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Characterization of Oxygen Levels in an Uninfected and Infected Human Blood-Cerebrospinal-Fluid-Barrier Model

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Abstract:

The host–pathogen interaction during meningitis can be investigated with blood-cerebrospinal fluid-barrier (BCSFB) cell culture models. They are commonly handled under atmospheric oxygen conditions (19–21% O₂), although the physiological oxygen conditions are significantly lower in cerebrospinal fluid (CSF) (7–8% O₂). We aimed to characterize oxygen levels in a *Streptococcus (S.) suis*-infected BCSFB model with transmigrating neutrophils. A BCSFB model with human choroid plexus epithelial cells growing on transwell-filters was used. The upper “blood”-compartment was infected and blood-derived neutrophils were added. *S. suis* and neutrophils transmigrated through the BCSFB into the “CSF”-compartment. Here, oxygen and pH values were determined with the noninvasive SensorDish® reader. Slight orbital shaking improved the luminescence-based measurement technique for detecting free oxygen. In the non-infected BCSFB model, an oxygen value of 7% O₂ was determined. However, with *S. suis* and transmigrating neutrophils, the oxygen value significantly decreased to 2% O₂. The pH level decreased slightly in all groups. In conclusion, we characterized oxygen levels in the BCSFB model and demonstrated the oxygen consumption by cells and bacteria. Oxygen values in the non-infected BCSFB model are comparable to in vivo values determined in pigs in the CSF. Infection and transmigrating neutrophils decrease the oxygen value to lower values.

Keywords: blood-cerebrospinal-fluid-barrier (BCSFB), *Streptococcus suis*, neutrophils, oxygen, hypoxia, physioxia, meningitis