Health effect of nanomaterial for vulnerable generations, focusing on placental toxicity

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Abstract

Nanomaterial (NM) have already been put to practical use in products in various industrial fields. However, their effects on reproduction and development are still not fully understood. From this viewpoint, we have attempted to evaluate the toxicity of NM, focusing on the placenta. In this study, we used silver nanoparticles as a model NM to identify hazards in the placenta. By using a human choriocarcinoma cell line BeWo, we have clarified that silver nanoparticles suppressed forskolin-induced syncytialization of placental cells, which is an essential differentiation process in the formation and maturation of the placenta.

Background & Results

Nanomaterial (NM) have been expected to have useful functions compared to conventional materials. Thus, they have already been put to practical use in products in various industrial fields, including food, cosmetics, and pharmaceuticals. However, due to their small size, there are concerns that NM may cause unexpected biological effects. Since the mother and fetus are particularly vulnerable to chemicals, there is a need to promote safety evaluation research. From this viewpoint, we have been conducting safety evaluation research of NM targeting vulnerable generations, and, given that normal fetal development depends on the placenta, we have been working to elucidate their toxicity of NM in the placenta and the mechanism of their toxicity.

In this study, we attempted to evaluate the toxicity of NM, focusing on the placental syncytialization, which is an essential differentiation process in the formation and maturation of the placenta. We used a forskolin-induced syncytialization model with a human choriocarcinoma cell line BeWo and selected silver nanoparticles with 10 nm in diameter (nAg10) and gold nanoparticles with 10 nm in diameter (nAu10) as model NM to which pregnant women may be exposed. Immunostaining analysis showed that the syncytial formation rate was not significantly different in the nAu10-treated group compared to the forskolin-treated group but was significantly suppressed in the nAg10-treated group. Besides, the mRNA expression level and supernatant concentration of hCGβ, a hormone whose production increases with syncytial formation, was significantly suppressed only in the nAg10-cotreated group compared to the forskolin-treated group. Furthermore, nAg10 significantly reduced the expression of *ERVFRD-1*, which encodes a protein related to cell fusion, and the expression of *sFlt-1 e15a*, a placental angiogenesis marker. These results suggest that nAg10 inhibited the syncytial formation process of placental cells.

Significance of the research and Future perspective

These findings suggest the need for risk analysis from the perspective of placental toxicity to understand the developmental and reproductive toxicity of NM. We hope that this study will contribute to the promotion of safety evaluation research of NM during pregnancy and, from the perspective of safe, useful, and sustainable nanotechnology, to develop safe forms of NM and ensure their safety.

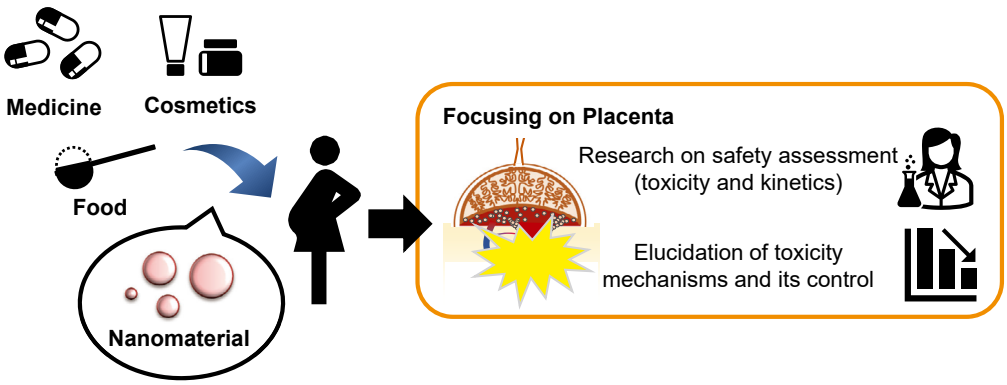

Figure 1. Overview of the research

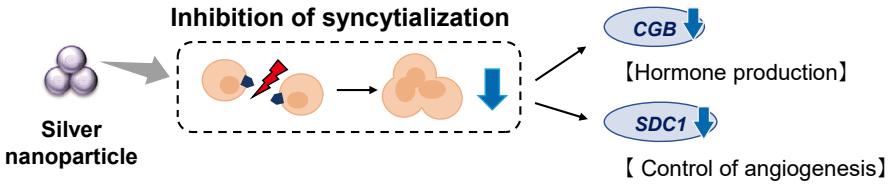

Figure 2. Effect of silver nanoparticle on syncytialization

Patent
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