PERSPECTIVE

A pathologist's view on nanotoxicology

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ABSTRACT

Nanotechnology, a new technology encompassing the tiniest known manufactured items, has emerged as a result of advances in chemistry and engineering. These items are gaining traction in the market and look to be on the verge of revolutionising engineering, cosmetics, and medicine. Unfortunately, nanotoxicology, which studies the health impacts of nanoparticles, lags behind breakthroughs in nanotechnology. Over the last decade, research of first generation nanotechnology goods have complemented previous literature on ultrafine particles and respirable durable fibres Nanosizing appears to enhance the toxicity of numerous particles, according to these research. First, when particle size reduces, surface area rises, speeding up soluble particulate dissolution and exposing more of the reactive surface of durable yet reactive particulates. Second, nanosizing allows particles to get through cellular and intracellular barriers more easily. Third, nanosizing allows particulates to interact with subcellular structures, such as microtubules and DNA, and sometimes even hybridise with them. Finally, nanosizing certain particles enhance pathologic and physiologic responses such as inflammation, fibrosis, allergic reactions, genotoxicity, and carcinogenicity, as well as changing cardiovascular and lymphatic function. Understanding how the size and physiochemical features of nanoparticles impact bioactivity is critical for ensuring that nanotechnology's exciting new products are utilised safely. This article presents an overview of nanoparticulate pathology and toxicity.

Key Words: Nanodrug; Genotoxicity; Biocompatibility; Pharmaceutic;

INTRODUCTION

Sientific advances have enhanced the capacity to produce particular particles in the size range of 1 to 100 nm, resulting in a surge in interest in nanotoxicology and Nanoscale Particulates (NPs). As part of the research of ultrafine particles, the toxicity of various NPs has been examined for a long time (Oberdörster, Oberdörster, and Oberdörster 2005). NPs, which are components of emissions from combustion and dust-producing industrial operations, are ultrafine particles. The quantity, chemical content and physical features of extremely minute particles in possible workplace and environmental exposures have all altered as a result of nanotechnologies newly designed NPs.

Nanotechnology is the manipulation of matter at the atomic level to build structures that can be used in engineering, research, and medicine to generate new products. Improved synthesis processes, quick developments in chemistry and physics at the atomic level, and a better knowledge of intracellular structures at the molecular level have all changed nanotechnology (Iijima 1991; National Research Council 2006).

Nanotechnology investments in the United States government totaled $1.1 billion in 2006. (National Research Council 2006). Nanotechnology goods have a market worth of $254 billion in 2009, with growth expected to reach $2.5 trillion by 2015. (Bradley, Nordan, and Tassinari 2009). Although others doubt accurate estimates, the growing number of patents supports nanotechnology's growing economic significance (National Research Council 2006). Particulates that have never been researched and others that have only been studied as components of mixes are among the novel created NPs. This article provides an overview of nanotoxicology and toxicologic pathologies in first-generation nanotechnology goods. For toxicologic pathologists used to working in the pharmaceutical business, it's worth noting that the regulation of many NPs differs significantly from that of medicines. Most nonpharmaceutical particles are controlled by their chemical content rather than their size and form, with the exception of certain mineral fibres. The Occupational Safety and Health Administration (OSHA) regulate airborne particles with a chemical composition not

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expressly stated in rules in the workplace as particulates not otherwise controlled (PNOR).For an 8-hour time-weighted average total PNOR concentration, the OSHA acceptable exposure limit (PEL) is 15 mg/m3. However, because the proportion of those PNOR in the respirable range is lower than the total PNOR, another PEL for PNOR with an aerodynamic diameter of 5 m exists. Toxicologic pathologists will often assess the pathologic alterations induced by NPs now in use in research facilities or even NPs that are widely utilised in industry. The importance of the study is heightened by ongoing NP exposures in students and employees. One source of concern is that as particulate sizes shrink, the surface area to mass ratio increases, and particulate toxicity is often, but not always, related to surface area rather than mass. One source of worry is that the surface area to mass ratio increases as particle size decreases, and particulate toxicity typically, but not always, corresponds with particulate size. Pathologists were essential in detecting these alterations, although detecting NP-induced changes necessitates a careful and frequently high-magnification examination. When examining morphologic changes produced by particles with dimensions less than 100 nm, the classic adage "high power, low brain" is no longer applicable. Although the vocabulary is reasonably simple to grasp, it is not highly standardised. The prefix nano implies one billionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a millionth of a (SCENIHR 2007). The words that arise are made up of this prefix and a common word.

CONCLUSION

Nanotechnology advancements have resulted in an avalanche of new items, including consumer goods, medical gadgets, and engineered medications. Nanotoxicology research has often trailed behind advancements in nanotechnology. However, existing nanotoxicology research shows that as particle sizes drop, toxicity increases. Greater surface area, capacity to pass through cellular barriers, contact with subcellular structures, and higher ability to activate neutrophils and induce the production of inflammatory mediators are all linked to increased toxicity. Exposure to NP has been shown to have systemic effects, notably in the cardiovascular and neurologic systems. However, these findings and the problems they provide for toxicologic pathologists present significant opportunity. Because many NPs are designed, toxicologists and pathologists can utilise them to test long-standing ideas. As a result, the early fibrosis caused in the lungs of SWCNT- and MWCNT-exposed rats implies that novel pathways for fibrosis should be considered. The ability to mark NPs allows researchers to track the distribution of certain NPs throughout tissues and subcellular structures within those tissues. The capacity to design NPs in precise dimensions enables for the discovery of key dimensions for cellular structure interaction and penetration. Finally, combining improvements in molecular pathology with knowledge of nanotechnology allows for the discovery of unexpected effects in NP investigations, such as disruption of mitosis, lymphangiectasia, sensory nerve alterations, and blood-brain barrier disruption. Toxicologic pathologists can help identify the dangers of nanoparticles so that health risks are decreased while nanotechnology's benefits are achieved.