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TITLE: DEPOSITION, RETENTION, AND TRANSLOCATION OF ULTRAFINE PARTICLES FROM THE CENTRAL AIRWAYS AND LUNG PERIPHERY

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ABSTRACT: Rationale: Little is known about clearance of ultrafine carbon particles from the different regions of the human lung. These particles may accumulate and present a health hazard because of their high surface area. Objectives: Technetium Tc 99m (Tc-99m)-radiolabeled 100-nm-diameter carbon particles were inhaled by healthy nonsmokers, asymptomatic smokers, and by patients with chronic obstructive pulmonary disease (COPD). Methods: Using a bolus inhalation technique, particle deposition was targeted either to the airways or to the lung periphery, and retention, clearance, and translocation were measured using retained radiotracer imaging. Measurements and Main Results: In vitro studies revealed that mean leaching of soluble Tc-99m-radiotracer from the carbon particles was 4.1 (2.6 [SD]) % after 24 hours. Cumulative 99mTc activity in urine at 24 hours was 1.1 (1.3) % of activity deposited in the lungs. In the lung periphery, particle retention was not affected by smoking or pulmonary disease; retention was 96 (3) % after 24 hours. The small amount of clearance could be attributed to leaching of the 99mTc label, suggesting negligible particle clearance. In healthy nonsmokers, retention of particles targeted to the airways was 89 (6) and 75 (10) % after 1.5 and 24 hours, respectively. Radiolabel activity did not accumulate in the liver. Conclusions: Within the limits of detection of our experimental system, most inhaled ultrafine carbon particles are retained in the lung periphery and in the conducting airways without substantial systemic translocation or accumulation in the liver at 48 hours. Repeated exposure may result in significant pulmonary accumulation of ultrafine particles.