PREFACE

Conventional vaccine strategies proved highly efficacious for decades in reducing mortality and morbidity due to infectious diseases. The major drawbacks of conventional vaccines, such as those including whole organisms or large proteins, seem to be the inclusion of unwanted antigens that not only contributes little to the protective immune response but also are likely to promote allergenic and/or reactogenic responses. Thus, peptide vaccines are an attractive alternative strategy based on the engineering of short peptide fragments that induce highly targeted immune responses, allowing the avoidance of allergenic and/or reactogenic reactions. A successful vaccine candidate should meet several criteria: immunogenicity, specificity, protective activity, and durability. First, it should be immunogenic, i.e., it should be able to elicit an immune response, both humoral and cell-mediated, that leads to the blocking and eradication of the disease-causing agent and clearance of the affected cells. Second, this immune response must specifically target (bind with a certain affinity) the region on the pathogen that has been mimicked by the immunogen used as a vaccine, that being a peptide, a protein, or a whole organism, and it must avoid cross-reaction with other self-antigens to prevent autoimmunity. Third, the elicited immune response should be able to prevent the establishment of a disease if the aim is to pursue a prophylactic vaccine, which is usually the case in pathogen-mediated infections, including prions. Finally, the vaccine must be able to induce the production of B and T memory cells, both required to ensure re-elicitation of the protective immune response should the organism encounter the pathogenic agent even years after immunization (Apellániz & Nieva, 2015).

A peptide vaccine usually consists of one or more peptide sequences of more than 15 amino acids long that induce B and T cell stimulation when presented by itself or bound to carrier proteins, scaffolds, or supramolecular complexes (e.g., liposomes). Moreover, peptides from one or several strains of the same pathogen might be included to ensure proper coverage of pathogen variability. Some peptide-based formulations devised following these strategies have rendered vaccines effective in preventing viral infection in animals (Bittle et al., 1982; Langeveld et al., 1994).

First chapter in this volume discusses new promising strategies of peptide vaccine development recently progressed in preclinical and/or clinical stage with main focus on the roles of peptides in the vaccine formulation from

epitope to adjuvant. Second article in this thematic volume gives an overview of applications of lipid vesicles (liposomes) to the development of membrane-proximal external region-targeting vaccines, both as type B adjuvants and epitope structure-shaping devices. This chapter introduces a new paradigm in peptide vaccine development: the structural stabilization of peptide epitopes through contacts with the membrane surface. The third chapter in this volume discusses strategies for developing successful prophylactic and therapeutic vaccines using lipoprotein-based immunogens that are safe, cost-effective, and suitable for human use. Authors support their point of view with a number of examples that demonstrate the merit of lipoproteins with intrinsic adjuvant properties for novel vaccine development. In the fourth chapter, authors review a strategy for improving the efficacy of peptide vaccines. They discuss recent studies providing a potent method of epitope screening and antibody production without conventional carriers. Instead, they adopted Lipoplex(O), comprising a natural phosphodiester bond CpG-DNA and a specific liposome complex, as an adjuvant. Lipoplex(O) induces potent stimulatory activity in humans and mice, and immunization of mice with several peptides co-encapsulated with Lipoplex(O) without carriers significantly induces each peptide-specific IgG2a production. This strategy can be applied in development of therapeutic antibodies or in defense against pandemic infectious diseases through rapid screening of potent B cell epitopes. In the fifth article of the thematic volume, authors discuss several different chemistries that have been pursued to obtain novel platforms onto which antigenic epitopes can be tethered, with the aim to achieve a higher antibody response. In this regard, they review the chemical strategies developed for the presentation of peptide epitopes. The final sixth chapter in this volume focuses on the role of mutations in viral proteins for the design strategy of vaccines against the viruses, which has been exemplified in hepatitis B virus.

The aim of this volume is to promote further research and development in the design of peptide vaccines in order to achieve highly targeted immune responses against different pathological conditions while avoiding allergenic and/or reactogenic reactions.

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