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TITLE: INFLUENCE OF ACID FUNCTIONALIZATION ON THE CARDIOPULMONARY TOXICITY OF CARBON NANOTUBES AND CARBON BLACK PARTICLES IN MICE

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ABSTRACT: Engineered carbon nanotubes are being developed for a wide range of industrial and medical applications. Because of their unique properties, nanotubes can impose potentially toxic effects, particularly if they have been modified to express functionally reactive chemical groups on their surface. The present study was designed to evaluate whether acid functionalization (AF) enhanced the cardiopulmonary toxicity of single-walled carbon nanotubes (SWCNT) as well as control carbon black particles. Mice were exposed by oropharyngeal aspiration to 10 or 40 ìg of saline-suspended single-walled carbon nanotubes (SWCNTs), acid-functionalized SWCNTs (AF-SWCNTs), ultrafine carbon black (UFCB), AF-UFCB, or 2 ìg LPS. 24 hours later, pulmonary inflammatory responses and cardiac effects were assessed by bronchoalveolar lavage and isolated cardiac perfusion respectively, and compared to saline or LPS-instilled animals. Additional mice were assessed for histological changes in lung and heart. Instillation of 40 ìg of AF-SWCNTs, UFCB and AF-UFCB increased percentage of pulmonary neutrophils. No significant effects were observed at the lower particle concentration. Sporadic clumps of particles from each treatment group were observed in the small airways and interstitial areas of the lungs according to particle dose. Patches of cellular infiltration and edema in both the small airways and in the interstitium were also observed in the high dose group. Isolated perfused hearts from mice exposed to 40 ìg of AF-SWCNTs had significantly lower cardiac functional recovery, greater infarct size, and higher coronary flow rate than other particle-exposed animals and controls, and also exhibited signs of focal cardiac myofiber degeneration. No particles were detected in heart tissue under light microscopy. This study indicates that while acid functionalization increases the pulmonary toxicity of both UFCB and SWCNTs, this treatment caused cardiac effects only with the AF-carbon nanotubes. Further experiments are needed to understand the physico-chemical processes involved in this phenomenon.