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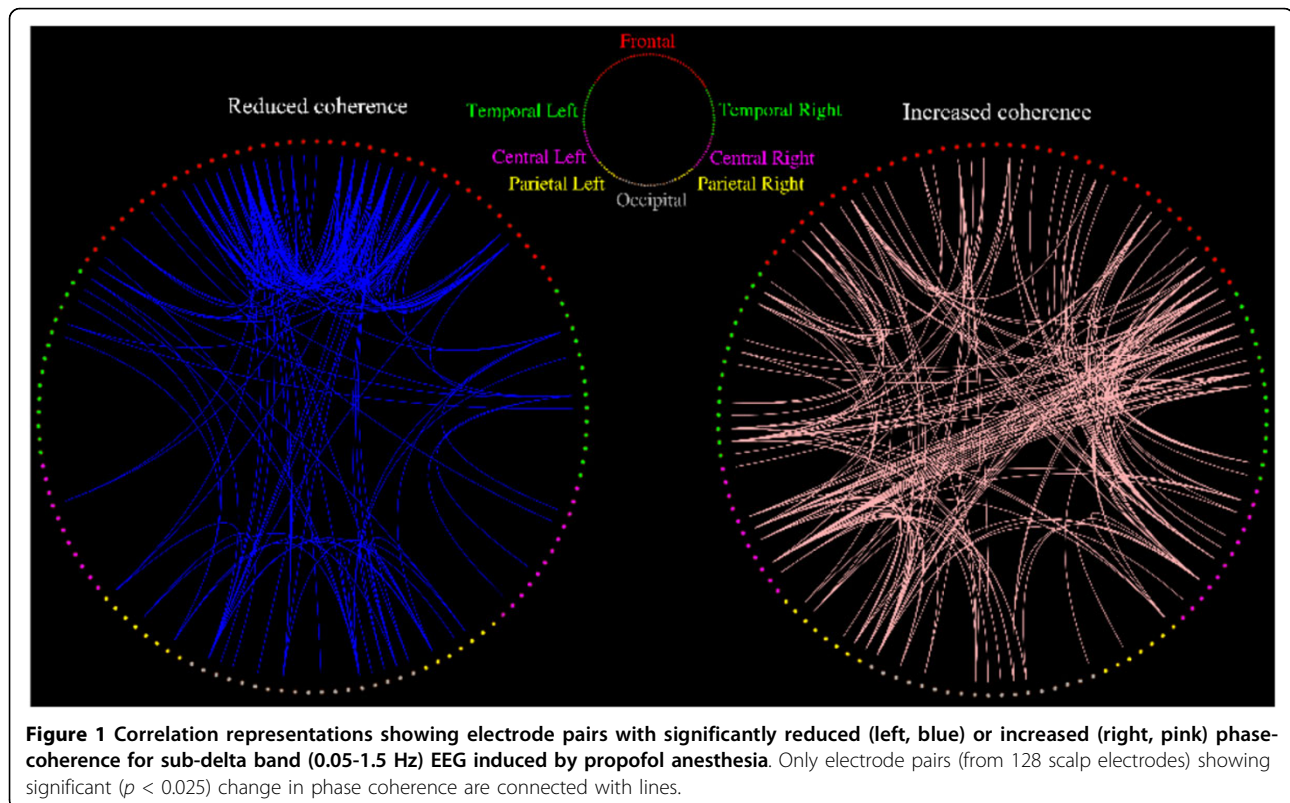
EEG slow-wave mediates the fragmentation and coupling of cortical networks in propofol-induced general anesthesia

Kaier Wang¹, Moira L Steyn-Ross¹, Alistair Steyn-Ross^{1*}, Marcus T Wilson¹, Jamie W Sleight²

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Electroencephalogram (EEG) recorded from propofol-induced general anesthesia is characterized by large amplitude slow-waves (0.1–1.5 Hz). Clinically, these lowest frequency components of the EEG signal become

dominant over other higher frequency components during and after loss of consciousness [1]. However, it remains unclear how these slow oscillations are produced and to what extent they reflect changes in cortical



* Correspondence: asr@waikato.ac.nz

¹School of Engineering, The University of Waikato, Hamilton, 3240, New Zealand

Full list of author information is available at the end of the article

network connectivity. Modeling anesthesia as a moderate reduction in interneuronal gap-junction coupling, a recent theoretical work by Steyn-Ross *et al* [2] predicts emergence of anesthetic slow-waves with chaotic dynamics. In the modeled anesthesia state, the weakened gap-junction coupling supports a codimension-2 bifurcation point where competing Turing (space) and Hopf (time) dynamics coexist, signifying spontaneous symmetry-breaking instabilities in the firing behavior of cortical neurons. Further, these chaotic slow-waves are found to perturb the neuronal coupling across the cortex, leading to a dramatic drop in global phase-coherence compared to its high level during consciousness. In this study, we analyze clinically-recorded EEG data to examine the model prediction for changes in phase-coherence between pairs of EEG channels in the sub-delta band during propofol anesthetic induction. Our study finds a coherence decrease in the frontal and occipital regions (see left panel of Figure 1), as well in the connection between them. Concomitantly, more strongly coupled neuronal activities are disclosed in the temporal-frontal, temporal-occipital and left-right temporal regions (right panel). Our clinical observation of reduced EEG coherence is consonant with cortical model predictions. However, our EEG study indicates that the coherence alternation is regional in nature, while the cortical model describes a spatially-uniform trend. Moreover, we did not find any theoretical prediction for the left- and right-temporal increased-coherence patterns. As the cortical model by Steyn-Ross *et al.* is spatially homogenous, *i.e.*, there are no explicit front-to-back or right-to-left directionality, it is unable to produce regional coherence changes. It appears that the Steyn-Ross cortical model best represents the cortical dynamics in the frontal region.

Authors' details

¹School of Engineering, The University of Waikato, Hamilton, 3240, New Zealand. ²Waikato Clinical School, The University of Auckland, Waikato Hospital, Hamilton, 3240, New Zealand.

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