

Multifunctional IgG/IgM antibodies and cellular cytotoxicity are elicited by the full-length MSP1 “*SumayaVac-1*” malaria vaccine in a phase I clinical trial

Micha Rosenkranz,^{1†} Kristin Fürle,^{1†} Julia Hibbert,¹ Anne Ulmer,¹ Arin Ali,¹ Thomas Giese,² Antje Blank,³ Walter E. Haefeli,³ Ernst Böhnlein,⁴ Michael Lanzer,¹ Richard Thomson-Luque^{4*}

¹Center for Infectious Diseases-Parasitology, Heidelberg University Hospital, Heidelberg, Germany.

²Institute for Immunology, Heidelberg University Hospital and German Center for Infection Research (DZIF), Heidelberg, Germany.

³Clinical Pharmacology and Pharmacoepidemiology, Heidelberg University Hospital, Heidelberg, Germany.

⁴Sumaya-Biotech GmbH & Co. KG.

†Equally contributed

Abstract: Radical control of malaria likely requires a vaccine that targets both the asymptomatic liver stages and the disease-causing blood stages of the human malaria parasite *Plasmodium falciparum*. While substantial progress has been made towards liver stage vaccines, the development of a blood stage vaccine is lagging behind. We have recently conducted a first-in-human clinical trial to evaluate the safety and immunogenicity of the recombinant, full-length merozoite surface protein 1 (MSP1_{FL}) formulated with GLA-SE as adjuvant. Here, we show that the vaccine, termed *SumayaVac-1*, elicited both a humoral and cellular immune response as well as a recall T cell memory. The induced IgG and IgM antibodies were able to stimulate various Fc-mediated effector mechanisms associated with protection against malaria, including phagocytosis, release of reactive oxygen species, production of IFN- γ as well as complement activation and fixation. The multifunctional activity of the humoral immune response remained for at least 6 months after vaccination and was comparable to that of naturally acquired anti-MSP1 antibodies from semi-immune adults from Kenya. We further present evidence of *SumayaVac-1* eliciting a recallable cellular cytotoxicity by IFN- γ producing CD8⁺ T cells. Our study revitalizes MSP1_{FL} as a relevant blood stage vaccine candidate and warrants further evaluation of *SumayaVac-1* in a phase II efficacy trial.