Revisiting the Trojan Horse Effect – On the role of lipophilic chemicals in the toxicity of fine and ultrafine combustion particles and implications for regulatory needs

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In Greek Mythology Odysseus and a troop of Greek soldiers hid inside the Trojan Horse to enter the walled city of Troy and win the war. This has become a frequent metaphor of tricks to invite or smuggle something harmful into a protected area. In particle toxicology the "Trojan Horse effect" postulates that particles mediate much of their effects by acting as carriers of harmful soluble components such as organic chemicals and transition metals. However, instead of hiding inside, these soluble components cling highly "visibly" to the outside of what is often a tiny particle core. Moreover, while the original Trojan Horse facilitated transportation across the otherwise impenetrable walls of Troy, many soluble components easily slip through biological barriers often leaving the solid particle core behind, more like a car parked at the gates.

This talk will discuss the importance of lipophilic organic chemicals in mediating cardiopulmonary effects from combustion particles. Decades of toxicological research have shown that lipophilic compounds are rapidly taken up in cells through passive diffusion and may be transported into circulation within minutes through the transcellular route, faster and to a larger extent than the solid particles on which they arrived. Focus will be given on the role polycyclic aromatic hydrocarbons (PAHs) and the aryl hydrocarbon receptor (AhR) in intracellular signalling and regulation of inflammatory reactions in lung epithelial cells and vascular endothelial cells. These effects may not be restricted to classical AhR activating PAHs such as benzo[a]pyrene, but likely also involves lower-molecular weight species including pyrene and phenanthrene, which have received limited attention in toxicology due to low mutagenic activity. Finally, the implications of this will be discussed in relation to the role of mass versus size or surface area as metrics for combustion particle exposure, and whether there actually is a need to regulate ultrafine particles.

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