In vitro study of malaria parasite induced disruption of blood–brain barrier

Lertyot Treeratanapiboon a,b, Katherina Psathaki c, Joachim Wegener c, Sornchai Looareesuwan d, Hans-Joachim Galla c, Rachanee Udomsangpetch a,b

a Department of Pathobiology, Faculty of Science, Mahidol University, Bangkok, Thailand
b Department of Parasitology, Faculty of Medical Technology, Mahidol University, Bangkok, Thailand
c Institute for Biochemistry, Westfälische Wilhelms University Muenster, Muenster, Germany
d Department of Clinical Tropical Medicine, Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand

Received 25 July 2005 / Available online 8 August 2005

Abstract

The mechanism of blood–brain barrier breakdown in the complex pathogenesis of cerebral malaria is not well understood. In this study, primary cultures of porcine brain capillary endothelial cells (PBCEC) were used as in vitro model. Membrane-associated malaria antigens obtained from lysed Plasmodium falciparum schizont-infected erythrocytes stimulated human peripheral blood mononuclear cells (PBMC) to secrete tumor necrosis factor alpha. In co-cultivation with the brain endothelial cell model, the malaria-activated PBMC stimulated the expression of E-selectin and ICAM-1 on the PBCEC. Using electric cell–substrate impedance sensing, we detected a significant decrease of endothelial barrier function within 4 h of incubation with the malaria-activated PBMC. Correspondingly, immunocytochemical studies showed the disruption of tight junctional complexes. Combination of biochemical and biophysical techniques provides a promising tool to study changes in the blood–brain barrier function associated with cerebral malaria. Moreover, it is shown that the porcine endothelial model is able to respond to human inflammatory cells.

Keywords: Plasmodium falciparum; Cerebral malaria; Tight junction; Endothelial cells; Electric cell–substrate impedance sensing

Biochemical and Biophysical Research Communications. 2005; 335 : 810–818