

Intra- and extracellular pH of the brain in vivo studied by ^{31}P -NMR during hyper- and hypocapnia.

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Studies were performed to determine the pH relationships among the extracellular, intracellular, and arterial blood compartments in the brain in vivo. Resolution of the extracellular monophosphate resonance peak from the intracellular peak in ^{31}P nuclear magnetic resonance (NMR) spectra of sheep brain with the calvarium intact enabled pH measurement in these respective compartments. Sheep were then subjected to both hyper- and hypoventilation, which resulted in a wide range of arterial PCO_2 and pH values. Linear regression analysis of pH in these compartments yielded slopes of 0.56 ± 0.05 for extracellular pH (pHe) vs. arterial pH, 0.43 ± 0.078 for intracellular pH (pHi) vs. pHe , and 0.23 ± 0.056 for pHi vs. arterial pH. These data indicate that CO_2 buffering capacity is different and decreases from the intracellular to extracellular to arterial blood compartments. Separation of the extracellular space from the vascular space may be a function of the blood-brain barrier, which contributes to the buffering capability of the extracellular compartment. A marked decrease in the pH gradient between the extracellular and intracellular space occurs during hypercarbia and may influence mechanisms of central respiratory control.