

Reproduction of EEG power spectrum over frontal region during the propofol-induced general anesthesia

Meysam Hashemi, Axel Hutt, Jamie Sleigh, Peter Beim Graben

► **To cite this version:**

Meysam Hashemi, Axel Hutt, Jamie Sleigh, Peter Beim Graben. Reproduction of EEG power spectrum over frontal region during the propofol-induced general anesthesia. Twenty Third Annual Computational Neuroscience Meeting: CNS - 2014, Jul 2014, Québec City, Canada. 15 (Suppl 1), pp.P211, 2014, <10.1186/1471-2202-15-S1-P211>. <hal-01026526>

HAL Id: hal-01026526

<https://hal.inria.fr/hal-01026526>

Submitted on 21 Jul 2014

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

POSTER PRESENTATION

Open Access

Reproduction of EEG power spectrum over frontal region during the propofol-induced general anesthesia

Meysam Hashemi^{1*}, Axel Hutt¹, Jamie Sleight², Peter beim Graben³

From The Twenty Third Annual Computational Neuroscience Meeting: CNS*2014
Québec City, Canada. 26-31 July 2014

The present work aims to reproduce certain changes observed experimentally in the EEG power spectrum over the frontal head region during general anesthesia induced by propofol. These observations include increased delta (0-4 Hz) and alpha (8-12 Hz) activities [1]. We extend a previous cortical model [2] and study a neuronal population model of a single thalamo-cortical module consisting of three different populations of neurons, namely cortical excitatory neurons, thalamocortical relay neurons and inhibitory thalamic reticular neurons (Fig. 1). Each module obeys a neural mass model. The cortical inhibitory population is neglected in our model to reveal the effect of propofol action in the thalamus. Our model describes well the characteristic spectral changes observed experimentally within the delta- and alpha- frequency bands in frontal and occipital electrodes with increasing concentration of propofol.

This shows that neglecting inhibitory action in the cortex but considering thalamic GABAergic action suffices to reproduce the data. From a modeling point of view, our reduced mathematical model is low dimensional and remains analytically treatable while still being adequate to reproduce observed changes in EEG rhythms. Moreover, it is shown that the propofol concentration acts as a control parameter of the system and that propofol-induced changes in the stationary states of the model system lead to changes in the corresponding nonlinear gain function that result in EEG power modulation: increases of power over the frontal region can be caused by an increase in the gain function of thalamocortical network. The results suggest that intra-thalamic inhibition from reticular neurons to relay cells plays an important role in the generation of

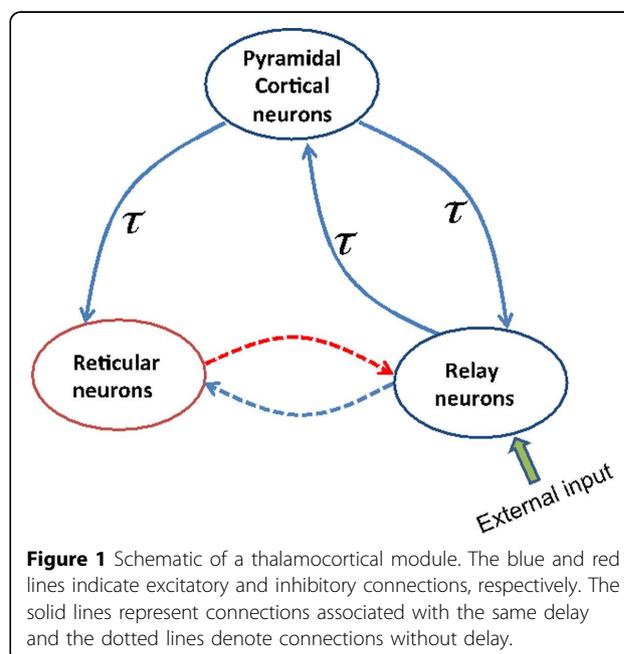


Figure 1 Schematic of a thalamocortical module. The blue and red lines indicate excitatory and inhibitory connections, respectively. The solid lines represent connections associated with the same delay and the dotted lines denote connections without delay.

the characteristic EEG patterns seen during general anesthesia.

Authors' details

¹INRIA CR Nancy - Grand Est, Villers-les-Nancy, France. ²Department of Anaesthetics, Waikato Hospital, Hamilton, New Zealand. ³Department of German Language and Linguistic, Humboldt-Universität zu Berlin, Germany.

Published: 21 July 2014

References

1. Cimenser A, et al: Tracking brain states under general anesthesia by using global coherence analysis. *PNAS* 2011, **108**:8832-8837.
2. Hutt A: The anaesthetic propofol shifts the frequency of maximum spectral power in EEG during general anaesthesia: analytical insights from a linear model. *Front. Comput. Neurosci* 2013, **7**:2.

* Correspondence: meysam.hashemi@inria.fr

¹INRIA CR Nancy - Grand Est, Villers-les-Nancy, France

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

doi:10.1186/1471-2202-15-S1-P211

Cite this article as: Hashemi *et al.*: Reproduction of EEG power spectrum over frontal region during the propofol-induced general anesthesia. *BMC Neuroscience* 2014 15(Suppl 1):P211.

**Submit your next manuscript to BioMed Central
and take full advantage of:**

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

