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Capillary oxygen saturation and tissue oxygen pressure in the rat cortex at different stages of hypoxic hypoxia.

Meyer B, Schultheiss R, Schramm J.

Department of Neurosurgery, University of Bonn, Germany.

The objective of this study was to generate data that allow for estimation of the validity of oxygen saturation (SO2) values in superficial cortical capillaries as calculated by a microreflectometric system (EMPHO II). Capillary SO2 and tissue oxygen pressure (PtO2) were measured simultaneously in the cortex of n = 13 Wistar rats under normocapnic (PaCO2 = 36 mmHg) arterial normoxia (PaO2 = 92 mmHg), moderate (paO2 = 53 mmHg) and severe hypoxic hypoxia (PaO2 = 31 mmHg) with microreflectometry and multiwire surface electrodes. Values were pooled according to arterial oxygenation levels, displayed as frequency histograms and compared via ANOVA ($p < 0.05$). In a Hill-plot (log PtO2 versus log SO2/(100 - SO2)) an in vivo tissue oxygen dissociation curve was obtained and a linear regression/correlation analysis performed. Mean +/- SD values of SO2 respectively PtO2 decreased from 45.6% +/- 14.6% resp. 26.8 +/- 8.2 mmHg during arterial normoxia to 32.6% +/- 10.2% resp. 20.2 +/- 6.6 mmHg during moderate and to 12.3% +/- 11.1% resp. 8.7 +/- 5.0 mmHg during severe hypoxic hypoxia. Linear regression analysis in the Hill-plot of values between 1% and 65% SO2 and 0.1 and 41 mmHg PtO2 revealed an excellent correlation ($r2 = 0.88$) with an increase of scatter below 10% SO2 or 1.5 mmHg PtO2. We conclude that SO2 values calculated by the algorithm of the applied microreflectometric system reflect very accurately cortical oxygen supply over a very wide range of oxygenation levels when compared to a gold standard reference. Only at extremely low levels (e.g. below 10% SO2) did we find possible inaccuracies with regard to truly absolute saturation values.

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