Preparation, Characterization and Optimization of PEGylated Single Walled Carbon Nanotubes (DSPE-PEG-SWCNTs) as Promising Novel Scaffolds for HbS Antigen delivery and Immune Stimulant Adjuvant

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Abstract

Introduction: Despite the success of current vaccines, there is a clear need for the development of vaccines with novel approaches against resistant pathogens such as HIV, HCV and TB (tuberculosis). Vaccine improvements may include the addition of new adjuvants, which are able to induce higher immune responses. SWCNTs display characteristics that are potentially useful in their development as scaffolds for vaccine compositions. These features include stability *in vivo*, multivalency and lack of intrinsic immunogenicity. In addition, the particulate nature of carbon nanotubes and their rapid entry into antigen-presenting cells, such as dendritic cells, make them especially useful carriers of antigens. Recent studies have demonstrated that carbon nanotube-based vaccines are promising in both infectious disease settings and cancer. In this study, we have developed optimized DSPE-PEG-SWCNTs for optimized HbS antigen loading and immune responses.

Methods and Results: Firstly, noncovalent functionalization of SWCNTs with DSPE-PEG5000-COOH and DSPE-PEG2000-COOH were performed to improve aqueous dispersibility, biocompatibility, immune stimulatory and antigen loading. HbS antigen loading was then optimized through D-optimal design. DSPE-PEG-SWNT type was a categorical factor and HbS antigen concentration, incubation time, temperature and stirring speed were numerical independent factors. Optimized solutions with LE% of 53% were achieved at 300 µg/ml of HbS antigen concentration with DSPE-PEG-2000-COOH.

Conclusions: Numerous approaches are in process in vaccine development including the use of nanocarriers with special features such as multivalency, stability, and a likelihood of internalization into antigen presenting cells. The use of carbon nanotubes is just beginning and a better understanding of the specifications that control this process, are required to optimize their future use in this field.

Key words: Optimization, Vaccine Adjuvants, DSPE-PEG SWNT, HbS Antigen

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