Regulation of Brain Rhythms as a Factor in Depression

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Introduction

- The theta rhythm is a mode of oscillating brain activity in the 3-12 Hz range.
- Studies have identified disturbance in EEG that include theta band rhythms, associated with mood disorders.
- Recent work has found that regulation of the theta rhythm and its coherence may be critical to coordinating the communication between brain structures.
The Hippocampus and Frontal cortex

• Many models of depression include alterations in the function of a number of brain regions including the frontal cortex, hippocampus, amygdala, striatum, and thalamus.

• Pharmacological manipulations that impact mood disorders can differentially affect theta rhythms in different structures (e.g. NE can enhance hippocampal theta and suppress frontal theta while serotonin can have the opposite effect).

• Patients suffering from depression have been reported to have increased theta rhythm coherence (Llinas et al., PNAS, 1999)
Regulation of the theta rhythm

- NMDA, AMPA, mGLUR receptor antagonists can have antidepressant effects and also affect the power and coherence of the theta rhythm in different structures.
- Preliminary work has also found that such manipulations can desynchronize brain structures such as the frontal cortex and hippocampus.
- Recent work has found that regulation of the theta rhythm and its coherence may be critical to coordinating the communication between these brain structures.
Additional connections

• Thalamic function is involved in coordination of cerebral cortical activity and rhythms. Failure of these systems to establish proper coordination may manifest itself in both waking state, and sleep state dysfunction.

• Thalamic structural abnormalities been associated with major depression (Young, et al, Am J Psychiatry, 2004).
Recording from multiple electrodes in multiple sites
forced

ACTIVITY

choice

COORDINATED ACTIVITY
Theta-frequency coherence is enhanced during ‘choice’ epochs.
The NMDA antagonist ketamine alters the hippocampo-prefrontal spike-LFP relationship.
Conclusions:

• Disturbance of communication between brain structures may be a contributing factor in a broad spectrum of behavioral and neuropsychological disorders.

• In characterizing and treating disorders that involve dysfunctional regulation of multiple brain structures, the expression and coordination of rhythmic interactions between structures in the theta band may represent a common underlying factor.
Wilson Lab Contributors

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