Translational Evaluation of Acid/Base and Electrolyte Alterations in Rodent Model of Focal Ischemia

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Background and Purpose:
Knowledge of blood gases could provide clinically valuable information about the cerebral infarct core and penumbra that is vulnerable to infarction. Information obtained from translational stroke studies advance our understanding of the pathophysiology of ischemic stroke. This study collected and analyzed early changes in blood gases and electrolytes for infarct volume and mortality in the rat model of stroke.

Methods:
3-month old Sprague-Dawey rats (n = 9) underwent permanent or transient middle cerebral artery occlusion (MCAO). Pre- and post-MCAO venous samples provided pH, pCO2, pO2, and electrolyte values (iCa2+, K+, and Na+). Linear regression determined predictors of infarct volume from these values, and Cox regression analyzed VBG changes between tMCAO (n = 28) and pMCAO (n = 29) to determine predictors of mortality.

Results:
The acid/base analysis indicated significant differences in the blood gas and electrolytes between pre- to post-MCAO. A decrease in pH with increases in pCO2, K+, iCa2+, and glucose changes were found in both MCAO models; while sO2, Hct, and Hbg were significant in tMCAO model; and Beecf and Na+ were significant in pMCAO rats. Furthermore, pH and iCa2+ are predictors of infarct volume, but not mortality. After pMCAO (n = 9), change in pH or iCa2+ significantly predicted infarct volume [$F(1,7) = 7.351$, $\beta = -0.716$, $p = 0.03$] and [$F(1, 7) = 6.782$, $\beta = -0.701$, $p = 0.035$]; as pH and calcium decreased, infarct volume increased. These variables explained 44% and 42% of the total variance in these models.

Conclusions:
There are acute changes in acid/base balance and electrolytes during stroke in rodent models. Additionally, we found pH and iCa2+ changes predicting stroke volume in the pMCAO rat model. These preliminary findings are novel, and warrant further exploration in human patients.