Abstract

Nanodiamond particles (NDPs) are quickly emerging nanomaterials that have unique physicochemical properties to be used as a sensing tool for diagnostics and real time monitoring of cellular processes due to their bright, stable and unbleachable internal fluorescence. They can be used also as a delivery vehicle for anticancer drugs and gene therapy. Furthermore, a growing body of evidence emerging from multiple studies reveals their superior biocompatibility when compared to other members of nanocarbon family. Majority of these assays were performed on cell lines of different origin (hepatic, endothelial, epithelial or blood-derived leukemic). There are only a few published studies describing the effect of NDPs on immune cells. The aim of our study was the more complex analysis NDPs on both lymphocytes (T, B, NK) and monocytes (macrophages, antigen-presenting cells, APCs, dendritic cells, DCs) from peripheral blood (PBMC) of healthy donors. We tested cell viability, relative distribution and phenotype of the above-mentioned subpopulations of PBMC incubated in the presence of NDPs of different size (8-150 nm) and surface chemistry (intermediates during the synthesis of targeted NDPs). Above that, we examined the NDPs interaction with cells using confocal and electron microscopy. The presented results demonstrated that the NDPs are internalized by monocytes/macrophages, but not by lymphoid cells. They are immunocompatibile, with the exception of positively charged NH_2-terminated NDPs. The peptides targeting NDPs to HER2/neu molecule or bombesine do not influence the viability of any tested population of PBMC. The Mannose-terminated NDPs significantly increased the apoptosis of CD14+ monocytes, but not the CD14- APCs or DCs. Further we determined an adjuvant effect of NDPs resulting in activation and maturation of APC and DCs (increased number of CD86+CD83+) together with the increased relative distribution of CD69 expressing B and NK cells. We can conclude that plain NDPs can serve as an efficient immunocompatible delivery vehicle for targeting of therapeutic molecules with adjuvant property preferentially on APCs and DCs. Their apoptosis-inducing nature can occur only under specific chemical modifications, which have to be analyzed further.

Keywords: Nanodiamond particles, biomedicine, immunocompatibility, activation, adjuvant effect.