EEG connectivity on sources in male non-smokers after nicotine administration during resting-state

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**Background:** New developments in pharmacology are based on non-invasive neuroimaging, particularly by leveraging and optimizing techniques and methodologies already validated in basic neuroscience. Particularly interesting is the use of connectivity measures of electromagnetic oscillatory activity regarding the modulation of vigilance. Indeed, several recent anesthesiology papers found a connection between vigilance and the connectivity measured from electromagnetic oscillatory activity. We present an EEG connectivity study aimed to establish whether nicotine-induced modulations of vigilance impact connectivity.

**Methods:** EEG activity was recorded in an eyes-open and eyes-closed condition before and after drug administration in thirty healthy male non-smokers. The subjects were randomly allocated either to a nicotine group (14 subjects, 7 mg transdermal nicotine) or to a placebo group. A double-blind placebo-controlled design was implemented. With source reconstruction procedure (eLORETA algorithm), we extracted thirteen time-series representing thirteen regions of interest (ROIs). Each ROI was anatomically precise and belonged to the resting-state network which seems to be modulated specifically by eyes-open and eyes-closed activity. In the literature such resting-state network is labeled as the Default Mode Network. Here we conducted connectivity analysis (renormalized Partial Directed Coherence, rPDC) on the ROIs’ time-series, focusing on the frequency range of 8.5 to 18.4 Hz. Such frequency range was further subdivided into three frequency bands ($\alpha_1$, $\alpha_2$ and $\beta_1$) in order to comply with current EEG standards of practice.

**Results:** Our connectivity analysis found that during eyes-closed, nicotine decreased feed-back connectivity (from precentral gyrus to precuneus, angular gyrus, cuneus and superior occipital gyrus) at 10.5-12.4 Hz ($\alpha_2$). During eyes-open, no significant results were found at any frequency range.

**Conclusions:** We interpreted the results by help of previous anesthesiology literature about an anti-correlated relationship between feed-back and feed-forward connectivity. Such relationship emerged by pharmacologically-induced sedation during eyes-closed condition. Our results suggest that nicotine potentially increases the level of vigilance. Such nicotine-effect is particularly prominent during the eyes-closed condition.