The Effect of Gold Nanoparticles on Dendritic Cells

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Gold is recognized as one of the most biocompatible and stable materials, and has been used for many years as a medical agent, among others in the form of salt for the treatment of rheumatoid arthritis [1]. More recent biological applications have been focusing on using gold nanoparticles for drug and gene delivery [2], or as a photothermal agent causing highly localized heating applicable in cancer therapy [3].

There is however very little information available concerning what influence such particles have on the immune system, e.g. on dendritic cells (DCs). DCs are present throughout the human body but are particularly localized at antigen-exposed sites, such as the skin. They are the most efficient type of antigen presenting cells having a capacity both to initiate primary and secondary immune responses, by expressing cytokines, MHC and co-stimulatory molecules such as CD80, CD83 and CD86 [4-5]. DCs decide whether an immune response should be initiated and are able to affect the development of T-helper cells into Treg-, Th1- or Th2-cells depending on their cytokines produced and their expression of co-stimulatory molecules [6].

We addressed the question whether spherical gold nanoparticles of 6 nm in diameter affect DCs, looking at morphology, viability, expression of cytokines and of co-stimulatory and antigen presenting molecules. This was assessed by using human monocyte derived DCs (myeloid DCs) and peripheral blood mononuclear cells from healthy blood donors together with gold nanoparticles [7], and various techniques including light microscopy, flow cytometry and ELISpot. After having overcome aggregation problems of gold nanoparticles by stabilizing with human serum albumin (HSA) and developed methods to produce nanoparticles with low lipopolysaccharide (LPS) contamination, experiments revealed that both morphology and viability were not affected by the gold nanoparticles. The expression of CD80, CD83, CD86 and MHC class II was only to a minor degree up-regulated after 6 and 24 h, and CD40 and MHC class I was not affected, which indicates biocompatibility of gold nanoparticles. This is further supported by low or no expression of the cytokines IL-10, IL-12 and IFN-alpha. HSA by itself did not have an effect on the DCs. In conclusion, gold nanoparticles of 6 nm in diameter are highly unlikely to initiate a danger signal to the immune system through the dendritic cells, and have therefore the potential to be used as inert carriers in biomedical applications.

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