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15th Annual Summit on

Vaccines and Immunization

February 20-21, 2017 Berlin, Germany

Pulmonary delivery of a mucosal nanocarrier vaccine for Pneumonia

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Statement of the Problem: There is a huge drive in the vaccine research field, pharmaceutical industry and Bill Gates Foundation for effective targeting of dendritic cells (DCs) to enhance the immune response and for needle-free vaccination. The pulmonary route has an abundance of antigen presenting cells (such as macrophages, DCs) for targeting vaccines. Furthermore, nanoparticles (NPs) due to their size can target DCs enhancing the immune response. However, NPs have poor aerosolization performance as dry powders.

Aim: The aim of this study was to compare encapsulated and adsorbed pneumococcal protein (PspA), onto poly(glycerol adipateco- ω -pentadecalactone), PGA-co-PDL, NPs to target lung DCs. Further to formulate these NPs into dry powder, nanocomposite microparticles (NCMPs) were suitable for pulmonary vaccine delivery.

Methodology & Theoretical Orientation: NPs were prepared using an emulsion solvent evaporation method and PspA was adsorbed (F1) onto the surface of NPs or encapsulated (F2) (100: 20 [NP: PspA]). F1 and F2 were spray-dried in an aqueous suspension of leucine (1:1.5) to produce NCMPs and characterized in terms of particle size, loading, cell viability, protein stability (SDS-PAGE), integrity (circular dichroism, CD), antigenicity (ELISA), aerosolization studies and lung immunization in mice.

Conclusion & Significance: F1 and F2 produced similar size NPs but the PspA loading was significantly greater in F2 (310.4±25.3 nm, 65.73±5.6 µg/mg) compared to F1 (322.83±4.25 nm, 19.68±2.74 µg/mg). F1 had FPF% >75%. The NPs appear to be well tolerated by DCs cell lines (F1 and F2 NPs \geq 90% cell viability) at 19.5 µg/mL after 4 h exposure. The antigenicity (>95%) confirmed that PspA was stable in both formulations after spray-drying. F1 induced an earlier control of the infection with lower bacterial load in the lungs after challenge. The results provide an indication that it may be feasible to use these NPs/NCMPs carriers containing protein antigens for pulmonary vaccine delivery against lung infection with pneumococci.

Biography

Imran Saleem is a Reader in Nanomedicine at Liverpool John Moores University, UK. His research interest includes "Developing novel delivery systems for targeting therapeutic agents to their site of action, with particular emphasis on lung diseases via dry powder pulmonary delivery". He has over 10 years of experience in the area of Micro/Nanoparticle Formulation and Drug Delivery Systems, and has published extensively in peer-reviewed journals, conference abstracts and book chapters. His research group is focused on "The design and development of carriers for delivery of bio-macromolecules including vaccines and drugs". Currently, his research group is working on the design and development of nanocarriers for pulmonary delivery of pneumococcal vaccine, gene delivery for treatment of COPD and lung cancer. He is currently investigating nanoparticle (NPs) delivery systems and manufacturing nanocomposite micro-particle carriers (NCMPs) for pulmonary delivery.

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