

DISINTEGRATION OF NEOCORTICAL CELL ASSEMBLIES UNDER GENERAL ANESTHESIA

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Neocortical activity in vivo falls into one of two states. The “synchronized” or “inactivated” state occurs during slow-wave sleep and deep anesthesia, characterized by large amplitude slow EEG activity. The “desynchronized” or “activated” state occurs during waking and REM sleep, characterized by less low-frequency activity, but increased power in the beta and gamma bands (20-100Hz).

Under urethane anesthesia, cortical EEG is usually inactivated. However, activated EEG may be induced by stimulus such as a tail pinch, even though consciousness is not regained. EEG activation can therefore occur in three different conditions: wakefulness, REM, and anesthesia. Nevertheless, one might expect different operating modes of cortical circuits in these conditions. We contrasted patterns of population activity in these activated states, using multi-site recordings in rat neocortex.

During waking or REM sleep, individual spike trains showed an irregular structure. At the population level, a “peer prediction” analysis (Harris et al, *Nature* 424:552-6, 2003) revealed repeatedly co-activated groups of neurons, suggesting that the irregular spike trains resulted from an organization of neurons into transiently synchronous cell assemblies.

During activated periods under anesthesia, a strikingly different pattern was observed. Spike trains were more regular and often oscillatory (5-20 Hz). However, the frequencies and spike times of simultaneously recorded cells showed no discernable global coordination, suggesting that the oscillations seen in each spike train were generated by cell-specific mechanisms, rather than an ongoing global oscillation. We suggest that the lack of neuronal coordination under anesthesia is related to the breakdown of cognitive activity in the anesthetized animal.