**Supplementary Text**

**EEG data collection details**

*Study 1: Propofol healthy volunteer study*

This study consisted of two separate electroencephalographic (EEG) data acquistions with the same experimental design. The first was a laboratory EEG study and the second a simultaneous EEG-FMRI data acquisition. The high quality data from the laboratory session were used rather than the EEG data collected simultaneously during FMRI that requires significant artifact rejection methods to be applied as part of pre-processing. Sixteen healthy volunteers with American Society of Anesthesiologists (ASA) physical status grade I or II and mean age of 29 years (range 18-43 years) participated in the study. The participating volunteers experienced a resting period with eyes closed and no drug administration for 10 minutes, followed by an ultraslow induction to loss of consciousness using propofol sedation. A target-controlled intravenous infusion of propofol was used with step increases of 0.2μg/ml to achieve a maximum effect site concentration (Ce) of 4μg/ml over 48 mins. After resting at the peak propofol dose for 10 minutes, the propofol sedation was switched off and subjects were allowed to emerge to wakefulness while EEG recording continued for 48 minutes.

Noxious laser, words and computer generated tone stimuli were presented to the participants during the induction and emergence phases of the experiment. Loss and recovery of an appropriate motor response (button presses) to the auditory word discrimination task was used to define the loss and recovery of behavioral responsiveness. EEG data were acquired using a 32-channel EEG cap (BrainCap MR, Easycap GmbH, Germany) and MR compatible amplifier system (MRplus, BrainVision GmbH, Germany) at 5kHz sampling rate using FCz as a reference electrode. Electrode impedances were kept below 5kΩ. Filtering (high-pass=0.5 Hz, low-pass filter=70 Hz, notch=50 Hz) was performed online by the acquisition software (BrainVision Recorder, version 1.10). Each individual’s EEG data was re-referenced to a common mean and downsampled to 125Hz. The EEG data were band-pass filtered 0.25 to 45Hz using a phase-preserving (‘filtfilt.m’) third order Butterworth filter.

*Study 2: Sevoflurane pre-surgery study*

The primary aim of this sub-analysis was to see if slow wave activity saturation occurs on induction of anesthesia using the volatile drug sevoflurane. These data were taken from previous work that was originally performed to derive a pharmacokinetic-pharmacodynamic model of the relationship between sevoflurane concentration and the EEG spectral entropy1. It thus provides the possibility to see how the slow wave activity reacts to a wide range of volatile anesthetic concentrations during induction of anesthesia. Prior to routine anesthesia and surgery, 21 patients were given a sevoflurane gas induction (3% inspired for 2 min, followed immediately by 7% inspired concentration) to achieve a Response Entropy of less than 20 for 5 minutes. After this time the sevoflurane concentration was decreased until the Response Entropy had climbed to 70; at which point the study was terminated. Emergence to wakefulness from anesthesia was not studied in this group. The patients did not receive any other medications and LOBR was assessed by loss of response to verbal command. EEG data was collected from a single channel from a standard prefrontal montage (Fp7-Fz) attached to the Datex-Ohmeda M-Entropy S/5™ Module (Datex-Ohmeda Division, Instrumentarium Corp., Helsinki, Finland); and digitised at 100Hz. Electrode impedances were kept below 5kΩ. The EEG data were band-pass filtered 0.25 to 45Hz using a phase-preserving (‘filtfilt.m’) third order Butterworth filter.

*Study 3: Desflurane-Fentanyl infusion study*

This randomized controlled trial was originally undertaken to determine if differing depths of volatile anesthetic agent had any influence on postoperative pain after a variety of surgical operations2. In brief, the study inclusion criteria were: healthy patients (ASA I or II) who were having general anesthesia that included endotracheal intubation and for surgery estimated to last for more than 180 minutes. The severity of the operations were classified as according to the NICE classification3 (see Table 3). The anesthesia protocol consisted of induction with 1-3 mg/kg propofol and 2 μg/kg fentanyl, followed by neuromuscular blockade, and maintenance with desflurane targeted at BIS ranges of either 30-40 or 45-60 by random allocation. A fentanyl infusion of 2μg/kg/hr, paracetamol 1g iv, and paracoxib 40mg iv provided the analgesic component of the maintenance. The exact point of LOBR was not defined in this study due to the very rapid transition in consciousness level, as is standard clinical practice. EEG data were collected from an Aspect EEG monitor (Vista, Covidien Medical Systems, MA) using a standard prefrontal montage (Fp7-Fz). Skin electrode impedances were all <5kΩ. The raw signal was digitized at 128Hz. As for the previous study, the EEG data were band-pass filtered 0.25 to 45Hz using a phase-preserving (‘filtfilt.m’) third order Butterworth filter.

*Study 4: Routine clinical care study*

This study is part of a multi-center effort to establish an open source database of EEG patterns and clinical outcome in patients emerging from general anesthesia4. In this observational study the administration of general anesthesia was entirely based on clinical grounds. We recorded drug information and EEG from 254 patients who were having general anesthesia for a variety of different surgical procedures. Again, the severity of the operations were classified as minor, moderate or major as in Study 3 (see Table 3). There were no constraints on the delivery of the anesthesia except that, during emergence, the arousal stimuli and responses of the patients followed a graded and timed protocol as detailed in 4. Anesthesia was induced in all cases with fentanyl and propofol, and a muscle relaxant used to facilitate endotracheal intubation in 158 cases. Anesthesia was maintained using a volatile agent (desflurane (N=66), sevoflurane (N=188) and incremental boluses of fentanyl or morphine. In three cases, a remifentanil infusion was used. Additional epidural anesthesia was used in N=5 cases. The data collection ceased once the subject became responsive to verbal commands. The EEG data were collected and preprocessed as for Study 3.

**References**

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