Pulmonary Toxicity of Particulate Matter Emitted from Firearms

Contact

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Citation:

Kim, Y., S. Vance, J. Aurell, B. Gullett, S. Gavett, Joseph Pancras, K. McNesby, AND Ian Gilmour. Pulmonary Toxicity of Particulate Matter Emitted from Firearms. Society of Toxicology Annual Meeting 2022 - Virtual, Research Triangle Park, North Carolina, March 23 - 31, 2022.

Impact/Purpose:

Smoke emissions produced by firearms contain relatively high levels of metals and organic combustion byproducts which have the potential for causing adverse health effects and potentially other longer-term disease processes in both the respiratory tract and other organs. However, little is known whether chemical properties of the smoke emissions vary with different weapon and ammunition types and how theses variables affect toxicity outcomes. We collected smoke particulate matter (PM) from the firing of two different gun types; 9 mm handgun and M4 rifle. le the water-insoluble components significantly induced lung toxicity to the same degree as the rifle PM at both time points. These findings suggest that different ammunition types can generate contrasting chemical spectra and that the rifle smoke PM effects are mostly driven by water-insoluble components, but higher levels of Cu may also partly contribute to the adverse effects. [This abstract does not represent EPA policy].

Description:

Smoke emissions produced by firearms contain relatively high levels of metals and organic combustion byproducts which have the potential for causing adverse health effects and potentially other longer-term disease processes in both the respiratory tract and other organs. However, little is known whether chemical properties of the smoke emissions vary with different weapon and ammunition types and how theses variables affect toxicity outcomes. We collected smoke particulate matter (PM) from the firing of two different gun types; 9 mm handgun and M4 rifle. PM samples were chemically analyzed and assessed for lung toxicity and lung function in CD-1 mice via oropharyngeal aspiration (20 μg of PM). Results showed that all PM was in the respirable size range but chemical compositions were largely different (e.g., high levels of Pb in the handgun and Cu in the rifle smoke). The handgun smoke PM did not induce lung toxicity at 4 and 24 h post-exposure while the rifle smoke PM significantly increased lung inflammation (neutrophil influx, increased protein and cytokine levels) and reduced lung function (breathing frequency, tidal volume and minute volume) at both time points. In separate experiments, mice were exposed to Cu microparticles (6 μg) with and without the Cu chelator penicillamine (20 μg), water-soluble components of the rifle smoke PM with and without removal of metal ions, and water-insoluble components of the PM. The Cu alone and water-soluble components increased neutrophil numbers but did not cause appreciable cellular damage or lung function changes at any time point. Penicillamine treated rifle smoke PM or Cu, slightly reduced lung inflammation and injury but did not improve the lung function decrements. The water-soluble components without metal ions did not induce lung toxicity

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