Molecular impact of functionalized nanodiamonds on *ex vivo* human immune cells response

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Abstract

Carbon-based nanomaterials have been explored for biomedical applications due to their unique physicochemical properties [1]. In this context, nanodiamonds (NDs) are gaining increasing interest thanks to their biocompatibility, structure and unique electrostatic properties for several nanomedicine applications such as drug delivery, bioimaging and cancer therapy [2,3,4]. However, before any effective application of NDs, their action on the immune system is not fully clarified yet [5]. Nowadays, no comprehensive studies were performed on the immune system with NDs. In this work, we propose an integrative characterization of the molecular impact of two different types of NDs, Oxidized (-Ox) and Aminized (-NH_2), on several human immune cell subpopulations such as T and B Lymphocytes, Natural killer (NK), monocytes and on red blood cells (RBCs). Both NDs showed no toxicity on RBCs and on the T and NK lymphocyte subpopulations. Only monocytes and B cells were affected by the presence of NDs-Ox at the highest concentration used while the functionalized ND-NH_2 counterpart showed no toxicity also on these cell types. NDs-Ox exposure increased proinflammatory cytokines secretion, such as IL6, IL1β, TNFα and IL10, while we found a reduced immune cell activation in -NH_2 treated samples. On monocytes, -NH_2 showed low levels of CD25 activation marker expression compared to -Ox. To deeply analyze the molecular immune impact of NDs a gene expression analysis of 84 immune genes was performed. Intriguingly, after 24h -NH_2 reduced the expression of genes related to a strong inflammatory response such as IL10, IL5, IL4 compared to the -Ox form. These results emphasize the importance of the amino group functionalization, enhancing the biocompatibility of ND-based nanomaterials. These data are of particular interest for further translational applications of amino-functionalized NDs being possible inert materials useful for drug delivery and bioimaging applications.

References

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