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EDITORIAL

Highlight report: Translocation of nanoparticles through barriers

Christoph van Thriel[1]

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Recently, Hedwig Braakhuis from Maastricht University and other Dutch colleagues have published a comprehensive review about in vitro systems to study translocation of nanoparticles through barriers (Braakhuis et al. 2015). Numerous in vivo studies have shown that nanoparticles can cross the barrier of the lung, gut, skin and placenta (Balasubramanian et al. 2010; Braakhuis et al. 2015; Creutzenberg et al. 2012; Elder et al. 2006; Semmler et al. 2004) and translocate directly via axons of the olfactory nerve into the CNS (Oberdorster et al. 2004). The degree to which these barriers can be passed depends on the physicochemical properties of the particles and varies widely between different particle types. Therefore, it would represent a large progress if this capacity could be predicted in vitro. In their comprehensive review, Braakhuis and colleagues critically discuss the large number of in vitro systems of barriers particularly of lung, gut, skin and placenta. The authors conclude that although these systems allow identification of qualitative differences between particles they have not yet been sufficiently calibrated with respect to the in vivo situation. The currently available in vitro systems of barriers do not yet allow quantitative predictions of real organisms (Braakhuis et al. 2015).

Currently, nanotoxicology represents one of the most intensively studied fields of toxicology (Hammad et al. 2014; Marchan 2012; Stewart and Marchan 2012). A particular focus is to gain a deeper understanding of the influence of physiochemical properties (Austin et al. 2014; Horie et al. 2013; Xiong et al. 2013), improve in vitro systems (Park et al. 2013, 2014; Bondarenko et al. 2013; Schluesener and Schluesener 2013; Hoelting et al. 2013) and predict genotoxic properties (Kumar and Dhawan 2013; Mohiuddin et al. 2014). In principle, in vitro systems of barriers (Braakhuis et al. 2015) could be integrated into in vitro systems aimed at predicting organ toxicity, such as liver (Godoy et al. 2013, 2015; Benet et al. 2014; Grinberg et al. 2014), kidney (Sanchez-Niño et al. 2014; Fujiki et al. 2014; Xu et al. 2013) and neuronal tissues (Waldmann et al. 2014; Krug et al. 2013; Frimat et al. 2010). On the other hand, it has been argued that due to limitations of in vitro systems further progress in nanotoxicology requires particularly adequate in vivo studies, for example to assess the long-term distribution and toxicity under exposure conditions relevant to humans (Gebel et al. 2014).

Considering the complexity of this field, the systematic review of Braakhuis et al. (2015) is extremely helpful for everyone who is interested in learning more about possibilities and limitations of in vitro systems to simulate nanoparticle translocation across the barriers of the human body.

✉ Christoph van Thriel
thriel@ifado.de

[1] Leibniz Research Centre for Working Environment and Human Factors, TU Dortmund, IfADo - Ardeystr. 67, 44139 Dortmund, Germany

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