cancer," said Lower, also a faculty member in the School of Environment and Natural Resources. "There seems to be something intrinsic about certain types of asbestos, blue asbestos in particular, that elicits a unique signal, and it triggers inflammation, the formation of pre-malignant cells and, ultimately, cancer."

The first protein to be studied is epidermal growth

factor receptor, which is present on the surface of every human cell. Understanding the intricacies of the binding process between the mineral and one or more proteins will provide an index of the biological activity of a particular type of asbestos, and might lead the researchers to figure out how to prevent or undo that interaction, Lower said.

Taylor said the driving motivation behind the research is the potential to find a way to intervene and prevent illness even after someone is exposed to asbestos. Mesothelioma symptoms don't typically appear until 30 to 50 years after exposure. After diagnosis, however, the cancer is difficult to control, and there is no cure.

Source: Ohio State University

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