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Serum albumin nanoparticles vaccine provides protection against a lethal *Pseudomonas aeruginosa* challenge

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ABSTRACT

Pseudomonas aeruginosa is an opportunistic pathogen that causes severe infections in immunocompromised individuals and in patients with cystic fibrosis. A range of vaccines to prevent infections caused by *P. aeruginosa* has already been tested, yet no vaccine against this pathogen is currently available. The goal of this study was to evaluate the potential of bovine serum albumin nanoparticles (BSA-NPs) associated with total *P. aeruginosa* ATCC 27853 antigens in inducing protection against the infection with virulent *P. aeruginosa* PA14 strain in murine model of nasal infection. Swiss mice were immunized with BSA-NPs associated with total *P. aeruginosa* antigens (NPPa) or empty NPs (NPe). As positive and negative control, groups of animals were immunized with total antigens of *P. aeruginosa* ATCC 27853 and phosphate buffered saline, respectively. Immunized mice were infected via nasal route using *P. aeruginosa* PA14 strain. The survival after 48 h was evaluated and the lungs from animals were processed for quantification of bacterial load, cytokine expression and histopathological analysis. After infection with *P. aeruginosa* PA14, animals immunized with NPPa had the highest survival rate, the lowest bacterial lung load, a controlled production of cytokines and few histopathological changes. These results indicate that NPPa immunization protected mice from infection, contributing for the elimination of the bacteria from the lungs, which consequently reflected the survival of the animals. Therefore, this vaccine was able to induce a functional response in an animal model of lethal infection and thereby is a promising platform for *P. aeruginosa* vaccines.

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1. Introduction

Pseudomonas aeruginosa is a gram-negative, extracellular, rod-shaped bacterium that is able to colonize and infect different hosts, such as animals, insects, plants and nematodes [1]. *P. aeruginosa* is widely distributed in nature and can be found in soil and water, as

well as in the intestinal and human skin microbiota [2]. It can also be isolated from abiotic environments, such as surfaces in medical facilities and hospital equipment [3,4].

P. aeruginosa is considered an opportunistic pathogen, affecting mainly patients with severe burns, acquired immunodeficiency syndrome, malignancy, neutropenia, and cystic fibrosis (CF) [5–8]. *P. aeruginosa* is an important nosocomial pathogen capable to infect hospitalized patients, mainly those with immunocompromising conditions. Therefore, *P. aeruginosa* is responsible for severe healthcare-associated infections [6,8,9]. Infections caused by this bacteria are difficult to treat and eradicate due to their intrinsic

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