Alterations In Welding Process Parameters Change Particle Characteristics And Influence Lung Responses

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Rationale: Arc welding processes generate complex aerosols of fine and ultrafine particulates that may be composed of hazardous metals, such as Mn, Cr, and Ni. The goal of the project was to determine if alterations in process parameters change the physical and chemical properties of generated welding fume (WF) and thus influence lung responses. **Methods:** Stainless steel WF was generated during spray welding at a standard voltage setting of 25V or at a higher voltage (HV) of 30V. Sprague-Dawley rats were exposed by inhalation to 40 mg/m^3 of each WF x 3 hr/d x 3 or 10 d. Control rats were exposed to filtered air. WF was collected in the rats' breathing zone, and particle morphology, size, and composition were determined by electron microscopy, MOUDI and SMPS size classifiers, and inductively coupled plasma-atomic emission spectroscopy, respectively. Bronchoalveolar lavage was performed on exposed rats at 1, 7, 21, and 42 days after exposure to assess lung injury and inflammation. **Results:** Collected WF was arranged as chain-like agglomerates of nanometer-sized primary particles and morphologically did not appear different when comparing WF generated at the different voltages. However, HV welding produced a greater number of ultrafine-sized particles. Fe, Mn, Cr, and Ni were the predominant metals in each WF with HV welding producing particles comprised of higher amounts of Mn and lower levels of Ni. In regards to lung responses, exposure to HV WF induced a significant increase in lung injury and inflammation early (1 day) after exposure which quickly subsided by 7 days, whereas exposure to the WF generated at 25V led to a delayed pneumotoxic response that was elevated at 7 days compared to HV WF and persisted for 21 days after exposure. By 42 days, lung injury and inflammation had returned to control levels, regardless of voltage. **Conclusions:** A modest increase in voltage during welding increased the number of ultrafine-sized WF particles, affected WF elemental composition, and altered the lung toxicity profile. These findings illustrate the influence of particle size and composition on lung responses and may ultimately help develop effective personal protective equipment (PPE), as well as, educate and protect welders from adverse health effects.

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