「経頭蓋磁気刺激が中脳ドパミン, アセチルコリン系の変化を介して意欲・覚醒レベル・学習・意思決定の変容をもたらすメカニズムの解明」

Development of novel repetitive Transcranial Magnetic Stimulation parameters from investigating the dynamical cognitive neural loop among the cerebral cortex, dopaminergic and acetylcholinergic systems

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■ 研究内容

中脳ドパミン，脳幹アセチルコリン系は大脳皮質から間接，直接的に入力を受け，出力を全脳に投射し，状況依存的なダイナミカルパターンで活動することで適切な意思決定や随意運動の遂行を調節しており，この神経回路網は様々な脳神経疾患と関係が深いと考えられています。

昨今，脳刺激による脳神経疾患治療への期待から，経頭蓋磁気刺激（TMS）などの非侵襲刺激の神経機序解明への関心が高まっています。

本研究では眼球運動課題，前肢到達運動課題などによる認知行動課題を課したサルを用い，運動領野，前頭葉などへの TMS による認知，意思決定行動の変容と中脳ドパミン，脳幹アセチルコリン系の状況依存的な神経活動の変容を解析し，皮質 TMS が認知，学習，注意，覚醒，意思決定機構に及ぼす神経機序を調べます。そして，最終的には臨床現場での安全で有効な TMS 法の発見を目指します。

■ Research works

Midbrain dopamine (DA) and brainstem acetylcholine (ACh) are implicated in the regulation of movement, arousal, reward, decision-making and learning and play an important role in neurological and psychiatric disorders. Several animal studies have shown that the cerebral (prefrontal and motor) cortex significantly influences on context dependent DA and ACh neural activity and transmitter releases toward the cerebral cortex. However, little is known about the importance of the neural loop structure consists of the cerebral cortex, DA and ACh with dynamical level beyond anatomical connections.

We will address this issue directly in the monkey brain. In view of the recent up-growing interest of non-invasive brain stimulation as potential tool for treatment of neurological and psychiatric disorders, it would be key to investigate dynamical interactions among the cerebral cortex, DA and ACh.

We will investigate how modulation of the focal cortical area (prefrontal and motor area) influences monkey's performance and behavior on psychological cognitive tasks (eye movement and forelimb reaching tasks) by using repetitive transcranial magnetic stimulation (rTMS). Combining this experiment and unit recording from DA and ACh neurons provides us with a valuable probe of brain research to investigate dynamical neural mechanism of behavior control in high temporal fidelity and to develop ideal rTMS treatment parameters for patients with neurological and psychiatric disorders.