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COMMENT

Human biological monitoring of nanoparticles, a new way to investigate potential causal links between exposure to nanoparticles and lung diseases?

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In addition to ultra-fine particles produced naturally or unintentionally released as a consequence of human activities, engineered nanomaterials are produced purposefully to take advantage of their unique physicochemical characteristics associated with their nanostructure. The growing development and applications of nanomaterials lead to an increasing release of these materials into the environment and consequently we are increasingly exposed to them.

Inhaled nanoparticles can deeply affect human health, especially, but not exclusively, in the context of air pollution. An update of the World Health Organization's air quality database was released in April 2022, warning that significant harm can be caused by even low levels of air pollutants.[1] As lungs are directly and constantly exposed to airborne pollutants, the effects of air pollution on the respiratory system has received much attention. Correlations have been reported between air pollution, especially particulate matter (PM), and the incidence and mortality of lung cancers.[2–4] PM was classified as a group I human carcinogen by the International Agency for Research on Cancer (IARC) based on data from human, animal and mechanistic studies.[5,6] But other cancers are also suspected to be related to air pollution such as childhood leukemia, cancers of the gastro-intestinal tract, bladder and kidney cancers or breast cancers.

In any case, inhaled nanoparticles can accumulate within the lungs where they are able to induce tissue damages. It has been especially reported that biopersistent engineered nanoparticles can induce pro-inflammatory reaction and oxidative stress, creating a microenvironment favorable to the development of diseases and especially cancers. In addition, due to their small size, inhaled nanoparticles can also cross the blood-air barrier and be distributed to other organs where they can trigger further damage.

Although epidemiological studies are informative, they are time- and resource- consuming. To get a better understanding of the chain of events from exposure to disease, alternative approaches such as the biological monitoring of biopersistent nanoparticles in patients could be used. Indeed, such biomonitoring would allow for the quantification of the internal dose of inhaled biopersistent particles, which differs from the external dose that can be measured by ambient monitoring (*i.e.*, atmospheric metrology). The assessment of the internal dose is a first step towards the characterization of persistent engineered nanoparticles in tissues and the understanding of this potential source of adverse effects.[7–9]

This approach has led to suggestions about the contribution of silica submicron particles to the development of sarcoidosis,[10] providing new research avenues. Similarly, it could improve understanding of the factors, which if they not actually cause may at least contribute to the development of cancers.

Combining the biomonitoring of nanoparticles in human samples and toxicological studies could improve understanding of the pathways involved in cancer development and also play a part in prevention, by limiting exposure to the incriminated sources of hazard.

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In conclusion, the biological monitoring of nanoparticles in human samples appears as an alternative approach to time- and resource- consuming epidemiological studies to highlight relationships between exposure to nanoparticles and lung diseases development.

Conflicts of interest

none.

CRediT authorship contribution statement

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