Cortical information integration and connectivity during propofol anesthesia

Zhenhu Liang
Lei Cheng
Shuai Shao
Xing Jin
Tao Yu
Jamie W. Sleight
Xiaoli Li

Video Abstract

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Abstract

How does a person experiencing anesthesia lose consciousness? Despite billions of surgeries, scientists still don't fully understand what happens in the brain when a patient goes under. New research in the journal *Anesthesiology*, however, provides a few more clues. Working in a group of patients with epilepsy, scientists used a new information measure to evaluate electrocorticography data – and found that with anesthesia, there is a reduction in information integration and network connectivity. The team recorded electrocorticograms, or intracranial E-E-Gs, from nine patients who were anesthetized predominantly with propofol and underwent surgical treatment for epilepsy in China. To assess information integration, the team used a measure called [genuine permutation cross mutual information], or G-P-C-M-I. In an earlier study, they found the measure performed better than others using scalp EEG recordings. This time, they wanted to see whether GPCMI could be used to estimate information integration at the cortical level with electrocorticograms. To understand the network changes as anesthesia set in, the group assessed one patient with electrodes placed in the temporal, parietal and occipital lobes as a case study. The GPCMI values fell after loss of consciousness, and were generally higher in the occipital area compared to the parietal region. In addition, the nodal clustering coefficient decreased and the nodal efficiency dropped abruptly around the time of loss of consciousness. In the same patient, the team also compared the connectivity of electrode pairs that were far apart or close together. Interestingly, the GPCMI values for nearby electrodes increased upon loss of consciousness. In all patients, the non-zero GPCMI values fell, on average, as the electrode separation distance grew, leveling off at distances of 3 centimeters. The percentage of genuine connections was also higher in the wakeful state relative to the unconscious states, indicating a higher efficiency of communication. The [nodal clustering coefficients] and [efficiency scores] showed broadly suppressed cortical connectivity during anesthesia. In most patients, the coefficients decreased after loss of consciousness, although there were some spatial differences. The results are consistent with the scalp EEG studies, and suggest a decrease in information integration and network complexity with anesthesia. This disruption of normal neural information may be responsible for loss of consciousness. Because the patients in the study had epilepsy, it's not clear whether the findings are representative of the rest of the population. Additional research is needed to generalize the results. Find out more by reading the full report today.