Abstract

BACKGROUND: Emissions from a large **peat** fire in North Carolina in 2008 were associated with increased hospital admissions for asthma and the rate of heart failure in the exposed population. **Peat** fires often produce larger amounts of smoke and last longer than forest fires, however few studies have reported on their toxicity. Moreover, reliable alternatives to traditional animal toxicity testing are needed to reduce the number of animals required for hazard identification and risk assessments.

METHODS: Size-fractionated particulate matter (PM; ultrafine, fine, and coarse) were obtained from the **peat** fire while smoldering (ENCF-1) or when nearly extinguished (ENCF-4). Extracted samples were analyzed for chemical constituents and endotoxin content. Female CD-1 mice were exposed via oropharyngeal aspiration to 100 μg/mouse, and assessed for relative changes in lung and systemic markers of injury and inflammation. At 24 h post-exposure, hearts were removed for ex vivo functional assessments and ischemic challenge. Lastly, 8 mm diameter lung slices from CD-1 mice were exposed (11 μg) ± co-treatment of PM with polymyxin B (PMB), an endotoxin-binding compound.

RESULTS: On an equi-mass basis, coarse ENCF-1 PM had the highest endotoxin content and elicited the greatest pro-inflammatory responses in the mice including: increases in bronchoalveolar lavage fluid protein, cytokines (IL-6, TNF-α, and MIP-2), neutrophils and intracellular reactive oxygen species (ROS) production. Exposure to fine or ultrafine particles from either period failed to elicit significant lung or systemic effects. In contrast, mice exposed to ENCF-1 ultrafine PM developed significantly decreased cardiac function and greater post-ischemia-associated myocardial infarction. Finally, similar exposures to mouse lung slices induced comparable patterns of cytokine production; and these responses were significantly attenuated by PMB.

CONCLUSIONS: The findings suggest that exposure to coarse PM collected during a **peat** fire causes greater lung inflammation in association with endotoxin and ROS, whereas the ultrafine PM preferentially affected cardiac responses. In addition, lung tissue slices were shown to be a predictive, alternative assay to assess pro-inflammatory effects of PM of differing size and composition. Importantly, these toxicological findings were consistent with the cardiopulmonary health effects noted in epidemiologic reports from exposed populations.