Health effects of ambient particulate matter—biological mechanisms and inflammatory responses to in vitro and in vivo particle exposures.

In this article, we review and analyze different modes of exposure to ultrafine particles in order to assess particle-induced inflammatory responses and the underlying mechanisms in vitro and in vivo. Based on results from monocytic cells cultured under submerged conditions, we discuss (1) the impact of particle properties such as surface area and oxidative potential on lipid metabolism as a highly sensitive regulatory pathway and (2) the interference of diesel exhaust particles with toll-like receptor-mediated inflammatory responses. Furthermore, new developments of air-liquid interface exposure used as an alternative approach to simulate cell particle interactions are presented. In addition to the in vitro approaches, animal exposure studies are described that apply selected mouse models to elucidate potential allergic and inflammatory pulmonary responses and mast-cell-related mechanisms after particle exposure. Long-term inhalation of ultrafine particles might lead to irreversible changes in lung structure and function. Clinical studies addressing the characteristics of inflammatory airway cells are a promising approach to understand underlying pathophysiological mechanisms in chronic obstructive
pulmonary disease. Finally, a potential outcome of human particle exposure is chronic cough in children. Here, discrimination between asthmatic and nonasthmatic cough by means of immunological parameters appears to be an important step toward improving diagnosis and therapy.