

Modulation of in vitro high-frequency network oscillations in the anterior cingulate cortex via corticosteroids

Authors:

Daniel Frías Donaire ¹, Evangelia Pollali ¹, Gürsel Çalışkan ^{1,2}

Affiliations:

¹ Institute of Biology, Otto-von-Guericke-University Magdeburg, Germany

² Center for Behavioral Brain Sciences (CBBS), Magdeburg, Germany

Abstract:

Corticosteroid hormones are released during stressful episodes and support the adaptation to stress via activation of mineralocorticoid and glucocorticoid receptors (MR and GR) in several limbic regions in the brain. Due to its critical role in integration of emotional and cognitive processing, anterior cingulate cortex (ACC) is one of the hub regions in the limbic system involved in stress adaptation. Accumulating evidence suggests that high frequency oscillations in limbic areas including the ventral hippocampus and amygdala play a fundamental role in mediation of innate anxiety and acute and chronic effects of stressful events. However, to date, how corticosteroids modulate high frequency oscillations in the ACC is not explored. In the current study, we performed extracellular field potential recordings in the cingulate cortex 1 (cg1) of ACC homologous to the human Brodmann area 24b using coronal slices (400 μ M) of C57BL/6 male mice. The field potential oscillations at the slow gamma (28-50 Hz) and beta ranges (10-28 Hz) were induced via bath-application of 800 nM kainate and 50 μ M carbachol providing both glutamatergic and cholinergic activation, respectively. Using three different concentrations of corticosterone (CORT; 0.1, 1 or 10 μ M), the main corticosteroid in mice, we observed an inverted U shape-like dose response curve with a strong increase of oscillation power only with moderate CORT concentration (1 μ M). This effects could be mimicked via specific activation of either GR (dexamethasone; 100 nM) or MR (aldosterone; 50 nM) indicating a synergistic role of both MR and GR in CORT-mediated increase of high frequency network oscillations in the ACC. These results will be substantiated via testing the impact of CORT under the blockade of either GR or MR activation using specific antagonists of GR (Mifepristone; 1 μ M) or MR (Spironolactone; 500 nM). Together, these results indicate that corticosteroids acutely modulate high frequency network oscillations that are relevant to processing of emotional and cognitive information in the ACC.