Occupational Safety & Health Reporter™

Source: Occupational Safety & Health Reporter: All Issues > 2009 > 10/29/2009 > News > Nanotechnology: Study Finds More Evidence That Inhalation Of Some Carbon Nanotubes May Be Harmful

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Nanotechnology

Study Finds More Evidence That Inhalation Of Some Carbon Nanotubes May Be Harmful

Multi-walled carbon nanotubes caused lung tissue scarring in mice, according to a study published Oct. 25 in *Nature Nanotechnology*.

"Our study shows for the first time that inhaled carbon nanotubes travel to the pleural lining surrounding the lungs and cause unique pathological effects," lead investigator James C. Bonner told BNA. The pleura is the tissue that lines the outside of the lungs. Asbestos fibers that reached that part of the lungs have caused the rare cancer mesothelioma, according to information from North Carolina State University, where Bonner works.

Bonner told BNA the study's results do not mean multi-walled carbon nanotubes will cause mesothelioma. The 14 week length of the study is too short to determine whether mesothelioma would occur, and mesothelioma does not readily develop in common species of laboratory mice, according to the study.

The results do mean that researchers need to find out what causes carbon nanotubes to be toxic, so the materials can be responsibly developed for their myriad anticipated useful purposes, he said. "It's important to get this right, so we don't go back years later with another pandemic like asbestos," he said.

Workplace Implications

The results underscore the need to minimize inhalation of nanotubes during handling until further long-term assessments are conducted, said the study, "Inhaled Carbon Nanotubes Reach the Subpleural Tissue in Mice."

"In my opinion, multi-walled carbon nanotubes should be treated like asbestos fibers until we know more," Bonner said.

The research team consisted of scientists working at the North Carolina State University, the Hamner Institutes for Health Sciences, and the National Institute of Environmental Health Sciences.

The team exposed mice for six hours to either one milligram per cubic meter of air (mg/m^3) or to 30 mg/m^3 of nickel-based multi-walled carbon nanotubes or, as a control, to carbon black nanoparticles. Carbon black can damage lung function. Lung tissues were collected at one day, two weeks, six weeks, and 14 weeks after inhalation.

Within one day, immune cells began to collect on the lung lining tissues of the mice exposed to 30 mg/m^3 of the multi-walled carbon nanotubes, the study said. Scarring was found at two and six weeks after inhalation in this high-dose exposure group. These effects were not seen in the lower-exposure group of mice nor in the mice exposed to carbon black, the study said.

'Target' for Nanotubes

"Our findings suggest that the pleura may be a target for nanotubes, and this is important since the pleura is a tissue that is sensitive to irritation and injury by fibers and is the site of mesothelioma formation," Bonner said.

It is reasonable to extrapolate from this study that other types of multi-walled carbon nanotubes would reach the pleura and remain there, Bonner said.

But whether multi-walled carbon nanotubes made with metals other than nickel would cause the same toxic effects is not known, he said.

Bonner said the results of this study should not be extrapolated to predict health effects from single-walled carbon nanotubes. The reason is that multi-walled carbon nanotubes remain stiff and fiber-like whereas single-walled carbon nanotubes tend to tangle, making it easier to clear them from the lungs, he said.

The results of this research are consistent with a May 20, 2008, study that found multi-walled carbon nanotubes injected into the abdominal cavity of mice caused inflammation, lesions, and other biological responses similar to asbestos in the pleural surface of the diaphragm (98 DEN A-9, 5/21/08).

Commentary on Study

Ken Donaldson and Craig A. Poland, who were part of the research team that conducted the 2008 study, wrote a "news and views" commentary that also appeared in the Oct. 25 issue of *Nature Nanotechnology*.

The strength of Bonner's study, they wrote, is that it used the more expensive and complex methods of an inhalation study.

"This is the first published study to demonstrate that inhaled carbon nanotubes reach the vicinity of the pleura," they wrote.

By Pat Rizzuto

An abstract of the study is available at http://www.nature.com/nnano/journal/vaop/ncurrent/abs/nnano.2009.305.html, which has information about purchasing the full study.

ISSN 1522-4082