Modulation of dendritic cell sensitization by combined exposure to allergens and nanoparticles

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Abstract

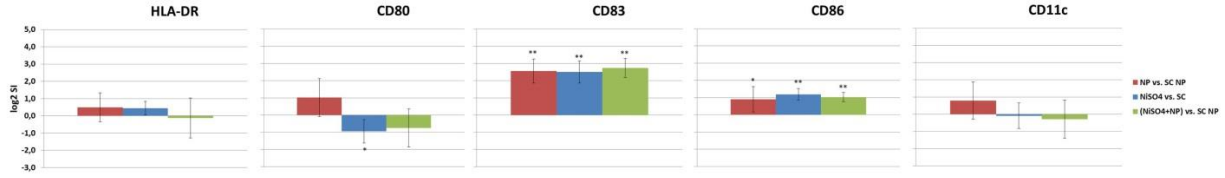
The adjuvant activity of air pollution particles in allergic airway sensitization is well known, but a similar role of manufactured nanoparticles in allergic sensitization has not been clarified. The goal of our study was to assess the possible alteration of an allergen-induced sensitization response by gold nanoparticles (NPs) through *in vitro* studies.

Immature myeloid dendritic cells (CD34-DC), differentiated from human cord blood-derived $CD34^+$ progenitor cells, were incubated in the presence of subtoxic concentrations of two sensitizing compounds and citrate-stabilized 50-nm gold NPs (4.4 µg/ml) for 24 hours, either as separate inducers or as a mixture. The chemical sensitizer nickel sulphate ($NiSO_4$, 160 and 430 µg/ml) and a whole Der p protein allergen mixture (20, 100 and 200 µg/ml) were used as model allergens. Activation and maturation of CD34-DC were studied as indicators of a sensitization response by measuring cell surface expression of the antigen-presenting HLA-DR receptor, the co-stimulatory molecules CD80, CD86 and CD83, and the integrin CD11c using flow cytometry.

Exposure of CD34-DC to NPs induced significant upregulation of the three co-stimulatory molecules as compared to dispersant treated cells. Der p alone did not stimulate any of the studied cell surface markers, but when co-incubated with the NPs it was observed to significantly inhibit NP-induced CD34-DC activation in a dose-dependent way. Sole exposure to $NiSO_4$ significantly upregulated CD86 and CD83, while downregulating CD80 expression in CD34-DC. When $NiSO_4$ and gold NPs were combined during co-exposure, we observed a cell activation pattern and levels similar to those induced by $NiSO_4$ alone, and thus significantly lower than an additive effect of both inducers (Figure).

These results indicate that gold NPs interfere with the allergens in the CD34-DC culture, resulting in decreased sensitizing effects. This may either be mediated via a physico-chemical or immune regulatory mechanism. Further investigation will enhance our insight in the possible impact that nanoparticles may pose to our health.

Figure



Mixture effect of Au-NPs and $NiSO_4$ on a sensitization response in CD34-DCs. Cells were co-exposed to Au-NPs (4.4 µg/ml) and $NiSO_4$ (430 µg/ml) for 24 hours, harvested, and analysed for surface marker expression. Mean log2 SI ± standard deviation (N=5) are shown (log2 SI of solvent control (SC) = 0). Significantly altered expression compared to respective SC is indicated with * ($p<0.05$) and ** ($p<0.005$) only for conditions with $|SI|>1.5$.