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Inhalation of Iron-Abundant Gas Metal Arc-Mild Steel Welding Fume Promotes Lung Tumors in Mice

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Abstract

Welding fumes were reclassified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC) in 2017. Gas metal arc welding (GMAW) is a process widely used in industry. Fume generated from GMAW-mild steel (MS) is abundant in iron with some manganese, while GMAW-stainless steel (SS) fume also contains significant amounts of chromium and nickel, known carcinogenic metals. It has been shown that exposure to GMAW-SS fume in A/J mice promotes lung tumors. The objective was to determine if GMAW-MS fume, which lacks known carcinogenic metals, also promotes lung tumors in mice. Male A/J mice received a single intraperitoneal injection of corn oil or the initiator 3-methylcholanthrene (MCA; 10 µg/g) and, one week later, were exposed by whole-body inhalation to GMAW-MS aerosols for 4 hours/day x 4 days/week x 8 weeks at a mean concentration of 34.5 mg/m³. Lung nodules were enumerated by gross examination at 30 weeks post-initiation. GMAW-MS fume significantly increased lung tumor multiplicity in mice initiated with MCA (21.86 ± 1.50) compared to MCA/air-exposed mice (8.34 ± 0.59). Histopathological analysis confirmed these findings and revealed an absence of inflammation. Bronchoalveolar lavage analysis also indicated a lack of lung inflammation and toxicity after short-term inhalation exposure to GMAW-MS fume. In conclusion, this study demonstrates that inhalation of GMAW-MS fume promotes lung tumors *in vivo* and aligns with epidemiologic evidence that shows MS welders, despite less exposure to carcinogenic metals, are at an increased risk for lung cancer.

Keywords: mild steel; welding; inhalation; iron; A/J mice; tumor promotion

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