Design of a multiepitope vaccine for the treatment of periodontal disease

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Abstract

Periodontal disease (PD) affects more than 40% of the global adult population and is prevalent in older individuals, African Americans, and low-income populations. PD not only causes significant tooth loss but is also a risk factor for cardiovascular disease, diabetes, and other diseases. Developing an efficacious periodontal vaccine could directly target these public health concerns and improve the quality of life for the global population. In PD, the formation of a dysbiotic biofilm and the outgrowth of key pathobionts in the microbiome (resulting from multifactorial factors) lead to host tissue destruction and, ultimately, bone loss. Traditional attempts at a PD vaccine have used live/attenuated/inactivated *Porphyromonas gingivalis* (Pg) cells, DNA, and virulent factors (multiple proteins) from Pg, with or without adjuvants; however, these attempts have only been moderately successful.

An *in silico* methodology that utilizes the power of subtractive proteomics, structural biology, bioinformatics, reverse vaccinology, and immunoinformatics tools was employed to design a novel protein vaccine for periodontitis, addressing the multifactorial nature of the disease using Pg and *A. actinomycetemcomitans*. Our design will include epitopes from select proteins of Pg and *A. actinomycetemcomitans'* outer membrane proteins. Unlike traditional vaccines, the new vaccine harbors B-cell, cytotoxic T lymphocyte (CTL), and helper T lymphocyte (HTL) epitopes. with in-built adjuvants fused together with peptide linkers. The codon-optimized DNA has been cloned into a plasmid (pET28b) and expressed in *E. coli* and purified. The long-term goal is to develop a cost-effective vaccine cocktail that mitigates socioeconomic disparities and serves as a supplement to mechanical therapy currently used for controlling periodontal disease.

Keywords

Periodontal disease, vaccine, in silico design, dysbiosis, bone loss