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Ultrafine particle deposition and clearance in the healthy and obstructed lung

Numerous epidemiological studies have shown associations between exposure to particulate air pollution and acute increases in morbidity and mortality, particularly in persons with chronic obstructive pulmonary disease. The dosimetry of ultrafine particles in the human lung is poorly characterized. We studied the deposition and clearance of an ultrafine technetium-99m labeled aerosol in 10 patients with chronic obstructive pulmonary disease and 9 healthy subjects. Particle retention was followed for 2 hours post-inhalation and again at 24 hours by gamma scintigraphy. Central-to-peripheral ratios indexed airway deposition. Particle accumulation in the liver was examined by quantifying activity below the right lung. The dose rate for an aerosol exposure of 10 ug/m³ was calculated. Patients had a significantly greater dose rate than healthy subjects (2.9±1.0 vs. 1.9±0.4 ug/hr, p=0.02). Central-to-peripheral ratios were slightly greater in patients than healthy subjects (1.11±0.10 vs. 1.01±0.11, p=0.05). Clearance did not statistically differ between health and disease. On average, 24-hour retention was 85±8% (corrected for isotope dissolution). No accumulation in the liver's vicinity was observed. Data suggest that relative to healthy subjects, patients with moderate-to-severe airways obstruction receive an increased dose from ultrafine particle exposure.

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